MBUS_RTH User Guide (for firmware version 285)

Features:

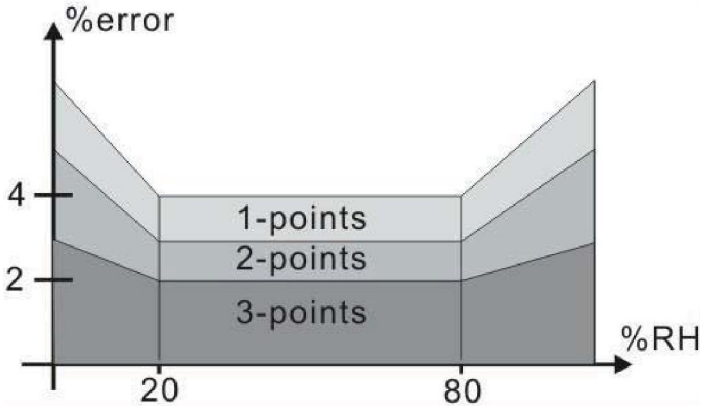
- High Impact Plastic Enclosure provides durability in Industrial & Commercial Environments
- Low Power Consumption
- Temperature and Humidity readings from a single sensor
- Network RS485 Communication via Modbus RTU
- Built-in 0-10V transducers to convert the sensor readings to analog outputs.

Supply voltage	12~24VAC +/- 20%, 50-60Hz: 12-24VDC +/- 20%
Power consumption	55mA at 24Vdc
Operation	10-37°C (50-99°F)
Storage	2-50°C (35-122°F)
Ambient humidity range	0-99%Rh non condensing
Humidity Sensor Element	Humirel HS1101 (2% Accuracy from 10-90%)
Material, enclosure	Flame proof plastic
Enclosure rating	IP31
Temperature sensor	10K thermistor (± 0.5°C Accuracy)
Color	White/Off-white
Weight	200g

The MBUS_RTH sensor monitors temperature and humidity in the space.

Humidity monitoring is done with the Humirel HS1101 sensor element. The Humirel Sensing Element exhibits linear behavior with respect to Relative Humidity. This reduces its complexity and increases its reproducibility and reliability to an overall 2% accuracy. Nonetheless, with error induced in PCB production and associated chips production, accuracy may be slightly lower.

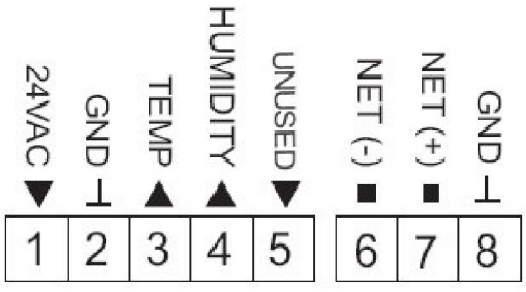
Performing a three point calibration procedure under a controlled humidity environment can be implemented to give an accuracy of 2% in the range of 10 to 90%.



The controller monitors temperature conditions in the space using a built-in thermistor sensor. It is located in such a way that it is not affected by the temperature of the wall or by internal heat created in the device cavity.

External wiring is connected to a terminal block on the back of the sensor.

1	24VAC live or + 24VDC (24VAC is recommended if using voltage outputs)
2	24VAC / 24VDC Common / Measurement neutral
3	Temperature Analog output 0-10V
4	Humidity Analog output 0-10V
6,7,8	Network communication



MODBUS Registers.

- Communication via RS485 at 19200, 8, None, 1

REG	BYTES	RANGE	DEFAULT	DESCRIPTION
4	1	0-255	- -	Software Version Lo Byte (29 for v285)
5	1	0-255	- -	Software Version Hi Byte (1 for v285)
6	1	0-255	254	ADDRESS. Modbus device address
7	1	0-255	13	Product Model # : MBUS_RTH = 13
8	1	0-255	3	Hardware Version
9	1	0-255	3	PIC Firmware Version
100	2	0-3000	- -	**ROOM TEMPERATURE reading in DegF**
101	2	0-3000	- -	**ROOM TEMPERATURE reading in DegC** Writing a temperature value to this register will calibrate the temp by automatically adjusting the calibration register (217)
185	1	0-1	1	Baudrate: 0=9600, 1=19200
186	1	1-2	1	Voltage Output for Temp: 1=0-10V, 2=0-5V
187	1	1-2	1	Voltage Output for Humidity: 1=0-10V, 2=0-5V
217	2	0-1000	500	Temperature Calibration. Default value of 500 means an offset of 0. Each unit is equivalent to a temp offset of 0.1Deg.
304	2	0-1000	- -	**RELATIVE HUMIDITY reading.** Writing a humidity value to this register will do calibration, for details refer to the Humidity Calibration section later in this manual.
306	2	0-10000	- -	Current Humidity raw A/D Sampling Value
307	2	701-900	800	High calibration point, RH
308	2	5000-8000	- -	Sampling data at high calibration point
309	2	451-700	600	Middle calibration point, RH
310	2	5000-8000	- -	Sampling data at middle calibration point
311	2	101-450	300	Low calibration point, RH
312	2	5000-8000	- -	Sampling data at low calibration point

