User's Manual
932
Retroreflectometer

Prepared by:

INSTRUMENT CERTIFICATION

If anyone has comments or suggestions regarding this manual, its format, content, or otherwise, please direct them to:

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Your input is appreciated

INSTRUMENT CERTIFICATION

RoadVista, certifies that this instrument was thoroughly tested, inspected and found to meet its published specifications when it was shipped from the factory. RoadVista, further certifies that its calibration measurements are traceable to the U.S. National Institute of Standards and Technology (NIST) formerly National Bureau of Standards to the extent permitted by the Bureau's calibration facility.

WARRANTY AND CUSTOMER SERVICE

All products manufactured by RoadVista are warranted to be free from defects in material or workmanship subject to the following terms and conditions. All other products sold by RoadVista are warranted only to the extent of that offered by the manufacturer.

(a)   PERIOD OF WARRANTY:

This warranty shall terminate one year after the date of shipment.

(b)   REPAIR OR REPLACEMENT:

Seller's obligations under this clause shall be limited to repair or correction of any defect of material or workmanship in any such product or to replacement of any defective product or part or unit thereof, notice of which shall have been given to Seller within the warranty period specified in subdivision (a) above.

(c)   LIMITATION AS TO REPLACEABLE COMPONENTS WHO'S LIFE IS A FUNCTION OF USAGE TIME:

Since the life of such components is a function of the customer's usage of them, all lamps and batteries are warranted only to the extent that the original manufacturer's warranty applies. Claims are limited to those presented within 30 days after occurrence of any failure.

(d)   CANCELLATION OF WARRANTY:

This warranty shall not apply if modifications not authorized in writing by Seller are made.

The warranties set forth in this clause are in lieu of any other warranties, expressed or implied, which the purchaser or others might have under or arising from this agreement, by statute, at law, in equity, or otherwise, INCLUDING ANY WARRANTY OR MERCHANTABILITY OR FITNESS. Goods sold subject to above warranty only, and Seller expressly denies any other warranties or representations, statutory, legal or equitable, expressed or implied.

RoadVista, provides repair services for all RoadVista products. A complete, modern Service Department, Stock Room and Calibration Facility are employed at the factory.

In the event the instrument does not function properly or is damaged, RoadVista should be contacted with regard to the specific symptoms of the problem.

NOTE

For all service requirements, please ask for the Customer Service Department. RoadVista must be contacted prior to any return shipment of equipment. Failure to do so will result in delayed return to the customers.

(e)   SCHEDULED MAINTENANCE

The 932 should be returned to RoadVista on a yearly basis to verify all aspects of the measurement system are within specification and perform standard routine maintenance. Standard maintenance includes the following;
- Replace lamp
- Verify optical alignment
- Update firmware with newest version
- Full system check

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SAFETY FIRST

Protect yourself. Follow these precautions:

- This Manual contains information about the proper procedures for preparing this product for its use and care.
- Follow the instructions of other manufacturer's equipment when used in conjunction with this product.
- Explosion Hazard. Do not use in the presence of flammable liquids, vapors, gases or dusts.
- FIRE HAZARD: DO NOT DRAPE OR COVER ANY LIGHT SOURCE WHILE IT IS OPERATING.
- Pay attention to **WARNING** statements. They point out situations that can cause injury or death.
- Pay attention to CAUTION statements. They point out situations that can cause equipment damage.
- The user of this product should be thoroughly familiar in the set-up, use, and care of this product.
- The user should carefully study this manual before using the equipment. Instructions should be followed, with special attention given to warnings, controls and user specifications. This manual should be available to the appropriate personnel.
- Before every procedure, carefully inspect the equipment to ensure it has been properly maintained and cleaned, and that it is fully functional. DO NOT use if inspection reveals anything unusual, including case damage or loose connectors.
- SAFETY PRECAUTIONS MUST ALWAYS BE EXERCISED WHEN USING ELECTRICAL EQUIPMENT TO PREVENT OPERATOR SHOCK, FIRE HAZARD OR EQUIPMENT DAMAGE.
- Don't touch any exposed wiring.
- All electrical equipment must be used with approved power cords and power plugs inserted properly into grounded AC power outlets.
- Don't plug in the power cord until directed to by the installation instructions.
- Don't bypass the power cord's ground lead with two-wire extension cords or plug adaptors.
- Don't disconnect the green and yellow safety-earth-ground wire that connects the ground lug of the power receptacle to the chassis ground terminal (marked with ⏚ or ⚠).
- To reduce the risk of fire and electric shock, do not expose electrical equipment to moisture. When cleaning, do not immerse any electrical device in liquid.

- Do not use or store liquids on or above the equipment.
- Electric shock hazard. If unit is not functioning properly, DO NOT OPEN. Please refer to the Maintenance and Troubleshooting section of this manual.
- Use only properly functioning cables that are made for system instrument connectors.
- Light sources produce high intensity light. Thermal burns can result from improper use of the light source.
- Use care not to point any operating light source directly at the eye.
- When light source is not in use, turn off the power.
- Keep any cooling vents and fans free of obstructions.

932 Portable Retroreflectometer

SECTION 1   INTRODUCTION

1.1 GENERAL INFORMATION

The RoadVista 932 Retroreflectometer measures retroreflection (R_A) and color of road signs and other materials, both in the field and in the laboratory. The 932 features a continuously adjustable entrance angle from -45° to + 45°, and a motor driven, automatically adjustable observation angle from 0.2° to +2.0° on the primary detector. The observation angle on the color detector is fixed at 0.33°.

The primary light sensor meets ASTM E1709 requirements with the CIE standard human eye response in conjunction with the CIE illuminant "A" lamp. The photometric filter accurately measures different colors without the need to calculate correction factors. The color detector features a 3-channel RGB sensor used to generate CIE1931 color coordinates.

The user interface features a super high resolution color touch screen. A separate graphics co-processor provides quick, intuitive response as well as clearly rendered text and images for easy viewing of pertinent data.

Revision 2.0 and above firmware includes a GPS to geo-locate measurements.

The 932 records the following items with each measurement:
- R_A value.
- Entrance Angle.
- Observation Angle.
- CIE1931 x and y coordinates.
- Current date and time.
- A user-entered comment of up to 18 characters.
- Temperature and Humidity.
- GPS Location
- GPS Accuracy

The internal memory has the capacity to store readings and accompanying data for more than 30,000 measurements in non-volatile flash memory.

Both USB and Bluetooth interfaces independently allow remote control of the instrument. These interfaces provide full connectivity, allowing for automation in laboratory or production environments. The Bluetooth transceiver can also be used to wirelessly expand the instrument's capabilities, and is limited to only what devices are available on the market.

