SENSIT
extend your senses

USER MANUAL

STHC 102 - COMBINED TEMPERATURE, RELATIVE HUMIDITY AND CO2 SENSORS

Combined Temperature, Relative Humidity and CO2 Sensors in spaces protected against the ingress of water, designed for use in railway vehicle applications

CE

8500.2	06.17
Replaces	8500.1

Legal regulations and standards:

- Electrical connection of the sensor can be performed only by a person qualified according to Sec. 5 of Decree No. 50/1978 Coll. and closely familiarised with this User Manual.
- The User Manual is a part of the product and should be kept during the whole lifetime of the product.
- The User Manual should be passed to any subsequent holder or user of the product.
- When disposing the product, it is necessary to observe Act No. 185/2001 Coll. on waste as amended and the implementing Decree No. 352/2005 Coll., on the disposal of electrical equipment and waste of electrical equipment, as amended. In the European Union, it is necessary to observe the Directive of the European Parliament and Council 2012/19/EU, on waste of electrical and electronic equipment - WEEE.
- All production passes through the final metrological inspection – comparison with standards or working instruments – is carried out for all the products. Continuity of the standards and working measuring instruments is ensured within the meaning of the Section 5 of Act No. 505/1990, on metrology. The manufacturer offers a possibility to supply the sensors calibrated in SENSIT s.r.o.'s laboratory (according to requirements of the EN ISO/IEC 17025 standard) or in an accredited laboratory.
- The sensors are delivered in packages guaranteeing resistance to mechanical impacts and complying with the requirements of Act No. 477/2001 Coll., on packaging, as amended, which is in conformity with the Directive of the European Parliament and Council 94/62/EC, on packaging and packaging waste, as amended.

Use of the sensor:

These combined sensors are designed to measure the carbon dioxide concentration, temperature and relative humidity of air in spaces protected against water. The sensor can be used for any control systems compatible with the MODBUS RTU communication protocol; communication takes place through the RS 485 bus. The working ranges of individual sensors are specified in the table of technical parameters. The sensors meet ingress protection IP 30 according to EN 60 529. Suitable design and high-quality material ensure that the sensors do not feel disturbing even in the interiors with high aesthetic requirements. The sensors are designed to be operated in a chemically non-aggressive environment, the use must be chosen with regard to the temperature and chemical resistance of the sensor head, including electronics.

Recommendation for sensor use and positioning:

- The sensor is suitable for the measurement of temperature, humidity and concentration of carbon dioxide (schools, theatres, lecture halls...), offices, interiors of residential houses, rail vehicles or even production floors with variable occupancy by persons.
- Installation is recommended on an inner wall at the height of 1.5 m, in areas of movement of persons, at places not exposed to direct sunlight and not influenced by heat from walls, heating radiators or lighting.
- **We recommend performing the first measurable value reading 0.5 to 1.5 hours after the sensor connection to the supply voltage,** when temperature conditions in the box have stabilized.

Operating conditions:

- temperature round the sensor: 0 to 45 °C   - With guaranteed accuracy of CO_2 sensor
                                                -30 to 70 °C   - Without guaranteed accuracy of CO_2 sensor
- relative humidity: 0 to 85% (Non-condensing moisture)   - With guaranteed accuracy of CO_2 sensor
                                                0 to 95% (Non-condensing moisture)   - Without guaranteed accuracy of CO_2 sensor
- atmospheric pressure: 87 to 106 kPa

Warnings and restrictions:

The sensor must not be used for temperature measurement in areas:

- where the specified technical parameters and operating conditions are not adhered to
- where there is a risk of a mechanical impact on the sensor or a potentially explosive atmosphere
- with a chemically aggressive environment
- where the sensor could be exposed to high air humidity with the possibility of condensation of inundation

The sensor should not be used for temperature measurement in areas:

- where it could be exposed to direct heat radiation (lights, heating radiators, etc.) or insolation
- where free access of air is not ensured and where free air flow is restricted (spaces under windows, recesses in walls, spaces under roof verges, balconies, etc.)
- where measurement errors could occur due to warm air from inner spaces (spaces above windows, doors and ventilation apertures)
- it is not advisable to install the sensor on facade sections with high thermal capacity, on walls in the vicinity of, for example, a chimney
- where the supply cable could be routed in parallel with power distribution lines (risk of induction of interfering signals and thus influencing the measurement results); a safe distance from the distribution network in parallel cabling can be up to 0.5 m, depending on the nature of interfering fields.

