INSTRUCTION MANUAL

ICESIGHT

MODEL 5433-3X

60-5433-3X (E0)
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CONTENTS

1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 5433 IceSight is a non-intrusive surface condition sensor for fixed installations. The sensor is factory calibrated to provide the user with surface condition (dry, damp, wet, snow and ice), surface friction coefficient or grip, surface temperature, air temperature and relative humidity. All measurements are performed in real-time with RS-232, RS-485 serial and Ethernet IP communications.

The sensor can be installed as a stand-alone unit or as a sensor component of a Road Weather Information System (RWIS) station. The unit can be configured, as an option, to provide a contact output to activate ITS devices directly from the sensor when winter weather conditions exist.

There are multiple configurations of the sensor that include wired Ethernet with or without wiring breakout box for wire termination options.

1.2 RECEIVING, INSPECTION AND UNPACKING

Many High Sierra Electronics products are scientific instruments. Exercise care during unpacking and installation. Remove the contents of the package carefully and compare the contents with the enclosed packing list. Should any items be missing, notify High Sierra Electronics Customer Service. Please have your packing list available when you call.

The following items should be found in your package:

- 5433 IceSight
- Cable assembly for sub model number ordered
- Sighting laser
- Two ¼”-20 screws with washer and lock washer
- 120 Ω termination resistor
- Test checkout sheet
- Resources can be downloaded at https://hsierra.com/support/library/
  - Product manual
  - IceSightCal_4.1.0.jar application
  - Configuration file

If any of the items are received in damaged condition, notify the carrier immediately and request an inspection. You must notify the carrier promptly. If a claim is not made in a timely period, then the carrier will not acknowledge any claim for the lost or damaged goods.

Claims for products lost or damaged in transit should be made by Buyer to the carrier, as risk of loss transfers to Buyer, and HSE's responsibility ceases upon its tender of products to Buyer, to Buyer’s representative, or to a common carrier. Title of the products shall not pass to the Buyer until HSE has received payment in full for

the products and all other sums due to HSE from the Buyer on any account. Until transfer of Title of the products, the Buyer shall ensure that the products are kept safe, secure and insured.

1.3 ORDERING GUIDE

5433-34..... IceSight with 30 ft main cable to bare leads
5433-35..... IceSight with 30 ft main cable to breakout box

5433-64..... IceSight replacement main cable, 30 ft with breakout box
5433-65..... IceSight replacement main cable, 30 ft with bare leads
5433-66..... Extra IceSight cable (per foot)
5433-70..... IceSight sensor pole mounting bracket, 3” to 8” pole
5407-01..... Power supply 12 VDC @ 1.5 Amp output

5433-80..... IceSight annual maintenance agreement, ship-in 1 time per year for clean, refurbish and calibrate. Includes necessary parts, including laser and optical parts if needed.

Note: The 30 ft main cable with tinned leads is recommended when the sensor will be installed on a tower or pole where the electronics or communication enclosure is within 30 ft of where the IceSight sensor will be installed. The breakout box option is useful in installations where the electronics or communications enclosure is a longer distance away.

2 SPECIFICATIONS

Range	10 to 50 ft (3 to 15 m) concrete 10 to 33 ft (3 to 10 m) black asphalt
Measurement Area	12 in (30.5 cm) diameter @ 33 ft (10 m)
Surface	Asphalt or Concrete
Sensitivity	0.01 in Ice/Water, 0.05 in Snow
Elevation Angle	30° to 85° from road surface, 45° optimum
Surface Temperature Range	-40° to 185°F (-40° to 85°C)
Surface Temperature Accuracy	±1° at 32°F otherwise ±2°F (±0.5°C at 0°C otherwise ±1°C)
Air Temperature Range	-40° to 149°F (-40° to 65°C)
Air Temperature Accuracy	±0.4 at 32°F, otherwise ±0.9°F (±0.2 at 0°C, otherwise ±0.5°C)
Relative Humidity Accuracy	±1.8% at 10% to 90% RH, ±3% at 0% to 10% and 90% to 100%
Voltage Range	9 to 30 VDC
Power Consumption	3.2 Watts
Operating Temp	-40° to 149°F (-40° to 65°C)
Surface States	Dry; Wet (3) - damp, wet, standing water; Snow (2) - snow, un-compacted snow; Ice (2) - ice, black ice
Surface Grip	0 to 1 and classified surface grip (good, fair, poor)
Optics Condition	Dirty lens output
Communication	EIA-485, multi-drop capable (up to 8 addresses), EIA-232, Ethernet
Targeting	High Visibility Green Laser
Safety	Eye Safe Class 1 Lasers
Mounting	Standard flat camera mount foot (3x ¼ in-20 holes spaced 1 in)
Dimensions	16.5 x 5.5 x 8.0 in (42 x 14 x 20 cm)
Weight	8 lb (3.6 kg)
Shipping Weight	15 lb (4.5 kg)

3 INSTALLATION

The 5433 IceSight is designed to be permanently installed, typically on a pole or lattice tower, with or without weather protection, and aimed downward at an asphalt or concrete surface. There are multiple sensors to consider when installing the IceSight which include the surface condition, surface temperature and ambient temperature and relative humidity sensors.

Considerations for the optical sensors that determine condition:

- Distance from the sensor to the surface area to be measured.
- Angle of the sensor to the surface.
- Measuring area or Field of View (FOV) of the sensor.
- Pavement surface. Cracks and/or paint on the pavement can cause erroneous readings. Install the sensor on a uniform section of pavement within the sensors field of view.
- There can be no obstructions in the line of site between the sensor and the measuring surface.

Considerations for the surface temperature sensor include:

- Distance from the surface area to be measured.
- Measuring area or Field of View (FOV) of the sensor.
- Any nearby, heated equipment or structures.
- Either direct or strong reflected sunlight (as from a large shiny metal surface) arriving at the IR sensor at the front of the unit can introduce significant error in the surface temperature measurement.
- There can be no obstructions in the line of site between the sensor and the measuring surface.

Considerations for the air temperature and relative humidity include:

- Any nearby heat sources.
- Any structures that would block airflow to the sensor. The sensor should be installed in such a way to maximize air flow to the sensor.

3.1 SITE SURVEY REQUIREMENTS

Upon ordering, information will need to be provided to HSE for the IceSight to be factory calibrated in preparation for field deployment. The directions below outline this required information.

Information needed at the time of order:

1. Sensor height from roadway surface (Y)
2. Distance from monitored spot (X)
3. Roadway surface: Asphalt, Concrete, Grooved Concrete, Hybrid (i.e. epoxy/aggregate mix)
4. Total distance from sensor to processing unit (Y+D), for cable sizing

5. Any possible line-of-site obstructions (i.e. curtain walls, utility poles, etc.)
6. Type of structure the sensor will be mounted (i.e. side of pole, wall or building, lattice tower, etc.)

Table 1. Installation Limitations.

