GE
Sensing

Telaire Vaporstat™ Model 9002 Infrared Absolute Humidity Sensor User Instructions

Introduction

The **GE Telaire Vaporstat™ 9002** sensor measures in applications in the range of 0 to 80°F dew point. The sensor package is designed for wall mounting. GE Telaire offers enclosures for mounting in a variety of applications including aspirated sampling of in-duct concentrations, outside air measurement and measurement in wet environments.

This manual contains procedures for installation, wiring and adjustment of the sensor, and provides conversion information to translate the dew point measurement of the sensor to other measurements of humidity, including grains/lb and relative humidity.

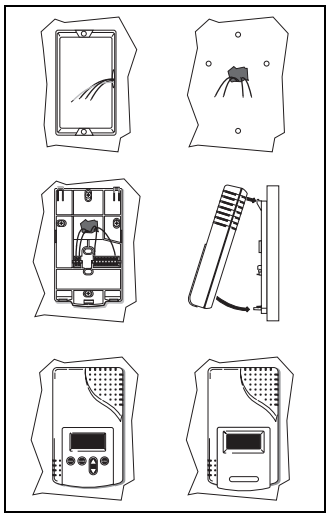
Field Calibration

The sensor features a dual-beam optical assembly that utilizes a neutral reference measurement to adjust for changes that my occur in the optics. Although this feature will minimize sensor drift, field calibration at sensor installation and subsequent periodic calibration is still recommended to maintain optimum accuracy.

Each sensor has an individually developed curve, based on a certified chilled mirror hygrometer, with over 8 calibration points. This individualized curve is stored in the sensor's permanent memory and is valid for the life of the sensor. Using a reference device to field calibrate the sensor at a known concentration re-establishes its original calibration accruacy. Reference devices include a calibrated reference dew point sensor or GE Telaire's Calibration Kit 2076.

Installing the Sensor

Install the sensor and the mounting plate as follows:



1. Prepare for installation by using the mounting holes configured for US or European junction boxes.
2. Use the mounting plate as a template to mark the mounting holes.
3. Secure the mounting plate to the wall or junction box and make the necessary wire connections.
4. Mount the Controller on the base by aligning the top clips and then securing to the bottom clips. A "snap" sound will indicate that the sensor is secure. The sensor will now have power. A 2 minute warm-up will take place. After 2 minutes, the sensor will stabilize and display the "**Normal Mode**" (current water vapor concentration).
5. Using the procedure outlined in the section "Model 9002 Operating Modes and Adjustments", adjust the sensor to provide the proper elevation correction for your location.
6. Finish installation by sliding the cover over the menu keys and secure with the screws being provided.

Wiring Diagrams (Typical)

The Model 9002 cannot be wired in a 2-wire configuration where the power supply also carries the current output of the sensor. Only the 3- and 4-wire configurations are possible, as shown in Figure 1 below.

