HPO-43
HUMIDITY TEMPERATURE PROBE

Instruction Manual

The HPO-43 humidity-temperature probe is an OEM product, primarily designed for applications such as weather stations, meteorological data loggers, hatching chambers, etc.

The HPO-43 operates with a DC supply voltage and has a low current draw. Relative humidity is measured with the HYGROMER™ C94 capacitive sensor and temperature with a Pt100 RTD. The signals from the sensors are converted into two linearized voltage output signals.

Power Supply

The HPO-43 requires a voltage source in the range of 5..28 VDC, capable of providing 3.5 mA.

In the case of data logger applications. battery power may be conserved by energizing the probe for only 0.5 seconds during each measurement (maximum error 0.25 %RH , 0.25°C). For best accuracy, the probe should be powered for a minimum of 10 seconds.

Output Signals

The HPO-43 provides two linearized voltage signals:

0..1 VDC = 0..100%RH
0..1 VDC = -40..60°C

On request, the temperature output signal can be made to correspond to -30..70°C or to 0..100°C.

☞ *Do not connect a load to the outputs with an impedance of less than 1000 Ω.*

Environmental Limits

Temperature Limits

The HPO-43 was designed to operate within -20°C and +60°C. The probe may be used at temperatures in the range of -40°C to +70°C but accuracy is not guaranteed. Operating the probe above 70°C may result in permanent damage.

Humidity Limits

The HPO-43 can operate within 0 and 100 %RH. Direct condensation does not damage the sensors. However, the humidity sensor will not provide correct readings as long as condensation is present and all sensors will not operate if the sensor leads are short circuited by condensation. The HPO-43 provides a humidity output that is referenced to the saturated water vapor pressure above liquid water. With this reference, the maximum humidity temperatures below freezing is as follows:

100 %RH at 0°C	95 %RH at -5°C	91 %RH at -10°C
87 %RH at -15°C	82 %RH at -20°C	78 %RH at -25°C
75 %RH at -30°C		

Temperature Compensation

Practically every make of relative humidity sensor requires a compensation for the effect of temperature on the humidity output signal in order to measure accurately over a wide range of temperature conditions. In the specific case of an instrument using a capacitive sensor, compensation is required because the dielectric characteristics of both the water molecule and the hygroscopic polymer used in the sensor vary with temperature. The electronic circuit of the HPO-43 uses data from an NTC temperature sensor to automatically compensate the effect of temperature on the accuracy of humidity measurement.

Sensor Protection

Always use the dust filter provided with the probe to protect the sensors. The standard wire mesh filter is sufficient for most applications. For applications that involve direct spraying of water and / or a lot of dust, use the optional foam filter.

Installation

Probe Location

Install the probe so that the local conditions at the sensors are typical of the environment to be measured.

In an outdoor environment:

- Use either a shield or a shelter to protect the probe and sensors from direct exposure to solar radiation and precipitation. Several shields are available from ROTRONIC (see specifications).
- In an open field, install the probe at least 3.3 feet (one meter) above ground. Increase this distance if the ground surface is concrete of black top (such as above a roof).

Wiring Connections

As a standard, the HPO-43 is supplied with a 2-meter cable (about 6.5 ft) terminated with tinned ends (on request the HPO-43 can be supplied with a connector). When a much longer cable is required (max.100 feet or 30 meters), consider using an extension cable. Remember that the probe will have to removed from its location to be calibrated from time to time.

Wires are coded as follows:

Supply Voltage (+)	**: Green**
Common (- / Ground)	**: Brown and Shield**
%RH (+)	**: Gray**
Temperature	**: Red**

Check for wiring errors before powering the probe. Improper wiring may damage the probe.

☞ *Whenever possible, we recommend grounding the (-) side of the probe supply voltage.*

Maintenance

Cleaning or Replacing the Dust Filter

The dust filter should be cleaned from time to time, depending on the conditions of measurement. Whenever possible, cleaning should be done without removing the filter from the probe. To replace the filter, unscrew the filter from the probe.