A failure to comply with these recommendations will negatively affect the measurement accuracy, reliability, and the service

Description of the sensor:

The sensor consists of a plastic head containing sensors of temperature, relative air humidity and CO_2 concentration and a terminal block for the connection of the supply cable. The plastic head consists of a base and a perforated cover, providing access of air to individual sensors. The supply cable is attached to the terminal board through the opening in the base. The base material of the sensor head is LEXAN™ Resin EXL5689.

Temperature and relative humidity are measured by an internal sensor whose signal is processed in a microprocessor and converted to an output signal. The CO_2 value is measured by an NDIR module whose digital signal is also converted to an output signal.

"CO_2" autocalibration – the function provides setting of the minimum CO_2 value corresponding to the outdoor concentration level. The autocalibration process assumes that, during a measured period of approx. 8.5 days (without interruption of the power supply), there will be at least one drop of CO_2 concentration to 400 ppm corresponding to the outdoor concentration. In permanently occupied and non-ventilated rooms, however, this function will not work and must be deactivated – register "settings – bit 0".
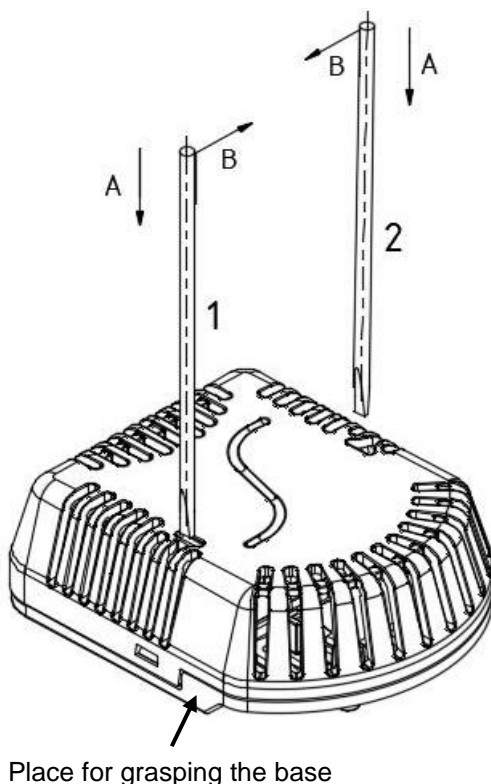
Installation of the sensor:

1. Before connecting the supply cable, detach the perforated cover from the plastic head base. Removing the cover requires a working tool – a thin screwdriver, a metal tube with a tip diameter of 2 to 2.5 mm and a minimum length of 30 mm. **During this operation, take care to prevent mechanical damage of the sensing element – refer to "Cover removal".**
   - use the left hand to firmly grasp the base (bottom of the box)
   - insert the box opening tool as deep as possible into the left opening No. 1 in the direction of the arrow A (when inserted, the tool is tilted at an angle parallel to the side wall of the box)
   - then, press the tool in the direction of the arrow B to dish the box cover and release it from its lock while slightly lifting the cover from the base.
   - repeat the same procedure on the other side of the box, through the opening No. 2
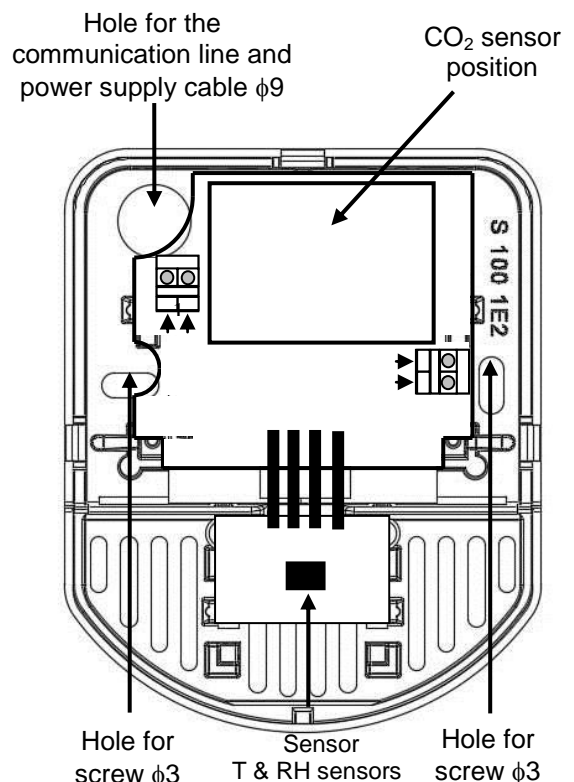   - when the cover has been unlocked on both sides, it can easily be separated from the base

