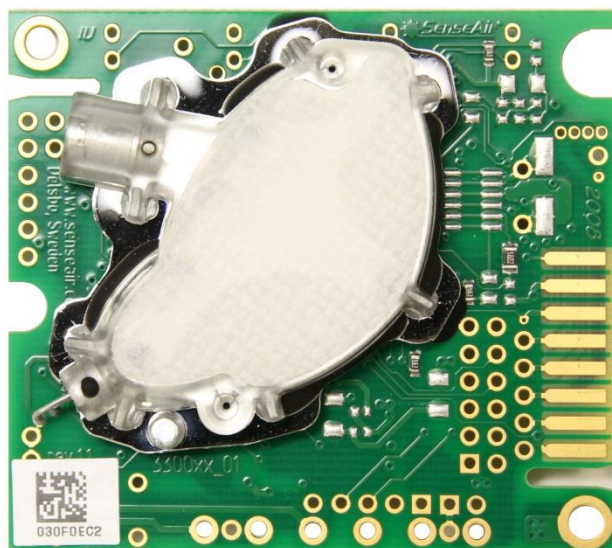# Product Specification

Senseair K33 ELG

Sensor for environment parameters logging

General

This document describes a family of sensor Senseair K33 ELG designed to measure and store records of environmental parameters such as:
- **Temperature**
- **Relative humidity**
- **CO_2 concentration** (up to 5000ppm range).

The sensor Senseair K33 ELG is designed for battery powered operation with low average power consumption without compromising measurement precision and resolution.

Virtual RTC (Real Time Clock) allows data and events logging with time stamps.

Events include sensor power on, logging start/stop, ABC self-calibration, user initiated zero- and background calibrations.

Reading of logger via I²C connector and Senseair's I²C – USB bridge (SADK).

I²C or UART communication can be used to read logged data for built in modules.

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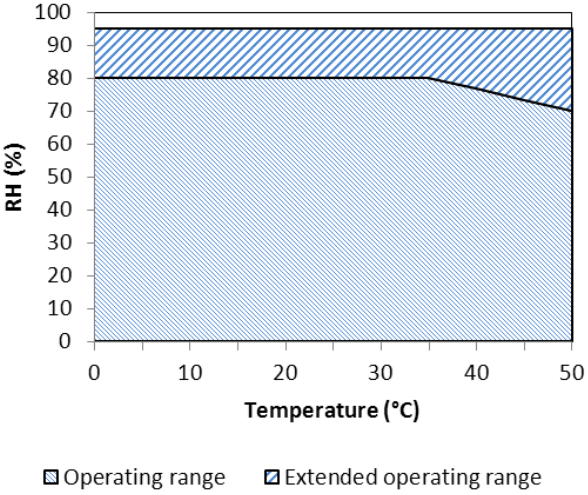
Item	Senseair K33 ELG
General performance	
Target gas	Carbon dioxide (CO_2)
Storage temperature range	-30—70 °C
Sensor life expectancy	> 10 years
Maintenance	Maintenance-free with enabled ABC [1]
Operating temperature range	0—50 °C
Storage environment	Non-condensing, non-corrosive environment
Operating environment	Residential, commercial and industrial spaces [2]
Electrical / mechanical	
Power supply	4.75—12VDC [3] maximum rating, powered via Vbat+ 5.5—12VDC [3] maximum rating, powered via G+
Average current	< 52µA (1 measurement/hour)
Peak current	< 250mA For maximum operating time (if powered by batteries), choose batteries that can deliver 250mA pulses without large voltage drops (for example batteries recommended for cameras)
Electrical connections	Vbat+, G+ and G0
Dimensions (Length x Width x Height)	57.15 x 50.80 x 11.80mm

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[1] ABC is disabled in default configuration.

[2] SO_2 enriched environments excluded.

[3] Notice that absolute maximum rating is 12V, so sensor can not be used with 12V±10% supply.

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CO₂ measurement	
Operating principle	Non-dispersive infrared (NDIR)
CO₂ operating temperature/humidity range	Operating range Extended operating range
Sampling method	Diffusion
Response time ($T_{1/e}$)	< 25s gas diffusion time
Measurement period	5 min to 0.5 year interval, a measurement period less than 5 min can be used, but then specified accuracy on RH and temperature measurements are not guaranteed
Measurement range	400—5000ppm
Repeatability	±20ppm ±1% of measured value
Accuracy	±30ppm ±3% of measured value [4]
Pressure dependence	+1.6% reading per kPa deviation from normal pressure
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

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[4] Accuracy is specified over operating temperature range at normal pressure 1013mBar. 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.

