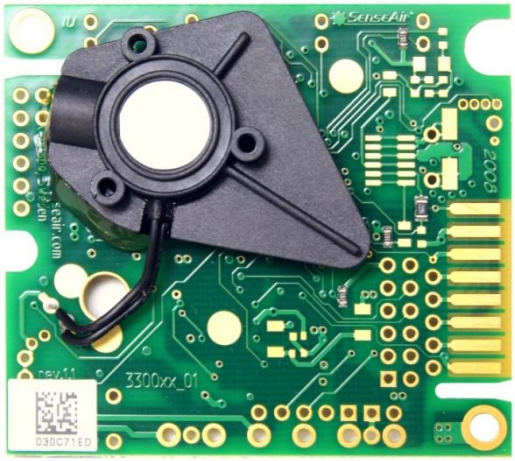
Product Specification

Senseair K33 ICB

Sensor for bio applications



General

Senseair K33 ICB is targeted on bio applications with required measurement range 0 to up to 30%$_{vol}$ CO_2. This document contains description of default appearance of Senseair K33 ICB.
The sensor is built on the Senseair K33 platform. This platform is designed to be a low power OEM module for built-in applications in a host apparatus or/and as a stand-alone CO_2 transmitter/switch module. 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. One can find extra ideas on connection and use of Senseair K33 platform in platform description.

Senseair K33 ICB has the same dimension and attachment points as K30 platform-based sensor.

Terminal description

The table below specifies terminals and I/O options available in the general K33 platform (see also the alternative connection pictures below).

Functional group	Descriptions and ratings
Power supply (all connection alternatives)	
G+ referred to G0	Power supply plus terminal Protected by series 3.3R resistor and zener diode Absolute maximum ratings 5—14V, stabilised to within 10%
G0	Power supply minus terminal Sensor's reference (ground) terminal
DVCC = 3.3 V	Output from sensor's digital voltage regulator. Series resistance 10R Available current 12mA Voltage tolerance (unloaded) ±3% max (±0.75% typ) Output may be used to power circuit (microcontroller) in host system or to power logical level converter if master processor runs at 5V supply voltage.
Communication	
UART (UART_TxD, UART_RxD)	CMOS physical layer, Modbus communication protocol. (refer TDE2336 "Modbus on Senseair K30, Senseair K33 and eSENSE"). UART_RxD line is configured as digital input. Input high level is 2.1V min Input low level is 0.8V max UART_TxD line is configured as digital output. Output high level is 2.3V (assuming 3.3V DVCC) min. Output low level is 0.75V max UART_RxD input is pulled up to DVCC = 3.3V by 56kOhm UART_TxD output is pulled up to DVCC = 3.3V by 56kOhm **ABSOLUTE MAX RATING G0 -0.5V ….. DVCC + 0.5V**
I2C extension. (I2C_SCL, I2C_SDA)	Pull-up to DVCC = 3.3 V. (refer "I2C comm guide rev2_00 DRAFT.pdf" or later version for details) **ABSOLUTE MAX RATING G0-0.5V ….. DVCC + 0.5V**

Table 1. I/O notations used in this document for the K33 platform with some descriptions and ratings (continued on next page).

NOTE! **the bolded texts that pinpoint important features** for the system integration!

Outputs	
OUT1, OC (Open collector)	Digital output, Open collector Series resistance 120R Max sink current 40mA May be configured as 1. Alarm indication output 2. PWM output, 10 (alt. 12 to 16) bit resolution. Period 1 .. 1000ms 3. Pulse length proportional to measured CO_2 value.
OUT2	Analog output 0—5V Buffered linear output 0—4 or 1—4VDC or 0—5V or 1—5V, depending on specified power supply and sensor configuration. R_{OUT} < 100R_{LOAD} > 5kOhm **Load to ground only!** Resolution 5mV
RELAY (RelayPoleNC RelayPoleCom RelayPoleNO)	RELAY It is not a standard option. Maximum switching capability 1A/50VAC/24VDC
Digital I/Os, used as Inputs in standard configuration. May be implemented as jumper field	
Din0 Din1 Din2	Digital switch inputs in standard configuration, Pull-up 56kOhm to DVCC 3.3V. Driving it Low or connecting to G0 activates input. Pull-up resistance is decreased to 4—10kOhm during read of input or jumper. Advantages are lower consumption most of the time the input/jumper is kept low and larger current for jumpers read in order to provide cleaning of the contact. Can be used for zero or background calibration forcing.
Din3	R/T control line for UART connection to RS485 driver.

