CW2, HW2, TW2 and PMW Living Space Products Field Offset Adjustment Procedure for Temperature and Humidity Outputs

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Introduction

Veris CW2, HW2, TW2 and PMW Series Living Space sensor products are built and calibrated to provide high accuracy temperature and humidity readings. Part of the temperature measurement is the inclusion of a temperature compensation algorithm that accounts for the self-heating of the unit due to electrical power consumption.

The self-heating correction is done using calibrated offset values that are determined in an environmental chamber for each specific model. Installing a sensor at a customer site can produce unique situations which can influence the accuracy of the sensor measurement.

Why is a field adjustment needed?

An adjustment of sensor readings may become necessary because the installation environment is generally different from the controlled factory test environment. Different mounting and less controlled environmental conditions can impact the sensor accuracy.

- High humidity environments are especially affected because of the non-linear relationship between humidity and temperature where small temperature changes cause substantially larger humidity changes. In such environments, the accuracy of the temperature sensor becomes crucial as it also affects the humidity measurement.
- Sensors are installed on different types of surfaces where air drafts from open conduits or pipe systems can have a significant cooling impact on sensor units. Strong air drafts in the room can significantly impact sensor data due to higher convective air throughput. This can even change the thermal behavior of the whole sensor unit itself.

Errors in the sensor readings due to the installation often are unavoidable, therefore CW2/HW2/TW2/PMW units allow the adjustment of the temperature reading to compensate for the influences of a specific environment. The temperature adjustment will correct the humidity reading at the same time and therefore provide most accurately the pair of temperature and humidity measurements.

When to use the temperature and humidity adjustment procedure

The temperature/humidity adjustment procedure will compensate for environmentally induced sensor errors that cause measurement data to be outside the specified accuracy range. After applying the procedure, the sensors will report data which are accurate within their specified ranges.

Specific influences based on the installation are mainly thermal influences by heat conduction, convection and cooling by airflow. Cooling by air convection inside the room is typically one of the strongest environmental influences the sensor experiences. Fast moving air has an impact on the built-in temperature compensation in CW2/HW2/TW2/PMW products and requires different considerations when conducting the adjustment procedure.

A main characteristic of the built-in temperature compensation is the requirement of a wait time after power-up to allow the sensor unit to reach a steady temperature state. This requirement is not necessary when performing the procedure in high airflow due to the high cooling impact of the fast-moving air. Typical environments that operate under high airflow conditions are, i.e., data centers which need airflow for humidity control.

For this reason, CW2/HW2/TW2/PMW sensors do not require any wait time to reach a thermal steady state and all procedural actions can take immediately after power-up.

Scope of the adjustment procedure

- The temperature and humidity readings of the CW2/HW2/TW2/PMW sensors will be compared to the readings of an independent handheld unit.

- The temperature readings of the CW2/HW2/TW2/PMW sensors will be adjusted to match the temperature reading of the handheld. At the same time the humidity reading will correct itself.

The adjustment is successful if temperature and humidity readings of the CW2/HW2/TW2/PMW sensors are within the range of the maximum assessed error of the handheld readings.

Optional step: If the error of the humidity reading in the CW2/HW2/TW2/PMW sensors is still outside the error margin, then its humidity reading will be adjusted to match the humidity reading of the handheld.

Adjustment Procedure

Requirements for the adjustment procedure

The adjustment procedure consists of a temperature and a humidity correction.

The following requirements are necessary to conduct a successful procedure:

- A properly installed sensor unit in compliance with the installation instructions.
- Product related documentation that describes how to technically adjust sensor readings of temperature and humidity.
- A reference temperature and humidity sensor with a preferred accuracy of equal or better than the CW2/HW2/TW2/PMW sensors. A handheld or other portable device is preferred as it is not mounted to any wall.
- IMPORTANT: Any electronic equipment coming from a different climate environment will need time to adjust to the new ambient temperature. i.e., a sensor coming from a colder or warmer environment will need several hours to adjust and perform to its specifications. Therefore, the sensor should be installed at its final location with typical operating conditions for a recommended time of 10 hours. This requirement is the same for any handheld unit that will be used as the reference unit for the adjustment procedure. Handheld units should not be used immediately as a reference when coming out of colder or warmer climates.

An error assessment at the end of the procedure will then determine the achieved accuracy of the CW2/HW2/TW2/PMW sensors compared to the reference, taking in account the accuracy of the reference sensor.