Dimension	Range
Distance from sensor to target (Z)	Asphalt: 10 to 33 feet, 3 to 10 meters Concrete: 10 to 50 feet, 3 to 15 meters
Angle (a)	30 to 85 degrees

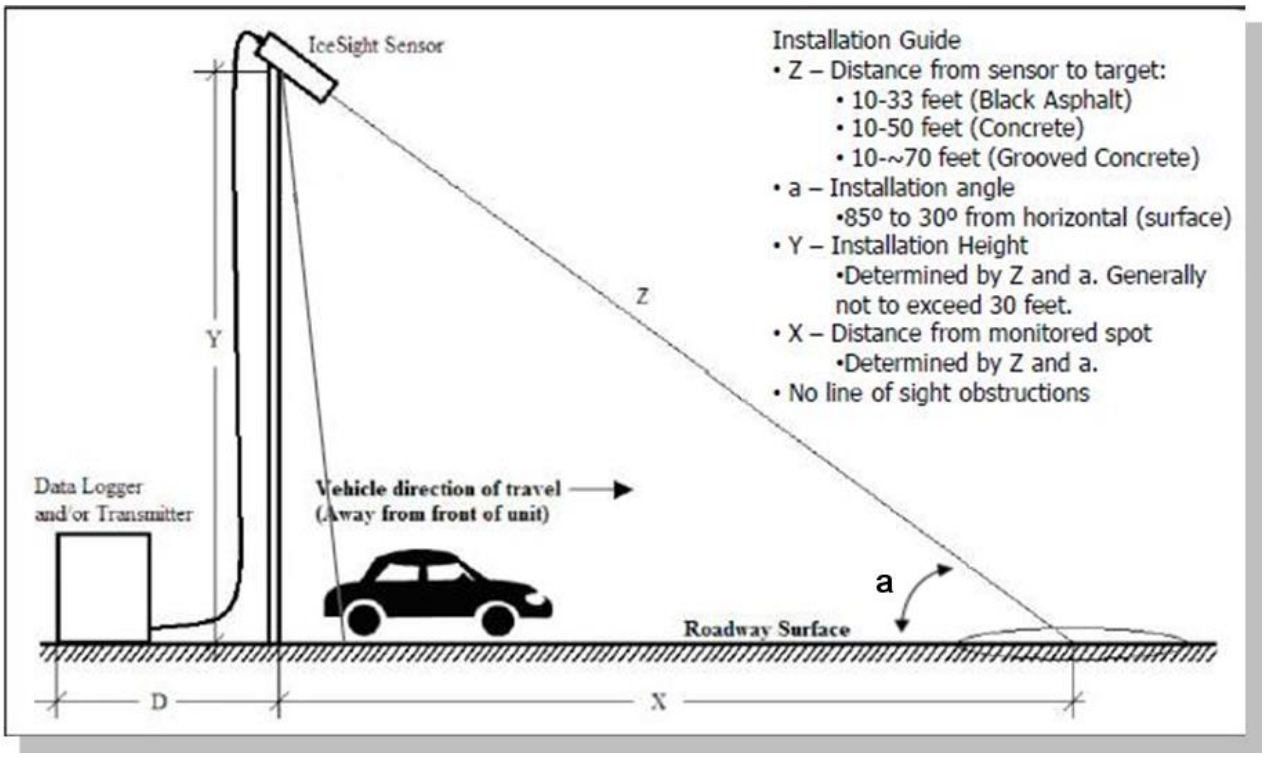

Figure 1 Installation

It is recommended to install the IceSight pointed North in the Northern hemisphere, or at an angle of incidence higher than the local maximum solar elevation when possible. This simple consideration shields the IR sensor from direct and most reflected solar radiation.

The installation angle and measuring distance can be calculated with the following equations:

$$a = \arctan\frac{Y}{X} \qquad Z = \sqrt{Y^2 + X^2}$$

Table 2. Example Mounting Heights, Distances, and Angles

Length base to road (X)		Height of sensor (Y)		Angle (A)	Distance sensor to road (Z)	
Feet	Meters	Feet	Meters	Degrees	Feet	Meters
5	2	9	3	60	10	3
5	2	14	4	70	15	4
5	2	28	9	80	29	9
10	3	6	2	30	12	4
10	3	8	3	40	13	4
10	3	10	3	45	14	4
10	3	12	4	50	16	5
10	3	17	5	60	20	6
10	3	27	8	70	29	9
10	3	57	17	80	58	18
20	6	12	4	30	23	7
20	6	17	5	40	26	8
20	6	20	6	45	28	9
20	6	24	7	50	31	9
20	6	35	11	60	40	12
20	6	55	17	70	58	18
30	9	17	5	30	35	11
30	9	25	8	40	39	12
30	9	30	9	45	42	13
30	9	36	11	50	47	14
40	12	23	7	30	46	14

3.2 FIELD OF VIEW

The area of measurement and its surroundings need to be considered when installing the sensor. There are two sensors to consider in respect to Field of View (FOV). These sensors include the infrared temperature and road condition optic sensors.

3.2.1 Surface Conditions FOV

The FOV angle of the surface condition laser optic sensors is about 1.6° and can also be stated as 0.8° from axis, called the half-angle. Table 3 shown below provides the approximate dimensions of the 1.6° FOV pattern when the IceSight is aimed at a 45° angle, as shown in Figure 1.

