HC322

HUMIDITY / DEW POINT AND TEMPERATURE TRANSMITTER

INSTRUCTION MANUAL

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 from the probe the metal filter base used to provide mechanical protection to the sensors.

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).

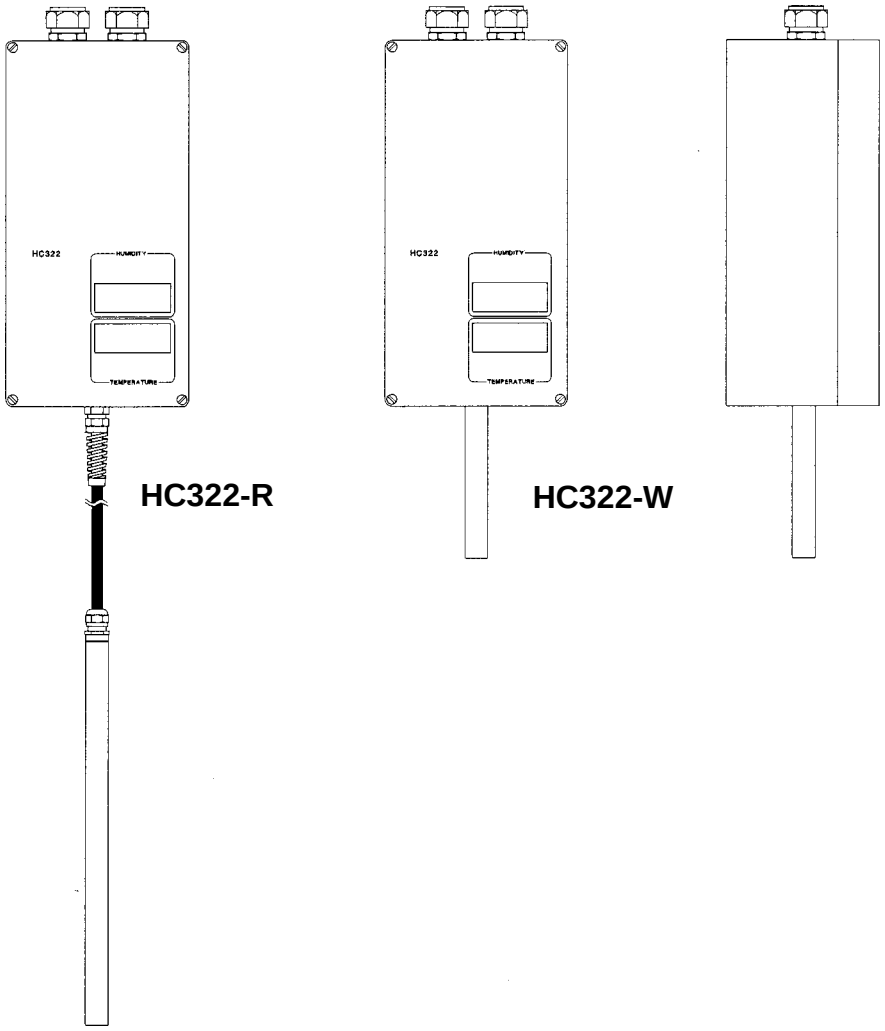
INTRODUCTION

The HC322 is a microprocessor based transmitter that uses the signals provided by a capacitive relative humidity sensor HYGROMER™ C94 and a Pt100 RTD temperature sensor to compute the dew point or one of the following parameters: wet bulb temperature, humidity ratio (absolute humidity) or enthalpy (energy content) of the air being measured.

The HC322 has two analog outputs: one for the computed parameter, the other for temperature. Both outputs are factory set to the range and engineering units specified when ordering. The HC322 also features a dual LED display as well as a serial RS232 communication port.

The HC322 is available in two basic configurations:

HC322-W : with integral probe, for wall installation (surface mount)
HC322-R: with remote probe (6 Ft of cable) for through wall installation.



OPERATING LIMITS

OPERATING THE HC322 OUTSIDE OF THE SPECIFIED LIMITS MAY RESULT IN INACCURATE MEASUREMENTS AND IN PERMANENT DAMAGE TO THE INSTRUMENT.

Temperature Limits at the Electronics

During operation, do not expose the enclosure of the HC322 to temperatures outside of the range of -29 to 55°C (-20 to 131°F).

Operating Limits at the Sensors

Both the humidity and temperature sensors of the HC322 can survive a wide range of conditions. Accuracy of the conversion of relative humidity into another parameter (dew point or other) tends to deteriorate at extreme conditions. Please, refer to the diagrams at the end of this manual. Repeatability of the HC322 remains good even at extreme conditions.

a) Temperature limits at the Sensors

MODEL	SURVIVAL LIMITS	NORMAL OPERATING RANGE
HC322-W	-29..55°C (-20..131°F)	-20..50°C (-5..122°F)
HC322-R	-75..160°C (-100..320°F)	-20..120°C (-5..248°F)

b) Humidity Limits at the Sensors

Avoid sudden condensation at the sensors. At high humidity conditions, condensation may form on the humidity sensor due to a sudden temperature difference with the environment. This does not damage the sensor. Condensation will cause the humidity reading to be stuck at 100%RH for as long as it is present. In extreme situations, the humidity and temperature sensor could be short circuited. This may make temperature go to the maximum of its range. Depending on temperature, the maximum humidity to which the probe can be subjected is as follows (see also the diagrams of chapter 8):

. 100 %RH up to 85°C (185°F)
. 90 %RH at 100°C (212°F)
. 60 %RH at 125°C (260°F)
. 25 %RH at 160°C (320°F)

Exceeding the above limits may "shift" the humidity sensor and require a new calibration.

Sensor Protection

With the exception of environmental test chambers and other "clean" applications, we recommend to always use the dust filter cartridge which is provided as a standard (this is held by a screw to the filter metal located at the tip of the probe.

Because conditions in an environmental chamber can change rapidly and require the fastest possible response from the probe to avoid condensation on the sensors, it is often preferable to use a wide mesh filter (available from ROTRONIC) as opposed to using the standard dust filter.

Do not remove the metal filter base from the probe.

INSTALLATION

- Prior to installing the HC322, you should make sure that you are familiar with the operating limits specified in chapter 2.
- The HC322 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.
- Do not remove the dust filter or slotted cap from the probe. Both sensors can easily be damaged when not protected. The ROTRONIC HYGROMER™ humidity sensor has the appearance of a small white paper tag. Do not remove from the probe!

General Guidelines

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 a 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.

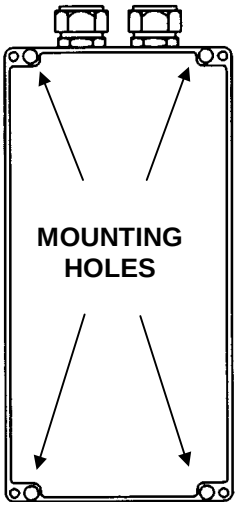
d) **Immerse as much of the probe as possible in the environment to be measured and leave the probe cable at room temperature.**

Installation of the Enclosure

Select a location where temperature does not exceed 131°F (55°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). 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.



