Product Specification

tSENSE (Disp)

CO_2, Temperature and RH sensor in a housing
with colour touch display

General

tSENSE (Disp) is an advanced and versatile 3-in-1 sensor in a housing, designed for installation in the air-conditioned zone. It measures CO_2 concentration, temperature and humidity in the ambient air accurately without need for additional compensation – true read. The data transmits to a BMS system or stand-alone controller using industry standard output signals and communication protocols.

Complies with ASHRAE standard 189.1 (±50ppm @ 1000ppm of measured CO_2 value)

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Key technical specification

Item	tSENSE (Disp)
General performance	
Operating environment	Residential, and commercial spaces
CO_2 measurement range	0 — 2000 ppm_{vol}.
Temperature measurement range	0 — 50 °C
Relative humidity measurement range	0 — 100% RH
Storage environment	Non-condensing, non-corrosive environment
Storage temperature range	-30 — 70 °C
Communication	Modbus (MB) or BACnet (BAC) protocol over RS485
Linear analogue outputs	Voltage 0 — 10 V.
Digital output	Relay
Warm-up time	≤1 min. (@ full specs 15 min)
Life expectancy	>15 years
Self-Diagnostics	Complete function check, red LED and LCD error indication (display model)
Display	Configurable colour LCD with CO_2 (ppm), Temperature (°C) and Humidity (% RH)
Maintenance	Maintenance-free when using Senseair ABC algorithm (Automatic Baseline Correction).[1]
CO_2 measurement	
Operating principle	Non-dispersive infrared (NDIR)
Sampling method	Diffusion
Response time ($T_{1/e}$)	<3 min diffusion time
Measurement period	15 s
Measurement range	0 — 2000 ppm_{vol}
Accuracy	±50 ppm @ (1000 ppm_{vol}, 17 — 28 °C and 30 — 60% RH) Typical full range: ±30 ppm ±3% of measured [2, 3]

[1] ABC is enabled in default configuration

[2] Accuracy is specified over operating temperature range 0 — 50 °C and relative humidity 0 — 95% RH non-condensing 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.

[3] Accuracy is defined after minimum three weeks of continuous operation with ABC enabled (default configuration)

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Key technical specification

Item	tSENSE (Disp)
Pressure dependence	+1.58% reading per kPa deviation from normal pressure 101.3 kPa

Temperature measurement

Operating principle	Bandgap temperature sensor
Temperature measurement range	0 — 50 °C
Temperature measurement accuracy	±0.5 °C (@ 17 — 28 °C), ±1.0°C (@ 0 — 50 °C)
Repeatability	±0.25 °C (@ 17 — 28 °C)
Response time	<6 min (Air velocity of 0.15 m/s)
Measurement period	15 s

Relative humidity measurement

Operating principle	Capacitive humidity sensor
Relative humidity measurement range	0 — 100% RH
Relative humidity measurement accuracy	±5% RH (@ 20 — 80% RH)
Hysteresis	±1% RH (@ 20 — 80% RH)
Annual drift	<±0.5% RH
Repeatability	±0.25 °C (@ 17 — 28 °C)
Response time	<6 min (Air velocity of 0.15 m/s)
Measurement period	15 s

Electrical / Mechanical

Power supply	12 V DC, 24 V DC, or 24 V AC ±20%, 50/60 Hz
Power consumption	<0.6 W
Peak power consumption	<2 W
Wiring connections	Screw terminal, max 1.5 mm^2 Containing: Power, GND, Out1, Out2, Out3, RS485, and passive temperature or relay (just one of them can be available).
Dimensions [mm]	125 x 85 x 22 (Length x Width x Height)

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Key technical specification

Item	tSENSE (Disp)
Dimensions display [mm]	49 x 37 (Length x Width)
Linear analogue outputs protection	PTC-fuses (auto reset), short-circuit safe
Linear analogue outputs conversion accuracy	±2% of reading ±2 0mV
Linear analogue outputs signal	Voltage output 0—10 V, R_{out} <100 Ω, Load: >5 kΩ
Linear analogue outputs resolution	10-bits, 10 mV steps, 0.1% steps of full ppm / °C / % RH range

