

# Surface Patrol™ HD

## User's Manual



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# Installation Instructions for Surface Patrol HD

## Introduction

Surface Patrol HD consists of:

- An infrared temperature sensor (Probe) that measures road surface temperature.
- A dew point, relative humidity, and ambient air temperature sensor
- A digital display that presents information from the sensors

The sensors are mounted outside the vehicle and are connected to the digital display that is mounted inside the vehicle. It is important to make sure that the sensors and the display mounted in a manner that will not interfere with safe vehicle operations. Please familiarize yourself with the manual prior to equipment installation.

In addition to temperature readings, the digital display can produce audible and visual indicators that are configurable based upon user preferences. For example, you can be informed that surface temperature is within a temperature range of your interest. Please familiarize yourself with both types of indicators so that you will be able to set them based on your preference. You may select either type of an indicator or to avoid distraction while driving completely disable both of them. Likewise, the display itself has two modes of operation, normal and dimmable. The settable indicators are there to help you to achieve your objectives, while driving safely.

## General Information

The system requires 12 VDC power supplied with the correct polarity as noted on the back of the digital display above the terminal strip positions noted with (+) for positive and (-) for negative polarity. It is recommended the power be connected to one of the vehicle's ignition switched power lines. However, this is not required because the current draw for this system is in the 20 mA DC range and load is minimal.

**NOTE:** If you choose to power the unit through the cigarette lighter a power converter is required. You will then need to cut and strip the wires. Then follow the instructions above.

After installation of the unit, there is a final temperature calibration test and possible adjustment. You may wish to check calibration before installation. You may find it easier to do the calibration before the infrared housing is mounted to your vehicle. Power the sensor, following the directions above, either with a nine volt battery or an AC adapter that can be plugged in a wall outlet.

**NOTE:** Allow the sensor to warm for 20 minutes before calibrating the unit. Additionally, calibrate the sensor only after the sensor has been in a relatively stable ambient temperature. For example, never calibrate the sensor in a heated garage or shed after being outside all night/day.

## **Installation Instructions**

### **I. Mounting the Surface Temperature Sensor Probe**

The sensor is an optical device. It must be pointed to the surface at a ninety degree angle. At (3) three feet, the circle diameter is approximately (1) one inch and at (6) six feet approximately (2) two inches. The physical mounting height or distance does not affect the accuracy of temperature readings. The sensor "sees" a circular target. The sensor probe should be kept away from any heat source that could cause inaccurate readings, i.e. vehicle's exhaust.

The optimum location for mounting the probe unit is "upwind" of the engine block. If not, at times heat from the engine will pass between the sensor and the pavement causing temperature spikes. The best location for mounting is behind the front bumper on snow plows and on the front of the front bumper on non-plow vehicles. Other locations are acceptable but may induce error from time to time during operation.

A. Do not mount the unit directly over tire tracks, vehicular traffic lanes will read higher than adjacent road surfaces

B. Recognize that the infrared signals received by the sensor are in the form of a conical shape, like an inverted flashlight. This requires the unit to be mounted so that it "sees" a clear view of the circular target.

C. Avoid hot engine surfaces, exhaust pipes and any obstruction between the sensor and the road surface.

D. The connecting cable is slightly over (18) eighteen feet in length, which limits the distance between the sensor head and the electronic display, which must be located inside the vehicle's cab. E. The self-contained mounting bracket requires drilling holes for the appropriate mounting location chosen for your vehicle.

### **II. Digital Display**

The digital display is a dual LED (Light Emitting Diode) display powered by the vehicle battery. One display is for surface temperature and relative humidity and the other is for ambient air temperature and dew point.

Mounting options are numerous; the primary concerns should be safety and ready visibility for the driver.

The display is powered from the ignition switch (see attached diagram). A light wire, 20 or 22 gage is adequate. Less than 50 mA DC is required.

### **III. Ambient/Dew Point Sensor**

The Surface Patrol HD relative humidity and dew point sensor is designed to work on all types of vehicles.