Procedure preparation

- Determine whether the application is a low airflow or high airflow application. If you can feel the air moving under normal operating conditions, consider it a high airflow application. Otherwise, in a low airflow application, the test should be conducted in the temporary absence of air drafts. Check for nearby air conditioner vents and ceiling fans that blow onto the unit.
- In all cases, the handheld unit should be at the location of the sensor for about one hour prior the beginning of the procedure. Handheld units also can have a measurement error due to a time delay if coming directly from a different climate environment.
- Handheld units typically have a short stud sticking out where the temperature and humidity sensors are built in. Place the handheld sensor stud in a position next to the CW2/HW2/TW2/PMW sensor in the bottom left corner. If the sensor has a humidity module installed, place it in the same position.
- If possible, support the handheld on the wall so you can step away to watch it. Position yourself to avoid breathing into the direction of the sensor.

- The ambient temperature should be in a range of 20 to 30 °C (specifications are typically written for 25 °C).
- The humidity range should be in the range of 10 to 80%.
- Prepare the sensor adjustment worksheet to document the sensor and handheld readings for the final accuracy assessment.

Temperature and humidity adjustment procedure

Note: CW2/HW2/TW2/PMW sensors have a built-in compensation for measurement errors due to a self-heating effect. This may require a wait time after power-up to obtain accurate readings based on whether the application is in a low-flow or high-flow environment.

1. Power on the unit. Make sure the immediate environment is only exposed to small temperature and humidity changes for the duration of the procedure.

   a) If the adjustment procedure is done in a high airflow environment, proceed to step 3.

   b) If the procedure is done in a low airflow environment, wait 2 hours before taking readings.

2. During the 2-hour warm-up time, place the handheld in a location close to the CW2/HW2/TW2/PMW sensor where temperature and humidity are assumed to be the same. The purpose is to keep both temperature sensors in a thermal steady state with the environment.

3. Turn on the handheld. Avoid any contact to the sensor or breathing on it. Wait until the handheld shows a stable reading.

4. Record the readings of the CW2/HW2/TW2/PMW and the handheld before adjustment.

   Temp, CW2/HW2/TW2/PMW (°C) _____
   Temp, Ref (°C) _____
   RH, CW2/HW2/TW2/PMW (%) _____
   RH, Ref (%) _____

5. Adjust the temperature of the CW2/HW2/TW2/PMW to match the handheld temperature as closely as possible (refer to the specific product instructions).

6. After the adjustment, record the obtained measurements for temperature and humidity and calculate the differences between the CW2/HW2/TW2/PMW and reference readings.

   Temp, CW2/HW2/TW2/PMW (°C) _____
   Temp, Ref (°C) _____
   RH, CW2/HW2/TW2/PMW (%) _____
   RH, Ref (%) _____

   Temp, CW2/HW2/TW2/PMW - Temp, Ref _____
   RH, CW2/HW2/TW2/PMW - RH, Ref _____

The following tables show the expected error margin of the reference sensor readings, taking into consideration the error margins of the CW2/HW2/TW2/PMW sensor. Select the accuracy ranges for temperature and humidity from the tables below and compare them to the temperature and humidity readings after the adjustment.

Select temperature reference accuracy:

Temperature Accuracy of Reference ± (°C)	Combined Error Margin CW2/HW2/TW2/PMW and Reference ± (°C)
0.1	0.22
0.15	0.25
0.2	0.28
0.25	0.32
0.5	0.54
1.0	1.02
1.5	1.51

Select RH reference accuracy:

RH Accuracy of Reference ± (°C)	Combined Error Margin CW2/HW2/TW2/PMW and Reference ± (°C)
1	3.9
1.5	4.1
2	4.3
2.5	4.6
3	4.8
3.5	5.2
4	5.5

7. Compare the temperature and humidity differences with the selected combined error margin from the table. The adjustment procedure is complete if the obtained temperature and humidity differences are within the expected error margin.

8. If the temperature matches and the humidity sensor still reads outside the error margin, an additional humidity adjustment can be done. Follow the instructions in the specific product information for how to perform the adjustment.

9. Record the final adjusted humidity value for the CW2/HW2/TW2/PMW The adjustment is complete.

   RH, CW2/HW2/TW2/PMW = _____ %

Setting Up Temp and Humidity Offsets

Protocol Units – Modbus

Function Codes:

Function Code	Function
03	Read holding (RW) registers
04	Read input (RO) registers
06	Write single register*
16	Write multiple registers
01	Read coils
05	Write single coil
15	Write multiple coils

32-Bit Holding Registers (Read/Write):

16-Bit Register Location	Description	Format
52 53	Offset temp by this value	32-bit
54 55	Offset humidity by this value	32-bit

Protocol Units – BACnet

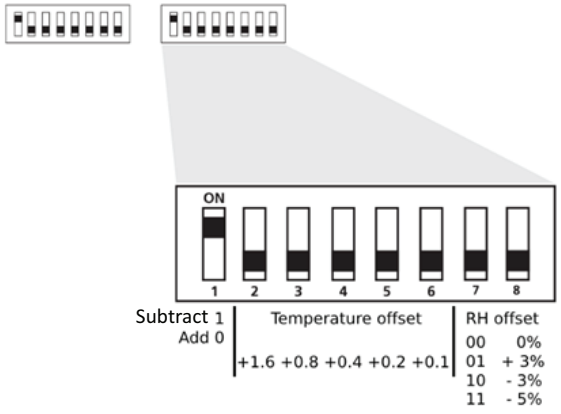
Two BACnet objects (analog values) are available to write the desired offset value for temperature and for humidity (see table below).