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Temperature measurement	
Temperature measurement range	-30—60 °C
Temperature measurement accuracy [5]	
Relative humidity measurement	
RH measurement range	0—100% RH non-condensing
RH accuracy [5]	-5—5% points within range 0—50% RH -5—15% points within range 50—100% RH
Logger properties	
Logger capacity	5400 logging points if CO_2 concentration, temperature and relative humidity are logged (with timestamp)
Logging data	Selectable, one data record can contain up to 14 bytes (max 4 variables)
Logging period	(1—255) * measurement period
Delay since setting jumper	0—255s (5s in default configuration)

Table 1. Key technical specification for Senseair K33 ELG

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[5] Minimum 5 minutes measurement period.

Use scenario Senseair K33 ELG

Senseair K33 ELG is a sensor for CO_2 concentration, temperature and relative humidity.

There are three ways to activate measurement/logging:

- Jumper (set AnIn1 high)

After power-on, sensor checks jumper presence, if jumper is not present (low level on input, AnIn1), sensor goes into sleep mode. If jumper is set (high level at input), sensor sleeps a predefined time (configured in EEPROM) and then start the measurement sequence. After measurement has been started the sensor wakes up periodically, makes measurements, stores result in on board non-volatile memory (if logger is activated) and goes into sleep mode until next measurement.

- Command "Force start measurement"

Another way to start/stop measurements is with the commands "Force Start Measurements" and "Force Stop Measurements", the sensor will act in the same way as if the jumper was set/reset.

- Command "Single measurement"

If only one measurement is desired the command "Single measurement" can be sent to the sensor. Then the sensor will measure once, store result in on board non-volatile memory (if logger is activated) and go back to sleep mode.

For correct timestamps the sensor's RTC has to be set after the sensor has been powered up. User can read logged data via serial port (UART with standard Senseair cable) alternatively I^2C-to-USB bridge.

Note: For correct timing it is important that RTC is set after battery is inserted.

Drawings below show battery connection (with polarity) to the sensor (Vbat+), pin assignment of UART and I^2C communication connectors.
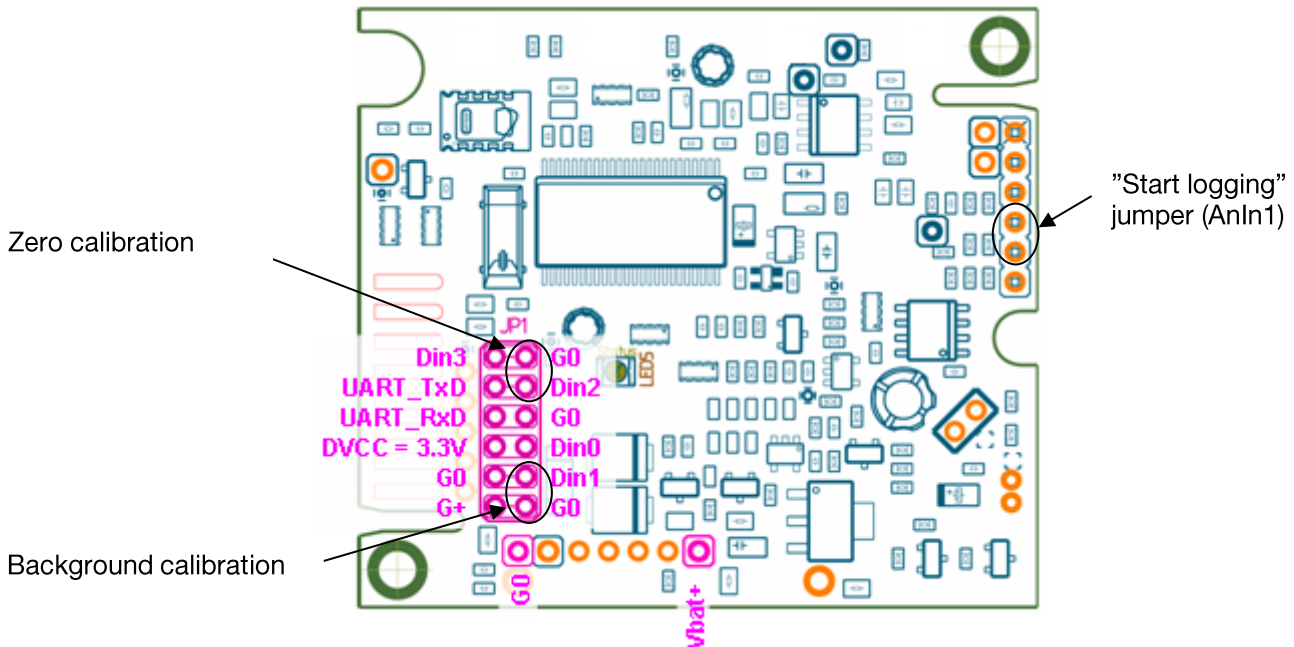

