

**HC321A**  
**HUMIDITY CONVERTER**  
**INSTRUCTION MANUAL**

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### 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 unnecessarily 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. 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).

## 1. OVERVIEW

The HC321A is a microprocessor based converter that computes dew point from the relative humidity and temperature measurements provided by a remote probe or transmitter. Instead of dew point, the HC321A can be factory set to compute one of the following: wet bulb temperature, humidity ratio (weight ratio of water vapor to dry air) or enthalpy (air energy content).

The HC321A has two analog outputs: one for the computed parameter (dew point), the other for temperature or relative humidity. Both outputs are factory set to the range and engineering units specified when ordering. The HC321A also features a dual LED display.

## 2. THEORY OF OPERATION

### 2.1 Computation Method

Based on the measurement of temperature provided by the remote probe or transmitter, the HC321A computes the corresponding value of the saturation water vapor pressure with a polynomial equation. The partial pressure of water vapor is then computed from the value of relative humidity. An iteration is used next to compute dew point temperature. The computations automatically provide a frost point for negative values, This removes the uncertainty typical of chilled mirror hygrometers.

In the temperature range of -50 to 200°C, the difference between the polynomial equation and the steam tables published by the American Institute of Physics (1972 Handbook) is less than 50 ppm (0.005%). In the range of 0 to 100°C, the equation agrees within 20 ppm with the values of Table X2.1 of ASTM standard E 337.

When the computed parameter is the humidity ratio, wet bulb temperature or enthalpy, barometric pressure is required as an input. The standard version of the HC321A uses a fixed pressure value. This value can be adjusted with a potentiometer to match local pressure. As an option, the HC321A is available with an additional input circuit to read the signal from a pressure transmitter.

For the computation of enthalpy, the HC321A follows the common practice of providing a relative value instead of an absolute value. In the metric system (kJ/kg), 0°C is used as the reference temperature and the enthalpy of dry air at 0°C is set to be equal to zero. A negative value of enthalpy is possible and this indicates an energy level that is less than that of dry air at 0°C. When the enthalpy output is set to the English system (BTU/Lb), the HC321A uses 0°F as the reference temperature.

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## 2.2 Accuracy

Accuracy of the computed parameter depends on the accuracy of the input signals.

The internal computations of the HC321A are very accurate. Assuming no error on the input signals, the computation error is less than 0.1% of the computed value.

## 3. DESCRIPTION

### 3.1 Power Supply

The HC321A is available for operation with one of the following types of voltage supply: 10-32 VDC, 10-32 VAC, 115VAC or 220VAC. The current draw is 170 mA at 24 VDC and 450 mA at 10 VDC. When operating with a DC supply voltage, the HC321A can be grounded at the (-) power terminal. When operating with an AC supply voltage, the third wire should be attached to the appropriate terminal (see Installation).

### 3.2 Input Circuits

The standard HC321A has 2 input circuits: one for relative humidity, the other for temperature. When required by the computations, pressure is provided internally by an analog voltage that can be adjusted with a potentiometer. As an option, the HC321A can be equipped with a third input circuit for the pressure signal provided by a remote pressure transmitter.

The HC321A is factory configured to accept either current or voltage input signals. In the voltage configuration, the input resistance is greater than 1 M $\Omega$ . In the current configuration, the input resistance is 10 $\Omega$ . When using current input signals, the HC321A must be the last device in the current loop.

A 12-bit A/D converter is used to read the analog signal from the input circuits. In order to provide the best possible resolution during the analog to digital signal conversion, the input signals are made to correspond to as much as possible of the 2.5 VDC span of the 12-bit A/D converter:

4-20 mA corresponds to 0.5-2.5 VDC.

0-20 mA, 0-10 V, 0-5 V or 0-1 V correspond to 0-2.5 VDC.

The input signals are factory set to the type of signal (current or voltage), range and engineering units specified when ordering.

Humidity Range Limits (1)	: 0..100%RH
Temperature Range Limits (1)	: -999..+999°C or °F
Pressure Range Limits (1)	: 0..9999 kPa / kp/cm <sup>2</sup> / PSIA / In Hg

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(1) Any partial range can be programmed between these limits. We recommend limiting the span of the signal to a maximum of 400 engineering units so as to maintain resolution of the A/D conversion within 0.1 engineering units.

