Series 836

1/4 DIN Digital Indicating Relative Humidity Controller

User's Manual

Watlow Controls, 1241 Bundy Blvd., Winona, MN 55987 507/454-5300, Fax: 507/452-4507

W836-DA10-8828
July, 1988
Supersedes: WWM-116
General Description

The Watlow Series 836 is a 1/4 DIN digital indicating relative humidity control with humidity and dehumidify outputs. The control mode is either dual PID or dual ON/OFF. All control parameters are user adjustable, with a LED display for direct readout of %RH or set point. A plug-in design simplifies installation and maintenance.

Input options include the Watlow wet/dry bulb RH sensor which uses a Type "E" thermocouple and a thermistor, or a millivolt input version with the capability to interface with a sensor or transducer that has a scaled millivolt output. Both versions have scaled analog outputs and set point input to interface with a ramping programmer or other instruments.

Dead band (Set II) is front panel adjustable while control parameters are internally adjustable.

Specifications

Control Mode

Dual PID:
- Proportional band: 5 to 50% RH, internal adjust for both outputs. Independent adjustments for each output.
- Reset: 0.05 to 0.5 repeats per minute, internal adjust for both outputs.
- Rate: 0 to 5 minutes, internal adjust for both outputs.
- Cycle time: 2 to 20 seconds, internal adjust for both outputs. Independent adjustments for each output.
- Dead band: 0 to 10% RH, front panel adjust.

Dual ON/OFF:
- Sensitivity adjust: 1 to 5% switching hysteresis, internal adjust for both outputs. Independent adjustments for each output via proportional band pots, which act as sensitivity adjustments.

Operator Interface
- 1/2" LEDs displaying process input value and, when setpoint knob is depressed, primary set point value.
- Optional display of dead band (Set II, deviation above primary set point).
- Display range: 0 to 100% RH.

Input
- %RH process input from sensor or mV signal.
- RH sensor input version: Wet/Dry bulb, from Watlow, #S005-0011-0000 or S005-0015-0000
- Input (cont.)
  RH sensor, using Type "E" thermocouple and a thermistor.
- MV input version: 5mV/digit from customer-supplied source.
- MV set point input, (from programmer or another control), 5 mV/digit.

Indication
- Linearized mV output corresponding to input signal, 5mV/digit.

Output

Control
- Primary (Humidify) and Secondary (Dehumidify).
- Dual triac, 1A @ 240VAC, zero-crossed switching, 1mA min. load.
- Dual switched DC, 5mA min. @ 1K load.

Accuracy
- Calibration Accuracy: ± 1% wet/dry RH at 77°F±5°F, (25°C ± 3°C) ambient & rated line voltage ± 1%.
- Linearization Accuracy: Refer to the Typical Error Chart, Chart 1.
- MV Signal I/O: ± 0.25% of span.
- Temperature Stability: ± 2μV / °F, (3.6μV/°C) ambient.
- Voltage Stability: ± 0.01% of span/% of rated line voltage.

Terminals
- #6 screws on barrier strip.

Power
- 120/240 VAC ± 10%, 60Hz ±5%.
- 110/220 VAC + 10% - 5%, 50Hz ±5%.
- 6VA power consumption.

Operating Environment
- 30 to 130°F/0 to 55°C.
- 0 to 90% RH, non-condensing.

Dimensions
- Height: 3.8 in. (96.52 mm)
- Width: 3.8 in. (96.52 mm)
- Behind panel depth: 6.0 in. (152.40 mm)
- Weight: 1.9 lb. (0.86 kg)

Related Devices:
- Extender #Z100-0423-0000 to facilitate installation and tuning.
- Sensor %RH, #S005-0011-0000 (-40 to 120°F)
- Sensor #S005-0015-0000 (-125 to 375°F).
- Thermistor Sensor #0800-0025-0000 for #S005-0011-0000.
- Thermistor Sensor #0800-0057-0000 for #S005-0015-0000 (-125 to 375°F).
Control
Series 336 = Digital indicating closed loop %RH control; dual PID or ON/OFF; dual outputs; 1/4 DIN.