Table 1. I/O notations used in this document for the Senseair K33 platform with some descriptions and ratings (continue, see previous page).

NOTE! **the bolded texts that pinpoint important features** for the system integration!

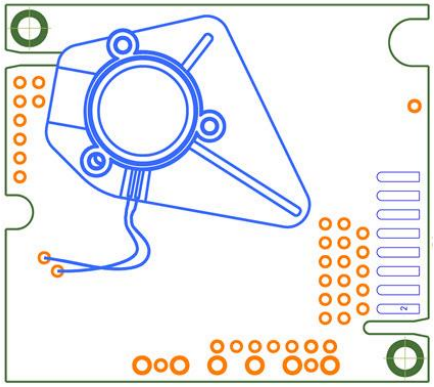


Figure 1 Senseair K33 (OBA side)

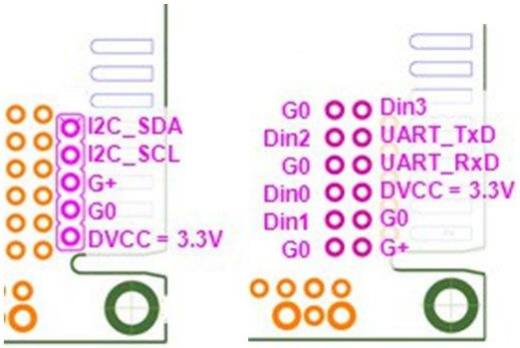


Figure 2. Senseair K33 ICB (OBA side)
UART and I²C connections

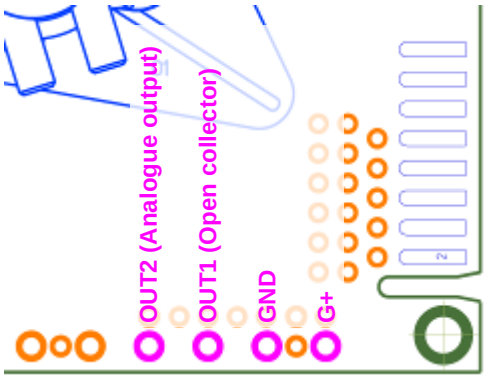


Figure 3. Senseair K33 ICB OBA side) (G+, GND, OUT1 and OUT2, 5.08mm hole spacing

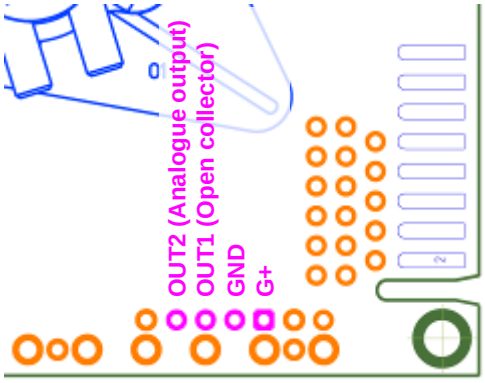


Figure 4. Senseair K33 ICB (OBA side) G+, GND, OUT1 and OUT2, 2.54mm hole spacing

Ground / Shield attachments

Both Analogue ground (AGND) and digital ground (DGND) are connected internally to the G0 terminal of the sensor. AGND is connected to the most sensitive analogue part of the sensor and DGND is connected to the digital part of the sensor.

Do NOT connect AGND and DGND together externally to sensor!