### 3.3 Microprocessor

The digital signals provided by the A/D input converter are fed by means of an 8-bit data bus to an 8031 microprocessor. Factory settings such as the input and output ranges and engineering units are stored in an EEPROM. A watchdog circuit ensures that computations restart automatically in the event of a power failure.

### 3.4 Output Circuits

The HC321A has two analog outputs: one output corresponds to the computed parameter (dew point or other), the other output repeats one of the input parameters (temperature, relative humidity or pressure) as specified when ordering.

Data from the microprocessor is converted by means of two 12-bit D/A converters. This provides a high resolution with 4096 steps on each output signal. For example, if the span of the dew point output is 150°C, output resolution is better than 0.04°C.

The HC321A is available with the following types of linear DC current or voltage output signals:

4-20 mA or 0-20 mA  
0-10 VDC or 0-5 VDC or 0-1 VDC

The current output signals can be read with any current sensing device having a maximum impedance of 500 ohms. When several devices are connected in series with the HC321A, the resulting impedance should not exceed 500 ohms, wiring included. In the case of a voltage output, the minimum load on the HC321A should not be less than 10 kohm.

Each output signal is factory set to both the range and engineering units that were specified when ordering. Outputs can be specified within the following limits:

a) Output 1 (computed parameter)

Dew Point Range Limits (1)	: -99.9..+999.9°C or °F
Wet Bulb Temperature (1)	: -99.9..+999.9°C or °F
Humidity Ratio Range Limits (1)	: 0..9999 g/kg or Gr/Lb
Enthalpy Range Limits (1)	: -999..9999 kJ/kg or BTU/Lb

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b) Output 2 (temperature, relative humidity or pressure)

Temperature Range Limits (1) : -99.9..999.9°C or °F  
%RH Range Limits (1) : 0..100 %RH  
Pressure Range Limits (1) : 0..9999 kPa / kp/cm2 / PSIA / In Hg

(1) Any partial range can be programmed between these limits. Since resolution depends on the span of the output signal, we recommend limiting the span of the temperature outputs to a maximum of 400°F or 400°C so as to maintain resolution within 0.1°F or 0.1°C.

### 3.5 Front Panel Display and Indicators

The front panel of the HC321A has two 4-digit LED displays and three LED indicators.

The top LED display (OUTPUT) shows the computed parameter. Depending on factory settings, this can be dew point, wet bulb temperature, humidity ratio or enthalpy.

The bottom display (INPUT) shows one of the input parameters: temperature, relative humidity or pressure. One of the three LED indicators is lit to show which parameter is being displayed. The displayed parameter can be selected by pressing on the switch located inside of the HC321A cover. The output signals are not affected by the display selection.

## 4. OPERATING LIMITS

<p>OPERATING THE HC321A OUTSIDE OF THE SPECIFIED LIMITS MAY RESULT IN INACCURATE MEASUREMENTS AND IN PERMANENT DAMAGE TO THE INSTRUMENT.</p>
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During operation, do not expose the enclosure of the HC321A to temperatures outside of the range of -29 to 55°C (-20 to 131°F).