Data may be uploaded to a Windows-based computer using the Graphical User Interface (GUI) that comes with the 932. Uploading is accomplished through the USB or Bluetooth interface, and stored in ASCII delimited format.

1.2 SPECIFICATIONS

ASTM E1709 Annular Geometry
Primary Observation Angle: Automated, variable from 0.2° to 2.0°.
Color Observation Angle: 0.33°.
Entrance Angle: Continuously variable from -45 o to +45.
Light Source Angular Sub-tense: 0.1°.
Primary Receptor Angular Sub-tense: 0.1°.
Color Receptor Angular Sub-tense: 0.4°.
Measurement Area: Approximately 1in (2.6cm) in diameter.
Measurement Range, Color Sensor: 10 to 2000 cd/lux/m$^{2.}$

Optical Specifications
Measurement Range, Primary Sensor: 0.1 to 10000 cd/lux/m^2 in 4 electrical auto-gained ranges.
Data Storage: >30,000 measurements via on-board flash memory.
Computer Interface: USB, Bluetooth.
Main Detector: Silicon photodiode with photopic filter combined with light source at CIE Illuminant "A" (2856°K).
Color Detector: RGB detector with photopic filter, calibrated to CIE1931 standard.
Calibration: Multi-color standards - Model 902 & 903 reference standard sets. Engineering and high-intensity grades in 6 colors, caps stored in a foam-lined carrying case.

Other Features
Display Interface: High Resolution Color Touchscreen.
Data Storage: Averaging. Selectable Metric/English units. Clock.
Comment Field: 18-character per measurement.
GPS: 56 channel

Power
Power Supply, Field Use: Removable/rechargeable 12 VDC, 2.4Ah Hi-Cd battery. (DeWalt P/N DC9071).
Power Supply, Laboratory Use: 15VDC Universal AC adapter.
Battery Charger: 12 VDC.
Sensor: Battery life.

Environmental
Operating Temperature: 10°C to 40°C (50°F to 104°F).
Operating Humidity: 0 to 95% non-condensing.
Sensors: Temperature, Humidity.

Dimensions
 932 Retroreflectometer
5 in. (12.7 cm) wide; 14 in. (35.6 cm) high; 16 in. (40.6 cm) long.
Weight (without battery): 4.6 lbs (2.1 kg).
Weight (with battery): 5.75 lbs (2.6 kg).

Carry Case

20.5 in. (52.1 cm) wide; 8.5 in. (21.6 cm) high; 17 in. (43.2 cm) long.

<u>**Accessories and Options**</u>
Standard Accessories:
- Two (2) Batteries.
- 110 or 220 VAC, 15V battery charger with wall adapter.
- 10mm and 15mm Measurement Area (Aperture) Reducers.
- Calibration Standard.
- Calibration Certificate.
- Windows-Based Software.
- USB Cable.
- Carrying Case.
- Shoulder Strap.

Additional Options:
- Annual Calibration Service.
- Adjustable Entrance Angle Attachment.
- 12 VDC Car Battery Charger.

1.3 ENVIRONMENTAL CONSTRAINTS

The RoadVista 932 is capable of operating between 10 and 40 degrees Celsius at altitudes up to 5000 feet. Relative humidity must remain between 0 and 95 percent, non-condensing. By keeping the instrument within these limits, heat and moisture damage to the circuit boards can be prevented.

WARNING: While the Model 932 Retroreflectometer functions to 10°C, do not place excessive pressure on the touch screen if the air temperature is +5°C or below. Doing so could cause the touch screen to crack. Before using at an air temperature of +5°C or below, make sure the instrument has been in a warm area. Periodically return the instrument to a warm area to raise the screen temperature when taking readings.

SECTION 2   INITIAL SETUP

This section includes procedures required to place the 932 Retroreflectometer into service.

2.1 UNPACKING AND INSPECTION

RoadVista has taken special care in packaging the instrument for shipment. Your 932 was shipped in a pressurized carry case. It is important that you carefully inspect the equipment for any damage that might have occurred during shipping. Visually inspect all the 932 components for dents or other signs of damage. If the instrument appears to be damage free, proceed to the Introduction, and become familiar with the mechanical features.

If damage is discovered, ascertain whether the shipping container shows damage caused by rough handling, making the shipper liable for damage. If a digital camera is available, take a picture of the shipping container and the instrument. Carefully re-package the instrument in its shipping container and include the photographs and/or comments in a separate envelope. Notify the shipper that the instrument needs to be returned because of shipping damage. Notify RoadVista of the damage. A RoadVista representative will explain how to return the equipment. This procedure will expedite the replacement of the damaged instrument.

2.2 INTRODUCTION

Model 932 Mechanical Features are shown in Figure 2.2-2

Figure 2.2-1 Model 932 Mechanical Features

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2.3 USB & SOFTWARE INSTALLATION

2.3.1 Windows GUI System Requirements

Before making any electrical connections, verify that your computer is configured with the following minimum requirements:

Operating System requirement (2.3.1) that both

- Operating System (supports 32-bit and 64-bit versions): Windows® XP, Vista, or Windows® 7.
- Hard Disk Space: Minimum required; 100 MB.
- Random Access Memory (RAM): Minimum required; 125 MB.

2.3.2 USB Installation

1. Plug the USB cable into the computer and then into the 932.
2. Power-up the 932 with the ON/OFF rocker switch.
3. The computer will recognize that a device is plugged into the USB port, and open the Hardware Wizard box.

Figure 2.3-3USB Installation Source

4. Select "Install from a list or specific location," (Figure 2.2) and click "Next" to open the next Wizard screen.

Figure 2.3 USB Driver Location

5. Select as shown in Figure 2.3 and click "Next".
6. USB driver software will take several seconds for installation.

NOTE: If the operating system directs a second installation, repeat the above steps until the system recognizes a successful installation.

7. When installation is complete, Figure 2.4 is displayed. Click "Finish" to close the Hardware Wizard box.

Figure 2.4 USB Driver Installation Completed

2.3.3 Windows Software Installation

1. Place installation CD into drive and select "Setup.exe."
2. Click "Run" (Figure 2.5).

Figure 2.3-4 Software Installation

3. The Launching Application box (Figure 2.6) opens briefly, followed by the Security Warning box (Figure 2.7).
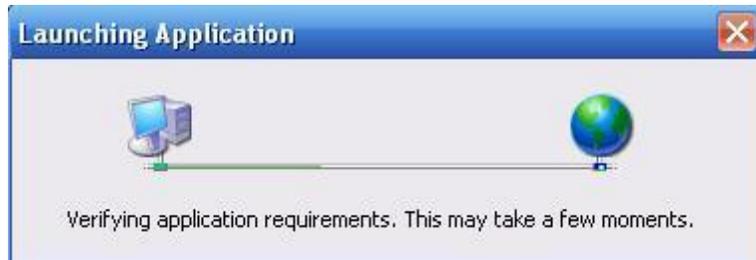
Figure 2.6 Launching Application

4. Click "Install" (Figure 2.7).

Figure 2.3-5 Security Warning

Figure 2.7 Security Warning

5. When installation is complete, click "Open" if the software will be used immediately, or "Cancel" if the software will be used at a later time.

