

RH411
DIGITAL THERMO-HYGROMETER

Operator's Manual



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2. Model and Serial numbers.
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RELATIVE HUMIDITY HANDHELD METER

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SECTION 1 INTRODUCTION

1.1 DESCRIPTION

The OMEGA® RH411 Handheld, Relative Humidity Meter is a high performance, portable, easy-to-use unit that can measure relative humidity as well as temperature. A unique feature of this unit is that it has a dual display for continuous indication of %RH and temperature in °C or °F. High and low peak values of both parameters can be read from the display. The RH411 can be used with a 9V battery or by using a 120VAC adaptor for benchtop use. By using the banana jacks on the front panel, the user can get analog voltage outputs.

1.2 FEATURES

- ✓ Dual display
- ✓ Dual analog outputs - 10mV/%RH and 10mV/°F
- ✓ °C/°F switchable
- ✓ %RH/Temperature probe sensor with 5 ft. cable
- ✓ Fast response
- ✓ Display hold feature
- ✓ Records and displays the high and low readings of the relative humidity and temperature
- ✓ 120VAC or 9V battery powered
- ✓ Digital calibration
- ✓ Tilting stand integral with case

1.3 SENSORS AND MEASUREMENT

The RH411 uses an external plug-in temperature/humidity sensor which measures both ambient temperature and relative humidity. Figure 1-1 shows the temperature/humidity probe.

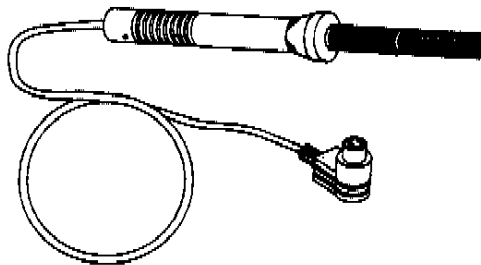


Figure 1-1. RH411 Probe

The temperature sensor is a low-power, semiconductor type, with a linear voltage output that is proportional to the temperature. The humidity sensor consists of a bulk polymer material deposited on a ceramic substrate. The mobility of the ions in the polymer changes with moisture content of the surrounding atmosphere. As a result, the sensor presents an impedance which is a non-linear function of the relative humidity. The sensor is driven by AC excitation and the wide dynamic range of its output is compressed with a logarithmic amplifier.

NOTE

All humidity sensors are susceptible to contamination from outside sources that can affect accuracy, and response time. Care should be taken to prevent excessive contamination by dirt, oil, grease, solvents, etc.

The electronically conditioned signal from both sensors are fed to a microprocessor via an analog to digital converter. The results of the processor calculations are then used to update the LCD display.

SECTION 2 UNPACKING

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378.

Upon receipt of the shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

Make sure the following items are in the shipping box.

QTY	DESCRIPTION
1	RH411 (serial # _____) - located under battery, refer to Section 3.2)
1	RH/Temp Probe with 5 ft cord and handle [calibration code # (H _____ T_____)]
1	120VAC Adaptor
1	9V battery
1	Operating Manual

SECTION 3 INSTALLATION AND OPERATION

3.1 PARTS OF THE RH411

Before using the RH411, it is essential for the user to become acquainted with the different parts of the meter. Figure 3-1 shows the main parts of the meter. Each of the highlighted areas are discussed in sections denoted by "()".

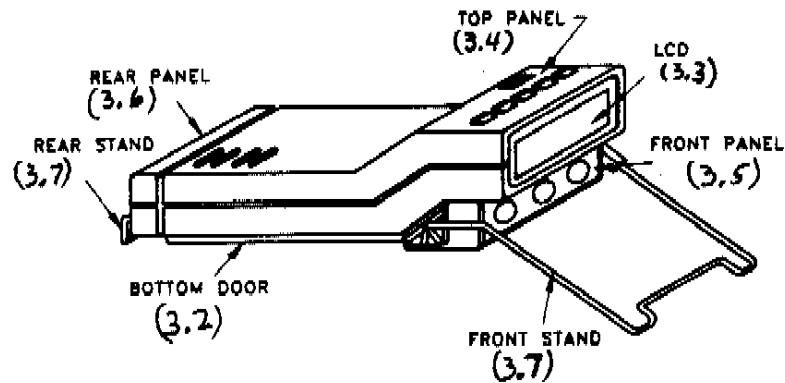


Figure 3-1. RH411 Meter

3.2 BOTTOM DOOR, BATTERY COMPARTMENT

The bottom door of the meter provides the user access to the battery compartment. Refer to Figure 3-2.

