TM-2000R

METEOROLOGICAL HUMIDITY-TEMPERATURE TRANSMITTER

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 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 or slotted cap) from the probe. Both sensors (humidity and temperature) can be mechanically damaged by careless removal of the protection.

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 (press 5 or ask for extension 21).

DESCRIPTION

Transmitters of the TM-2000R series are used to measure relative humidity and temperature in meteorological applications. Linearized output signals (DC current or voltage) are provided for transmission over a length of cable to a remote display, recorder or data processing unit.

The TM-2000R features the ROTRONIC HYGROMER™ C94 capacitive humidity sensor. This well proven sensor offers exceptional durability and stability in all kinds of industrial environments. This fact is reflected in the 3-year full warranty that covers the transmitters of the TM-2000R 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.

OPERATION

Power Supply

The TM-2000R is available for operation with one of the following supply voltages:
220VAC (on request), 110 VAC, 24 VAC and 10 to 35 VDC.

DC operated units require a 65 mA power supply. Units with 4-20mA outputs require a minimum supply voltage that depends on the load connected to the outputs. With a load of 500 Ohm on each output, the minimum voltage required is 15 VDC.

Units that operate with an AC voltage are equipped with a 2.5VA transformer. These units accept up to a ± 15% variation from the nominal value of the supply voltage.

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 the transmitter housing).

Temperature Operating Range and Temperature Limits

The TM-2000R can operate within -22 to 150°F (-30 to 65°C).

Operating the transmitter and/or its probe outside of the temperature limits can result in innaccurate measurements and, in extreme situations, may cause permanent damage.

Humidity Limits

The TM-2000R can operate within 0 and 100 %RH. The humidity output 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.		

When measuring high humidity conditions, condensation may occur on the humidity sensor due to a sudden difference in temperature between the probe and its 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 TM-2000R provides automatic compensation for the effect of temperature on the humidity sensor. The temperature compensation uses normal room temperature as a reference. Because of this, full calibration of the unit (4-point calibration) is done at normal room temperature rather than at the temperature of operation at the sensor.

Sensor Protection

Always use the TM-2000R with the dust filter provided with the probe to protect the sensors.

Output Signals

The TM-2000R is available with the following output signals: 0-20 mA, 4-20 mA, 0-1 V or 0-5 V. The output signal depends on the type specified when ordering. A label located on the transmitter housing shows the type of output signal for each unit..

The output signals are linear and are consistent with the requirements of most data/signal processing instrumentation (panel meter, controller, computer card, etc.).

Units with current outputs behave as a variable source of current and adjust 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.

Units with voltage outputs behave as a variable voltage source and adjust the voltage across the terminals as a function of relative humidity and temperature. The output signal may be read with any voltage sensing device having a minimum impedance of 100 kohms. When several devices are connected in parallel with the transmitter, the resulting impedance should not be less than 1000 ohms.

Transmitters that combine humidity and temperature measurement have a return terminal (-) which is common to both the humidity and temperature signals. Both unit outputs are internally connected to the common wire (-) by means of a 1 Microfarad capacitor. This reduces the influence of electromagnetic induction on the output signals and provides protection of the output circuits against transients.

Grounding and Lightning Protection

We strongly recommend grounding the TM12R and to provide lightning protection both to the probe and transmitter enclosure.

The return terminal (-) on the output signal(s) side is internally connected to the third terminal (GND) on the supply voltage side.
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INSTALLATION

General Recommendations

The TM-2000R transmitter was designed for outdoor use. The case provides NEMA 4 protection to the electronics and the dust filter prevents rain water from getting to the sensors. The probe is separated from the electronics case by a length of cable so as to prevent any transmission of heat from the case to the probe.

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

- Use either a shield or a louvered 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 4 feet (1.2 meter) above ground in the case of a grassy, non reflective field. For roof top installation or any installation above a reflective surface, a minimum elevation of 33 ft (10 meter) may be required.

Probe Installation Inside a Shelter

Do not install the probe in an upward position as condensation water could accumulate under the filter at the level of the sensor leads. Install the probe in a downward position. If this is not possible, install the probe horizontally.

If so desired the case can be attached to the shelter using screws. Remove the case cover to get access to the 4 holes for mounting the case. These are separated from the inner section of the transmitter case. Screws with an approximate diameter of 5/32" should be used. The position, location and dimensions of the mounting holes are shown on the "installation" diagram.