Figure 2.8 Software Installation Completed

SECTION 3   SYSTEM OPERATION

This section includes procedures required to operate the 932 Retroreflectometer.

3.1 SYSTEM POWER UP

NOTE: Fully charge the battery before each use.

1. Power-up the 932 with the ON/OFF rocker switch. The logo screen is displayed until the system has completed the boot up sequence (shown in the lower left corner of the color touch screen). When complete, the 932 displays the MAIN MENU.
   - Reminder: The green LED will pulse when functioning properly.

3.2 ROAD VISTA 932 GUI FLOW CHART

Figure 3-1 shows 932 Graphical User Interface (GUI) menu interaction. A button is located in the lower left corner of most screens to allow the user to return to the MAIN MENU.

CAUTION

Use only a finger, or Stylus pen provided to press the touch screen buttons.   Using any hard, pointed device to press the touch screen will damage the screen.

Main Menu

Measure | Calibrate | Setup | View Data

Comment

Set Time
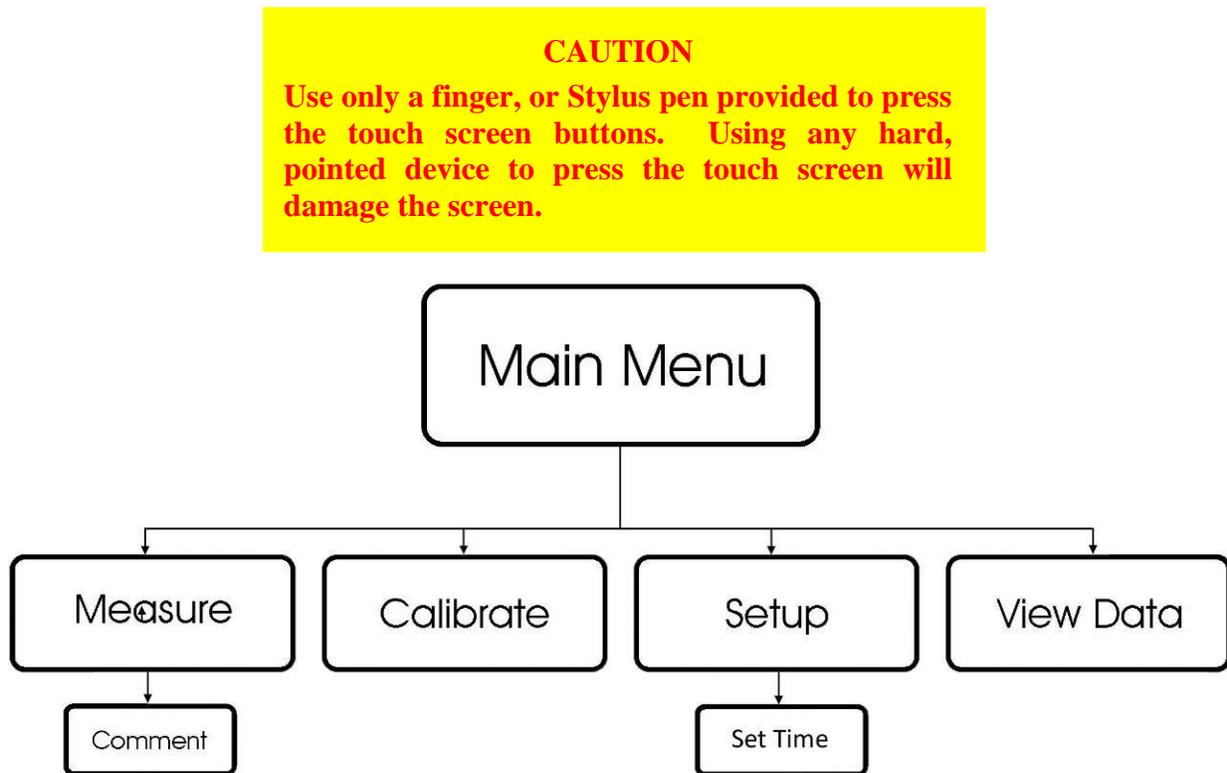
Figure 3.1 Graphical User Interface (GUI) Flow Chart

3.3 COMMON SCREEN FEATURES

Refer to Figure 3.2 and associated bullet items for common screen features.

- **USB Icon:** Displays when a USB cable for a device is connected to the USB connector.
- **Bluetooth Icon:** Displays when a Bluetooth cable for a device is connected to the Bluetooth connector.
- **GPS Icon:** Displays when a valid GPS signal has been acquired.
- **Current Temperature:** Displayed when the unit power is on.
- **Current Humidity:** Displayed when the unit power is on.
- **Battery Charge:** Available battery charge is displayed when the unit is running on battery power.
- **Current Time:** Displayed when the unit power is on.
- **Current Date:** Displayed when the unit power is on.
- **Screen Title:** Name of screen.
- **Navigation Buttons:** Press to navigate to a different screen.
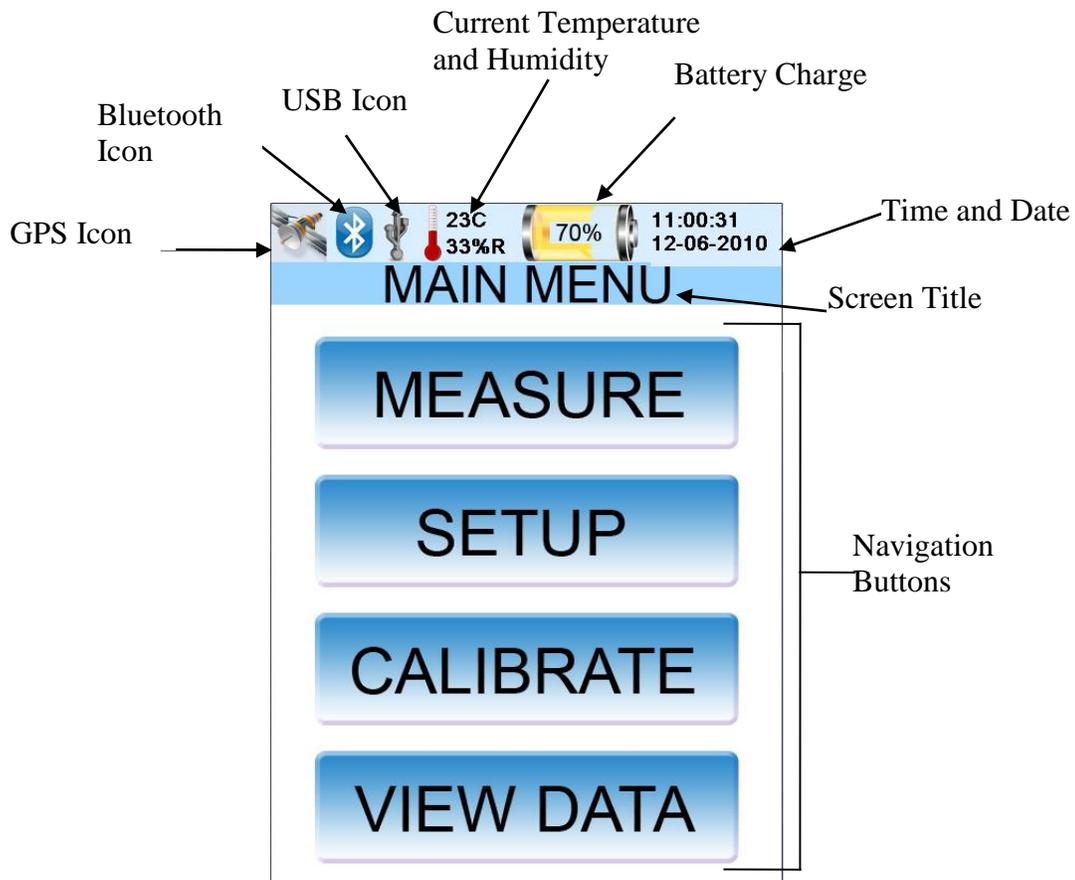
Figure 3.2. Common Screen Features