## 5. INSTALLATION

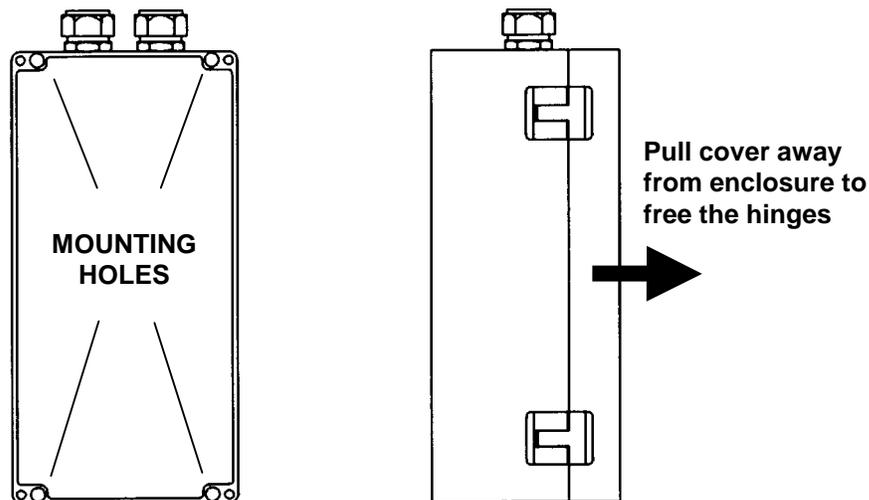
- Prior to installing the HC321A, you should make sure that you are familiar with the operating limits specified in chapter 2.
- The HC321A is available in many different combinations of power supply, output signals, ranges, etc. Please, read the label located on the side of the enclosure for the specifications of the unit that you are installing.

### 5.1 Installation of the Enclosure

Select a location where temperature does not exceed 122°F (50°C).

The enclosure is designed for wall (surface) installation. To gain access to the 4 mounting holes, loosen the 4 screws located on the front panel (one at each corner). Before opening, pull the cover away from the enclosure to free the hinges (see drawing). The hinges will not pivot unless they are free. The 4 mounting holes are separated from the inner compartment of the enclosure. A screw size of 6/32" is appropriate.

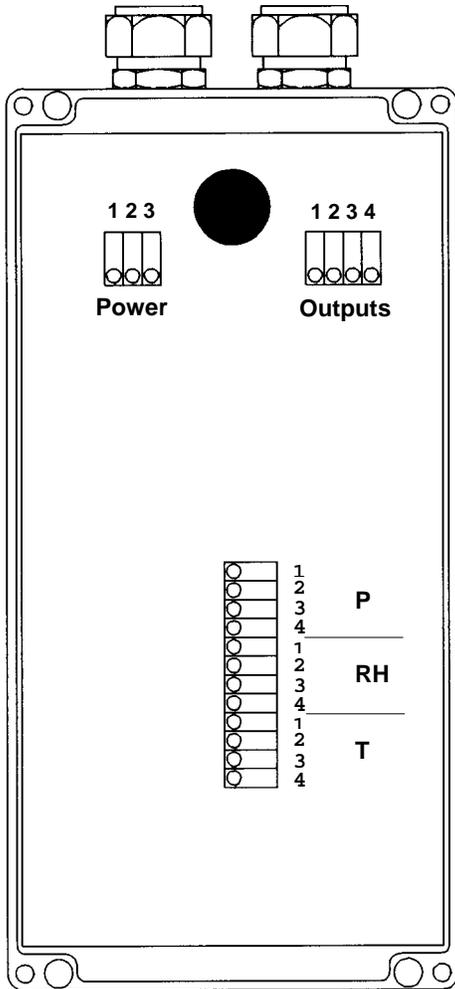
If the surface of the mounting wall is at a temperature of more than 100°F, use an insulating spacer (not provided) between the transmitter enclosure and the wall or duct. This spacer should be at least 1" thick.



## 5.2 Wiring

**Make sure that you can correctly identify the function of each terminal. Applying power to the output terminals can severely damage the transmitter.**

a) HC321A with Current Input Signals (see label on enclosure)



### **POWER** (see label on enclosure)

a) 10-32VDC or 10-32VAC (no transformer)

- 1: (+)
- 2: (-) or GND
- 3: Not Used

b) 110 or 220VAC (transformer)

- 1: Phase
- 2: Neutral
- 3: 3d Wire or GND

### **OUTPUTS** (see label on enclosure)

- 1: (+) Temperature, %RH or Pressure
- 2: (-)
- 3: (+) Computed Output (Dew Point or other)
- 4: (-)