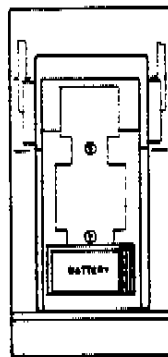


Figure 3-2. Bottom of RH411 with Door Removed

To remove the bottom door, turn the meter over, and slide the door to the rear of the meter, using the finger access provided (refer to Figure 3-3a). The user can now access the battery. To re-install the bottom door, place the door into the track on the bottom case and slide it forward until the door latch engages. Refer to Figure 3-3b.

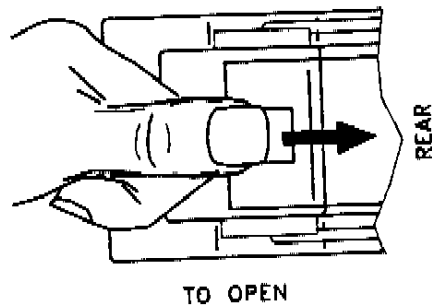


Figure 3-3a. How to Open Door

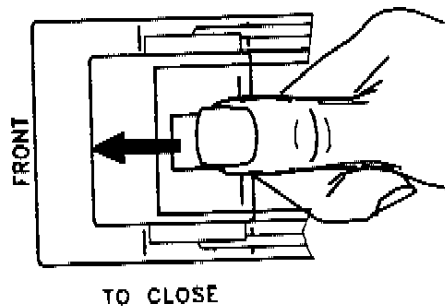


Figure 3-3b. How to Close Door

3.2.1 BATTERY INSTALLATION OR REPLACEMENT

The RH411 is designed to use a single 9V battery. Since alkaline batteries last approximately 100 hours, you may want to use the AC adaptor for use with standard 120V/60Hz power for extending the operation of the RH411.

If the battery voltage drops below 7V, the display shows , alerting the user to replace the battery. When the battery voltage is below 6.0V, it is too low for reliable operation. The display shows  and all dashes "-- ---".

To install or replace the battery, go through the following steps.

1. Turn off the RH411.
2. If applicable, remove the probe from the rear of the meter, and any probe connections from the front of the meter.
3. Remove the bottom door.
4. Remove the battery from the compartment and carefully remove it from the battery clip.
5. Attach a new battery to the battery clip and place the battery back into its recess in the case.
6. Replace the bottom door.

3.3 LIQUID CRYSTAL DISPLAY (LCD)

Refer to Figure 3-4.

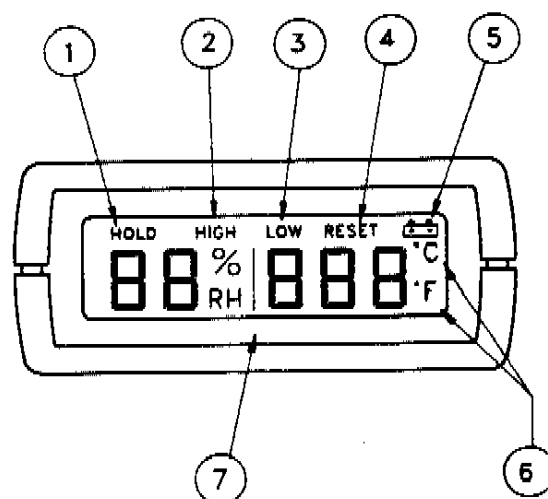


Figure 3-4. LCD Display

ITEM	LABEL	DESCRIPTION
1	HOLD	Display values are frozen
2	HIGH	High RH & TEMP peaks are shown
3	LOW	Low RH & TEMP peaks are shown
4	RESET	Stored peak values are reset to the current ambient values
5		Low battery voltage Indicator
6	°C °F	Celsius and Fahrenheit Indicators
7	88% 888	Display: %RH on left side, temperature in °C or °F on right side

3.4 TOP PANEL

Refer to Figure 3-5.