Output
A = Triac, 1A
B = Switched DC

Control Mode
1 = Dual 3-mode (PID)
2 = Dual ON/OFF

Input
500 = Wet/Dry Bulb Sensor
700 = MV Signal (5mV/digit input)

Set Point II
1 = Deviation, not displayed
2 = Deviation, displayed

Typical Error Chart

<table>
<thead>
<tr>
<th>RH</th>
<th>40</th>
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Chart 1 - RH Linearization Chart

The Relative Humidity indicator will be within the tolerance indicated when temperature depression information for the psychrometric tables is converted to a $\mu$V input and connected to the input.

WATLOW Series 836 User's Manual
Figure 1 - Series 836 Case Dimensions

Figure 2 - Mounting Requirements
WARNING:

To avoid potential electric shock, use National Electric Code safety practices when wiring and connecting this unit to a power source and to electrical sensors or peripheral devices.

All wiring and fusing should conform to the National Electric Code and to any locally applicable codes also.

Figure 3 - 120 VAC Power Wiring

Figure 4 - 240 VAC Power Wiring
Input Wiring

Wire your unit according to the figures showing the correct input.

MV Input
Terminal Designations

9.  
10.  
11.  Not used  
12.  
13. Set point (+) out  
14. Programmer (+) in  
15. MV (+) input  
16. MV (-) input

Figure 5 - MV Input (836X-X700-0X00)

Wet/Dry Bulb Sensor Input
Terminal Designation

9. S1 (T/C -, Red)  
10. S2 (T/C +)  
11. S3  
12. S4 Thermistor  
13. Set point (+) out  
14. Programmer (+) in  
15. Signal conditioner (+) out  
16. Circuit common (-)

Figure 6 - Wet/Dry Bulb Sensor Input (836X-X500-0X00)
Output - Terminals 1 through 8

Wire your unit according to the figures showing the correct output.

**WARNING:**
All wiring and fusing must conform to the National Electric Code NFPA70.
Contact your local board for additional information. Failure to observe
NEC safety guidelines could result in injury to personnel.

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**Figure 7 - 1A Solid State Output (836A-XXXX-0X00)**

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**Figure 8 - 12VDC Output (836B-XXXX-0X00)**
NOTE:
If you are using the programmer input, remove the internal jumper wire W-110 or the 836 will not function correctly. See Figure 11.

Figure 9 - Remote set point (with programmer)

Figure 10 - Local/remote set point (with programmer)

NOTE:
Use dry circuit for SW1 (SW1 customer supplied)

Programmer Input Jumper Locations

CAUTION:
This jumper is soldered onto the printed circuit board. It must be removed when using a programmer input, or the 836 will not function correctly.

Figure 11 - Series 836 Jumper Location
NOTE:
All fuses must be selected for proper protection in a given application.

Figure 12 - Series 836 System Wiring Example
Wet Bulb/Dry Bulb Field Calibration Procedure

NOTE:

This calibration information is provided as a service. Proper field calibration can be achieved by following this procedure. If your control is in warranty, that warranty will be void if this field calibration is performed improperly.

836X-X500-0X00

Wet Bulb/Dry Bulb Input
% RH Range: 0-100% RH
Scale Factor: 5mV/LSD

Equipment Required:
- Precision millivolt source.
- 100K decade box.
- Digital voltmeter (DVM).

Procedure:

1. Connect the millivolt source to input terminals 9 (+) and 10 (-). Connect the decade resistance box to thermistor inputs 11 and 12.

2. Set the decade resistance box to 76.429KΩ. Set the millivolt source to 0.000mV. Connect the DVM to terminals 12 (+) and 10 (-). Adjust the 0% RH pot for 0000 + 5mV on the DVM. Set the "100% Max" pot full clockwise. See Figures 13 and 14 for potentiometer locations.

3. Connect the DVM to terminals 15 (+) and 16 (-). Set the millivolt input to + 0.622mV. Set the decade resistance box to 45.494KΩ. Adjust the 10% RH pot for an indication of 0.05 ± 0.002VDC on the DVM. Adjust the Zero pot for 10 on the display of the control.

4. Set the millivolt input to 0.000mV. Adjust the 100% RH pot for an indication of 0.500V ± 0.002VDC on the DVM. Adjust the FS (Full Scale) pot for 100 on the display of the control.