**DO NOT GROUND CURRENT OUTPUTS!**

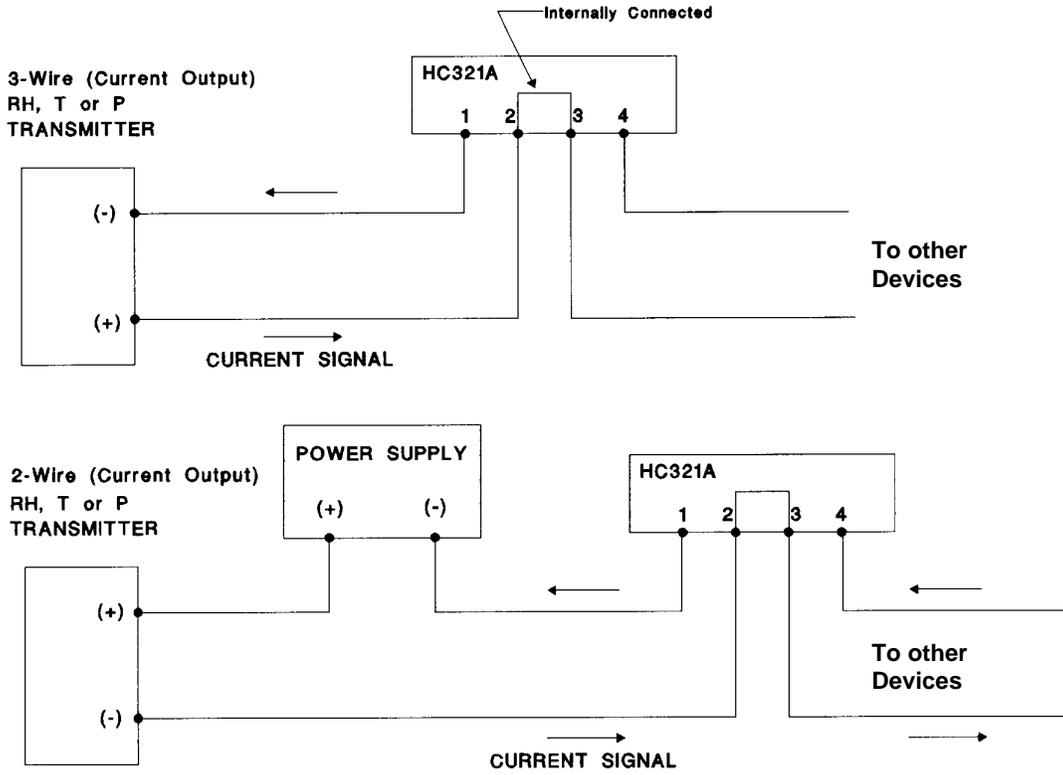
### **INPUTS** (see label on enclosure)

- P** :Pressure (optional)
- RH** :Relative Humidity
- T** :Temperature

- 1: (-)
- 2: Internally connected with 3
- 3: Internally connected with 2
- 4: (+)

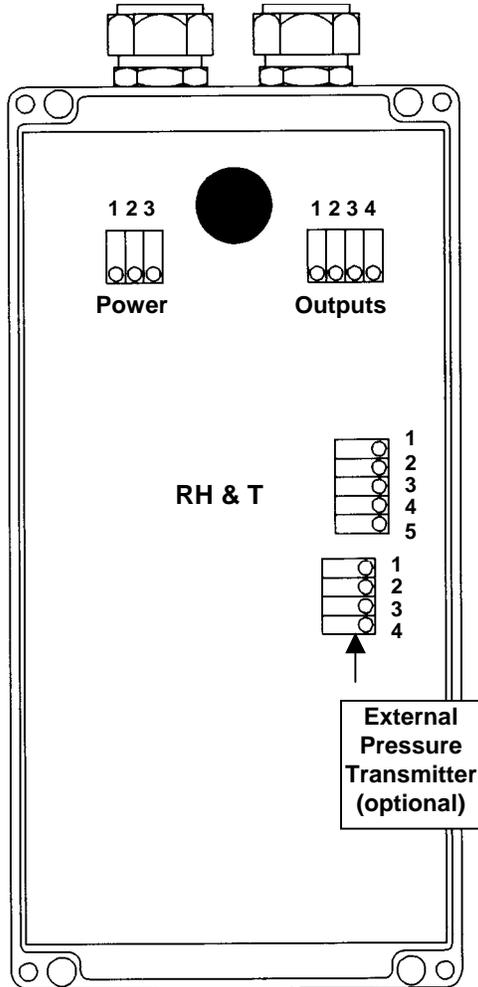
See wiring diagram.