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3.4 SETUP SCREEN

Refer to Figure 3.3 and associated bullet items for SETUP screen features. More detailed information is shown in *italics*.

- **Instrument Firmware:** Firmware version that controls instrument operation.
- **Display Firmware:** Firmware version that controls Graphical User Interface (GUI).
- **Calibrate Touchscreen Button:** Corrects an out of sync screen.
  If the touch screen appears to be out of sync, recalibrate the screen by pressing the "Calibrate Touchscreen" button, and touching six different areas of the screen as they are identified.
- **Set Time Button:** Allows for manually setting time and date.
  To change the time and/or date;
      a. Press "Set Time". The SET TIME screen displays (Figure 3.4).
      b. Press the field to be changed. The colors reverse for that field.
      c. Enter a new value from the keypad.
      d. When all the values are set correctly, press "Set Time" to lock any changes.
      e. Press "Return to Setup".
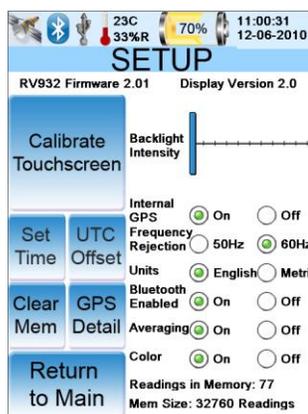
Figure 3.3. Setup Screen
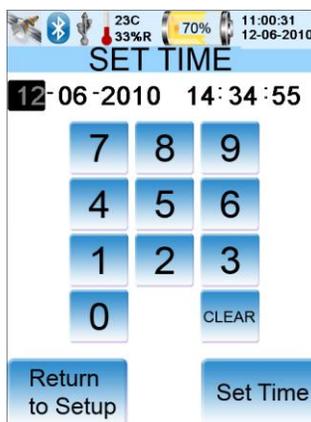
Figure 3.4. Set Time Screen

- **Clear Memory Button:** Clears the unit of all readings.
- **Backlight Intensity:** Continuously adjustable slider bar.
  Adjust the screen brightness by sliding the bar left or right for optimum display. The new setting is stored by pressing the "Return To Main" button.
- **Interal GPS:** Enables or disables the Internal GPS
- **Frequency Rejection:** Filters out the local AC power frequency (which may interfere with an accurate measurement).
  For example, select 60Hz throughout the United States.
- **Units:** Allows the user to select either English or Metric values.
- **Bluetooth Enabled:** Allows the user to turn the Bluetooth feature On or Off.
  Turning the Bluetooth feature Off when not in use will extend battery charge.
- **Averaging:** Allows the user to turn averaging On or Off.
  Averaging On allows for taking up to 20 measurements, and saving the average as a single reading. Averaging Off causes the 932 to always take single measurements and record each as a single reading.
- **Readings in Memory:** Displays the number of readings currently in memory. Maximum capacity is 30,000 readings.
- **Mem Size:** Displays the total memory capacity of the instrument.

3.5 GPS AND UTC SCREENS

The GPS screen allows the user to check the status of the GPS receiver. Additionally, the user can select from the following GPS formats:

- ddd.dddddd - displays positional information in decimal degrees
- ddd mm.mmmm – displays positional information in degrees and decimal minutes. Note: Use this format when exporting data to Google Earth.
- ddd mm ss.sss – displays positional information in degrees, minutes, and decimal seconds.
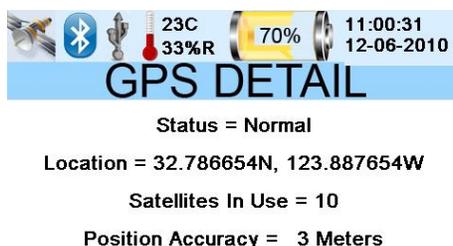
Figure 3.5-6 GPS Detail Screen

The internal CPU uses UTC time and therefore requires an offset for local time correction. The hour is based on a 0-24 scale. If you do not have a GPS fix, you may manually set the time in the Set Time Screen
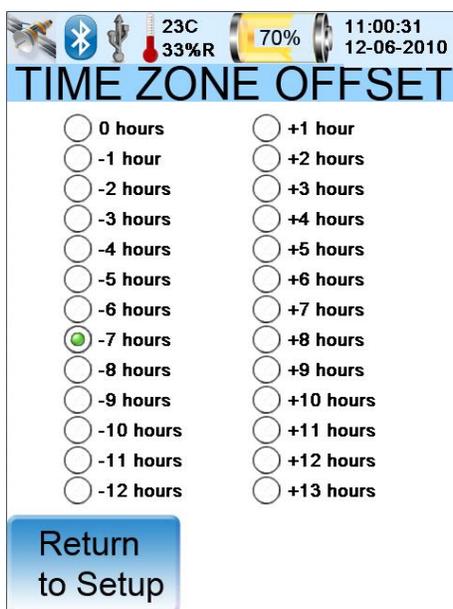
3.6 CALIBRATING THE 932

The unit may be calibrated at any entrance angle and any observation angle. However, the calibration must match the angles of the calibration standard being used. In addition, the

entrance angle must not change when moving between the dark and the light calibration steps. An entrance angle change of more than 0.5 degrees will prevent calibration.