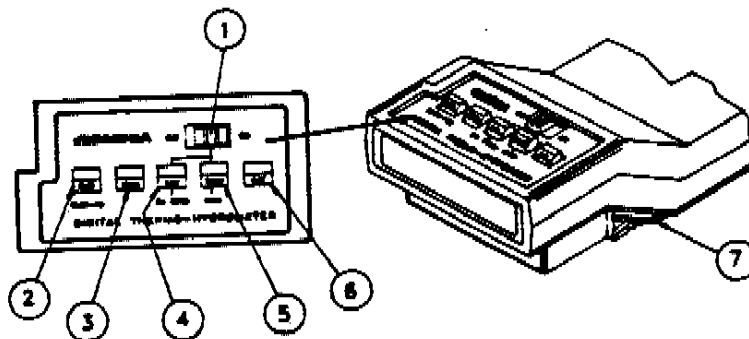


Figure 3-5. Top Panel of Meter

ITEM	LABEL	DESCRIPTION
1	Off/On	Power Switch This switch turns the RH411 on and off
2	Hold	The Hold button has two functions: 1- This button, when pressed, freezes the display values until pressed again and shows "HOLD" on the display. 2- This button is also used to "wake" up the meter (from the "sleep state") if the display has gone blank while the on/off button is switched ON. The blank display indicates inactivity of the meter after 15 minutes of inactivity of the buttons. Peak values are not updated during this time.
NOTE An alternative method to turn the display back on, would be to turn off the meter and then turn it back on.		
3	High	The High button has two functions: 1- Upon pressing and holding the High button, the meter displays the highest RH and temperature readings obtained since it was last reset. The display shows "HIGH". 2- The High button is also used to calibrate the instrument to the probe used. Refer to Section 5.1 for more details.

ITEM	LABEL	DESCRIPTION
4	Low	The Low button has 3 functions: 1- Upon pressing and holding the Low button, the meter displays the lowest RH & temperature readings obtained since it was last reset. The display shows "LOW". 2- The Low button is also used to calibrate the instrument to the probe used. Refer to Section 5.1 for more details. 3- The Low button disables the sleep function when used as follows: turn off the meter, then turn on the meter while pressing the Low button. Keep it pressed until you see the display go through the self test and then show "no SLP". Upon releasing the Low button, you will see the calibration codes and then the normal operation of the display.
5	Reset	The Reset button has 2 functions: 1- It resets the internal peak values to the current ambient values. The display then shows "RESET" and the meter keeps track of new peak values. The peak values are also reset upon power up. 2- Reset is used in conjunction with the Off/On switch to enter the calibration mode. Refer to Section 5.1 for more details.
6	C/F	Temperature Mode Button This button is used to choose between degrees Celsius and degrees Fahrenheit
7		Front Stand (refer to Section 3.7).

3.5 FRONT PANEL

Refer to Figure 3-6.

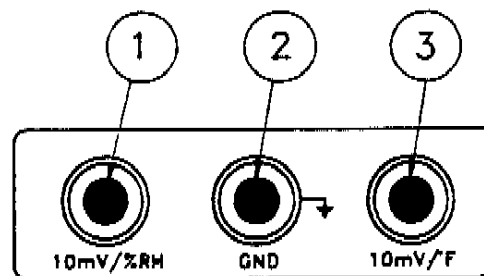


Figure 3-6. Front Panel of Meter

ITEM	LABEL	DESCRIPTION
1	10 mV/%RH	Analog output for humidity
2	GND	Common ground connection for analog outputs
3	10 mV/°F	Analog output for temperature

3.6 REAR PANEL

Refer to Figure 3-7.

