

# Air Gap Field Installation Guide

A Manual for Field Installation and Maintenance Procedures for Deployment of Air Gap Measurement Systems Using the Sutron Xpert 9210B DCP with the Miros Microwave Sensor and the Laser Technology, Inc. Universal Laser Sensor

Version 3.1



September 2014

**noaa** National Oceanic and Atmospheric Administration

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U.S. DEPARTMENT OF COMMERCE

National Ocean Service

Center for Operational Oceanographic Products and Services

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## Revision History

<b>Date</b>	<b>Revision Description (Reason/What)</b>	<b>Updated By</b>
September 2014	Version 3.1: Removed sensitive content, updated Appendix F, updated to reflect the current number of air gap installations, and updated information on power connections and battery manufacturers.	Kathleen Bailey Warren Krug
November 2011	Version 3.0: Added Satlink information, DCP modifications, and SOP #5.4.2.4.3 Technical Expert Help (Go To/Call List)	Warren Krug
April 2010	Version 2.0: Update installation of air gap system with laser sensor replacing trigonometric leveling, and maintenance	Warren Krug
February 2009	Version 1.0: Installation of air gap system, trigonometric procedures, and maintenance	Warren Krug



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## **Foreword**

CO-OPS has accepted the responsibility for implementing the measurement of air gap, the distance between the water's surface and the lowest point (low steel) of a bridge. This measurement determines the vessel's clearance or air gap as it passes under a bridge, providing important information for marine pilots. Air gap sensors are becoming an integral part of the Physical Oceanographic Real-Time System (PORTS<sup>®</sup>), an expanding suite of instruments that measure and disseminate observations of environmental and meteorological parameters.

In May 2008 CO-OPS approved the use of a Laser Technology, Incorporated (LTI) Universal Laser Sensor (ULS) as a quality control device for the air gap system. This field installation guide describes the improvements to the system, including the laser sensor, updated data collection platform (DCP) and software, a Geostationary Operational Environmental Satellite (GOES) transmitter, 12-volt power supply for the Miros microwave sensor, and the elimination of the PORTS<sup>®</sup> Interface Board. A "Hydro-type" system is now being used, which creates a cleaner looking installation.

In January 2009, the requirement for trigonometric leveling of the system was removed if a laser sensor is installed as part of the system.

<p><b>This manual covers air gap systems installed after June 2008.</b></p>
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This Field Installation Guide does not cover the funding or siting of the air gap system, as these issues are outside the scope of this document. It is written for use by CO-OPS personnel and/or CO-OPS PORTS operations and maintenance contractors who are familiar with the air gap system and experienced in the installation of air gap sensors and equipment.



## **Introduction**

The National Ocean Service (NOS) Center for Operational Oceanographic Products and Services (CO-OPS) manages several programs to monitor the Nation's coastal waters. The Physical Oceanographic Real-Time System (PORTS<sup>®</sup>) is one of NOS's vanguard improvements in providing environmental information to the maritime community. PORTS<sup>®</sup> provides real-time tide, current, and meteorological information to improve navigational decision-making, maximize a port's safety and economic performance, and prevent loss of life from maritime accidents.

As vessel sizes and the number of bridges increase, "ship-hit-bridge" stories are becoming more common. Less widespread are reports of ships that could not enter or exit a harbor due to air gap (bridge clearance) limitations. However, the economic gains to be realized by enhanced commerce and the avoidance of collisions are considerable, and mariners have voiced a clear requirement for air gap information.

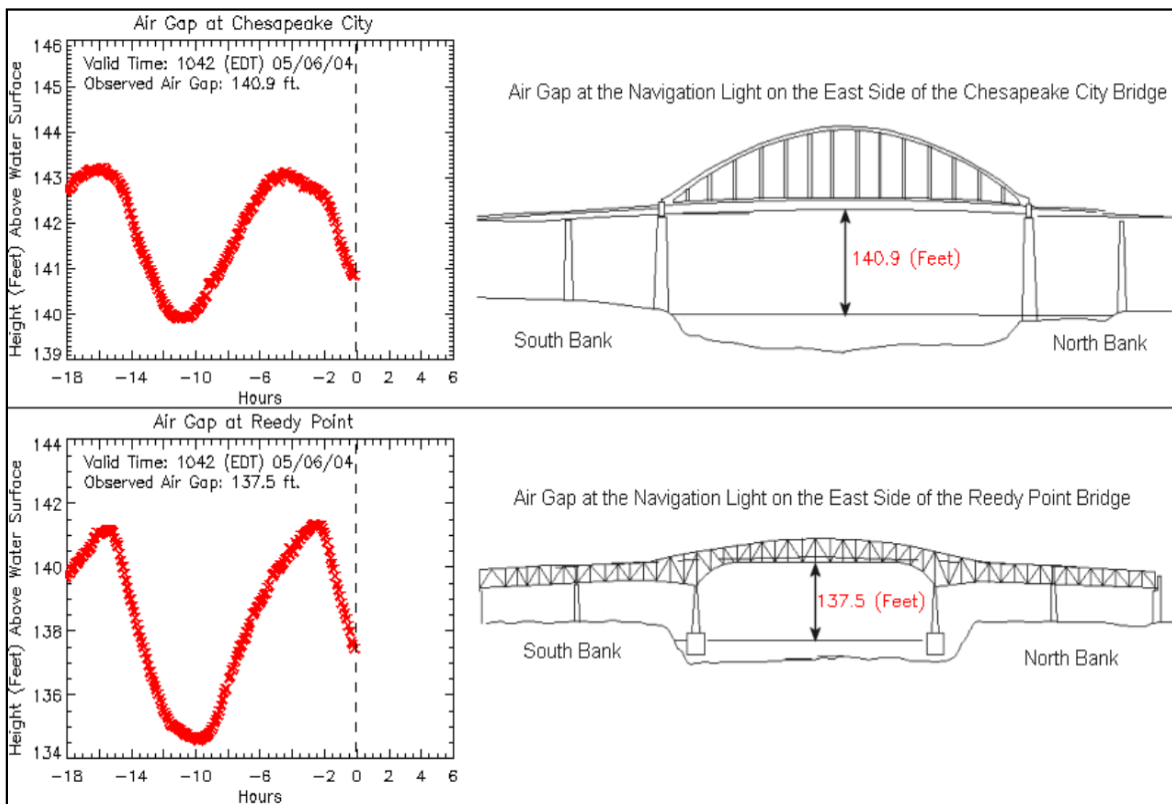
Measuring the air gap between the water surface and the low steel of a bridge and making that measurement available to mariners are essential to help prevent damaging bridge strikes. A real-time determination of available clearance for bridges with significant seagoing vessel traffic of different sizes is critical for port authorities who are responsible for maritime safety in their area of operations. There are numerous documented cases of accidents where passing ships struck bridges, causing loss of life, damage estimated in the millions of dollars, and harmful ecological effects.

With ships taking advantage of every available inch of channel depth, plus the added difficulty of ship squat calculations, determining the available clearance of a ship under a bridge is complex. Bridge clearance information that includes water-level measurement helps mariners quickly determine the ship's margin of safety and contributes greatly to the prevention of maritime accidents.

As part of an expanding suite of instruments needed for PORTS, CO-OPS has accepted the responsibility for implementing the installation of air gap sensors. The Port Authority of New York and New Jersey, the U.S. Coast Guard, and the Maryland Port Administration requested and funded the development and installation of the first air gap sensors.

Microwave sensor technology for measuring air gap was selected from among several options because it has the advantage of a relatively large footprint on the water surface, providing a spatial integration in contrast to a laser's single point, as well as being immune to fog and rain. After careful evaluation of multiple sensors, CO-OPS' Ocean Systems Test and Evaluation Program (OSTEP) selected the Miros air gap sensor because it demonstrated lower costs, longer range, better precision, smaller size, lighter weight, less power demand, and wider environmental tolerance than other units tested. OSTEP continues to test other sensor designs and will likely integrate other types of microwave radar sensors into the suite of air gap sensors in the near future.

CO-OPS has successfully installed twelve operational systems, two of which are on bridges that span the western and eastern ends of the Chesapeake & Delaware Canal (fig. 1-1). Other systems include the Bayonne Bridge (New Jersey), the Chesapeake Bay Bridge (Annapolis), and the Gerald Desmond Bridge (Los Angeles). The more recent installations are on the Don Holt Bridge (South Carolina), Verrazano-Narrows Bridge (New York City), the Huey Long Bridge and Crescent City Connector (New Orleans), the Oakland Bay Bridge (California), the Dames Point Bridge (Florida), and the I-210 Bridge (Lake Charles, Louisiana). These installations include the Laser Technology, Incorporated (LTI) Universal Laser Sensor (ULS) and the latest Sutron Xpert 9210B data collection platform (DCP). Mounting diagrams for these systems can be found in appendix A.



**Figure 1-1.** Air gap data and diagrams of the Chesapeake City Bridge and Reedy Point.

## **1.0 Purpose of this Document**

This Field Installation Guide is for personnel who install and maintain air gap systems and includes the information needed for field personnel to stage equipment and successfully deploy, repair, and perform preventative maintenance on PORTS<sup>®</sup> air gap measurement systems. Although system standardization is a goal, the uniqueness of each bridge will require subtle installation/setup differences with each station. Therefore, this is a living document that contains the many lessons learned from each deployment. New lessons learned from operational experience and each subsequent deployment will be added in updated versions as appropriate.

**This Field Installation Guide should only be used by personnel who have system expertise and previous field experience and are familiar with CO-OPS air gap installations, systems, and equipment.**

## **2.0 System Overview**

The air gap system consists of an air gap sensor, a data collection platform (DCP), and data communications hardware to transmit data to the CO-OPS server in Silver Spring, Maryland.

### **2.1 Miros Microwave RangeFinder™**

The Miros microwave RangeFinder™ (fig. 2-1) operates according to the FMCW (frequency modulated continuous wave) principle. FMCW sensors emit a microwave FM chirp signal and receive an echo from the water surface. The signal propagation delay given by the distance from the antenna to the water surface causes a beat signal in the receiver. This beat frequency is converted to an accurate distance via advanced signal processing, thus, the range is proportional to changes in frequency. The digital signal processing is performed by a Motorola HC16 microprocessor. The special purpose range finder firmware performs data acquisition, range filtering and signal decimation, spectral analysis, range tracking, and data presentation. Table 2-1 provides the Miros sensor specifications. More technical information on the Miros microwave RangeFinder can be found in the Miros User Manual, which is available at the Chesapeake Instrument Laboratory (CIL).

The original Miros sensors required a 24-volt direct current (Vdc) power source. All new sensors are equipped with a 12-V power supply board that eliminates the need for the PORTS Interface Board. Older sensors will be upgraded to the new board when serviced. All upgrades must be performed at the CIL, and the sensor must be checked at the calibration facility.



**Figure 2-1.** Miros Microwave RangeFinder.

**Table 2-1.** Miros sensor specifications

<b>ATTRIBUTE</b>	<b>DESCRIPTION</b>
<b>Range</b>	SM-094/50 3 to 50 m SM-094/85 3 to 85 m Minimum range: 1 m for all models
<b>Accuracy</b>	±1 cm (nominal, against fixed target) ±1 mm (averaged measurements, against /fixed target)
<b>Measurement Principle</b>	CWFM
<b>Frequency of Operation</b>	9.4 - 9.8 GHz
<b>Modulation</b>	Triangular
<b>Output Power</b>	-6 dBm (1/4 mW) (nominal)
<b>Antenna</b>	Type: Printed circuit patch antenna Beam-width: 5 degrees (one way half power) Gain: > 24 dB Antenna (reduced effective aperture, the antenna is designed to have symmetrical patterns in E and H-plane)
<b>Voltage</b>	+12 Vdc +30/-10%
<b>Current</b>	0.2 A
<b>Environmental</b>	Temperature: -30 °C to + 50 °C Humidity: 10 - 100%, condensing
<b>Housing Material</b>	Aluminum EN AW 5052 (57S) Finish: Enameled Color: Grey RAL 7035
<b>Ingress Protection</b>	Designed to meet IEC IP66
<b>Dimensions and Weight</b>	Max dim. (H x W x D): 70 x 510 x 420 mm Weight: 7 kg

### **2.1.1 Miros Inspection and Acceptance Test (IA)**

The CIL/SIL performs a detailed inspection and acceptance test of every sensor received from the factory prior to sensor deployment. The tests included a physical inspection of the sensor housing, cables, and shipping package for any signs of damage, as well as a communications and parameter check and a 4-point, 96-hour range test that collects data at 10 m, 20 m, 40 m, and 60 m on an outdoor reference range. An over-the-water test is also conducted as a final system check. Additional information about these checklists and tests can be found in appendix B and appendix C.

### **2.2 Laser Technology, Incorporated Universal Laser Sensor**

The Laser Technology, Incorporated (LTI) universal laser sensor or ULS (fig. 2-2) is a pulsed range finder that sends a single pulse of light, typically 8 milliseconds (ms) in duration, to a target and measures the time it takes for the pulse to return to the unit. Given that the speed of light is relatively constant, the distance to the target can be calculated. Because the duration of the pulse is in milliseconds, one pulse does not provide an accurate measurement. Therefore, the range finder uses a series of pulses and averages them, yielding a more accurate measurement. Table 2-2 provides the LTI sensor specifications. A complete LTI ULS User Manual is available at the CIL.



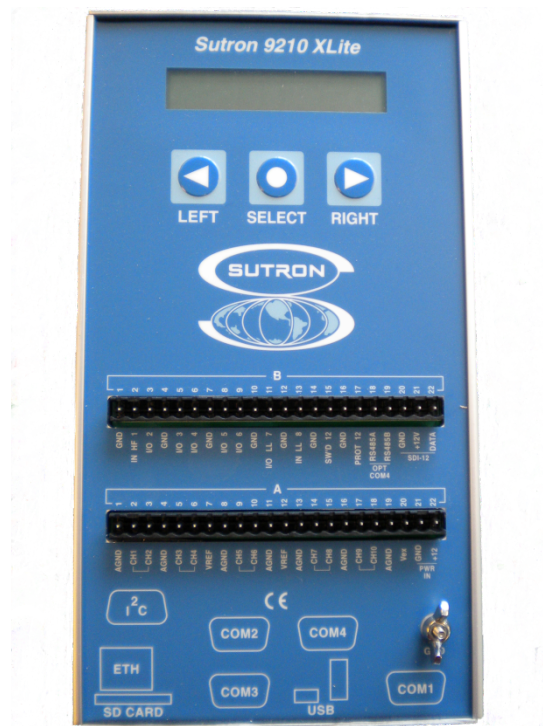
**Figure 2-2.** Laser Technology, Inc. universal laser sensor (ULS).

**Table 2-2.** LTI sensor specifications.

ATTRIBUTE	DESCRIPTION
<b>Pulsed Laser</b>	905 nm (infrared) High Power      400 nJ per pulse Medium Power    200 nJ per pulse Low Power        100 nJ per pulse Average Power    Proportional to PRF (pulse firing rate) Eye Safety        FDA CFR 21 Class I - 7 mm
<b>Accuracy</b>	± 4 cm typical    Non- Cooperative Target ± 2 cm typical    Cooperative Target
<b>Resolution</b>	0.01 ft (1 mm)
<b>Internal Laser Pointer</b>	Wavelength      650 nm (red) Eye safety        FDA CFR 21 Class I 1 meter Switch            Software controlled Output power     1 mW (average)
<b>Communications</b>	Configuration Port RS232 1200 – 230400 baud Universal Port     RS232 1200 – 230400 baud RS485 1200 – 230400 baud 4 – 20 mA
<b>Physical</b>	Dimensions      5.3 in (L) × 4.75 in (W) × 2.5 in (H) 13.5cm (L) × 12cm (W) × 6.3cm (H) Weight            1.75 lbs (0.8 kg) Enclosure        Anodized Aluminum Weather          IP 54 Temperature     -22 °F to +140 °F -30 °C to + 60 °C

### 2.3 Data Collection Platform

The Data Collection Platform (DCP) used with the Miros microwave radar sensor is manufactured by Sutron Corporation and is part of the Xpert family of DCPs. The Sutron Xpert model 9210B DCP (fig.2-3) is based on a 32-bit microprocessor using the Microsoft® Windows CE operating system. The unit has integrated analog and digital I/O modules, four RS232 serial ports, an SDI-12 port and an I2C port for additional I/O modules (fig. 2-4). The system also includes a CD data card slot and Ethernet port. The unit is packaged in an 11-inch (in) × 6-in × 3-in aluminum case. Table 2-3 outlines the Sutron DCP system specifications. Appendix D provides more information about the DCP. A full Sutron Xpert 9210B manual is available at the CIL/SIL.



**Figure 2-3.** Sutron Xpert DCP model 9210 B



**Figure 2-4.** Sutron Xpert 9210B DCP I/O/ modules

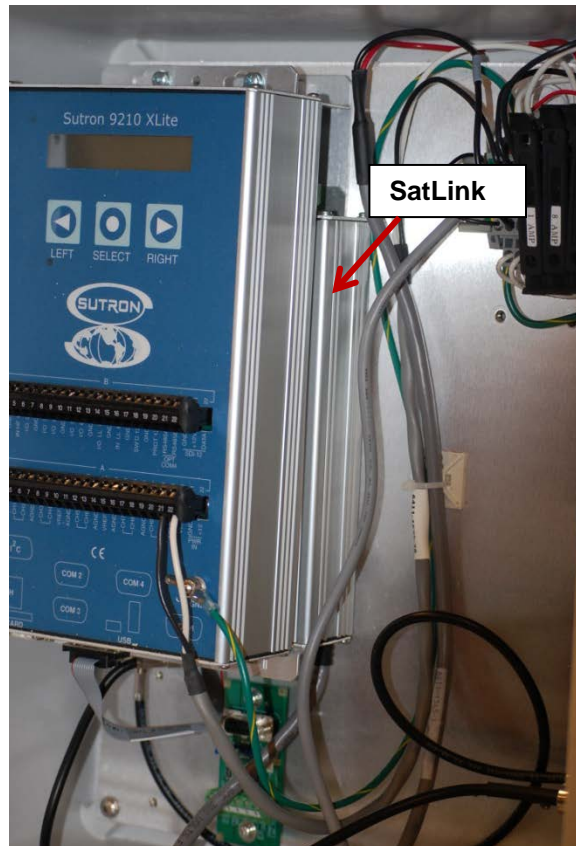
**Table 2-3.** Sutron 9210B DCP specifications.

<ul style="list-style-type: none"><li>• 32 bit microprocessor running Microsoft Windows CE operating system</li></ul>
<ul style="list-style-type: none"><li>• 8 channel digital I/Os (6 bi-directional)</li></ul>
<ul style="list-style-type: none"><li>• 10 channel 16 bit A/D inputs (0-5Vdc full scale)</li></ul>
<ul style="list-style-type: none"><li>• Software control of switched 12Vdc power on the I/O modules</li></ul>
<ul style="list-style-type: none"><li>• 32MB flash disk</li></ul>
<ul style="list-style-type: none"><li>• 32 MB RAM</li></ul>
<ul style="list-style-type: none"><li>• 4 RS232 ports that can be used for sensor inputs or outside communications such as LOS radio, GOES satellite, telephone or IP modems.</li></ul>
<ul style="list-style-type: none"><li>• CD card slot for additional storage, up to 2 GB</li></ul>
<ul style="list-style-type: none"><li>• Ethernet port</li></ul>
<ul style="list-style-type: none"><li>• Input power 10-16 Vdc (40 mA, 230 mA with Display on)</li></ul>

## 2.4 Data Transmission

A Sutron Satlink GOES transmitter, model SatLink2 has been added to the system to provide GPS timing and transmission of the data every 6 minutes. The unit, which is a combined GOES transmitter and logger, is mounted behind the 9210 DCP (fig. 2-5). The unit has integrated analog, digital and SDI-12 inputs, and an RS232 port that can be used to program and troubleshoot the unit. NOS/CO-OPS does not use the unit as a logger because of software and data storage limitations; all data are acquired and recorded in the DCP. The GOES transmitting information, channel assignment, time of transmission, transmission window, and other parameters are sent from the DCP via the RS232 port. This port is also used to acquire status information from the SatLink by the DCP after each transmission. These data are available on the DCP under the **Setup Tab** on the main screen. Appendix E provides instructions for loading the GOES setting into the DCP. This information is usually loaded during system testing and should not be changed unless directed to by the CIL/SIL. Table 2-4 outlines the Sutron SatLink transmitter specifications.

Data are transmitted one of two ways: either via the PORTS data acquisition system (DAS) or GOES. Each way follows the same path as other CO-OPS data types. Figure 2-6 illustrates both paths for transmitting air gap sensor data.