Remote Probe Installation (HC322-R)

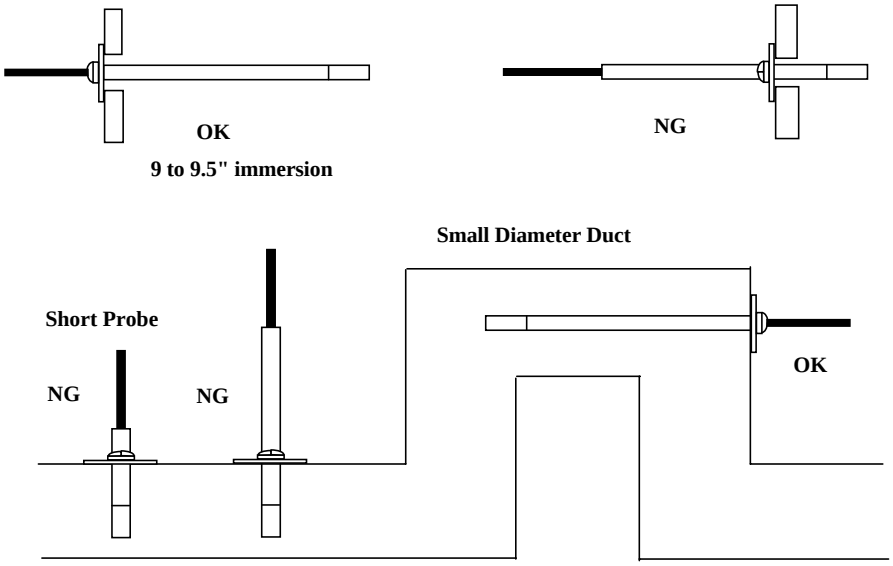
The remote probe of the HC322-R is designed for through wall installation.

a) Probe Holder

We recommend using a probe holder mod. QMA-15 (order separately). This holder is a mounting flange that is equipped with a compression fitting.

b) Immersion Depth

Make sure that 9 to 9.5" (230-240 mm) are immersed in the environment to be measured. Insufficient probe immersion may cause the temperature of the sensors to be different from that of the sensors environment. A temperature difference can create a large error of measurement and/or a malfunction (condensation on the sensors). For best accuracy, do not expose the probe cable to extreme temperatures (only the probe should be immersed in the environment to be measured).



c) Probe Position

Install the probe with tip of the probe looking downward or install the probe horizontally. Proper probe position prevents the accumulation of condensation water at the level of the sensor leads.

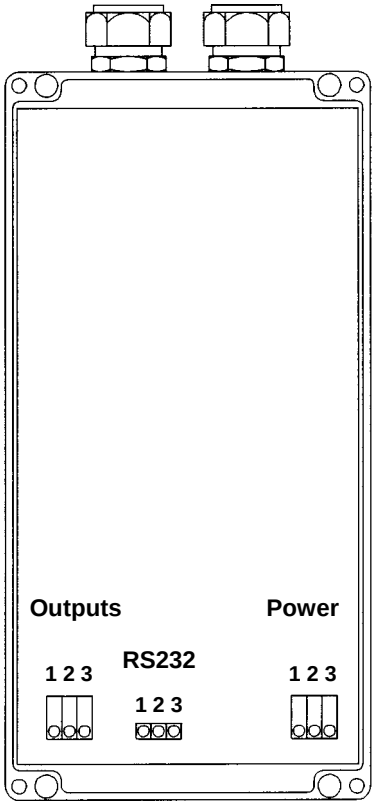
d) Calibration Access Orifice

When the humidity and temperature conditions of the application tend to be fairly stable, future maintenance (calibration checks) may be greatly facilitated by providing a calibration access orifice 3.5 to 4” away from the probe to permit the insertion of a portable reference probe. The calibration access orifice should have the same diameter as the orifice used to install the probe. We recommend that this orifice be equipped with a QMA-15 probe holder and a stopper.

Battery operated indicators and probes are available from RIC.

Wiring

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



POWER (see label on enclosure)

a) 24VDC or 24VAC (no transformer)

1: Neutral or DC(-)
2: GND
3: Phase or DC(+)

b) 110 or 220VAC (transformer)

1: Neutral
2: GND
3: Phase

OUTPUTS (see label on enclosure)

1: (-) GND (common)
2: (+) Humidity or Computed Parameter
3: (+) Temperature

RS232 PORT

1: TXD
2: RXD
3: GND

a) Conduit Adapters

The standard HC322 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.

b) 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.

c) 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.

d). Grounding

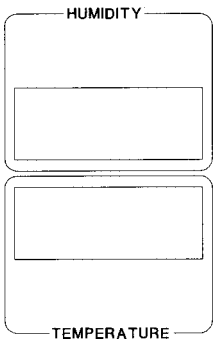
We generally recommend grounding the HC322, especially if the electronics will be subjected to a low humidity environment (35 %RH or less). Grounding of the HC322 should be done at the power supply. If the HC322 is configured to provide for current output signals, the outputs will not work properly if directly grounded or if connected to a device that is referenced to ground.

OPERATION

Upon power up, the HC322 is immediately ready to operate. For correct readings, allow the probe to come to temperature equilibrium with the environment to be measured.

The HC322 was factory set according to the specifications provided when ordering. A label located on the side of the enclosure provides details on the configuration of the HC322: computed parameter (dew point or other), type of output signals (4..20mA or other), range and engineering unit of each parameter. Most of the settings of the HC322 can be changed by the user (see User Configurable Settings).

Display



The top 4-digit LED display is labeled HUMIDITY and shows relative humidity or the computed parameter (for the factory settings, please refer to the label on the side of the enclosure). The factory settings can be changed with a Laptop or PC (see User Configurable Settings).

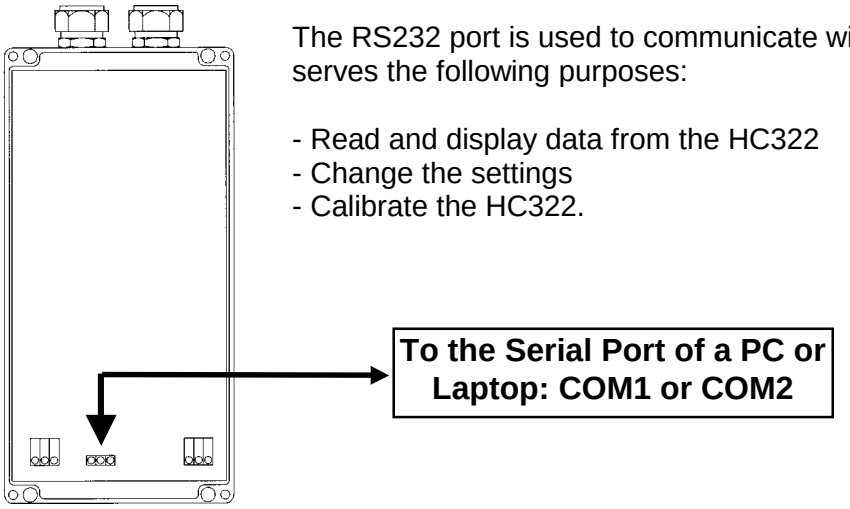
The bottom display is labeled TEMPERATURE

Analog Output Signals

The analog output signals (computed parameter and temperature) have been factory set as specified when ordering. Consult the label on the side of the enclosure for the specifications of these outputs.