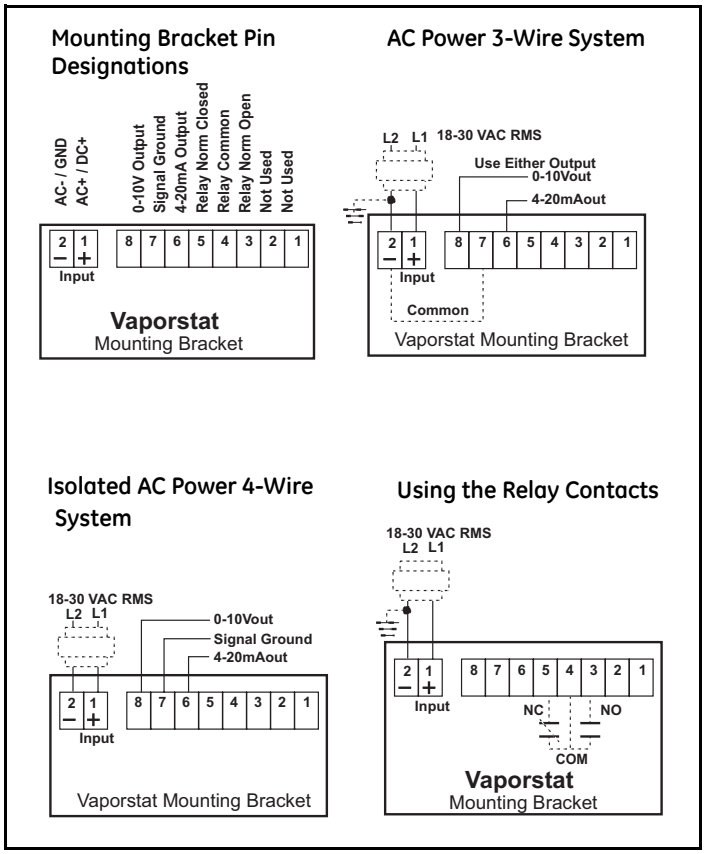


Figure 1: Wiring Diagrams (3- and 4- Wires)

Model 9002 Operating Modes and Adjustments

Operating Modes

The Model 9002 has the following three operating modes:
Measurement Mode - The sensor operates in the measurement mode.

Adjustment Mode - Allows for adjustment of sensor operational characteristics, including:

- Altitude correction
- Configuration of display/output
- Adjust measurement range
- Adjust analog output signal range, and
- Adjust relay set point and dead band.

Calibration Mode - This mode can be used to calibrate the sensor in the field.

Keypad Buttons

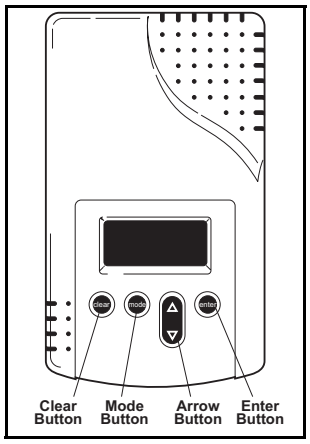
Clear Button - Allows to Exit Adjustment or Calibration **mode** and return to measurement mode.

Mode Button - When in the Adjustment Mode, the **mode** button will advance the Model 9002 to the next variable that can be adjusted.

Arrow Button - Allows user to increase or decrease values or choose between selected variables.

Enter Button - Programs new settings or selection into the sensor.

Clear + Mode (3 sec) - Enter Adjustment Mode



Clear + Enter (3 sec) - Enter Calibration Mode

Adjusting the Sensor Using the Onboard Keypad

The sensor is shipped with the factory default settings (as shown in Table 1 below), which can be adjusted, using the keypad and display. When in Adjustment Mode, the selection of various adjustment parameters appears sequentially in the order detailed below. Pressing **clear** at any time will exit the Adjustment Mode.

Note: *If an adjustment is made to any of the sensor parameters, it will be retained by the Model 9002 even when the sensor is powered* ***OFF****. Adjustments to the output of the sensor will only apply to the unit of measure selected for the display mode. The non-selected display mode will continue to operate at its factory setting. For example, if the output range of the dew point measurement is adjusted, the grains/lb settings will not be affected and remain at the initial factory settings.*

Factory Settings

Table 1: Model 9002 Default Factory Settings

Default Measurement Unit	**Dew Point**	
Selected Measurement Unit	Dew Point	Grains/lb
Display	°F Dew Point	Grains/lb
Measurement Range	0 to 80 °F Dew Point	0 - 140 Grains/lb
Analog Output	0 - 10 V and 4 - 20 mA	0 - 10 V and 4 - 20 mA
Relay Set Point	55°F Dew Point	65 Grains/lb
Relay Hysteresis (Dead Band)	2°F Dew Point	5 Grains/lb
Altitude	N/A	Sea Level (0 feet)

Adjustments Required for Installation

Select Display Units (°F dew point or grains/lb) (Factory set for dew point.) - The units selected for display on the LCD will also correspond to the units used for the analog output and relay setting of the Model 9002.

Set Elevation - Since the density of air and gases are affected by altitude, a correction must be made to the reading in grains/lb units, depending on the altitude. The sensor is factory set for sea level operation.

Calibration - It is also recommended that the user perform a single point zero or ambient calibration of the sensor to ensure maximum accuracy at start-up. For details, see the "Calibration" section on page 4.