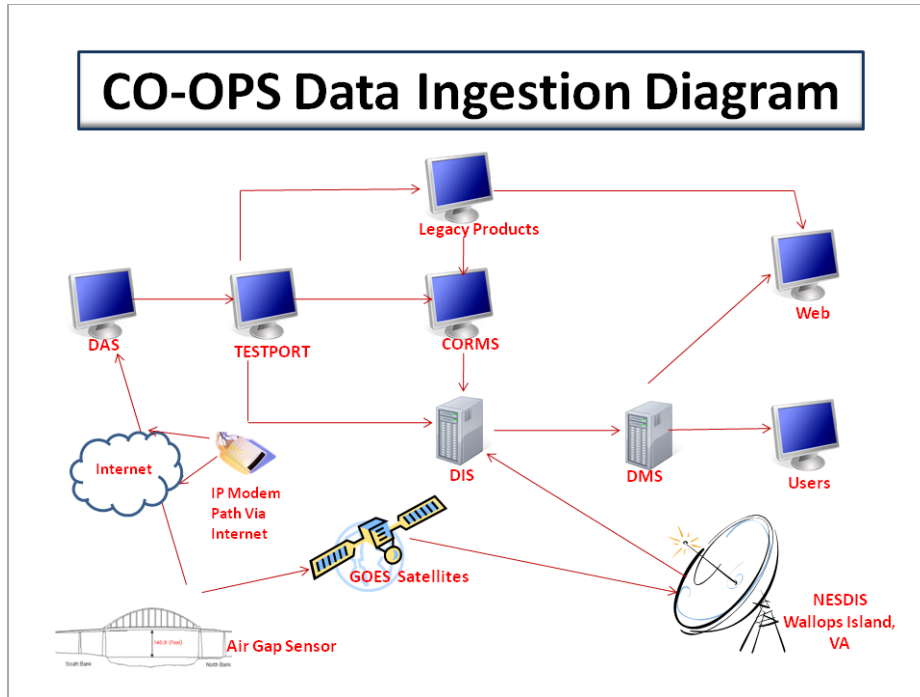


**Figure 2-5.** SatLink mounted behind the 9210 DCP.

**Table 2-4.** Specifications of Sutron SatLink transmitter.

ATTRIBUTE	DESCRIPTION
<b>Weight</b>	2.2 lb.
<b>Size</b>	5.5 in x 7.70 in x 1.75 in
<b>Environmental</b>	-40 °C to +60 °C
<b>Operating Voltage</b>	10.4 to 15.0 Vdc, reverse voltage protected
<b>LED indicators</b>	Status Fault Transmit
<b>Connections</b>	Power: Built-in cable GPS: SMA (Bulkhead Mounted) RS232: DB9 SDI-12: 3 position removable terminal strip Tipping Bucket: 2 position removable terminal strip Analog input: 8 position removable terminal strip RF: N-Type
<b>Interface Protocol</b>	Sutron SatLink Logger protocol Supports other DCPs in dumb logger mode at 9600 baud
<b>Measurements</b>	Supports 16 sensors or measurements Independent measurement schedules for each sensor Analog Inputs: 4 channels (single ended 0-5 V, differential, or ratiometric) Tipping Bucket: Dedicated switch closure counter input SDI-12: V1.0, V1.1, V1.2, V1.3 sensors User enterable labels for sensors Powerful Mathematical Equation Editor for analog sensor data Equation processing allows user entry of virtually any equation Manually entered readings
<b>Analog Measurement Specifications</b>	A/D Resolution: 24-bit A/D converter A/D Accuracy: +/- 0.02% FS @ 25°C, +/- 0.03% FS when transmitting Temperature Coeff: +/- 5 ppm/C typ. +/- 10 ppm/C max Linearity: +/- 0.005% FS Reference Output: 2.5 Volt, 10 mA. max (for temperature sensors) Switched +12 V Out: 500 mA. Max
<b>Log</b>	120,000 floating point readings Individual time stamps to 1 second Can log numbers as small as 1E-38 or as large as 3E+38 (IEEE32 float) Non-volatile flash memory Quality flag for each value
<b>Data</b>	Data Merge Mode supports merging of SatLink Logger data with data from external logger prior to transmission Circular Buffer Mode - enhanced transmission data management. Excess data is stored and sent on subsequent transmissions.
<b>Alarms</b>	User configurable for each sensor Alarm types: high alarms, low alarms, and rate of change alarms
<b>Timekeeping</b>	Sync to GPS within 10 ms Frequency discipline to within 10 Hz

ATTRIBUTE	DESCRIPTION
<b>Power Requirements @ 12.5 Vdc</b>	Quiescent: 6 mA typ 300 BPS Transmission: 3.8 A (Typ) 1200 BPS Transmission: 4.8 A (Typ) Protection against open or short circuit loads on transmitter output
<b>Recommended Antenna</b>	Sutron YAGI (10.5 dB gain), 5000-0080
<b>Transmission Modes</b>	100 BPS random and scheduled 300 BPS random and scheduled 1200 BPS scheduled 4800 BPS INSAT selectable 10 min window (3 randomized repeat sequence) METEOSAT Alert and Self Timed ARGOS/SCD Format
<b>Transmission Character Sets</b>	ASCII Pseudo-binary
<b>Transmitter Output Power</b> 12 SATLINK2 Logger and Transmitter Operations and Maintenance Manual	Software selectable power levels 7-watt (W) nominal, 100/300 BPS (+/- 1dB) 14 W nominal 1200 BPS (+/- 1 dB) 3.5-W (adjustable to 18 W) INSAT



**Figure 2-6.** Possible paths for air gap sensor data.

## **3.0 Field Deployment and Maintenance Instructions**

Because each air gap sensor installation is unique, this document is an installation and maintenance guide, not a step-by-step instruction. No two bridges are exactly the same; therefore, techniques used for individual sensor design and mounting will vary. The document also assumes that only personnel who are experienced with air gap systems will be installing them.

An extensive site reconnaissance is conducted prior to each sensor installation. Personnel should review the CO-OPS Bridge Clearance Site Reconnaissance Procedures, as well as all documentation from the reconnaissance for the particular installation being performed. The CO-OPS Bridge Clearance Site Reconnaissance Procedures, which also contains the documentation forms, can be found in appendix F.

### **3.1 Initial Installation**

#### **3.1.1 Notify Local Contact**

The CO-OPS PORTS Site Representative or the PORTS Implementation Manager will supply the field crew with a Points of Contact (POC) list for each air gap station. The Field Crew Chief must notify the appropriate local contact and agree on an installation date. Systems located on busy bridges may require a bridge or lane closure, which may need a 2- to 3-week advance notice. Bridge or lane closures are expensive and disruptive; therefore, it is important that all equipment is fully checked and functional before closures are scheduled. The Field Crew Chief should also check for any previously-planned closures or work, installing the system at that time if possible. The same holds true for routine maintenance; check for a scheduled closure and arrange for maintenance to occur at the same time.

#### **3.1.2 Safety Precautions**

Personnel must comply with all CO-OPS Field Safety Policy and NOAA Safety Policy. NOAA and CO-OPS Safety Procedures require that hard hats, safety reflective vests, safety shoes, and climbing gear be worn by all persons at all times while on bridges. Hard copies of this safety information are stored internally in the CO-OPS Chesapeake facility library, on the CO-OPS common drive in the Field\_Safety\_Manual folder, and on the Chesapeake common drive in a folder called Field\_Safety\_Manual. The most current version of the NOAA Safety Policy is stored at:

[http://www.corporateservices.noaa.gov/ames/administrative\\_orders/chapter\\_209/209-1.html](http://www.corporateservices.noaa.gov/ames/administrative_orders/chapter_209/209-1.html).

### 3.1.3 System Mounting

Since no single mounting system works on all bridges, this Field Installation Guide uses the Reedy Point Bridge test site as a guide. Other mounts can be found in appendix A, and additional mounts will be added as they are designed and installed. The sensor should be mounted on a suitable support structure with an open vertical view of the water surface. The mount should be designed to provide adjustments to ensure the sensor is level to the water surface. The Reedy Point system uses the Miros-designed mount. Plans for the mount can be found in appendix A. The use of an electronic level like the one in the Air Gap Tool Kit (see appendix G) should be used to adjust the mount to within  $\pm 0.5$  degrees with the sensor installed.

The sensor at the Reedy Point test site is mounted on the south side of the man-cage, which is located on the east side of the Route 9 Bridge in Delaware City, Delaware (fig. 3-1 and fig. 3-2 show top view and front view, respectively). This is the same location of the Reedy Point operational air gap system, which is mounted on the north end of the man-cage. The test sensor is mounted to a stainless steel frame, which is mounted to the man-cage using stainless steel U-bolts. Because the sensor case is aluminum, it must be isolated from the frame to prevent corrosion. Figure 3-3 shows the correct location of the plastic isolation washers. **DO NOT** install the sensor without these washers. The laser sensor is mounted in a Pelco waterproof camera case, which is vertically mounted next to the Miros microwave radar sensor. The Pelco case is mounted to a stainless steel channel, which is mounted to the man-cage by using U-bolts and stand-off blocks. The DCP, batteries, and related equipment are located in a NEMA4 enclosure to the right of the sensors and are secured using a Unistrut mounting system.



**Figure 3-1.** Top view of Reedy Point Bridge Miros mount.



Figure 3-2. Side view of Reedy Point Bridge Miros mount.

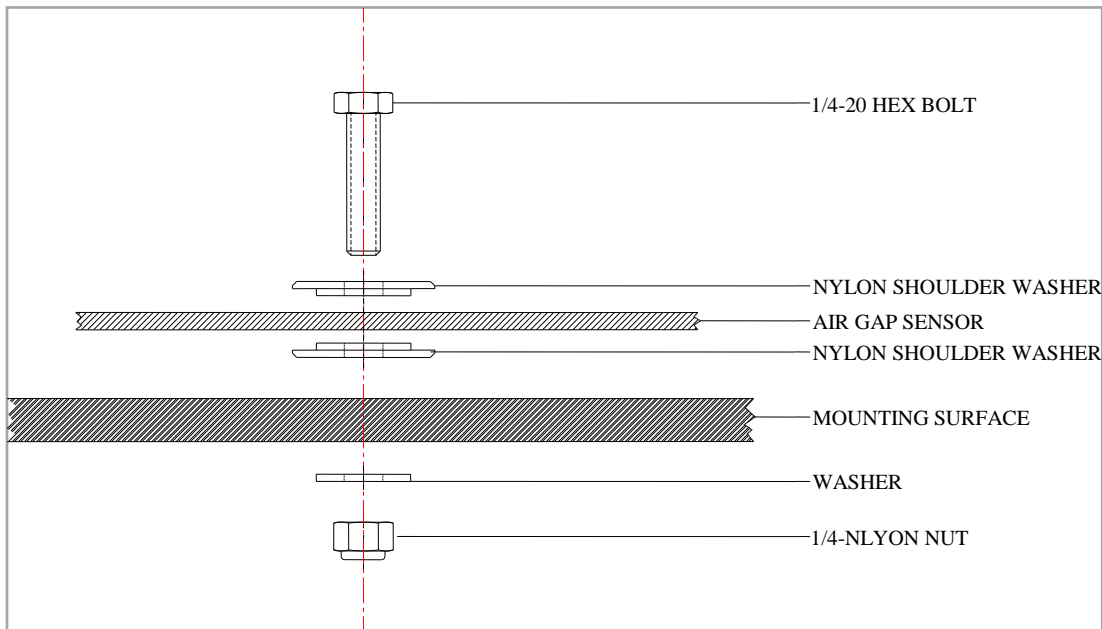


Figure 3-3. Correct position of the plastic isolation washers.

## **3.2 Systems Connections**

### **System Modifications**

The DCP used in air gap applications is based on the NOS Hydro platform with the following hardware modifications:

- Additional fuse holders for the microwave and laser sensors
- A second terminal strip used by the laser sensor for power and communications
- A second PolyPhaser for the IP modem

These modifications are usually completed by the CIL/SIL, and no additional work is required by the field party installing the sensor. See appendix H for a list of parts needed to make the modifications and for additional information.

### **Power Connections**

System power is provided by three 12-V, 40-Ah batteries mounted in a white APX enclosure (fig 3-4). The batteries are charged by the three 110-Vac charges mounted to the enclosure backing board. During installation, 110-Vac power is run to the enclosure and connected to a power strip, which is also mounted on the backing board. The batteries are connected to the fuse panel inside the gray PVC Hydro case using the pre-wired power cables, as shown in the air gap power wiring diagram in fig 3-4. The power cables enter through cable fittings on the right side of the case (fig 3-5). Two batteries are wired in parallel and provide power to the Miros microwave and LTI laser sensors; the third battery provides power to the DCP/SatLink and IP modem. A larger wiring diagram can be found in appendix I. **DO NOT** change any wiring or connections unless directed to do so by the CIL/SIL. Any changes made to the wiring or connections must be noted on the Station Report.

The CO-OPS standard battery for all measurement systems is the PowerSonics PS12400. Contact the CIL/SIL for additional information

### **Sensor Connections**

Cables for the microwave and laser sensors are routed through the right side of the PVC Hydro case using the provided fittings and are wired to the main terminal strip (fig 3-6). The connections on the strip are shown on the air gap data wiring diagram (fig 3-7). The connections from the terminal strip to the DCP communications ports are pre-wired at the CIL/SIL—**DO NOT** make changes to wiring or connections unless directed to do so by the CIL/SIL. Any changes made to the wiring or connections must be noted on the Station Report.

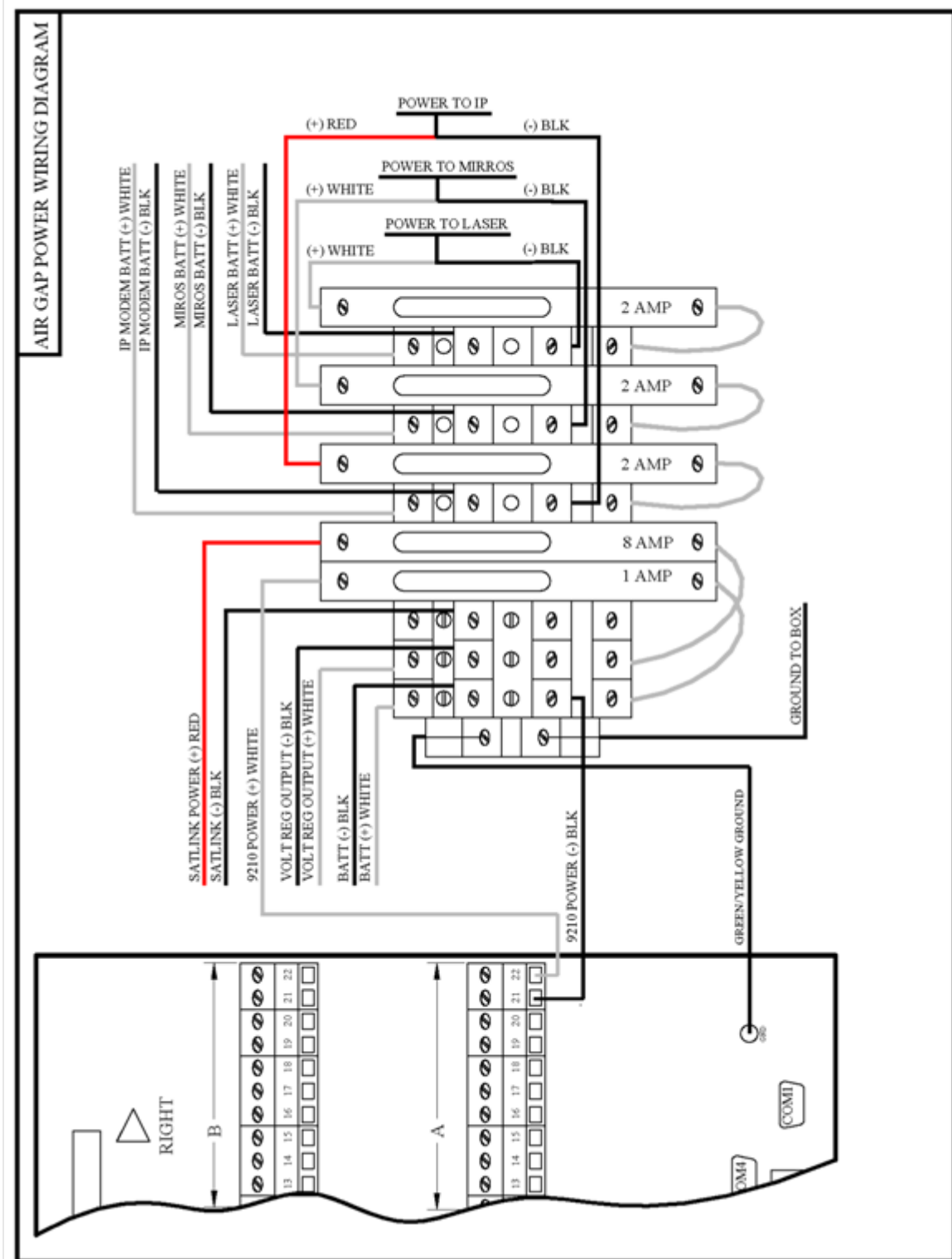
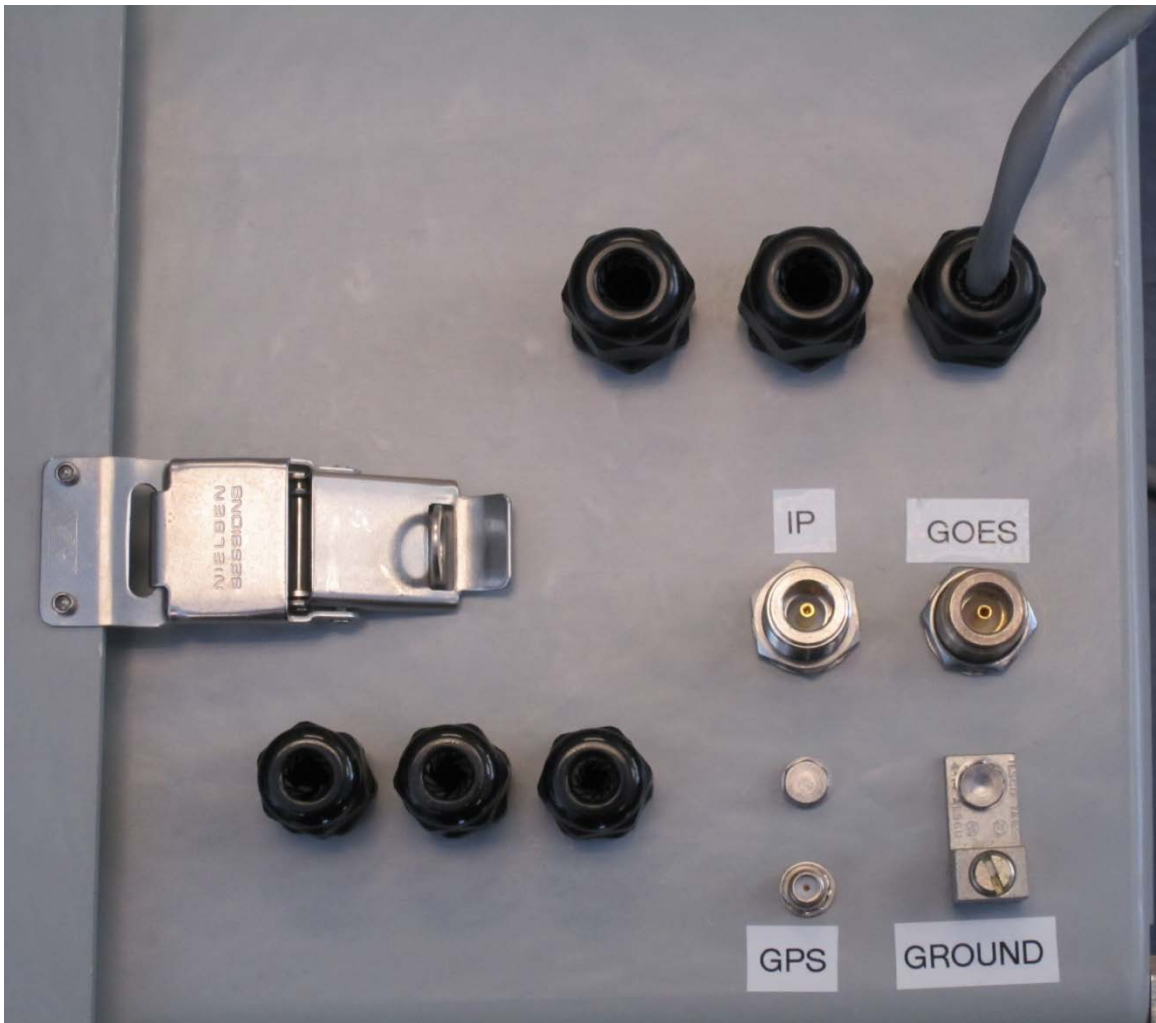


Figure 3-4. Air gap power wiring diagram.