Note: the analog output signals are clamped to the range limits defined when ordering.

RS232 Communication Port



The RS232 port is used to communicate with a PC or Laptop and serves the following purposes:

- Read and display data from the HC322
- Change the settings
- Calibrate the HC322.

Any standard communication software such as Hyperterminal (Windows 98) can be used to communicate with the HC322. The following example shows how to set up the communication using Hyperterminal. Similar settings may be used with other software.

In Windows 98, click on the Start button and select Programs, Accessories and Hyperterminal. To create a new communications folder, double click on Hypertrm.exe. Enter HC322 as the name, select an appropriate icon and click on the OK button. On the next screen, select Connect using: Direct to Com 1 or Direct to Com 2, as appropriate. The next screen is the Properties screen. Make the following selections:

Bits per second	: 9600
Data bits	: 8
Parity	: None
Stop bits	: 1
Flow control	: Xon / Xoff

Click on the OK button to open the Hyperterminal screen and begin the communication.

Data from the HC322 should appear in tabular form on the PC or Laptop screen, similar to the following example:

```
  %RH      TEMP(C)       hPa   DP/FP (C)
 46.4         24.1   1013.25        11.9
 46.4         24.1   1013.25        11.9
 46.4         24.1   1013.25        11.9
 46.4         24.1   1013.25        11.9
 46.4         24.1   1013.25        11.9
```

Note: the header is printed after every 20 lines of data and may not appear right away when the communication is established. The header can be turned off (see User Configurable Settings)

USER CONFIGURABLE SETTINGS

Upon being powered up, the HC322 defaults to its normal operating mode (measurement). After establishing communication, the HC322 can be switched to the CONFIGURATION / CALIBRATION mode by pressing the '**C**' key on the keyboard of the PC or Laptop (do not press the ENTER key). This causes the following menu to appear on the screen of the PC or Laptop:

Utilities Main Menu

```
              HC322
        UTILITIES MAIN MENU

    (1) SET UP
    (2) CALIBRATE
    (3) SHOW SET UP / CALIBRATION DATA
    (4) SHOW SOFTWARE VERSIONS
    (5) RS232 OPTIONS
    (0) EXIT AND RETURN TO NORMAL MODE

        ENTER YOUR CHOICE >
```

Selections are made by pressing the corresponding numerical key on the keyboard of the PC or Laptop (do not press the ENTER key).

Note: when in the CONFIGURATION / CALIBRATION mode, the display of the HC322 shows the words "SEt UP". The HC322 is in a waiting mode and the analog outputs are frozen.

Set Up

This menu selection includes the following steps:

• Temperature Unit and Global Unit System

The following menu permits the selection of the temperature unit. The choice of the temperature unit (°C / °F) also globally determines the unit system (Metric / English) :

```
TEMPERATURE - OUTPUT CHANNEL
    CHANNEL SETUP OPTIONS

(1) TEMPERATURE   in deg. C
(2) TEMPERATURE   in deg. F

ENTER YOUR CHOICE       >1
```

• Range of the Temperature Analog Output Signal

Two menus are used to define the lower and upper limit (in the engineering unit previously selected) of the temperature analog output signal (see note below).

Example: if the previous selection was °C and the analog output for temperature is configured to a range of 4..20 mA, entering 0 and 100 will cause the analog output to be 4..20 mA = 0..100°C.

```
TEMPERATURE - OUTPUT CHANNEL
ENTER LOWER LIMIT OF ANALOG OUTPUT      >0.000

TEMPERATURE - OUTPUT CHANNEL
ENTER UPPER LIMIT OF ANALOG OUTPUT      >100.000
```

Note: Negative values are permitted. The analog output is clamped to the values entered above. The HC322 local display and the data sent to the RS232 port are not clamped.

• Humidity / Computed Parameter

The next menu is used to select between humidity or a computed parameter. The units for the different parameters derive from the choice made for the temperature unit:

Metric Unit System:

```
HUMIDITY - OUTPUT CHANNEL
    CHANNEL SETUP OPTIONS

(1) HUMIDITY          in % RH
(2) DEWPOINT          in deg. C
(3) MIXING RATIO      in g/kg (grams per kg)
(4) ENTHALPY          in kJ/kg
(5) WETBULB           in deg. C
```

English Unit System:

```
HUMIDITY - OUTPUT CHANNEL
    CHANNEL SETUP OPTIONS

(1) HUMIDITY          in % RH
(2) DEWPOINT          in deg. F
(3) MIXING RATIO      in gr/lb (grains per pound)
(4) ENTHALPY          in BTU/lb
(5) WETBULB           in deg. F

ENTER YOUR CHOICE       >2
```

Note: the selection made with this menu affects the local HC322 display, the analog output corresponding to the computed parameter and the data sent to the RS232 port.

When the choice is Dew Point, an additional menu is used to define the computations below freezing:

```
SELECT PARAMETER TO COMPUTE BELOW FREEZING

(1) FROST POINT
(2) DEW POINT

ENTER YOUR CHOICE       >1
```

• Range of Humidity / Computed Parameter (Analog Output Signal)

Two menus are used to define the lower and upper limit (in the engineering unit previously selected) of the analog output signal corresponding to the computed parameter (see note below).

Example: if the previous selection was dew point in °C and the analog output for the computed parameter is configured to a range of 4..20 mA, entering 0 and 100 will cause the analog output to be 4..20 mA = 0..100°C dew point.

```
HUMIDITY - OUTPUT CHANNEL
ENTER LOWER LIMIT OF ANALOG OUTPUT        >0.000

HUMIDITY - OUTPUT CHANNEL
ENTER UPPER LIMIT OF ANALOG OUTPUT        >100.000
```

Note: Negative values are permitted. The analog output is clamped to the values entered above. The HC322 local display and the data sent to the RS232 port are not clamped.