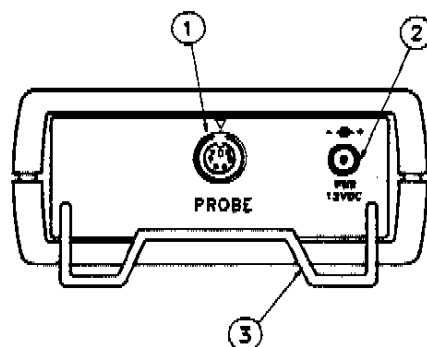


Figure 3-7. Rear Panel of Meter

ITEM	LABEL	DESCRIPTION
1	PROBE	Jack for RH/Temp Probe
2	PWR 12 VDC	Jack for 120VAC to 12 VDC adaptor
3		Rear Stand (refer to Section 3.7)

3.6.1 Probe Connection

Before turning on the RH411, perform the following probe connections:

Connect the RH/Temp Probe to the rear of the RH411 observing arrow. Refer to Figure 3-8.

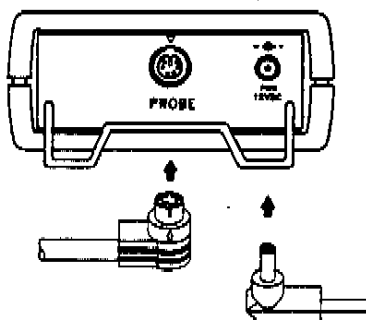


Figure 3-8. How to Connect Probe

3.6.2 AC Adaptor

If you want to operate the RH411 using the AC adaptor, plug the adaptor into the power jack at the rear of meter next to the RH/Temp probe. Refer to Figure 3-8.

3.7 FRONT AND REAR STANDS

The RH411 is equipped with two stands; one that folds down in the front and one that pulls out in the rear. The five-position front stand offers a wide range of operating and viewing angles for field or benchtop use. The rear stand slides out to accommodate and protect the probe plug.

SECTION 4 OPERATION

4.1 GOOD PRACTICE GUIDELINES

1. Check the condition of the probe before using.
2. Always make sure the screen over the probe sensor is clean.
3. DO NOT obstruct the probe screen.
4. DO NOT immerse the probe or meter in any liquid, since serious damage may occur.
5. If the battery symbol is displayed, the battery should be replaced as soon as possible.

4.2 HOW TO TAKE A MEASUREMENT

Make sure the RH/Temp probe is plugged in before turning the unit on. (If the probe is not plugged in, the meter will display incorrect values). To turn on the RH411, use the power slide switch on the top panel of the meter.

NOTE

If the switch is ON, but the display is blank, press the Hold button to "wake" the meter from the sleep mode. The sleep mode conserves battery and sensor life. If nothing is visible on the LCD, check the battery or AC adaptor connections.

When the meter is first turned on, it displays all the segments on the LCD as a self test. The self test display clears and then the LCD shows a 2-digit humidity calibration code on the left side and a 1-digit temperature code on the right. For example, 68 8 is displayed, where 68 is the humidity calibration code and 8 is the temperature calibration code. These 2 groups of numbers should match the calibration codes on the RH/Temp probe.

If the code numbers do not match, you must reprogram these numbers or else accurate measurements will not take place. Section 5 covers how to change the calibration codes.

4.2.1 Normal Operating Mode

After showing the calibration codes, the display goes into normal operating mode by displaying the relative humidity on the left side **AND** temperature in °C or °F on the right side. This dual display is unique to the RH411, and is constantly updated.

Response time is enhanced with increased air circulation. This may be achieved by either gently waving the probe back and forth, or by placing the probe in a moving air stream. Refer to Section 6, Specifications, for more detailed information on response time.

4.2.2 Relative Humidity Measurement

Once in the normal operating mode, the dual display constantly updates the relative humidity reading which ranges from 0% to 99%.

4.2.3 Temperature Measurement

Once in the normal operating mode, the dual display constantly updates the temperature reading which ranges from 0°F to 120°F (-18°C to 49°C). Each time the meter is turned on, the display defaults to °F. °C is selectable by pressing the C/F button.

4.2.4 Analog Measurement

For analog measurements, the RH411 features two analog output jacks. Both voltages are present from the front panel at all times. These two signals correspond to 10mV/%RH (humidity) and 10mV/°F (temperature). The load presented to either of these jacks should be greater than 47kΩ.

These two analog signals can be connected to a variety of equipment, including chart recorders, control electronics, remote displays and an analog input card in a personal computer. The connectors allow for continuous monitoring of relative humidity and temperature simultaneously.