Adjustment Mode

1. Hold the **Clear + Mode** buttons for 5 seconds.
2. Each adjustment mode will appear sequentially on the display. Pressing **Mode** or **Enter** will move to the next adjustment value. The sequence that adjustment values will appear are as follows:

- Altitude
- Display Units
- Analog Output, and
- Relay

Altitude Adjustment

1. Use the **Arrow** button to adjust altitude up or down in 500 ft. increments.
2. When altitude is set, press **Enter** to store the correction in the sensor.
3. Press **Mode** to move to water vapor display or **Clear** to exit the Adjustment Mode.

Display/Output Units between Dew Point (DEW PT) or Grains/lb (Grains)

1. Press **Mode** button to leave or skip the elevation selection.
2. Use **Arrows** to select **GRAINS** or **DEW PT**.
3. Press **Enter** to confirm selection.
4. Press **Mode** to move to SETTINGS or **Clear** to exit the Adjustment Mode.

Output Adjustments

It is only necessary to make the adjustments described in this section if you would like to adjust the measurements range of the sensor and/or the analog output range, or adjust relay settings. If you do not wish to make these adjustments, press **Clear** after you have selected the display/output units.

Adjust Output Ranges

1. Use the steps described above in the section "Adjustments Required for Installation" to cycle through the startup adjustments on the sensor until you see the display SETTINGS.
2. Press the **Mode** button to begin to adjust settings.

Adjust Measurement Value for Lower Output Limit

Note: *The lower output limit adjustment does not affect the display.*

1. The display will indicate **GRN FROM** or **DP FROM**.
2. Use the **Arrow** button to adjust the sensor output value you want to correspond to the low limit used for the analog output.
3. Press **Enter** to confirm selection; an arrow should flash on the lower display (not necessary if no adjustment is made).
4. Press **Mode** to move to the next selection.

Adjust Measurement Value for Upper Output Limit

Note: *The upper output limit adjustment does not affect the display.*

1. The display will indicate **GRN TO** or **DP TO**.

Note: *It is possible to adjust the output to consider concentrations up to 300 grains or a 100 °F dew point.*

2. Use the **Arrow** button to adjust the sensor output value you want to correspond to the upper limit used for the analog output.
3. Press **Enter** to confirm the selection (not necessary if no adjustment is made).
4. Press **Mode** to move to the next selection.

Analog Output - The analog output of the sensor will correspond to the units selected for the LCD display. The sensor is set at the factory to provide linear 0-10 volt and 4-20 mA outputs over the full measurement scale of the sensor. If necessary, the analog output range and the measurement range can be user-adjusted to meet any unique requirements such as a data logger, which may only accept a 0-5 volt input.

Select the Analog Output Scaling Units

The top line of the display will read **OUTPUT**.

1. Use the **Arrow** button to select if you want to scale the measurement range to **V** or **mA**. It should be noted that the scaling adjustment you select will be applied to both the voltage and mA output. For example, if you program 0-5 volt output for a 0 to 80 °F measurement range, the mA output will be 4-12 mA for a 0 to 80 °F measurement range.
2. Once you have selected the preferred value for scaling (**V** or **mA**), press **Mode**.

Select the Lower Limit for Analog Output

1. The top line of the display will read **V FROM** (or **mA FROM**).
2. Use the **Arrow** button to select the lower analog output value you wish to use to correspond to the low limit measurement value set in step 2 of the section *"Adjust Measurement Value for Lower Output Limit"* above.
3. Press **Enter** to confirm selection (not necessary if no adjustment is made).
4. Press **Mode** to move to the next selection.

Select the Upper Limit for Analog Output

1. The top line of the display will read **V TO** (or **mA TO**)
2. Use the **Arrow** button to select the upper analog output value you wish to use to correspond to the low limit measurement value set in step 2 of the section *"Adjust Measurement Value for Upper Output Limit"* .
3. Press **Enter** to confirm the selection (not necessary if no adjustment is made).
4. Press **Mode** to move to the next selection

Relay Set Point and Hysteresis

The normally open/closed relay contacts can be set to a specific set point and hysteresis (dead band). The set point is the point at which the relay is energized as concentrations rise. Hysteresis is the difference at which the relay de-energizes when concentrations drop below the set point. The sensor relay is factory-set to energize at 55 °F dew point (65 grains/lb). The hysteresis is factory-set at 2 °F dew point (5 grains/lb).