There are two types of mounting options that are supported:

- Mirror Mount

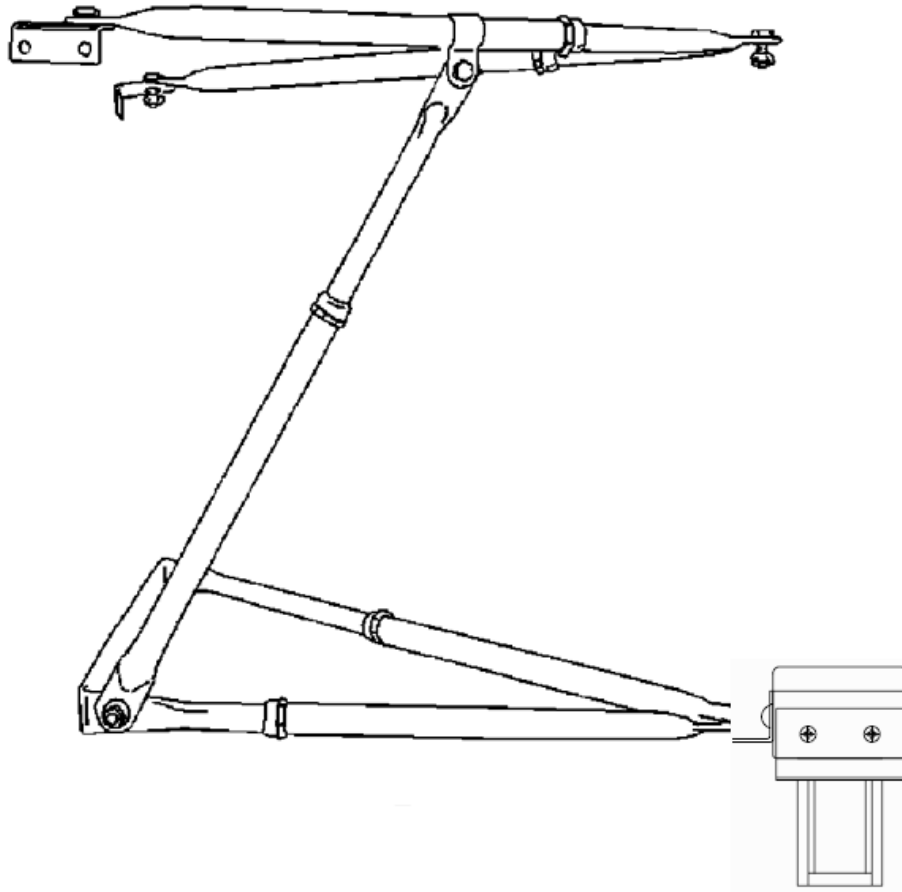
- Hood Mount

When mounting the unit on a vehicle, consideration must be given to the mounting location to insure optimal performance. The unit should not be exposed to external heat sources such as from engine exhaust or directly over surfaces that radiate heat in direct sun light. The sensor is manufactured to work on all types of weather but should not be installed in locations prone to excessive road debris or contaminants.

The procedures for using these mounting options are described in the following sections.

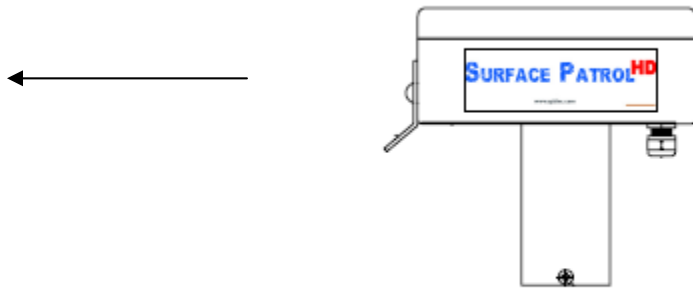
### *Mirror Mount*

Using the supplied mirror mount bracket the housing can be mounted to the driver's side mirror on the commonly used west coast style mirror mount as shown in Figure 1.



**Figure 1 - Mirror Mount**

When installed the unit must face forward to allow for adequate airflow while vehicle is in motion. The direction of vehicle travel is shown by the arrow in Figure 2.