Table 1: Key technical specification for tSENSE (Disp)

Terminal descriptions

The table below specifies terminals and I/O options available on the tSENSE (Disp)

Functional group	Descriptions and ratings
G+:	Power supply voltage may be AC or DC. Positive pole of DC power supply shall be connected to G+. Sensor performs half wave rectification of supplied AC voltage. Power supply lines are protected by a varistor and fuse from voltage spikes and over voltage. Nominal specification: 12 V DC, 24 V DC, or 24 V AC ±20%, 50/60 Hz Power consumption: <0.6 W
G0:	Connected to sensor's ground. Negative pole connection for DC power supply

Outputs The outputs can be configured with PC software UIP (version 5 or higher). See information at https://senseair.com/download

Linear analogue outputs:

Out1: CO_2	Buffered linear output 0 — 10 V, corresponds to 0 — 2000 ppm_{vol}. Resolution: 10-bits, 10mV steps.
Out2: Temperature (T)	Buffered linear output 0 — 10 V, corresponds to 0 — 50 °C. Resolution: 10-bits, 10mV steps.
Out3: Relative humidity (RH)	Buffered linear output 0 — 10 V, corresponds to 0 — 100% RH. Resolution: 10-bits, 10 mV steps.
CO_2 /T /RH	Configurable via touch display.

Digital output:

Relay (RL)	On ≥1000ppm_{vol} CO_2, Off ≤900 ppm_{vol}, CO_2. Form C / DPDT, I_{max}: 1 A/50 V AC/24 V DC
Input Source CO_2/ T/ RH	Configurable via touch display.

Serial Communication

RS485	Modbus (MB) or BACnet (BAC) protocol

Table 2: I/O notations for tSENSE (Disp)

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Maintenance

The tSENSE (Disp) is basically maintenance free. 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.

Calibration option	CO_2 concentration level
Background calibration	Assuming 400 ppm CO_2 sensor exposure
Zero Calibration	Assuming 0 ppm CO_2 sensor exposure

Table 3: Calibration options for the tSENSE (Disp)

The calibration options can be achieved by Senseair software (UIP5) which can be free downloaded at https://senseair.com/download, or by Modbus communication (more information in document TDE0103 which is available at Senseair website), or using calibration option on tSENSE display (more information in document UMA0176 which is available at Senseair website).

tSENSE (Disp) has a manual option to achieve the background calibration by pushing the blue button which you can find in the bottom side of the housing for 15 seconds in fresh air (400 ppm CO_2) more information available in document UMA0176.

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 Modbus / BACnet protocols on RS485. Out of Range is the only bit that is resets automatically after return to normal state. All other error bits should be reset manually after return to normal by power off/on.

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Sensor error codes and action plan

Bit #	Error code	Error description	Suggested action
0	CO_2 sensor: com error	Not able to communicate with CO_2 sensor module.	Restart the sensor by power OFF – power ON. Contact local distributor.
1	CO_2 sensor: CO_2 measure error	CO_2 measurement error.	Background calibration (for more details please read page 15 in UMA176 document which you can find at Senseair website). Contact local distributor. See note 1!
2	CO_2 sensor: temperature measure error	Temperature measurement error.	Restart the sensor by power OFF – power ON. Contact local distributor
3	RH/T sensor: com error	Not able to communicate with RH/T sensor module	
4	RH/T sensor: RH measure error	Relative humidity measurement error	
5	RH/T sensor: T measure error	Temperature measurement error, sensor will use CO_2 sensor temperature if RH/T temperature is unavailable, S_Temp will be set to NTC_Temp	
6			
7			
8	Output configuration error	Error in output configuration, output is still updated.	Check connection and loads of outputs. Check detailed settings and configuration with UIP software ver.5 or higher. Contact local distributor.
9	Memory error	One or several bytes of sensors parameters memory (settings) are corrupt	Restart the sensor by power OFF – power ON. Contact local distributor.

Table 4: Sensor error codes and action plan

Note 1. 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 can also indicate the need of zero calibration. If the CO_2 readings are normal, and still the error code remains, any other sensor probe mounted (if any) can be defect, or the connection to this probe is broken.

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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