HP 101A Series
Humidity Temperature Probes

INSTRUCTION MANUAL

CONTENTS

PLEASE, READ THIS FIRST

- Check the product for any physical damage that may have occurred during shipment. We carefully pack and routinely insure all shipments. If any damage has occurred, it is your responsibility to file a claim with the carrier, **prior to returning the damaged product**. Please note that our warranty does not cover damage during shipment.

- Prior to using the probe get fully familiarized with the operating limits and with the measurement tips provided in this manual.

- Do not unnecessarily remove the sensor protection (slotted cap or dust filter) from the probe. Both sensors (humidity and temperature) can be mechanically damaged by careless removal of the protection. The ROTRONIC HYGROMER™ humidity sensor looks like a small white paper tag. Do not remove from the probe!

Each ROTRONIC instrument is carefully calibrated before shipment. No further adjustments should be required before installation. If you have any question or problem, please call our service department at 631/427-3898 and press 5 (or ask for extension 21).

DESCRIPTION

The HP101A humidity and temperature probes were designed to operate with the ROTRONIC indicators A2 and AM3. These probes are available in 4 basic configurations that cover typical requirements for humidity measurement:

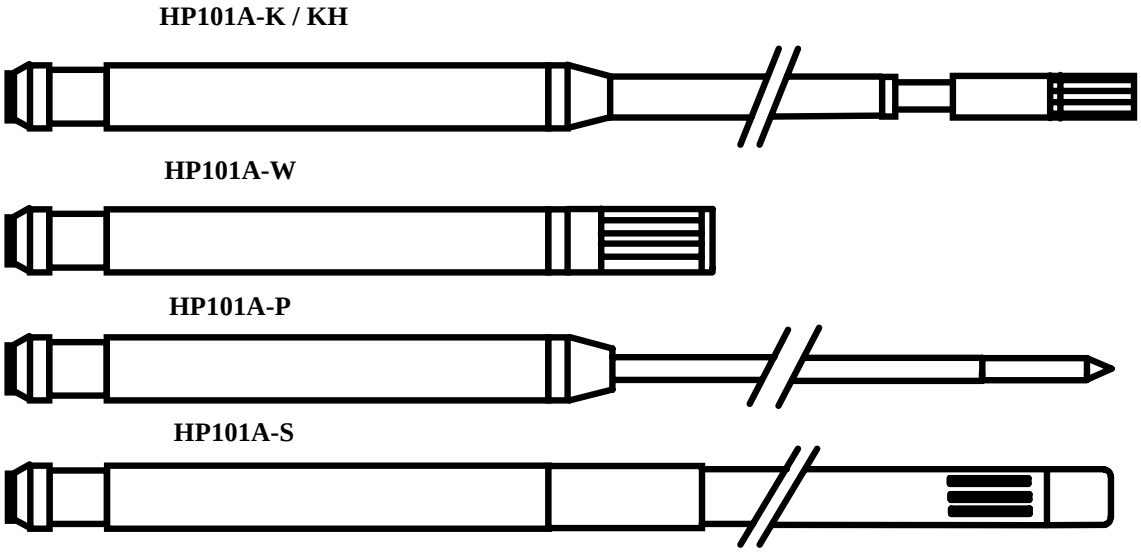
- **K Probe** (HP101A-K and HP101A-KH): Fast response air probe with extended tube for measurement in rooms (clean rooms, research laboratories, manufacturing areas), air ducts, dryers, incubators, environmental chambers, etc. For more demanding applications, a special version of this probe (HP101A-KH) was designed to survive temperatures at the sensors within the range of -60..390°F (-50..200°C)

- **W Probe** (HP101A-W): Compact air probe for measurement in rooms under stable temperature conditions..

- **P Probe** (HP101A-P): Tubular probe for the measurement of hygroscopic materials in bulk (powders, granules or pellets). Typical areas of application include pharmaceutical powders, powdered sugar, dried foods, beverages in powder form, coffee and cocoa beans, tea leaves, cereals, seeds, etc.

- **S Probe** (HP101A-S): Sword probe for the measurement of paper stacks and rolls.