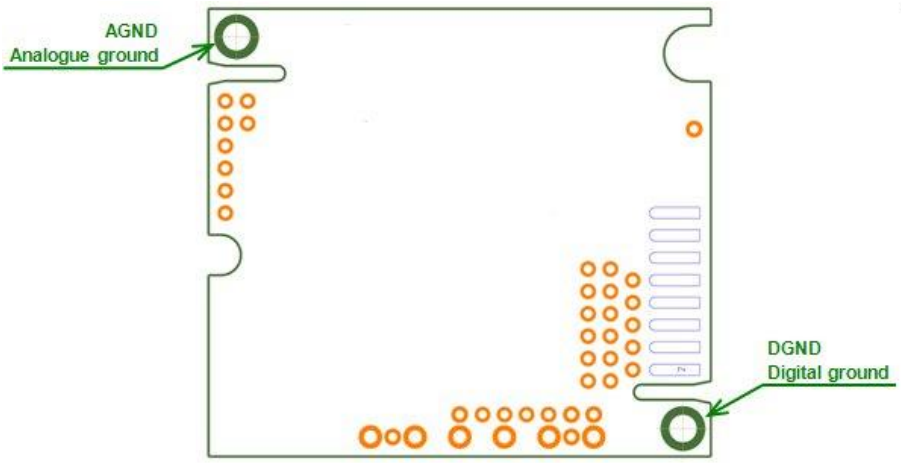


Figure 5. Senseair K33 ICB ground / shield attachment

Maintenance

Since the ABC algorithm cannot be used in all applications it is disabled in the sensors default appearance. When used in environments where the built-in self-correcting ABC algorithm can be enabled the Senseair K33 ICB is basically maintenance free.

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 with enabled ABC algorithm (at least three (3) ABC periods after installation) or after zero/background calibration.

Calibration

Default: ABC Off
When enabled the ABC algorithm (Automatic Baseline Correction) constantly keeps track of the lowest reading of the sensor over an ABC period (7.5 days interval) and slowly corrects for any long-term drift detected as compared to the expected fresh air value of 0.04%$_{vol}$ CO_2.

Rough handling and transportation might result in a reduction of sensor reading accuracy. If the ABC algorithm is enabled, it will tune the readings back to the correct numbers. The default "tuning speed" is however limited. This limit is application specific. In case that the ABC function is disabled (default appearance) or one cannot wait for the ABC algorithm to cure any calibration offset, two switch inputs Din1 and Din2 are defined for the operator to select one out of two prepared calibration codes.

If Din1 is shorted to ground, for a minimum time of eight (8) seconds, the internal calibration code **bCAL** (background calibration) is executed, in which case it is assumed that the sensor is operating in a fresh air environment (400ppm CO_2).

If Din2 is shorted instead, for a minimum time of eight (8) seconds, the alternative operation code **CAL** (zero calibration) is executed in which case the sensor must be purged by some gas mixture free from CO_2 (i.e. Nitrogen or Soda Lime CO_2 scrubbed air). If unsuccessful, please wait at least 10 seconds before repeating the procedure again. Make sure that the sensor environment is steady and calm!

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

Table 2. Switch input default configurations for Senseair K33 ICB

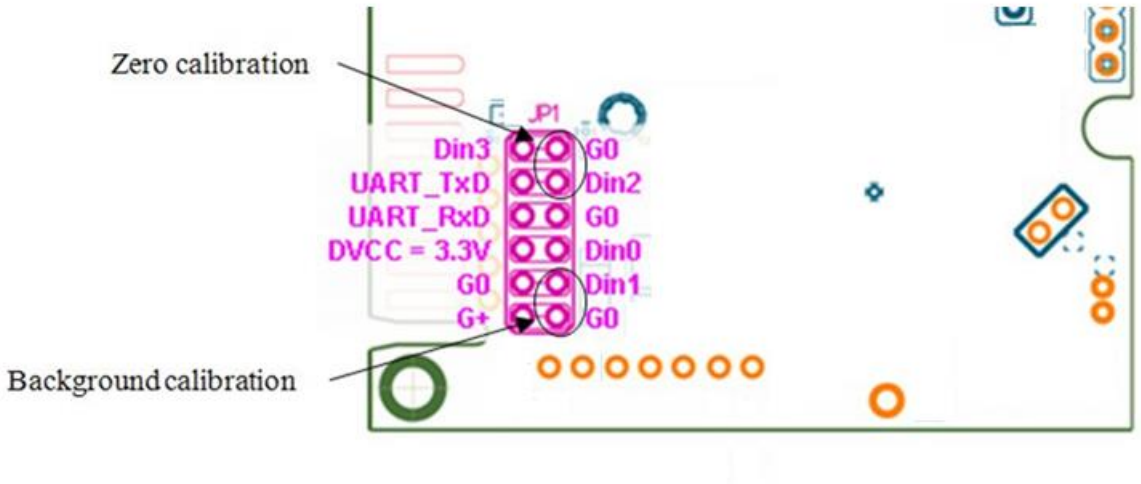


Figure 6. Senseair K33 ICB (component side) zero and background calibration inputs for calibration jumpers.