To calibrate the instrument, follow these steps:
1. Verify the MAIN MENU screen (Figure 3.5) is displayed.
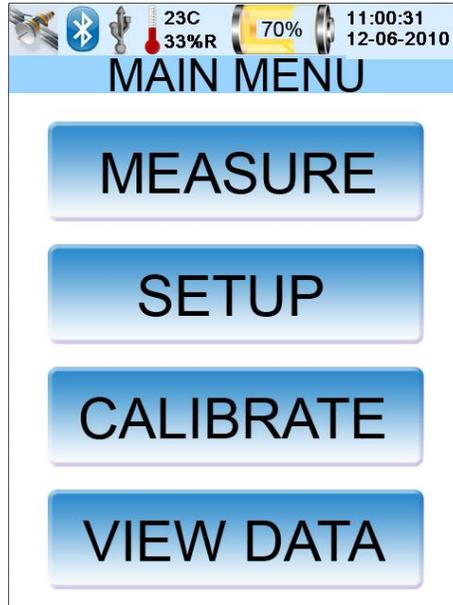
Figure 3.5. Main Menu Screen

2. Press CALIBRATE. The CALIBRATE screen (Figure 3.6) is displayed.
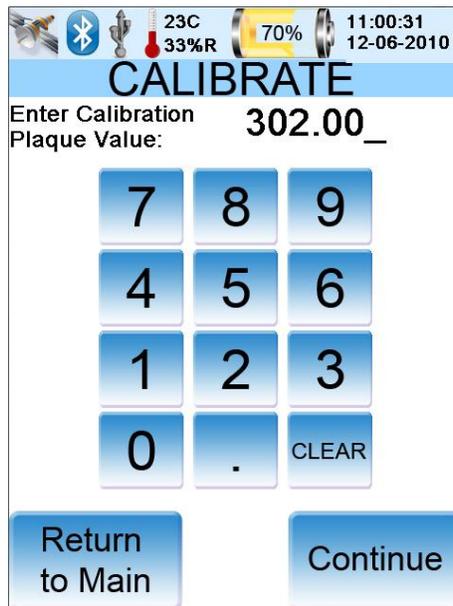
Figure 3.6. Calibrate Screen

3. Press CLEAR to delete the current Calibration value.

4. Using the keypad, follow the onscreen display to enter the Plaque Value from the Calibration Standard.
5. Press Continue. The CALIBRATE DARK screen (Figure 3.7) appears.
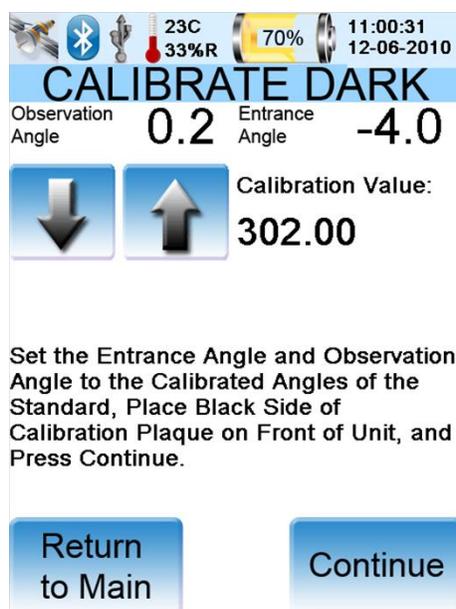
Figure 3.7. Calibrate Dark Screen

6. To set the Entrance Angle (see the onscreen instructions), loosen the entrance angle frame lock knob and place the frame against any flat surface. Tip the 932 up or down until the "Entrance Angle" reading matches the Entrance Angle value on the calibration standard. Tighten the frame lock knob.
7. To set the Observation Angle, press the up and down arrows to change the "Observation Angle" value to match the Observation Angle value on the calibration standard.
8. Place the entrance angle frame near the center of the black side of the calibration standard. Press the "Continue" button. The instrument calibrates, then displays the CALIBRATE PLAQUE screen (Figure 3.8).
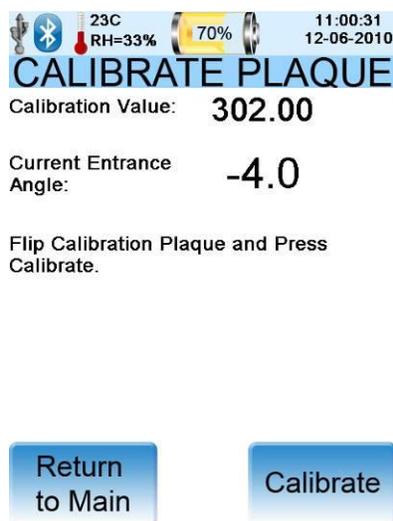
Figure 3.8. Calibrate Plaque Screen

9. Flip the calibration standard and place the entrance angle frame near the center of the white side of the calibration standard. Press the "Calibrate" button. The instrument calibrates, then displays the MAIN MENU screen.

The instrument is now ready to take measurements.

3.7 MEASUREMENTS

Refer to the following bullet items and Figure 3.5 for MEASURE screen features. More detailed information is shown in *italics*.

- **Observation Angle:** Angle between the light source and the receptor. Up and down arrows permit the user to change this value from 0.2° to 2.0°.
- **Entrance Angle:** Angle of the entrance frame in front of the 932. *Tilt the entrance angle frame to change this value.*
- **Candela formula:** Current reading formula.
- **Reading #:** Number of readings saved to memory. Maximum capacity is 30,000 readings.

NOTE: The surface to be measured must be larger than 1" in diameter. If the surface is smaller than this, an aperture reducer that is smaller than the surface to be measured must be used. If an aperture reducer is required, the 932 MUST be calibrated with the aperture reducer in place.

NOTE: To obtain an accurate measurement, perform a calibration on the instrument (paragraph 3.5) prior to use, at least once per day.

The 932 always operates in one of two measurement modes, as determined by the SETUP screen (paragraph 3.4). These are one measurement per reading (Averaging Off), or multiple measurements per reading. (Averaging On).

