High Sierra Electronics

Model 6703 Ultrasonic Level Sensor
Instruction Manual 60-6703-02(A) (DRAFT)

Replaces 60-6703-01(A) as of December, 2006

TABLE OF CONTENTS

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1.0 INTRODUCTION

In December, 2006, the electrostatic sensor used by *High Sierra Electronics* (*HSE*) was rendered obsolete by the manufacturer. The replacement sensor has different installation requirements and different programming. The new sensor may be mounted in the standard sensor housing provided by *High Sierra Electronics* when replacing an existing electrostatic sensor. Instructions for the necessary alteration are provided in Appendix 8.6 The new electrostatic sensor program is compatible with all windows based computers with a serial communication port.

The instructions that follow are specific for open water applications where the sensor is installed in a housing provided by *High Sierra Electronics* and where the signal is received by the *HSE* Model 3200 series of transmitters. If the equipment used is manufactured by other vendors, the *APG 9000* series instruction manual should be used to determine sensor settings for the equipment and specific application. *High Sierra Electronics* may also be consulted for sensor use in other applications.

1.1 General Description:

The Model 6703 Ultrasonic Level sensor uses ultrasonic bursts to measure the distance from the transducer to the target (surface water). Each burst contains a series of 1-20 pulsed sound waves that emit in the shape of a cone, reflect off the target, and are received by the sensor. The time required for the sound burst to travel to and from the target is converted into a distance measurement by the sensor.

Ultrasonic sensing is affected by several factors including target surface characteristics, distance, size, angle of transducer to target and temperature stratification of the air mass between the sensor and the target. The ideal target surface is hard, smooth, and perpendicular to the face of the transducer.

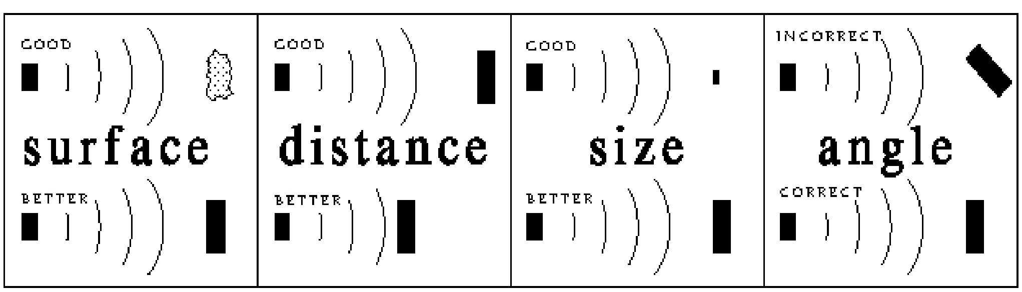


Figure 1: Sensor and Target layout[1]

[1] Source: Lundhal Instruments Inc. DCU-7070 Operators Manual, September 1998

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.

If any of the items are received in damaged condition, notify the carrier immediately and request an inspection. You must notify the carrier within 15 days of shipment. If a claim is not made within that time period, then the carrier will not acknowledge any claim for the lost or damaged goods.

1.3 Specifications:

Supply Voltage:	10 - 30 VDC
Output Signal	0 - 5 VDC
Power Consumption:	
Active:	38mA @12.8V
Sensor Power up time:	7 seconds minimum

1.4 Parts Included:

APG 9000 series Instruction manual
10-second program chip for 3206 ALERT transmitter (if needed)[2]
HSE Model 6703: IRU 9429 Ultrasonic Sensor
Signal cable to *HSE* Model 3200 series transmitter (or other RTU
APG IRU software program disc and RS-232 program cable (Optional[3])
Sensor Enclosure (optional)

2.0 INSTALLATION

Before heading out to the field to install the Ultrasonic sensor and its enclosure, it is best to verify that all components are operating per specifications. Refer to section *2.3 Sensor Check* for information on determining if the equipment is operating correctly.

The following instructions are for sensor mounting only.

See the installation instructions for other equipment necessary to complete this installation.

[2] If sensor and transmitter are on a single order, the 10 second program chip will be installed on the Model 3206 logic board. Program chips manufactured after July 2007 generate a 10 second analog warmup by enabeling JB12 on the 3200 series logic board.

[3] The utility program and programming cable are necessary to check calibration and change settings on the sensor. Only one programming cable is needed regardless of the number of sensors in a system.

2.1 Sensor Housing mounting:

High Sierra Electronics offers a custom sensor housing designed for the site at which the ultrasonic sensor is to be installed. *Appendix 8.2* shows a typical sensor housing that might be mounted to a bridge rail. The transmitter for this unit is located in a standpipe or building located off of the bridge. *Appendix 8.3* shows a sensor housing large enough to include a transmitter. Variations of these standard housings may be custom ordered for unique site conditions.

It is best to choose a mounting location with a vertical path free of any abutments or vegetation that might interfere with the sound path of the ultrasonic bursts (The sound cone is 9 degrees off axis). At low flows the target area should be clear of vegetation and protruding rocks. Be sure that the sensor range is greater than the total elevation change of the water to be measured. If the water level falls to a point beyond the range of the sensor, erratic sensor data will be transmitted.

Do not leave the sensor installed in the housing if it is necessary to drill holes in the concrete to which the housing is to be attached. In some installations the sensor must be installed in the housing prior to final attachment, but it is always best to check that the mounting is correct and secure before placing the sensor. Install conduit from the sensor housing to the transmitter location. Remove the green Phoenix connectors from the signal cable before pulling the signal cable through the conduit. Pull the signal cable from the transmitter through the conduit to the sensor housing. Reattach the signal cable wires to the connector (Refer to wire diagram 06-6703-04, Appendix 8.1A for the proper wire placement in the Phoenix connector).

2.2 Sensor mounting:

Feed the sensor signal cable through the ¾ inch FPT fitting (adapter ring) at the end of the tube and out the open end of the 2 ½ inch PVC tube.[4] Thread the sensor into the ¾ inch FPT adapter ring . Loosely hand tighten only (even hand tightening may make it difficult to unthread the sensor from the adapter ring if the sensor needs to be removed for any reason). Lower the sensor and 2 ½ inch PVC tube assembly into the sensor housing until the collar at the top of the PVC tube rests on the centering screws in the 4 inch aluminum tube. Slightly tighten the centering screws so that the PVC tube does not move in the aluminum housing. Attach the signal cable from the sensor to the signal cable from the transmitter. The Phoenix connectors that join the signal cable should not be directly exposed to rainfall. The connection should be made in the sensor enclosure (or in a conduit fitting that is easily accessible).

Once the sensor is installed and connected to the transmitter, check that the sensor is reporting appropriate values. If the sensor housing location is not readily accessible,

[4] It is possible to slip the Phoenix connectors through the opening without removing them from the signal cable. Fold the connector over the signal wires. Slip the 5 terminal Phoenix through first, then the 3 terminal phoenix connector.

check that the system is operating correctly before final placement of the sensor (section 2.3).

2.3 *Sensor Check:* (See Appendix 8.4 and 8.5)

Remove the 2 ½ inch PVC tube and sensor from the sensor housing. You may need to loosen the three screws on the 4 inch aluminum tube which hold the PVC tube in place. It is always best to check at least two elevations to see that the span is correct. If the calibration check described in Appendix 8.4 and 8.5 is not possible, an alternate is described below. If the sensor is easily removed from the housing, the target for the short distance can be the road or a nearby wall. Return the sensor to the housing and record the raw value that is transmitted to a base station. If there is a staff gauge or other reference level available, use the reading of the reference gauge to set the base reading of the ultrasonic sensor. If no reference gauge is available, use a tape measure to determine the distance between the sensor face and the water and use that measurement to set the base reference. See Section 3 for instructions on how to make adjustments to the analog output of the sensor. See section 3.4 for additional information for sites that have the sensor mounted well above the high water level.

After returning the PVC tube and sensor assembly to the sensor housing, be certain to tighten the centering screws that hold the assembly.