**Figure 2 - Direction of Travel**

### *Hood Mount*

An alternative universal mount can also be used. This type of mount is useful for mounting to a smaller vehicle such as a pickup truck, but may also be used on larger vehicles if required. The bottom of the mount has a small flange that can be attached to the inside lip of the vehicle fender with screws or shimmed and held in place by merely closing the vehicle hood as shown in Figure 3. It can also be used to mount the unit to the top of the vehicle such as on a light bar or ladder rack.



**Figure 3 - Hood Mount**

The sensor requires no calibration or setup. While in use, periodic checks may be required if used during heavy snowfall that may cover the front of the unit, in such a case airflow to the sensor could be obstructed and cause the unit to react more slowly. If required, the unit may be cleaned by simply washing the housing and allowing it to dry or driving the unit and allowing it to air dry.

Performance of the unit may degrade over time if exposed to extreme amounts of chemicals, dust, or other contaminants. In these cases, the filter and/or the sensor element can be easily replaced by following the sensor/filter replacement instructions in the Sensor/Filter Replacement section.

#### **IV. Surface Temperature Sensor Final Calibration & Test**

A primary use of Surface Patrol HD is to identify temperatures at the point of freezing. Therefore, final check out should confirm operation at this temperature. Recommended procedure is to fill a cup with chopped ice, then fill with cold water. After a few minutes this will provide a surface temperature of approximately 32 °F when the cup is placed directly at the end of the sensor cone. If the digital meter is not reading 32 °F at this time, make an adjustment as described in the attached diagram. **This calibration check should be done on a regular basis. QTT recommends once a month. Additionally, we recommend that the lens is cleaned every time you check calibration. For a more accurate calibration test, clean the lens before you calibrate to ice.**

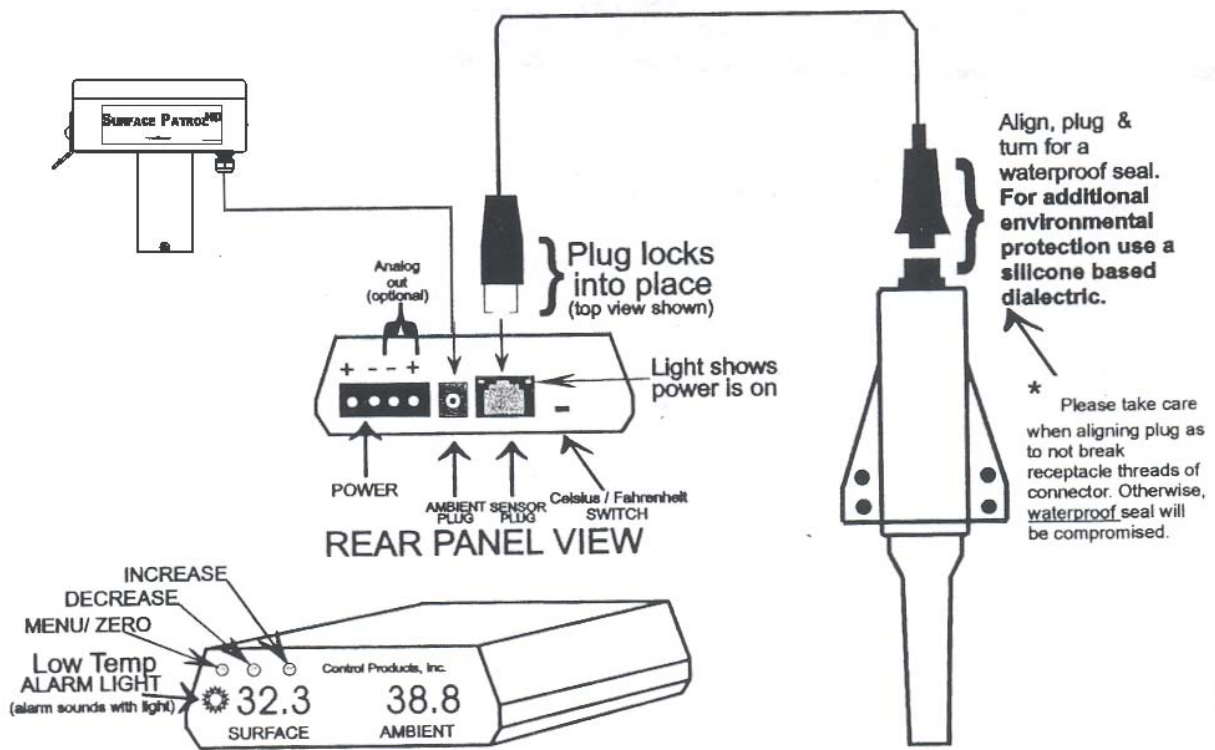
**NOTE:** The surface temperature sensor can sometimes take up to 20 minutes to read accurately after initially being powered. Usually the inaccuracy is so minimal that the user will rarely notice.