☞ *If you remove or replace the filter, make sure that the sensors do not get caught. The humidity sensor is sometimes mistaken for a "white paper tag". Do not remove from the probe! Before putting on a new dust filter, check the alignment of both sensors with the probe. The wires that connect the sensors to the probe are very thin and bend easily. If this happens, correct the alignment by holding the sensor very gently with a pair of small flat nosed pliers. Do not puncture the sensor with sharp pliers or tweezers or pull too hard on the sensor.*

Periodic Calibration Check

Long term stability of the humidity sensor is typically better than 1 %RH per year. For maximum accuracy, calibration of the unit may be verified every 6 to 12 months.

Applications where the probe is exposed to significant pollution may require more frequent verifications. The calibration procedure is described in detail in this manual.

Both the Pt 100 RTD temperature sensor and associated electronics are very stable and should not require any calibration after the initial factory adjustment.

Calibration Basics

Temperature Calibration

The stability of the Pt100 RTD sensor used to measure temperature is such that temperature calibration in the field is seldom required.

In order to be able to correctly evaluate the accuracy of the temperature measurements provided by the probe, you should be able to meet the following requirements:

• Both the probe and a reference thermometer should be ventilated with the same stream of air. Any dust filter used to protect the sensors should be removed from the probe. If the probe has only a slotted cap, this may be left on the probe.

• Air velocity should be within the limits of 200 to 500 feet/minute (1 to 2.5 meters/second). Any comparison between two instruments at velocities under 200 feet/minute may not be valid. Air velocity above 500 feet/minute may damage the unprotected humidity sensor.

• The temperature of the air stream should be constant or at least it should not change at a rate that is less than 10 times the shortest time constant of either the probe or reference thermometer.

☞*If you are not able to meet the above requirements, you may not be able to verify the accuracy of the probe.*

Humidity Calibration

When calibrating humidity, **temperature stability is the single most important requirement**. Do not calibrate unless the probe is at room temperature (20 to 25°C) and this temperature is stable to ±0.25°C or better during the period of time required for each calibration point. Do not calibrate outdoors. Indoors, do not calibrate close to an air vent or a heater, in direct exposure to sun rays, etc.

Calibration Device

The calibration device model EM15 fits the HPO-43. This calibration device is a small airtight container that screws on the tip of the probe and seals around the humidity sensor. During calibration, a known reference humidity is produced inside the calibration device by means of a humidity standard (usually an aqueous salt solution).

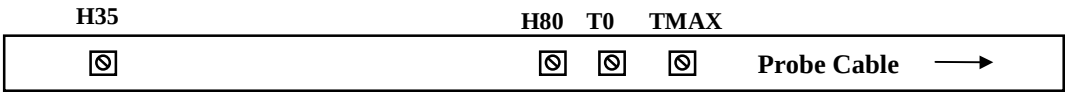
Humidity Standards

RIC humidity standards are available in boxes of 5 glass ampoules of the same value, which can be stored indefinitely. Standards in the range of 5 to 95 %RH are non-saturated aqueous salt solutions that are precisely titrated at our factory for the right concentration. The 0 %RH humidity standard is made of small granules of a highly porous ceramic that have been dried at a high temperature. A Material Safety Data Sheet is available for each standard. Since most standards are a salt solution, parts which have come in contact with the liquid should be cleaned after each use.

Calibration Procedure

Calibration Potentiometers

Unscrew the cable grip so as to free the cable. Next, unscrew the probe barrel from the tip of the probe (where the sensors and calibration device are located). You may want to use a pair of small pliers to hold the tip of the probe. Now, pull back the probe barrel so as to expose the circuit board and gain access to the calibration potentiometers.



Calibration Sequence

Full calibration of the HPO-43 requires a 2-point calibration of temperature and a 2-point calibration of humidity.

Calibration should be done exactly in the sequence indicated in this manual. Because of the high stability of the Pt100 RTD sensor, temperature calibration is optional. However, if temperature calibration becomes necessary, it must be done prior to humidity calibration and must always be followed by a humidity calibration.

Temperature Calibration (optional)

Should a temperature calibration be necessary, you should proceed as follows, depending on the equipment available to you:

a) Two Temperatures Air Generator:

- Connect a voltmeter to T (+) and COM (-)
- Position the T max potentiometer in the middle of its span.
- Set the air generator at 0°C and adjust the probe output with the T 0 potentiometer.
- Set the air generator at a temperature such as 40 to 50°C and adjust the probe output with the T max potentiometer.