**Figure 3-5.** Power cables enter through the right side of the gray Hydro box.

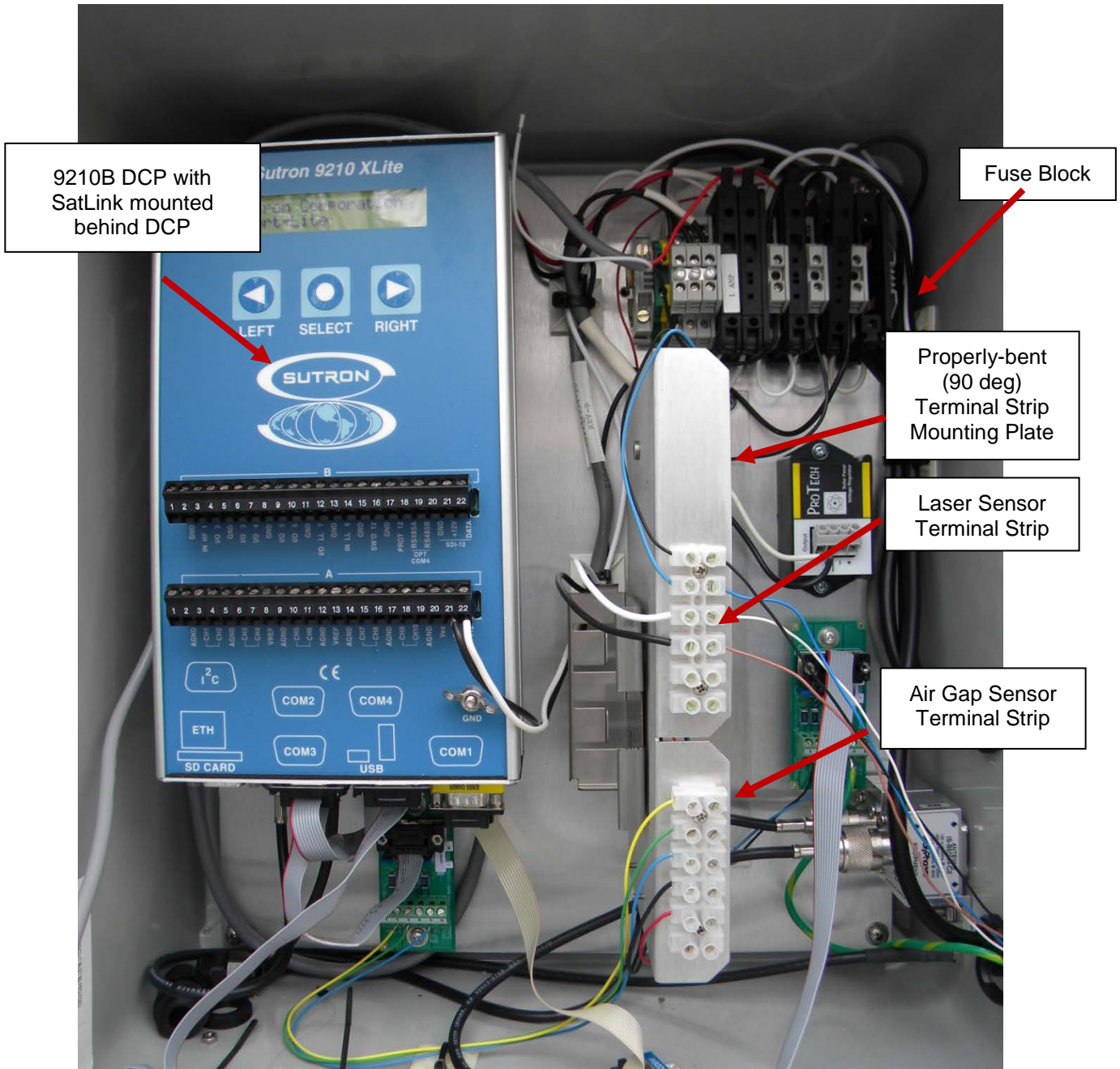


Figure 3-6. Typical CO-OPS Hydro-type setup for air gap.

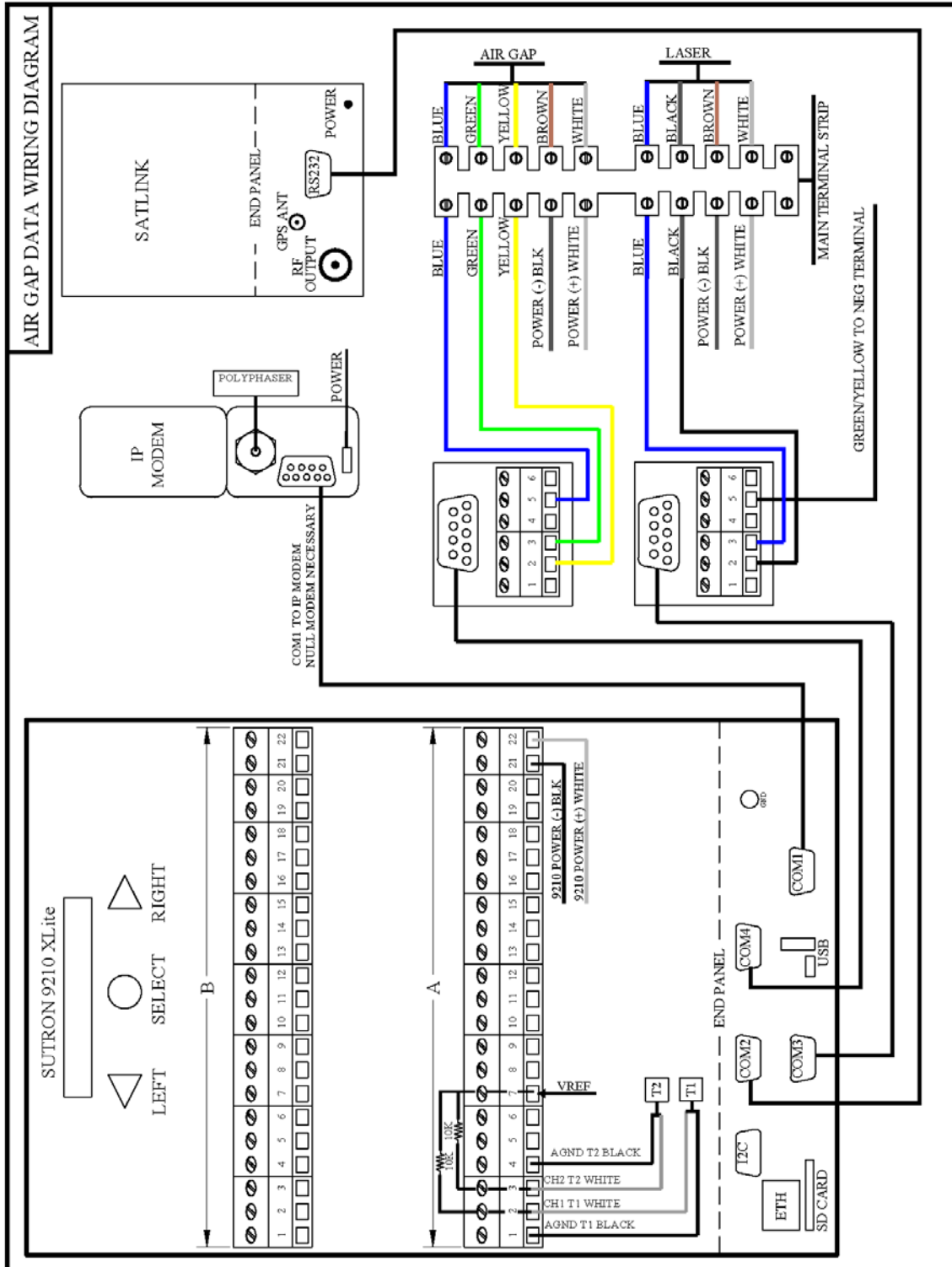


Figure 3-7. Air gap data wiring diagram.

## **Communications Connections**

Three bulkhead antenna connections are located on the lower right side of the PVC Hydro case and are marked for their use. Connect the proper antenna to its connector as shown (fig 3-5). Take care when making the connections with the GOES and IP cables. Two 90-degree adapters are provided to eliminate any sharp bends in these cables. Connections inside the box are pre-wired at the CIL/SIL—**DO NOT** make changes to wiring or connection unless directed to do so by the CIL/SIL. Any changes made to the wiring or connections must be noted on the Station Report.

## **Ground Connections**

The ground connection point is located on the right side of the PVC Hydro case (fig 3-5). All grounds inside the box are connected to this point. A ground cable must be run from this point to a suitable external ground. No other grounds are needed for the system.

### **3.3 Miros Setup and Testing**

1. Check the setup of the Miros microwave sensor for correct values (appendix J).
2. Connect a computer to the RS232 terminal block with a 9-pin serial cable and a null modem adapter.
3. On the computer, run Procomm or some other terminal emulator (such as Hyperterm), setting the COM port of the computer to 9600-N-8-1.
4. Apply power to the Miros sensor. You should see messages similar to this:

```
MIROS C54x bootloader ver 1.6.0 built on Sep 30 2004 [17:45:26]
Flash initialization OK. [Intel 28F640J3A]
External SRAM test on page 3    OK
Watchdog is enabled.
Space to enter command-mode [#####]
No activity detected on primary or secondary port.
Boot application id : 0
Application CRC check : OK [75E9h:75E9h]
Application name   : Rangefinder v7.1.3.out
Application description: No description.
Info: Data memory words copied: 00002FE8h
Info: Program memory words copied: 00009F80h
Info: Branching to address [0001:8079]
C
Miros Range Finder Ver. 7.1.3 built on Jul 21 2005 20:14:03
EPLD version 1.3
Flash initialization OK
Flash: Intel 28F640J3A
Config OK. Parameters read from FLASH
Noise spectrum is cleared
Processing starting
No interruption on primary port. Trying secondary
70.000 70.000
70.000 70.000.....
```

### **3.3.1 Examine Setup Values**

To examine the setup values:

Type **ALL** and press ENTER.

You will see the following values; make sure that these values are the same as those on the setup sheet (appendix J). **DO NOT** change any setup values unless instructed to do so by the CIL/SIL. Any changes made to these setup values must be recorded on the setup sheet in appendix J and included with the site report paperwork. For a complete description of the following setup parameters, see the Miros RangeFinder Technical Handbook Section 2, Sensor User Manual, page 25.

```
min    100
det    100.0 %
wtc    4.7 sec (s)
win    1.0 m
tout   5.0 sec (s)
ser    0
freq   2 Hz
htc    0.5 sec (s)
atc    59.5 sec (s)
ntc    0.0 sec (s)
top    1
ch     2.0  50.0 m
MIROS Altimeter SW ver. 6.4a
Maximum range      50 m
Ant. beam width    5 deg
```

Type **ALTCONFIG** and press **ENTER**.

You will see a second set of values, like the ones above. **DO NOT** change any of these values unless instructed to do so by the CIL/SIL. The following values are the calibrations for the sensor; each sensor will have different calibrations.

```
Meas      375.0 mm/ch  -913.0 mm
Fft       256
fft-time  226.45 msec (ms)
tot-time  324.21 msec (ms)
sweep-time 22.24 msec (ms)
range     50 m
ant       5 deg
as-type   1
as-gain   0.0 %
as-offset 0 mV
```

### 3.3.2 Change Setup Values

To change the setup value:

1. Type the parameter, the correct number, and then press ENTER.

Example: Type *min* 100 (then press ENTER)

The system will save any changes made.

2. Type **ALL** and press ENTER to check the new value.
3. Record all setup values.

### 3.3.3 Check Data from the Miros

To check data from the Miros:

1. With the computer connected to the Miros sensor, run Procomm or some other terminal emulator (such as Hyperterm), setting the COM port of the computer to 9600-N-8-1. Then:

Type **GV** and press ENTER. You will get a value from the sensor:

aa.aaa bb.bbb where aa.aaa is the one time measured value in meters and bb.bbb is the averaged value

2. Each time you type the **GV** command and press ENTER you will get real-time data from the sensor.
3. Disconnect the computer cable and null modem adapter from the RS232 block.
4. Reconnect the flat ribbon cable from the 9210B DCP.

## 3.4 LTI Laser Setup and Testing

Setup commands for the laser are sent by the DCP when Recording is turned on. No action by the user or installer is required. **DO NOT** make changes to the laser or change the software values unless instructed to do so by the CIL/SIL. The following explains how to check communications to the laser and make changes if needed. A copy of the laser manual is available at the CIL/SIL.

1. Connect a computer to the RS232 terminal block with a 9-pin serial cable and a null modem adapter.
2. On the computer, run Procomm or some other terminal emulator (such as Hyperterm), setting the COM port of the computer to 9600-N-8-1.
3. Apply power to the laser.
4. Type **\$BM**. Press **ENTER** on the computer. You should see data from the laser.
5. If you receive an error code ERR 1, contact the CIL/SIL for assistance.

### 3.4.1 Sensor Calibration

During setup and testing of the air gap system, a calibration check is conducted on the LTI laser sensor. The sensor is mounted on the top of the reference I-beam and tested at 13 different points by moving the target in 3.05-m (10-ft) increments from 35.1 m to 68.6 m (115 ft to 225 ft). The I-beam is marked using a certified steel tape pulled taut at 20 lb in accordance with tape manufacturer’s specifications. The ULS collects and logs 1-Hz data, which are rounded to a resolution of 1 cm. The averaged data from each of the 13 points are compared to the steel tape and recorded in a spread sheet. An example is shown in table 3-1.

**Table 3-1.** Example of averaged data.

Tape (ft)	Tape (m)	ULS #001025	ULS - tape			
225	68.580	68.59	0.010			
215	65.532	65.57	0.038			
205	62.484	62.48	-0.004			
195	59.436	59.43	-0.006			
185	56.388	56.38	-0.008			
175	53.340	53.33	-0.010			
165	50.292	50.28	-0.012			
155	47.244	47.23	-0.014			
145	44.196	44.19	-0.006			
135	41.148	41.13	-0.018			
125	38.100	38.1	0.000			
115	35.052	35.05	-0.002			
AVG			-0.003			
STDEV			0.014			

### 3.4.2 Laser Setup

The factory defaults must be changed before the laser can be used or if the sensor is reset to factory settings. The laser sensor does not have a single command to display the setting. OSTEP has written two simple Procomm scripts, one that collects and stores the present setting of the sensor and the second that writes and saves the approved setting to the sensor. These scripts can be found in appendix K or from the CIL/SIL.

### 3.4.3 Getting Sensor Settings

The settings can be found either by connecting the computer directly to the sensor via the sensor’s RS232 or through the 9210B DCP using the **Passthru** command. In either case, run the **Get\_Laser\_Setting** script in Procomm (appendix K). Make sure the **Get\_Laser\_Setting** script is loaded in the Aspect directory under Procomm.

## Direct Connection

Using Procomm, connect the computer directly to the laser sensor via the RS232 port. Check that the port settings are 9600–N-8-1. Run the **Get\_Laser\_settings** from the drop-down menu. Procomm will connect to the laser, set it to the command mode, request the setting, and store the data in a file under the **Capture** directory. Step-by-step instructions are presented in the following paragraphs.

1. Connect the computer to the sensor via an RS232 cable. Start Procomm and set the system to use Direct Connect COM 1 (bottom left of screen) using a baud rate of 9600, 8 bits, no parity, and 1 stop bit as shown in fig. 3-8. For computers that do not have a serial port, select the correct COM port in Procomm for the USB port that has the serial adapter.

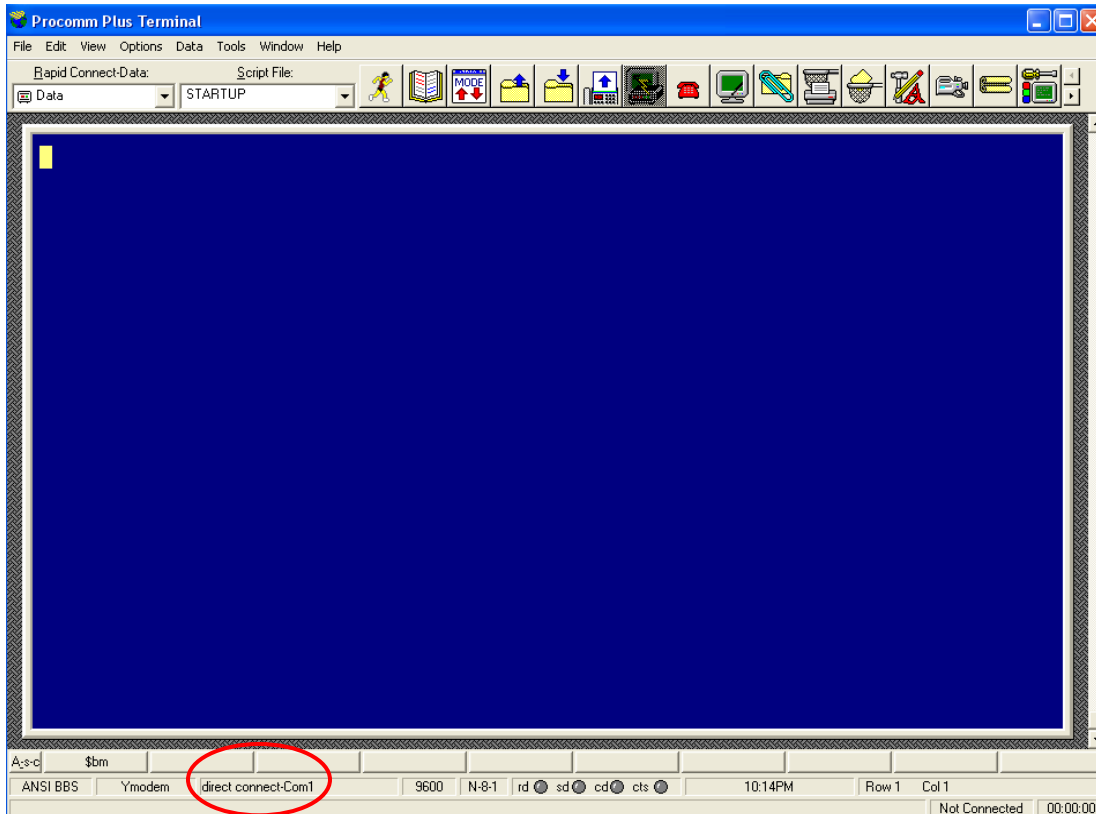
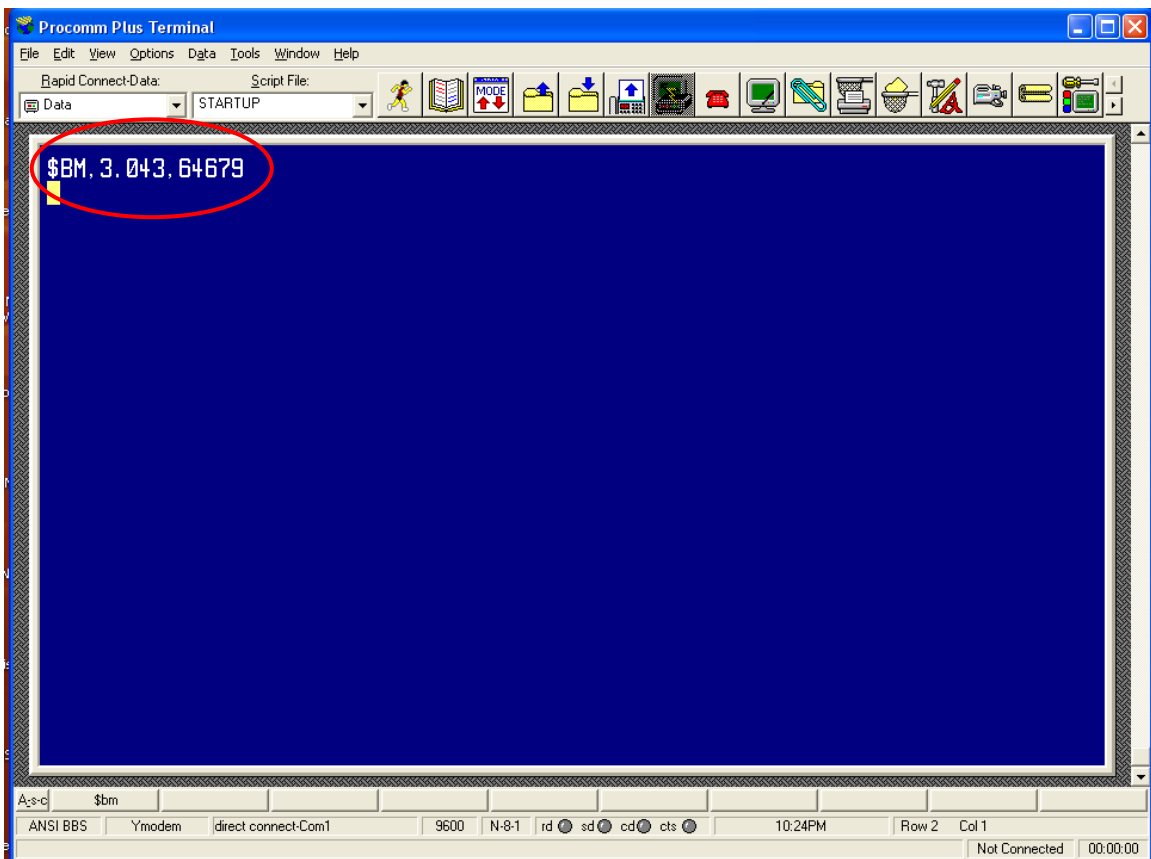


Figure 3-8. Procomm setup.