4.2.4.1 Humidity Analog Signal

The humidity analog output signal on the RH411 is accessed by the 10mV/%RH and ground (common) connectors. The output corresponds to the humidity range of the sensor: 0% RH to 99% RH. Refer to Figure 4-1 for orientation of wires.

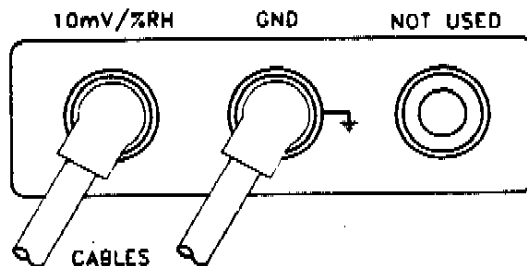


Figure 4-1. Humidity Analog Signal Wiring

4.2.4.2 Temperature Analog Signal

The temperature analog output signal on the RH411 is accessed by using the 10mV/°F and ground connectors. The range of the analog output corresponds to the full temperature range of the instrument which is 0°F to 120°F. Refer to Figure 4-2 for orientation of wires.

NOTE

If the display is in °C, the output is still in °F.

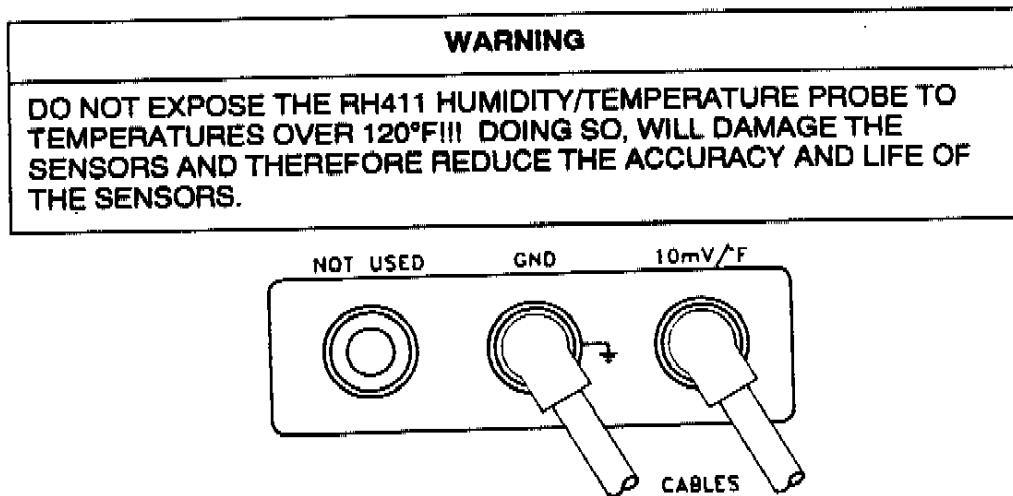


Figure 4-2. Temperature Analog Signal Wiring

4.3 HOW TO DISABLE THE SLEEP FUNCTION

To disable the sleep function; turn off the meter, then turn on the meter while pressing the Low button. Keep it pressed until you see the display go through the self test and then show "no SLP". Upon releasing the Low button, you will see the calibration codes and then the normal operation of the display.

SECTION 5 CALIBRATION

The user may want to change the calibration codes for several reasons:

- The calibration codes on the sensor probe and the RH411 do not match.
- A replacement probe is being used, and the calibration codes must be changed to match.
- You want the RH411 to more closely match the readings of another instrument.
- You want to perform your own recalibration. In this case, go through Section 5.2, Instrument Calibration.

5.1 HOW TO SET CALIBRATION CODES ON THE RH411

Before changing the calibration codes, examine the probe and find the 2-digit RH code and the 1-digit temperature code. These codes must match the codes displayed on the meter. To change the calibration codes, go through the following steps.

NOTE

The following 6 steps are also necessary to input codes needed for doing a general recalibration of the RH411 (not only for calibrating known probe calibration values to the RH411).

