



RoadWatch® Field Calibration Unit Owner's Manual



RoadWatch® is a patented system used to indicate both surface (road) and air temperatures. The RoadWatch® sensor is a type of infrared (IR) temperature measuring device. IR temperature sensors work by detecting the amount of thermal energy given off by an object in its field of view. As a camera picks up the intensity and color of light to recreate an image, an IR detector must 'see' its target. The IR intensity is related to both the target temperature and its surface type or 'emissivity' as viewed by the sensor. The sensors are made from very stable components and should require only occasional verification that the indications are still within specification.

The **RoadWatch®** Field Calibration Unit (FCU) has been designed to minimize measurement errors by comprising a complete and easy to use test environment. All the key pieces to provide a repeatable and accurate sensor validation are included. The target surface, viewing area, and distance are held constant within the test fixture. The sensors and calibrator target are fixed in place in a thermally stable environment. Since the system is not dependent on external control, errors from power consuming modules, electronic circuit drift, and oscillation prone feedback networks are minimal. Instead, the FCU utilizes a factory calibrated and certified temperature sensor, a solid heat-holding block, and a digital processor to automatically execute the calibration.

This document attempts to cover everything you need to know about your RoadWatch® Field Calibration Unit — from unpacking the box for the first time to normal operation to recertifying the standard to troubleshooting and maintenance. This document has the following sections covering various stages of ownership.

- Abbreviations
- Items included
- Preparation
- How it works
- Basic operation
- Advanced features
- Care & Maintenance
- FAQs
- Troubleshooting
- Features & Specifications
- Warranty

NOTES:

Abbreviations:

- AIR - Air or ambient temperature
- FCU - Field Calibration Unit
- OBJ - Object or road temperature, road target represented by the metal block
- RTO - Road Target Object (Calibration Target)
- RW - RoadWatch®
- STD - Standard sensor
- UUT - Unit Under Test
- M8 - A standard type of circular connector approx. 8mm diameter

Tools & Supplies

For most cases the verification or recalibration process should not require the use of tools. The sensor easily removes for the aluminum housing by sliding the white inner sleeve up through the main housing. Leave the aluminum housing attached to the vehicle. The sensor cable connection can then be unscrewed by hand to completely remove the sensor core. A clean damp, non-abrasive rag should be used to carefully clean the sensor lens area.

NOTES:

Items Included in Kit



Figure 1 - FCU Enclosure

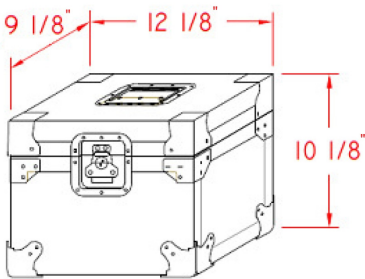


Figure 2 - Hardshell Enclosure
P/N: 849-1000-102



Figure 3 -
FCU Power Supply



Figure 4 -
Standard Sensor
P/N: 849-1000-104

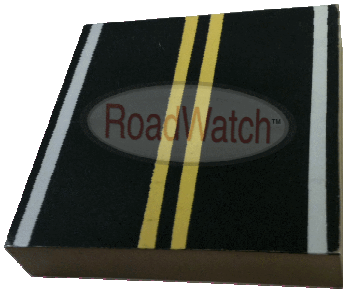


Figure 5 - Road Target Object
P/N: 849-1000-154

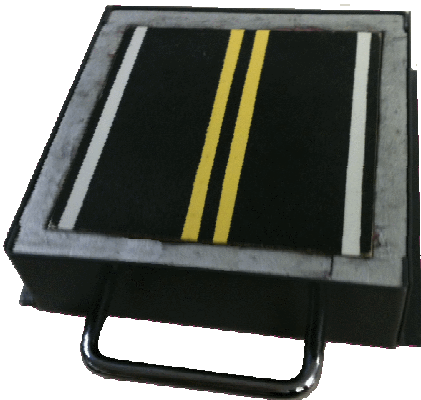


Figure 6 - Road Target Tray
(shown with Road Target Object)

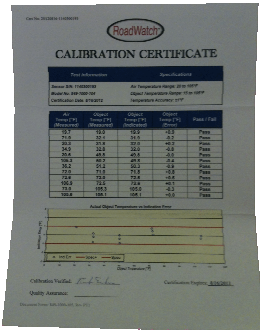


Figure 7 - Calibration Certificate
P/N: 849-1000-105 (re-cert)