2. Test the connection by requesting a reading from the sensor.

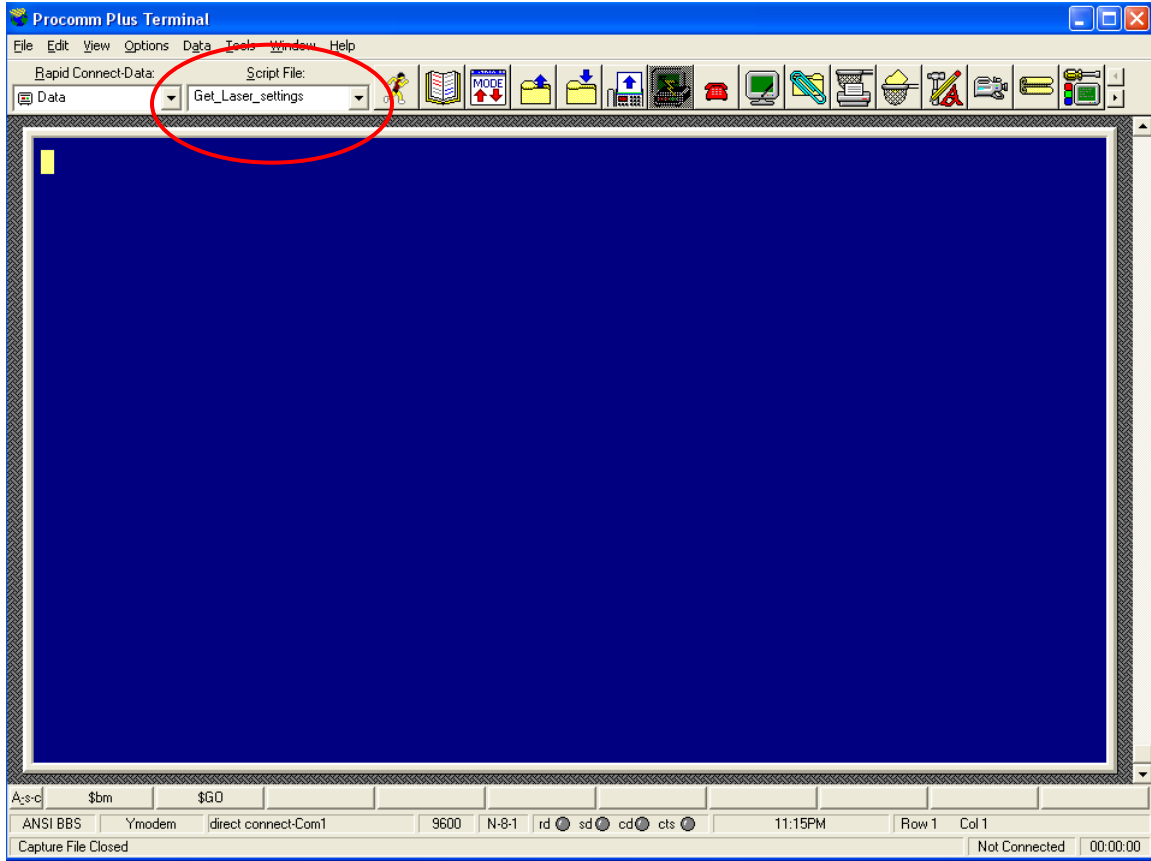
Type: \$BM then press ENTER.

The sensor will respond with a \$BM and two values as shown in fig. 3-9. The first value is the distance between the sensor and the target in meters (3.043). The second is a measure of the signal strength (64679). This reading assumes the sensor is in an operational mode. If the sensor is in the command mode, it will respond with \$ER, 86. This response is not a problem because you are just checking to make sure that the communications between the computer and the sensor are operating properly. The \$ER, 86 response shows that you are connected to the sensor.



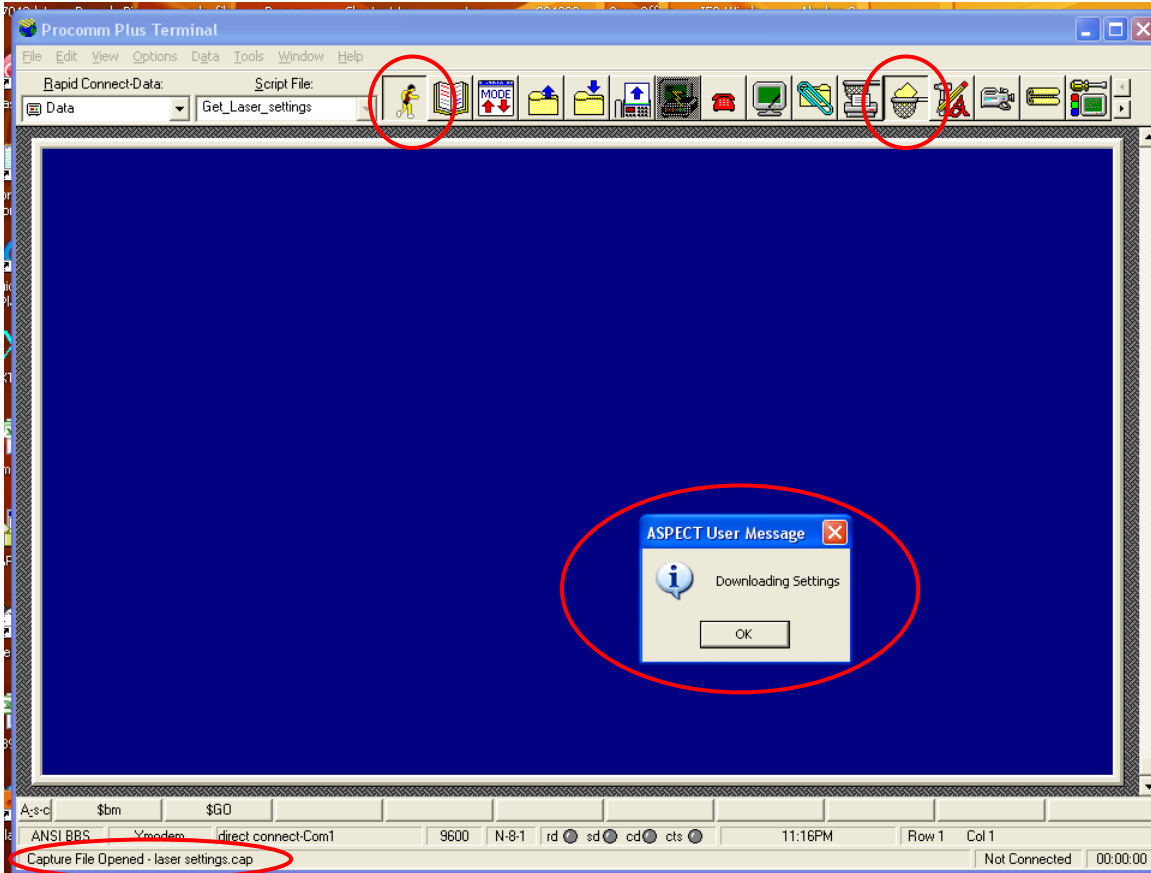
**Figure 3-9.** Sensor response with a \$BM and two numerical values.

3. Using the mouse, select the **Get\_Laser\_settings** script from the **Script File** drop-down menu as shown in figure 3-10:
4. Press the **START/STOP SCRIPT** button.



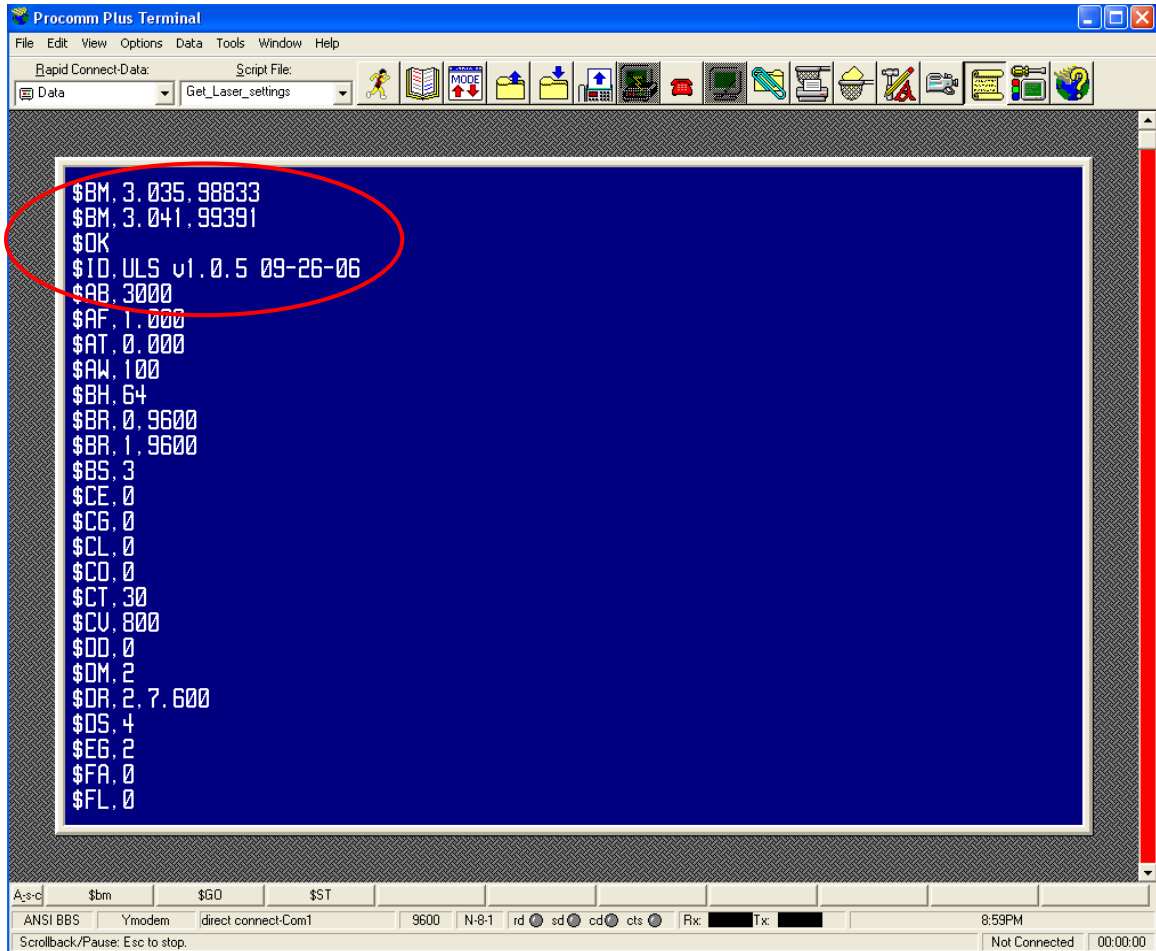
**Figure 3-10.** Get\_Laser\_settings selected from the Script File drop-down menu.

5. After you click the **STOP/STOP SCRIPT** button, the “running man” will be indented, as will the **CAPTURE** button. At the lower left of the screen, the **Capture file** status will change from closed to laser settings.cap (fig.3-11).
6. In a few seconds a user message will appear on the screen. Click **OK** for the script to continue.



**Figure 3-11.** Click **OK** for the script to continue.

- At this point the script will send a number of commands to the sensor to get its setup values (fig. 3-12). The first is a data request, the second switches the sensor into the command mode, and the third shows the software version of the sensor. Table 3-2 contains a list of the commands used by the script.



```
Procomm Plus Terminal
File Edit View Options Data Tools Window Help
Rapid Connect-Data: Script File:
Data Get_Laser_settings
$BM, 3. 035. 98833
$BM, 3. 041. 99391
$DK
$I0, ULS v1. 0. 5 09-26-06
$AB, 3000
$AF, 1. 000
$AT, 0. 000
$AW, 100
$BH, 64
$BR, 0. 9600
$BR, 1. 9600
$BS, 3
$CE, 0
$CG, 0
$CL, 0
$CO, 0
$CT, 30
$CV, 800
$D0, 0
$DM, 2
$DR, 2. 7. 600
$DS, 4
$EG, 2
$FA, 0
$FL, 0
A:~c $bm $G0 $ST
ANSI BBS Ymodem direct connect-Com1 9600 N-8-1 rd sd cd cts Fix Tx:
Scrollback/Pause: Esc to stop. 8:59PM Not Connected 00:00:00
```

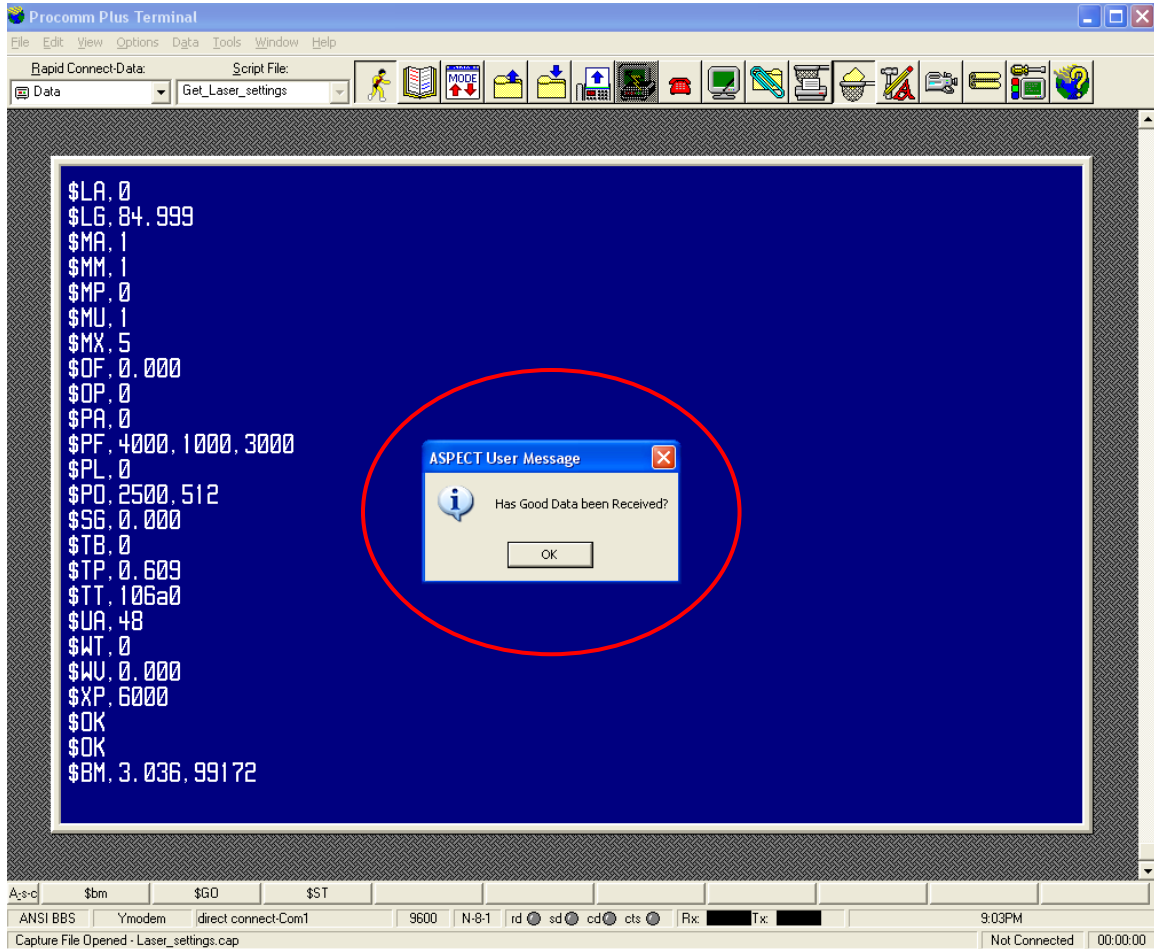
Figure 3-12. Script commands sent to the sensor to get its setup values.

**Table 3-2.** Commands used by the script.

<b>Command</b>	<b>Function</b>	<b>Approved Settings</b>	<b>Notes</b>
\$AB	Average Bounds in Picoseconds	3000	
\$AF	4-20 ma Fault Current Value	xxx	Not used if CL=0
\$AT	Fault Timeout for 4-20 ma Current Loop	xxx	Not used if CL=0
\$AW	Averaging Weight	100	
\$BH	Bin Threshold	64	Not used if MM=1
\$BR	Config Port Baud Rate	9600	
\$BR,1	Output Port Baud Rate	9600	
\$BS	Bin Size	3	Not used if MM=1
\$CE	Cosine	0 off	
\$CG	Check Gate	1	Enable
\$CL	4-20ms Current Loop On/Off	0	Off
\$CO	Continuous Measurement Output Mode	0	Off
\$CT	Current Trip Threshold	30	Not used if MM=1
\$CV	Cosine Value	xxx	Not used if CE=0
\$DD	Dithering	0	Off
\$DM	Display Mode	2	Distance and Intensity
\$DR	Dampening	xxx	Not used if OP=0
\$DS	Dampening	xxx	Not used if OP=0
\$EG	Enable Gate	6	Enables short and long gates
\$FA	First, Last, Most and All	0	First
\$FL	Cooperative Filter	0	Non cooperative target
\$FT	Flyer Trap	0	Not used if MM=1
\$IL	Initial Lock	6000	
\$LA	Detection Mode	0	Not used if MM=1
\$LG	Long Gate	85	Long gate set to 85 meters
\$MA	Measurement Auto Start On/Off	1	On, Sensor is measuring at power up
\$MM	Measurement Mode	1	Set to averaging
\$MO	Measurement Output Port	0	Data outputting to configuration port
\$MP	Minimum Pulse Width Rejection	0	Disabled
\$MU	Measurement Units	1	Output in meters
\$MX	Maximum False Pulses	5	Not used if MM=1
\$OF	Unit Offset	0	No offset entered
\$OP	Output Processing	0	Off