3.0 CALIBRATION

High Sierra Electronics calibrates the sensor before shipment to either a customer specified range, or to the full thirty-five foot range of the sensor. If the calibrated range is suitable for the site and the sensor check performed in section 2.3 is satisfactory, no further calibration is necessary. If the range of the sensor needs to be changed, follow the instructions below.

3.1 *Equipment needed:*

Clip leads or Model 6708-test harness (optional) – Appendix 8.1B
12-Volt Battery
Tape measure
Plywood or cardboard target (4ft x 4ft minimum)
Digital Voltmeter (4 ½ digit voltmeter)
Remote Station Tester
APG IRU utility program: *12000swj.exe*, and RS-232 program cable

3.2 *Calibration Procedure:*

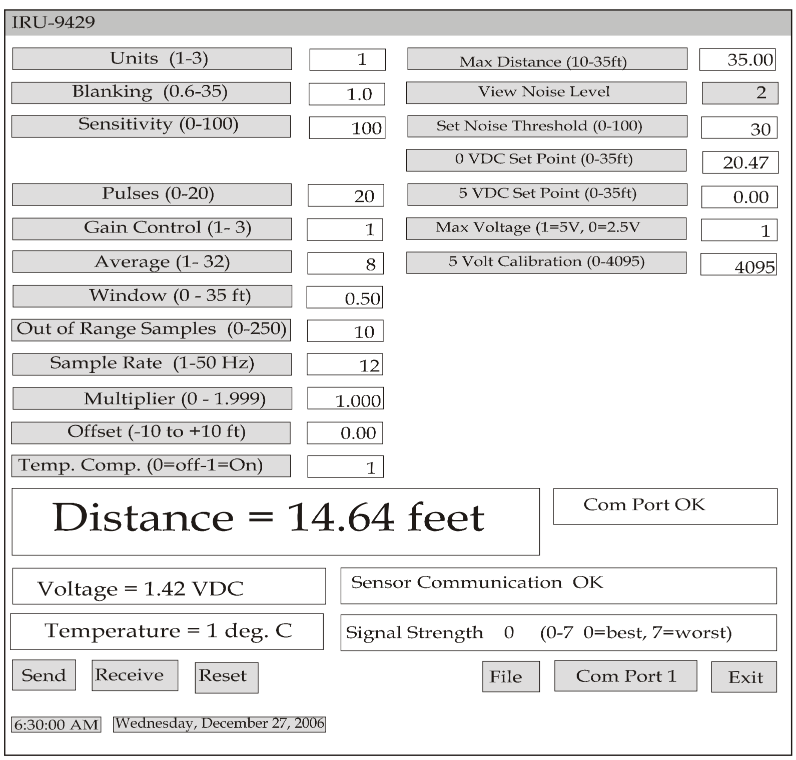
Install the *12000swj.exe* on the computer. Connect the RS-232 interface cable between the three pin Phoenix connector attached to the sensor signal cable and a serial port of the computer.

The sensor must be powered continuously during sensor calibration. It is best to calibrate the sensor with the full length of signal cable attached. If a model 6708 test harness is available, plug in the female MS connector from the Ultrasonic signal cable to the male connector of the test harness (see Appendix 8.1B).

If a Model 6708 test harness is not available it may be best to attach a separate piece of signal cable at the green Phoenix connector rather than use the MS connector at the end of the signal cable. Use clip leads to attach to a 12 volt battery[5].

Connect the test harness clip leads to the 12 volt battery, the red lead to the positive (+) terminal and the black lead to the negative (-) terminal. When using the test harness the sensor is powered directly from the battery, not through the 12 VDC switched circuit of the transmitter. For initial calibration, do not connect the female MS connector to the transmitter.

Open the 12000swj.exe calibration program on the computer. It takes several seconds for communication between the sensor and the interface program to become established. A display screen will then fill with the settings that are pre-programmed into the sensor by High Sierra Electronics to work in a typical open water application. Changes to the sensor settings can be made at the site to account for site specific conditions. Once the sensor is working properly it is best to save the sensor settings on the computer used for field use. In the event of problems with the sensor, the sensor program may quickly be loaded into a replacement sensor.



12000swj.exe interface program

[5] The battery from the Model 3200 series transmitter may be used if a spare battery is not available.

3.3 *Sensor Parameters:*

It should be noted that the default parameters described below are *High Sierra Electronics* settings and they are not the same as APG factory default settings. Do not click the *Reset* button in the sensor interface program unless you want to restore the sensor to the APG defaults. If the sensor is reset the HSE default values must be entered in the appropriate program window or loaded into the sensor from a saved text file.

Units: allows the user to select the unit of measure for screen programming. The options are feet, inches and millimeters where **1= ft**., 2 = in., and 3 = mm.

Blanking: sets a dead band distance in front of the sensor. When the sensor transmits the ultrasonic pulse, the transducer does not stop vibrating instantaneously. It takes about 1-3 milliseconds to send the burst and then ring-down, depending on the number of pulses sent in the burst. Any echoes that return before the sensor finishes transmitting can not be received by the sensor. This is the reason for the minimum distance specification. The minimum setting for the 9000 series is 0.6 ft.

The blanking may be set at distances greater than the minimum. There are instances when an object close to the sensor is being detected, preventing the sensor from detecting the intended target beyond. Setting the blanking distance greater than the unwanted object can help eliminate the interference. Care must be taken that the intended target does not come closer to the sensor than the blanking distance. **If the target is closer than the blanking distance, errors in the distance measurement will occur.**

Sensitivity: controls the gain or amplification setting of the sensor. The sensitivity is expressed as a percentage of maximum with options of 0 to 100%. The ideal setting is as low as possible while still allowing reliable tracking of the target. For open water applications it is recommended that the sensor be set to automatically determine the sensitivity needed. Set the sensitivity to 100 and set the **Gain control** setting to **1** (autosense). If this sensor will be used in a stilling well or other application other than open water, consult the APG Instruction manual for proper sensor settings.

Pulses: controls the number of ultrasonic waves sent in each burst. The greater the number of pulses the stronger the transmitted signal. For open water applications, it is best to set the pulses to 20 and the autosense function of the sensor will determine the correct pulse rate.

Gain Control: Set to **1** for open water applications**.** In a stilling well the gain control for this sensor may be set to **2.**

Average, Window, and *Out of Range Samples* are three parameters that affect the filtering settings used to determine which echoes qualify as legitimate targets.

Average: defines the number of sensor readings (samples of a target) that will be averaged together by the sensor. The default for open water application is **8.**

Window: specifies a range in which target readings will be accepted. Any reading that falls within this range is accepted as a valid target and is figured into the averaging buffer. The acceptance window is **plus** or **minus** the specified distance from the present distance reading. The default setting is **0.5** ft but should be changed if there is turbulence or large standing waves on the water surface within the sensor sound cone.

Out of Range Samples: indicates the number of consecutive readings (samples) outside the Window that will need to be detected before the sensor recognizes them as legitimate targets.

Sample Rate: adjusts the speed of the sensor readings. The sample rate is express in Hertz. The default for open water applications is **12.**

Multiplier: is used to bring the detected distance in line with the physical measurement. Set the temperature compensation function before checking to see if the multiplier needs adjustment. See Calibration, section 3.4 for instructions on changing the multiplier.

Offset: adjusts the zero point of the sensor. For most applications, it is recommended that this setting not be adjusted. (If needed an offset to the zero point of the sensor to maintain a given span may be made using the 0 and 5 volt setpoint parameters.)

Temp. Comp: The default setting(HSE) is **1** (temperature compensation on). With this setting, changes in signal output due to change in temperature is minimized. *NOTE: care must be taken that the sensor is not exposed to direct sun light. The radiant heat of the sun can heat the sensor above the ambient air temperature causing the sensor signal to fluctuate until the air temperature and the sensor temperature equalize.*

Max Distance: the default setting of 35 feet may be used regardless of the range needed. If the maximum range will be less than 35 feet, this value may be lowered. This change will decrease the time required for the sensor to obtain a stable reading.