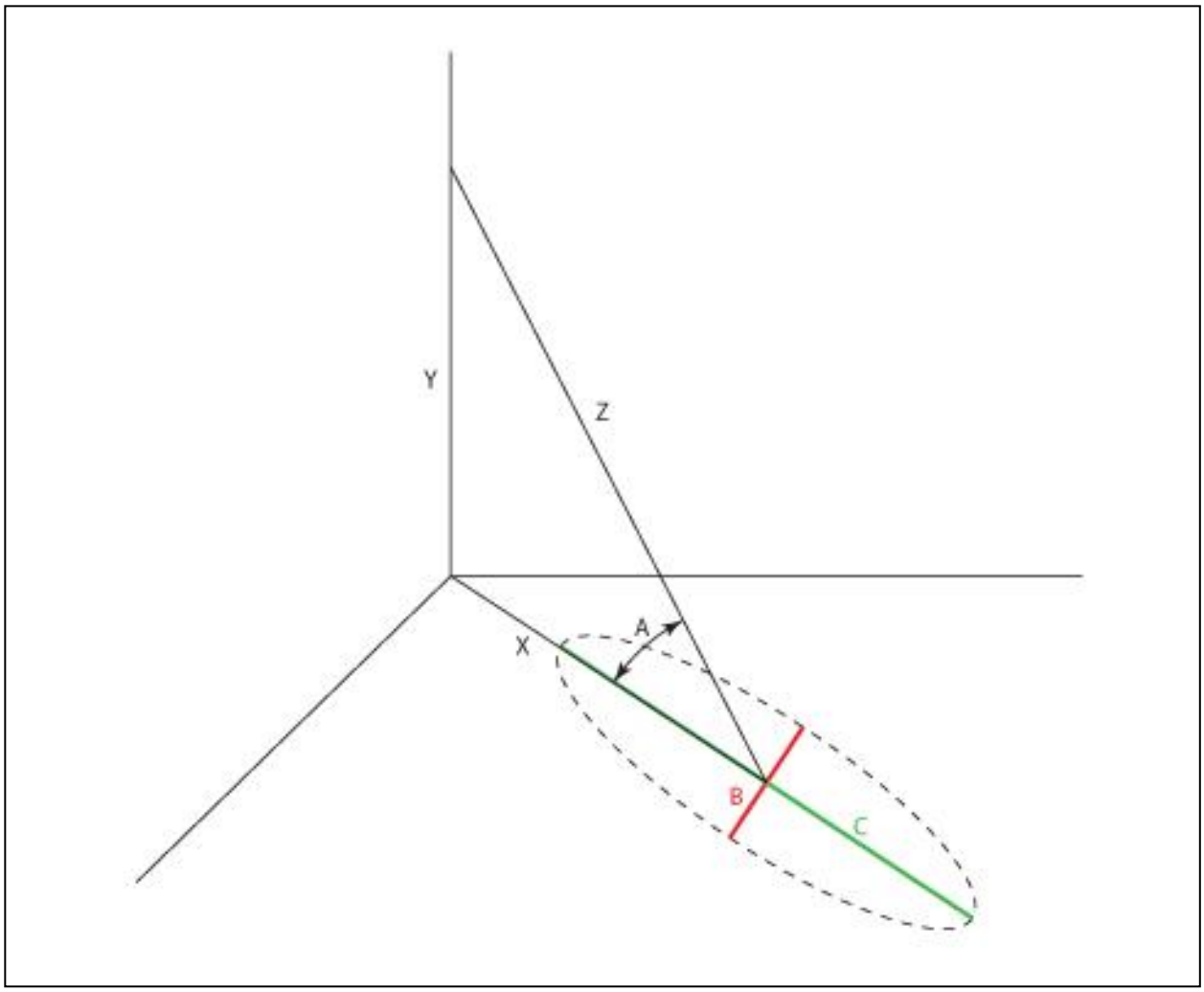

Figure 2. Elliptical pattern

Table 3. Elliptical pattern from 1.6° FOV projected onto flat surface at 45° angle A

Height of sensor (Y)		Short Dimension (B)		Long Dimension (C)		Area	
Feet	Meters	Inches	cm	Inches	cm	Inches^2	cm^2
10.0	3.0	3.4	8.5	6.7	17.0	17.6	113.8
15.0	4.6	5.0	12.8	10.1	25.5	39.7	256.1
20.0	6.1	6.7	17.0	13.4	34.1	70.6	455.4
25.0	7.6	8.4	21.3	16.8	42.6	110.3	711.5
30.0	9.1	10.1	25.5	20.1	51.1	158.8	1024.5
35.0	10.7	11.7	29.8	23.5	59.6	216.1	1394.5
40.0	12.2	13.4	34.0	26.8	68.1	282.3	1821.4

3.2.2 Surface Temperature FOV

The Field of View angle of the infrared surface temperature sensor is 12° and can be stated as 6° from axis, called the half-angle. Objects within this angle contribute about 75% to the measured IR power. However, sources surrounding this area still contribute about 25% of the total measured IR power. Objects in the outer area, outside of an approximate 90° field of view, or 45° from axis, contribute insignificantly.

Table 3 and Table 4 shown below provide approximate dimensions of the 12° Field of View pattern when the IceSight is aimed at a flat surface at an angle of 90° and 35°, as shown in Figure 1.

Table 4. 12° Field of View (FOV) projected onto a flat surface directly downward, perpendicular to the surface.

Height of sensor (Y)		FOV Diameter		Area	
Feet	Meters	Feet	Meters	Feet²	Meters²
10.0	3.0	2.1	0.6	3.5	0.3
15.0	4.6	3.2	1.0	7.8	2.9
20.0	6.1	4.2	1.3	13.9	5.2
25.0	7.6	5.3	1.6	21.7	8.1
30.0	9.1	6.3	1.9	31.2	11.6
35.0	10.7	7.4	2.2	42.5	15.8
40.0	12.2	8.4	2.6	55.5	20.6

Note: Though the infrared temperature sensor can operate properly perpendicular to the road, the condition optical sensors can't. Follow the recommended installation procedures.

Table 5. Elliptical pattern from 12° field of view projected onto flat surface at 35° angle A.

Height of sensor (Y)		Short Dimension (B)		Long Dimension (C)		Area	
Feet	Meters	Feet	Meters	Feet	Meters	Feet²	Meters²
10.0	3.0	2.1	0.6	3.1	1.0	5.2	0.5
15.0	4.6	3.2	1.0	4.7	1.4	11.7	1.1
20.0	6.1	4.2	1.3	6.3	1.9	20.8	1.9
25.0	7.6	5.3	1.6	7.9	2.4	32.5	3.0
30.0	9.1	6.3	1.9	9.4	2.9	46.8	4.3
35.0	10.7	7.4	2.2	11.0	3.4	63.7	5.9
40.0	12.2	8.4	2.6	12.6	3.8	83.2	7.7

3.3 FIELD INSTALLATION PROCEDURE

Proper installation of the unit is extremely important in obtaining maximum performance and accuracy of the system.

3.3.1 Needed for Installation

To install the IceSight in the field, the following equipment will be necessary.

- IceSight and included components (see section 1.2)
- 9 to 30 VDC power supply
- Lap-top computer with wired Ethernet
- Data Processing/Logging/Transmitting equipment
- Mounting equipment (contact HSE for options)
- Protractor
- Tape Measure

3.3.2 Installation Procedure

Review the following installation procedures once the component check has been completed. A certified electrician may be required to check wiring connections prior to application of power.

Caution: Reverse polarity or over-voltage power supplies can cause serious damage to the unit.

1. Attach IceSight to a suitable mounting bracket using the integral mounting block. There are three ¼-20 threaded holes spaced 1 inch apart for mounting. The hole pattern will fit most standard camera mounting equipment. Contact HSE for optional mounting brackets to fit your need. It is important that the IceSight be securely mounted to the mounting structure.
2. Attach the mounting bracket to the mounting structure at the specified height (Y). Typical mounting structures include a lattice tower or a minimum 4-inch rigid conduit or pole.
3. Using a protractor or the typical installation distance table, set angle of sensor to specified angle.
4. Align the laser pointer along the IceSight housing rail as pictured.

Image 1

5. Using the green spotting laser, choose a spot inside the nearest lane of traffic. The target should be uniform, dry and free of any debris or markings including any cracks and painted lines. An ideal target is a 3' diameter circle of bare concrete or asphalt at no more than 10 meters distance between sensor and roadway. The angle (a) in Figure 1 must be between 85° and 30° with an optimal angle at 45° from horizontal road surface. Adhering to these distances and angles will assure that the sensor can receive enough returned laser signal to make reliable measurements.

Image 2

Image 3

Image 4

6. After the location is chosen, secure the IceSight sensor to the mounting structure making sure all mounting hardware is tight.
7. Remove the spotting laser and retain for future use by placing items in bag provided.
8. If equipped with a breakout box, attach to the mounting structure. The breakout box is ideal for installations requiring longer distance cable runs.
9. Wire the sensor per your application. Installations vary depending on the IceSight model provided and the type of communications. Refer to Section 4.1 for sensor wiring diagrams.

**** DO NOT Power up system until all connections are made. ****

Caution: Reverse polarity or over-voltage power supplies can cause serious damage to the unit.

a. Connect the serial and or Ethernet wire to your processing unit or communications device. The IceSight comes standard with RS-232, RS-485 and TCP/IP communications protocols.
b. Connect (GND) from power supply to GND IN on terminal block.
c. Connect +9 to 30 VDC from power supply to IceSight VDC IN on terminal block.
d. Connect IceSight sensors cable to the main cable using the weather resistant quick connector. **Care** should be taken to prevent the bending of pins, allowing the connector to mate without force. Once the keyways are aligned, press the connectors together and twist. You will feel an assuring "click".

Note: Always cover the female connector end with the provided tethered cap when removing the IceSight sensor. This will ensure the prevention of moisture damage to the connector and cable.

Image 5

9. Power up the system and verify that the green LED pilot indicator is lit.
    a. LED indicator is located behind the flat plate glass, below the lasers on the front of the unit.

Note: The IceSight sensor needs to be powered on for at least 20 minutes before proceeding with calibration.