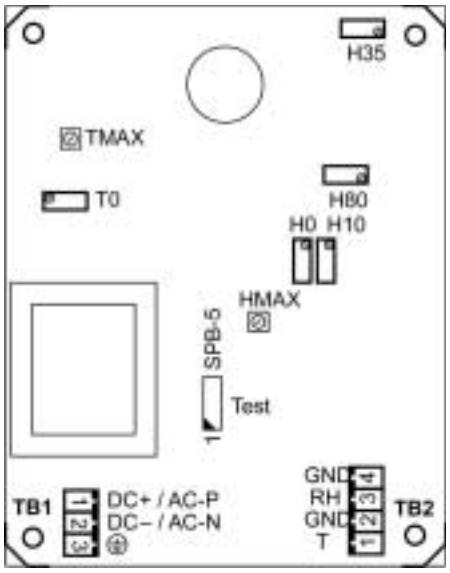
Probe Installation in a Shield

Two different shields are available from ROTRONIC to protect the probe of the TM-2000R: natural aspiration shield model SMP 41002 and motor aspirated shield model MAS 41003.

A mounting plate with U-bolts (model A-TM2000) is available from ROTRONIC to attach the enclosure of the TM-2000R on a pole.

Terminals

Be sure to correctly identify the function of each terminal (see label inside enclosure cover). Applying power to the output terminals (TB2) can severely damage the transmitter.

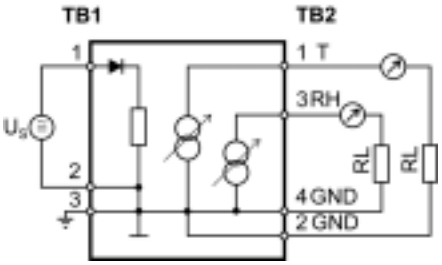


If your unit was supplied with a connector, a connector diagram is attached to this manual.

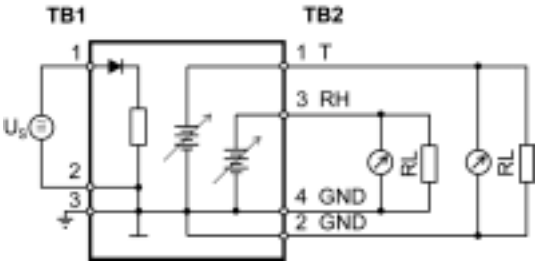
The humidity and temperature output signals share a common wire (-). When using a dual recorder, this should be a model that accepts a common return wire (you may have to move a jumper or a dip switch in the recorder or controller).

Electrical Diagrams

DC supply voltage or 24 VAC without transformer

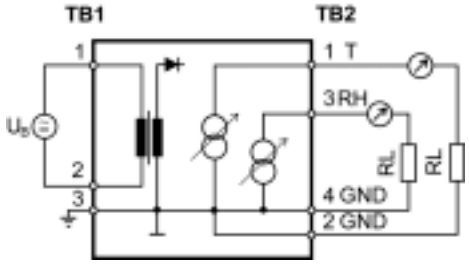


Current Output Signals

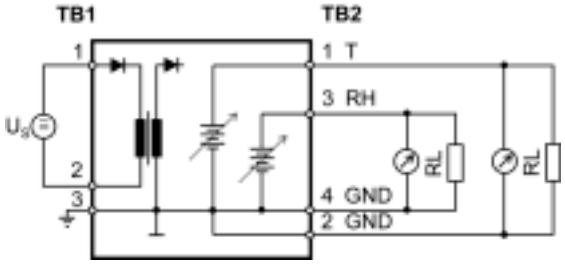


Voltage Output Signals

115VAC or 24VAC with transformer



Current Output Signals



Voltage Output Signals

Wiring

As a standard, the TM-2000R is supplied with two sealing cable grips and two terminal 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.

Preferably, use two cables with an outside diameter of 0.236 to 0.275 inch (6 to 7 mm) and with at least 3 wires each (18AWG). If you are installing a 24 VAC or a 24 VDC unit, you may use only one cable with at least 5 wires. Depending on the installation, you may have to use a cable with twisted pairs or a shielded cable to avoid interferences. 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 interferences due to electromagnetic induction caused by switching.

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.

. Current outputs: 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.

. Voltage outputs: the maximum cable length can be determined under consideration of the voltage drop caused by the current flowing to the devices connected to the unit. The voltage drop in the cable depends both on cable resistance and on the equivalent resistance of the devices connected in parallel to the unit. The total resistance connected to each unit output must at least be equal to 100 kohms. Cable resistance should not be more than 1/1000 of the load resistance.

Grounding

We generally recommend grounding the TM-2000R.

MAINTENANCE

Cleaning or Replacing the Dust Filter:

The dust filter is made of a stainless steel base and a removable filter cartridge that slips over the base. To avoid mechanical damage to the sensors do not remove the filter base from the probe. The filter cartridge should be cleaned or replaced from time to time, depending on the conditions of the application.