Reading the Temperature using the 0-10V output

To measure the temperature using a 0-10V analog input, simply connect your input to Pt.3 on the MBUS_RTH terminal block and connect your input common to Pt.2 on the MBUS_RTH terminal block. The voltage that you read corresponds to the actual temperature as follows:

Temperature = (Volt x 10) + offset offset should be determined when calibrating

Reading the Humidity using the 0-10V output

To measure the humidity using a 0-10V analog input, simply connect your input to Pt.4 on the MBUS_RTH terminal block and connect your input common to Pt.2 on the MBUS_RTH terminal block. The voltage that you read corresponds to the actual humidity as follows:

%RH = (Volt x 10) + offset offset should be determined when calibrating

CALIBRATION

Temperature Calibration

To calibrate the temperature you will need a handheld mercury or digital thermometer. Hold the meter close to the thermostat and allow it to come to equilibrium. Connect the Sensor to a PC with a RS485 cable. Run a Modbus Tool that can display & modify the registers. After the temperature settles, write the correct temperature to **Register 101**, which will automatically adjust the calibration register 217 by the proper amount. Or you can also directly adjust the calibration register 217 to have the same affect.

You can repeat writing if necessary until the readings from the thermostat and meter agree. Note that the written value should be ten times of actual temperature. For example, if the temp is 22.3 DegC you should write 223.

The thermostat will store the calibration figures through extended power outages and should not need to be adjusted for many years. When calibrating, make sure to let everything come to equilibrium. The thermostat should be powered up for 5 minutes prior to calibration and the thermometer should be left near the thermostat during that time.

Humidity Calibration (this set of instructions is valid for MBUS_RTH software version 285)

Register 304 holds the current Humidity Value
Register 306 holds the current raw A/D sampling value from the sensor

Registers 307-308 contain the high set of calibration registers
Registers 309-310 contain the mid set of calibration registers
Registers 311-312 contain the low set of calibration registers

Here is the proper procedure that should be used to calibrate the Humidity on the MBUS_RTH:

1) Read registers 307 – 312 and write down all of those values somewhere, just in case something goes wrong and you want to go back to the values that you started with.

2) Put the MBUS_RTH into a controlled environment that is at a known humidity level. Once the MBUS_RTH raw A/D sampling value in register 306 stabilizes, write the known humidity level X 10 into register 304. So if you put the MBUS_RTH into a controlled environment that is at 75%RH, then you would write a value of 750 into register 304.

3) When you issue the write request to register 304, the current raw A/D sampling value (from register 306) and the value that you wrote into register 304 will automatically be stored into the proper set of calibration registers, depending on the %RH value that you are calibrating to.
    a. If you are calibrating the sensor in a controlled environment that is at a %RH level that is >= 70.1% and <= 90.0%, and you write a value between 701 and 900 into register 304, then the HIGH set of calibration registers (Registers 307 & 308) will automatically be changed.
    b. If you are calibrating the sensor in a controlled environment that is at a %RH level that is >= 45.1% and <= 70.0%, and you write a value between 451 and 700 into register 304, then the MID set of calibration registers (Registers 309 & 310) will automatically be changed.
    c. If you are calibrating the sensor in a controlled environment that is at a %RH level that is >= 10.1% and <= 45.0%, and you write a value between 101 and 450 into register 304, then the MID set of calibration registers (Registers 311 & 312) will automatically be changed.

As you can see by reading the information given above, in order to calibrate the sensor properly:

- The HIGH calibration point must be >= 70.1% and <= 90.0%
- The MID calibration point must be >= 45.1% and <= 70.0%
- The LOW calibration point must be >= 10.1% and <= 45.0%

Calibration tips:

- The main error in calibration comes from not waiting long enough for everything to come to equilibrium.
- For temperature, the sensor inside the thermostat is a digital chip capable of resolving down to 0.06°C so the weak link in calibrating is usually the procedure used rather than the sensor accuracy.
- Make sure the sensor is mounted in a location free of drafts.
- The MBUS_RTH should be powered up for 5 minutes prior to any calibration.
- If using the voltage outputs to measure the temp & humidity, it is recommended to use 24VAC as the power source for the unit, because the voltage outputs will be most stable in this configuration.