Adjust Relay Activation Levels

1. The top line of the display will read **RELAY ON**.
2. Use **Arrows** to select relay on value desired (set point).
3. Press **Enter** to confirm the selection.
4. Press **Mode** button to the next selection.
5. The top line of the display will read **HYSTER**.
6. Use **Arrows** to select relay hysteresis value desired (dead band).
7. Press **Enter** to confirm the selection.
8. Press **Mode** button to exit the adjustment mode.

Calibration

Overview - Periodic calibration of the Model 9002 is recommended to maintain optimum accuracy throughout the life of the sensor. Sensor calibration can be verified or re-established at any time by using a reference device. Appropriate reference devices include:

- A recently calibrated hand-held dew point sensor, or
- Flowing a zero calibration gas through the sensor.

Calibration using this technique will re-establish the sensor to its original factory calibration curve. **GE Telaire** offers the model 2076 calibration kit, which provides a zero calibration gas, certified to have less than 0.1 grains/lb of water vapor content, and is ideal for this purpose.

Infrared sensors are unique as in that sensor drift occurs at the zero point of the sensor calibration and not the span concentration; therefore, span calibration of the sensor is not required.

Refer to the model 2076 calibration kit manual for additional information.

Calibration Description - The sensor provides the following two choices for calibration:

- Single Point Calibration
- Zero Point Calibration

Each method adjusts the zero setting of the sensor. Only one of these methods should be used for calibration.

Single Point Calibration

This calibration mode allows the user to calibrate the sensor in ambient air to a known concentration as measured by a recently calibrated reference device (e.g., a hand held sensor which displays dew point or grains). This type of calibration will ensure that the greatest sensor accuracy is provided at or near this concentration used for calibration. This type of calibration is particularly recommended if high accuracy of the sensor is required over a narrow range of operation (e.g., clean rooms). To perform this calibration, you must be confident that the reference device you are using has been recently and properly calibrated. The calibration kit is not necessary to perform a Single Point Calibration.

Zero Point Calibration

This calibration mode allows the user to calibrate the sensor to a verified zero concentration of water vapor. The display may not indicate 0.0 during the calibration process, which is normal.

Calibration Procedure

NOTICE!

Use of cellular telephones or radio transceivers within two (2) feet of the sensor during calibration process could cause sensor interference, calibration errors and affect sensor accuracy. Please refrain from using these devices during sensor calibration.

Determine which calibration procedure you will use to calibrate the sensor - Single Point or Zero Point calibration. For best results, the sensor should be allowed to warm-up for at least ten minutes prior to calibration.

Note: *The calibration kit is not necessary to perform a Single Point Calibration.*

Single Point Calibration

The reference measurement device should be warmed up in normal measurement/operating mode. The Model 9002 should be in an environment where concentrations will remain very stable for a minimum of 10 minutes during calibration. Avoid breathing in the direction of the sensor; exhaled air contains high levels of moisture and could disrupt the calibration process.

Perform a Single Point Calibration as follows:

1. Press and hold the **Clear + Enter** buttons on the Model 9002 for 5 seconds. The word **CAL** will appear in the top line of the LCD display.
2. Use the **Arrow** buttons to change the display to read **SINGLE**. When **SINGLE** is displayed, a water vapor value will display in the lower screen.
3. Use the **Arrow** button to adjust the sensor to reflect the concentration displayed on your reference device.
4. Press the **Enter** button to calibrate the sensor to the value selected on the display based on ambient air conditions. Once the **Enter** button is pressed, the calibration process will take approximately 8 minutes, during which time the green LED below the display will flash. Once calibration is complete, the sensor will revert to its normal display mode.

Zero Point Calibration

All tubing should be connected between the gas bottle and the sensor inlet flow port, as shown in Figure 2 below. Gas should be flowing to the sensor at a rate of 80-100 cc/minute for a minimum of 5 minutes prior to initiating calibration.