3.7.1 Measurement Steps

1. Verify the MEASURE screen (Figure 3.5) is displayed.
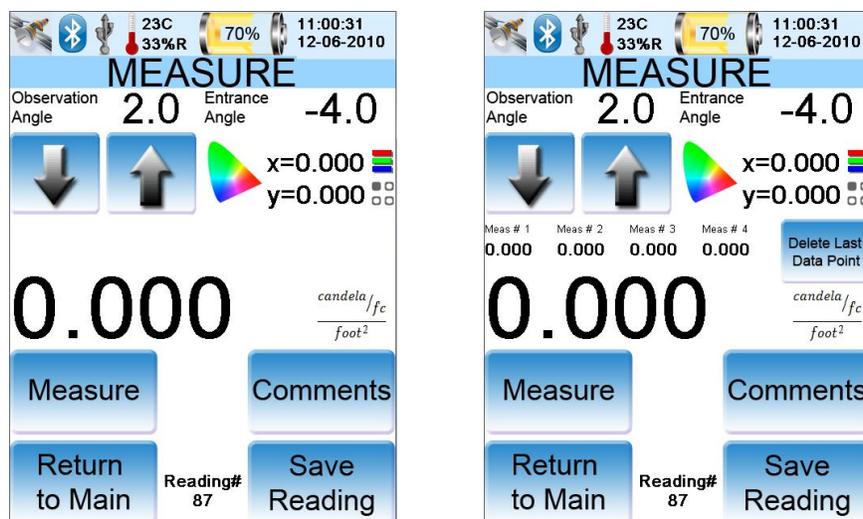
Figure 3.9. Left: Single Measurement Screen; Right: Averaging Measurement Screen

2. Place the entrance angle frame against the surface to be measured, and select Measure, or pull the 932 trigger. The screen displays WAIT while the measurement is being taken.

- **Single measurement mode (Averaging Off):** The measurement is shown above the Measure button. If the measurement is to be saved as a reading, select "Save Reading".
- **Averaging measurement mode (Averaging On):** The first measurement is shown below "Meas # 1", and the average reading is shown above the Measure button. Continue taking measurements (maximum 20 measurements). The second measurement is shown below "Meas # 2", and the average reading is updated. Measurements 5 through 20 are shown below "Meas # 4" as they are taken, and previous measurements slide to the left. Press Delete Last Data Point button to remove the most recent measurement. Only the 4 most recent measurements are shown, however all measurements are averaged as a single reading. Select "Save Reading" to save the average of this group of measurements and reset all measurement values to "0".

NOTE: When the unit has reached 20 measurements in averaging mode, the 932 will stop taking measurements until the current group is saved as a reading.

3.7.2 Entering Comments

Comments, up to 18 characters in length may be added to the reading.

1. From the MEASURE screen, select the Comments button. The COMMENTS screen appears (see Figure 3.10), containing an alpha/numeric keypad.

Figure 3.10. Comments Screen

2. Type information and characteristics about the reading. Note the following:
    *   **Space button:** Enters a space in text. Each space uses one of the 18 available characters for this comment.
    *   **Shift button:** This button toggles upper case on or off. When upper case is set, the Shift button functions as a "shift lock" button.
    *   **Bksp button:** Pressing this button deletes the most recently entered characters, one at a time.
    *   **Clr button:** Pressing this button erases all characters on the screen.
3. When the comment is complete, press Return to Measure. The comment is sent to non-volatile memory, and the MEASURE screen returns.

3.8 VIEW DATA

The VIEW DATA screen allows the user to view any data saved to memory. All the data along the left edge of the screen is from the MEASURE or COMMENTS screens.
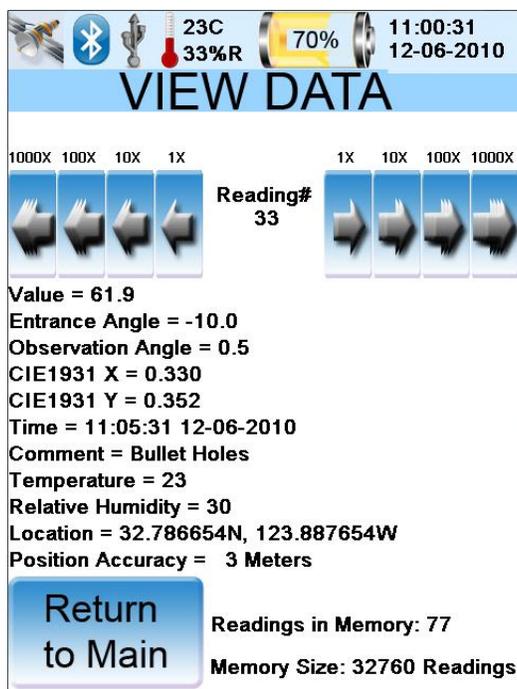
Figure 3.11. View Data Screen

Use the left and right arrows to navigate to specific reading numbers. Arrows identified as 1X increment (right pointing) or decrement (left pointing) the currently displayed reading # by 1. Arrows identified as 10X increment or decrement the currently displayed reading # by 10, and so on.

To reach a specific reading, select the appropriate left or right pointing arrows. For example, if the current reading is # 552, and you want to display reading # 56, press the left pointing 100X arrow 5 times (to display reading # 52), then the right pointing 1X arrow 4 times to reach reading # 56.

3.9 WINDOWS INTERFACE

The Model 932 Windows interface program allows the user to download all readings held in memory. Once the readings are downloaded, they may be saved as a .csv file in a spreadsheet program such as Excel.

3.9.1 Connecting the Model 932 USB Interface to a Computer

1. Verify a computer with the RoadVista 932 software installed is available and powered on.
2. Power-up the 932 with the ON/OFF rocker switch. Wait while the system completes the boot up sequence. When complete, the logo screen is replaced with the MAIN MENU, and the green LED pulses.

3. Connect a USB cable between the 932 USB connector and the computer. The USB icon is displayed on the 932 screen.

3.9.2 Connecting the Model 932 Bluetooth Interface to a Computer

1. Verify a computer with the RoadVista 932 software installed is available and powered on.
2. Power-up the 932 with the ON/OFF rocker switch. Wait while the system completes the boot up sequence. When complete, the logo screen is replaced with the MAIN MENU, and the green LED pulses.
3. Enable the Bluetooth on the 932 SETUP screen (Paragraph 3.4). The Bluetooth icon is displayed on the 932 screen.