• Fixed Pressure Value

Computation of the following parameters requires barometric pressure as an input:

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

For these parameters, it is important to enter a pressure value that matches the conditions of the application (for example: average barometric pressure at the local altitude). Depending on the global unit system, one of the following menus is used:

Metric:

```
PRESSURE - INPUT CHANNEL
CHANNEL SETUP OPTIONS

(1) PRESSURE      in hPa (mbar)   (STP: 1013.25)
(2) PRESSURE      in kPa          (STP: 101.325)

    ENTER YOUR CHOICE       >1
```

English:

```
PRESSURE - INPUT CHANNEL
CHANNEL SETUP OPTIONS

(1) PRESSURE      in PSI          (STP: 14.69)
(2) PRESSURE      in INCHES Hg    (STP: 29.12)

    ENTER YOUR CHOICE       >1
```

Note: the standard pressure at sea level (STP) is indicated next to each choice.

RS232 Options

This menu selection is used to turn on and off the header for the RS232 port. When the header is on, it is being printed after every each 20 lines of data.

```
SELECT ONE OF THE FOLLOWING OPTIONS:

(1)PRINT TO PC SCREEN WITH HEADER
(2)PRINT TO PC SCREEN WITHOUT HEADER

ENTER YOUR CHOICE  >
```

MAINTENANCE AND TROUBLESHOOTING

Cleaning or Replacing the Dust Filter:

The dust filter should be cleaned from time to time, depending on the conditions of measurement. Cleaning should be done without removing the metal filter base from the probe. To clean or replace the filter, only the filter cartridge should be removed (it is held by a screw to the filter base).

Periodic Calibration Check

When the probe is operated within the limits specified earlier, 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.

Error Messages

When an error condition exists, the display of the HC322 will show an error message:

Message	Description	What to do
Err0	Bad Check Sum (EPROM)	Contact Factory
Err1	Bad RAM	Contact Factory
Err2	No Calibration Data	Recalibrate Temperature and Humidity. Contact factory if problem persists
Err3	Stack Overflow	Unpower and power again. Contact factory if problem persists
-HH-	Condensation on the Humidity Sensor. This can occur at high humidity when the probe is colder than the environment.	Allow probe to dry. Check the calibration. Contact factory if problem persists

-OL-	Display Overflow	The value to be displayed exceeds the capacity of the display. Check the value by displaying the data on a PC or Laptop. Try reducing the number of displayed decimals (only for pressure and mixing ratio).
-S1-	Humidity sensor shorted or open	Check the condition of the humidity sensor leads. Strong condensation at the sensor and on the leads may result in a short circuit.
-S2-	Temperature sensor shorted or open	Check the condition of the temperature sensor leads. Strong condensation at the sensor and on the leads may result in a short circuit.

CALIBRATION

Calibration of the HC322 is entirely by means of software and requires the use of a PC or Laptop.

The normal procedure consists of a 2-point calibration of temperature followed by a 2-point calibration of humidity. The first calibration point is used by the software to compute an offset and the second point is used to compute a slope. Accuracy at low humidity can be enhanced by using up to two additional humidity calibration points (to fine tune the linearization of the humidity sensor).

In addition to the normal calibration procedure, the HC322 also permits a one-point calibration of either temperature or humidity. The effect of a one-point calibration is to add a correction value (or offset) to measurements across the whole range. The one-point calibration procedure should be used only for small adjustments. A typical example is to use a one-point calibration to offset the tolerance of the RTD sensor when the temperature signal has been calibrated at two points by substituting a decade box for the RTD. In applications where conditions are fairly constant, a one point calibration may be used for on-site calibrations. We do not recommend doing this in applications where conditions are essentially variable.

Since the HC322 automatically applies a temperature correction to the humidity signal, it is important to follow any temperature calibration with a humidity calibration.

To calibrate, connect the HC322 to the serial port of a PC or Laptop and start your communication software. Verify that the HC322 and the PC or Laptop are communicating (data should appear on the screen of the PC or Laptop), Set the HC322 in the CONFIGURATION / CALIBRATION mode by pressing the '**C**' key on the keyboard of the PC or Laptop. The screen of the PC or Laptop displays the following menu:

```
            HC322
      UTILITIES MAIN MENU

   (1) SET UP
   (2) CALIBRATE
   (3) SHOW SET UP / CALIBRATION DATA
   (4) SHOW SOFTWARE VERSIONS
   (5) RS232 OPTIONS
   (0) EXIT AND RETURN TO NORMAL MODE

      ENTER YOUR CHOICE >
```

Note: when in the CONFIGURATION / CALIBRATION mode, the local display of the HC322 shows the words "Set up". The HC322 is in a waiting mode and the analog outputs are frozen.

Temperature Calibration

Temperature can be calibrated using one of the following methods:

a) Substitution Method:

The Pt100 RTD is removed from the probe and substituted with a precision decade box. The decade box is used to simulate two temperatures T1 and T2 (2-point calibration). After putting the RTD back on the probe, it is generally necessary to do a one-point calibration at room temperature against a reference thermometer so as to offset any tolerance of the RTD.

Note: do not power the HC322 when removing or installing the RTD.

b) Direct Method:

The probe is placed in a ventilated, temperature controlled environment and exposed to two temperatures T1 and T2. The temperatures T1 and T2 that are measured with a reference thermometer.

In both cases, the temperature T2 should be greater than the temperature T1. Other than this, the values T1 and T2 can be freely chosen as long as they fit the requirements of the application. Unless the application is over a narrow temperature range, accuracy may be lost by calibrating at two values that are very close one to the other.

Note: when calibrating against a reference thermometer, it is important to follow these guidelines:

- *Both the RTD (probe of the HC322) and the reference thermometer should be ventilated and placed in the same stream of air. Remove any filter cartridge from the probe. Do not remove the slotted cap used to provide mechanical protection to the sensors.*
- *Air velocity should be within the limits of 200 to 500 feet/minute (1 to 2.5 meters/second). Proper comparison between two temperature instruments requires an*

air velocity of at least 200 feet/minute to provide good uniformity of temperature. Air velocity above 500 feet/minute may damage the unprotected humidity sensor.

Two-Point Temperature Calibration Procedure

Connect the HC322 to the serial port of a PC or Laptop and start the communication software. When the HC322 and the PC or Laptop are communicating (data appears on the screen), set the HC322 in the CONFIGURATION / CALIBRATION mode by pressing the ‘C’ key on the keyboard of the PC or Laptop.