Warning:

It is not advisable to open the box by pushing the side locks inwards – as it can lead to the locks breaking off and losing their function of locking the base-cover connection. It can also result in mechanical damage to the outer surface of the box.

<table>
<tr><td align="center">**Cover disassembly:**</td><td align="center">**Drawing of the base:**</td></tr>
</table>

Place for grasping the base

Hole for the communication line and power supply cable $\phi 9$

CO_2 sensor position

S 100 1E2

Hole for screw $\phi 3$ Sensor T & RH sensors   Hole for screw $\phi 3$

2. Put the drilling template on the expected location of the sensor or at a location where the supply cable is lead out from a wall and mark the position of drilling points with a diameter of 3 mm for the installation of the base and, if necessary, also a drilling point with a diameter of 9 mm for the power cable. **The recommended working position of the sensor is defined in such a way that the round section of the box is oriented downwards – refer to "Base drawing".**

3. At the designated drilling points for the installation of the base, drill the holes for dowels or cut M3 threads for mounting screws or bolts.

4. Insert the power cable through the 9mm hole, attach the base to the surface and fix it using two screws or bolts. The length of the mounting bolts or screws for fastening must be chosen with respect to the thickness of the plastic head base.

5. Connect the power cable to the terminals according to the "**Wiring diagram**", position the perforated cover onto the base and lock it by clicking in.

6. After installing and connecting to the electrical measuring equipment, the sensor is ready for use. The sensor does not require any special servicing or maintenance.

Wiring diagram:

GND, PWR	–	Power supply Ucc
K+, K-	–	communication line
BUS END	–	RS 485 line END
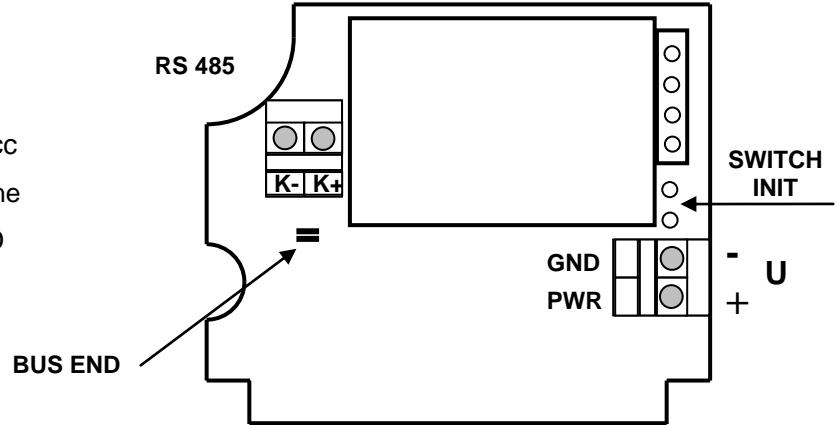
Technical parameters:

Temperature measurement range **	0 to 45 °C	With guaranteed accuracy of CO_2 sensor
	-30 to 70 °C	Without guaranteed accuracy of CO_2 sensor
Temperature measurement accuracy *	± 0,5 °C in range 0 to 65°C ± 0,7 °C in range 65 to 70°C ± 1,1 °C in range -30 to 0°C	
Relative humidity measurement range	0 to 85 %	With guaranteed accuracy of CO_2 sensor
	0 to 95 %	Without guaranteed accuracy of CO_2 sensor
Relative humidity measurement accuracy *	± 3 % in range 10 to 90 % ± 4,5 % in range 0 to 10 % and 90 to 95 %	
CO_2 measuring range	400 to 5000 ppm	
CO_2 measuring accuracy	± 200 ppm *	
Time response CO_2 (90%)	90 s	
Output signal	RS 485 / MODBUS RTU	
Supply voltage U	15 to 30 VDC	
Rated supply voltage U	24 VDC	
Consumption	maximum: 500 mW typical: 250 mW	
Ingress protection	IP 30 according EN 60 529	
Recommended wire cross section	cross section: 0,14 to mm^2 outer diameter: max. 6 mm	
Dielectric strength according EN 50155	1,5 kVDC for time 1 minute	
Shock and vibration according EN 61373	category 1, class B	
Dimension of the head	71,9 x 59 x 27	
Material of the head	LEXAN™ RESIN EXL5689	
Weight	min 35 g	