Technical specification (continuous operation)

Item	Senseair K33 ICB
General performance	
Target gas	Carbon dioxide (CO_2)
Storage temperature range	-40—70 °C
Sensor life expectancy	➢ 15 years
Maintenance interval	Maintenance-free when using Senseair ABC algorithm (Automatic Baseline Correction).
Self-diagnostics	Complete function check of the sensor module
Warm-up time	1 min
Operating temperature range	0—50 °C
Operating humidity range	Non-condensing, non-corrosive environment
Operating environment	Residential, commercial, industrial spaces and potentially dusty air ducts used in HVAC (Heating Ventilation and Air-Conditioning) systems
Electrical / mechanical	
Power input	5—14VDC max rating, stabilised to within 10% (on board protection circuits) [1]
Current consumption	40mA average < 200mA average during IR lamp ON (120ms) < 250mA peak power (during IR lamp start-up, the first 50ms)
Electrical connections	terminals not mounted (G+, G0, OUT1, OUT2, Din1, Din2, TxD, RxD)[2]
Dimensions [mm]	51 x 58 x 12 (Length x Width x approximate Height)
CO_2 measurement	
Sensing method	Non-dispersive infrared (NDIR) waveguide technology with ABC (automatic background calibration algorithm)
Sampling method	Diffusion or flow, subject for discussion with customer
Response time (T1/e)	< 20s, diffusion or tube IN/OUT (0.2l/minute gas flow)
Measurement range	0—30%$_{vol}$.
Digital resolution	0.001%$_{vol}$.

[1] Notice that absolute maximum rating is 14V, so that sensor can be used with 12V±10% supply.
[2] Different options exist and can be customised depending on the application. Please contact Senseair for further information!

Item	Senseair K33 ICB
Repeatability	±0.1%$_{vol}$. CO_2 ±2% of measured value
Accuracy	±0.5%$_{vol}$. CO_2 ±3% of measured value [3, 4]
Pressure dependence	+1.6% reading per kPa deviation from normal pressure, 100kPa
On-board calibration support	Din1 switch input to trigger Background calibration @ 400ppm (0.04%vol) CO_2 Din2 switch input to trigger Zero calibration @ 0ppm CO_2
Linear signal output:	
OUT2	
- D/A resolution	5mV
- Linear conversion range	0–5VDC for 0–20%$_{vol.}$
- Electrical characteristics	R_{OUT} < 100, R_{LOAD} > 5kOhm, Power input > 5.5V
PWM output	
Electrical characteristics	Open collector with series 120R resistor, 10kOhm pull-up resistor to protected power (+)
Minimum output concentration	0%$_{vol}$
Output cycle period	1004ms
Output high level max duration	1002ms (@20%$_{vol}$)
Resolution	0.5ms (@0.01%$_{vol}$ = 100ppm)

Table 3. Key technical specification for Senseair K33 ICB

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

[4] 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.

