Product Specification

aSENSE

(Ind) (Duct) (RL)

Carbon dioxide and temperature sensors in a housing

aSENSE Disp

General

The aSENSE are CO_2 and temperature sensors in a housing. The aSENSE RL has a programmable output for relay control of of e.g. mixed air dampers, humidifier and fans. Designed for CO_2 based ventilation it measures CO_2 concentration and temperature in the ambient air in rooms and in ventilation ducts. The data is transmitted to a BMS system or stand-alone controller using industry standard output signals and communications protocols.

Item	aSENSE specification
Measured gas	Carbon dioxide (CO_2)
Operating Principle	Non-dispersive infrared (NDIR) waveguide technology
OUT1 CO_2	0 – 10VDC, 0 – 2000ppm CO_2
Accuracy CO_2	±30ppm ±3% of measured value [1], 2
Response time ($T_{1/e}$) CO_2	<3 min. diffusion time
Pressure Dependence	+1,6% reading per kPa deviation from normal pressure, 100kPa
OUT2 Temp	0 – 10VDC, -20 – 60ºC
Accuracy Temp	±1°C
Operation Temperature Range	0 – 50ºC
Operation Humidity Range	0 – 85RH% (non-condensing)
Operating environment	Residential, commercial [3]
Storage temperature	-40 – 70°C (display models: -20 – 50°C) [2]
Dimensions wall mounted [mm]	120 x 82 x 30
Dimensions duct mounted [mm]	152 x 85 x 47 (Probe length: 245mm)
Dimensions industrial housing [mm]	152 x 85 x 47
Power supply	12 – 24VDC or 24VAC (50 – 60Hz) ±20%, half-wave rectifier input
Power consumption	<1W average
Life expectancy	>15 years [3,4]
Yearly drift	< ±150ppm @1000ppm [5] < ±100ppm @0ppm [5] (can't define amount of drift during power-off)"
Serial communication	UART (Modbus protocol)
Maintenance	No maintenance required as Auto Background Correction, ABC, is used. [2, 3]

Table 1: Key technical specification for the aSENSE (Ind) (Duct) (RL)

Note 1: Accuracy is specified over operating temperature range. Specification is referenced to certified calibration mixtures. Uncertainty of calibration gas mixtures (+-2% currently) is to be added to the specified accuracy for absolute measurements.

Note 2: In normal IAQ applications, accuracy is defined after minimum three (3) ABC periods of continuous operation with ABC.

Note 3: This device generation of heat (self-heating due to power consumption) does not influence/violate temperature accuracy specification of this device, as long as CO_2 measurement (lamp blink) interval is ≥ 15s.

Note 4: Repeatability is included. Uncertainty of calibration gases (+-2% currently) is added to the specified accuracy.

Note 5: Yearly drift of unpowered sensor is not defined.

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Terminals and outputs description

Cable connections	Descriptions and ratings
Power supply	
~ + ~+	Positive pole of DC power supply is connected to +~. Sensor performs half wave rectification of supplied AC voltage. Power supply lines are protected by varistor from voltage spikes and over voltage. A fuse and a diode protect the electronics. Nominal specification: 12—24VDC, 24VAC +-20%, 50—60Hz Absolute minimum to maximum ratings 12—40VDC
⊥	Connected to sensor's ground. Negative pole connection for DC power supply
Outputs for both aSENSE and aSENSE RL	
Out(1)	Factory setting is linear output, 0-10VDC for 0—2000ppm CO_2
Out(2)	Factory setting is linear output, 0-10VDC for 0—20°C
Outputs for aSENSE RL	
5 NC	Relay output Normally Closed
6 COM	Relay Output Common
7 NO	Relay Output Normally Open
8	Not used
Indicators	
Yellow status LED	OFF = OK, Lit = Fault.
Red status LED	Lit when the relay is closed
LCD	LCD is dedicated to represent measured values and status of the sensor.
Jumpers	
Start point jumper	Jumper in top position gives 0-100% output, 0-10V as default Jumper in lower position gives 20-100% output, 2-10V as default
Out(1)	Jumper in left position gives mA output Jumper in right position gives V output, default
Out(2)	Jumper in left position gives mA output Jumper in right position gives V output, default
Serial Communication	
UART (TxD, RxD)	Available from JP3. 5V CMOS logical levels, ModBus communication protocol. Logical levels corresponds 5V powered logics. Protection 56R resistors are added on RxD and TxD lines RxD line is configured as digital input. Input high level is 2.1V min Input low level is 0.8V max TxD line is configured as digital output. Output high level is 4.0V Output low level is 0.75V max RxD input is pulled up to DVCC = 5V by 56kΩ TxD output is pulled up to DVCC = 5V by 56kΩ