* The temperature and relative humidity stabilization period is 0.5 to 1.5 hours after connection to a power supply, depending on the conditions around the sensor (airflow, set correction amount, communication frequency, etc.). Guaranteed accuracy is achieved within 0.5 hours after power connection.

** For a short period, the sensor may be exposed to temperatures ranging from -40 to 80 °C.

Safety:

Within the type tests, the product safety and the technical parameters have been assessed according to the following standards and technical regulations, as amended:

- EN 60950-1, EN 60529, EN 60770-1

MODBUS protocol description: (complete description of the protocol – www.modbus.org)

0x01	**Read Coil Status**	bit reading
0x03	**Read Holding Registers**	word reading (16 bits)
0x0F	**Write Multiple Coils**	bit writing
0x10	**Write Multiple Registers**	word writing

note: – 50 registers can be read or written in one query
– default values are stated in brackets for the address type

Register Description:

Name	Address	Type	Description	Note
module ID	1 LSB 1 MSB	R	module identification	0xF204
firmware	2 LSB 2 MSB	R	firmware version	
status LSB	3 LSB	R, W RAM	low byte module status **bit 0** – enables writing in EEPROM **bit 1** – enables SW reset **bit 4** – EEPROM initialization	**EEPROM initialization -** after power connection, SWITCH INIT must be short-circuited – when writing bit 4 to"1", SWITCH must be disconnected (indicated by bit 2 in MSB); **SW reset** can be performed by writing the register SW reset (adr. 1002)

status MSB	3 MSB	R, RAM	high byte module status
			bit 0 – 0 normal mode
			  – 1 init mode
			bit 1 – 1 when the next data is written in the memory stored in EEPROM, all data is written in **EEPROM**
			  – 0 when the next data is written, **received** data is written **only in RAM**
			bit 2 – 1 – EEPROM initialized
			bit 3 – reserve
			bit 4 – 0
			bit 5 – enables SW reset
			bit 6 – 0
			bit 7 – 1	

ADDRESS	4 LSB	R,W EEPROM (0x01)	module address	**!! ATTENTION !!** the change will take effect only after the device is restarted (register setting will be executed immediately, address change after the restart)
BAUD RATE	4 MSB	R,W EEPROM (9600 bps, 13dec)	communication without parity 10 dec … 1200 bps 11 dec … 2400 bps 12 dec … 4800 bps 13 dec … 9600 bps 14 dec … 19200 bps 15 dec … 38400 bps 16 dec … 57600 bps 17 dec … 115 200bps	**!! ATTENTION !!** the change will take effect only after the device is restarted (register setting will be executed immediately, speed change after the restart)

Serial port settings	5 LSB	R,W EEPROM (without parity, one stop bit, 0x00)	setting of serial link parameters
			bit 0–1 parity 00 – no parity
			                                  01 – even
			                                  10 – odd
			bit 2 number of stop bits 0 – one
			                                    1 – two
				!! ATTENTION !! the change will take effect only after the device is restarted