All probes feature a compensation that eliminates potential errors resulting from cable resistance for lengths up to 330 ft (100 meters).



OPERATION

1. Power Supply

The HP101A probes accept an unregulated supply voltage between 4.8 and 30.0 VDC. The current consumption is 10 mA.

The HP101A probes do not have to be continuously energized. Measurements require that the probe be energized for 0.25 seconds after which the power can be turned off to conserve energy.

2. Output Signals

The HP101A provides two linearized voltage output signals: one for humidity and the other for temperature.

Relative humidity Output Signal (linear)	0...1.0 VDC = 0 to 100%RH
Temperature Output Signal (linear)	-0.5..2.0 VDC = -50..+200°C

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

3. Temperature Limits

The HP101A probes can operate within -20°C..+60°C (-5..140°F) at the electronics (located inside the probe grip).The temperature limits at the sensors depend on the probe configuration:

HP101A-W:	-20..+60°C (-5..+140°F)
HP101A-K:	-40..+150°C (-40..+300°F)
HP101A-KH:	-50..+200°C (-60..+390°F)
HP101A-P:	-20..+60°C (-5..+140°F)
HP101A-S:	-20..+60°C (-5..+140°F)

Operating the probes outside of the temperature limits may result in inaccurate measurements and can cause permanent damage.

4. Humidity Limits

The HP101A probes can operate within 0 and 100 %RH. Direct condensation on the sensors does not damage the sensors. However, the humidity sensor will not provide correct readings as long as condensation is present. The HP101A probes provide a humidity output that is referenced to the saturated water vapor pressure above liquid water. With this reference, the maximum humidity at 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		

5. 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 HP101A probes uses data from the temperature sensor to automatically compensate the effect of temperature on the accuracy of humidity measurement.

6. Sensor Protection

Always use the slotted cap or dust filter provided with the probe to protect the sensors.

MEASUREMENT

When using a portable probe, it is important to keep in mind that there is no such thing as an instantaneous humidity and temperature measurement.. By nature, this type of measurement requires that the probe be given sufficient time to equilibrate with the environment to be measured.

The most common source of error in relative humidity measurement is a difference between the temperature of the probe and the temperature of the environment at the time of measurement. At average and high humidity levels, even a small difference such as 1 or 2°F will result in a substantial error on relative humidity. For this reason, it is always a good idea to monitor the temperature display for stability when measuring relative humidity.

Equilibration time will be shorter and errors will be less likely when using the correct probe configuration for your application:

APPLICATION	PROBE CONFIGURATION
Air Measurement under Variable or Stable Temperature Conditions	HP101A-K HP101A-KH (high temperature probe)
Air Measurement in Rooms under Stable Temperature Conditions	HP101A-W (compact air probe)
Powders, Granulates or Pellets in bulk	HP101A-P
Stacks and Rolls of Paper	HP101A-S

1. Measurements in Air

The following are the two most important points for measurements in air:

- Initial temperature difference between probe and environment.

The larger the initial temperature difference, the longer it takes to measure. Measurements in dryers and environmental chambers at temperatures above room temperature may require special handling of the probe. When the probe is inserted in a hot environment,

condensation will occur on the sensors when the dew point of the environment is higher than the temperature of the probe. At dew points below 90 to 100°C, condensation will not alter the calibration of the humidity sensor. However, the sensor will have to dry before it can provide a valid measurement. In extreme situations, it may be necessary to warm up the probe before the measurement so as to prevent condensation. This can be done by placing a humidity insulating shield (for example a metal cap) on the tip of the probe and by letting the shielded probe come to the temperature of the dryer or chamber. Once the probe is at the temperature of measurement, it should be withdrawn to remove the shield, and rapidly inserted again in the dryer or chamber.

- Air movement at the sensors

Non-moving air is an excellent temperature insulator and works against rapid equilibration of the probe. For this reason, the standard sensor protection on air probes is a slotted cap. This permits air movement at the sensors. Unless the environment requires it, you should not use a dust filter on an air probe because filters do not permit air movement at the sensors.

