F100 Series

HUMIDITY
AND
HUMIDITY-TEMPERATURE
TRANSMITTERS

INSTRUCTION MANUAL

20020628

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 installation, get fully familiarized with the operating limits of the product and with the installation instructions provided in this manual.

- Do not remove the sensor protection (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

Transmitters of the F100 series are used to measure humidity or a combination of humidity and temperature in manufacturing areas, clean rooms, research laboratories and other industrial applications. The electronic circuitry is of the 2-wire loop powered type. Linearized output signals (DC current) are provided for transmission over a length of cable to a remote display, recorder, controller or data processing unit.

The F100 series features the ROTRONIC HYGROMER™ capacitive humidity sensor. This well proven sensor offers exceptional durability and stability in all kinds of environments. This fact is reflected in the 3-year full warranty that covers the transmitters of the F100 series. Reliability is further enhanced by the easy-to-perform field calibration. Measurement accuracy and fast response are provided over the entire range of humidity conditions, even when the sensor is exposed to extremely high or low humidity over long periods of time. An electronic compensation circuit maintains the accuracy of humidity measurement at all temperatures.

Models that measure both humidity and temperature, use an RTD Pt100 temperature sensor.

The F100 series is available in the following configurations:

Model	Measurement	Circuit Type	Installation
F100W	Humidity	2-Wire Loop Powered	Wall (Surface)
FT100W	Hum. + Temperature	2-Wire Loop Powered	Wall (Surface)
F100D	Humidity	2-Wire Loop Powered	Duct (Through Wall)
FT100D	Hum. + Temperature	2-Wire Loop Powered	Duct (Through Wall)
F100R	Humidity	2-Wire Loop Powered	Remote Probe (6 Ft cable)
FT100R	Hum. + Temperature	2-Wire Loop Powered	Remote Probe (6 Ft cable)
F100P	Humidity	2-Wire Loop Powered	Remote Probe (6 Ft cable) NPT 1/2” fitting (150 psi)
FT100P	Hum. + Temperature	2-Wire Loop Powered	Remote Probe (6 Ft cable) NPT 1/2” fitting (150 psi)

OPERATION

Power Supply

Depending on the load connected to the output, transmitters of the F100 series require a supply voltage between 10 and 35 VDC. The minimum supply voltage can be determined as follows:

V min = 10 V + [0.02 x Load (ohm)].

For the maximum load of 500Ω, the minimum supply voltage is 10 + [0.02 x 500] = 20 VDC.

The maximum current consumption is 20 mA per circuit.

Output Range

The range of the relative humidity output is 0 to 100%RH. The temperature output depends on the range specified when ordering (see label on case cover).

Temperature Operating Range and Temperature Limits

The F100 series can operate within 32 to 122°F (0 to 50°C) at the electronics.

The temperature operating range of models for surface (wall) installation is the same as the temperature limits at the electronics. For other models, the temperature limits at the sensor(s) are -5..176°F (-20..80°C).

Operating the transmitter and/or its probe outside of the temperature limits can result in permanent damage.

Humidity Limits

As far as possible, avoid sudden condensation at the sensors. When measuring at high humidity, condensation may occur on the humidity sensor due to a sudden difference in temperature with the environment. This does not damage the sensor. However, this will produce an overflow reading (an output signal of more than 100 %RH) for as long as condensation is present on the humidity sensor.

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 F100 series uses an NTC located next to the humidity sensor to provide automatic compensation for the effect of temperature on the humidity sensor. The temperature compensation uses normal room temperature as a reference. Because of this, calibration of the unit is done at normal room temperature rather than at the temperature of operation at the sensor.

Sensor Protection

Transmitters of the F100 series are supplied as a standard with a stainless steel filter base and a wire mesh cartridge to protect the sensors from dust and particles. Some applications with extremely fine particles and liquid droplets may require the use of a foam cartridge (option) instead of the wire mesh cartridge.

Do not remove the stainless steel filter base from the probe.

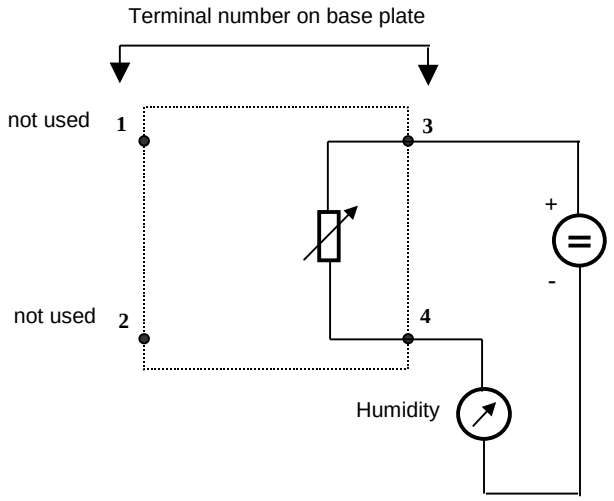
Output Signals

The F100 provides 4-20 mA current signals. The output signals are linear and are consistent with the requirements of most data/signal processing instrumentation (panel meter, controller, computer card, etc.).