	5 MSB		reserve	
EEPROM writes	6 LSB 6 MSB	R, EEPROM	number of writes in EEPROM	EEPROM initialization doesn´t zero this register, doesn´t rotate
	7 LSB 7 MSB		reserve	
	8 LSB 8 MSB		reserve	
Actual Temp	9 LSB 9 MSB	R, RAM	current measured temperature in 0.01 °C with sensor correction (see **temp sensor corr**)	16bit signed value
Actual RH	10 LSB 10 MSB	R, RAM	current measured humidity in 0.01 % with sensor correction (see **rh sensor corr**)	16bit signed value
Actual CO2 ppm	11 LSB 11 MSB		current CO_2 value in ppm 0.01 % with sensor correction (see **CO_2 sensor corr**)	In ppm
	12 LSB 12 MSB		reserve	
	13 LSB 13 MSB		reserve	
	14 LSB 14 MSB		reserve	
Temp sensor corr	15 LSB 15 MSB	R,W EEPROM (-2,9 °C)	temperature sensor correction in 0.01 °C (self-heating effect of electronics)	16bit signed value
RH sensor corr	16 LSB 16 MSB	R,W EEPROM (7,6 %)	relative humidity sensor correction in 0.01 %	16bit signed value
CO2 sensor corr	17 LSB 17 MSB	R,W EEPROM (0 ppm, 0x0000)	CO_2 sensor correction (elimination of the influence of altitudes, calibration,...	With the CO_2 sensor autocalibration activated, this register is set automatically every 8.5 days with uninterrupted power supply.
settings	18 LSB 18 MSB	R,W EEPROM (enabled, Powered on 0x0003)	configuration register for autocalibration bit 0 – enables CO_2 autocalibration bit 1 – CO_2 power supply 0 – off 1 – on	
	19 LSB 19 MSB 20 LSB 20 MSB		reserve	
uptime	1000 LSB 1000 MSB 1001 LSB 1002 MSB	R	Uptime (s)	
SW reset	1002 LSB 1002 MSB	R,W, RAM	Writing of a non-zero value performs a SW reset, if previously enabled.	See Status LSB bit 1
Serial num.	1003 LSB 1003 MSB 1004 LSB 1004 MSB	R, W OTP	Module serial number, writing only at module production.	

Default Parameters:

Baud Rate	9600 bps, 13 dec	Stop Bits	1	Temp sensor corr	-2,9 °C
Data Bits	8	Module Address	0x01	RH sensor corr	7,6 %
Parity	None	Module ID	0xF204	CO2 sensor corr	---
Settings	Autocalibration enabled, CO2 power enabled				

Declaration of Conformity

SENSIT s.r.o. provides the product with the **EU Declaration of Conformity** issued according to Act No. 90/2016 Coll. and Act No. 22/1997 Coll., as subsequently amended. The product is in accordance with the following directives:

- European Parliament and Council Directive 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- European Parliament and Council Directive 2014/30/EU of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility

Storage, delivery, complaints and repairs:

The sensors can be stored at place with ambient temperature 5 to 40 °C and relative humidity 5 to 85%

Each delivery contains the following unless otherwise agreed by the customer sensor according to purchase order, Instruction Manual, including Guarantee Certificate and Delivery Note

Guarantee and after-guarantee repairs of sensors are ensured by the manufacturer. The product must be delivered including a copy of the Guarantee Certificate, duly packed and fit to shipment so as not to get damaged during transportation.

GUARANTEE CERTIFICATE

The product is covered by guarantee for 24 months from the date of purchase.

In this period, the manufacturer will remove all material or manufacturing defects arisen demonstrably during the applicable warranty period. The manufacturer is liable for the technical and operational parameters of the product given in the user manual. Any identified defects will be claimed by the buyer without undue delay after their identification or, as appropriate, after the buyer was able to identify them during his routine care. A completed Warranty Certificate with a brief description of the defect plus the product must be submitted with the claim.

Warranty does not cover a product:

- That was damaged during transport and inappropriate storage, improper commissioning and/or that has been used for a purpose other than specified
- That has been used in an improper manner, inconsistent with the user manual and/or generally applicable technical standards or safety regulations
- That is worn or damaged as a result of normal use of the product, without loss of its operational characteristics and guaranteed technical parameters
- Into which unskilled intervention, unauthorised structural or other changes (reprogramming, resetting of set parameters, etc.) have been made
- That is mechanically damaged, e.g. by fall, being hit by a hard object, cleaning with unsuitable agents, power cord tearing/breaking, breaking or other damage of individual product parts
- That has been exposed to adverse external influence, e.g. object intrusion, wrong supply voltage, influence of chemical processes, electrical surge (obviously burnt components or printed circuits), dusty, dirty, aggressive or otherwise unsuitable environment, except normal variation
- That has been damaged by an incidental or natural disaster or as a result of natural or external phenomena, such as storm, fire, water, excessive heat
- That is claimed without the Warranty Certificate or nameplate.

Rights and obligations regarding the rights arising from defective performance will be governed by the applicable legislations and the applicable Business Terms and Conditions of SENSIT s.r.o. and this Warranty Certificate.

Date of sale confirmation:

Serial number: