Indoor sensors on 1- wire bus in designs

The sensors are designed for measuring physical quantities in interiors with high aesthetic demands.

Depending on the type, it is possible to measure temperature, relative air humidity, CO_2 concentration, analog signal 0÷10V or use a digital input.

The information about measured values is transmitted using the DS2438 circuit on a 1-wire communication bus.

Each sensor has its own unique address, which must be found via the bus using a Master device - e.g. a 1 wire extension from Loxone. If more accurate temperature measurement is required, a DS18B20/DS18S20 temperature sensor can be added to all types, in which case the device will communicate at two addresses.

The sensor electronics, including terminal blocks, are glued into the blanks of the required designs.

The sensors must be protected from dirt, excessive dust or direct exposure to water!

Basic technical parameters

Supply voltage (terminal 3)[1]	5 VDC
Current consumption	max. 2 mA (except types with CO_2 measurement)
Ext. Supply voltage **xTC1W-5V** (term. 4)	5 VDC
Current consumption **xTC1W-5V** (term. 4)	10mA + pulsed 80 mA / 400ms every 2s
Type of used temperature sensor	DS2438 / SHT31-ARP / DS18B20 / DS18S20
Accuracy of temperature measurement [1]	DS2438 ± 2°C / SHT31-ARP ± 0,5°C / DS18x20 ± 0,5°C
Type of used humidity sensor	SHT31-ARP
Measurement range of humidity	0 ÷ 100%
Humidity resolution	0,25%
Accuracy of RH (+25°C)[1]	± 3% (20 ÷ 80 %RH)
Range of CO_2 measurement	0 ÷ 5000ppm
Resolution of CO_2 (**xTC1W-5V+DB**)	5ppm
Resolution of CO_2 (**NTC1W-5V**)	12,5ppm
Accuracy of CO_2 measurement	± (30 ppm + 3%MV)
Sampling interval of CO_2 measurement	cca 2s
Measurement range of AI	0 ÷ 10 VDC
Resolution of AI measurement	0,009765625V
Accuracy of AI measurement	0,05V
DI (digital input)	Active - activated by connecting the terminals 2,4: terminals connected: rVsens = ≤5 [b] / Vsens = ≤0,00122 [V] not connected : rVsens = ≥1000 [b] / Vsens = ≥0,2441 [V] Pasive - activated by voltage at the terminals 2,4: ≤1V : rVsens = ≤5 [b] / rVsens = ≤0,00122 [V] ≥2.5V (max.30V) : rVsens = ≥1000 [b] / Vsens = ≥0,2441 [V]
Communication	1-wire
HW Communication interface	DS2438 (+DS18x20)
Galvanic separation input - output - 1wire	no
Range of working temperature and humidity [2]	-10 ÷ 40°C / 0 ÷ 100 %RH without condensation
Range of recommended storage temp. / RH	10 ÷ 50 °C / 20 ÷ 60 % RH
Protection level	IP40 (EN 60529)
Type of terminal board	CPP (conductors max. 1 mm^2)

1 The accuracy of temperature and RH measurement depends on the stability of the supply voltage Ucc (+5V = terminal 3), since the SHT31-ARP sensor is directly powered from it, see: Formulas for calculating the value of measured quantities.

2 In types with CO2 measurement, the measured temperature is influenced by the CO2 sensor, which has several times higher temperature losses than the rest of the electronics. After connecting and warming up the device for at least 2 hours, the effect of self-heating stabilizes at a certain value. Using a reference thermometer placed near the device, the difference between the temperature measured by the device and the temperature of the reference thermometer is calculated and this value Tcor[°C] can be subtracted from the measured value T[°C] in the system to obtain the actual temperature value.

3 The devices are intended for use in residential interiors.
The sensor operates stably within the recommended measuring range, which is 5 ÷ 60 °C and 20 ÷ 80 %RH. Long-term exposure to high humidity, especially >80%RH, results in a gradually increasing deviation of the RH reading (+3%RH after 60 hours >80%RH). After returning to the normal range, the RH measurement slowly returns to the calibrated values. Long-term exposure to extreme conditions can accelerate the aging of the sensor. More detailed information on the conditions of long-term use of the sensor in conditions outside the normal range, especially at rel. humidity >80%RH, is provided directly on the manufacturer's website http://www.sensirion.com.
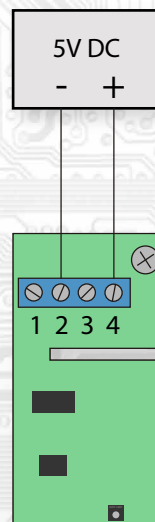
Wirring diagram (fig. 1)

Connecting of external source
type xTC1W-5V

5V DC
− +

1 2 3 4

1 2 3 4

Terminal 1........1- wire
Terminal 2....... common terminal (GND)
Terminal 3.......± 5V (Ucc)
Terminal 4.......Analog (AI) / Digital input (DI)
/ external power source +5V of sensor CO_2 (type **xTC1W-5V**)

External temperature sensor **DS18B20/DS18S20** is connected to terminals 1 ÷ 3

List of types :   *(in parentheses is the input signal source)*

HT1W	= **T** (DS2438 + SHT31) + **RH** (SHT31)	
HTA1W	= **T** (DS2438) + **RH** (SHT31) + **AI** (analog input 0÷10V)	
HTD1W	= **T** (DS2438) + **RH** (SHT31) + **DI** (digital input)	
NTA1W	= **T** (DS2438) + **AI** (analog input 0÷10V)	
NTD1W	= **T** (DS2438) + **DI** (digital input)	
NTC1W-5V	= **T** (SHT31) + **CO₂** (0÷5000ppm) with ext. power source 5V	

Types with temperature sensor DS18B20 (or DS18S20) = **xx1W+DB (xx1W+DS**):

HT1W+DB	= **T** (DS2438 + SHT31 + DS18B20) + **RH** (SHT31-ARP)
HTA1W+DB	= **T** (DS2438 + DS18B20) + **RH** (SHT31) + **AI** (analog input 0÷10V)
HTD1W+DB	= **T** (DS2438 + DS18B20) + **RH** (SHT31) + **DI** (digital input)
NTA1W+DB	= **T** (DS2438 + DS18B20) + **AI** (analog input 0÷10V)
NTD1W+DB	= **T** (DS2438 + DS18B20) + **DI** (digital input)
NTC1W-5V+DB	= **T** (DS18B20) + **CO₂** (0÷5000ppm) with ext. power source 5V
HTC1W-5V+DB	= **T** (DS18B20) + **RH** (SHT31) + **CO₂** (0÷5000ppm) with ext. power source 5V

T = temperature; **RH** = relative humidity; **AI** = analog input 0÷10V; **DI** = digital input;
CO₂ = concentration CO_2

The SHT31 or DS18B20 sensor is located in a metal housing on the front of the device.

__Assembly and connection__

The devices are designed for installation in installation boxes.
The electrical connection of the wires is made on the terminal board with a wire with a cross-section of max. 1 mm2
according to Fig. 1. After connecting the terminal board, the front cover with the sensor is placed in the device
frame. This completes the mechanical installation.
When disassembling, proceed in the reverse order.

Description of measured quantities:

T (temperature):
All types have a temperature sensor, which is part of the DS2438 circuit.
In the HT1W and NTC1W types, an SHT31 temperature sensor is additionally available, mounted in a metal housing on the front side of the blanking plate for more accurate temperature measurement.
If more accurate temperature measurement is required, a DS18B20/DS18S20 temperature sensor can be added to all types (types xx1W+DB/ xx1W+DS).In this case, the device will communicate at two addresses.

RH (relative humidity):
To measure RH, an SHT31 sensor is used, mounted in a metal housing on the front side of the blanking plate, the output of which is processed by one of the A/D converters of the DS2438 circuit.

CO2 (concentration CO2):
CO2 measurement is performed by a connected module that converts the CO2 concentration into a voltage signal, which is further processed by one of the A/D converters of the DS2438 circuit.
The CO2 module is powered by an external 5VDC voltage source. The positive terminal of this source is connected to terminal 4, the negative terminal is connected to common terminal 2 (GND).
The CO2 sensor contains optical elements that "age" during operation and the sensor loses its accuracy. Therefore, the sensor is supplied from the factory in automatic calibration mode (automatic self-calibration - ASC). For the correct functioning of the ASC, it is necessary to ensure regular complete ventilation of the room. If this condition cannot be met, it must be stated in the order and the manufacturer will supply the sensors without automatic calibration mode. In this case, it is advisable to send the device to the manufacturer for calibration check after approximately every 2 years of operation.

AI (analog input 0÷10V):
To measure AI, one of the A/D converters of the DS2438 circuit is used. The positive pole of the signal is connected to terminal 4, the negative pole to terminal 2 (GND).

DI (digital input):
The digital input can be connected as active, when the circuit responds to the resistance between terminals 4 and 2.
A normally open or normally closed contact is therefore connected to terminals 4, 2.
Or it can be connected as passive, when the circuit responds to the voltage between terminals 4 and 2. A DC voltage can therefore be applied to terminal 4 (+) versus 2 (GND), e.g. a normally open or normally closed contact connected to the power supply.

Formulas for calculating the value of measured quantities:

1. Calculation from bit values of registers:

rVDD   = register value VDD (supply voltage to DS2438) [b]
rVAD   = register value VAD [b]
rVsens = register value Vsens [b]

$T(SHT31) [°C]$ = -66,875+218,75*((0,00390625*rVsens)/(rVDD*0,01))
RH [%]   = -12,5+125*((rVAD*0,01)/(rVDD*0,01))
AI [V]   = 0,009765625*rVsens
CO2 [ppm]   = 12,5*rVAD

2. Calculation from voltage values:

VDD   = voltage value (supply voltage to DS2438) [V]
VAD   = voltage value [V]
Vsens = voltage value [V]

$T(SHT31) [°C]$ = -66,875+218,75*(16*Vsens/VDD)
RH [%]   = -12,5+125*(VAD/VDD)
AI [V]   = 40*Vsens
CO2 [ppm]   = 1250*VAD

The sensors can be supplied in designs from ABB, Legrand, Eaton, Schneider Electric, Vimar, Efapel, Gira, Jung...