Preparation

1. Place the Road Target Object (RTO) in a freezer or other storage location near 32°F (0°C) for at least 30 minutes.
2. Follow the 'Sensor Unit Removal' instructions to extract the sensors from the metal housing. If possible, leave the metal housing attached to the vehicle.
3. Gather all the sensors, or Units Under Test (UUTs), you wish to process.
4. Inspect each sensor for signs of physical damage and replace if cracked or signs of moisture have penetrated the sensor seals. The lens area should also be free from scratches and not discolored.
5. Carefully clean each sensor endcap with a damp cloth. Warm soapy water should be adequate but clean isopropyl alcohol may be used if contaminants remain. Do not power wash or use abrasive or solvent type cleaners.
6. Place the Field Calibration Unit (FCU) and the standard sensor in a temperature stable environment, such as a heated instrument shop or office area. Keep away from open external doors or heating/cooling vents.
7. Place cleaned sensors in a location near the FCU. Do not cover them or keep them in a box so they can adjust to the location temperature.
8. Allow sufficient time for all the test pieces to adjust to the room temperature environment, at least 20 minutes. More time may be required if sensors have come from a very hot or cold location.
9. Locate an AC power outlet or extension cord for the FCU Power Supply.

Sensor Unit Removal and Reinstallation

The RoadWatch® sensor unit was designed to be able to be serviced independently of other components. Below describes how to remove and reinstall a sensor unit.

1. You may or may not need to remove the sensor outer metal housing. Leave housing attached if possible. If removal is needed, loosen the set screw(s) and slide the sensor assembly out.
2. Gently push on the sensor window (bottom center of sensor head). This will loosen and push the sensor with inner housing out the top. Continue pushing until about half of the inner housing is displaced.
3. Pull the sensor and inner housing from the outer housing out completely. Set outer housing aside.



ROADWATCH® LIMITED WARRANTY

Commercial Vehicle Group, Inc. (CVG) warrants the RoadWatch® System (the Product) to be free from defects in material and workmanship for a period of one (1) year from the date of original purchase by the consumer, as evidenced by the sales receipt. In the absence of such purchase receipt, the warranty period shall be eighteen (18) months from the date of manufacture as indicated by the manufacturing code.

CVG will repair or replace, at its option and free of charge during the warranty period, Product that proves defective in material or workmanship under normal installation, use, and service provided the Product is returned to the factory, transportation charge prepaid. Product returned to our factory must be accompanied by a photocopy of the purchase receipt. In the absence of such purchase receipt, the warranty period shall be eighteen (18) months from the date of manufacture as indicated by the manufacturing code. Any damage to the Product as a result of misuse, abuse, neglect, accident, incorrect wiring, improper installation, destruction or altering of the manufacturing code, repair or alteration outside our factory, or any violation of instructions furnished by us will void the warranty. CVG makes no warranty against driver's loss of control of any vehicle equipped with the Product. Installation labor, removal and reinstallation charges are not the responsibility of CVG, or the selling dealer or distributor.

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RoadWatch® technology is protected under US patents 5796344, 6166657, & 6206299 with additional US and foreign patents pending.

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RoadWatch® Field Calibration Unit

Features

- Powder coated steel enclosure
- High visibility OLED display and tactile 3 button keypad
- Certified Standard Sensor
- Calibration Target* (With special .96 emissivity road simulating coating)
- Rugged hard shell storage case
- Full 1 Year Warranty for Parts & Manufacturing Defects



Specifications

- **Standard Sensor**
 - $\pm 1^{\circ}\text{F}$, $.5^{\circ}\text{C} \pm 1$ digit accuracy
 - 0 to 140°F operating range
 - 20 to 105°F calibrated range
 - **FCU Temperature***
 - 20 to 100°F storage range
 - 65 to 85°F operating range
 - $\pm 1^{\circ}\text{F}$ per minute stability**
 - **Power Supply**
 - 3.6 to 5.3Vdc, 200mA max. output
 - 90 ~ 264 VAC 50/60 Hz input
 - Connector: 2.1 x 5.5 center positive standard
- *Non-condensing humidity