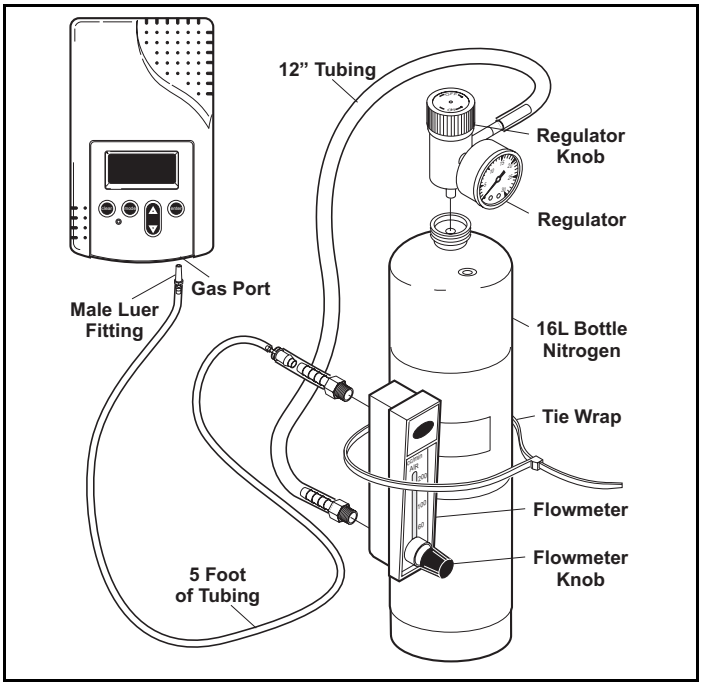


Figure 2: Zero Point Calibration - Setup

1. Attach the short hose to the bottom port on the flowmeter.
2. Attach the long hose to the top port on the flowmeter.
3. To insure the flowmeter is kept in the vertical position, secure the flowmeter to the side of gas bottle using the supplied tie wrap.
4. Remove the protective cap from the nitrogen bottle and attach the gas regulator.
5. Attach the open end of the bottom hose (located on the flowmeter) to the gas regulator. Slide the hose far enough on the gas port to ensure a secure, airtight connection.
6. Insert the male Luer fitting (located on the longer hose) into the calibration port, located on the bottom of the Model 9002.
7. Verify all the components are installed correctly and initiate the calibration process by turning the knob on the regulator. Turn the knob until the indicator reaches 7 psi.
8. Turn the flowmeter knob until the floater reaches 80 -100 cc/ min.
9. Allow the gas to flow for at least 5 minutes before proceeding.
10. Press and hold the **Clear + Enter** buttons on the keypad for 5 seconds. The word **CAL** will appear in the top line of the LCD display.
11. Use the **Arrow** buttons to toggle to the **ZERO** calibration mode.
12. When **ZERO** is displayed, press the enter button to initiate the calibration process.
13. Once the **Enter** button is pressed the calibration process will take approximately 8 minutes, during which time the green LED below the display will flash repeatedly. Once calibration is complete the sensor will revert to its normal display mode.
14. Once the display has returned to normal, turn the gas off and disconnect the tubing connection to complete the process.

Conversion Factors

Dew Point and Relative Humidity (RH)

While the measure of relative humidity is highly dependent on the temperature of air, the measurement of dew point is not. We can use dew point to predict what the relative humidity of air will be at a particular temperature. For a designer or controls contractor, this means that dew point can be used to predict and control water concentrations in air to ensure a target relative humidity is not exceeded for a design indoor temperature condition. The conversion factors chart, as shown in Figure 3 below, can be used to establish dew point set points for various common target relative humidity levels over a range of typical conditioned space temperatures.