View Noise Level: (view only) indicates the number of echoes being detected by the sensor. Noise levels in excess of 20 to 30 is an indication that noise sources are present and may interfere with the sensor operation. Reducing the sensitivity may help reduce the amount of noise detected.

Set Noise Threshold: controls a filter that will eliminate interference from temporary high noise levels. If a noise level exceeds this threshold, the sensor will maintain the last measurement before the high noise level was detected. The default setting is **30.**

The analog output will be scaled between the value (in feet) entered in the *0 VDC Set Point* and *5 VDC Set Point* windows. For open water operation, the analog output is usually inverted. The signal strength increases as the water level rises. If the detected target is outside the scaling range, the sensor will output either full scale or minimum scale depending on the location of the target. See figure 3.1 for an example of a typical setup. Changes may be made to the Analog scaling parameters without affecting other parameters such as the multiplier.

0 VDC Set Point: In open water applications, this is the distance between the sensor and the stream or lake bottom (Potential channel scouring should be included) or the lowest expected water level. This distance will vary dependent on site conditions. The default setting is either **20.47** or **35**.00 feet.

5 VDC Set Point: In open water applications, this distance is the closest the water will get to the sensor, the blanking distance or the sensor face depending on site conditions. The default setting is **0.0** feet.

5 Volt calibration: The default setting for this parameter is **4095.** See section 3.7 for an explanation of why and when this parameter may be changed.

3.4 Calibration example:

In a typical ALERT application the analog output will be inverted as illustrated in the example below. In this example the water level is not expected to rise more than 18 feet from the low water elevation. A span of 20.47 feet is selected but the sensor will be mounted 19.5 feet above the low water elevation.

In this instance the 5 Volt distance is set to 0 ft., and the 0 Volt distance is set to 20.47 ft. The distance from the sensor to the bottom of the channel is not greater than the 20.47 foot span so even with no water in the channel, a signal would be transmitted. The example below shows expected ALERT data values at several elevations. Note that in the example the maximum distance is set to reflect channel scouring so that in the event that the channel goes dry there is still a signal returned to the base station. Zero values are not transmitted to the base station so it is best that the sensor be set up to always produce a signal that will be transmitted to the base station.

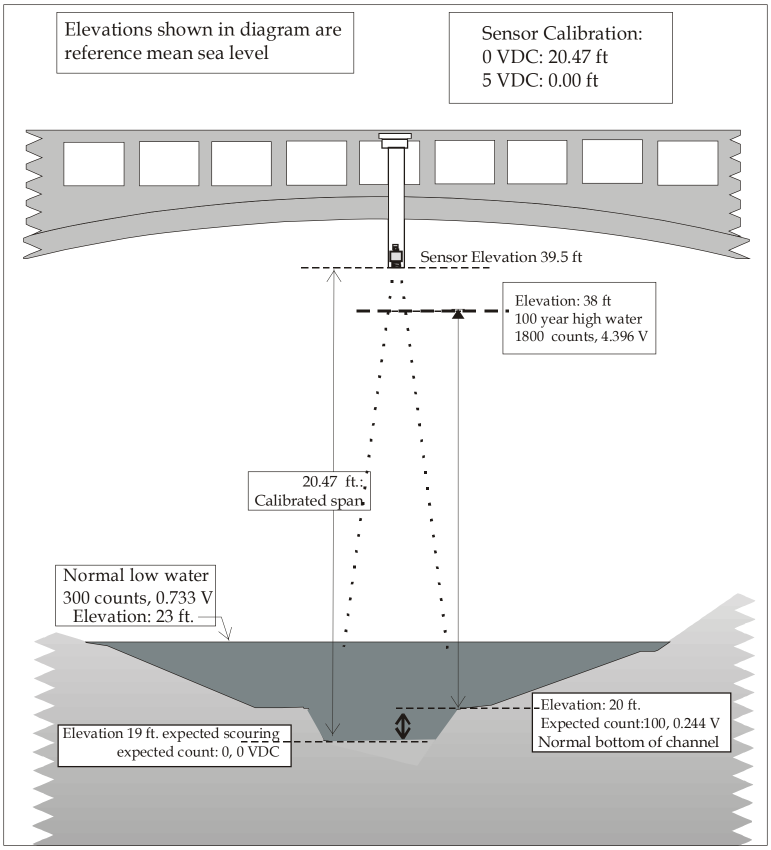


Figure 3.1

In a more complex example, the sensor is mounted further from the water but the total water level rise is still not greater than 20.47 feet. In this example it is best to maintain a span calibration of 20.47 feet but place an offset in the sensor in order to minimize the number of sensor calibrations and to ease field checking of the sensor. This example also shows the effects of the water level rises above the expected high water or drops below the greatest distance that the sensor can measure (unexpected scouring). There are two methods of generating an offset: The first is to use the offset window in the program, but it is recommended to use this function only for small changes in the offset. The best means of generating a large offset is to change the zero and 5 VDC set points in the sensor. In the example below, the 20.47 foot span calibration is maintained but a 10 foot offset has been introduced in both the zero and the 5 VDC setpoints. Note that if the water level rises above the 5 volt setpoint the signal returned remains at 2047. If the water level drops below the maximum range of the sensor, no value will be returned.

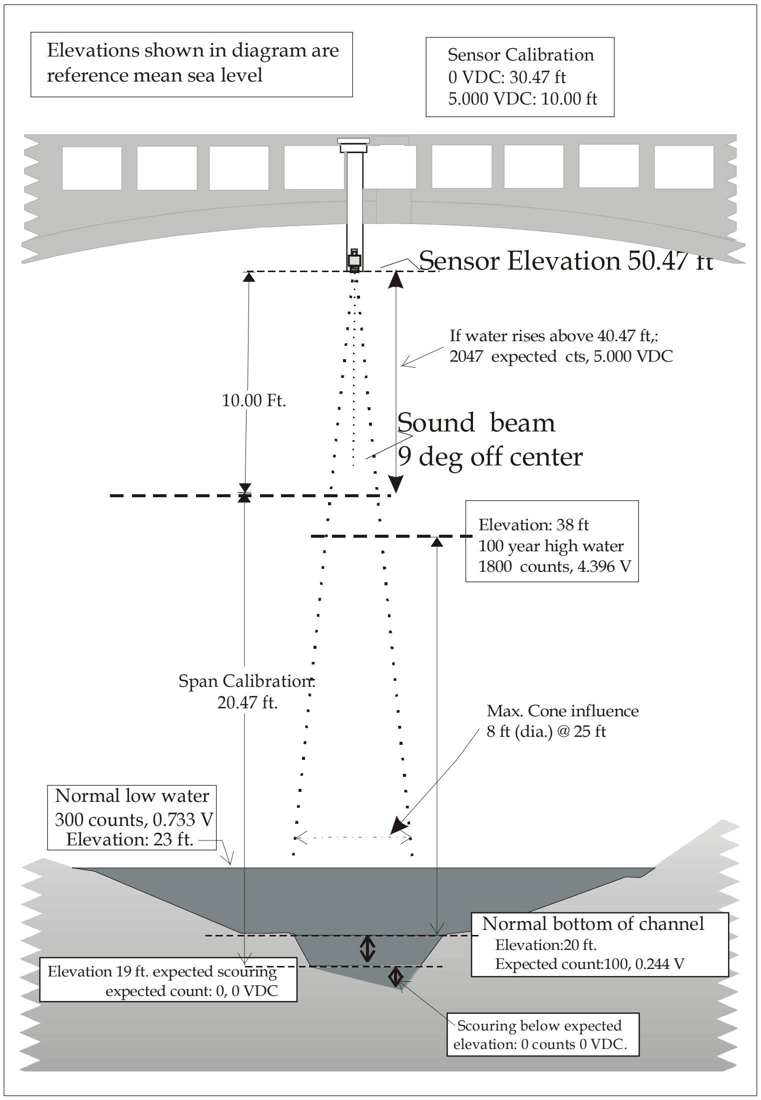


Figure 3.2

3.4 *Calibrating the Multiplier:*

Set up the sensor, a Model 3206 transmitter, a laptop computer and a target in an area large enough to perform the calibration. If outdoors, let the sensor acclimatize (out of direct sunlight) for 1 hour. After the sensor has become acclimatized, set up the target a measured distance from the sensor and record the distance. This distance should be near the maximum range of the sensor to be calibrated. Connect the sensor to the Model 6708 test harness and connect the test harness to a 12 Volt battery. Power up the sensor and open the APG utility. Record the distance shown on the display. Let the sensor run for a few minutes to verify that the distance reading shown on the display is stable. If the reading is not stable, try changing the sensor sensitivity.