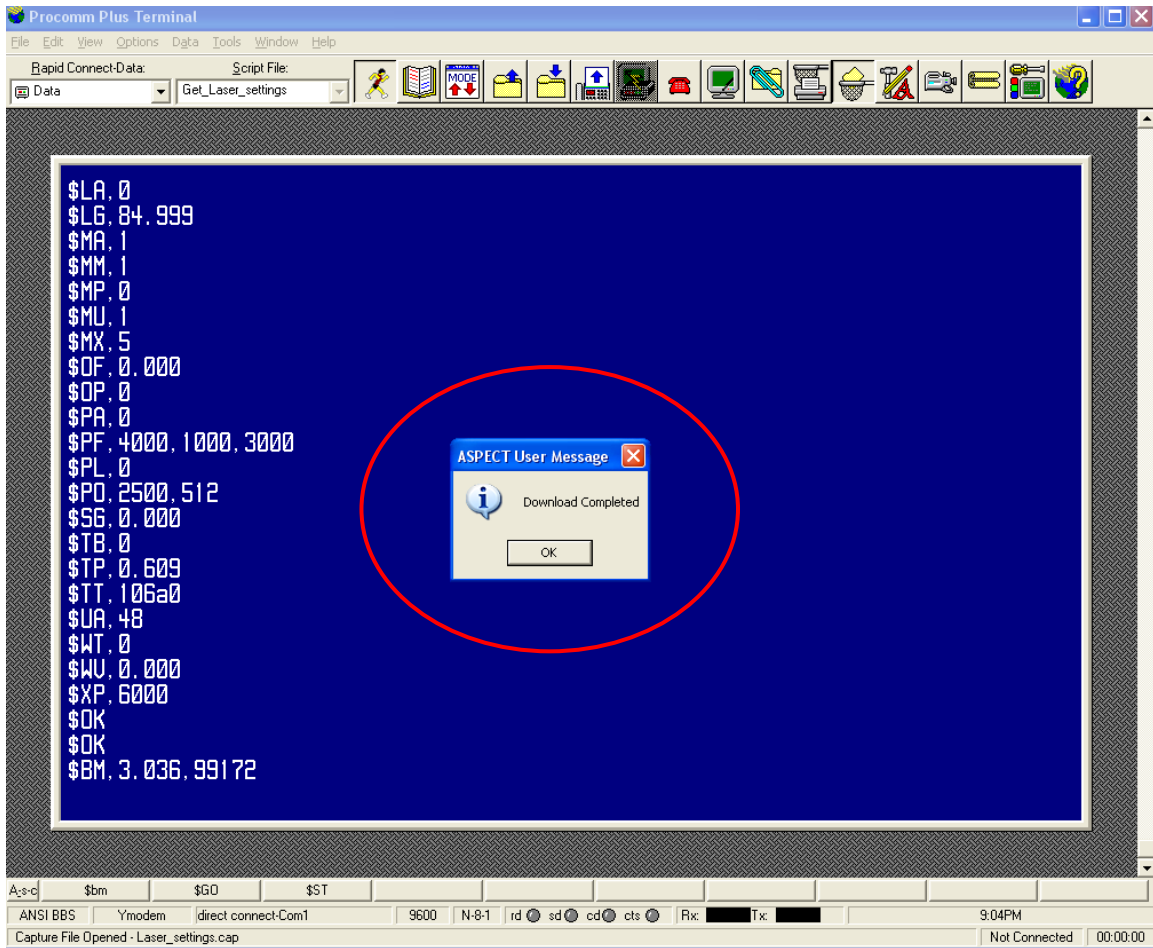
<b>Command</b>	<b>Function</b>	<b>Approved Settings</b>	<b>Notes</b>
\$PA	Pointer Autostart On/Off	0	Off
\$PF	PRF Rate	4,000	
\$PL	Power Level	0	High level
\$PO	Pulses/Measure	4,000	
\$PT	Pointer On/Off	0	Pointer is off
\$SG	Short Gate	40	Short gate set to 40 meters
\$TB	Time Between Events	0	Not used if MM=1
\$TP	Trip Point	0	Not used if MM=1
\$TT	Trip Point Time Out	106ae	Hex value within 25 counts of 106
\$UA	Unit Address	xxx	Not used when in RS232 mode
\$US	Unit Status	7	Read only
\$WT	Windowing Time Out	xxx	Not used if OP=0
\$WV	Windowing Error Range Value	xxx	Not used if OP=0
\$XP	Maximum Pulse Width Rejection	xxx	Not used if OP=0
\$BM	Data Request		Data is send to output port
\$SU	Saves Settings		Save settings
\$ST	Stops the sensor and places it in the command mode.		Set sensor to command mode
\$GO	Starts the sensor. Use \$BM to get data.		Starts the sensor
			A \$ must precede the command to be accepted

- At the end of the script, the sensor goes back into measurement mode. You will then see a data request (\$BM) as shown on the last line in fig. 3-13. Check the values and make sure they are close to the value at the beginning of the download (as in fig. 3-13). If you receive an error message, contact the CIL/SIL. Click **OK** in the User Message block to continue.



**Figure 3-13.** After making sure values are close to those at the beginning, click **OK** to continue.

9. A new user message will appear when all settings have been downloaded. Click **OK** to close the **Capture file** and end the script (fig. 3-14).



**Figure 3-14.** Click **OK** to close the **Capture file** and end the script.

10. Exit Procomm and disconnect the cables.

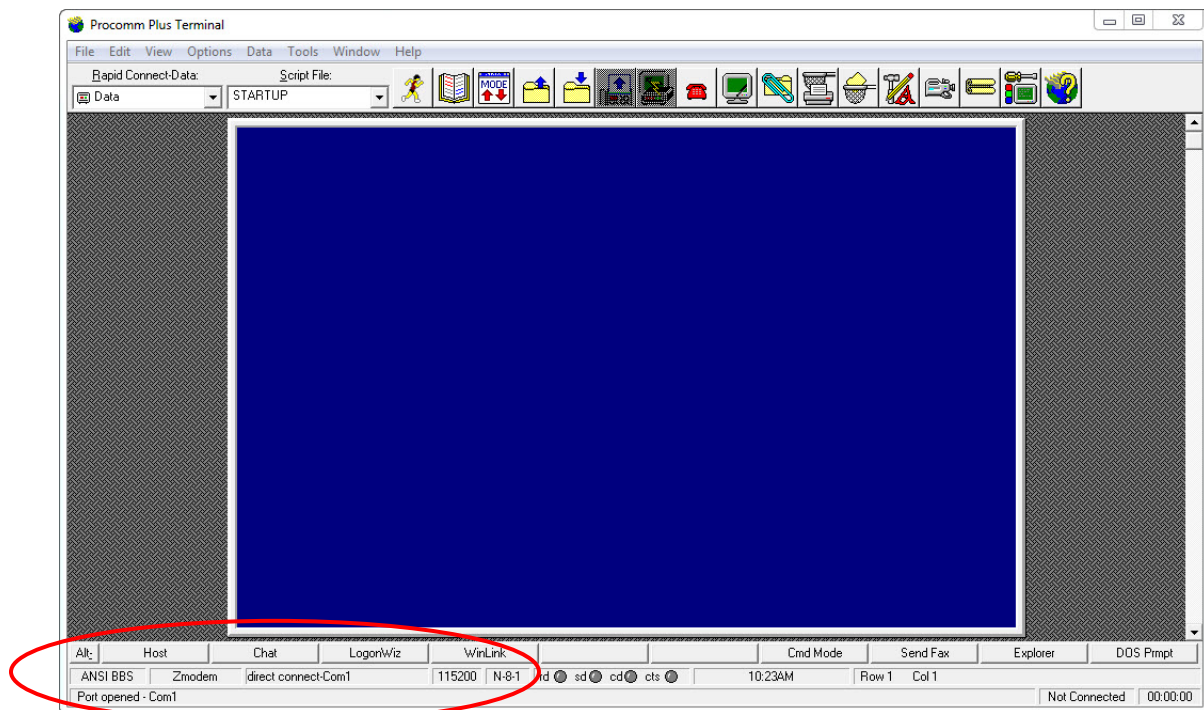
11. The **Capture file** can be viewed by going into the **Capture** directory under the Procomm directory. The file name is **Laser Settings.cap**. The following shows an example of a **Capture file**.

```
$BM,2.258,31603
$OK
$ID,ULS v1.0.5 09-26-06
$AB,3000
$AF,1.000
$AT,0.000
$AW,100
$BH,64
$BR,0,9600
$BR,1,9600
$BS,3
$CE,0
$CG,0
$CL,0
$CO,0
$CT,30
$CV,800
$DD,0
$DM,2
$DR,2,7.600
$DS,4
$EG,2
$FA,0
$FL,0
$FT,2500
$IL,6000
$LA,0
$LG,84.999
$MA,0
$MM,1
$MP,0
$MU,1
$MX,5
$OF,0.000
$OP,0
$PA,0
$PF,4000,1000,3000
$PL,0
$PO,2500,512
$SG,0.000
$TB,0
$TP,0.200
$TT,106a
$UA,48
$WT,0
$WV,0.000
$XP,6000
$OK
$OK
$BM,2.257,31421
```

## Passthru Connection

Passthru is an Xpert utility that allows a user to connect to a device on one of the COM ports. The user logs into the Xpert using Procomm, stops recording, shuts down the Xpert application, and runs the Passthru utility. The following paragraphs provide step-by-step instructions for using the Passthru utility to get the laser setting.

1. Connect the computer to the sensor via an RS232 cable. Start Procomm and set the system to use Direct Connect COM 1 (bottom left of screen) using a baud rate of 115200, 8 bits, no parity and 1 stop bit (fig. 3-15). If your computer does not have a serial port, select the correct COM port in Procomm for the USB port that has the serial adapter.



**Figure 3-15.** Procomm settings using Direct Connect COM 1

2. At the Login prompt, enter the username and password, provided by CIL/SIL.
3. At the **\Flash Disk>** prompt:

Type **recording off** and then press **ENTER**.

The system will respond with *Stopping*, and then with *Recording is OFF*. It may take as much as two minutes for the system to stop recording.

The system will respond with a second **\Flash Disk>**

Type **shutdown** and then press **ENTER**.

This will shut down the Xpert application, and again, this may take two minutes to complete.

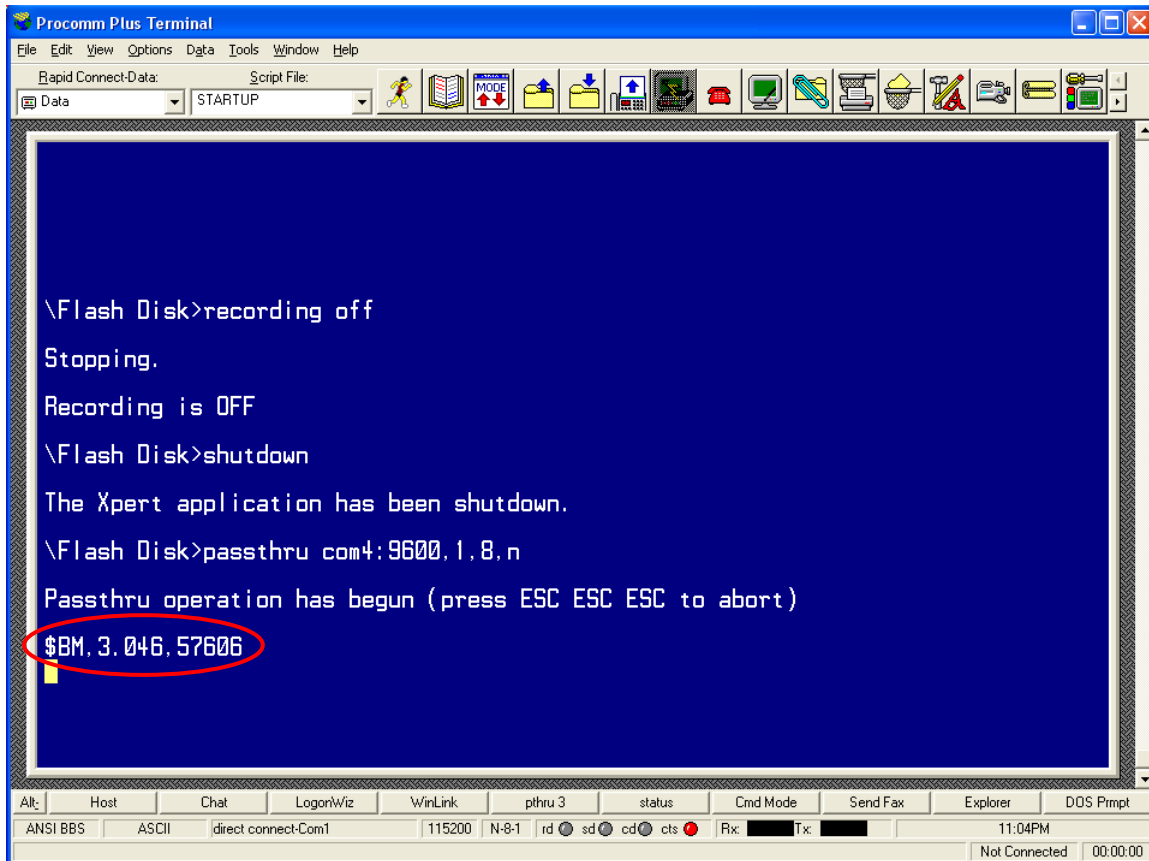
The system will respond with a third **\Flash Disk>**

Type **passthru com4:9600,1,8,n** and then press **ENTER**.

This command sets the COM port to a baud rate of 9600 with 1 stop bits, 8 data bits, and No Parity.

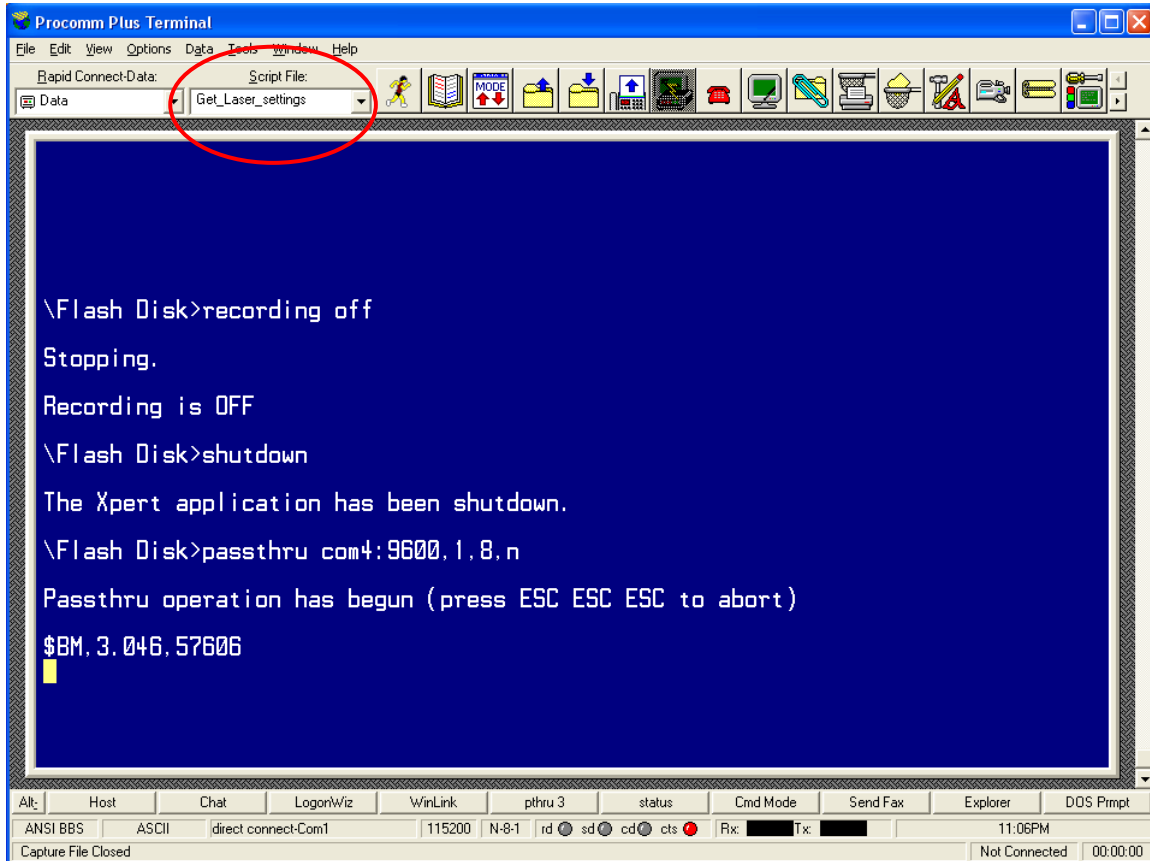
4. Type **\$BM** and then press **ENTER**.

The sensor will respond with a \$BM and two values as shown in fig. 3-16. The first value is the distance between the sensor and the target in meters (3.044). The second is a measure of the signal strength (51475). This reading assumes the sensor is in operational mode. If the sensor is in command mode, it will respond with \$ER, 86. This response is not a problem because you are just checking to make sure the communications between the computer and the sensor are operating properly. The \$ER, 86 response shows that you are connected to the sensor.



**Figure 3-16.** Sensor response with a \$BM and two numerical values.

- Using the mouse, select the **Get\_Laser\_settings** script from the **Script File** drop-down menu as shown in fig. 3-17.
- Press the **START/STOP SCRIPT** button.



**Figure 3-17.** Using the mouse, select the **Get\_Laser\_settings** script from the **Script File** drop-down menu.

- After you press the **STOP/STOP SCRIPT** button, the “running man” will be indented, as will the **CAPTURE** button. At the lower left of the screen the Capture file status will change from **closed** to **laser settings.cap** (fig. 3-18).
- In a few seconds a user message will appear on the screen. Click **OK** for the script to continue.

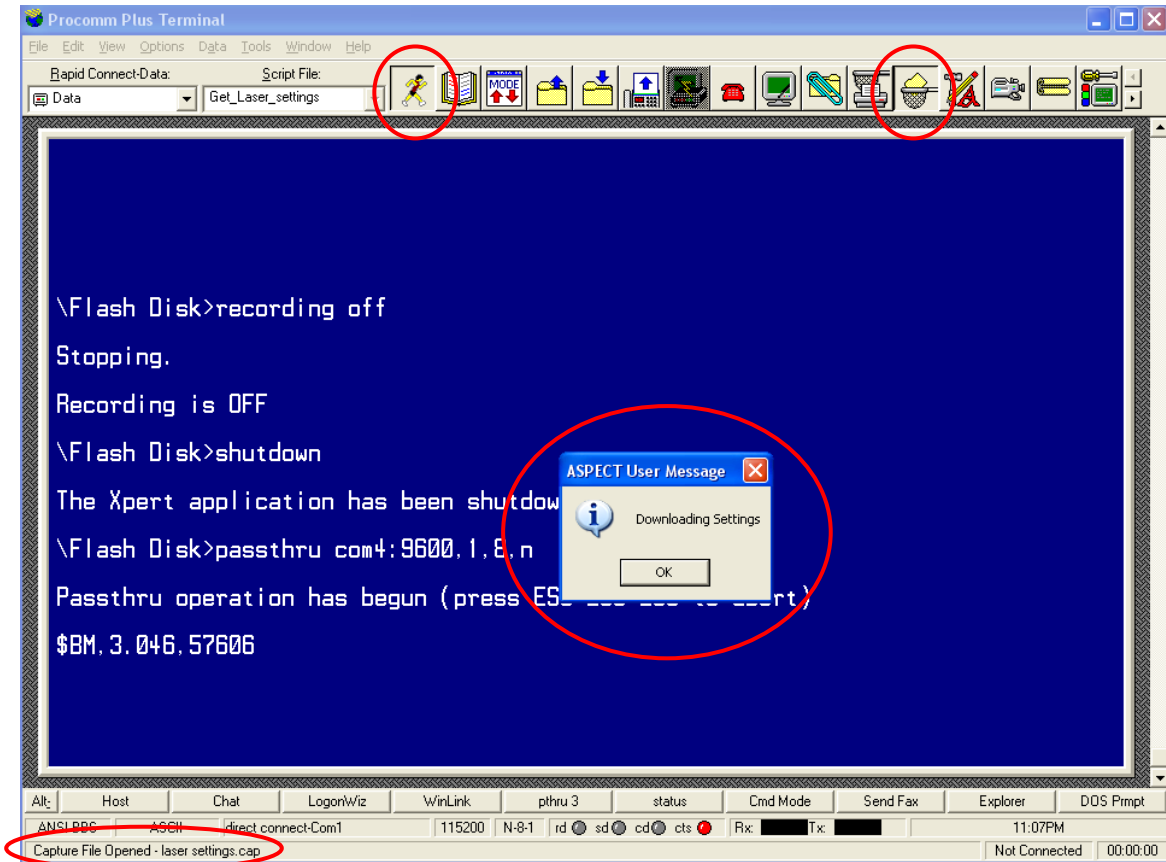
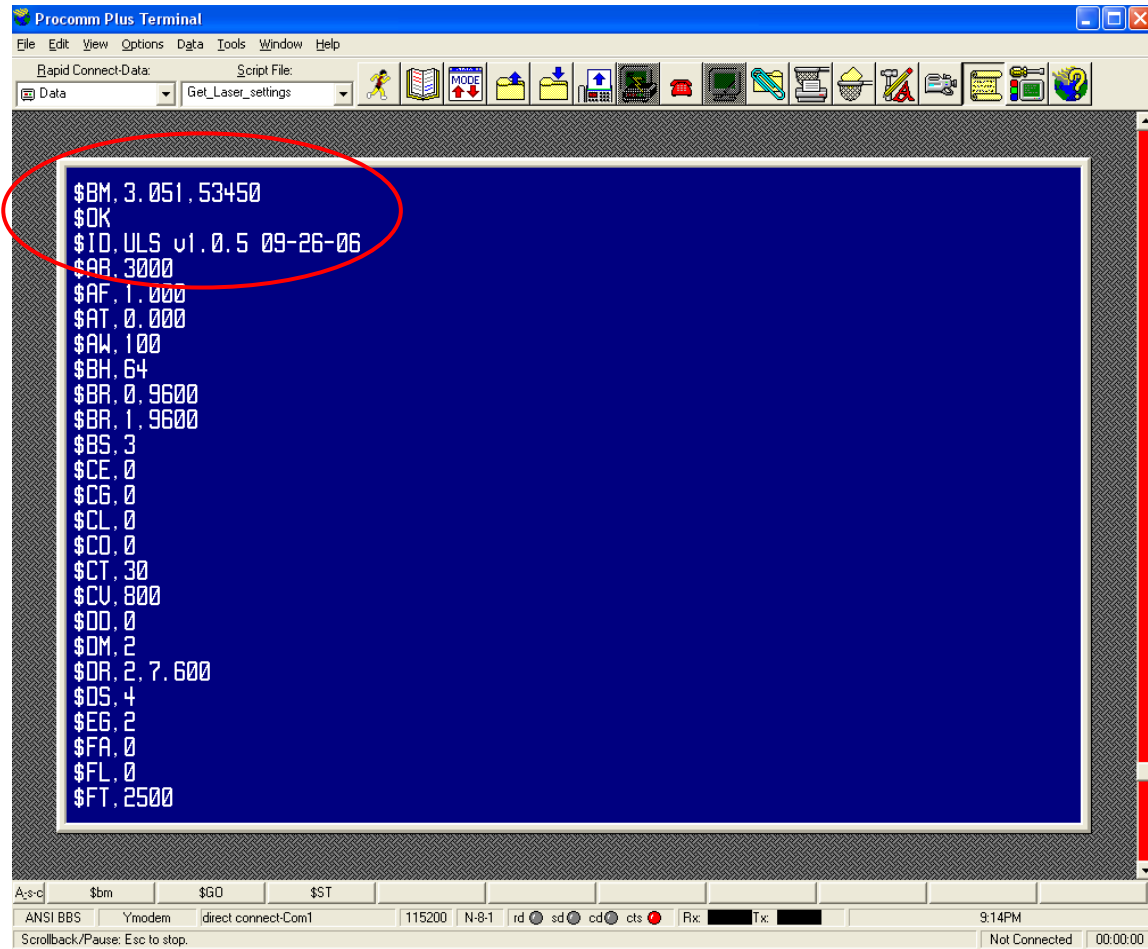


Figure 3-18. Click OK on Downloading Settings for the script to continue.