b) Wiring Diagram for Current Input Signals



Note: The HC321A must be the last device in the current loop.

c) HC321A with Voltage Input Signals (see label on enclosure)



**POWER** (see label on enclosure)

a) 10-32VDC or 10-32VAC (no transformer)

- 1: (+)
- 2: (-) or GND
- 3: Not Used

b) 110 or 220VAC (transformer)

- 1: Phase
- 2: Neutral
- 3: 3d Wire or GND

**OUTPUTS** (see label on enclosure)

- 1: (+) Temperature, %RH or Pressure
- 2: (-)
- 3: (+) Computed Output (Dew Point or other)
- 4: (-)

**RH & T INPUTS** (see label on enclosure)

- 1: Not used
  - 2: Not used
  - 3: (-) Common
  - 4: (+) Temperature
  - 5: (+) Relative Humidity
- See paragraph e)

**PRESSURE TRANSMITTER** (optional)

- 1: (+)
- 2: Not used
- 3: Not used
- 4: (-)

d) Conduit Adapters

The standard HC321A is supplied with two 1/2" conduit adapters. If only one conduit adapter is being used, make sure to seal the other one.

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.

e) Connecting Cables

Preferably, use cables with 18 AWG wires. Depending on the installation, you may have to use a cable with twisted pairs for the signals or a shielded cable to avoid interference.

f) Maximum Cable Length

In order to determine the maximum length of cable that can be used to connect the transmitter to other devices, you should know the resistance per unit of cable length.

- . 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.

g). Grounding

Grounding of the HC321A should be done at the power supply.

We generally recommend grounding the HC321A, especially if the electronics will be subjected to a low humidity environment (35 %RH or less).

**WARNING!!!**

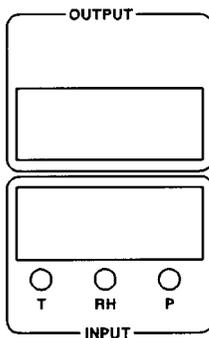
If the HC321A has current outputs, the outputs **will be severely damaged** if directly grounded or if connected to a device that is referenced to ground.

## 6. OPERATION

Upon power up, the HC321A is immediately ready to operate. For correct readings, allow the probe to come to temperature equilibrium with the environment to be measured.

The HC321A was factory set according to the specifications provided when ordering. These settings are not user selectable. A label located on the side of the enclosure provides details on the configuration of the HC321A: computed parameter (dew point or other), type of output signals (4..20mA or other), range and engineering unit of each parameter.

### 6.1. Display

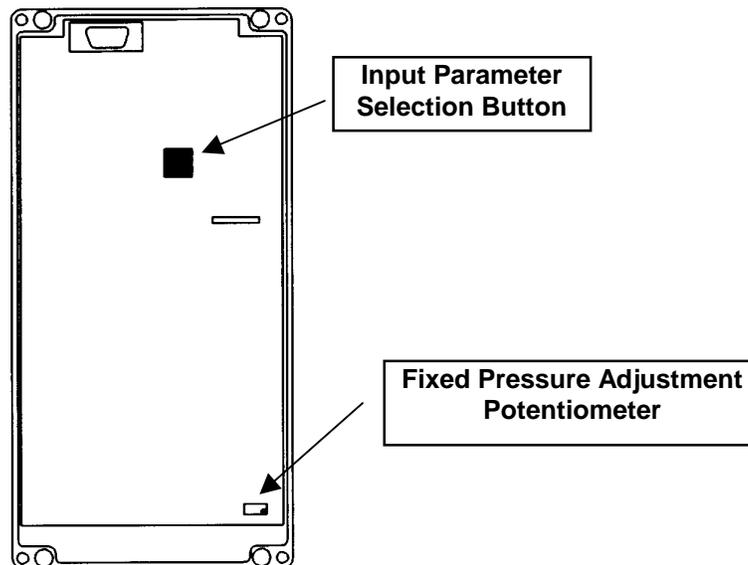


The top 4-digit LED display is labeled OUTPUT and shows the computed parameter (please, refer to the label on the side of the enclosure).