The Multiplier (M) equals the measured distance (D_m) divided by the displayed distance (D_d).

$$M = D_m / D_d$$

Example: M = 20 ft /20.15 ft = 0.99256.

Set the Multiplier parameter of the sensor to the computed number. The display should now read the correct distance.

Place the target close to the sensor at measured distance greater than the "*blanking* distance. The display should read the measured value. If the recorded values are as expected, proceed to the final calibration. If the recorded values are not as expected, or the sensor becomes unstable, repeat the calibration procedure. Let the sensor sit for a period of time and watch the display to see that the readings remain stable.

3.5 Final Calibration Check with HSE 3200 series transmitters :

1. Connect the Sensor to a 3200 series ALERT transmitter. Be sure to check that the transmitter logic board is equipped with a program chip in U7 that allows a minimum seven (7) second analog warm-up[6].

3. Set up the receiver, the decoder and the computer with a data collection program.

4. Power the ALERT Transmitter.

5. Test the sensor: Aim the sensor at a target a known short distance from the sensor and press the "test" button on the transmitter. Record the transmitted value.

6. Aim the sensor at a target a known long distance from the sensor and press the test button of the transmitter. Record the transmitted value.

7. Compute the expected change in value between the short and long distance to the target. If the sensor has a 32 foot range and the distance between the two points is 14 feet, than the expected voltage differential should be: 14ft/32ft x 2047 = 895 counts (each raw count is 0.0156 feet with a 32 foot range). Compare that with the actual difference in transmitted values.

If the transmitted values are within the tolerance limits expected, the calibration is complete. If the values are not within the tolerance expected, repeat the test a couple of times. If the recorded values are still out of tolerance, repeat the calibration procedure.

3.6 Alternate Final Calibration Check: (RTU other than HSE 3200 series transmitters)

1. Connect a Digital Voltmeter to the Model 6708 test harness (Appendix 8.1B). Connect the test harness to a 12VDC battery.

2. Aim the sensor at a target a known short distance from the sensor. Record the voltage displayed on the DVM. Be certain that the voltage is stable.[7]

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[6] As of December, 2006 new a 10 second analog warm-up program chip is provided when a Model 6703 is ordered. The seven second analog warm-up used in previous installations is sufficient in most cases and no change is necessary.

[7] It should be noted that the voltmeter reading may not be the same as the voltage reading shown on the display. The important condition is that the voltage span be correct for that determined by the change in distance.

3. Aim the sensor at a target a known long distance from the sensor. Record the Voltage displayed on the DVM. Be certain that the voltage is stable.

4. Compute the expected change in voltage between the short and long distance to the target. Example: If the sensor has a 32 foot range and the distance between the two points is 14 feet, than the expected voltage differential should be: 14ft/32ft x 5 V = 2.188 V (± .005V). Compare the computed value with the actual difference.

If the DVM values are within the tolerance limits expected, the calibration is complete. If the values are not within the tolerance expected, repeat the test a couple of times. If the recorded values are still out of tolerance, repeat the calibration procedure.

3.7 5 Volt calibration:

2/26/07: Section under construction.

4.0 MAINTENANCE

The maintenance requirements of the Ultrasonic sensor are housekeeping in nature. At regular intervals, the Ultrasonic enclosure and sensor need to be cleaned. Spiders and insects may use the housing and there may be accumulations of insect larva or spider webs interfering with the sensor signal. Clean the sensor taking care to not damage the sensor element. If the sensor element appears to be damaged, return the sensor to *High Sierra Electronics* for replacement.

The area of the sound cone needs to be cleared of obstructions and debris. Overhanging vegetation will adversely affect the signal as will protruding rocks, tree trunks or other debris.

It is recommended that a span check be performed at regularly scheduled intervals. If there is no easy way to check the sensor span calibration in the field, check *Appendix 8.4* to see if the field calibration procedure described in that section might work.

5.0 TROUBLESHOOTING

5.1 General instructions:

The first check of this system should be to determine that the battery is charged to sufficient capacity to power the sensor, radio and the *High Sierra Electronics* 3206 ALERT Transmitter. If battery capacity is in doubt, recharge or replace the battery. If the battery is good, most other problems that occur are due to loose wires or connections. Check that all wires are secure in their proper locations and that all connectors are secure. Verify that the *High Sierra Electronics* 3206 ALERT Transmitter has a ten second sensor warm-up program chip installed in U7 of the 12000 logic board. The label on the program chip says "10-sec". The standard 3206 program chip has a one second warm-up. On the 12003 connector board, the jumper on JB3 should be off. The jumper at JB6 should be on 1-2.

While the "Test" button on the transmitter is pushed and held, a clicking sound may be heard from the sensor (providing that the sensor is within hearing range).

5.2 Acoustic Sensor Test:

When testing the Ultrasonic sensor to verify that it is giving an accurate reading, it is best to power the sensor from a separate 12-volt battery. Follow the calibration procedure as outlined in Section 3 with the following exception: Power the sensor without any additional signal cable that may be attached to the sensor. Look for stability of the output readings, but do not be overly concerned about readings that may be different than those seen though a long signal cable.

If the sensor works properly without additional signal cable, check the installed additional signal cable for tight connections and shorts or opens in the line. Replace the additional signal cable if necessary. Repeat the test with the long signal cable. If the sensor with signal cable appears to be operating correctly but problems persist check to see that the transmitter is working properly.

6.0 RETURNS

If you need to return this product for any reason, call *High Sierra Electronics* at 530-273-2080 between 8:00 a.m. and 4:30 p.m. Pacific Standard Time. Ask for a Return Authorization Number (RA#) to be assigned to your sensor. Carefully pack the sensor so that it will not be damaged in shipment, and write the RA# on the outside of the box and on any paperwork enclosed with the unit. Please include a brief description of the problem and the conditions under which the unit failed.

7.0 WARRANTY

All *High Sierra Electronics'* manufactured products are warranted against defects in materials and workmanship for a period of three (3) years from the date of shipment. If the equipment fails due to such defects, *High Sierra Electronics* will, as its option, repair or provide a replacement for the defective part or product. In no case will *High Sierra Electronics* be liable for more than the original purchase price.

Equipment supplied by *High Sierra Electronics* and manufactured by others, carries the respective manufacturer's warranty. *High Sierra Electronics* assumes no warranty obligation, either express or implied, for equipment manufactured by others and supplied by *High Sierra Electronics*.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANT ABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH IS EXPRESSLY DISCLAIMED.