3.9.3 Establishing Computer Communication

1. Open the RoadVista 932 software. The Download Manager screen appears (Figure 3.12).
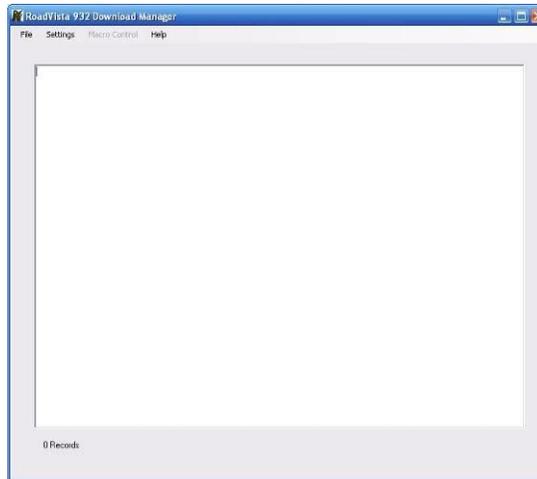
Figure 3.12. Download Manager Screen

2. Select Settings, Com Port (Figure 3.13). The Com_Port_Dialog box opens (Figure 3.14).

Figure 3.13. Setting Com Port

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3. Click the Auto Locate 932 button.
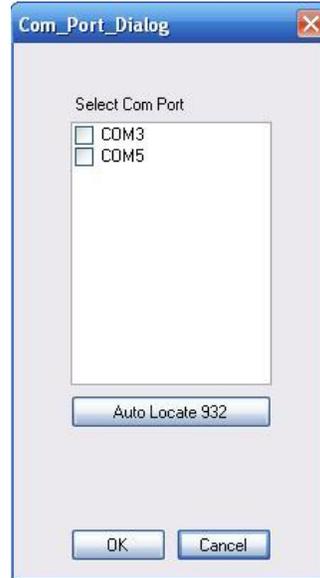
Figure 3.14. Auto Locate Com Port

4. The Model 932 software will find and display the Com Port connected to the 932 (Figure 3.15).
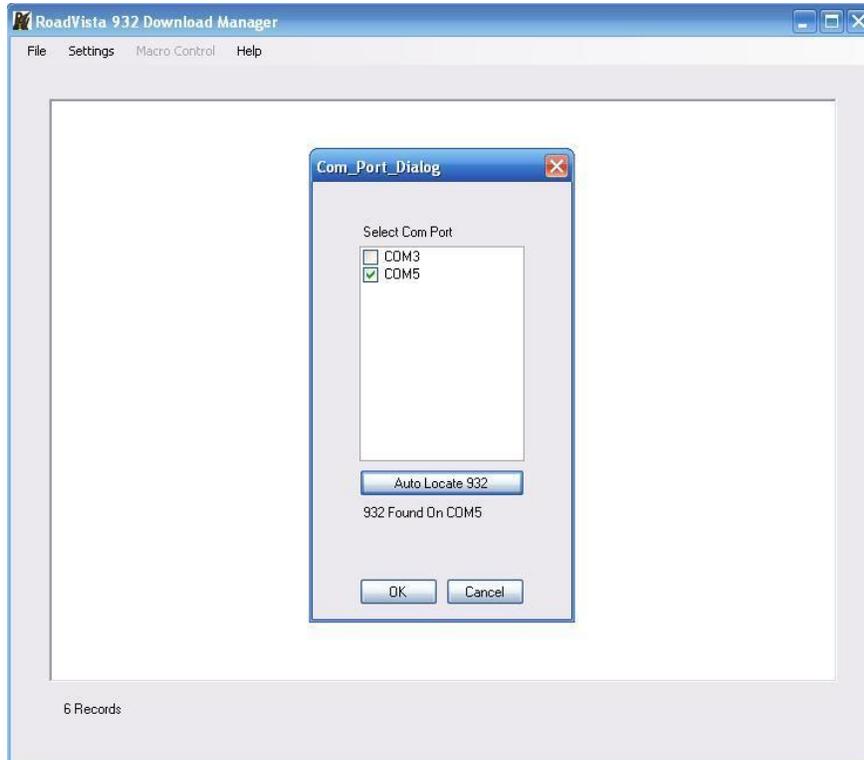
Figure 3.15. Com Port Enabled

5. Click OK to close the Com_Port_Dialog box.

3.9.4 Download and Save Readings as Data Files

1. Select File, Download Data (Figure 3.16). The Download Manager screen opens, listing all saved readings (Figure 3.17). Contents of the Download Manager is fully editable.

Figure 3.16. Enabling Download Manager
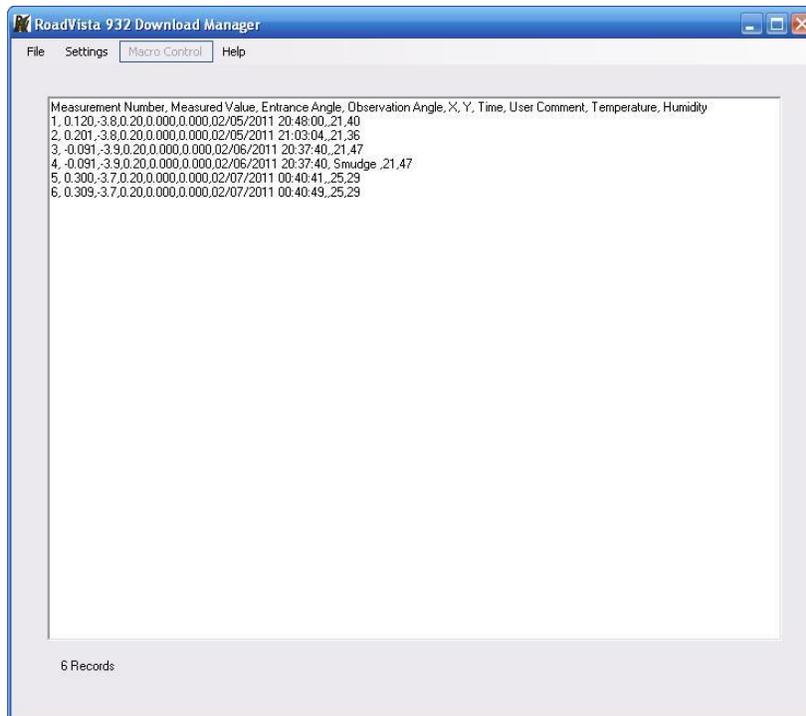
Figure 3.17. Download Manager Screen