**Note:** If the computed parameter is dew point, negative values are automatically converted to frost point (above ice).

The bottom display is labeled INPUT and shows one of the input parameters: temperature, relative humidity or pressure. Three LED's located below the display show which input parameter is being displayed (T, RH, P).

Upon power up, the default input parameter is temperature. The INPUT display is user selectable. To select the parameter being displayed, open the cover of the HC321A and press on the red button located inside of the cover.



## 6.2 Fixed Pressure Adjustment (Standard HC321A)

The effect of pressure on dew point is automatically taken into account through the measurement of relative humidity. Therefore, no barometric pressure input is required.

Unlike dew point, the following computed parameters require barometric pressure as an input:

- Humidity Ratio (g/kg or gr/lb)
- Wet Bulb Temperature (°C or °F)
- Enthalpy (kJ/kg or BTU/lb)

The standard version of the HC321A used a fixed value of pressure. This value can be adjusted by the user to match the conditions of the application (for example: average barometric pressure at the local altitude).

To adjust the value of the fixed pressure, open the HC321A cover. Press on the input parameter selection button to display the current value of the fixed pressure on the INPUT (bottom) display. Pressure is displayed in the engineering unit that was set at the factory (see label on the side of the enclosure). The pressure value can be adjusted with the potentiometer shown on the previous drawing.

*Note: the pressure adjustment potentiometer is not installed on models that have the optional terminal block to accept the signal from an external pressure transmitter.*

## 6.3 Output Signals

The output signals (computed parameter and one input parameter) are factory set and are not user adjustable. Consult the label on the side of the enclosure for the specifications of these outputs.

The output signals are not affected by the selections made on the display. For example, if one of the outputs was set to be the dry bulb temperature, changing the INPUT (bottom) display from temperature to relative humidity has no effect on the output.

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## 7. SPECIFICATIONS

Output Signals (linear)	4-20 mA or 0-20 mA, max. 500 $\Omega$ 0-10VDC or 0-5VDC or 0-1VDC, min. 10 k $\Omega$
Output Range Limits (1)	Dry Bulb: -99.9..+999.9°C or °F Dew Point: -99.9..+999.9°C or °F Wet Bulb: -99.9..+999.9°C or °F Humidity Ratio: 0..9999 g/kg or Gr/Lb Enthalpy: -999..9999 kJ/kg or BTU/Lb
Input Signals (linear)	4-20 mA or 0-20 mA, 10 $\Omega$ 0-10VDC or 0-5VDC or 0-1VDC, >1 M $\Omega$
Standard Inputs Range Limits (1)	Humidity: 0..100%RH Temperature: -99.9..+999.9°C or °F
Optional Pressure Input Limits (1)	0..9999 kPa or kp/cm <sup>2</sup> or PSI or In Hg
Computational Accuracy	Better than 0.1% of reading
Resolution	4096 steps (inputs and outputs)
Computing Cycle	1.0 sec
Temperature Limits at Electronics	-20..131°F (-29..55°C)
Normal Operating Temp. at Electronics	-5..122°F (-20..50°C)
Supply Voltage	115 VAC or 220 VAC or 10-32VDC/VAC 170 mA at 24 VDC/ 450 mA at 10 VDC
Wiring Type	Terminals 18 AWG Max. 1/2" Conduit Adapters (x2)
Electrical Connections	Inputs (2 or 3): 2 Wires per Signal Outputs (2) : 2 Wires per Signal D/C Power : 2 Wires A/C Power : 2 Wires + Ground
Case Dimensions	240 (H) x 120 (W) x 100 (D) mm (9.45 x 4.72 x 3.94")
Weight	3.2 lbs (1450g)
Case Material	Polycarbonate
Case Protection	NEMA 4 / DIN IP 65

- (1) Any partial range can be factory set. To maximize resolution, we recommend limiting both the temperature and dew point ranges to a maximum span of 400°F or 400°C.

### OUTLINE DRAWINGS