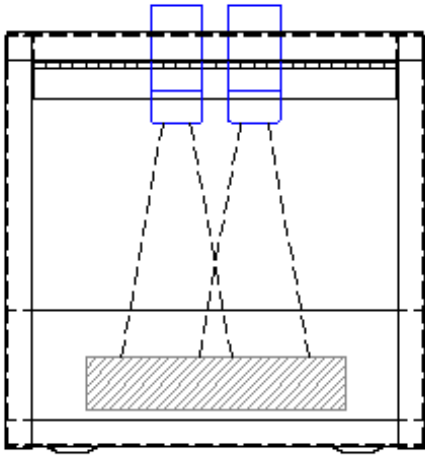
4. Separate the sensor inner housing to reveal the sensor unit.
5. Before removing the sensor unit, take note of how the cable is routed through the slots toward the top of the inner housing. These slots provide strain relief for the cable.
6. Remove the sensor unit from the housing. It will still be connected to the cable going into the vehicle. Secure it so it does not strike the ground or objects.
7. Unscrew the mating connectors to free the sensor from the vehicle.
8. To reinsert a sensor, lay cable from the bottom of the unit up to the strain relief slots. Route through the slots.
9. Set sensor unit in housing aligning the notches on the sides which hold the sensor unit in place. The sensor unit should be on top of the cable. You may have to adjust the cable up or down so that it will lay in place properly. The window of the sensor should point out of the hole in the housing bottom. The sensor cable exit should point toward the top or closed end of the inner housing as shown.
10. Place the other half of the inner housing in place and close together. Ensure cable is coming neatly out of the bottom, that the sensor element is pointing out of the bottom hole, that the cable is not pinched between the two halves, and the housing seams fully close.
11. Slide the loose cable extending out of the sensor inner plastic housing into the top of the outer metal sensor housing.
12. Slide the sensor unit into the outer housing and press firmly into place.
13. If you removed the sensor head assembly from the sensor clamp, reinstall now so that the sensor head assembly is secure. The cable will dangle.
14. Trace and remove tie straps for the existing sensor cable till you reach the M8 connector.
15. Disconnect the old sensor cable.
16. Connect the new sensor cable.
17. Secure with tie straps the cable along path the old cable followed.
18. Perform test to verify system operates.



How It Works

The FCU is designed to verify and calibrate RoadWatch® sensors. The Road-Watch® sensor is a type of infrared (IR) temperature measuring device. IR temperature sensors work by detecting the amount of thermal energy given off by an object in its field of view. As a camera picks up the intensity and color of light to recreate an image, an IR detector must ‘see’ its target. The IR intensity is related to the temperature as well as the color, which can be thought of as the surface type or ‘emissivity’ of the object(s) viewed by the sensor. The emissivity of a perfect ‘black body’ is defined to be 1.0. Concrete and asphalt have an emissivity around 0.96 and the FCU uses a target with a special coating to model this surface.

There are several IR temperature sensor calibrators on the market. These are often termed black body targets. These devices usually have relatively small target areas and use a correction factor to compensate for different emissivities. They also employ a complex and expensive electric cooling & heating device to control temperature. The target surface is then reference measured at a single point. These active devices are very inefficient and are susceptible to creating non-uniform temperatures throughout the target surface and require regular and costly recalibrations. The FCU uses a simple passive block as a calibration target. The block is made of specially chosen material that conducts and retains heat to assure a uniform and stable temperature. This, along with the special surface coating provides a high fidelity model which closely reproduces the way the sensors operate in the real world application. At the factory, the block’s temperature is precisely measured using a certified and traceable temperature sensor. This reading is then used to certify an IR sensor which is supplied with the unit. This standard then becomes the traceable measurement that is used to indicate the FCU’s target block temperature during normal operation.