4 OPERATION

4.1 WIRING

The IceSight sensor comes with a rugged waterproof connector on a 1-foot pig tail. Depending on the model of IceSight ordered the main cable will connect to the 1-foot pig tail connector. The main cable options include bare wire with tinned leads or a breakout box with included terminal block. The bare wire option is recommended for installations where the sensor is within 30 feet of the communicating device. The breakout box is convenient for installations that require long installation distances. Consult the ordering guide for sensor options.

Note: It is recommended to power down your system before wiring the IceSight unit.

Table 6. Main cable wiring diagram

	Wire Color	Connector Pin Position
RJ-45	Orange	5
	White/Orange	4
	Green	3
	White/Green	2
Earth Ground	Green	1

	Wire Color	Function	Connector Pin Position
Power	Black	Power Ground	12
	Red	+9-30 VDC	11
RS-232	Black	RS-232 Tx	10
	White	RS-232 Rx	9
	Black*	RS-232 Ground	8
RS-485	Red	RS-485 Tx+	7
	White	RS-485 Tx-	6
Ethernet	Black	TX-	5
	Blue	TX+	4
	Black	RX-	3
	Yellow	RX+	2
	Shield	Housing Ground	1

*Black wire for RS-232 ground is from the Black/Green pair.

For the breakout box wiring option, the main cable is wired to terminal blocks in a weatherproof enclosure for convenient wiring.

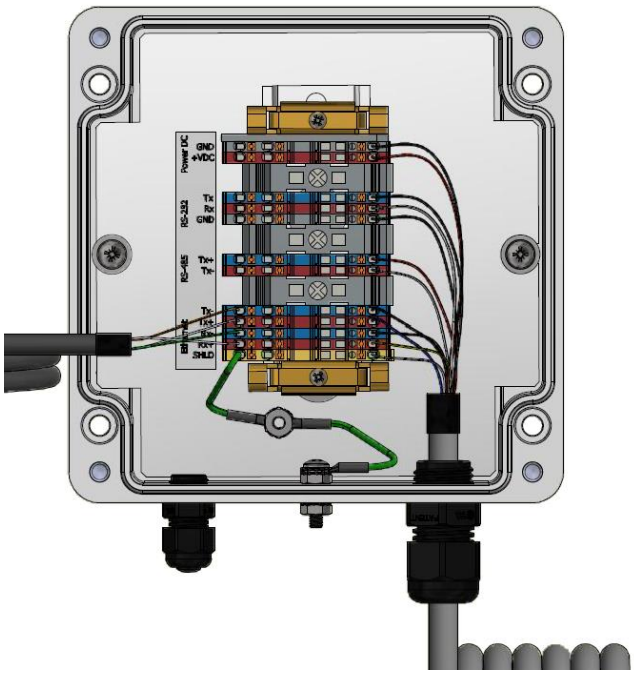

Figure 3. Breakout box

4.2 CONNECTING TO THE ICESIGHT SENSOR

A computer running at least Java 8 will be needed to connect to the IceSight for setup and calibration. An available Ethernet port will be needed for IceSight models with an Ethernet RJ-45 connector.

1. Connect to the IceSight Sensor with the Java application to view streaming data.
    a. Wired Connection: Set your laptop to an IP address in the range of the one specified in documentation and on the serial number tag located on the bottom of your unit. (example: 192.168.1.2)

    Note: The factory default address is set to 192.168.1.120 on IceSight sensors with serial numbers greater than 37542 and 192.168.1.180 on sensors less than.

2. Run the Java Applet (IceSightCal4.1.0.jar). Pre-install Java on the PC, if necessary.
3. Enter the IP address of the IceSight sensor. The default IP address from the factory is 192.168.1.120.
4. After clicking Connect, the calibration panel should appear.

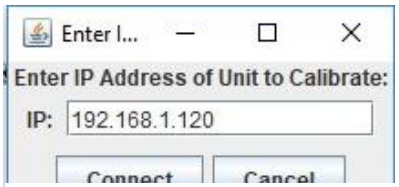

Image 6 Calibration Panel Connection

Note: Occasionally, the connection will time out. If this happens, you can click on Data > Stop Live Feed and click on Data > Start Live Feed to restart the connection.

4.3 CALIBRATION PANEL

The calibration panel is a tool used to connect to the IceSight sensor to display data, record data, calibrate the sensor and configure the sensor. It is a Java Applet and needs to be run on a computer with the latest version of Java installed.