2. Select File, Save Data to .csv File (Figure 3.16). The Save As screen opens (Figure 3.18). Navigate to the desired folder and save the file.
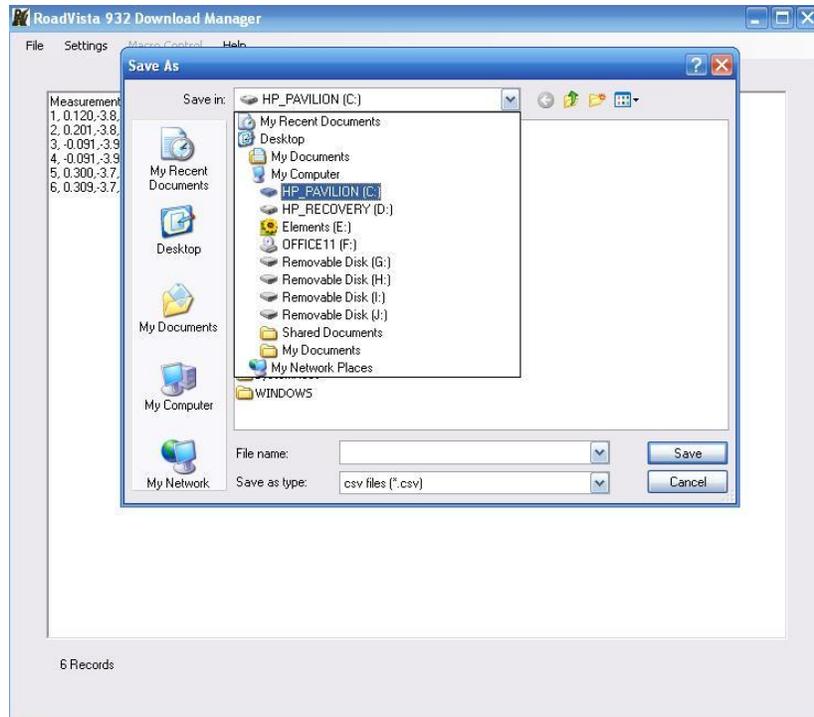
Figure 3.18. Save File Navigation Screen

Data saved as a .csv file can easily be imported by a spreadsheet program such as Excel.

After saving the file, the user may choose to delete the 932 readings (paragraph 3.4). Deleted readings cannot be recovered.

3.9.5 Using the Model 932 With a Bluetooth Device

Any Bluetooth device used with the Model 932 must support Serial Port Protocol (SPP), and be able to initiate a Bluetooth connection. To connect the Bluetooth, follow these steps:

1. Verify the Model 932 is powered-up and the green LED pulses.
2. Enable Bluetooth on the 932 SETUP screen (Paragraph 3.4)..
3. From the remote device, perform a search for Bluetooth devices. The 932 will show up as "RV932".
4. Pair the two devices, using "0000" as the passkey.
5. Open a serial connection on the remote device with the 932. When the serial connection is correctly initiated, a Bluetooth icon will appear near the top left of the 932 screen.

SECTION 4   MAINTENANCE AND TROUBLESHOOTING PROCEDURES

4.1 SECTION OVERVIEW

The 932 Retroreflectometer has **no user-serviceable components**. If the green LED is not pulsing, the 932 internal CPU has malfunctioned. If this occurs, cycle the 932 power off, then on. If the problem persists, or if any other problem develops, refer to paragraph 4.2, Factory Repair.

4.2 FACTORY REPAIR

RoadVista maintains a factory repair department to return the 932 Retroreflectometer to within specification. If returning any portion of the 932 Retroreflectometer for calibration or repair, please contact the factory for a Return Material Authorization (RMA) number prior to shipment. Please use the following to contact the factory:

Phone (858) 279-6044
FAX (858)576-9286
www.roadvista.com

Attach a detailed description of the specific problem (to minimize turnaround time), repack the instrument in its original case (if available), and ship it to the factory at the following address:

RoadVista
9925 Carroll Canyon Road
San Diego, CA 92131

Attn: Repair Department

4.3 SCHEDULED MAINTENANCE

The 932 should be returned to RoadVista on a yearly basis to verify all aspects of the measurement system are within specification and perform standard routine maintenance. Standard maintenance includes the following;

- Replace lamp
- Verify optical alignment
- Update firmware with newest version
- Full system check

4.4 STORAGE

When not in use, the 932 should be stored in its original shipping carton to protect it from damage, dust particles, and other potentially harmful environmental conditions.

4.5 CLEANING

Only the 932 exterior surface and touch screen may be cleaned.

<div style="background:yellow; color:red">

CAUTION

When cleaning the 932, keep all cleaning materials and fingers away from the touch screen and lenses.

DO NOT use chemical cleaning agents that may damage the plastics, paint, or metal.

</div>

To clean the exterior surface, create a cleaning solution by combining water and a mild detergent. Dampen a soft cloth in the solution, and wring out the excess liquid. Wipe the 932 in a circular motion, making sure that the solution does not seep into any crevices.

To clean the touch screen, use only a new, dry, delicate task wiper, moving it in a circular motion.

APPENDIX A – DATA FORMAT

This section explains the raw data format used by the 932. This data is sent out the USB and Bluetooth ports during each measurement, and can be downloaded and saved as a .csv file as described in paragraph 3.9.4.

Here is an example raw file, with 1 data point:

1,100.2,-4.0,0.33,0.345,0.422,02/15/2011 14:30:22,LARGE SMUDGE,22,45

Each column is separated by a comma.

Column 1: Measurement number
Column 2: Measurement value
Column 3: Entrance Angle
Column 4: Observation Angle
Column 5: CIE X value
Column 6: CIE Y value
Column 7: Month/Day/Year Hour:Minute:Second
Column 8: User Comment
Column 9: Temperature
Column 10: Humidity
Column 11: GPS Latitude
Column 12: GPS Longitude
Column 13: GPS Estimated Accuracy

Using the USB or Bluetooth interface, the following commands can be used (this list is available by typing "?" or "HELP":

```
AD1F=Y<cr> - Set the rejection frequency to Y (50 or 60)
BEEP<cr> - Sound test beep
CAL_DARK<cr> - Calibrate dark side of Test Plaque (must be followed with CAL_LIGHT)
CAL_LIGHT<cr> - Calibrate light side of Test Plaque (first do CAL_DARK)
CLEAR MEMORY<cr> - Clear the Memory
DUMP<cr> - Dump various parameters
FIRMWARE<cr> - Switch to Firmware Update Mode
MSR<cr> - Take Measurement
SAVE<cr> - Save Current Measurement to Memory
SHOW VER<cr> - Show Firmware Version
TRANSFER ALL<cr> - Transfer all data in memory
SET COMMENT=CCCCC<cr> - set current measurement comment to CCC, maximum 18 characters long
SET OA=X.XX<cr> - set the observation angle to X.XX
SET UNITS=METRIC<cr> - set units to metric
SET UNITS=ENGLISH<cr> - set units to english
```

Revision #	Changes Made	Effective Date	ECN #
A	Initial Release.	01 MAR 11	N/A
B	Updated CAUTION/WARNING notes	02 FEB 12	6465
C	Updated Bluetooth/USB command notes in Appendix A; Updated factory address; Updated product description	19 MAY 14	
D	GPS additions		
E	Updated Gamma Scientific Address	09 DEC 16	6566