Sensor PWM output timing diagram

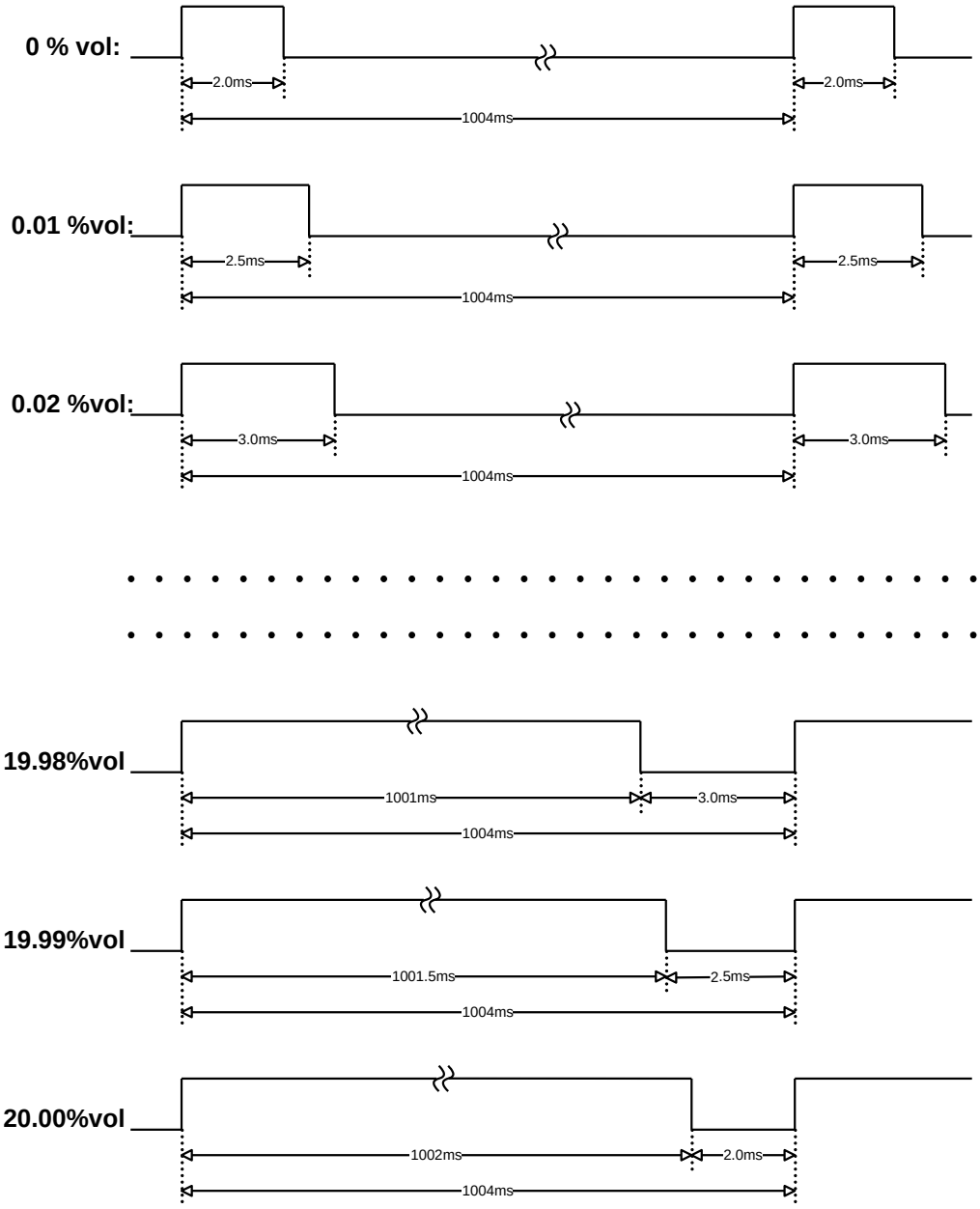


Figure 7. Senseair K33 ICB OUT1 timing diagram.

Gases that may affect operation of sensor

Since optical part has no reflective coating, stability of the sensor is governed by corrosion resistance of electronic assembly.

Corrosive environments containing but not limited by hydrogen sulfide, ammonia, ozone, sulphuric acid, sulfur dioxide should be avoided.

IMPORTANT NOTICE

1. Senseair reserves the right to make changes to the information contained in this document without notice. When you consider any use or application of Senseair product stipulated in this document ("Product"), please make inquiries the sales office of Senseair or authorised distributors as to current status of the Products.
2. All information included in this document are provided only to illustrate the operation and application examples of Senseair Products. Senseair neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Senseair or any third party with respect to the information in this document. You are fully responsible for use of such information contained in this document in your product design or applications. Senseair ASSUMES NO LIABILITY FOR ANY LOSSES INCURRED BY YOU OR THIRD PARTIES ARISING FROM THE USE OF SUCH INFORMATION IN YOUR PRODUCT DESIGN OR APPLICATIONS.
3. The Product is neither intended nor warranted for use in equipment or systems that require extraordinarily high levels of quality and/or reliability and/or a malfunction or failure of which may cause loss of human life, bodily injury, serious property damage or serious public impact, including but not limited to, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. Do not use Product for the above use unless specifically agreed by Senseair in writing.
4. Though Senseair works continually to improve the Product's quality and reliability, you are responsible for complying with safety standards and for providing adequate designs and safeguards for your hardware, software and systems which minimise risk and avoid situations in which a malfunction or failure of the Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption.
5. Do not use or otherwise make available the Product or related technology or any information contained in this document for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). When exporting the Products or related technology or any information contained in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. The Products and related technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Please contact Senseair sales representative for details as to environmental matters such as the RoHS compatibility of the Product. Please use the Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Senseair assumes no liability for damages or losses occurring as a result of noncompliance with applicable laws and regulations.
7. Resale of the Product with provisions different from the statement and/or technical features set forth in this document shall immediately void any warranty granted by Senseair for the Product and shall not create or extend in any manner whatsoever, any liability of Senseair.
8. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Senseair.

www.senseair.com