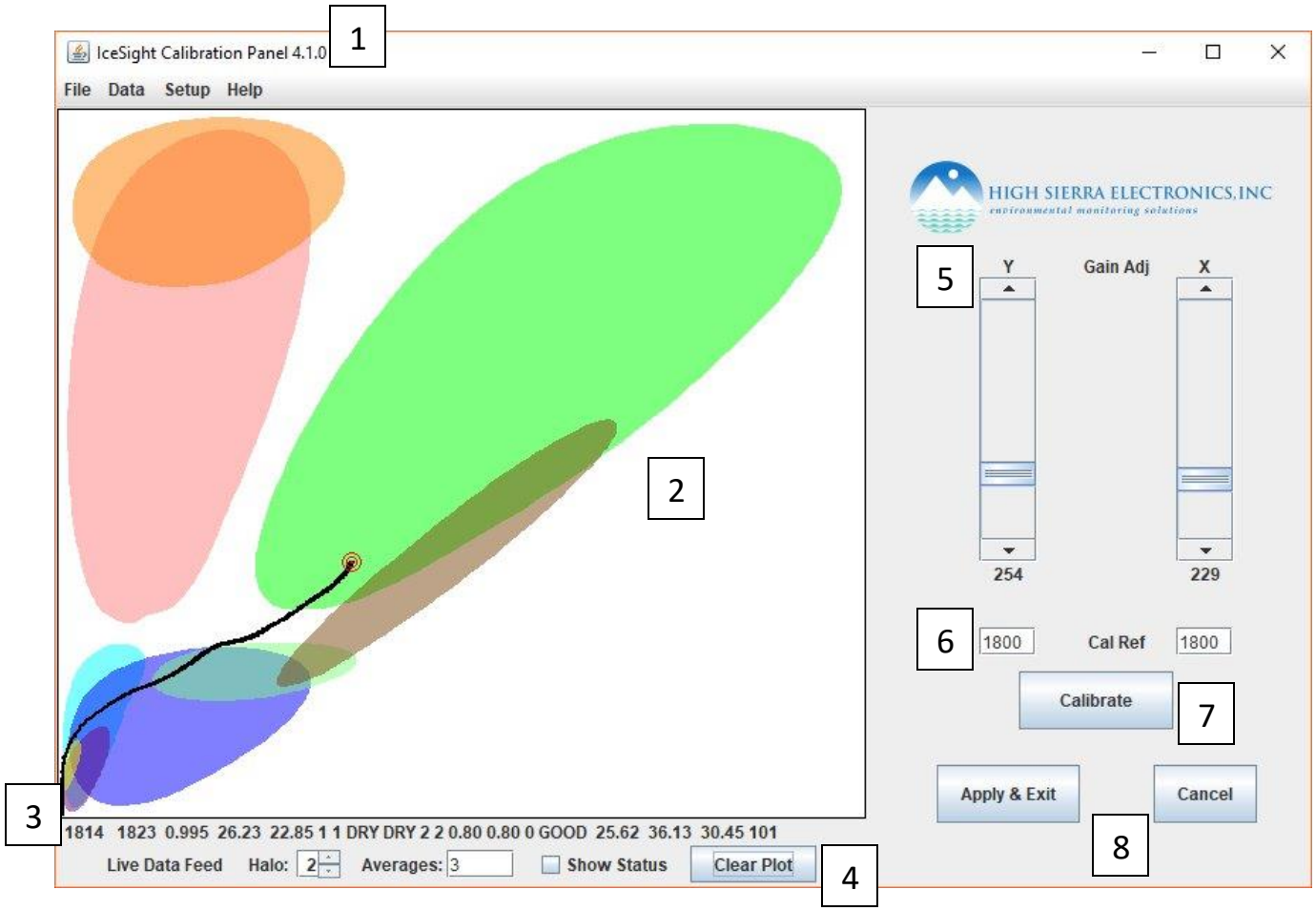

Image 7 Calibration Panel screenshot

1. The top line shows the name and version number of the program. When reporting problems with this program, please be sure to include the version number of the program. The next line is the menu bar for the program.
2. Below the menu bar is a large graphic that depicts the current condition. Road condition states are depicted using large “balloons”.
3. Below the condition graphic is the raw data feed from the IceSight unit. This is the data that is sent out the serial ports of the unit (RS-232 and RS-485), and available on the Ethernet connection using Telnet. All the above information is encoded into this raw data feed line, along with some additional data used by HSE for diagnostic purposes.
4. Below the data string is the connection status, halo, averages, show status and clear plot settings.
    a. Connection Status: if the connection is active, the status will show “Live Data Feed”. If this line shows some sort of error, then you are not properly connected to the unit.

b. Halo: the halo setting can be increased or decreased to help with the visibility of the current data point on the condition graphic.

c. Averages: the current number of averages used by the IceSight. This can be set to any numeric value of 1 or greater (3 is used by default for the IceSight). The lower the number, the faster the system will respond (but possibly with less accuracy). Changing this value does not affect the actual response of the unit until you click on the "Submit & Exit" button (described below).

d. Show Status: click on the box to display the Java applet status window. This will display the current values from the IceSight in a more user-friendly format.

e. Clear Plot: This clears the dots on the condition graphic.

5. Gain adjustment sliders: moving the gain of the X and Y lasers will change the calibration base line. These numbers are indicative of the amount of laser light received by the unit. The gain number should be below 750. A typical setting is ~450 at 10 meters.

Note: Changes to the "Gain" values will take effect immediately but will not be stored in permanent memory of the unit until "Apply & Exit" is selected. These "temporary" changes will persist until they are either changed or the unit is powered off.

6. Calibration Reference: the calibration reference point should remain 1800 and 1800 for the X and Y lasers. This is the dry calibration reference point.
7. Calibrate: the calibrate button starts the auto calibration feature. The gain sliders will gray out while this process is taking place in the current IceSight model. Legacy IceSight models with model numbers less than 1804-0292 or alternative number scheme calibration procedure is the same but will follow a slightly different process internally.
8. In the lower right corner of the calibration panel is the "Apply & Exit" and "Cancel" buttons. These buttons are used to write any configuration changes to the sensors memory or cancel the changes of the current session.

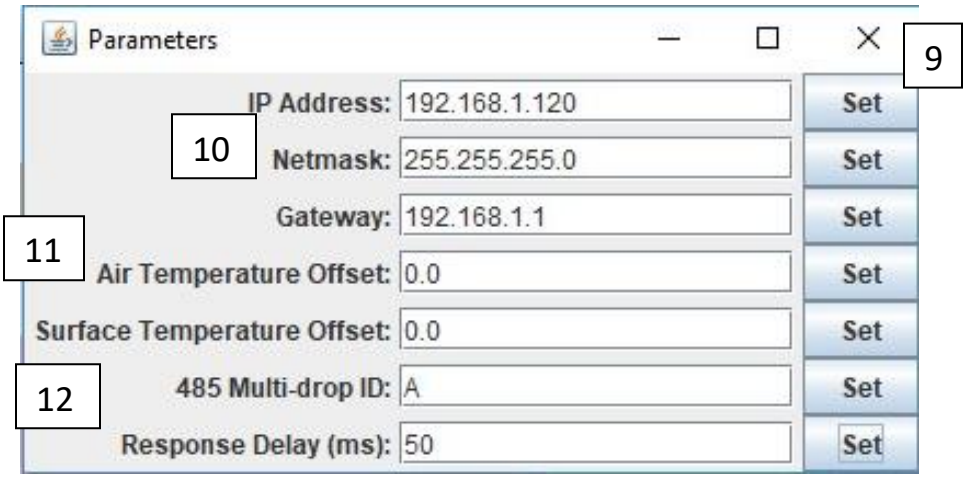

Image 8 Calibration Panel Parameters

9. The parameter inputs each have their own "Set" button. These allow the parameter to be saved back to the IceSight ("Set"). After making a change to any of the parameters, you will need to click on its "Set" button to send the change to the IceSight. All the settings, except for the three network

settings, take effect immediately after clicking on “Set”, but are only stored in temporary memory. In order to make these permanent, click on “Apply & Exit” on the main window.

10. The first three parameters, “IP Address”, “Netmask”, and “Gateway”, control the network connection of the IceSight. To change the network settings, enter the new IP Address, Netmask and Gateway. Select the “Set” button next to the updated parameter. Select “Apply & Exit” on the main window to save the settings. The configuration program will close, and the Ice Sight unit will reboot with the new network settings.
11. Temperature offsets can be applied to the primary air temperature and the surface temperature. In most cases an offset is not needed. The “Air” sensor detects the temperature of the air surrounding the unit. The “Surface” sensor detects the temperature of the road surface.
12. The final two parameters “485 Multi-drop ID” and “Response Delay (ms)” are used when the IceSight is connected via RS-485. In normal operation, the “485 Multi-drop ID” is left blank or NULL, and the IceSight will periodically transmit its data feed on the RS-485 line automatically. When the “485 Multi-drop ID” is set to an ID of A through H, each unit will refrain from transmitting its data line on the RS-485 line until it has received a command on the RS-485 network. The “Response Delay” is the delay time that the unit will use after receiving a correct command and before turning on its transmitter.

Tips and Tricks:

a. Disconnects can be resolved without closing the program by selecting Data from the menu, Stop Live Feed, then Start Live Feed.
b. The halo number field at the bottom changes the size of the red dot for the X-Y plot so it can be more visible. Try 3-5.
c. The “Clear Plot” erases the bread crumb trail.
d. Image 7 shows a typical wet-dry calibration curve. The black line of dots represents the progression from wet back to dry due to evaporation of water on the surface. The colored “bubbles” represent various surface states.

4.4 CALIBRATING ICESIGHT SENSOR

Calibrating the IceSight sensor is vital to the performance of the sensor. Please follow the calibration steps to ensure accurate results. A dry, uniform asphalt or concrete surface is required for calibration of the IceSight sensor.

1. After a successful installation apply power to the sensor. Make sure there are no obstructions between the sensor and the surface.
2. Wait 20 minutes with the power applied to the unit to let the lasers acclimate.
3. Connect to the sensor using the IceSightCal4.jar program. Procedure can be found in the “Connecting to an IceSight Sensor” section 0.
4. Verify the calibration reference numbers are set to 1800 and 1800. Select the “Calibrate” button. The gain sliders will gray out while the calibration process is active and will populate again when the process is complete.

   Note: The calibration process can take up to 5 minutes to complete.