2. Measurement of Materials in Bulk

These measurements require the use of a dust filter to protect the sensors from direct contact with the material to be measured. The foam filter used on the HP101A-P probe is not penetrated by liquids and can be easily be washed with a mild detergent.

Because of the filter, the sensors are surrounded by non-moving air and can adapt only slowly to the temperature and humidity of the material. Measurements usually require at least 15 to 30 minutes.

If the material is hot and humid, condensation will occur on the sensors unless the probe has been warmed up prior to insertion in the material. This can be done by placing a humidity insulating shield (for example a metal cap) on the tip of the probe and by letting the shielded probe come to the temperature of the material. Once the probe is at the temperature of measurement, it can be rapidly withdrawn to remove the shield, and inserted again in the material.

3. Measurement of Paper Stacks and Rolls

To introduce the HP101A-S probe in a paper stack, the layer of paper above the desired measuring location must be lifted a little. Do not force the probe into the paper stack since this would break the probe. To speed up measurements, move the probe by about half an inch after about 30 seconds. This bring the slots located at the tip of the probe in contact with fresh paper. When the initial temperature of the probe and that of paper are close, equilibration typically requires 5 to 10 minutes. Avoid touching the metal parts of the probe with the hand prior or during measurements since this affect the temperature of the probe.

The HP101A-S probe can also be used to measure paper rolls. Cut through 3 or 4 layers of paper, over a length of 7 to 10 inches from one edge of the roll, to permit insertion of the probe. Tape the cut paper over the probe so as to cover it.

MAINTENANCE

1) Cleaning or Replacing the Dust Filter:

If the probe has a dust filter, this filter should be cleaned from time to time, depending on the conditions of measurement. Cleaning should be done without removing the filter from the probe. Gently wipe the filter with a solution of water and mild detergent.

If cleaning does not remove most of the stains, the filter should be replaced. To do this, unscrew the filter from the probe. When removing 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. Be careful not to puncture the sensor with sharp pliers or tweezers and do not pull too hard on the sensor.

2) Periodic Calibration Check:

Long term stability of the humidity sensor is typically better than 1 %RH per year. For maximum accuracy, calibration of the probe should 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 under "CALIBRATION".

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

1. 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 a slotted cap, this should 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 cannot correctly check the accuracy of temperature measurement and should not attempt to calibrate temperature.

2. 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 close to an air vent or a heater, in direct exposure to sun rays, etc. If necessary during calibration, place the tip of the probe with the calibration device on it (see below) inside an insulating box filled with sand.

a) Calibration Device:

The calibration device is a small airtight container that fits on the instrument 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).

PROBE	CALIBRATION DEVICE
HP101A-K	ER15 (slip on)
HP101A-KH	ER15 (slip-on)
HP101A-W	EM25 (screw-on) Remove slotted cap or filter prior to installation on probe. Be very careful during this operation since the sensors are not mechanically protected.
HP101A-P	EGL (slip-on)
HP101A-S	EGS (slip-on)

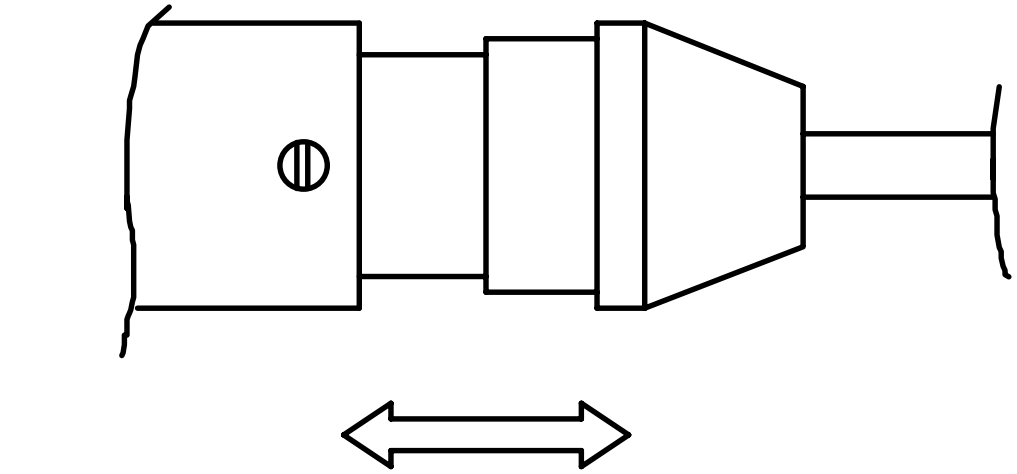
b) Humidity Standards:

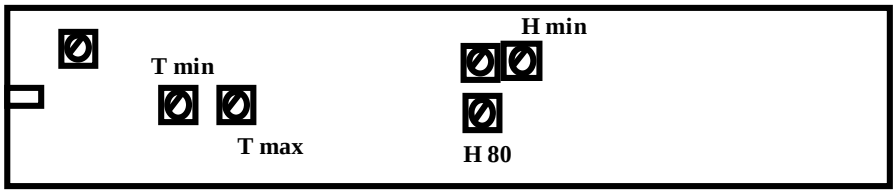
RIC humidity standards permit calibration by non-skilled personnel. These standards are available in boxes of 5 glass ampoules of the same value, which can be stored indefinitely. Standards in the range of 5 to 95 %RH are non-saturated aqueous salt solutions that are precisely titrated at our factory 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

1. Calibration Potentiometers

To access the calibration potentiometers, remove the 3 screws located near the tip of the probe. Carefully pull back the probe barrel (or probe grip) from the tip of the probe to gain access to the electronic board.





2. Calibration Procedure

Full calibration of the HP101A probes requires a 2-point calibration of temperature and a 3-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.

2.1 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 the probe to the indicator.
- 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 min potentiometer. If you cannot go as low as 0°C, you will have to repeat the entire procedure a few times.
- Set the air generator at a temperature such as 40 to 50°C and adjust the probe output with the T max potentiometer.

b) One Temperature Air Generator (Room Temperature)

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 the probe to the indicator.
- 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 min 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 min potentiometer.

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

2.2. Humidity Calibration

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

- Install the calibration device on the probe so that the receptacle (solution holder) is below the sensors. Check for a tight fit and remove the receptacle from the calibration device.
- Connect the probe to the indicator.
- 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.**

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.

The low humidity calibration is the last step of the calibration sequence.

- Repeat the procedure used before with either a 10%RH or a 0 %RH standard. Allow at least 90 minutes for equilibrium.
- At equilibrium, adjust the probe output with the H min potentiometer
- Remove the calibration device from the probe. Thoroughly clean the receptacle. *HP101A-W probe: pay attention not to catch the unprotected sensors. Put the sensor protection back on the probe.*

SPECIFICATIONS

Humidity Sensor	all probes, except KH	ROTRONIC HYGROMER™ C94
Temperature Sensor		Pt100 RTD
Humidity Measuring Range		0..100 %RH
Temperature Measuring Range		See limits at sensors
Temperature Limits at Sensors		K Probe: -40..+150°C (-40..+300°F)
		KH Probe: -50..+200°C (-60..+390°F)
		W Probe: -20..+60°C (-5..+140°F)
		P Probe: -20..+60°C (-5..+140°F)
		S Probe: -20..+60°C (-5..+140°F)
Operating Temperature at Electronics		-20..60°C (-5..140°F)
Humidity Output Signal (linear)		0..1 VDC = 0..100%RH
Temperature Output Signal (linear)		-0.5..2.0 VDC = -50..200°C *
Minimum Load per Output		1000 Ω
Accuracy (at 20..25°C)		± 1 %RH from 0 to 100%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 and Low %RH***
		Tmin and Tmax
Supply Voltage		4.8 to 26.5 VDC
Max. Current Consumption		10 mA
Connector		LEMO, 5-pin
Sensor Protection	K and W Probe:	slotted cap (standard)
		filter (optional)
	P probe	filter
Weight		70..150g (0.15..0.33lb)

*) ROTRONIC indicators provide conversion to °F.

**) When calibrated against highest quality reference standards. Both factory calibration and field calibration with ROTRONIC standards result in ±1.5%RH accuracy or better.

***) Calibration with low %RH potentiometer can be done at any value between 0%RH and 10%RH.