Figure 1. Senseair K33 ELG powered via Vbat+ and data read via UART terminal

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Terminal descriptions

Table below specifies what terminals and I/O options are available in the general K33 platform (see also layout picture Fig 2).

Functional group	Descriptions and ratings
Power supply	
G+ referred to G0:	Absolute maximum ratings 5.5—12V, stabilised to within 5% 6.0—9V preferred operating range. Protected against transients on G+, limited protection against reverse polarity (can withstand reverse polarity temporarily)
Vbat+ referred to G0	Absolute maximum ratings 4.75—12V, stabilised to within 5% 6.0—9V preferred operating range.
DVCC = 3.3V	Output from sensor's digital voltage regulator. Series resistance 10R Available current 12mA Voltage tolerance (unloaded) ±3% max (±0.75% typical) 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.
Serial communication	
UART	CMOS physical layer, ModBus communication protocol. Logical levels correspond 3.3V powered logics. Refer TDE2336 "ModBus on Senseair K30, Senseair K33 and eSENSE" for electrical specification. 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 (TxD, RxD) ABSOLUTE MAX RATING G0-0.5V ….. DVCC + 0.5V
I^2C extension	
I^2C (SDA, SCL)	Pull-up of SDA and SCL lines to 3.3V. (Refer "I2C comm guide 2_15.pdf" or later version for details) ABSOLUTE MAX RATING G0-0.5V ….. DVCC + 0.5V

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Functional group	Descriptions and ratings
Inputs & optional jumper field	
Din0 Din1 Din2 Din3	Digital switch inputs have pull-up 56kOhm to DVCC 3.3V most of the time. Pull-up resistance is decreased to 4…10kOhm only during read of input / jumper to provide cleaning of the contacts by larger currents. They are the same as inputs on IDC connector. Din1 is used for background calibration. Din2 is used for zero calibration. Din3 can be used as R/T pin for a RS485 driver (not default configuration, contact Senseair for more information).
AnIn1	Input set to DVCC activates measurement/logging cycle, input released (or held low) set sensor into sleep, in sleep mode sensor check AnIn1 and support communication.

Table 2. I/O notations used in this document for the Senseair K33 platform with some descriptions and ratings

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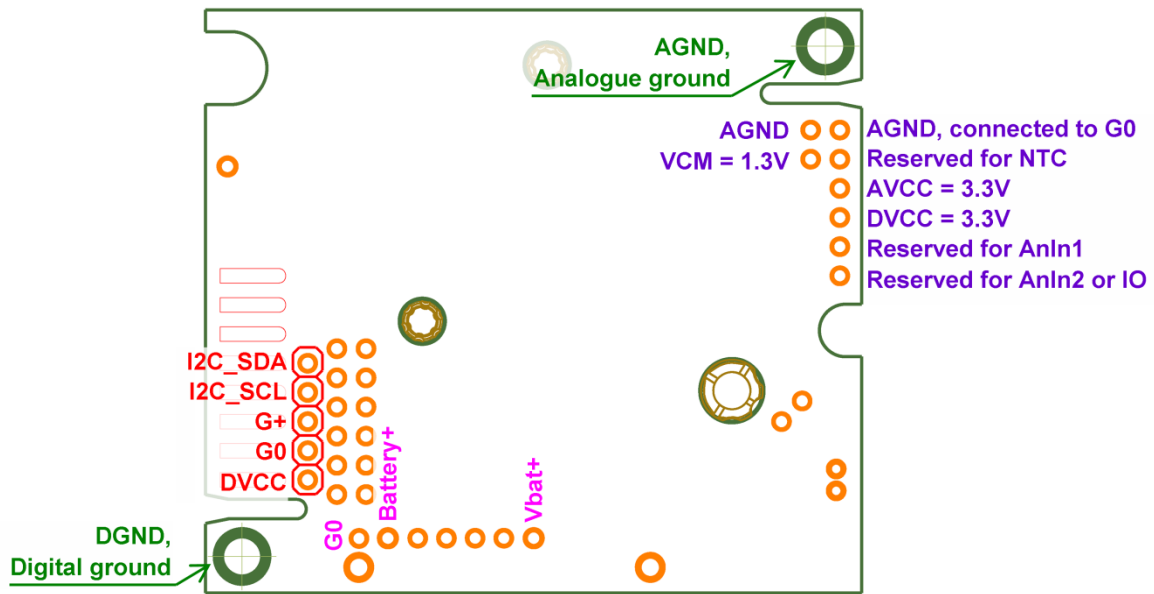
General PCB overview