1. Turn the power switch off.
2. Press the Reset button at the same time as turning on the meter. The display shows "ch cod" after the display self test. Remove your finger from the Reset button. Next, the calibration code is shown with only the left-hand digit of the RH code blinking.
3. To change the flashing digit: *increase* it by pressing the High button. Holding down the button causes the digit to cycle faster, from 0, 1, 2 through 8, 9, A, b, and c. Set it to agree with the code on the probe handle.
4. *Decrease* it by pressing the Low button. Holding down the button causes the digit to cycle faster from c, b, A, 9, 8 down through 2, 1, and 0. Set it to agree with the code on the probe handle.
5. After the 1st digit is changed, press the Reset button. This starts the blinking of the 2nd digit of the RH code. Using the High & Low buttons, change the digit as necessary.
6. Press Reset a third time to activate the blinking of the temperature code. After changing the temperature code as necessary, press and hold the Reset button until the normal operating display is shown.
7. The temperature and RH codes on the display should now match the codes on the probe handle. If they don't, repeat steps 1-6.

O Highest
C Lowest

5.2 GENERAL INSTRUMENT CALIBRATION

NOTE

The following calibration procedure should be performed by a qualified technician.

If you have access to accurate temperature and humidity calibration equipment, you may want to calibrate the instrument on your own.

FIRST YOU CALIBRATE THE RH411 IN A "HUMID" ENVIRONMENT

1. Set up the RH411 with the temperature/humidity sensor in a sealed jar with saturated salt of the appropriate concentration as shown in Figure 5-1.

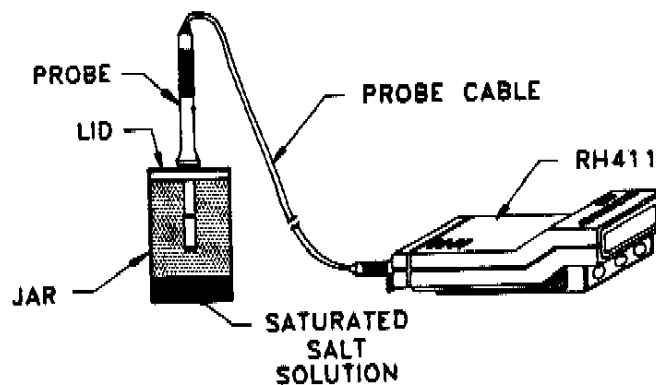


Figure 5-1. Calibration Setup

2. To calibrate humidity, first place the probe in a saturated salt environment (jar) of 33% RH using magnesium chloride. If you are not experienced with saturated salt solutions you will not obtain good results. If you are experiencing difficulty, contact OMEGA Engineering. After the probe reading reaches equilibrium (after 1 hour), take a reading.

If the reading is TOO LOW by n counts, the first digit of the humidity code needs to be DECREASED by n counts. If the reading is TOO HIGH by n counts, the first digit of the humidity code needs to be INCREASED by n counts.

For continuity, go from example 1 to example 3, or example 2 to example 4 after reading step 3.

EXAMPLE 1: you obtain a reading of 31. The error is -2 since 31 is 2 counts lower than 33. The initial humidity code being 87 has to be reduced to 67 (just change the first digit). For more clarity, see the following.

READING IN 33% ENVIRONMENT	HUMIDITY CODE	ERROR	CORRECTED HUMIDITY CODE IN 33% "HUMID" ENVIRONMENT
31	87*	-2	67*

* the first digit is flashing and changes in this case.

EXAMPLE 2: you obtain a reading of 37. The error is +4 since 37 is 4 counts higher than 33. The initial humidity code being 65 has to be increased to A5 (just change the first digit). For more clarity, see the following.

READING IN 33% ENVIRONMENT	HUMIDITY CODE	ERROR	CORRECTED HUMIDITY CODE IN 33% "HUMID" ENVIRONMENT
37	65*	+4	A5*

* the first digit is flashing and changes in this case.

Change the first digit before proceeding to the next step, since a change in the first digit affects readings throughout the range. Go through Section 5.1 to set the calibration codes in the RH411. Check to see that the reading is 33. If it is not, adjust the first digit of the code again.

- Next place the probe in a saturated salt environment of 75% RH using Sodium Chloride (NaCl). After the probe equalizes, (after 1 hour), take a reading.