**NOTE:** The Dew Point sensor is factory calibrated and does not need to be calibrated in the field.

#### **V. Additional Installation Hints**

- **Use dielectric grease on all external cable connections and pins to protect against corrosion**
- Never weld on a vehicle with electronic equipment installed and powered
- Disconnect the negative battery terminal when wiring electronic devices
- Unpack all parts and check packing list for completeness
- Untie and layout all cables supplied to ensure proper lengths
- Route cables so that they will not be damaged or abused
- When routing cables through metal openings, always use grommets to prevent cable damage

# Operation & Surface Temperature Sensor Calibration



**Figure 4 – Basic System Schematic**

This section describes how to operate the Surface Patrol HD and calibrate the surface temperature sensor. The dew point sensor of the Surface Patrol HD is factory calibrated and doesn't need to be calibrated in the field.

## Display Pushbuttons

There are three momentary contact pushbuttons located on the front of the digital display and shown in Figure 4. These pushbuttons are recessed and are accessed through small holes in the display lens. Pressing any pushbutton will briefly sound the meters beeper to confirm the operation. These buttons are designated, from left to right, as **MENU / ZERO**, **DECREASE** and **INCREASE**.

**MENU / ZERO BUTTON:** Performs multiple functions.

Calibration: If the sensor is pointed at an "ice bath" press and release **MENU/ZERO** to calibrate. It will only calibrate the sensor if the surface temperature is within between 27 °F and 37 °F. You will know that you are looking at ice when you hear the alarm sound. Once pointed at ice and the **MENU/ZERO** button has been pressed and released, the left-most digits will flash. Keep the sensor pointed at ice for 6 or 7 seconds until the left-most digits quit flashing. The sensor is

now calibrated to ice or 32 °F. Again, if the sensor is not pointing at ice the calibration function will NOT work.

If the **MENU/ZERO** pushbutton is pressed and held for a couple of seconds, you will enter *menu mode* operation. In this mode, the left-most digits display a label indicating which feature has been selected. The right-most digits display the value being modified. In this mode the other two buttons increase and decrease the modifiable (right-most) value. To toggle to the other menu options simply push the **MENU/ZERO** button until you reach the desired menu option. If you press and hold the **MENU/ZERO** button for two seconds again the display reverts to normal operation.

**INCREASE BUTTON:** This button, while in menu mode, increases the current modifiable (right-most digit) value. Increasing past the maximum value "wraps around" to the minimum value. This button "auto-repeats" if pressed and held.

**DECREASE BUTTON:** This button, while in menu mode, decreases the current modifiable (right-most digit) value. Decreasing below the minimum value for a variable "wraps around" to the maximum value.

#### **MENU VARIABLES:**

While in menu mode, a number of options can be viewed and modified.

##### ***Indicator***

This variable allows you to use the default setting (visual and audible indicators). The display will show:

Alr 03

However, the user can also turn the indicator completely off (Alr 00) or turn the visual indicator on and the audible indicator off (Alr 02) and finally turn the audible indicator on and the visual indicator off (Alr 01).

##### ***Display***

This variable allows you to select which display mode you would like to view.

Dis 03

A display mode of 01 will only display the surface temperature and the ambient air temperature on the display. A display mode of 02 will only display the relative humidity and the dew point. A display mode of 03 will switch between the two modes about every 10 seconds.

##### ***Offset***

This variable lets you manually change the temperature probe's field calibration instead of using the automatic zero calibration described above.

Off 0.0

Where the right-most digits show the probe's current offset. The maximum range of this variable is +/- 6 degrees. This variable is always in degrees Fahrenheit regardless of the setting of the C / F selection switch. Increments are 1/4 degree F increments.