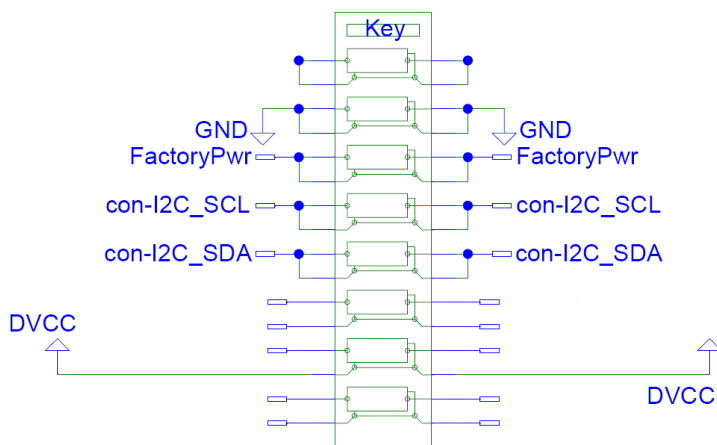Figure 2. Senseair K33 ELG I/O notations and terminals

Figure 3. Senseair K33 ELG edge connector (seen from component side)

Maintenance

The models based on Senseair K33 platform are basically maintenance free in normal environments thanks to the built-in self-correcting ABC algorithm.

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 sensor's lowest reading over a predefined period and slowly corrects for any long-term drift detected as compared to the expected fresh air value of 400ppm CO_2.

Since timing (time between measurements) can be configured in BLG/ELG it is important to make sure that the sensor has possibility to measure "fresh air" during the predefined period.
It is recommended that ABC configuration is optimised for its tasks during a dialog between Senseair and the OEM customer. In default configuration for BLG/ELG sensors ABC is switched off.

Calibration

Rough handling and transportation might, result in a reduction of sensor reading accuracy. For post calibration convenience, in the event that 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 during a measurement cycle (flashing lamp), 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 during a measurement cycle (flashing lamp), the alternative operation code **zCAL** (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).

Make sure that the sensor environment is steady and calm during calibration!

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 3. Switch input default configurations for Senseair K33 ELG

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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. If this byte is not zero, the logic output terminal **Status** will be put into Low level state.

The full error codes are available from the UART port or via I²C 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/I²C overwrite, or by power off/on.

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	Humidity/temperature sensor communication error Unable to communicate with humidity/temperature sensor.	Try to restart sensor by power OFF/ON. Contact local distributor.
3	8	RH error Timeout or invalid RH value from humidity sensor.	Try to restart sensor by power OFF/ON. Contact local distributor.
4	16	Detector temperature out of range Indicates to high/low (out of range) detector temperature.	Check detailed self-diagnostic status with software tools. Contact local distributor.
5	32	CO_2 out of range Measured CO_2 value is out of range.	Try sensor in fresh air. Perform background or zero calibration. Contact local distributor.
6	64	Memory error Error during memory operations.	Try to restart sensor by power OFF/ON. Contact local distributor.
7	128	Space temperature out of range Measured temperature is out of range.	Try to restart sensor by power OFF/ON. Contact local distributor.

Table 4. Error codes and action plan

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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