5. Repeat Steps 3 and 4 until all of the above readings are correct with no further adjustments necessary.

6. Set the mV input to 0.622 mV. Adjust the 100% Max pot for an indication of 0.5V on the DVM, and 100 on the display of the control.

7. Set the millivolt input to 0.316mV, the control display should read 050 ± 1.

Figure 13 - Series 836 Potentiometer Locations (right side)

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NOTE:

This calibration information is provided as a service. Proper field calibration can be achieved by following this procedure. If your control is in warranty, that warranty will be void if this field calibration procedure is performed improperly.

836X-X700-0X00

Millivolt Signal Input
mV input: 0 to 500mV

Equipment Required:
- Precision millivolt source.
- Digital voltmeter (DVM).

Procedure:

1. Connect the millivolt source to input terminals 15 (+) and 16 (-).

2. Set the millivolt source to 0.00mV. Adjust the Zero pot for 000 on the display of the control. See Figures 13 and 14 for potentiometer locations.

3. Set the millivolt source to 500mV. Adjust the FS pot to 100 on the display of the control.

4. Repeat Steps 2 and 3 until all of the readings are correct with no further adjustments necessary.

5. Set the millivolt source to 250mV. The display should read 050 ± 1.

Figure 14 - Series 836 Potentiometer Locations (left side)
Tuning Procedure for Time Proportioning Controls with Auto Reset and Rate

836X-1XXX-0X00

Initial Settings:
1. Humidity and dehumidify cycle time: Turn maximum counter clockwise (CCW).
2. Humidity and dehumidify proportional band: Turn maximum clockwise (CW).
3. Rate: Turn maximum CCW.
4. Reset: Turn maximum CW.
5. Set II (Dead Band): Turn maximum CCW.

See Figure 14 on Page 11 for potentiometer locations.

Proportional Band Adjustment

Humidity Proportional Band Adjustment
Follow the same procedure as above, except enable the Humidity function, disable the De-humidify function, and adjust Set I for the most commonly used humidify RH. Use the H-PB (Humidity-Proportional Band) potentiometer.

Humidity and Dehumidify Combined Proportional Band Adjustment
Enable both humidity and dehumidify functions. Adjust Set I for the most commonly used humidify and dehumidify RH settings. Fine tuning of the proportional band adjustments D-PB and H-PB may be necessary if hunting occurs on either humidify or dehumidify.

Rate Adjustment
Rotate the Rate pot 1/4 turn CW. Increase the set point 20-30% RH, and observe the approach to set point. Decrease the set point 20-30% RH, and observe the approach to set point. If the load temperature overshoots, repeat the Rate Adjustment procedure until optimum approach to set point is achieved.

If the Rate pot is advanced too far, the system will be overdamped and approach to set point will be very sluggish.
Reset Adjustment
Adjust Set I for 50% RH. A slow setting (0.05 CCW repeats/min.) requires long periods of time for the RH to reach set point. If the reset time is set too fast (0.5 CCW repeats/min.), the system may become unstable and oscillate about set point RH.

To adjust reset time, rotate the Reset pot 1/4 turn CCW and observe stability. Continue adjusting CCW until the system becomes unstable. Rotate CW very slowly to gain stability.

Set II (Dead Band) Adjustment
The dead band is adjustable from 0-10% RH. Slowly adjust Set II dead band while observing the humidify and dehumidify LED. Set II dead band should be adjusted so that humidify and dehumidify are not alternately energizing. Ideal control is when the RH can be maintained without interaction of humidify and dehumidify.

Cycle Time Adjustment
Best control is usually achieved with faster cycle times. However, if a mechanical contactor or solenoid is used to switch power to the load, slower cycle times may be desirable to minimize the wear on the mechanical components. Turn Humidify or Dehumidify Cycle Time pot CW for slower cycle times.

Tuning Procedure for ON/OFF Controls

836X-2XXX-0X00

Initial Settings:
1. Set H-PB and D-PB pots to midpoint.

Switching Sensitivity Adjustment
This may be adjusted 1% CCW to 5% CW. Pot H-PB is the sensitivity adjustment for humidify. D-PB is the sensitivity adjustment for dehumidify. If a narrow temperature differential is desired, set these pots CCW. If the temperature differential is not critical, adjust these pots CW to increase the life of the mechanical contactors.