### **LED Brightness (low)**

This variable sets the "dim" display brightness level. This brightness is used when the meter is in low ambient light conditions. The range of this variable is 0 (dimpest) to 15 (brightest). The display will show:

Llo 01

### **LED Brightness (high)**

This variable sets the "high" display brightness level. This brightness is used when the meter is in high ambient light conditions. The range of this variable is 0 (dimpest) to 15 (brightest). The default display will show:

Lhi 15

### **Analog Output Range (low)**

*This variable is only meaningful if the optional isolated analog output module is installed*

This variable defines the temperature, in degrees Fahrenheit, that will result in the analog output being set to its minimum value. The default display is:

Alo -40

*This indicates that a temperature of -40 F will produce an analog output of 4 am (or 1.00 V). The range variable is from -50 F to 999F.*

### **Analog Output Range (high)**

*This variable is only meaningful if the optional isolated analog output module is installed.*

This variable defines the temperature, in degrees Fahrenheit, that will result in the analog output being set to its maximum value. The default display is:

Ahi 140

This indicates that a temperature of +140 F will produce an analog output of 20 mA DC (or 5 V DC). Note that the minimum and maximum values also define the hard limits of the output. In other words, with a maximum Analog Output Range of 140 F, all temperatures greater than or equal to this maximum value will produce that maximum analog output.

### **Special Operations Mode**

*This variable is only relevant if the display is equipped with the optional serial output module.*

This variable sets the operational mode of the meter. For all normal operations, this should be set to 0. The default display is:

OP 0

Contact the factory for special operational modes.

### **Serial Baud Rate**

**NOTE:** *This variable is only relevant if the display is equipped with the optional serial output module.*

This variable sets the optional serial communications module's baud rate. The first 2 digits of the baud rate are shown on the display. The default display is:

bd 96

The baud rate can be selected from **9600**, **4800**, **2400**, and **1200** baud.

#### ***INTERNAL PUSHBUTTON***

There is a single pushbutton inside the digital display that is used for calibration purposes. **This is intended for a factory test and not normal operations, so the display mode does *not* time out as the menu selections do. Avoid pushing this button.**

## Thermal Mapping Interface and Operation

The system schematic and operational notes for use of Surface Patrol HD with the thermal mapping configuration is show in Figure 5.