Object Name	Min Value	Max Value
Temp offset	-5	5
Humidity offset	-10	10

Object Name	Object Identifier	Object Property
Temp offset	AV 7	Offset value to add to the temperature sensor output value
Humidity offset	AV 8	Offset value to add to the humidity sensor output value

Analog Units

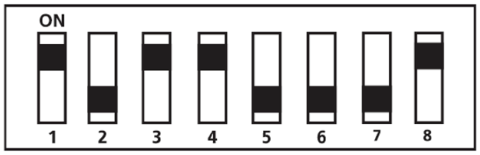
On analog models the second DIP switch (on the right) is used to set up desired temperature and humidity offsets.



The first switch position is used to confirm if it is a positive (OFF) or negative (ON) temperature offset. Switches 2-6 are used to set a temperature offset value (see mapping above). Switches 7-8 are used to select a humidity offset to apply among the available values.

Temperature offset ranges from -3°C to 3.1°C in 0.1°C increments.

Example:



In this case, the following offsets are programmed:

- Temperature offset is - (0.8 + 0.4) = -1.2 °C
- Humidity offset is + 3% RH

Worksheet

Location:

Date:

Sensor Model:

Serial Number:

Reference Sensor Model:

1. Power on the unit and wait 2 hours before taking readings. Make sure the immediate environment is only exposed to small temperature and humidity changes within accuracy during the time of the procedure.

   a. For high airflow environments, wait 5 minutes and proceed to step 3.
   b. For low airflow environments, wait 2 hours before taking readings.

   Start Time: _____

2. During the warm-up time, keep the handheld placed in a location close to the CW2/HW2/TW2/PMW where temperature and humidity are assumed to be the same. The purpose is to keep both temperature sensors in a thermal steady state with the environment.

3. Turn on the handheld. Avoid any contact to the sensor or breathing onto it too closely. Wait until the handheld shows a stable reading.

4. Record the readings of the CW2/HW2/TW2/PMW device and the handheld before adjustment.

   Time: _____

   Temp, CW2/HW2/TW2/PMW, (°C): _____ Temp, Ref, (°C): _____
   RH, CW2/HW2/TW2/PMW, (%): _____ RH, Ref, (%): _____

5. Adjust the temperature of the CW2/HW2/TW2/PMW device to match the handheld temperature as closely as possible (refer to the specific product instructions).

6. After the adjustment, record the obtained measurements for temperature and RH and calculate the differences between the CW2/HW2/TW2/PMW and reference readings.

   Temp, CW2/HW2/TW2/PMW, (°C): _____ Temp, Ref (°C): _____ Temp, CW2/HW2/TW2/PMW - Temp, Ref: _____
   RH, CW2/HW2/TW2/PMW, (%): _____ RH, Ref (%): _____ RH, CW2/HW2/TW2/PMW - RH, Ref: _____

7. The tables below show the expected error margin of the reference sensor readings taking into consideration the error margins of the CW2/HW2/TW2/PMW sensor. Select the accuracy ranges for temperature and humidity from the tables below and compare them to the remaining temperature and humidity deviations after the adjustment.

Temperature Accuracy of Reference ± (°C)	Combined Error Margin CW2/HW2/TW2/PMW and Reference ± (°C)
0.1	0.22
0.15	0.25
0.2	0.28
0.25	0.32
0.5	0.54
1.0	1.02
1.5	1.51

RH Accuracy of Reference ± (%)	Combined Error Margin CW2/HW2/TW2/PMW and Reference ± (%)
1	3.9
1.5	4.1
2	4.3
2.5	4.6
3	4.8
3.5	5.2
4	5.5

Worksheet (cont.)

8.	Compare the temperature and RH differences with the selected combined error margin from the table. The adjustment procedure is complete if the obtained temperature and RH differences are within the expected error margin.
9.	If the temperature matches and the RH sensor still reads outside the error margin, an additional RH adjustment can be done. Follow the instructions in the specific product information how to perform the adjustment.
10.	Record the final adjusted RH value for the CW2/HW2/TW2/PMW device. The adjustment is complete. **RH, CW2/HW2/TW2/PMW:** _____%

12345 SW Leveton Drive
Tualatin, OR 97062 USA
www.veris.com