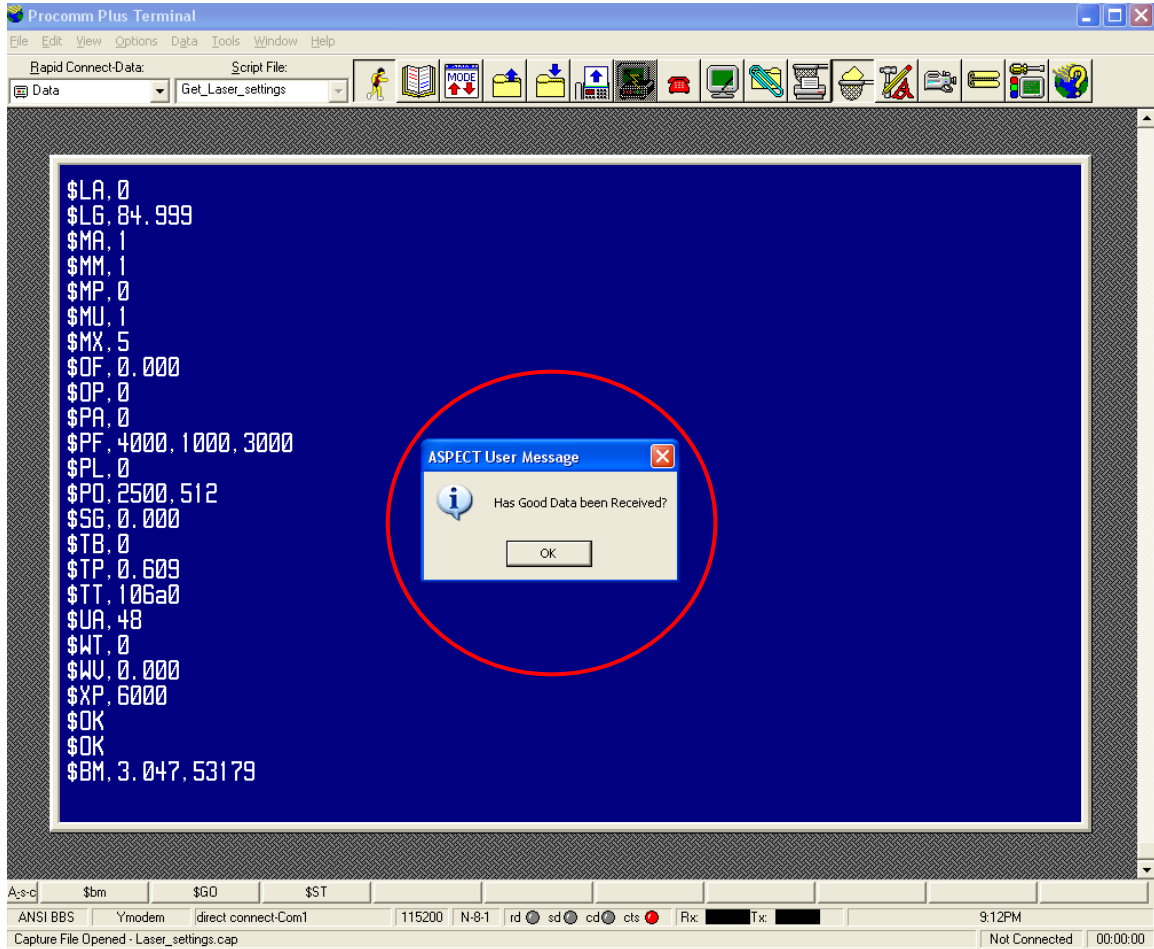
- At this point the script will send a number of commands to the sensor to get its setup values. The first is a data request, the second switches the sensor into the command mode, and the third shows the software version of the sensor (fig. 3-19). See table 3-2 for a list of the commands used by the script.



```
Procomm Plus Terminal
File Edit View Options Data Tools Window Help
Rapid Connect-Data: Script File:
Data Get_Laser_settings
$BM, 3.051, 53450
$OK
$ID, ULS v1.0.5 09-26-06
$AB, 3000
$AF, 1.000
$AT, 0.000
$AW, 100
$BH, 64
$BR, 0.9600
$BR, 1.9600
$BS, 3
$CE, 0
$CG, 0
$CL, 0
$CO, 0
$CT, 30
$CU, 800
$DD, 0
$DM, 2
$DR, 2.7.600
$DS, 4
$EG, 2
$FA, 0
$FL, 0
$FT, 2500
A:~C $bm $GO $ST
ANSI BBS Ymodem direct connect-Com1 115200 N-8-1 rd sd cd cts Rx: Tx: 9:14PM
Scrollback/Pause: Esc to stop. Not Connected 00:00:00
```

Figure 3-19. Commands for getting setup values from the sensor.

- At the end of the script, the sensor goes back into measurement mode. You will then see a data request (\$BM) as shown on the last line in fig. 3-20. Check the values and make sure they are close to the value at the beginning of the download as in fig. 3-20. If you receive an error message contact the CIL/SIL. Click **OK** in the User Message block to continue.



**Figure 3-20.** If values are close to those at the beginning of download, click **OK**.

11. A new user message will appear when all settings have been downloaded. Click **OK** to close the **Capture file** and end the script (fig. 3-21).

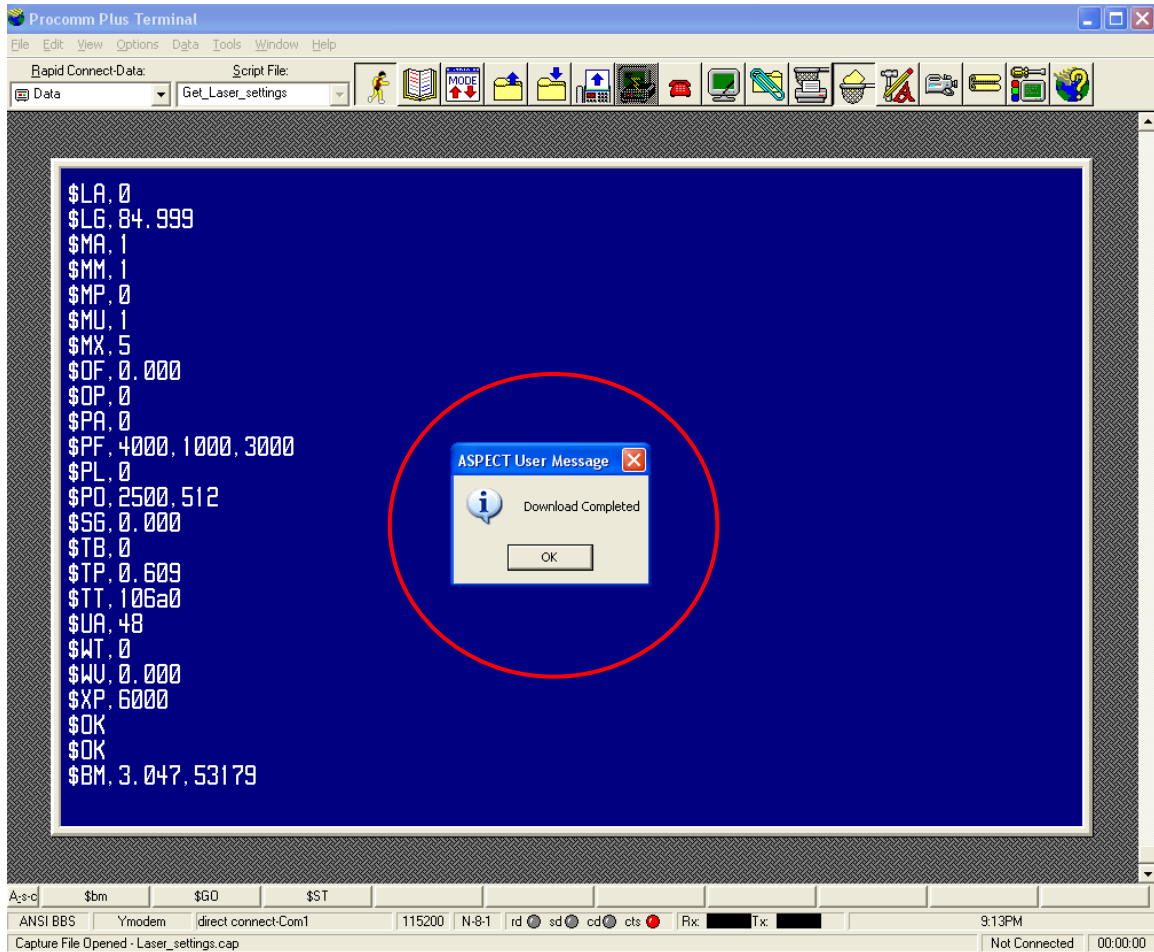
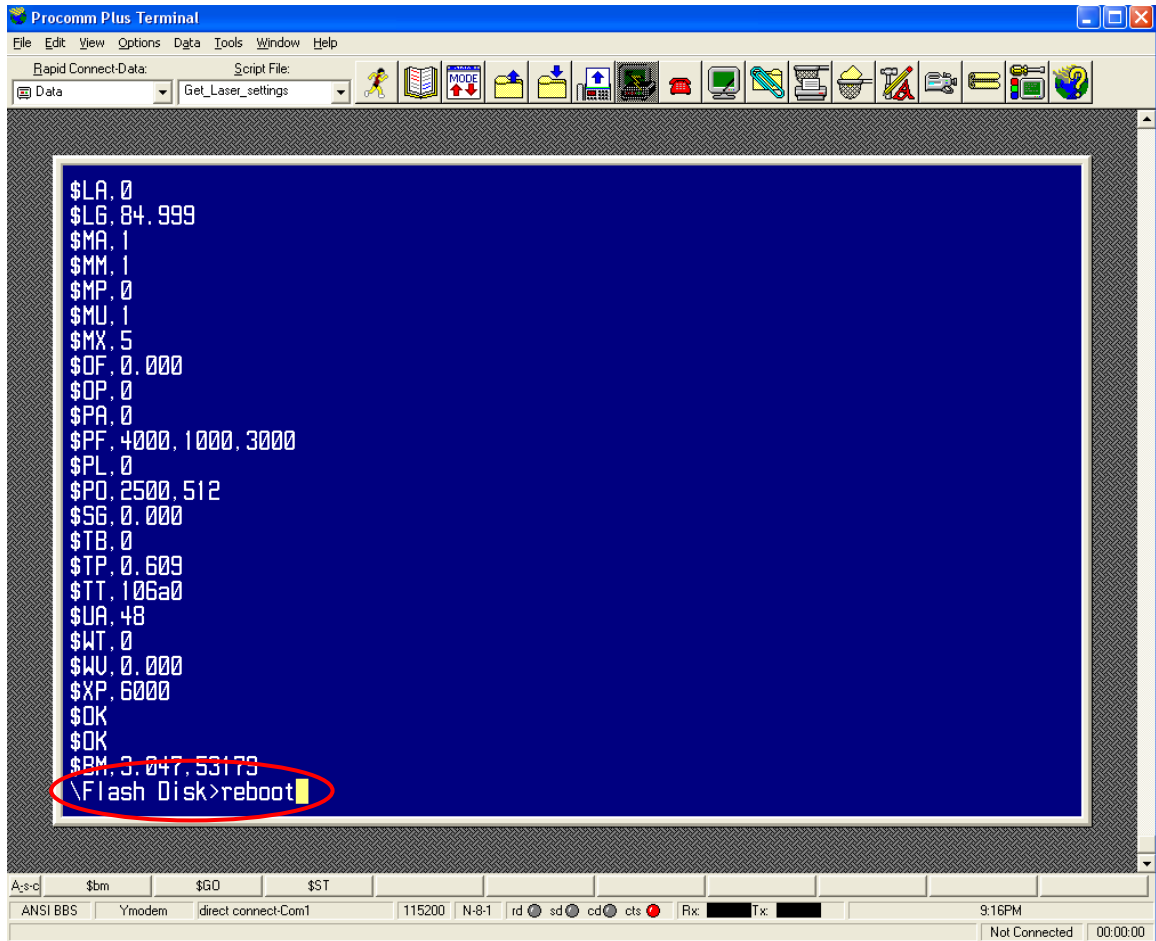


Figure 3-21. Close the Capture file.

12. After the script stops, press the ESC key three times to exit the Passthru utility. The system will respond with the **\Flash Disk>** prompt.
13. Type **reboot** and then press **ENTER** to restart the Xpert (fig. 3-22).



**Figure 3-22.** Restart the Xpert DCP.

### 3.4.4 Sending Sensor Settings

The laser settings can be uploaded to the sensor by either connecting directly to the sensor via the RS232 serial port or through the Xpert 9210B DCP using the Passthru command. Either way, run the **Send\_Laser\_Setting** script in Procomm. Be sure to load the **Send\_Laser\_Setting** script in the Aspect directory under Procomm.

#### Direct Connection

Using Procomm, connect directly to the laser sensor via the RS232 serial port. Be sure that the port settings are 9600-N-8-1. Run the **Send\_Laser\_Settings** from the drop-down menu. Procomm will connect to the laser, set it to the command mode, and load the approved settings to the sensor. The following paragraphs provide step-by-step instructions.

1. Connect the computer to the sensor via an RS232 cable. Start Procomm and set the system to use Direct Connect COM 1 (bottom left of screen) using a baud rate of 9600, 8 bits, no parity and 1 stop bit as shown in fig. 3-23. If your computer does not have a serial port, select the correct port in Procomm for the USB port that has the serial adapter.

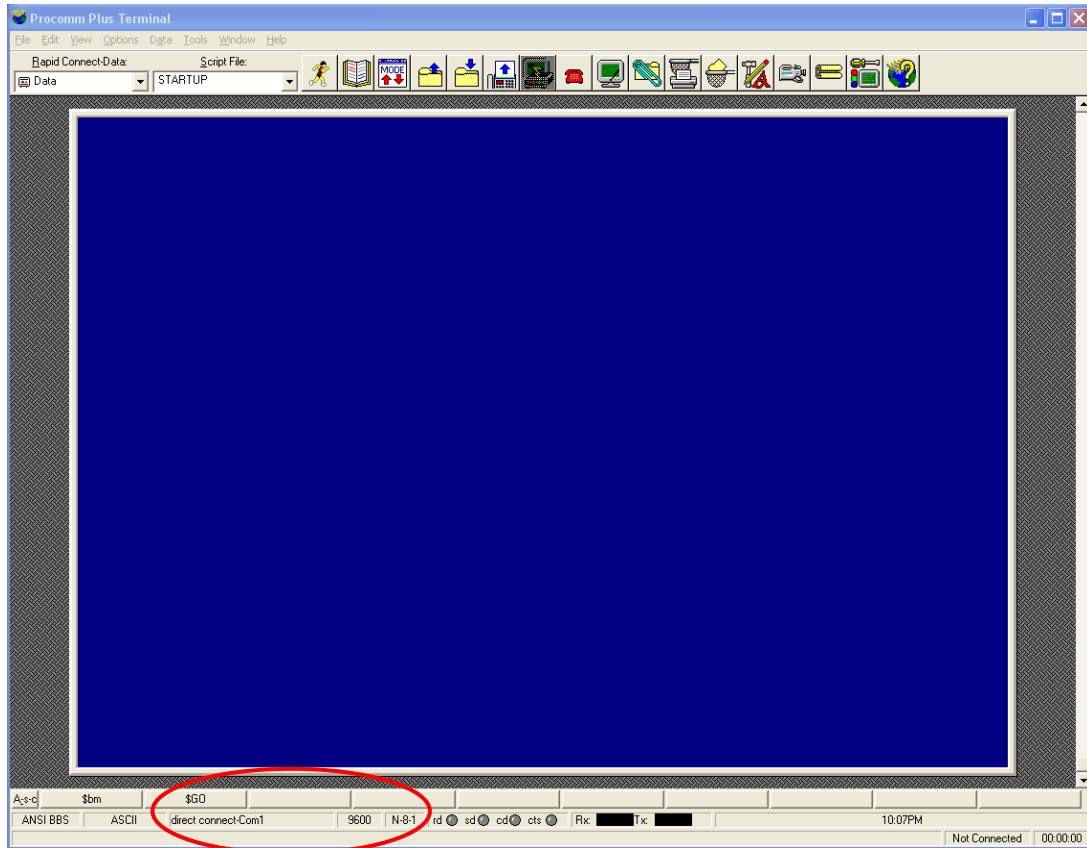
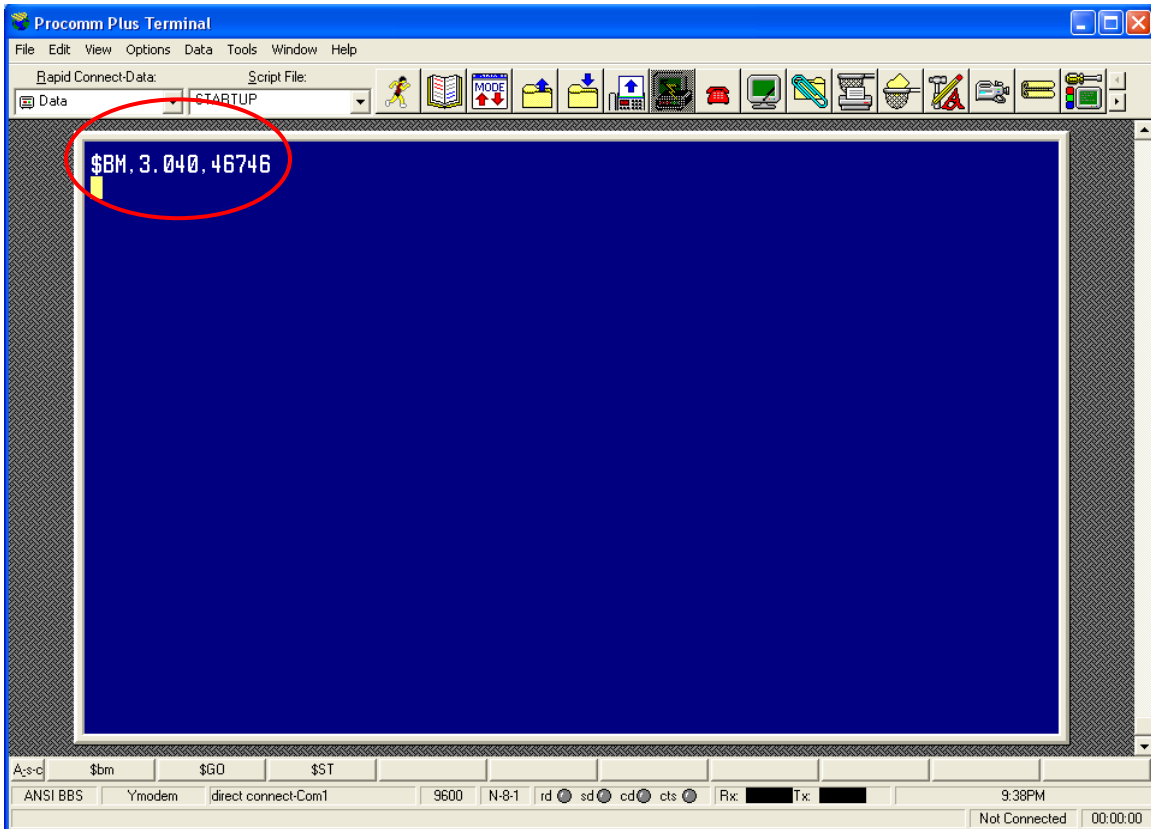


Figure 3-23. Set system to use Direct COM 1.