When the UTILITIES MAIN MENU appears, press the ‘2’ key on the keyboard (do not press the ENTER key). The CALIBRATION MENU appears:

```
CHOOSE ONE

   (1) TEMPERATURE CALIBRATION
   (2) HUMIDITY CALIBRATION
   (3) CALIBRATE THE ANALOG OUTPUTS
   (0) RETURN TO MAIN MENU

       ENTER YOUR CHOICE >
```

Press the ‘1’ key on the keyboard of the PC or Laptop. The following warning should appear on the screen:

```
        TEMPERATURE CALIBRATION MAY AFFECT
        THE ACCURACY OF THE HUMIDITY DATA
        FOR BEST RESULTS, CALIBRATE HUMIDITY
        AFTER CALIBRATING TEMPERATURE

        PRESS ANY KEY TO CONTINUE
```

Press any key (for example, the space bar). The TEMPERATURE CALIBRATION MENU should appear:

```
CHOOSE ONE

        (1) 2-POINT CALIBRATION AT T1 and T2 (T2 > T1)
        (2) 1-POINT TEMPERATURE CALIBRATION (Any Value)
        (0) EXIT TEMPERATURE CALIBRATION

            ENTER YOUR CHOICE >
```

Press the ‘1’ key on the keyboard of the PC or Laptop. The following warning should appear:

```
2-POINT TEMPERATURE CALIBRATION PROCEDURE
THIS WILL CANCEL ALL PREVIOUS CALIBRATION DATA
Do you wish to Proceed??...Press Y or N
```

Press the ‘Y’ key on the keyboard of the PC or Laptop to begin the 2-point temperature calibration procedure (you can abort the process by pressing the ‘N’ key). The following menu should appear:

```
SELECT THE CALIBRATION REFERENCE

        (1) DEG C
        (2) DEG F

            ENTER YOUR CHOICE >
```

Press either the ‘1’ or the ‘2’ key, depending on the temperature unit of the reference (thermometer or decade box). The following message should appear on the screen:

```
TEMPERATURE CALIBRATION POINT #1

Place the Probe in a Stable Environment
or
Use a Decade Box to simulate the RTD

PRESS ANY KEY TO CONTINUE
```

Place the probe of the HC322 in an environment at a stable temperature T1 or adjust the decade box to the temperature T1.

Press any key. The screen now displays the temperature measured with the current calibration settings (offset and slope):

```
        TEMPERATURE CALIBRATION
        PRESS ANY KEY WHEN DATA IS STABLE
        TEMPERATURE (deg. C)
             24.42
             24.42
             24.41
             24.41
             24.40
             24.39
```

When the screen data is stable, press any key (the letter ‘E’ to the right of the data indicates stability).

```
             24.05    E
             24.05    E
             24.05    E
             24.05    E
        ENTER THE CALIBRATION TEMPERATURE (deg. C)      >24.06
```

Type on the keyboard the value of the reference temperature and press the ENTER key.

The words “Calibrating, Please wait” appear on the screen. After about one minute, the screen should change to:

```
TEMPERATURE CALIBRATION POINT #2

Place the Probe in a Stable Environment
or
Use a Decade Box to simulate the RTD

PRESS ANY KEY TO CONTINUE
```

Place the probe of the HC322 in an environment at a stable temperature T2 (T2 should be higher than the temperature T1) or adjust the decade box to the temperature T2. Follow the same procedure as for the first calibration point.

When the process has been completed, the following message should appear on the screen:

```
2-Point Temperature Calibration Completed

If you have substituted the RTD with a Decade Box
Do a 1-Point Calibration with the RTD back on the Probe

PRESS ANY KEY TO CONTINUE
```

Press any key. The temperature calibration menu should appear on the screen:

```
CHOOSE ONE

        (1) 2-POINT CALIBRATION AT T1 and T2 (T2 > T1)
        (2) 1-POINT TEMPERATURE CALIBRATION (Any Value)
        (0) EXIT TEMPERATURE CALIBRATION

            ENTER YOUR CHOICE >
```

If you have directly calibrated against a reference thermometer, press the ‘0’ key. If you have calibrated with a decade box, we recommend that you do a one-point calibration at room temperature against a reference thermometer.

When exiting the temperature calibration menu, you will be asked to enter the date of calibration (month, day and last 2 digits of the year).

One-Point Temperature Calibration Procedure

The 1-point calibration procedure is done against a reference thermometer (no substitution with a decade box). During this procedure, we strongly recommend that both the RTD (Probe) and the thermometer be adequately ventilated.

Go to the TEMPERATURE CALIBRATION MENU:

```
CHOOSE ONE

        (1) 2-POINT CALIBRATION AT T1 and T2 (T2 > T1)
        (2) 1-POINT TEMPERATURE CALIBRATION (Any Value)
        (0) EXIT TEMPERATURE CALIBRATION

            ENTER YOUR CHOICE >
```

Press the ‘2’ key. The following menu should appear:

```
SELECT THE CALIBRATION REFERENCE

        (1) DEG C
        (2) DEG F

         ENTER YOUR CHOICE >
```

Press either the ‘1’ or the ‘2’ key, depending on the temperature unit of the reference thermometer. The following message should appear on the screen:

```
1-POINT TEMPERATURE CALIBRATION

Place the Probe in a Stable Environment
PRESS ANY KEY TO CONTINUE

Press any key.
```

The screen changes to the following:

```
TEMPERATURE CALIBRATION
        PRESS ANY KEY WHEN DATA IS STABLE
        TEMPERATURE (deg. C)
             24.16
             24.16
             24.16
             24.16
             24.16
             24.16
             24.16
```

When the screen data is stable, press any key (the letter ‘E’ to the right of the data indicates stability).

```
     24.25    E
     24.25    E
     24.25    E
     24.25    E
ENTER THE CALIBRATION TEMPERATURE (deg. C)      >24.25
```

Type on the keyboard the value of the reference temperature and press the ENTER key. The screen should change to:

```
CALIBRATION COMPLETED
PRESS ANY KEY TO CONTINUE
```

Press any key. The screen should show the TEMPERATURE CALIBRATION MENU:

```
CHOOSE ONE

        (1) 2-POINT CALIBRATION AT T1 and T2 (T2 > T1)
        (2) 1-POINT TEMPERATURE CALIBRATION (Any Value)
        (0) EXIT TEMPERATURE CALIBRATION

            ENTER YOUR CHOICE >
```

Press the ‘0’ key. Upon exiting the temperature calibration menu, you will be asked to enter the date of calibration (month, day and last 2 digits of the year).

Humidity Calibration

Humidity can be calibrated using one of the following methods:

a) Physical Humidity Standard

Physical humidity standards (usually aqueous salt solutions) can be used to generate two known relative humidity values (H1 and H2) in a closed environment where the probe is placed. Usually, the equilibration process takes about 60 minutes.

The ER15 calibration device is a small airtight container that slips over the probe of the HC322 and seals around the humidity sensor. The ER15 includes a receptacle to hold the humidity standard. ROTRONIC provides certified humidity standards that can be used by non-skilled personnel. These standards are available in boxes of 5 glass ampoules of the same value and 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. See 12 (Addendum) for instructions on how to use the ER15 and humidity standards.