   Note: If there is high traffic volume, the calibration process can take longer to complete. Try changing the “Averages” (Section 4.3 number 4) to 1 (you will have to click on “Apply & Exit”

and connect again for the change to take affect) and start the calibration procedure again. Remember to set the “Averages” back to 3 after the calibration procedure is done.

5. Verify that the Y and X laser output values (the first two values in the raw data string) are reading near 1800. The calibration process can be run again if the X and Y laser values are more than 10 units above or below 1800.
6. Click the Show Status checkbox in the calibration panel to display the status indicator (Image 9). Or, a display can be accessed through a standard web browser by inserting the IP address of the unit into the URL of the web browser (Image 10).
7. Click on “Apply & Exit” to save the calibration to long term memory.

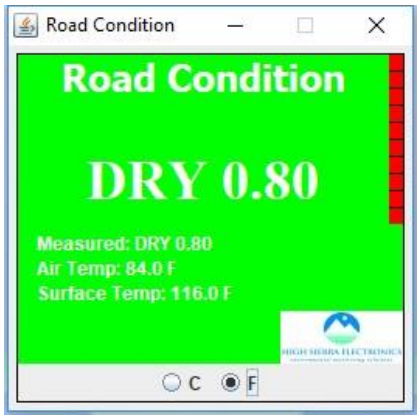

Image 9 Status Indicator

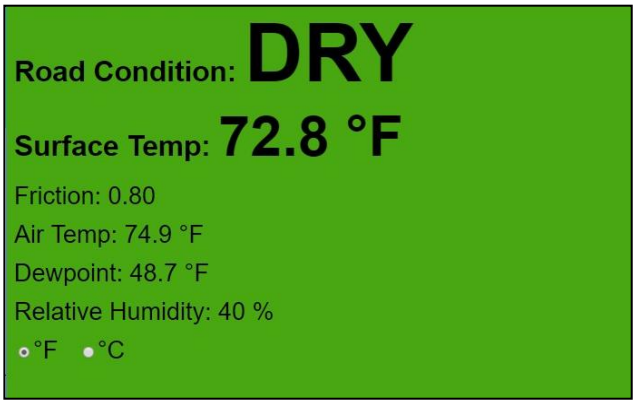

Image 10 Web Status

8. Test the sensor calibration:
    a. Pouring or spraying water on the target should result in a WT1 (damp) or WT2 (wet) reading.

4.5 COMMUNICATIONS PROTOCOL

The Model 5433 IceSight integrates seamlessly with current RWIS/ESS applications and other road surface monitoring infrastructures via its RS-232, RS-485 and TCP/IP outputs.

4.5.1 TCP/IP

The Model 5433 IceSight comes standard with a RJ-45 Ethernet connection. The sensors data output stream can be accessed via its TCP/IP address on port 1776. The default IP address from the factory is 192.168.1.120. Accessing the data can be accomplished in several ways.

1. For TCP/IP data parsing, data is available by opening a telnet session to the noted port, e.g. telnet 192.168.1.120 1776, issued from a command line prompt.
2. The connection supports the IceSightCal4 Java Applet for IP-Set, Setup and Calibration.
3. Internal Web Server - The sensor’s operating system provides a simple web server that provides a single static web page that opens a Telnet connection back to the system and updates the web page

with each line of data sent. With the sensor on the same network as the computer, simply point the browser to the sensor's IP address and the page will be displayed.

4.5.2 Serial

The base Model 5433 IceSight comes standard with both RS-232 and RS-485 serial communication protocols.

RS-485:

The data source is available via RS-485 in two modes, streaming (default), which mimics the data available via RS-232, and multi-drop Polled. The mode is changed to polled by setting two fields in the parameters screen of the IceSightCal4 program. Eight sensor Multi-drop ID settings (A-H) and Response Delay (50ms default) can be set. A null (blank) Multi-drop ID sets the mode back to Streaming. Apply & Exit from the main screen saves the settings to the processor.

In polled mode the RS-485 port remains tri-stated until it receives a command "XD<cr><lf>", where X is the address. Once the sequence is received, the sensor waits for the response delay time, and sends "R" followed by a space and the current response string.

The IP address can be retrieved from the RS-485 line upon power up or reset when in streaming mode. When polled mode is enabled, the IP address can be retrieved by sending the command "Xd<cr><lf>" where X is the address A through H (note the lower-case d).

For multiple sensors on one multi-drop line or long cable lengths (greater than 200 meters), a removable 121Ω termination resistor can be provided. RS-485 supports distances up to 4,000 feet with proper cabling and termination. The termination resistor should be removed for each sensor except the sensor on the end of the line.

RS-232:

The data source is available via RS-232. The same ASCII data source is streamed using a terminal program on a computer connected to the output serial port. Upon power up or reset the IP address is printed on the first line of the RS-232 output stream with the data stream beginning on the next line.

RS-232 supports distances of up to 50 ft.

Table 7. RS-485 and RS-232 Serial Settings

Baud Rate	9600 bps
Data Bits	8
Parity	None
Stop Bits	1
Handshaking	None

4.5.3 ASCII Data

Each line of the ASCII stream contains thirteen or more values, each separated by at least one space, as demonstrated by the following example:

1321 1210 1.091 32.1 35.4 3 3 WET WET 7 7 0.86 0.86 0 FAIR 32.22 33.55 33.55 -102

Table 8. Data Definitions

Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ASCII	1321	1210	1.091	32.1	23.4	3	3	WET	WET	7	7	0.86	0.86	0	FAIR	32.22	33.55	33.55	-102
format	YYYY	XXXX	R.RRR	AAA.A	BBB.B	C	D	EEE	FFF	G	H	I.II	J.JJ	K	LLLL	MMM.MM	NNN.NN	OOO.OO	PPP.PP

Table 9. Data Descriptions

Position	Example	Format	Data Type	Description
1	1321	YYYY	Floating point	Reported Y voltage (0-5,000 mV)
2	1210	XXXX	Floating point	Reported X voltage (0-5,000 mV)
3	1.091	R.RRR	Floating point	Ratio of the voltages (y/x)
4	32.1	AAA.A	Floating point	Air temperature (Celsius), secondary, (100.1 signifies an error condition)
5	23.4	BBB.B	Floating point	Surface temperature (Celsius), (100.1 signifies an error condition)
6	3	C	Integer	Displayed condition code number (0-15)[1] [2]
7	3	D	Integer	Measured condition code number (0-15)[1] [2]
8	WET	EEE	Text	Mnemonic for displayed condition[1] [2]
9	WET	FFF	Text	Mnemonic for measured condition[1] [2]
10	7	G	Integer	Displayed friction code number (0-31)[1]
11	7	H	Integer	Measured friction code number (0-31)[1]
12	0.86	I.II	Floating point	Displayed friction code value[1]
13	0.86	J.JJ	Floating point	Measured friction code value[1]
14	0	K	Integer	"dirty lens" value[3] (0-10)
15	FAIR	LLLL	Text	"grip" value (GOOD, FAIR, POOR)
16	32.22	MMM.MM	Floating point	Relative humidity (%)
17	33.55	NNN.NN	Floating point	Air temperature (Celsius), **primary**, (100.1 signifies an error condition)
18	33.55	OOO.OO	Floating point	Air temperature (Celsius), tertiary, (100.1 signifies an error condition)
19	-102	PPP.PP	Floating point	-102 Legacy code, 101 current code, -101 in calibration state

1. Measured condition, measured friction code, measured mnemonic, and measured friction are instantaneous values. Displayed condition, displayed friction code, displayed mnemonic, and displayed friction are filtered values.