The adjustment for Set II (Dead Band) for the ON/OFF version is the same as that of the Tuning Procedure for Time Proportioning Controls with Auto Reset and Rate.

⚠️ NOTE:
PID setup in a complex system is not a five minute task, but may require an eight hour day, depending on the thermodynamics of the system. A chart recorder is recommended for observing RH changes.

All PID settings should be made at nominal RH settings. The PID settings may require fine tuning when operating at different RH. The same PID settings will work in all identical environmental chambers, once the optimum PID settings have been established.
1. **Proportional Band** - In a simple time proportional control system, when the actual process RH is below set point and outside the proportional band limit, 100% power is applied to the load.

When the actual process RH is above set point and outside the proportional band limit, 0% power is applied to the load.

When the actual process RH is within the proportional band, the controller will proportion the amount of power applied to the load, 0 to 100%.

2. **RH Droop** - Phenomenon that occurs in a proportional control system without reset. As the proportional band is increased, the average process RH may drop or rise to a point that is not the set point RH. This action takes place even though the load has stabilized.

3. **Automatic Reset (Integral)** - Used in proportional control systems to automatically pick up any system droop. Normally this action is adjustable, and adjusts the time for reset to obtain agreement between actual process RH and controller set point.

4. **Rate (Derivative)** - Action that anticipates the rate of actual process RH rise and automatically widens the proportional band to prevent overshoot. Returns the proportional band to the static adjustment when the set point RH is stable within the static band boundaries.

5. **Switching Sensitivity or Differential** - The output will de-energize when the actual RH reaches the set point RH. The switching sensitivity or differential is the drop in RH required to re-energize the output.

6. **ON/OFF** - The output is turned full ON below set point and stays turned ON until the process RH reaches set point, then the controller turns the output full OFF. At this point, depending on the design of the system, the process RH will overshoot the set point RH by some degree.

As the RH drops down below set point (an amount equal to the switching sensitivity or differential) the output is once again turned full ON.

7. **Zero-Crossed Switching** - Load is activated only during the time period that the sine wave (see Page 12) is going through zero. This eliminates RFI and EMI radiation (applies to solid state outputs only).

8. **Dead Band** - A band between humidification and dehumidification functions where no output action occurs.

9. **Oscillation or Hunting** - Occurs when the proportional band is too narrow or the system is upset by some outside source. The actual process RH is not controlled within the proportional band on its extreme RH excursions.

Load RH may never stabilize. Control is either full ON or full OFF, not within the proportional band.

10. **Cycle Time** - Time interval between consecutive ON sequences. For example, at a setting of 2 seconds, 25% power is required to maintain load RH at set point. Power will be applied for 1/2 second every 2 seconds.

11. **Anti Reset** - Inhibits reset action when the actual process RH is outside the proportional band.

12. **Dew Point** - The temperature at which condensation first occurs when a vapor is cooled.

13. **Relative Humidity** - Ratio of the quantity of water vapor in the atmosphere, to the quantity which would saturate at the existing temperature.

14. **Music Notes** - Musical notes are used to alert you to important details.

15. **Stop Sign** - The Stop Sign alerts you to "WARNING," a safety hazard which could affect you and the equipment.

16. **Deer Crossing Sign** - The Deer Crossing Sign alerts you to a "CAUTION," a safety or functional hazard which could affect your equipment or its performance.
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<tr>
<th>Problem</th>
<th>Probable Cause</th>
<th>Action</th>
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<td>No display.</td>
<td>The A.C. Input is not connected or is connected improperly.</td>
<td>Check the A.C. input connections. If not present or correct, connect per Line Voltage Wiring. See Page 5, Figures 3-4. If present and correct, return the unit to the factory.</td>
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<td>The display continuously indicates 0 or 100% RH.</td>
<td>1. An open sensor.</td>
<td>Repair or replace.</td>
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<td>2. The polarity is reversed on the thermocouple input.</td>
<td>Connect per Wiring by Input Type. See Page 6, Figures 5-6.</td>
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<td>3. A faulty sensor.</td>
<td>Repair or replace. Refer to the Watlow Demonstration Bottle Wet Bulb/Dry Bulb Sensor Data Sheet, WDMS-DA10-8827</td>
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<tr>
<td>A display error.</td>
<td>1. A poor sensor connection.</td>
<td>Check the sensor location and the sensing element.</td>
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<td>2. Faulty sensor.</td>
<td>Repair or replace.</td>
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<td>Poor humidity control.</td>
<td>The load temperature is unstable.</td>
<td>Adjust the proportional band, cycle time, reset, and rate per the Tuning Procedure. See Page 12 and 13. Temperature control must be stable to achieve proper control of Relative Humidity.</td>
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<tr>
<td>The load will not turn ON.</td>
<td>1. An open sensor.</td>
<td>Repair or replace.</td>
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<td>2. Check the fuses, circuit breakers and the load.</td>
<td>Repair or replace.</td>
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<td>3. The load LED will not turn ON.</td>
<td>Return the unit to the factory.</td>
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<td>Cannot control the unit with the external programmer.</td>
<td>Improper wiring.</td>
<td>Remove jumper W-110. See Programmer Input Jumper Locations, Page 8, Figure 11.</td>
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Returns