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Fax: (530) 273-2089

REVISIONS			
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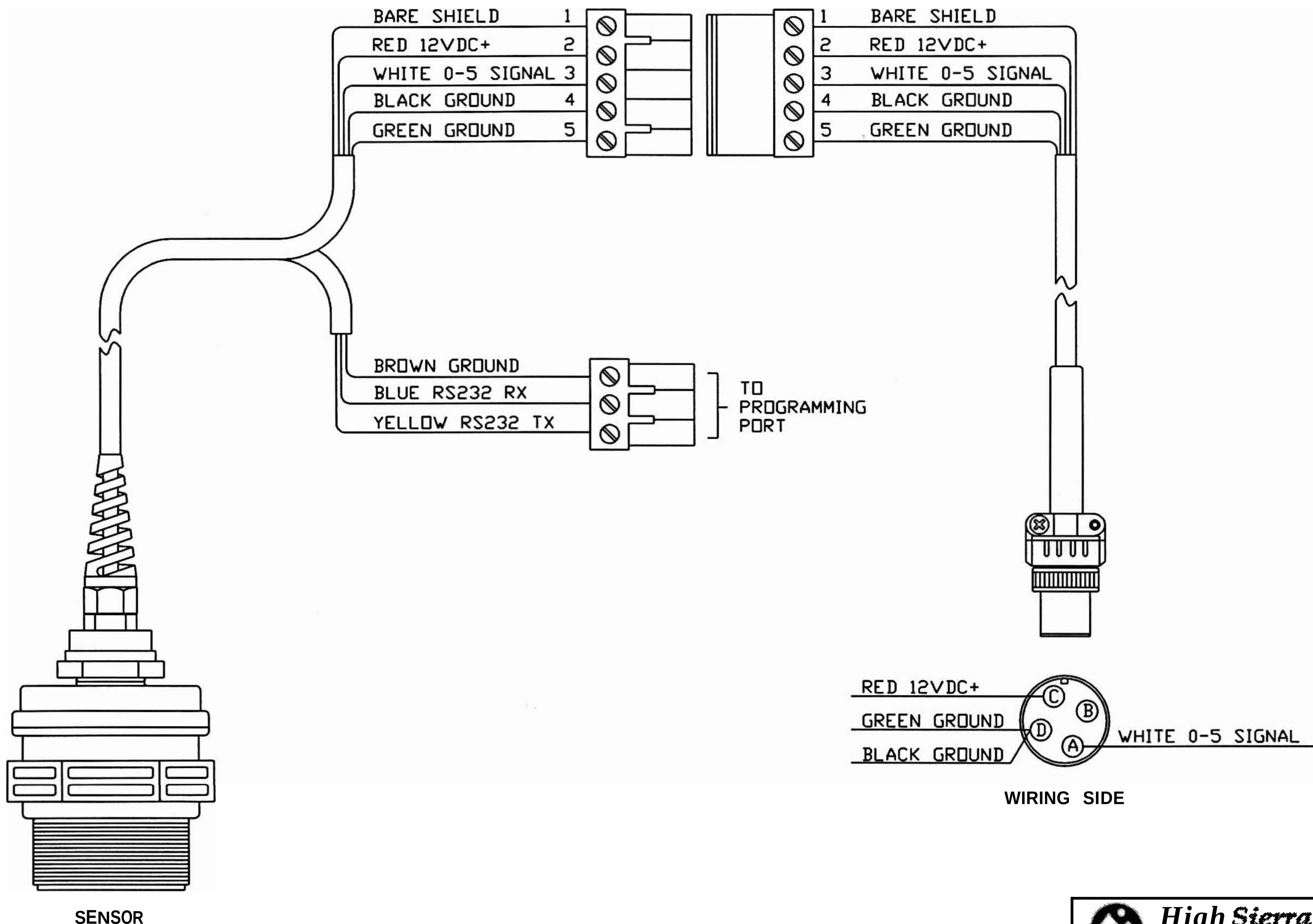

High Sierra Electronics GRASS VALLEY, CALIFORNIA		
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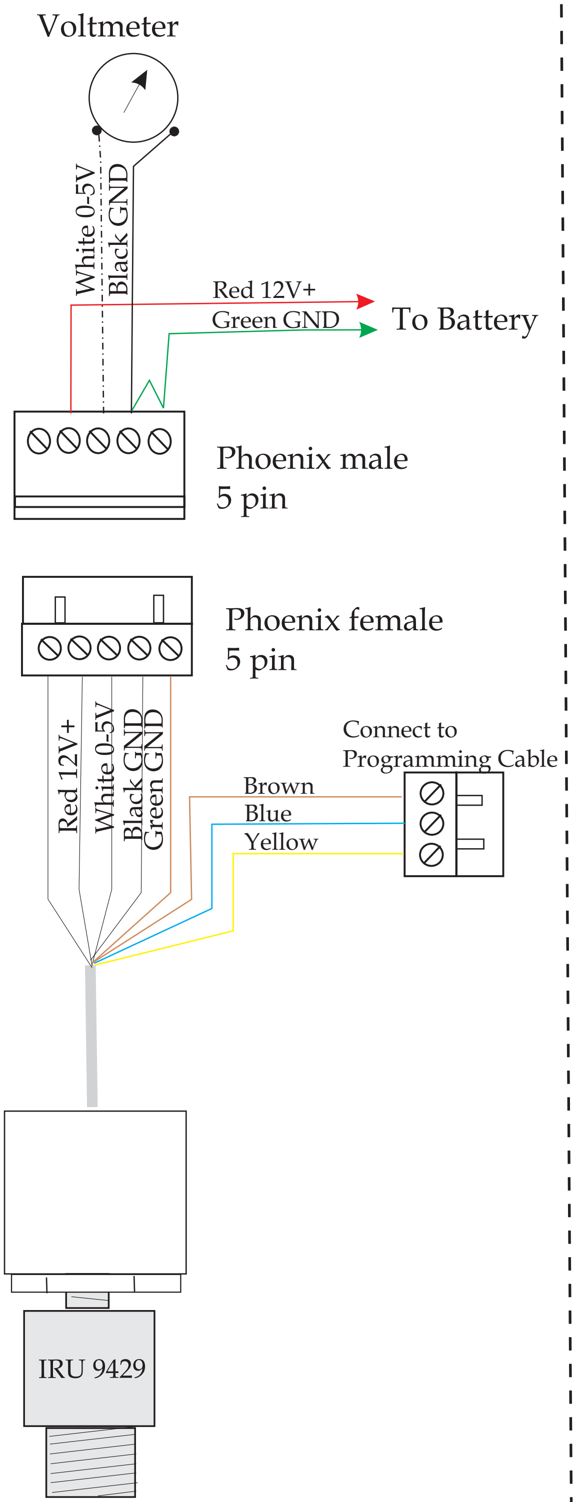
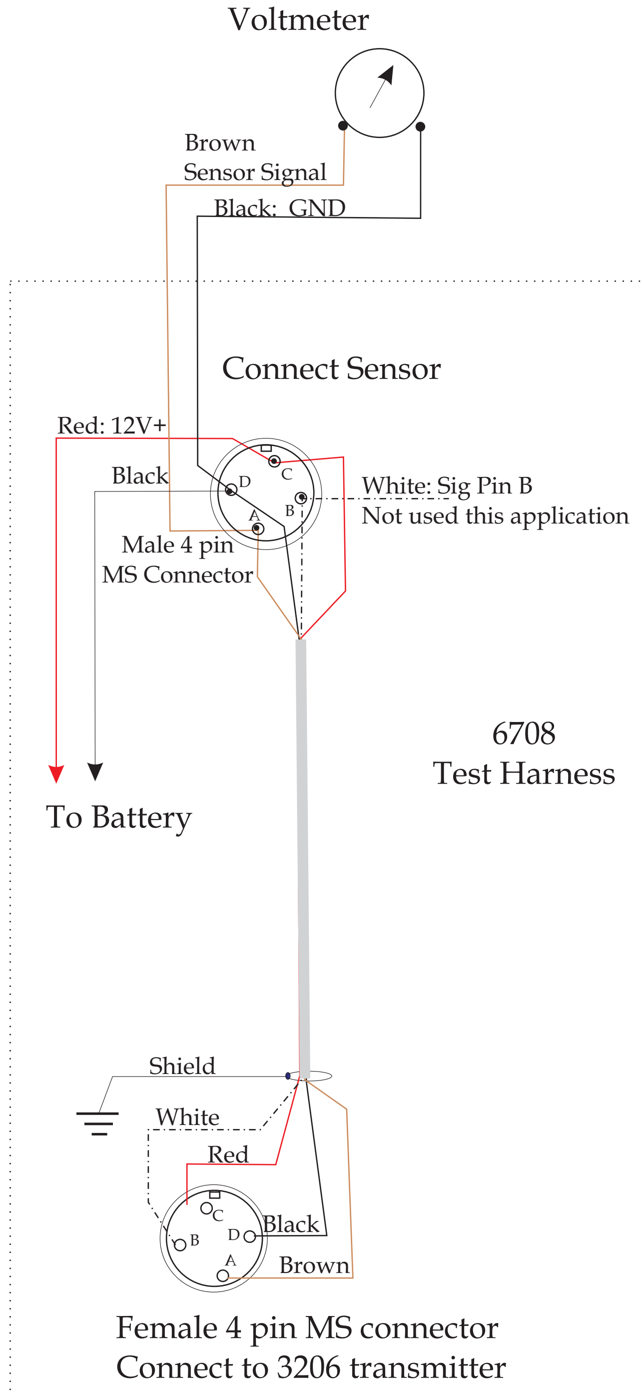
MODEL NO.: 6703-04		DRAWING NUMBER' 06-6703-04
DRAWN BY: NAE	DATE: 01-15-07	
SIZE: A SCALE: NONE	APPROVED BY:	SHT. NO: 1 OF 1