Table 2: Cable connections of the aSENSE

General PCB overview

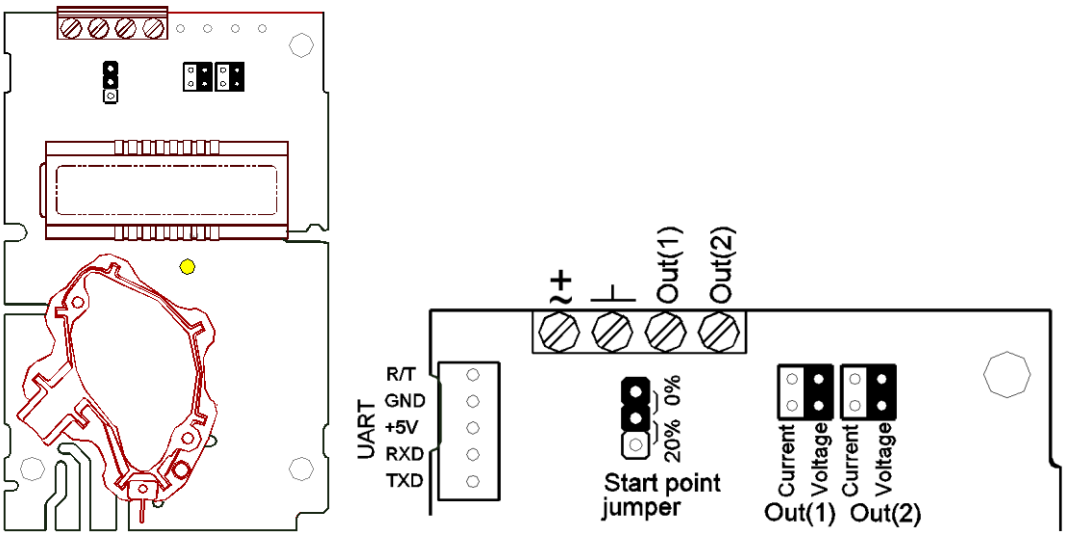

Figure 1 The aSENSE PCB with jumpers and terminal area enlarged at right

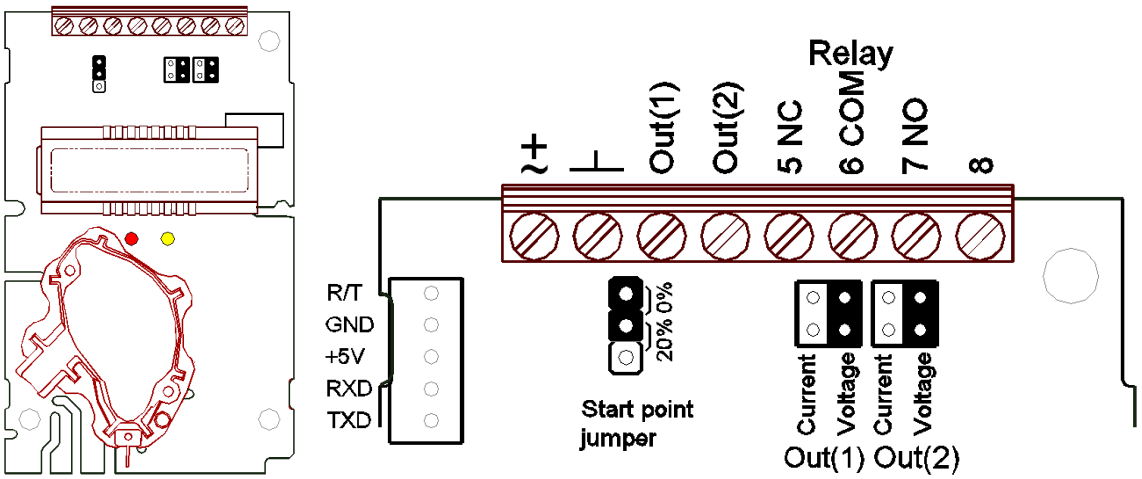

Figure 2 The aSENSE RL PCB with jumpers and terminal area enlarged at right

Calibration

The aSENSE and aSENSE RL are maintenance free in normal environments thanks to the built-in self-correcting **ABC** *(Automatic Baseline Correction)* **algorithm**. This algorithm constantly keeps track of the sensor's lowest reading over an ABC period and slowly corrects for any long-term drift detected as compared to the expected fresh air value of 400ppm CO_2.