FCU Inside View

Troubleshooting

Observation	Cause	Action
FCU does not power on. No display or LEDs lit.	<ul style="list-style-type: none">• Disconnected or damaged power supply• Damaged FCU	<ul style="list-style-type: none">• Check & replace power supply if needed• Contact Factory, Obtain RMA#
UUT (STD) channel constantly reads ‘err’	<ul style="list-style-type: none">• Bad UUT (STD) sensor• Failed FCU internal connection	<ul style="list-style-type: none">• Try another sensor in UUT (STD) port• Contact Factory, Obtain RMA#
UUT won’t calibrate—reads ‘Operation Failed’ or ‘Sensor firmware too old to recal’	<ul style="list-style-type: none">• Old sensor version	<ul style="list-style-type: none">• Ok to use if indication meets spec• If out of spec, replace
I calibrated my UUT at 32°F but now it’s off at room temperature	<ul style="list-style-type: none">• The calibrator can only correct the indication using a fixed offset	<ul style="list-style-type: none">• Calibrate at most important operating temperature• If out of spec replace sensor
FCU reads ‘Temp diff too large...’	<ul style="list-style-type: none">• UUT is too inaccurate to recalibrate• Obstruction or foreign object inside calibrator	<ul style="list-style-type: none">• Check UUT lens & clean or replace if damaged• Remove drawer and sensors. Look in holes for clear view
RTO plate drawer stuck	<ul style="list-style-type: none">• Drawer has retainer tabs• RTO plate dislodged	<ul style="list-style-type: none">• Lift drawer slightly then pull• Try to move plate with a dowel rod through sensor port

FAQs—cont.

Q: I've lost or damaged my Road Target Object (plate) or Standard Sensor. Can I order a replacement?

A: Yes. RTO P/N: 849-1000-150-004 or STD P/N: 849-1000-104. Contact your local distributor or customer support at 1-800-459-7328 or email: roadwatch@cvgrp.com.

Q: I've checked the standard against another IR temperature sensor and they don't agree—which one do I believe?

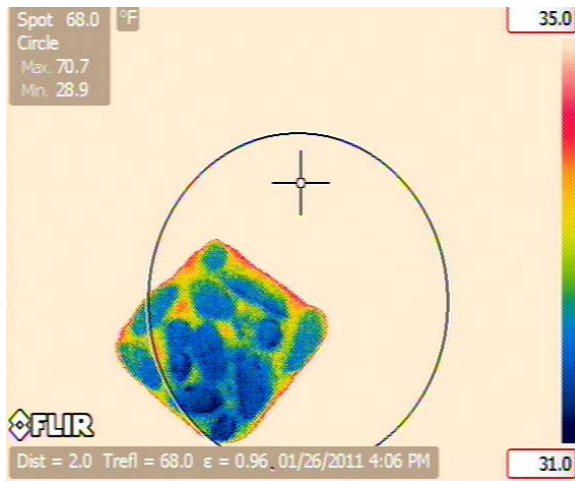
A: Many IR temperature devices are not as accurate as the RoadWatch® standard sensor. They may only be calibrated at a single point or not at all. Also they may have been set for an emissivity other than 0.96 which will result in larger errors as the object and air temperature difference grows greater. Refer to their spec sheet or calibration records. You may also compare against a second RoadWatch® standard sensor.

Q: I need accuracy greater than 1°F. Can the sensor be re-calibrated to a tighter specification?

A: Other than in a laboratory setting, not really. IR temperature sensors operate with very low energy signals. This signal only slightly heats or cools an internal element and then it must reference this change to its internal temperature. Since the sensors operate over such a wide range of ambient temperature, small changes in ambient temperature and heat flow paths limit their final 'real-world' accuracy.

Q: Is this calibration system really more accurate than a bucket of ice water?

A: Yes. It is very difficult to arrive at a uniform temperature with a bucket of ice water. Pure ice is never above 32°F and pure liquid water is never below 32°F. As seen in this IR photo, neither ice nor the water can force the mixture to a uniform 32°F.



Basic Operation

1. **!! Caution !!** Use only the power converter supplied with the unit. Improper power applied to the unit can cause permanent damage and will void the warranty.
2. After finishing the preparation section, apply power to the FCU using the 5Vdc power source supplied with the unit. There is no power switch.
3. **!! Caution !!** Be very careful mating the sensor connectors. Misalignment can cause bent pins and non-repairable damage to the sensors. Physical damage to the connectors is not subject to warranty coverage. Also, DO NOT over tighten. The pin connections can easily be made even without screwing them in.
4. Prepare to mate the cable connection - Align the sensor cable mating key towards the front of the FCU and carefully insert into each respective connector receptacle behind the sensor ports. **!!**
5. Install the Standard sensor (STD) into the right side sensor port on top of the FCU.
6. Place one UUT into the left side sensor port on top of the FCU.
7. The FCU will start displaying the AIR and Plate Object (OBJ) temperatures. The STD sensor will be on the right side and the UUT will be on the left.
8. Once all the temperature indications are stable, the ready light will transition from red to yellow to green. You do not need to wait for a green ready light as the FCU will do this for you.
9. Press the [*] 'Select' key once to advance to the 'Perform OBJ Recal?' display screen.