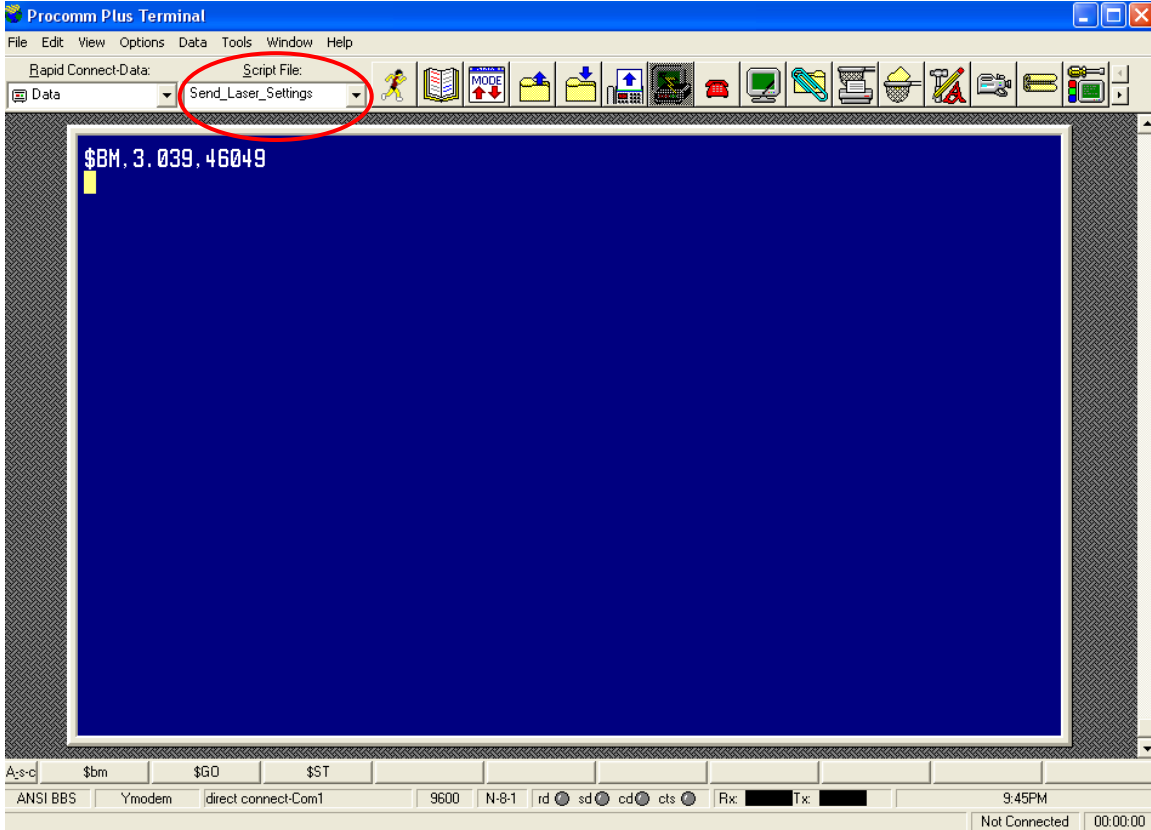
2. Test the connection by requesting a reading from the sensor.  
Type **\$BM** and then press ENTER.

The sensor will respond with \$BM and two values as shown in fig. 3-24. The first value is the distance between the sensor and the target in meters (3.040). The second is a measure of the signal strength (46746). This reading assumes the sensor is in operational mode. If the sensor is in command mode, it will respond with \$ER, 86. This response is not a problem because you are just making sure that the communications between the computer and the sensor are operating properly. The \$ER, 86 response shows that you are connected to the sensor.



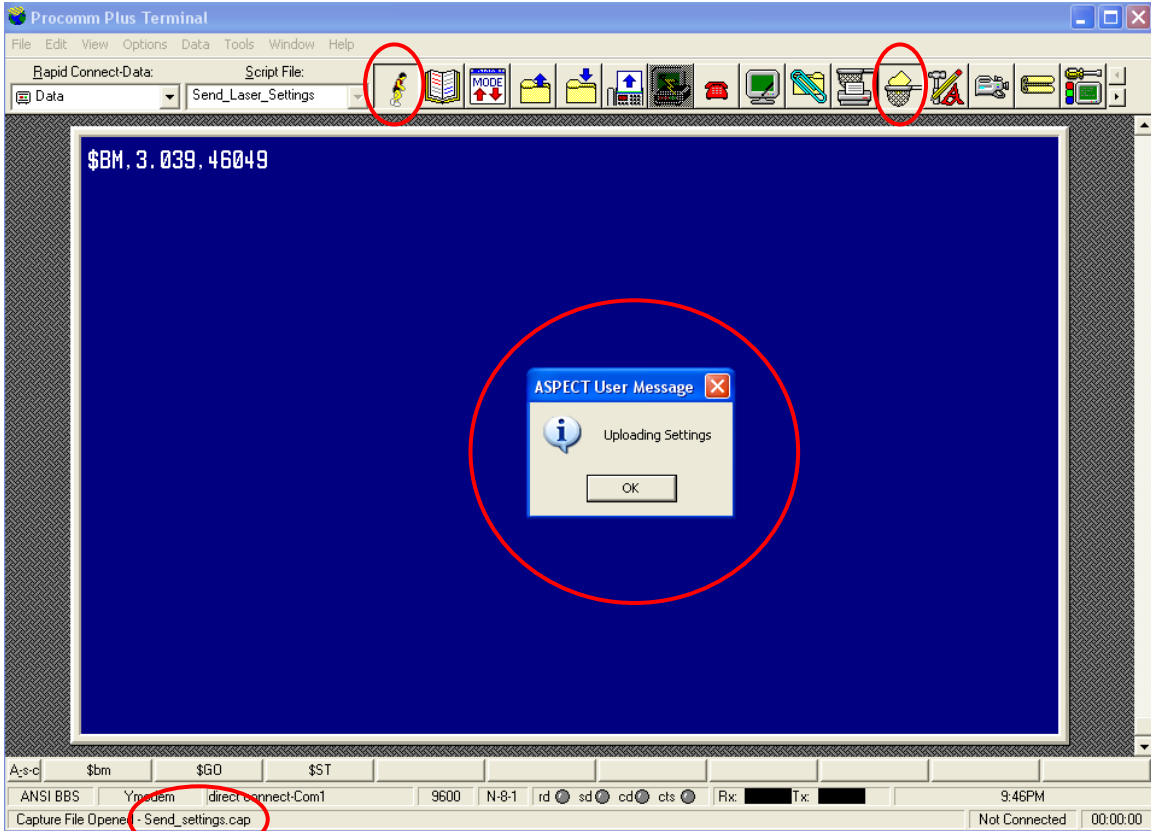
**Figure 3-24.** Sensor response to request for values.

3. Using the mouse, select the **Send\_Laser\_Settings** script from the **Script File** drop-down menu as shown in fig. 3.25.
4. Click the **START/STOP SCRIPT** button.



**Figure 3-25.** Select **Send\_Laser\_Settings**, then click on **START/STOP SCRIPT** button to continue.

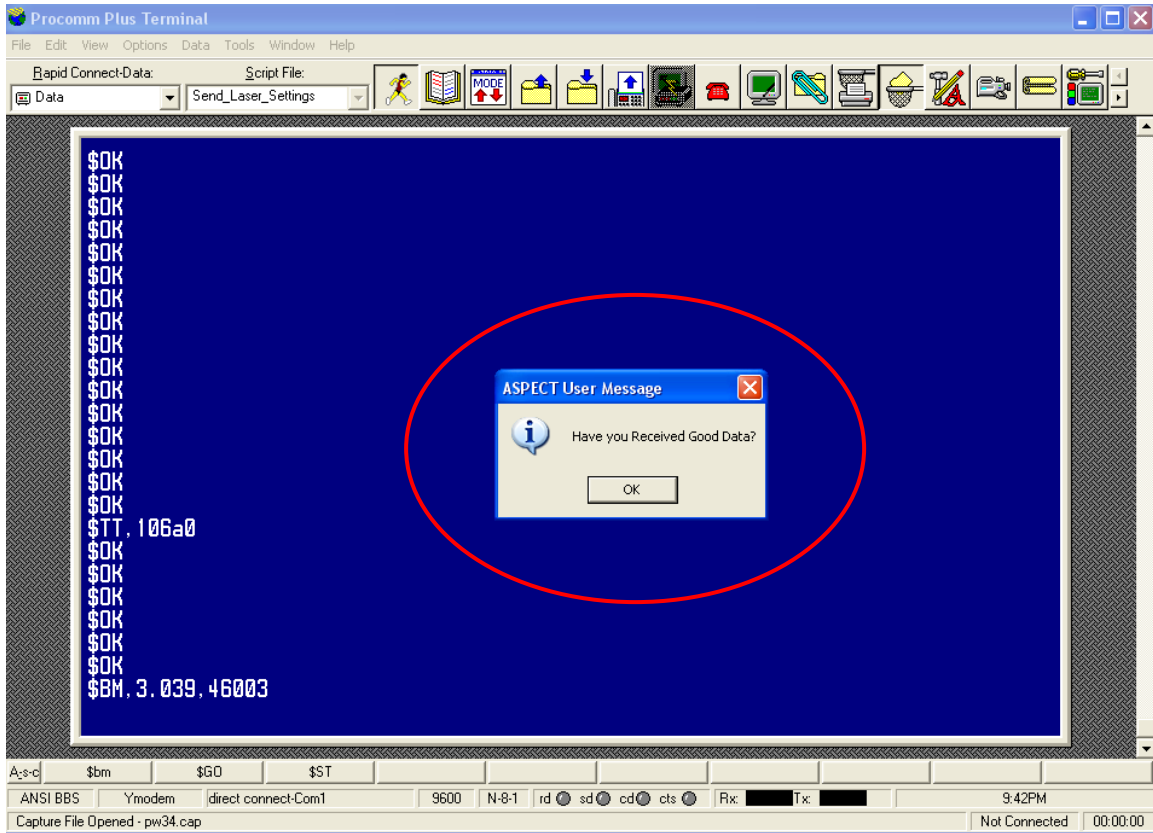
5. After you press the **START/STOP SCRIPT** button, the “running man” will be indented as will the **CAPTURE** button. At the lower left of the screen the **Capture file** status will change from closed to **Laser\_Settings.cap** (fig 3-26).
6. In a few seconds a user message will appear on the screen. Click **OK** for the script to continue.



**Figure 3-26.** Status changes from closed to **Laser\_Settings.cap**.



- At the end of the script, the sensor goes back into measurement mode. You will then see a data request (\$BM) as shown on the last line in fig 3-28. Check the values and make sure they are close to the value at the beginning of the download (as in fig. 3-27). If you receive an error message, contact the CIL/SIL. Click **OK** in the **User Message** block to continue.



**Figure 3-28.** Compare beginning values with those provided on the last line.

9. A new user message will appear when all settings have been sent to the sensor. Click **OK** to close the **Capture file** and end the script (figs.3-29 and 3-30).

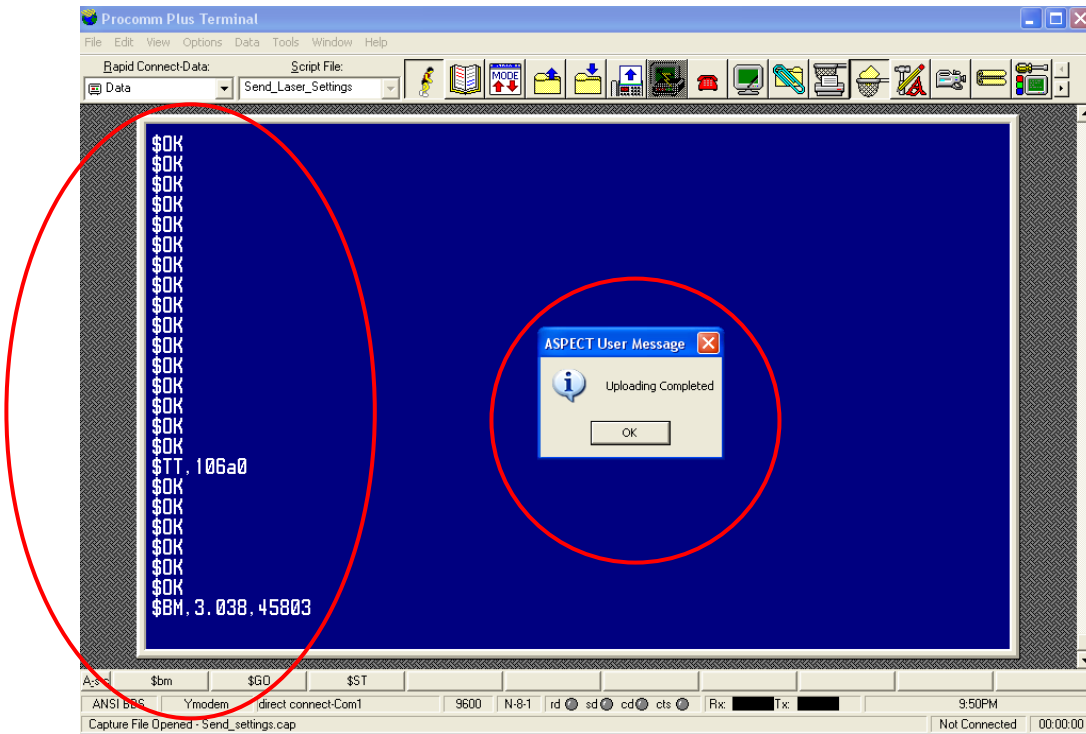


Figure 3-29. Click OK to end the script.

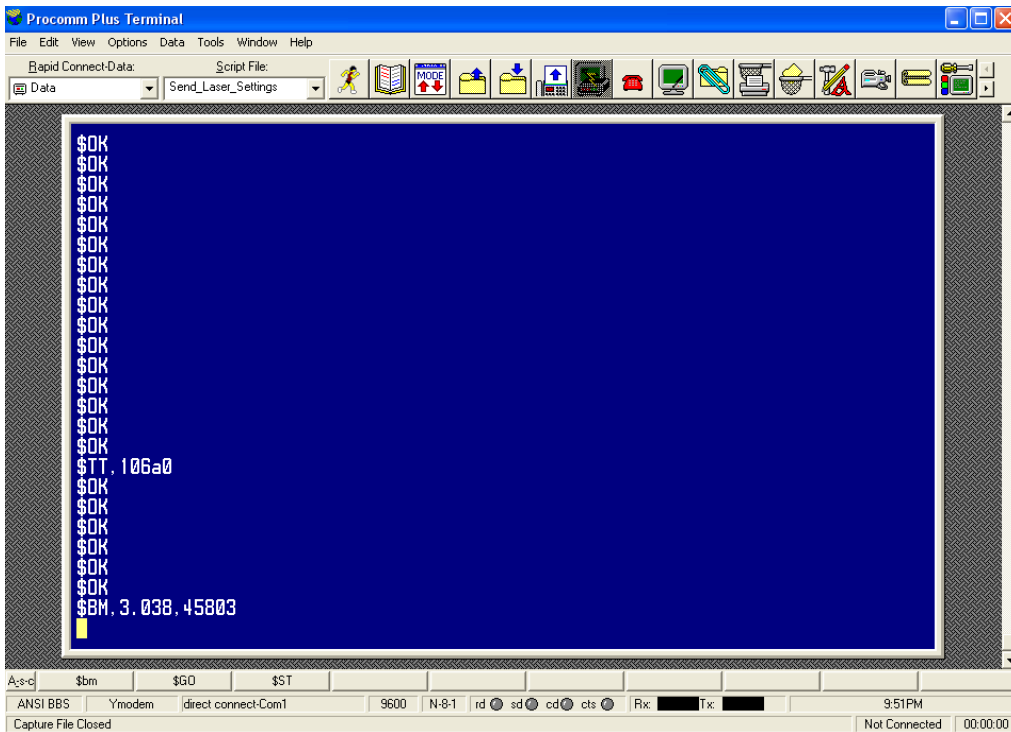


Figure 3-30. Example of screen you get once you've ended the script.



## **Passthru Connection**

Passthru is an Xpert utility that allows a user to connect to a device on one of the COM ports. The user logs into the Xpert using Procomm, stops recording, shuts down the Xpert application, and runs the Passthru utility. The following shows step-by-step instructions using Passthru to get the laser setting.

1. Connect the computer to the sensor via a RS232 cable. Start Procomm and set the system to use Direct Connect COM 1 (bottom left of screen) using a baud rate of 115200, 8 bits, no parity, and 1 stop bit. If your computer does not have a serial port, select the correct COM port in Procomm for the USB port that has the serial adapter.
2. At the Login prompt enter the username and password, provided by CIL/SIL.
3. At the **\Flash Disk>** prompt:

Type **recording off** and then press **ENTER**.

The system will respond with **Stopping**, then with **Recording OFF**. It can take as much as two minutes for the system to stop recording.

The system will respond with a second **\Flash Disk>**

Type: **shutdown** and then press **ENTER**.

This will shut down the Xpert application; again, it may take two minutes to complete.

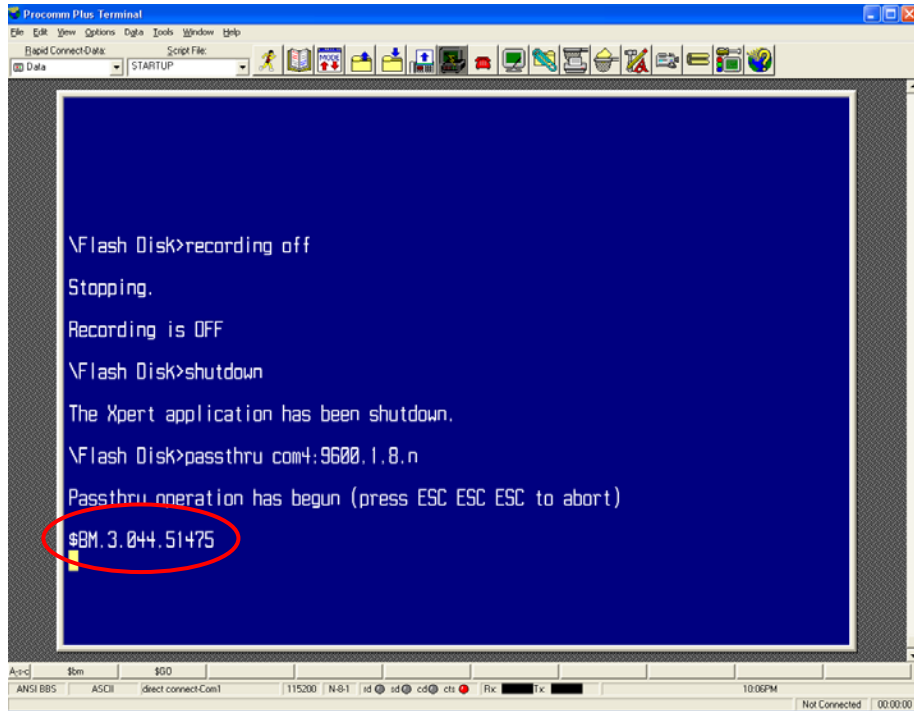
The system will respond with a third **\Flash Disk>**

Type **passthru com4:9600,1,8,n** and then press **ENTER**.

This command sets the COM port to a baud rate of 9600 with 1 stop bits, 8 data bits and No Parity.