The transmitter behaves as a variable load and adjusts the current flowing through the terminals as a function of relative humidity and temperature. The output signal may be read with any current sensing device having a maximum impedance of 500 ohms. When several devices are connected in series with the transmitter, the resulting impedance should not exceed 500 ohms, wiring included.

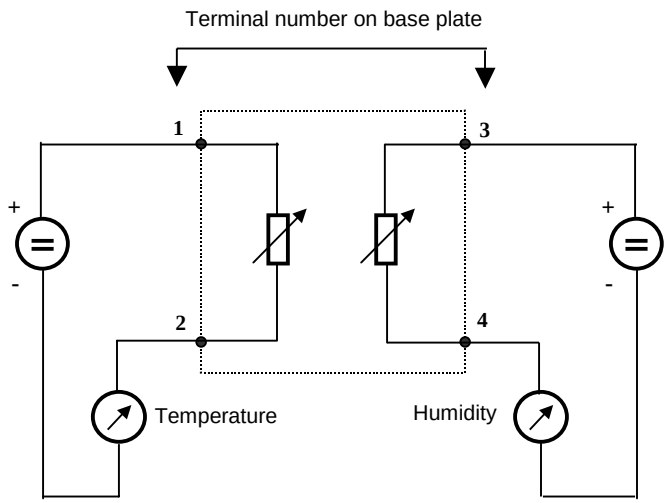
Wiring Diagrams

The wiring diagram for transmitters that measure humidity only is as follows:

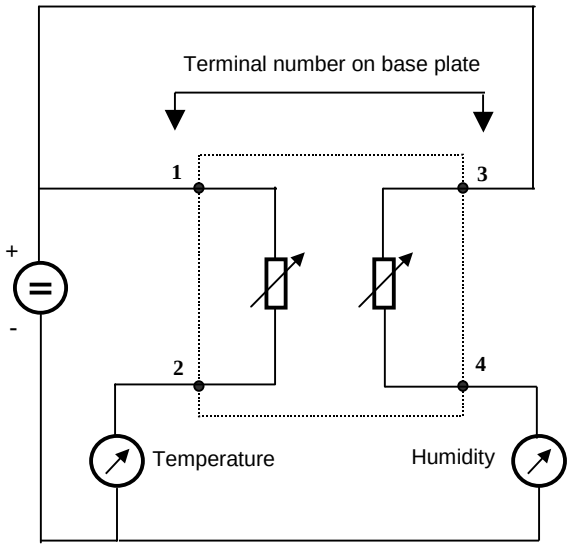


The wiring diagram for transmitters that combine humidity and temperature measurement is as follows:

2-Wire Transmitter (4-20 mA outputs)
using two independent power supplies



2-Wire Transmitter (4-20 mA outputs)
using a single power supply



Grounding

Operation of the F100 series does not require that the unit be electrically grounded. However, we recommend grounding the instrument, especially if the electronic circuits are subjected to a low humidity environment (less than 35 %RH).

INSTALLATION

- **Do not remove the stainless steel filter base from the probe. The sensor can easily be damaged when not protected.**
- **The ROTRONIC HYGROMER™ humidity sensor has the appearance of a small white paper tag. Do not remove!**

Mechanical Installation

1. General Recommendations

Relative humidity is extremely dependent on temperature. Proper measurement of relative humidity requires that the probe and its sensors be at exactly the temperature of the environment to be measured. Because of this, the location where you choose to install the probe can have a dramatic effect on the performance of the instrument. The following guidelines should guarantee good instrument performance:

a) **Select a representative location**: install the probe where humidity, temperature and pressure conditions are representative of the environment to be measured.
b) **Provide good air movement at the probe**: air velocity of at least 200 ft/ minute (1 meter/second) facilitates adaptation of the probe to changing temperature.
c) **Avoid the following:** (1) Close proximity of the probe to a heating element, a cooling coil, a cold or hot wall, direct exposure to sun rays, etc. (2) Close proximity of the probe to a steam injector, humidifier, direct exposure to precipitation, etc. (3) Unstable pressure conditions resulting from excessive air turbulence.
d) **Immerse as much of the probe as possible in the environment to be measured.**

2. Installation of the Transmitter Enclosure

Remove the enclosure cover to get access to the 4 holes for mounting the enclosure. These are separated from the inner section of the transmitter case. Screws with an approximate diameter of 5/32" should be used. If the surface of the mounting wall is at a temperature of more than 100°F, use an insulating spacer (not provided) between the transmitter enclosure and the wall or duct. This spacer should be at least 1" thick.