Program/Test Model 6703

Program/Test without Model 6708 Test Harness



Program/Test with Model 6708 Test Harness



High Sierra Electronics
155 Spring Hill Drive, Grass Valley CA 95945
Phone: (530) 273-2080 Fax: (530) 273-2089

TITLE: Program/Test Wiring			
MODEL NO.: 6703	DRAWING NO.: 61-6703-81B	REV.:	APPROVED BY:
DATE: 2/21/2007		DRAWN BY: JAB	
FILE NAME:		SHEET: 81B	DO NOT SCALE

REVISIONS			
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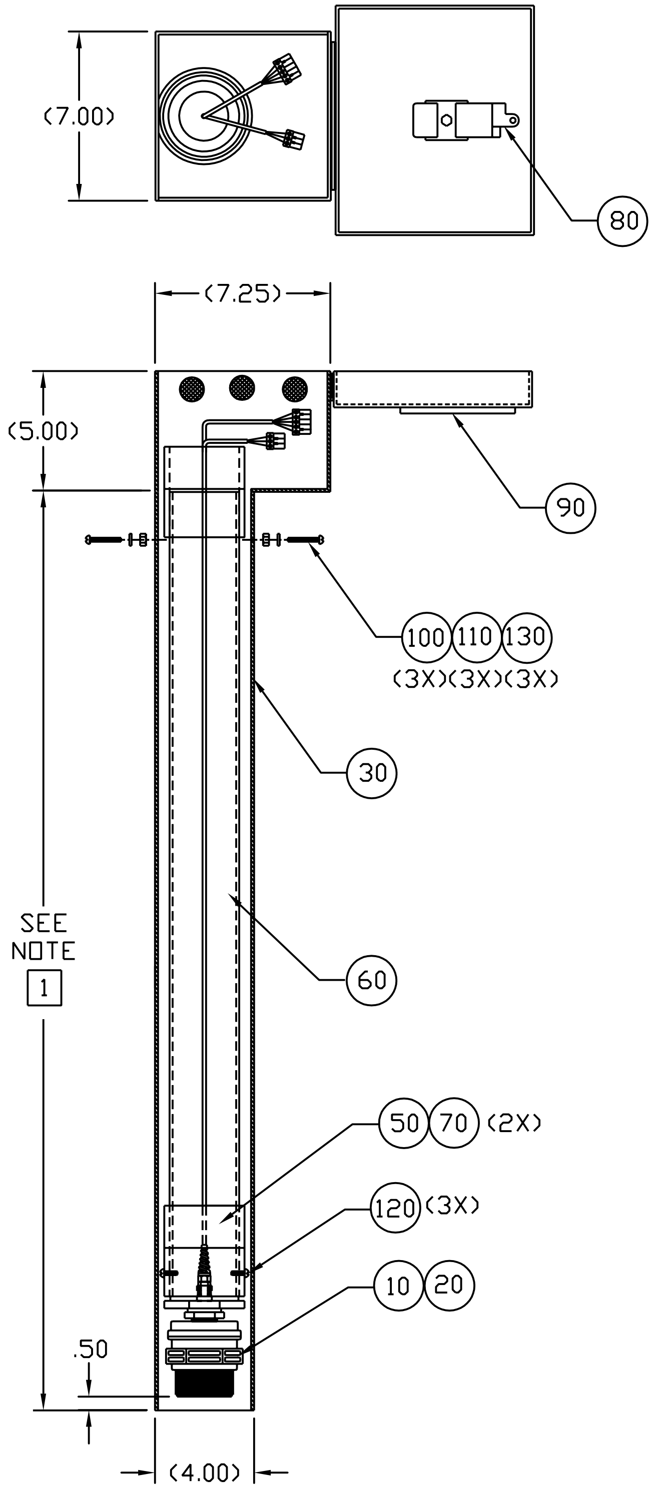

NOTES:

1. HOUSING AND PVC CONDUIT LENGTH IS CUSTOMER SPECIFIED.
2. UNISTRUT MOUNTING KIT IS INCLUDED BUT NOT SHOWN FOR CLARITY.

High Sierra Electronics GRASS VALLEY, CALIFORNIA			
TITLE: ULTRASONIC ENCLOSURE ASSEMBLY WITH 6703 SENSOR			
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SIZE: B	SCALE: NONE	APPROVED BY:	SHT. NO.: 1 OF 1

61-6700-83

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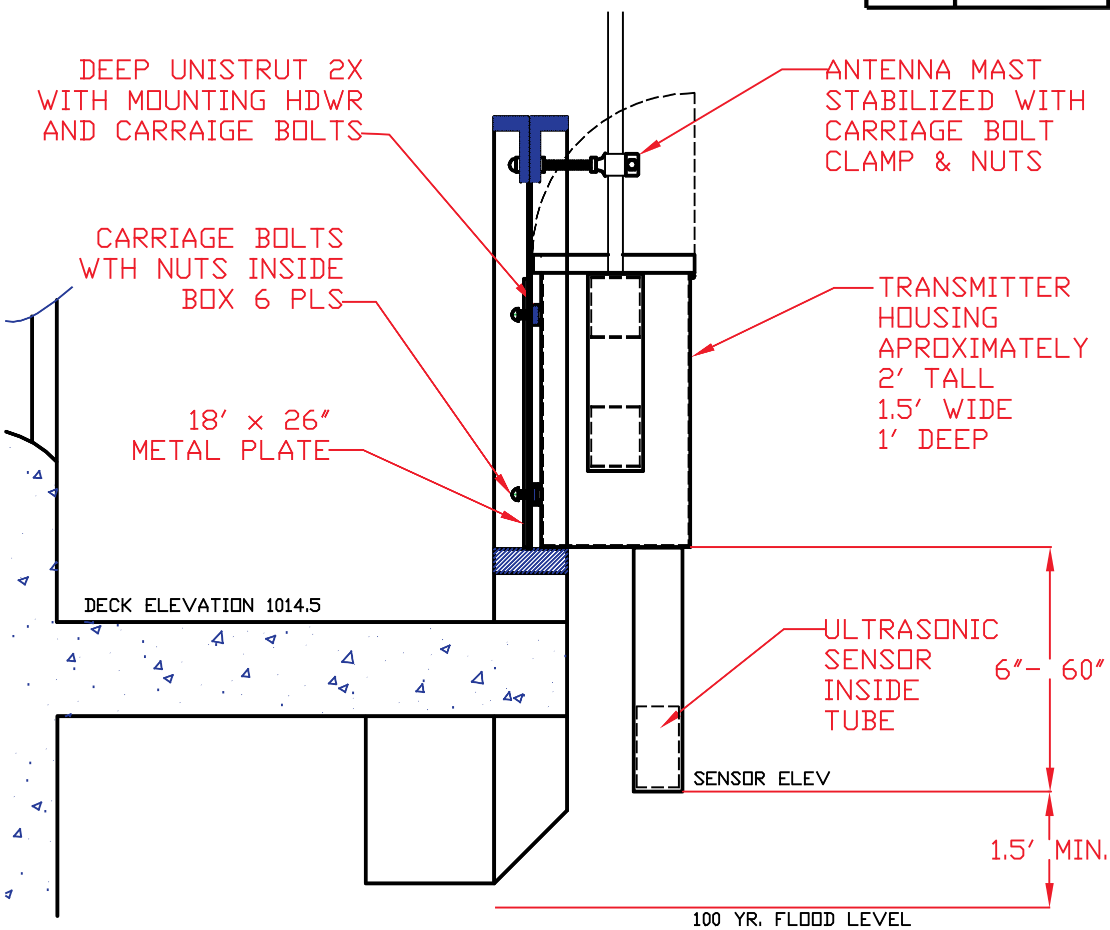