Note: during calibration with a physical humidity standard, ***temperature stability at the probe is the single most important requirement****. Calibrations should be performed*

at room temperature (20 to 30°C). Temperature should be 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 heater, in direct exposure to sun rays, etc. Temperature stability can be improved by placing the tip of the probe and calibration device inside of a box filled with sand.

b) Humidity Generator and Reference Humidity Instrument

Humidity generators are convenient to use and save time during calibrations. However, humidity generators tend to be quite expensive and are not available to most users. Unlike physical humidity standards, use of a humidity generator offers the choice of calibrating the HC322 either in relative humidity or directly in dew point. The HC322 software offers both choices for each calibration point. At high humidity values (above 80%RH), preference should be given to a relative humidity reference. At low humidity values (below 30..50%RH), using a direct dew point reference generally results in better accuracy

When using a humidity generator and a reference instrument, you should meet the requirements already mentioned for a temperature calibration (air flow, temperature stability).

Note: when calibrating against a chilled mirror instrument, it is important to note that the HC322 requires the frost point (below freezing only) as the calibration reference. To eliminate the reading uncertainty typical of a chilled mirror instrument for values below freezing, write down the initial reading and generally wait for 15 to 30 minutes to permit the transition from dew to frost on the mirror. The frost point is always higher than the dew point.

Humidity calibration requires at least two reference values H1 and H2. The value H2 should be higher than the value H1. Otherwise, both values can be freely chosen. Typical values are 35 %RH for H1 and 80 %RH for H2. As a means of improving accuracy at low humidity (below 30%RH), the HC322 software has provision for up to two additional calibration points H3 and H4. The value H3 should be lower than the value H1 and the value H4 should be lower than the value H3. Typical values are 10%RH or -12°C frost point for H3 and 0 %RH or -30°C frost point for H2.

Two-Point Humidity Calibration Procedure

Connect the HC322 to the serial port of a PC or Laptop and start the communication software. When the HC322 and the PC or Laptop are communicating (data appears on the screen), set the HC322 in the configuration / calibration mode by pressing the ‘C’ key on the keyboard of the PC or Laptop.

When the utilities main menu appears, press the ‘2’ key on the keyboard (do not press the ENTER key). The calibration menu appears:

```
CHOOSE ONE

   (1) TEMPERATURE CALIBRATION
   (2) HUMIDITY CALIBRATION
   (3) CALIBRATE THE ANALOG OUTPUTS
   (0) RETURN TO MAIN MENU

       ENTER YOUR CHOICE >
```

Press the ‘2’ key on the keyboard of the PC or Laptop. The humidity calibration menu should appear on the screen:

```
CHOOSE ONE

        (1) CALIBRATION AT H1 and H2 (H2 > H1)
        (2) CALIBRATION AT H3 (H3 < H1)
        (3) CALIBRATION AT H4 (H4 < H3)
        (4) 1-POINT HUMIDITY CALIBRATION (Any Value)
        (0) EXIT HUMIDITY CALIBRATION

            ENTER YOUR CHOICE >
```

Press the ‘1’ key on the keyboard of the PC or Laptop. The following warning should appear:

```
2-POINT HUMIDITY CALIBRATION PROCEDURE
WARNING: PREVIOUS CALIBRATION DATA WILL BE LOST
Do you wish to Proceed??...Press Y or N
```

Press the ‘Y’ key on the keyboard of the PC or Laptop to begin the 2-point humidity calibration procedure (you can abort the process by pressing the ‘N’ key). The following menu should appear:

```
HUMIDITY CALIBRATION POINT #1
Place the Probe in a Stable Environment
PRESS ANY KEY TO CONTINUE
```

Place the probe of the HC322 in an environment at a stable humidity H1 and at stable temperature conditions.

Press any key. The screen should display the following menu:

```
SELECT THE CALIBRATION REFERENCE

      (1) RELATIVE HUMIDITY in %RH (example:35%RH)
      (2) DEW POINT in deg C (example:10 deg C)
      (3) DEW POINT in deg F (example: 10 deg F)
      If Choice is Dew Point: Use the Frost Point below Freezing!

          ENTER YOUR CHOICE >
```

Press the key corresponding to the humidity unit of the reference (physical humidity standard or reference instrument). The screen should now display the humidity measured with the current calibration settings (offset and slope) as well as the temperature.

```
HUMIDITY CALIBRATION
PRESS ANY KEY WHEN DATA IS STABLE
```

```
HUMIDITY %RH            TEMPERATURE (deg C)
       50.04                   24.02
       50.03                   24.03
       50.02                   24.03
       50.01                   24.03
       50.00                   24.03
```

When the data is stable, press any key (the letter ‘E’ to the right of the data indicates stability).

```
       49.83      E           24.02     E
       49.83      E           24.02     E
       49.83      E           24.02     E
       49.82      E           24.02     E
       ENTER THE CALIBRATION POINT (%RH)      >49.82
```

Type on the keyboard the value of the reference humidity and press the ENTER key. The words “Calibrating, Please wait” appear on the screen. After about one minute, the screen should change to:

```
HUMIDITY CALIBRATION POINT #2
Place the Probe in a Stable Environment
PRESS ANY KEY TO CONTINUE
```

Place the probe of the HC322 in an environment at a stable humidity H2 (H2 should be higher than the humidity H1). Follow the same procedure as for the first calibration point.

When the process has been completed, the following message should appear on the screen:

```
2-Point Humidity Calibration Completed
PRESS ANY KEY TO CONTINUE
```

Press any key. The humidity calibration menu should appear on the screen:

```
CHOOSE ONE

        (1) CALIBRATION AT H1 and H2 (H2 > H1)
        (2) CALIBRATION AT H3 (H3 < H1)
        (3) CALIBRATION AT H4 (H4 < H3)
        (4) 1-POINT HUMIDITY CALIBRATION (Any Value)
        (0) EXIT HUMIDITY CALIBRATION

            ENTER YOUR CHOICE >
```

When exiting the humidity calibration menu, you will be asked to enter the date of calibration (month, day and last 2 digits of the year).

Additional Humidity Calibration Points

Choices 2 and 3 of the HUMIDITY CALIBRATION MENU are optional and permit to use one or two additional calibration points so as to enhance accuracy at low humidity.

Calibration point H3 should have a lower value than calibration point H1. Similarly, calibration point H4 should be lower than calibration point H3.

The procedure is similar to the procedure already described for the 2-point calibration.

One-Point Humidity Calibration

Choice 4 of the HUMIDITY CALIBRATION MENU permits a 1-point calibration of humidity (on-site calibration). Normally, this menu choice should not be used, except in situations where the measured range of humidity is very narrow.

The procedure is similar to the procedure already described for the 2-point calibration.

Changing and Calibrating the Analog Outputs

A row of 8 jumpers is provided just above the analog outputs terminal block. The jumpers are labeled on the board JP 105 to JP 112. Depending on the type of output signal, use the following combinations (unpower the unit when changing the jumpers):

Analog Output Signals	Jumper Configuration
0…1 V	Close 105, 108, 109, 112
0…5 V	Close 105, 107, 108, 109, 111, 112
0…10 V	Close all jumpers
0…20 mA or 4…20 mA	Remove all jumpers

After changing the jumpers, choice 3 of the CALIBRATION MENU should be used to do an electrical calibration of the analog outputs. The analog signal corresponding to the computed parameter (or humidity) is calibrated first and the signal corresponding to temperature is calibrated next.