Replacement Foam Cartridge : SP-F15
Replacement Wire Mesh Cartridge: SP-G15

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 unit 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

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 cannot meet the above requirements, you cannot correctly check the accuracy of temperature measurement and 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 heat,

etc. If necessary during calibration, place the tip of the probe and calibration device inside an insulating box filled with sand.

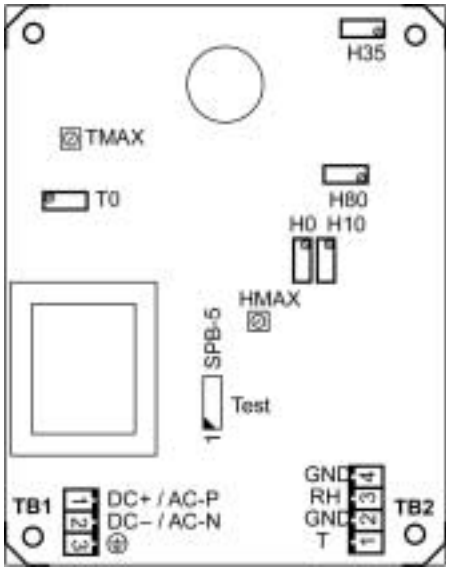
a) Calibration Device:

The ER15 calibration device is a small airtight container that can be slipped on the probe and tightened to seal. 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.

Calibration Potentiometers and Test Connector SPB-5



Calibration Procedure

Full calibration of the I-2000 series requires a 2-point calibration of temperature (if applicable) and a 4-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.

During calibration, you may remove the filter cartridge from the probe but not the filter base. Removing the filter base may result in mechanical damage to the sensors.

1. Temperature Calibration (optional)

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

a) Temperature controlled chamber:

- Connect a DVM to the T (+) and COM (-) terminals on TB2.
- Position the T max potentiometer in the middle of its span.
- Set the the temperature at 0°C and adjust the probe output with the T0 potentiometer. If you cannot go as low as 0°C, you will have to repeat the entire procedure a few times.
- Set the temperature at 40 to 50°C and adjust the probe output with the T max potentiometer.

or

b) RTD simulator and 1-point adjustment at 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 a DVM to the T (+) and GND (-) terminals on TB2.
- 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 T0 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 T0 potentiometer.

After calibrating temperature you should always calibrate humidity since the humidity signal is compensated based on the temperature signal.

2. Humidity Calibration

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

- 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 under the sensors. Remove the receptacle from the calibration device.
- Connect a voltmeter to the RH (+) and GND (-) terminals on TB2.
- 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 first with a 10%RH and after this with a 0 %RH standard. Allow each time at least 90 minutes for equilibrium.
- At equilibrium, adjust the probe output with the H10 potentiometer (10 % standard) or with the H0 potentiometer (0 % standard).
- Remove the calibration device from the probe. If it was removed, put the filter cartridge back on the filter base. Thoroughly clean the receptacle.

SPECIFICATIONS

Humidity Sensor	ROTRONIC HYGROMER™ C94
Temperature Sensor	Pt100 1/3 DIN RTD
Operating Temperature	-20..150°F (-30..65°C)
Humidity Measuring Range	0..100 %RH
Standard Temperature Measuring Range	-30…70°C other ranges on request.
Output Signals (linear)	4-20 mA (max. load 500Ω) 0-5 V (min. load 1000 Ω) other signals on request.
Accuracy at 68..77°F (20..25°C)	± 1.0 %RH from 0 to 100%RH (*) ± 0.5°F (±0.3°C)
Repeatability	± 0.5%RH and <±0.1°F / ±0.1°C
Humidity Sensor Stability	better than 1%RH over a year
Response Time (at 73°F/23°C without filter)	15 seconds with 3 ft (1 m) / sec air velocity
Calibration Potentiometers	35, 80, 10 and 0%RH / T0 and Tmax
Supply Voltage	115 VAC or 24 VAC/2.5VA or 10-35VDC/65 mA at 24VDC
Min. DC Voltage for 4-20 mA Outputs	5 VDC + 0.02 x Load, Min. 10 VDC
Electrical Connections	4 or 5 Wires + Ground / Terminals 12 AWG Cable Grips (Conduit Adapters are Optional)
Sensor Protection (standard)	standard: wire mesh cartridge optional: foam cartridge (marine environment)
Probe Dimension/Material (standard)	250 x 15 mm (PPS)
Case Dimensions	160 (H) x 120 (W) x 75 (D) mm (6.3 x 4.73 x 2.95")
Weight	1.8 lbs (820g)
Case Material	Polycarbonate (Aluminum is Optional)
Case Protection	NEMA 4 / DIN IP 68

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