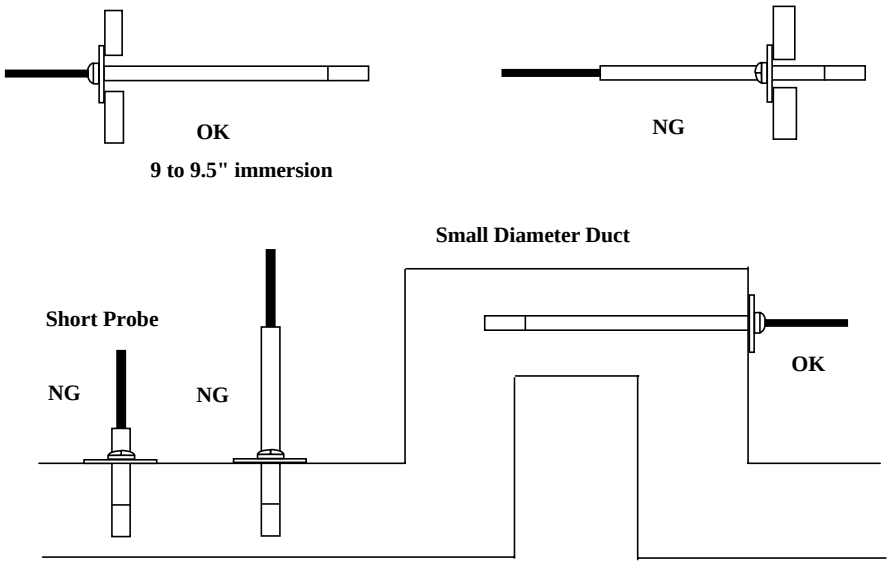
3. Probe Installation

Probe Holder

For installation through a wall, we recommend using a probe holder mod. QMA-15. This holder is a mounting flange that is equipped with a compression fitting.

Immersion Depth (Through Wall)

For through wall installation make sure that 9 to 9.5" (230-240mm) are immersed in the environment to be measured. Probe immersion depth is critical. Insufficient probe immersion may result in a difference between the temperature of the sensors and that of the environment. This will create a large error of measurement and/or a malfunction.



Probe Position

Install the probe so as to prevent the accumulation of condensation water at the level of the sensor leads. Install the probe so that the probe tip is looking downward. If this is not possible, install the probe horizontally.

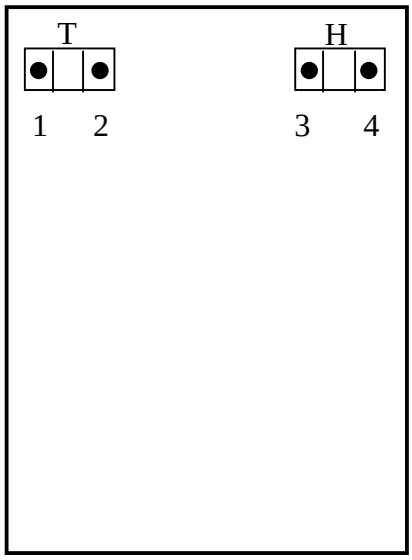
Calibration Access Orifice (Through-Wall Probe Installation)

If the transmitter is going to be used for an application where humidity and temperature conditions are fairly constant, future maintenance may be greatly facilitated by providing a calibration access orifice next to the probe to permit the insertion of a calibrator.

RIC can provide a calibrator (reference instrument) with a probe having dimensions similar to the probe of the F100 series. Therefore, the calibration access orifice should have the same size as the orifice used to install the probe. We recommend that this orifice be equipped with a QMA-15 probe holder.

Electrical Installation

Make sure that you can correctly identify the function of each terminal.



Temperature (if applicable):
1 : (+)
2 : (-)

Relative Humidity:
3 : (+)
4 : (-)

Note: on each terminal block, the central position is not used.

If your unit was supplied with a connector, a connector diagram is attached to this manual.

1. Standard Wiring

The standard F100 series transmitter is supplied with two sealing cable grips and two terminals blocks.

The cable grips provide effective sealing only with cables having the proper outside diameter. If only one cable is being used to wire the unit, make sure to seal the unused cable grip.