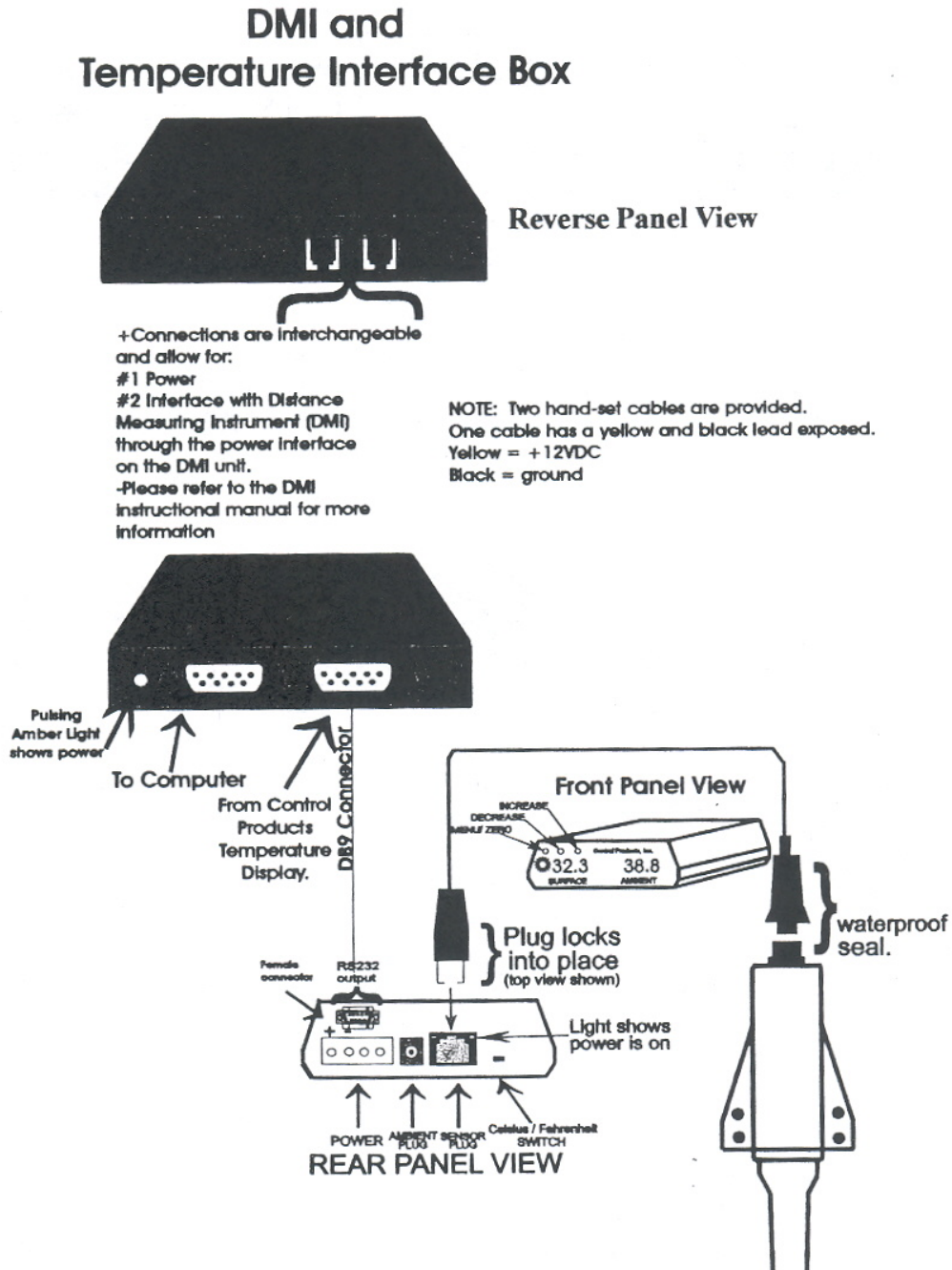


Figure 5 - Thermal Mapping System Schematic

## Dew Point Sensor Filter Replacement

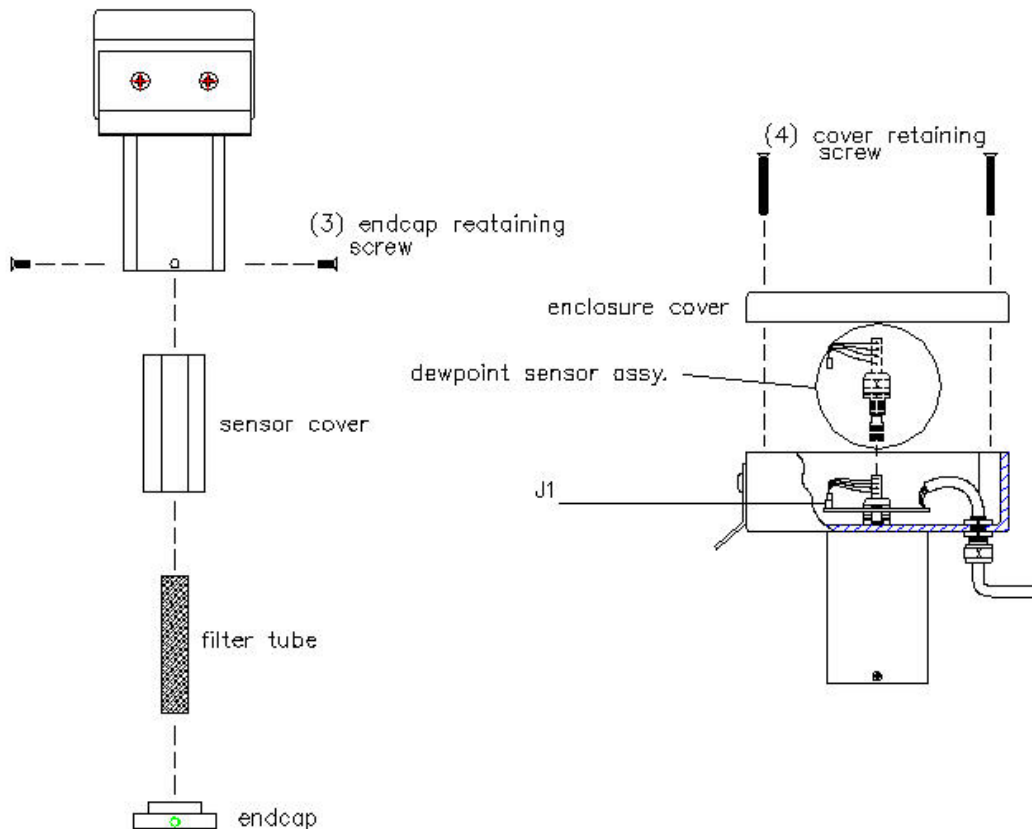
The dew point sensor filter can be replaced by first removing the three Phillips screws located at the bottom of the housing assembly. Removing the three screws will release the end cap and the sensor cover. Once removed the filter element inside the sensor cover is replaced by sliding it out of the cover and the replacement inserted into the cover. The sensor cover is placed back onto the end cap and inserted back into the outer shell cover and the screws reinstalled. Refer to the exploded view of the sensor in Figure 6.