[2] Condition Codes:

0	UNK	Unknown	
1	DRY	Dry	
2	WT1	Damp	
3	WT2	Wet	
4	SN1	Snow	
5	IC1	Ice	
6	WT3	Standing Water	
7	SN2	Deep Snow	
8	IC2	Black Ice	
9	MAX	Error	
10	ERR	Error	

[3] Note that values of 2, 6 and 8 would indicate lens cleaning is necessary.

0	Not “Soiled” in any way.
1	Within “Soiled” zone, but not for very long.
2	Within “Soiled” zone for long enough to be of concern.
3	Not Used.
4	Received optical signal is low enough that lens could be “Soiled” if condition continues for a long time. Note that a 4 reading is normal in adverse weather conditions.
5	Low enough that lens could be “Soiled”, and also within of “Soiled” zone for a short time.
6	Low enough that lens could be “Soiled”, and also has been inside of “Soiled” polygon long enough to be of concern.
8	Low for long enough that lens should be considered “Soiled”.
9	Low for a long time and also within the “Soiled” zone for a short time.
10	Low for a long time and also within the “Soiled” zone for a long time.

The line is terminated with a carriage return (control-M, 0x0D) and a linefeed (control-L, 0x0C). The overall length of the string (including the carriage return/linefeed) varies but will not exceed 100 characters.

4.6 ALTERNATIVE CONNECTION METHODS

In addition to connecting with the provided IceSight Calibration Software, data can be retrieved in the following alternative methods.

4.6.1 Telnet

Data can also be viewed by using the terminal program Telnet, connect to the IceSight unit using the IP address provided on port 1776 (Ethernet connection required). You should immediately see data starting to stream in the command window.

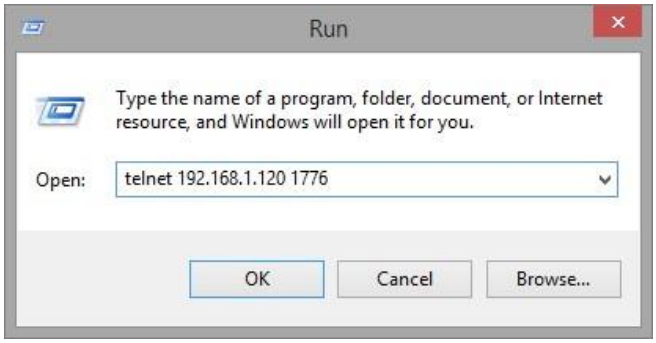

Image 11 Telnet Example

```
2473   5000  0.495   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD  21.41  19.39  32.29 -102.
2486   5000  0.497   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD  21.34  19.39  32.29 -102.
2470   5000  0.494   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD  21.35  19.39  32.29 -102.
2469   5000  0.494   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD  21.35  19.40  32.29 -102.
2484   5000  0.497   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD   0.00  19.39  32.29 -102.
2480   5000  0.496   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD   0.00  19.39  32.29 -102.
2482   5000  0.496   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD  21.35  19.39  32.29 -102.
2507   5000  0.501   24.4   32.2 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD  21.40  19.40  32.29 -102.
2081   5000  0.416   24.4   23.3 1 1 DRY DRY 2 2 0.80 0.80 0 GOOD  21.40  19.39  32.29 -102.
1838   5000  0.368   24.4   23.3 1 1 DRY DRY 2 3 0.80 0.70 0 GOOD  21.34  19.39  32.29 -102.
1786   5000  0.357   24.4   23.3 1 1 DRY DRY 2 3 0.80 0.70 4 GOOD  21.34  19.39  32.29 -102.
1781   5000  0.356   24.4   23.3 1 1 DRY DRY 2 3 0.80 0.70 4 GOOD  21.41  19.39  32.27 -102.
1604   5000  0.321   24.4   24.4 1 1 DRY DRY 2 3 0.80 0.70 4 GOOD  21.41  19.39  32.27 -102.
1661   5000  0.332   24.4   23.9 1 1 DRY DRY 2 3 0.80 0.70 4 GOOD   0.00  19.39  32.27 -102.
1750   5000  0.350   24.4   23.3 1 1 DRY DRY 2 3 0.80 0.70 4 GOOD  21.40  19.39  32.26 -102.
1772   5000  0.354   24.4   23.9 1 1 DRY DRY 2 3 0.80 0.70 4 GOOD  21.35  19.39  32.27 -102.
1762   5000  0.352   24.4   23.3 1 1 DRY DRY 3 3 0.70 0.70 4 GOOD  21.41  19.40  32.27 -102.
1763   5000  0.353   24.4   23.3 1 1 DRY DRY 3 3 0.70 0.70 4 GOOD  21.34  19.39  32.27 -102.
1775   5000  0.355   24.4   23.3 1 1 DRY DRY 3 3 0.70 0.70 4 GOOD  21.41  19.39  32.27 -102.
1762   5000  0.352   24.4   23.3 1 1 DRY DRY 3 3 0.70 0.70 4 GOOD  21.40  19.39  32.27 -102.
1762   5000  0.352   24.4   23.3 1 1 DRY DRY 3 3 0.70 0.70 4 GOOD  21.40  19.41  32.27 -102.
1770   5000  0.354   24.4   23.3 1 1 DRY DRY 3 3 0.70 0.70 4 GOOD  21.41  19.41  32.27 -102.
1779   5000  0.356   24.4   23.9 1 1 DRY DRY 3 3 0.70 0.70 4 GOOD  21.34  19.41  32.27 -102.
```

Image 12 Telnet Example

4.6.2 Terminal Program

HyperTerminal or similar program may be used with serial communication through a computer's com port. A compatible serial to RS-232 or RS-485 converter will be needed.