The Watlow Series 836 is warranted to be free of defects in material and workmanship for 18 months after delivery to the first purchaser for use, providing that the units have not been misapplied.

Since Watlow has no control over their use, and sometimes misuse, we cannot guarantee against failure. Watlow’s obligations hereunder, at Watlow’s option, are limited to replacement, repair or refund of purchase price, and parts which upon examination prove to be defective within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse or abuse.

Warranty

The following procedure applies for any products returned to the factory:

1. You must call Watlow Customer Service, 507/454-5300, for a Return Material Authorization (RMA) number before returning any item for repair. We need this information:
   - Ship-to address
   - Bill-to address
   - Contact name
   - Phone number
   - Ship via
   - Your P.O. number
   - Symptoms and/or special instructions
   - Name and phone number of person returning the material.

   We will not accept a return without an RMA number. The RMA number must appear on the outside of the carton and on all paperwork. Cartons without RMA numbers will be returned. Ship on a freight prepaid basis.

2. You need prior approval and an RMA number from the Customer Service Department when you are returning an unused product for credit. Also, we must apply a 20 percent restocking charge for all returned stock controls and accessories.

3. After we receive your return, we will examine it to determine the cause for your action.

4. In cases of manufacturing defect, we will enter a repair order, replacement order or issue credit for material.

5. If the unit is unrepairable, we will return it to you with a letter of explanation. Repair costs will not exceed 50 percent of the original cost.

Shipping Claims

When you receive your Watlow control, examine the package for any signs of external damage it may have sustained enroute. If there is apparent damage either outside the box or to its contents, make a claim with the shipper immediately. Save the original shipping carton and the packing material.

Watlow Controls

Watlow Controls is a division of Watlow Electric Manufacturing Company of St. Louis, Missouri. Watlow is an established manufacturer of industrial electric heating products, in business since 1922. Watlow boasts the ability to begin with a full set of specifications and to complete an industrial product that is manufactured totally in-house, in the U.S.A. Products designed and manufactured by Watlow are electric heating elements, sensors, electronic temperature controls and power switching devices.

The Watlow Controls operation has been designing solid state electronic control devices since 1962, and has earned the reputation as an excellent supplier to original equipment manufacturers. These OEMs depend upon Watlow Controls to provide compatibly engineered controls which they can incorporate into their products with confidence.

Watlow Controls resides in a 100,000 square foot marketing, engineering and manufacturing facility in Winona, Minnesota.
Watlow Demonstration Bottle
Wet Bulb/Dry Bulb Sensor
Data Sheet

**General Description**
The Watlow RH Demonstration Sensor is a classic wet bulb/dry bulb sensor. Used in conjunction with several Watlow controls, the demonstration sensor utilizes a Type "E" thermocouple for wet and dry temperature differential, and a thermistor for a dry bulb temperature reference.

The thermocouple and thermistor are connected to a common sensor terminal block. A 100% cotton wick provides sufficient capillary action for operation of the wet bulb sensor.

**Specifications**

- **Differential T/C**
  - Type E thermocouple for Wet/Dry temperature differential.
  - Thermistor for Dry temperature reference.
  - Common sensor terminal block.
  - Connection via 4 wire copper cable.
  - 100% cotton wick for Wet bulb.