High Sierra Electronics GRASS VALLEY, CALIFORNIA			
TITLE: STEEL RAIL MOUNTED TRANSMITTER			
N.H.A.:		DWG.NO.: 61-6700-83	
DRAWN BY: JEANIE ALVEY		DATE: 03-11-04	
SIZE: A	SCALE: NONE	APPROVED BY:	SHT. NO.: 37 OF 53

8.4 *Simple Field Calibration fixture:*

An on site calibration check can be performed with a simple calibration tube as shown in the drawing of *Appendix 8.5.* In this example a 4 ½ foot extension tube is used. Actual site conditions may require a shorter (or longer) extension tube.

8.4.1 *Materials needed:*

1	4 ½ foot section of 2 1/2 inch PVC (or other custom length).
1	2 ½ " PVC coupling (slip to MPT[8])
1	10 foot length 1/4 inch rope (safety line)
2	1/4 x 4 inch threaded rod each with 2 nuts.
1	10 foot length of extra signal cable (Optional)

8.4.2 *Tools :*

PVC Glue
electric drill
1/4, and 5/16 inch drill bits
1/8 inch flat blade screwdriver

8.4.3 *Assembly Procedure:*

Some preparation is best done before proceeding into the field.

Glue the PVC coupling onto the extension tube. Mark two points on the PVC extension tube exactly 4.00 feet apart[9]. The first mark should be ~3 inches from one end. Drill a ¼ inch hole all the way through the tube at the two marked points. Be certain that the hole is perpendicular to the axis of the tube. Drill a 5/16 inch hole through one wall at the end of the PVC extension tube that will be open after assembly. Attach the safety line to the PVC extension tube through this hole.

Strip and tin the ends of the extra signal cable. If 5 pin Phoenix connectors are available, attach a male connector on one end, and a female connector on the other end.

Feed the extra signal cable through the PVC extension tube, the male end should be at the end of the tube that is to attach to the Phoenix connector on the sensor. (If no Phoenix connectors are available, the signal cable may be attached at the existing Phoenix connectors with a small screwdriver.)

Insert the ¼ inch bolts through the two thru holes and secure with nuts.

8.4.4 *Procedure for use*

For the field calibration, a remote station tester is needed in order to view the data transmitted during the calibration check. If no remote station tester is available, a Model 6708 test harness or an alternate method of connecting the sensor to a 12VDC

[8] MPT=Male Pipe Thread, FPT= Female Pipe Thread

[9] The distance between bolt hole centers may be any convenient value. Adjust the extension tube length and hole centers as desired. The minimum suggested distance is 1 foot between centers.

supply is needed. The sensor output voltage may be read using a digital volt meter (DVM).

Disconnect the signal cable from the sensor to the transmitter.
Loosen the three screws that secure the PVC collar in the sensor housing.
Remove the PVC tube from the sensor housing.
Attach the extra signal cable to the sensor cable.
Remove the ¼ inch threaded rod at the top of the sensor/tube assembly.
Thread the extension tube onto the sensor/tube assembly.
Secure the safety rope to the guard rail or other secure attachment.

Note: See section 8.4.5 if the sensor housing is not in an accessible location.

Lower the *calibration assembly* (Sensor, tube and extension tube) into the sensor housing until the lower bolt rests on the housing. Generate a transmission. Record the value of the transmitted data. It is always best to collect several transmissions to see that the value reported is stable.

Raise the *calibration assembly* and remove the lower bolt. Lower the assembly until the upper bolt rests in the housing. Generate a transmission and record the value. Repeat as above.

Calculate the expected change in value and compare to the actual change.

If the change in value is as expected, see Section 8.5. If the change in value is at variance with the expected value, repeat the test. If the calibration is still off, re-calibrate the sensor per *Section 3*.