If the reading is too low by n counts, the second digit of the humidity code needs to be decreased by n counts. If the reading is too high by n counts, second digit of the humidity codes needs to be increased by n counts.

EXAMPLE 3: you obtain a reading of 72. The error is -3 since 72 is 3 counts lower than 75. The initial humidity code being 67 (from example 1) has to be reduced to 64 (change the second digit). For more clarity, see the following.

READING IN 75% ENVIRONMENT	HUMIDITY CODE	ERROR	CORRECTED HUMIDITY CODE IN 75% "HUMID" ENVIRONMENT
72	67*	-3	64*

* the second digit is flashing and changes in this case.

EXAMPLE 4: you obtain a reading of 76. The error is +1 since 76 is 1 count higher than 75. The initial humidity code being A5 (from example 2) has to be increased to A6 (change the second digit). For more clarity, see the following.

READING IN 75% ENVIRONMENT	HUMIDITY CODE	ERROR	CORRECTED HUMIDITY CODE IN 75% "HUMID" ENVIRONMENT
76	A5*	+1	A6*

* the second digit is flashing and changes in this case. A change in the second digit does not affect readings at 33% and lower. Check to see that the reading is 75. If it is not, adjust the second digit of the code again.

NEXT YOU CALIBRATE THE RH411 IN A "TEMPERATURE" ENVIRONMENT

4. To calibrate temperature, set the instrument to °F (DO NOT USE °C) and place the sensor probe in a known, stable environment between 60°F and 90°F. Read the display after allowing the probe to reach equilibrium after a 15 minute warm-up period.
5. If the reading is too low by n counts, the temperature code (third digit of the calibration code to the right side of the display) needs to be decreased by n counts. If the reading is too high by n counts, the temperature code needs to be increased by n counts.

Changing the temperature code will not affect the humidity calibration. Refer to Section 5.1 to change the calibration codes.

SECTION 6 SPECIFICATIONS

TEMPERATURE

	RANGE	ACCURACY	
RANGE:	0°F to 120°F -18°C to 49°C	±1°F ±1°C	
SENSOR:	Solid State		
RESPONSE TIME:	STILL AIR	WAVING GENTLY	RESPONSE
	3 minutes	20 seconds	for 63% of a step change
	7 minutes	40 seconds	for 90% of a step change
	10 minutes	60 seconds	for 98% of a step change
DISPLAY RESOLUTION:	1°F/1°C		

HUMIDITY

	RANGE	ACCURACY	
RANGE:	5% - 20% 20% - 90% 90% - 99%	±5% at 25°C ±3% at 25°C ±5% at 25°C	
SENSOR:	Resistive polymer Sensor should not be used in prolonged condensation		
RESPONSE TIME:	STILL AIR	WAVING GENTLY	RESPONSE
	25 seconds	15 seconds	for 63% of a step change
	50 seconds	35 seconds	for 90% of a step change
	90 seconds	60 seconds	for 98% of a step change
DISPLAY RESOLUTION:	1% RH		

SPECIFICATIONS (Cont'd)

DISPLAY

TYPE:	Liquid Crystal Display
DISPLAY MODES:	Switchable between °C and °F.
SIZE (VIEWING AREA):	2.36" x 0.71" (60mm x 18mm)
(CHARACTER SIZE):	0.43" (11mm) high

ELECTRONICS

TYPE:	Microprocessor-controlled and linearized HI and LO peak hold for both temperature and humidity
OPERATING TEMPERATURE:	0°F to 120°F, (-18°C to 49°C)
CONDITIONS:	0-90% RH non-condensing
ANALOG OUTPUT:	10 mV/RH, 10mV/F $\pm$ 10 mV connected to >47k Ω impedance
BATTERY LIFE:	100 hrs for an alkaline battery

POWER SOURCE

DC BATTERY:	9V battery
AC ADAPTOR:	120VAC/60 Hz to 12VDC adaptor

DIMENSIONS

METER:	3.19"L X 2.36"W X 7.09"D (81mm x 60mm x 180mm)
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WEIGHT:	(14 oz approx.)
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