- **Normal Operating Temp:** 40 to 180°F (4 to 82°C)
- **Demonstration Version,** complete with water bottle.
  - Height: 5 in.
  - Diameter: 2 in.
  - Cable Length: 10 ft.
  - Ambient Extremes: -112 to 302°F (-80 to 150°C) for dry bulb thermistor sensor.
  - -20 to 221°F (-29 to 105°C) for wet bulb.

- **Hi Temp Version**
  - Terminal Block: 1.8 in. x 0.6 in. x 0.5 in. high
  - Cable Length: 3 ft.
  - Thermocouple: 10 in. lead length
  - Wick Length: 6 in.
  - Ambient Extremes: -112 to 482°F (-80 to 250°C) for dry bulb thermistor sensor.
  - -20 to 221°F (-29 to 105°C) for wet bulb.

**Ordering Information**

- **RH Sensors, Wet/Dry Bulb**
- **Differential T/C**
  - S005-0011 = Demonstration Bottle
  - S005-0015 = Hi Temp

**Operation**
The Watlow Wet Bulb/Dry Bulb RH sensor utilizes the same principle as the sling psychrometer used in physics laboratories. The wet bulb temperature is a function of the cooling effect produced by the evaporation of water from the wick. The amount of evaporation is directly related to the relative humidity of the ambient air. While the wet/dry temperature differential is proportional to % RH, the proportion changes as the ambient temperature changes. Therefore, the Watlow demonstration sensor has a separate thermistor to accurately sense ambient temperature.

**System Design**
Wet/Dry sensor performance depends on design and installation factors such as adequate wicking action and air flow.

Good wicking requires clean, 100% cotton wicks and clean water, all factors to ensure that the capillary action is sufficient to supply the wet bulb with the quantity of water necessary for evaporation. Also, the wick should not be kinked or pinched which would restrict capillary action. Distilled, but not de-ionized, water is recommended.

De-ionized water should not be used because it can become aggressive toward stainless steel and begin to erode the steel. This leaves deposits in the wet sock.

Air flow over the wet bulb is required to evaporate the water and the volume must be sufficient to evaporate the maximum quantity (which varies with the ambient %RH and temperature). The air should flow over the wet bulb after passing the reference junction or ambient sensor, in this case the thermistor. The air immediately downstream of the wet bulb is cooler than ambient.

**Related Devices:**
- Wick, cotton: #0830-0111

**NOTE:**
Ambient extremes are the minimum and maximum temperature the components of the wet bulb/dry bulb sensor can withstand. When operating below 32°F or above 212°F (0°C or 100°C) the water must be drained form the system.

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Set Up

Areas to be aware of when designing an RH system.

- If you're using the sensor and wick without the demonstration bottle, a constant water level has to be established; i.e., using a tray with a float and the wick located in the tray.

- Set up a positive air flow over the sensing elements (600 ft./minute minimum). The wet junction should be isolated from the dry junction to prevent the air coming over the wet sock from affecting the dry junction temperatures.

- Allow enough wick exposed to the moving air to get the proper depression temperature, 1-1/2" to 2" depending on the application.

- The wick should have sufficient capillary action to keep the wet junction wet. A 100% cotton wick should be used.

- The portion of the wick, below the wet junction, should not have anything tight around it which would restrict capillary action.

- The wet junction should have a good contact with the wick.

- The length of the Type "E" TC wire should be long enough to prevent the temperature of the dry junction from affecting the wet junction as a result of the thermo conductivity of the wire (>12').

- The water tray should preferably be made of plastic so the wet bulb junction is not partially grounded through the water as it would be with a metal container to chassis ground.

Maintenance

The wet sock and water source for the wet junction require periodic maintenance.

- The sock should be washed out on a regular basis. A sock that is dirty or contaminated with deposits from the water will have capillary action reduced, thus limiting the amount of water getting to the wet junction. The wick should be washed in a solution of 50% vinegar/50% water, and rinsed in distilled water. A sock that can't be cleaned up should be replaced.

- The water must be maintained! Keep the water system clean and fill with distilled water when necessary. Do not use de-ionized water. Care should be exercised when working with the sensor. The people maintaining a sensor should be instructed on how to remove and re-install the sock keeping the distances correct for that particular application.

Figure 1 - Demonstration Bottle Wiring