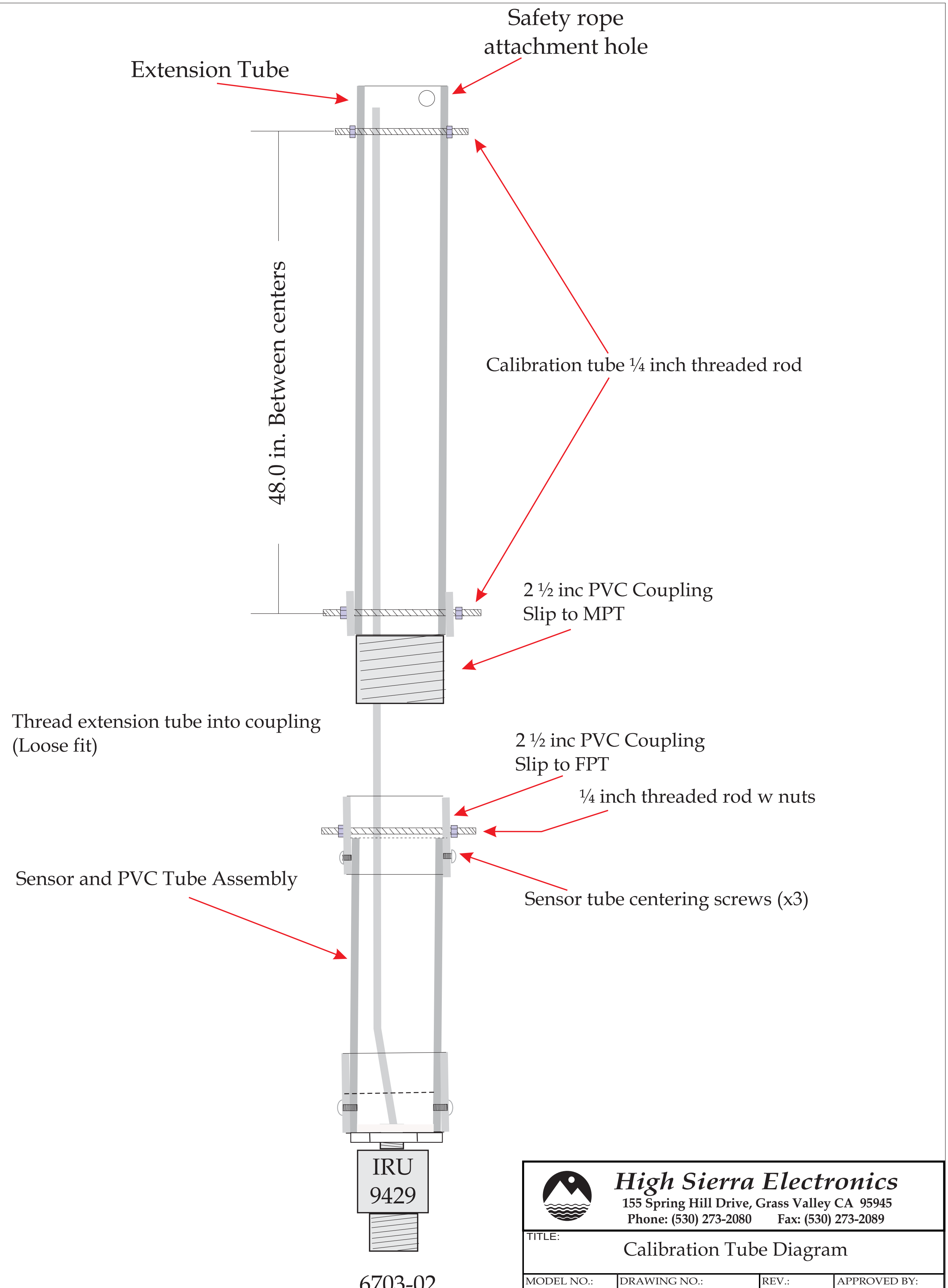
8.4.5 Alternate calibration check

If the sensor housing is not easily accessible, once the sensor is removed from the sensor housing, the bridge railing may be used in place of the sensor housing as an access point for the *calibration assembly*. Be sure to secure a safety line on the *calibration assembly*. Secure the safety line to the bridge rail or sensor housing. Allow enough slack in the line to raise and lower the *calibration assembly*. The thru bolts can rest on the top of the rail at the two *calibration assembly* elevations. Be sure that there are no obstacles in the sound cone path. The *calibration assembly* must be steady and plumb before generating a transmission. Generate transmissions at two elevations and compute the expected change in value. Compare to the actual value.

8.5 Final:

If the change in value meets expectation, remove the PVC extension tube. Replace the ¼ inch threaded rod at the top of the *sensor/tube assembly* and re-install the *sensor/tube assembly* in the sensor housing. Secure the centering screws. Generate a transmission to test that the sensor is working properly.

Calibration Fixture



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TITLE: Calibration Tube Diagram

MODEL NO.:	DRAWING NO.:	REV.:	APPROVED BY:
6703	61-6703-85A		

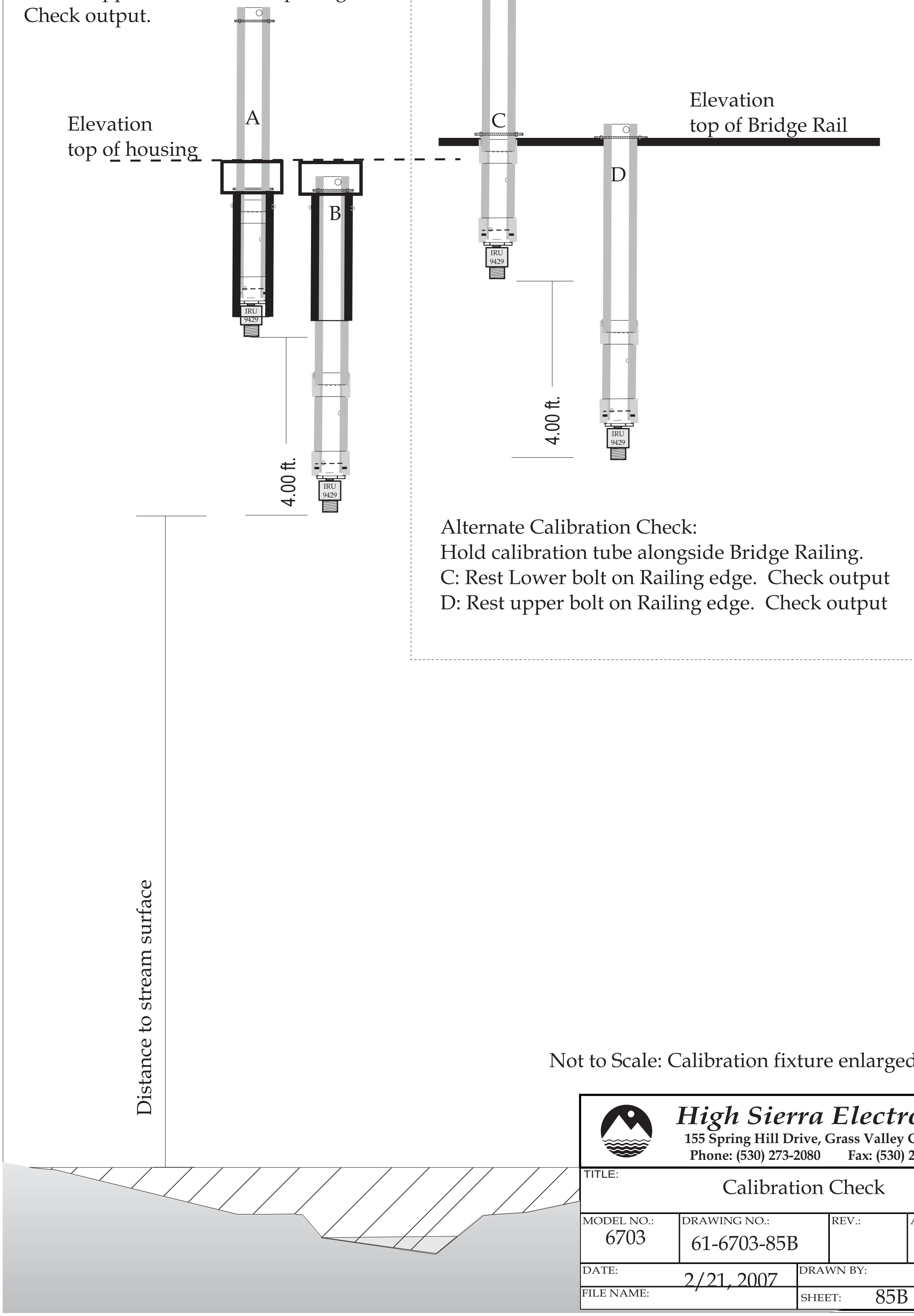
DATE:	DRAWN BY:
2/21/2007	JAB

FILE NAME:

SHEET: 85A

DO NOT SCALE

Calibration Check:
A: Rest Lower bolt on Tube opening
Check output.
B: Rest upper bolt on Tube Opening
Check output.



Alternate Calibration Check:
Hold calibration tube alongside Bridge Railing.
C: Rest Lower bolt on Railing edge. Check output
D: Rest upper bolt on Railing edge. Check output

Not to Scale: Calibration fixture enlarged for clarity

High Sierra Electronics
155 Spring Hill Drive, Grass Valley CA 95945
Phone: (530) 273-2080 Fax: (530) 273-2089

TITLE: Calibration Check			
MODEL NO.: 6703	DRAWING NO.: 61-6703-85B	REV.:	APPROVED BY:
DATE: 2/21, 2007	DRAWN BY: JAB		
FILE NAME:	SHEET: 85B	DO NOT SCALE	

PVC Tube Modification

Modification Instructions:
Remove the 6703 sensor (DCU 7070) from the PVC tube.
Loosen the three centering screws that hold the PVC tube in the Housing (A).
Remove the PVC tube from Sensor Housing.

Cut off the ring at the top of the tube. Cut at the shoulder. De-burr the cut end.
Glue a PVC coupling (slip to FPT) on the top of the PVC tube.
Cut 4 ½ inches off of the bottom of the PVC tube. De-burr the cut end.
Cut the Original PVC tube at the measured elevation. De-burr the cut end.

Thread the IRU2129 onto the adapter coupling.
Feed the sensor cable through the PVC tube.
Press the coupling assembly onto the PVC tube.
Check that the length is correct. The sensor end should not extend beyond the end of the 4 inch housing tube. If it does, measure that distance.
Make a mark on the coupling (top of the tube) at a point such that a threaded ¼ inch rod with nuts will pass through the coupling.
Remove the sensor/coupling assembly from the PVC tube. Adjust PVC tube length if necessary (cut ¼ inch more than the measured distance that the sensor extended out the end
Glue the sensor/coupling assembly onto the PVC tube.
Drill the ¼ " hole through the coupling at the top of the assembly.
Insert a ¼ inch threaded rod through the hole. Thread and fasten the nuts on the rod.

Place the assembly in the housing (B). Adjust the centering screws.
Connect the signal cable to the transmitter.
Test that the sensor is operating properly.