**NOTE:** The opening in the sensor cover must face the rear of the housing.

## Dew Point Sensor Replacement

The dew point sensor is replaced by removing the four enclosure screws on the top of the housing. Once the cover is removed the sensor assembly is located directly in the center of the interface PCB. Unplug connector J1 and using a 7/16 deep well socket gently unscrew the sensor assembly. The new sensor assembly is installed by applying a drop of stud lock “Loctite or equivalent” to the threads of the sensor mount and carefully screw the assembly into the housing and torque to 5 inch pounds plug in connector J1 and reinstall the housing cover. Refer to the exploded view of the sensor in Figure 6.

**NOTE:** Care must be taken when handling the sensor assembly and should only be handled from the wiring end and not the sensing element.



**Figure 6 - Dew Point Sensor Exploded View**

## Troubleshooting Techniques

### ❖ My SURFACE sensor is reading inaccurately:

- First take protective cone OFF by unscrewing captive screws.
- Clean lens with NON-abrasive material.
- If sensor is still reading inaccurately (i.e.,  $> \pm 6$  °F or  $\pm 3.3$  °C from surface temp.) then you must do a "User Calibration":
- In order to do a user calibration you must:
  - Make an "ice bath" by mixing water with ice and allowing it to acclimate for ~3 minutes.
  - Point sensor at ice bath and push calibration button (as described in instruction manual) ONCE.
  - The sensor will then blink for ~ 7 seconds and automatically calibrate to 32 °F (0 °C).
- If sensor error is still too large (i.e.,  $> \pm 6$  F or  $\pm 3.3$  °C) and/or the sensor will not accept the "User Calibration" the sensor must be sent back to the manufacturer for calibration. On most occasions a "User Calibration" will suffice.

### ❖ How often should I check the accuracy of the SURFACE sensor?

- It is recommended that a regular calibration check be performed.
  - When you are doing normal vehicle maintenance (oil / oil filter change) check calibration of sensor.
  - Like anything on your vehicle, the life and accuracy of the sensor depends on how well you maintain the system.

### ❖ My DEW POINT sensor is not outputting any data:

- Make sure sensor is plugged into back of display.
  - If sensor is plugged in and still does not output any data make sure the sensor is plugged into the wiring harness.
  - If sensor still will not output any data then the sensor needs to be replaced and you should contact the manufacturer.

### ❖ My SURFACE sensor is not outputting any data:

- Make sure sensor is plugged into back of display.
- If sensor still does not output any data make sure that the wiring harness (refer to Figure 4) is plugged into connector on probe.
  - Inspect connection between wiring harness and surface probe.
  - If there are broken pins or excessive corrosion, the sensor must be returned to manufacturer.
  - If not make sure to apply dielectric silicon (as described in instruction set) so that no corrosion occurs. An inspection of this connector should be made once every SIX months.