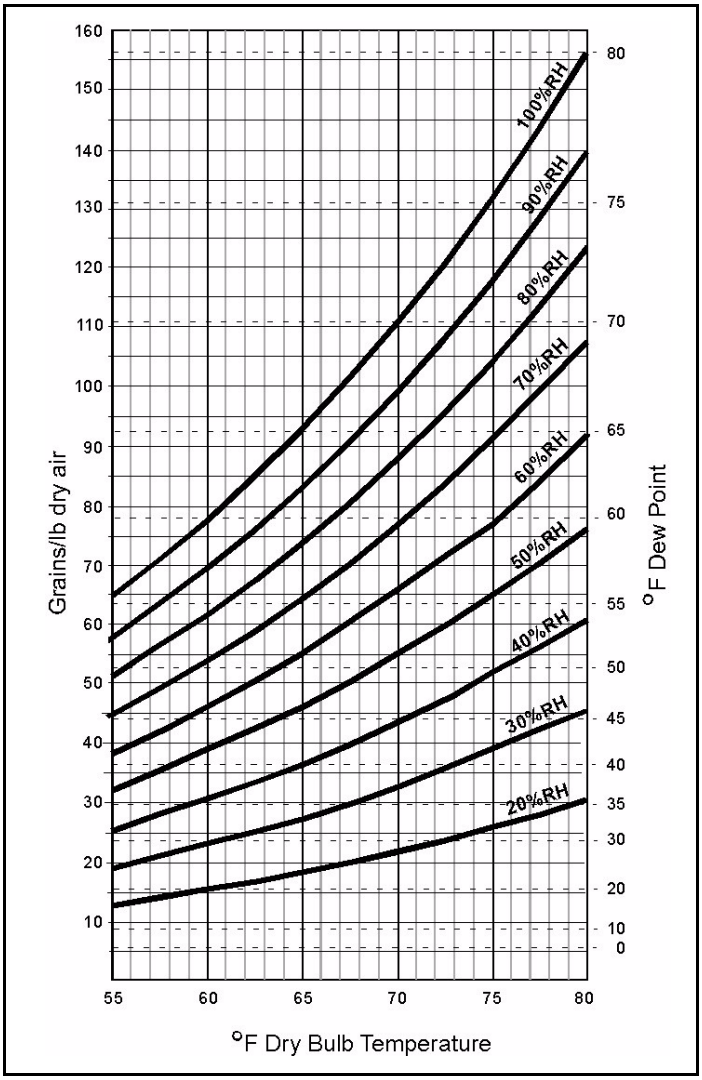


Figure 3: Conversion Factors - Chart

Specifications

Measurement Method

- Non-Dispersive Infrared (NDIR)
- Dual-Channel
- Non-Interactive.
- Non-Saturating

Sensor Output Units

°F Dew Point

Measurement Range

0 °F to 80 °F (-18 °C to 27 °C) Dew Point

Typical Dew Point Accuracy @ 77 °F (25 °C), 26 °F to 80 °F DP Range (-3 to 27°C DP)

(As measured against a factory certified reference):

±3.6 °F (2 °C) Dew Point

Altitude Correction

User adjustable in 500 ft. increments using keypad

Operating Temperature Range

- Room and Duct: 32 °F to 120 °F (0 °C to 49 °C), 1508 enclosure required for duct mounting
- Outdoor: -20 °F to 120 °F (-29 °C to 49 °C), when installed in 1551 enclosure

Storage Temperature

14 °F to 170 °F (-10 °C to 77 °C)

Input Power

- 18-30 VAC, 50/60 Hz (half-wave rectified)
- 18-42 VDC
- 1.75 VA average, 2.75 VA peak

Analog Outputs (available simultaneously)

- 0-10 VDC (100 Ohms output impedance)
- 4-20 mA (RL_{max} to 500 Ohms)

Relay Output

- Normally Open and Normally Closed (SPDT)
- Gold Bifurcated, 2A max @ 24 V

Limited Warranty

18 months (see warranty card for details)

Sensor Rated Life

15 years

Accessories

2076 Calibration Kit

Warranty Repairs

GE Sensing will repair Telaire product that fails to meet the terms provided for in the Return and Warranty Policy Statement (*See*, http://www.gesensing.com/service/brochures.htm). Warranty period shall start from date of manufacture and be based on product category and type of equipment as specified in Table 1: Product Warranty Periods. For all warranty repairs, GE Sensing will bear all product repair parts, labor, and standard ground shipping charges.

This product is covered by one or more of the following patents:

5,650,624/5,721,430/5,444,249/5,747,808/5,834,777/5,163,332/5,340,986/5,502,308/6,344,798/6,023,069/5,370,114/5,601,079/5,691,704/5,767,776/5,966,077/6,107,925/5,798,700/5,945,924/5,592,147/6,255,653/6,250,133/6,285,290

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