Rough handling and transportation might, however, 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 however limited to about 30—50ppm/week.

An internal self-adjusting calibration function takes care of normal long term drift associated to the CO_2 sensor. To secure the highest accuracy, a time interval of five years is recommended between CO_2 calibrations, unless some special situations have occurred.

A zero calibration can be performed by use of pure nitrogen or air that has passed through a chemical absorber and a PC together with the *UIP software version 5* (or higher) or by shortening of holes marked in figure 3 for at least 10 seconds. The sensor needs stable gas flow for at least 3 minutes before zero calibration. The Zero Calibration bag can be used to produce carbon dioxide free air. The software can be free downloaded from https://senseair.com/download. The RS232-cable and the zero calibration bag can be ordered from SenseAir. The cable is to be connected to the UART port slide connector (see Fig. 3 or 4). For change of control parameters and re-calibration of temperature this PC tool has to be used. Zero calibration can be done with PC and *UIP software version 5* or by shorting marked holes in figure 3. The check can be done on site without interfering with the ventilation system.

A Back ground calibration is an easy way to correct a sensor's zero point. The sensor needs fresh air (380—420ppm CO_2). Shorten holes, marked in figure 3, for at least 10 seconds.

This is for sensors with measuring ranges 0—2000 ppm:
When a zero calibration shall be executed a plastic tube with 2.2mm outer diameter and 0.8 mm inner diameter shall be inserted in marked holes of the sensor. Plastic tubing is connected to the tube. The gas flow should be between 0.3 and 1.0 l/min. The sensor needs stable gas flow for at least three (3) minutes before zero calibration. Shorten marked holes for at least 10 seconds. A successful calibration is acknowledged by five (5) flashes of the yellow LED. If unsuccessful, please release input and wait at least 10 seconds before repeating the procedure again. Make sure that the sensor environment is steady and calm!

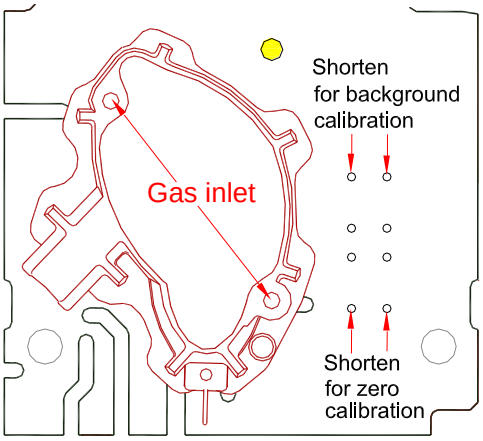

Figure 3 Holes to shorten for calibration

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 error codes are available by connecting a PC with a special RS232 cable connected to the UART port slide connector. The error codes are shown in the software UIP (version 5 or later). *Warm up* 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 manually after return to normal by power off/on.

The yellow LED lights yellow at heating phase after power up and if an error has been detected.

Error code and action plan

Bit #	Error code	Error description	Suggested action
0	N/A	Fatal Error	Try to restart sensor by power OFF/ON. Contact local distributor
1	2	Reserved	
2	4	**Algorithm Error.** Indicate wrong EEPROM configuration.	Try to restart sensor by power OFF/ON. Check detailed settings and configuration with UIP software version 5 and higher. 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 UIP software version 5 and higher.
4	16	**Self-Diagnostic Error.** Algorithm timeout	Check detailed self-diagnostic status with UIP software version 5 and higher. Contact local distributor
5	32	Out of Range Error Accompanies most of other errors. Resets automatically after source of error disappearance.	Try sensor in fresh air. Check connections of temperature and relative humidity probe. Check detailed status of measurements with UIP software version 5 and higher. *See Note 1!*
6	64	Memory Error Non-fatal error during memory operations.	Check detailed settings and configuration with UIP software version 5 and higher.
7	128	Warm Up state Is always set after power up or power failure. Resets after restart sequence.	If it doesn't disappear in half a minute, check power stability.

Table 3 Error codes

Note 1. If 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 the error code remains, the temperature sensor can be defective 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!

NOTE! The sensor accuracy is defined at continuous operation (at least tree (3) ABC periods after installation)

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