Note—Important:

Since IR temperature measurement technology uses an internal temperature reference, it is required that both the UUT and the STD sensors arrive at a stable internal temperature. This operation may take a few minutes.

10. Press [+] to automatically recalibrate the UUT or press [*] return to the indication screen.
11. The FCU will assure the UUT's firmware version is new enough (Approximately Dec 2010 or later) by checking an internal mode flag. Following this verification it will monitor the temperature stability before updating the calibration. Once the process has completed, you will see a confirmation message on the display. The UUT should then agree with the STD to within ± 1 degree.

Advanced Features

The FCU is also capable of adjusting the air temperature calibration, changing between °F & °C and displaying the UUT serial number.

!! Caution !! Performing advanced features should not be needed during the course of normal operation. In particular, to perform an air recalibration it is important to know that there is no air flow inside the calibration unit. This is required to maximize the accuracy of the object calibration and to minimize heat transfer of the road target object. Therefore it will take an even longer time for both the standard and UUT sensors to arrive at a steady air temperature. Should the air temperature actually need an adjustment it may be necessary to wait until the sensors have completely acclimated to ambient temperature by manually observing the air indications. Wait until both the STD & UUT air temperatures have not changed over a reasonable amount of time. This will depend on the initial temperature of both sensors. All sensors are factory calibrated in a precision environmental chamber with well circulated air. The rated accuracy specification requires a nominal amount of air to flow past the sensors to achieve a proper air indication.

1. Simultaneously press both the [-] & [+] keys together and release. 'Perform AIR Recal?' will be shown on the top display line. Pressing [*] at any time will present the next option.
2. Select [+] at the AIR recalibration screen to recalibrate the air temperature indication. Note: Since the sensors are not mounted on a moving vehicle, it may take longer for the indication to arrive at a steady level. Typically this step is not needed—read caution above.
3. When prompted, press either [-] or [+] to change the units to °C or °F.
Note:
This will also change the STD sensor memory as well as the installed UUT. The FCU will remain in the chosen units until changed again by the same method. The displayed units of measure will continue to follow that of the STD even after the FCU is repowered power, regardless of the °C/°F configuration of UUT units.
4. To access the UUT serial number and FCU version press [*] at the 'Set Temp Units' screen.
5. Pressing [*] again returns the FCU to its basic operating mode.

Care & Maintenance

The RoadWatch® Field Calibration Unit Kit requires very little maintenance.

!! Caution !! The FCU enclosure is constructed of rust resistant powered coated steel with a polycarbonate cover skin. However, the unit is not sealed and should never be sprayed.

Use a damp cloth to clean the enclosure. Warm soapy water should be adequate but you may also wipe down with isopropyl alcohol if contaminants remain. Mild degreasers can also be applied to a cloth and then wiped on the affected areas. Do not use abrasive or solvent type cleaners.

!! Caution !! The kit contents should be stored in the hard shell case but do not transport the unit with the road target object stored inside the tray. The plate can easily become dislodged and damage the internal components. Internal damage from the plate or other foreign objects are not covered by the warranty.

Recertification of the standard sensor is recommended on a yearly basis. The National Institute of Standards & Measures (NIST) has issued a 'Good Measurement Practice' document. GMP 11 states "*Proper calibration intervals allow specified confidence intervals to be selected and they support measurement traceability*". Recertification is an important process to verify temperature indications are as accurate as possible and to comply with many emerging government or self-imposed quality control standards. Only the standard sensor needs to be returned to reissue a new certificate of calibration. Contact customer support at 1-800-459-7328 or email: roadwatch@cvgrp.com for more details.

FAQs

- Q: How do I know the standard is reading the correct temperature?
A: Each standard sensor has been fully calibrated at the factory at several air and object temperature combinations. A yearly calibration process has been followed and is traceable back to the NIST.
- Q: Our calibration certificate has expired. How far off can the standard be?
A: If the care and maintenance guidelines are followed and the equipment has been kept clean there should be no reason for significant errors. Since there are no moving parts or environmental fatigue potential error sources are minimal. In any case, yearly recertification is recommended.