2. Connecting Cable

Preferably, use cables with an outside diameter of 0.236 to 0.275 inch (6 to 7 mm) and with 18AWG wires. Depending on the installation, you may have to use a cable with twisted pairs or a shielded cable to avoid interference.

3. Maximum Cable Length

In order to determine the maximum length of cable that can be used to connect the transmitter to other devices, the first step is to find out what is the resistance per unit of length of the cable that you plan on using. The maximum permissible cable length, connecting the unit to other devices, is determined by the total resistance resulting from the addition of the cable resistance and that of the devices connected in series with the unit. This resistance should not exceed 500 ohms.

4. Where to run the Cables

Avoid running the cables connecting the unit in the same conduit as 110 VAC power cables. If this cannot be avoided, a shielded cable or a cable with twisted wires may be required to prevent interference due to electromagnetic induction caused by switching.

5. Grounding

We generally recommend grounding, especially if the electronics will be subjected to a low humidity environment (35 %RH or less).

MAINTENANCE

Cleaning or Replacing the Dust Filter

Depending on the conditions of the application, the filter cartridge should be either cleaned or replaced from time to time. To remove the cartridge, hold the base of the filter preferably with a strap wrench (to prevent marring the filter base) and loosen the screw at the top of the filter. Make sure to securely tighten the screw after replacing the cartridge. Do not remove the stainless steel filter base from the probe.

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 should be verified every 6 to 12 months.

CALIBRATION BASICS

Temperature Calibration (if applicable)

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 cannot meet the above requirements, you should not attempt to calibrate temperature.

Humidity Calibration

When calibrating humidity, temperature stability is the single most important requirement. Do not run the full humidity calibration process 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 and calibration device inside an insulating box filled with sand.

a) ER15 and ERV15 Calibration Device:

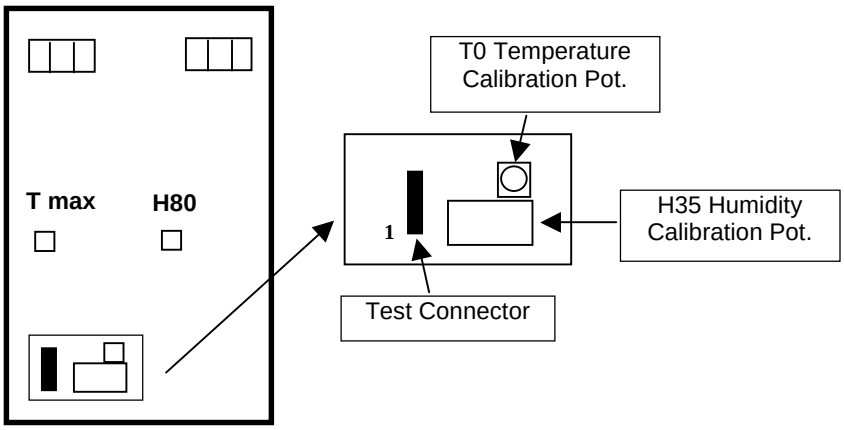
Both the ER15 and ERV15 are small airtight containers that fit on the probe and seal around the humidity sensor. Use the ERV15 for wall mounted units and the ER15 for all other units. During calibration, a known reference humidity is produced inside the calibration device by means of a humidity standard (usually an aqueous salt solution).

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 humidity standards other than the 0 %RH standard are a salt solution, parts which have come in contact with the liquid should be cleaned after each use.

3. Calibration Potentiometers and Test Connector

Transmitters of the F100 series are equipped with a 5-pin keyed test connector that permits reading the signal(s) without interrupting the operation of the transmitter.



Test Connector Pin #	Wire Color	Signal
1	Green	Humidity (+)
2	Yellow	Humidity (-)
3	Brown	not used
4	White	Temperature (+)
5	Gray	Temperature (-)

ONE-POINT CALIBRATION

A one-point calibration may be appropriate when the requirement is to provide accurate measurements over a narrow range of conditions. This is typical of many applications in the area of process control, clean rooms, HVAC, etc.

The advantage of the one-point calibration is that it can be done on site, without interrupting the readings.

The method of calibration consists in adjusting the output (s) or display of the instrument to be calibrated against the output (s) or display of a reference instrument (calibrator). The output(s) of the instrument to be calibrated are read by connecting a voltmeter to the test pins located (see calibration potentiometers and test pins).

To be valid, a one-point calibration should meet the following requirements:

- The humidity and temperature conditions that are prevalent during calibration must be reasonably stable. Over a period of 15 min., temperature should not vary by more than 1°F (0.5°C).