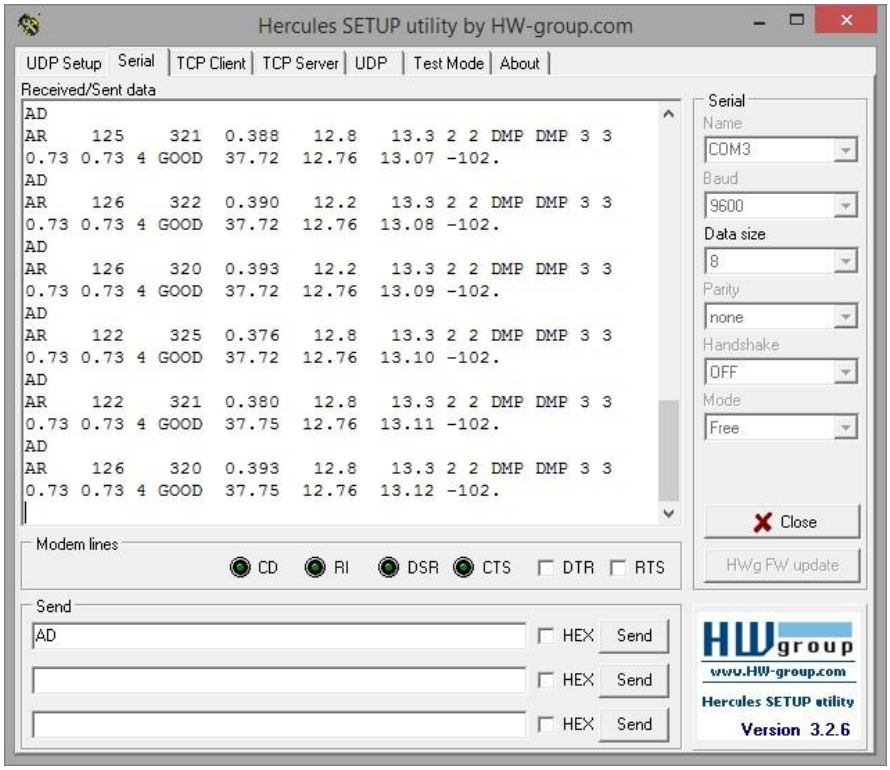

Image 13. Example RS-485 polled connection

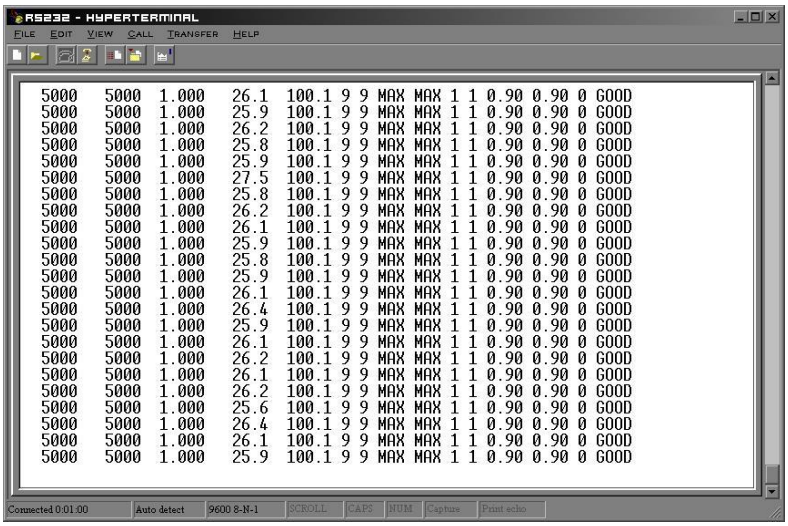

Image 14. Example RS-232 connection

5 MAINTENANCE

Periodic maintenance will need to be performed to insure successful operation of the IceSight sensor. Maintenance intervals are recommended to be performed twice a year before and after the winter season. However, interval times should ultimately be determined by the environment the sensor is monitoring.

***HSE is pleased to offer an Annual Service Plan for this IceSight Sensor. Please contact us for pricing and details.

5.1 LENS CARE

During a maintenance interval the lens should be cleaned of any obstruction or debris. This should be performed by first removing the spray guard.

Before removing, take notice of the compression depth of the gray foam. There should be approximately 1/16” of spacing (gray foam gasket) between the sensor housing plate and the spray guard. The spray guard is mounted with two thumb screws. A flat head screwdriver can be used to assist in the removal process. The spray guard is tethered by the chain for convenience and can be left to hang while cleaning the lens. Only use soapy water and a terry cloth to gently clean the glass lens. Initially use lots of water to flush contaminates from the lens. Then clean gently with a mild soap dilution (i.e., dish soap). Flush with clear water and dry. Upon completion, reinstall the spray guard being careful to properly align the thumb screws. Retighten screws until foam gasket is approximately 1/16” thick.

5.2 RECALIBRATING

Recheck the calibration values during every maintenance visit. If the X and Y values on a dry surface are not within a value of 10 of the nominal 1800 value, refer to the procedure in Section 4.4 for calibrating the sensor.

Before clicking “Calibrate”, note the current readings on dry asphalt. This will indicate how much debris and dirt have built up on the target surface. If large amounts persist, clean and dry the target area before recalibrating. Using the sighting laser and mounts, check to make sure the sensor is still pointed at the intended target. Upon completing the calibration, be sure to click “Apply & Exit”.

6 TROUBLESHOOTING

Use the techniques below to rectify problems with your IceSight sensor. If these steps do not solve your problem, contact HSE technical support at (800) 275-2080.

6.1 START-UP

- My IceSight does not initialize.
  - Check that all connections are secure and cables undamaged.
  - Check that the DC power supply is on and connected to the supplied terminal block correctly (refer to section 3.3 of this manual).
  - Cycle power.

6.2 COMMUNICATION

- I can’t connect to my IceSight using the Ethernet.
  - Check that the power supply is enough to supply the correct voltage and current.
  - If you can see the IceSight network but cannot connect, make sure that your computer is set in the correct range of IP addresses.
  - If you are connected to the Ethernet but cannot connect to the IceSight, check that you are trying to connect to the IP address supplied with your IceSight. Default is 192.168.1.120 and try 192.168.1.118.
  - Make sure no other device on the network being used to connect to the IceSight has the same IP address as the IceSight.
  - Make sure you’ve designated the proper port number (1776) when trying to access the IceSight through telnet or the terminal program.
  - If you still have a problem, contact HSE for possible repair/replacement.

6.3 ICESIGHT OUTPUT

- My IceSight is reading “unknown” (UNK) or inaccurately.
  - Cycle power to re-initialize the system.
  - Check that the IceSight is installed at the height and angle for which the sensor was calibrated.
  - Check to see if there are any obstructions between the sensor and the roadway. Also check the front window of the sensor for or dirt.
  - If the IceSight is focused on a clean, dry surface, try performing an auto calibration.
  - Check that the IceSight is not viewing a pothole, a metal expansion joint, or other feature that may have inconsistent optical properties.

7 RETURNS

Repairs to equipment are processed by our Manufacturing Department. When repair service is needed, please contact High Sierra Electronics for confirmation of your equipment's warranty status and to obtain a Return Merchandise Authorization (RMA) Number. Review our Warranty information at https://hsierra.com/support/warranty/ and Return Authorization Policy at https://www.hsierra.com/support/rma-policy/.

You must first request an RMA number from High Sierra Electronics before returning any products or equipment parts for repair or evaluation.

1. Complete and submit our Return Merchandise Authorization Request form at https://www.hsierra.com/support/rma-form. Once received, your request will be reviewed, and an RMA Number will be provided to you via e-mail. **Do NOT return your product prior to receiving a valid RMA number**.

2. Ship the equipment, appropriately packaged, to our factory at the address provided below, clearly indicating the authorized RMA number marked on the outside of each return package.

3. Transportation charges for return equipment are the responsibility of the customer.

High Sierra Electronics, Inc.
155 Spring Hill Drive, Suite 106
Grass Valley, CA, 95945, USA

8 PARTS, SPARES AND ACCESSORIES

For part numbers to spare parts and accessories, please refer to our website: http://hsierra.com/products, email at sales@hsierra.com or call sales at (800) 275-2080 between 7:00 a.m. and 4:00 p.m. PST.

9 WARRANTY

Refer to HSE Warranty Statement on our website or call to obtain more information: https://hsierra.com/support/warranty/ or (800) 275-2080.

10 CHANGE HISTORY

REV	ECO	DESCRIPTION	DATE	NAME
C	1452	a) Updated java applet picture and description. b) Updated inconsistencies in the specification table. c) Corrected text that referred to 12 VDC to reflect 9 - 30 VDC. d) Updated website references to hsierra.com. e) Updated screenshot of the latest web display with the C and F buttons.	4/26/2018	B. Hansen
D	1653	a) Package contents to remove CD and include link to the web library. b) Remove WiFi option. c) Added new breakout box image and updated wiring diagram.	2/06/2020	B. Hansen
E0	1698	a) Updated breakout box image to show earth ground connection. b) Added earth ground to breakout box wiring diagram. c) Updated cover page with AEM logo and formatting. d) Added “Change History” section.	2/24/2022	K. Suponch