For this calibration, you should connect a 4 ½ digit multimeter to terminals 1 (-) and 2 (+) of the outputs terminal block (Humidity / Computed Parameter. - see Wiring). The procedure consists in adjusting first the low end of the output signal (for example 4 mA) and then the high end of the signal (for example 20 mA). The keyboard of the PC or Laptop is used to adjust the output signal. All necessary instructions are provided on the screen of the PC or Laptop (allow for some reaction time after each adjustment).

After calibrating the signal corresponding to the computed parameter, connect the digital multimeter to terminals 1 (-) and 3 (+) of the outputs terminal block (temperature) and repeat the procedure.

Note: this procedure is purely an electrical calibration and has no effect on the temperature and humidity calibrations described earlier.

Show Set Up / Calibration Data

Selection 3 of the Utilities Main Menu is used to display the set up and calibration data on the screen of a PC or Laptop. The data is displayed in the following order:

```
HUMIDITY CALIBRATION DATA [MM/DD/YY]:   4/8/00

   CALIBRATION POINTS                CALIBRATION TEMPERATURE
   H1 RH   :          35.0           T(H1) deg C:      30.6
   H2 RH   :          80.0           T(H2) deg C:      29.1
   H3 RH   :          11.7           T(H3) deg C:      31.3
   H4 RH   :           0.2           T(H4) deg C:      30.3
```

Date of Calibration

Calibration Unit:
RH = Relative Humidity
°C or °F = Dew Point

Temperature during Humidity

Press any key to display the next set of data

```
TEMPERATURE CALIBRATION DATA [MM/DD/YY]:        4/8/00

   CALIBRATION POINTS
   T1 deg C:          27.7
   T2 deg C:          80.3
```

Press any key to display the next set of data

```
HUMIDITY INPUT SET UP DATA:
MODE    DECIMAL L_COUNT H_COUNT L_VALUE H_VALUE
 1       1       1660    2944     34.39   79.48
```

Low A/D Counts

High A/D Counts

2-point Calibration Data (prior to temperature compensation of the humidity sensor)

```
TEMPERATURE INPUT SET UP DATA:
MODE    DECIMAL L_COUNT H_COUNT L_VALUE H_VALUE
 1       1       997     1639     27.66   80.30

PRESSURE INPUT SET UP DATA:
MODE    DECIMAL L_COUNT H_COUNT L_VALUE H_VALUE
 1       3       0       4000    1013.25 1013.25
```

Number of Decimals
3 = Floating Decimal

Pressure Unit
1 = hPa

Value of the Fixed Pressure
or
Range of the Pressure Probe

```
HUMIDITY / PARAMETER OUTPUT SET UP DATA:
MODE    DECIMAL L_COUNT H_COUNT L_VALUE H_VALUE
 2       1       786     3943      0.00  100.00
```

Computed Parameter
2 = Dew Point in °C

Low and High D/A Counts

Range of the Analog Output
example: 0..100°C

```
TEMPERATURE OUTPUT SET UP DATA:
MODE    DECIMAL L_COUNT H_COUNT L_VALUE H_VALUE
 1       1       790     3977      0.00  100.00
```

Temperature Unit
1 = °C

Press any key to return to the main menu.

GENERAL DESCRIPTION

Power Supply

The HC322 is available for operation with one of the following types of voltage supply: 24 VDC, 24 VAC, 115 VAC or 220 VAC. With 24 VDC, the current draw is 180 mA. When operating with a DC supply voltage, the HC322 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).

Analog Outputs

The HC322 has two analog outputs: one output corresponds to relative humidity or to the computed parameter (dew point or other, as specified when ordering), the other output corresponds to temperature.

The HC322 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 HC322, the resulting impedance should not exceed 500 ohms, wiring included. In the case of a voltage output, the minimum load on the HC322 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 (relative humidity or computed parameter)

Relative Humidity Range Limits	: 0…100 %RH
Dew Point Range Limits (1)	:-99.9..+999.9°C or °F
Wet Bulb Range Limits (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

b) Output 2 (temperature)

Temperature Range Limits (1)	: -50..200°C (-58..392°F)

(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 200°C.

Front Panel Display

The front panel of the HC322 has two 4-digit LED displays.

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

The bottom display (TEMPERATURE) shows the dry bulb temperature.

THEORY OF OPERATION

Computation Method

The HC322 measures relative humidity with a HYGROMER™ C94 capacitive sensor and temperature with a Pt100 RTD. Using temperature, the HC322 computes the 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 can be set to provide the frost point or the dew point for values below freezing. 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.

Mixing ratio, wet bulb temperature and enthalpy require barometric pressure as an input. The HC322 uses a fixed pressure value. This value should be adjusted to match the local pressure.

For the computation of enthalpy, the HC322 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 HC322 uses 0°F as the reference temperature.

Accuracy and Repeatability

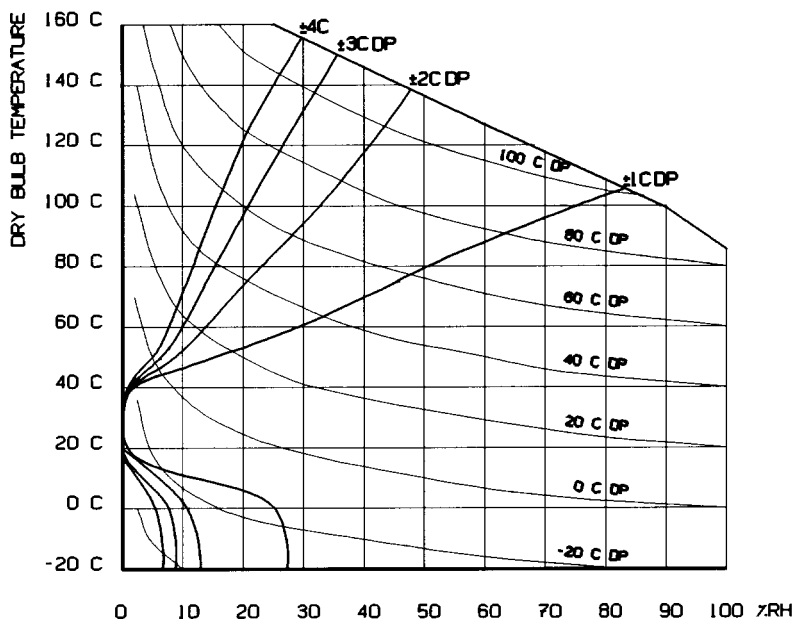
The HC322 measures temperature with an accuracy of ±0.3°C (±0.5°F) and humidity with an accuracy of ±1.5%RH or better at 20..30°C (68..86°F). Humidity accuracy is better than ±3.0%RH within the temperature range of -20..120°C (-5..248°F).