- The probe of both instruments should be ventilated or placed in the same stream of moving air. Air velocity should be at least 200 ft/min (1m/s).

  Usually, it is temperature equilibrium that takes the longest time. Depending on the initial conditions, equilibration can take from a few minutes to as long as 15..20 minutes. If the initial temperature difference between the two probes is more than a few degrees, be sure to wait about 15 min. before calibrating.

The ROTRONIC A2C calibrator can be used to directly read the signal(s) provided by the test connector. The A2C comes with test cable AK3029-B used to connect the A2C with the transmitter. The humidity-temperature probe connected to the A2C provides the reference readings necessary to check the accuracy of the F transmitter. As an alternative, any suitable reference instrument may be used and the signal(s) from the test connector can be read with a multimeter (use test cable AK3029-4P to connect the DVM to the transmitter).

The signals from the test connector have a range of 40..200 mV corresponding to 4..20 mA. For humidity, this corresponds to 0..100%RH. For temperature, this corresponds to the range specified when ordering the transmitter (see label on the transmitter).

For example, if the transmitter has the following outputs:

4..20 mA = 0 .. 100 %RH
4..20 mA = -30 .. 70°C

A humidity reading of 0.15 V would correspond to an output signal of 15 mA and, therefore, to a humidity of (15 - 4)/16 x 100 = 68.7 %RH

A temperature reading of .09 V would correspond to an output signal of 9 mA and, therefore, to a temperature of -30 + (9 - 4)/16 x 100 = 1.25°C.

If an adjustment of the transmitter is required, use the potentiometer(s) T0 and H35 located next to the test connector.

FULL CALIBRATION

Full calibration of the F100 series requires a 2-point calibration of temperature (if applicable) 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.

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 a voltmeter to the T (+) and COM (-) terminals.
- 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) Decade Box and Reference Thermometer (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.
- Connect a voltage source and a multimeter to the 1 (+) and 2 (-) terminals.
- Position the T max potentiometer in the middle of its span.
- Set the decade box to simulate the minimum temperature of the range.
- Adjust the probe output with the T0 potentiometer.
- Set the decade box to simulate the maximum temperature of the range.
- Adjust the probe output with the T max potentiometer.
- Put the Pt100 RTD back on the probe and check the probe at room temperature against a reference thermometer. If necessary, adjust the probe output with the T0 potentiometer.

2. Humidity Calibration (use ER15 or ERV15 calibration device and EA35, EA80 humidity standards)

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

- Slip the calibration device on the probe and make sure it seals tightly on the probe. The receptacle of the calibration device (or solution holder) should be below the sensors. Remove the receptacle from the calibration device.
- Connect a voltage source and a multimeter to the 3 (+) and 4 (-) terminals.
- 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.

SPECIFICATIONS

Circuit Type	2-Wire, Loop Powered
Humidity Sensor	ROTRONIC HYGROMER™ C94
Temperature Sensor (FT Models)	Pt100 RTD
Operating Temperature at Electronics	32..122°F (0..50°C)
Humidity Measuring Range	10..100 %RH
Humidity Output Range	0..100%RH
Temperature Measuring Range (FT Models)	See temperature Limits
Standard Temperature Output Range (FT Models)	0..100°F or 0..100°C Max. span: 212°F or 100°C
Temperature Limits at Sensors	Wall Mount Models: 32..122°F (0..50°C) Other Models: -5..176°F (-20..80°C)
Output Signals (linear)	4-20 mA (max. load 500Ω)
Accuracy at 68..77°F (20..25°C)	± 2%RH from 10 to 100%RH ± 0.5°F (±0.3°C)
Repeatability	± 0.3%RH and ±0.2°F (±0.1°C)
Humidity Sensor Stability	better than 1%RH over a year
Response Time (without filter)	10 seconds (%RH and temperature)
Calibration Potentiometers	2 for Humidity, 2 for Temperature
Supply Voltage	10..35VDC; min. 10V + [0.02 x Load]
Sensor Protection	S.S. Filter with Wire Mesh Cartridge
Probe Dimension/Material	Wall: 100 x 15 mm (3.94 x 0.6”) Duct and Remote: 250 x 15 mm (9.84 x 0.6”) Compressed Air: 150 x 15 mm (5.91 x 0.6”)
Probe Material	PPS
Case Dimensions	160 (H) x 80 (W) x 55 (D) mm (6 3/8 x 3 1/8 x 2 1/4")
Case Material	Polycarbonate (Metal is Optional)
Case Protection	NEMA 4 / DIN IP 65
Weight	0.8 lbs (340 g)
Probe Holder (Duct and Remote)	QMA15 (Order Separately)