☞ *If you cannot go as low as 0°C, you may have to repeat the entire procedure a few times.*

b) Single (Room) Temperature Air Generator

Remove the Pt100 RTD from the probe and replace it by a decade box that simulates the resistance of the RTD at different temperatures. Adjust the electronic circuit as follows:

- Connect a voltmeter to T (+) and COM (-)
- Position the T max potentiometer in the middle of its span.
- Set the decade box to simulate 0 °C.
- Adjust the probe output with the T 0 potentiometer.
- Set the decade box to simulate a temperature of either 50 or 100°C.
- Adjust the probe output with the T max potentiometer.
- Put the Pt100 RTD back on the probe and check the probe at room temperature. If necessary, adjust the probe output with the T 0 potentiometer.

☞ *After calibrating temperature you should always calibrate humidity since the humidity output is affected by the temperature output.*

Humidity Calibration

Calibration Device

To install the calibration device, unscrew the sensor protection (dust filter) from the tip of the probe and replace it with the calibration device model EM15. Position the probe and calibration device so that the receptacle (or solution holder) is below the sensors. Remove the receptacle from the calibration device.

☞ *Be very careful during this operation since the sensors are not mechanically protected.*

First Calibration Value

The first calibration adjustment should be at **35 %RH** or at a value close to that.

- Connect a voltmeter to %RH (+) and COM (-)
- Set the H80 potentiometer in mid position.
- Place one fiber disc (each box of RIC humidity standards includes 5 discs) in the receptacle of the calibration device. The purpose of this disc is to prevent accidental spilling of the solution inside the calibration device or on the humidity sensor.
- Tap the top of one ampoule of 35 %RH solution so that all liquid drops to the bottom of the ampoule. Snap off top and empty contents on fiber disc. **Since the ampoule is made of glass, exercise proper caution (gloves, safety glasses) when snapping off the top.**
- Put the receptacle back on the calibration device and make sure that the solution does not come in contact with the sensor: **The solution inside the calibration device should never be on top of the sensors.**
- Allow at least 60 minutes to insure that the calibration device, the solution and the sensor are in a state of equilibrium. This is verified by monitoring the voltmeter.
- At equilibrium (stable output signal), adjust the reading of the voltmeter with the H35 potentiometer.
- Remove the receptacle from the calibration device. Throw away the wet disc (non reusable). **Thoroughly wash and dry the receptacle, removing all traces of the humidity standard.**

Second Calibration Value

Use **80 %RH** as the second calibration value as this provides the best overall accuracy over the full range of measurement.

- Repeat the procedure used for the 35 %RH adjustment with an 80 %RH standard. Allow at least 60 minutes for equilibrium.
- At equilibrium, adjust the probe output with the H80 potentiometer
- Remove the receptacle from the calibration device and clean thoroughly.

☞ *Carefully reassemble the probe, making sure that the O-rings and the cable grip provide adequate sealing.*

Specifications

Humidity Sensor	ROTRONIC HYGROMER™ C94
Temperature Sensor	Pt100 RTD
Operating Temperature Limits	-20..+60°C *)
Humidity Output Signal (linear)	0..1.0 VDC = 0..100%RH
Temperature Output Signal (linear)	Standard: 0 1.0 VDC = -40..+60°C
	Optional: 0..1.0 VDC = -30..+70°C
	Optional: 0..1.0 VDC = 0..+100°C
Minimum Load per Output	1000 Ω
Accuracy (at 20..25°C)	± 2 %RH from 10 to 100%RH
	± 3 %RH from 0 to 10 %RH
	± 0.3°C
Repeatability	± 0.3 %RH and ±0.1°C
Humidity Sensor Stability	better than 1 %RH over a year
Response Time (without filter)	10 seconds (%RH and temperature)
Calibration Potentiometers	35, 80%RH
	T0 and Tmax
Calibration Device (order separately)	EM15
Supply Voltage	5 to 28 VDC
Current Consumption	about 3.5 mA
Cable Length	2 meters (6.5 ft), tinned ends
Sensor Protection	Standard: wire mesh filter NC-W15
	Optional: steel cap and foam filter
Dimensions	see below
Weight	120g (0.27 lb.)

*) Probe may operate down to -40°C and up to +70°C without damage. Accuracy is not guaranteed outside of the -20°C to 60°C limits.