The internal computations of the HC322 are very accurate. Assuming no error on the input signals, the computation error would be less than 0.1% of the computed value.

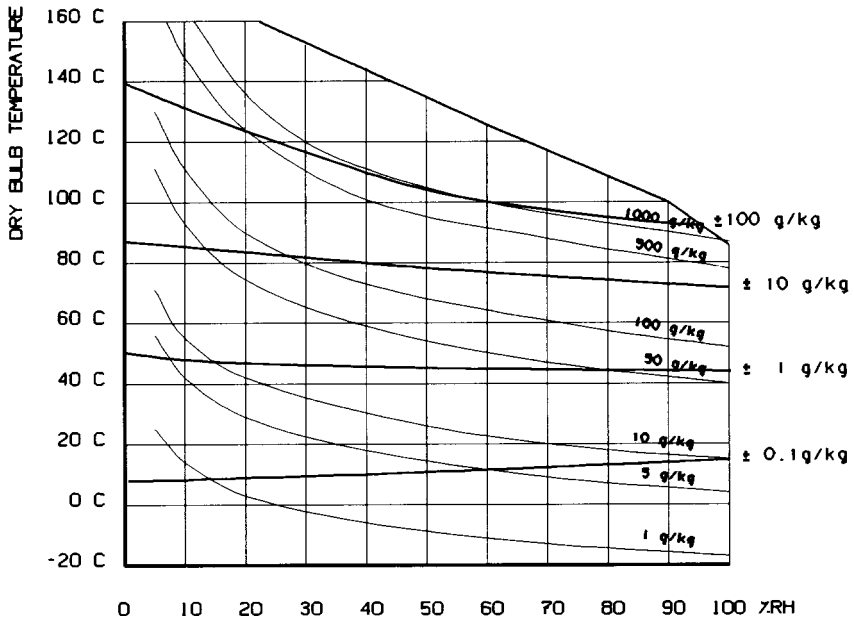
Accuracy of the computed parameter depends on the humidity and temperature conditions (see diagrams). For example, at room temperature, the HC322 measures dew point of -20°C (-4°F) with an accuracy better than ±1°C (±1.8°F).

Over the range of operating conditions, the typical repeatability is ±0.4°C DP (±0.7°F DP) or better. With a mixing ratio output (g/kg or gr/lb), repeatability is ±0.03 g/kg to ±10 g/kg (±0.2 gr/lb to ±70 gr/lb).

DEW POINT ACCURACY



MIXING RATIO ACCURACY



SPECIFICATIONS

Configurations	HC322-W: Wall Mount HC322-R : Remote Pbe
Humidity Sensor	ROTRONIC HYGROMER™ C94
Temperature Sensor	Pt100 RTD
Standard Measuring Ranges HC322-W	0..100 %RH 0..100°F Dry Bulb (Output 1) -50..100°F Dew Point (Output 2) other outputs/ranges: see below.
Standard Measuring Ranges HC322-R	0..100 %RH 0..300°F Dry Bulb (Output 1) -50..250°F Dew Point (Output 2) other outputs/ranges: see below.
Output Signals (linear)	4-20 mA or 0-20 mA, max. 500 Ω 0-10VDC or 0-5VDC or 0-1VDC, min. 10 kΩ
Optional 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
Temperature Limits at Electronics	-20..131°F (-29..55°C)
Normal Operating Temp. At Electronics	-5..122°F (-20..50°C)
Temperature Limits at Sensors	HC322-W: -20..131°F (-29..55°C) HC322-R : -100..320°F (-75..160°C)
Normal Operating Temp. at Sensors	HC322-W: -5..122°F (-20..50°C) HC322-R : -5..248°F (-20..120°C)
Humidity Limits at Sensors	100%RH up to 185°F (85°C) 90%RH at 212°F (100°C) 60%RH at 260°F (125°C) 25%RH at 320°F (160°C)
Optional Pressure Input (linear)	4-20 mA or 0-20 mA 0-10VDC or 0-5VDC or 0-1VDC
Pressure Input Impedance	Current: 10 ohm, Voltage > 1 Mohm
Pressure Range Limits (1)	0..9999 hPa / kPa / PSI / mm Hg / In Hg
Accuracy at 68..86°F (20..30°C)	± 1%RH from 0 to 100%RH ±1.8°F (±1.0°C) DP or better ± 0.5°F (±0.3°C)
Repeatability	±0.3%RH / ±0.7°F DP (±0.4°C) ±0.2°F Dry Bulb (±0.1°C)
Humidity Sensor Stability	better than 1%RH over a year
Response Time (without filter)	10 seconds (%RH and temperature)

Supply Voltage	115 VAC or 220 VAC or 24 VDC/VAC 180 mA at 24 VDC
Wiring Type	Terminals 18 AWG Max. 1/2" Conduit Adapters (x2)
Electrical Connections	Press. Input : 2 Wires (optional) Outputs (2) : 2 Wires per Signal D/C Power : 2 Wires A/C Power : 2 Wires + Ground
Probe Cable Length (HC322-R)	6 feet (2 m)
Sensor Protection	Dust Filter (standard)/ Slotted Cap (Optional)
Probe Dimension/Material	HC322-W: 100 x 15mm (PPS) HC322-R : 250 x 15 mm (PPS)
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
Remote Probe Holder	QMA15 (Order Separately)

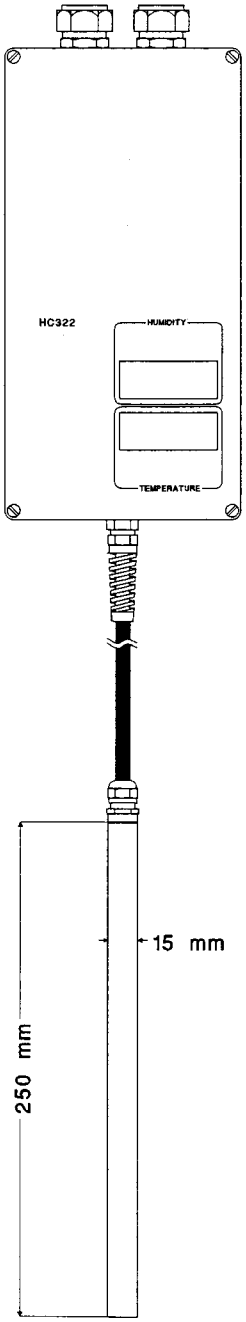
(1) Any partial range can be factory set. To maximize resolution, we recommend limiting both the temperature and dew point ranges to a maximum span of 400°F or 200°C.

ADDENDUM: How to Use the ROTRONIC Humidity Standards

- Slip the ER15 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.
- 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 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 display.
- When done, 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.**

OUTLINE DRAWINGS

HC322-R



HC322-W