4. Type: **\$BM** and then press **ENTER**.

The sensor will respond with a \$BM and two values as shown in fig. 3-31. The first value is the distance between the sensor and the target in meters (3.044). The second is a measure of the signal strength (51475). This reading assumes the sensor is in operational mode. If the sensor is in command mode, it will respond with \$ER, 86. This response is not a problem because you are just checking the communications between the computer and the sensor. The \$ER, 86 response shows that you are connected to the sensor.

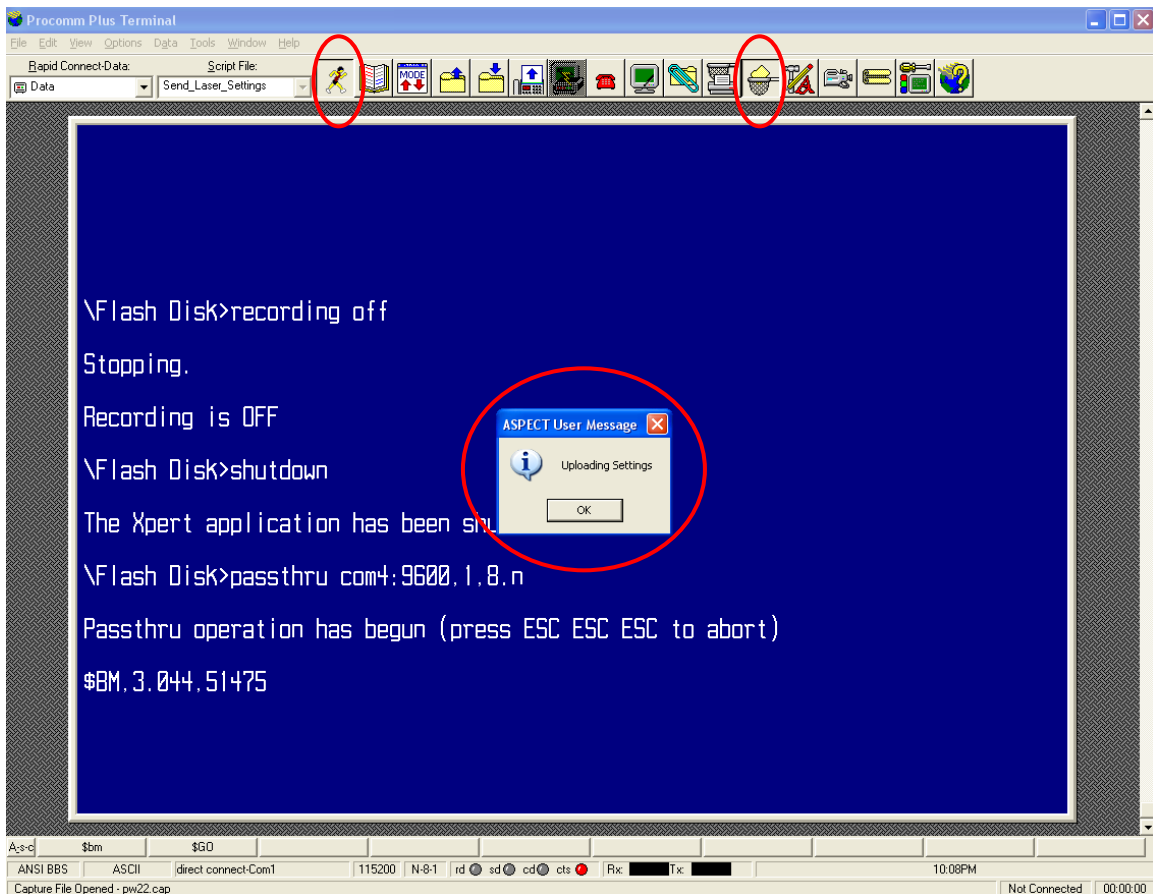


**Figure 3-31.** Sensor response to request for distance and signal strength values.

- Using the mouse select the **Send\_Laser\_Settings** script from the Script file drop-down menu as shown in fig. 3-32.

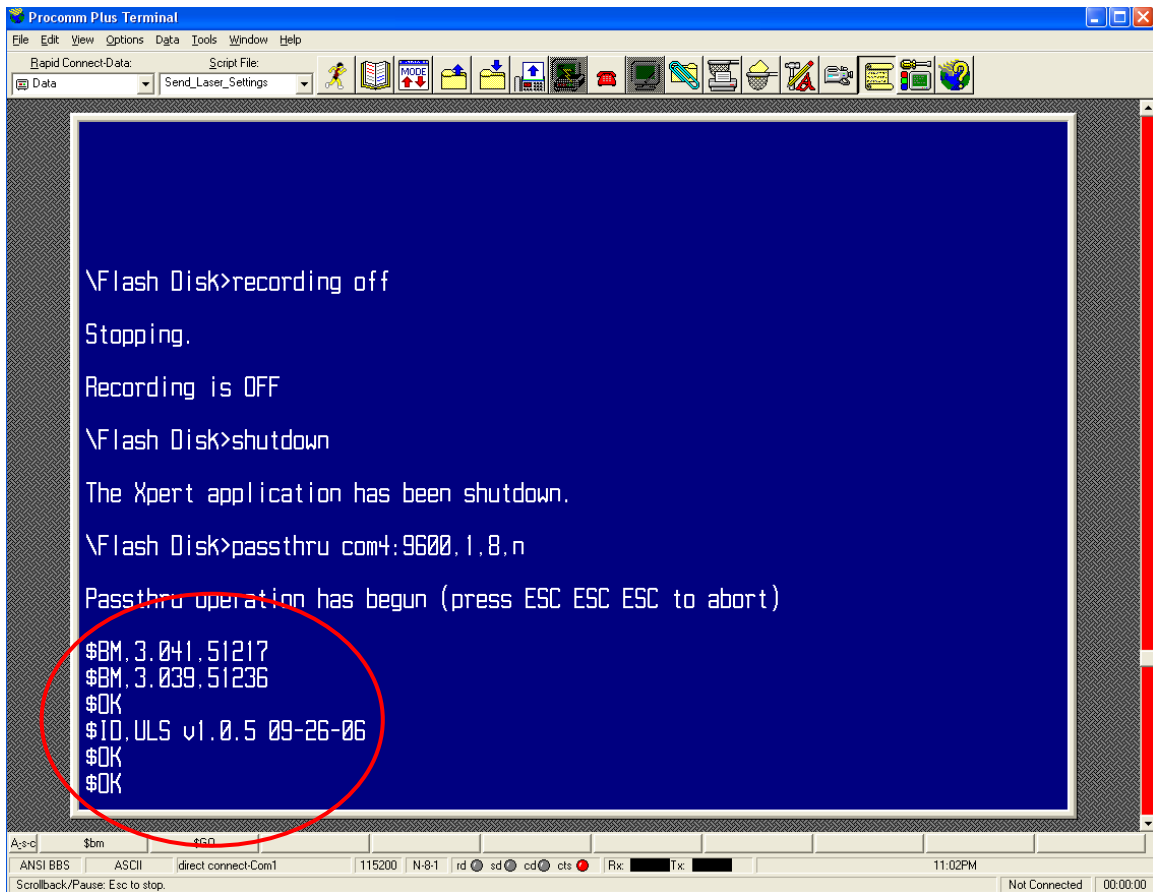
Press the **START/STOP SCRIPT** button.

- After you press the **STOP/STOP SCRIPT** button, the “running man” will be indented, as will the **CAPTURE** button. At the lower left of the screen, the **Capture file** status will change from closed to **Laser Setting.cap** or pwxx.cap where xx is the captured file number (fig. 3-32).
- In a few seconds a user message will appear on the screen. Click **OK** for the script to continue.



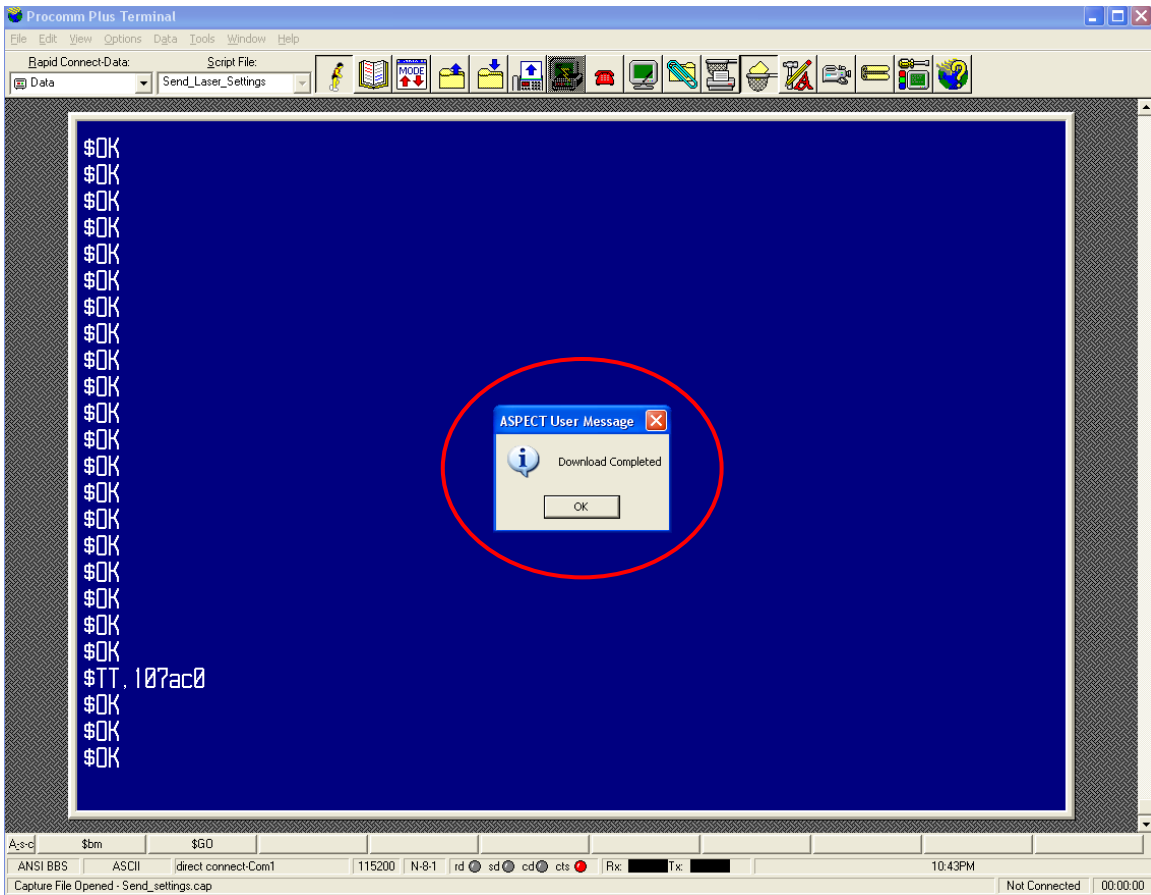
**Figure 3-32.** Click **OK** to upload settings.

- At this point the script will send a number of commands to the sensor, including the approved settings (fig. 3-33). The first command is a data request, the second switches the sensor into the command mode, and the third shows the software version of the sensor. After the third command, the settings are uploaded. The sensor returns an **OK** for each successful command and an **ER, 1** for commands that fail. A fail command is most likely caused by an older laser with an earlier software version rather than a problem with the sensor. The script is written using the newest set of commands, and some commands may not be in all sensors. Contact the CIL/SIL if there are errors. You will need to provide the **Get\_Laser\_Setting** and **Send\_Settings.cap** files. Table 3-2 contains a list of the commands used by the script.



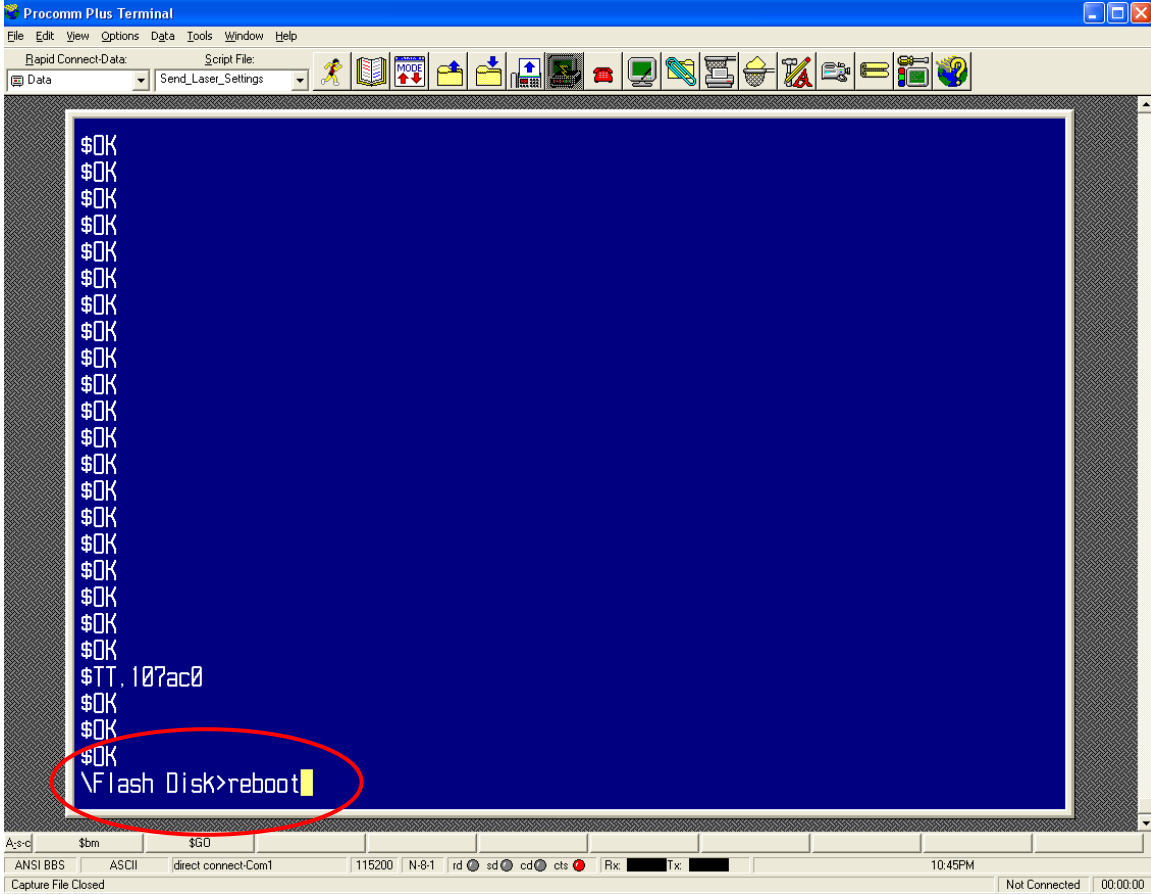
**Figure 3-33.** Commands contain approved settings.

9. A new user message will appear when all settings have been sent to the sensor. Click **OK** to close the **Capture file** and end the script (fig. 3-34).



**Figure 3-34.** After all settings have been sent to the sensor, click **OK** to end script.

10. After the script stops, press ESC three times to exit the Passthru utility. The system will respond with the \Flash Disk> prompt (fig 3-35).
11. Type **reboot** and press **ENTER** to restart the Xpert.



**Figure 3-35.** Restart the Xpert by typing **reboot** and pressing **ENTER**.

### **3.5 Get PORTS Data from the DCP**

To get PORTS data from the DCP:

1. Using a computer, run Procomm or some other terminal emulator (such as Hyperterm), setting the COM port of the computer to 9600-N-8-1.
2. Press ESC. You will get the login/password prompts. Contact CIL/SIL for the login/password information.

3. After entering the login/password you should now see the following:

```
NOS 85739281 07/11/2014 14:48:00
Q1( 44.660 0.038 2.00 29.537 29.366
Q2( 44.720 0.025 1.00
L1< 12.662
DAT 0.000
SNS 0.000
```

Table 3-3 shows an interpretation of each line in the PORTS data file.

## Air Gap Field Installation Guide

**Table 3-3.** Interpretation of PORTS data file

<b>Line 1</b>	
<b>NOS</b>	National Ocean Service
<b>85739281</b>	Station Number Chesapeake City Air Gap
<b>07/11/2014 14:48:00</b>	Date and time of observation
PORTS data are reported every 6 minutes starting at 6 minutes after the hour. This is NOT the station time or date.	
<b>Line 2</b>	
<b>Q1(</b>	Denotes microwave air gap data Q = air gap data 1 = 1 <sup>st</sup> air gap sensor at the station ( = GOES flag
<b>44.660</b>	Air gap data in meters (m) The water is 44.664 m from the lowest point of steel on the bridge.
<b>0.038</b>	Standard deviation
<b>2.00</b>	Outlier count
<b>29.537</b>	The temperature value from temp 1
<b>29.366</b>	The temperature value from temp 2
<b>Line 3</b>	
<b>Q2(</b>	Denotes laser data Q – air gap data 2 = 2 <sup>nd</sup> air gap sensor at this station (laser) ( = GOES flag
<b>44.720</b>	Laser data in meters (m)
<b>0.025</b>	Standard deviation
<b>1.0</b>	Outlier count
<b>Line 4</b>	
<b>L1&lt;12.662</b>	Denotes battery L = battery 1 = 1 <sup>st</sup> battery at this station < = GOES flag
<b>12.662</b>	Battery value in volts direct current (Vdc)
<b>Line 5</b>	
<b>DAT</b>	Station datum value, always 0.0 for air gap
<b>Line 6</b>	
<b>SNS</b>	Station datum offset, always 0.0 for air gap

### **3.6 Field Maintenance**

There are no field replaceable parts to the Miros microwave or LTI laser sensors; however, several items should be checked during the quarterly and annual station visits. Use the following procedure, along with the Annual Inspection Checklist, during your visit to ensure the continuing operation of the system. This list also includes items to be checked or replaced with the DCP portion of the system. The checklist can be found in fig. 3-36 and also in appendix L. A list of tools (Air Gap Tool Kit) needed to maintain the system can be found in appendix G.

At the completion of the maintenance visit, a site report must be submitted to the Task Manager or PORTS site representative. Any checklists, worksheets or photographs should be included with the site report.

#### **Sensor Replacement**

OET (Operational Engineering Team) must be advised if either sensor will be replaced. If both sensors will be replaced during a maintenance visit, prior approval from OET is required. Approval from OET must be requested one week in advance or as soon as possible in case of an emergency maintenance visit. OET can be contacted via email at [nos.coops.oetteam@noaa.gov](mailto:nos.coops.oetteam@noaa.gov) or by telephone at 301-713-2897, extension 183 or 191.

#### **Pre-Inspection**

- Before a visit can be made to a site, you must contact the Bridge Authority and receive permission to work on the bridge. The bridge contact information should be included in the most recent station report. If you have difficulties contacting this person, contact the Task Manager or PORTS site representative for assistance. **Do not go on the bridge without permission under any circumstances.** On the Annual Inspection checklist, enter the name of the Bridge Authority representative you spoke with, along with the time and date. See section 3.1.1 of this manual for additional information.
- Contact CORMS (301-713-2540) and advise them that you are working at the site. CORMS will send out an email to the appropriate parties. On the checklist, record the name of the operator you spoke with and the time and date that you contacted CORMS.

#### **System Inspection**

**Make a visual inspection of the site.** Look for damage to any components, loose cabling or hardware, as items may have come loose due to bridge vibration. Check for corrosion or any sign of tampering. Check that the sensors are level ( $\pm 0.5$  degrees) with an electronic level such as the one in the Air Gap Tool Kit list found in appendix G. If you

find the level is not correct, record the value on the checklist and contact OET. Place a check mark after each item in the checklist and write any additional information in the comment section. Use either a cleaner such as Simple Green or plain water to clean the sensor face and windows. Remember to rinse all surfaces. **DO NOT wipe the sensor face or windows with a dry rag.** Replace the desiccant in the laser housing.

The Miros sensor case is aluminum and is mounted (in most installations) on a stainless steel frame. If you discover corrosion on and/or around the Miros mounting bolts, check that the isolation washers have been installed. If you discover that the washers are missing, contact CIL/SIL immediately for assistance. Wash the area carefully and look for scratches in the finish of the sensor. Do not remove the sensor unless instructed by CIL/SIL. If necessary, take a picture of the corrosion to help determine the correct course of action. Cell phone cameras work fine.

**Before running any checks on the DCP, copy all the Xpert files to your laptop.** In the electronics box, check the screws that hold down the DCP/Satlink, connection boards, and other items, as they may have become loose from bridge vibration. Check the battery connections and record the battery voltages on the checklist. If you have upgraded the Xpert operating system (OS), check the box and include the OS version. If not, include the present version. Replace the desiccant in the DCP if needed.

**If one of the sensors has been moved for any reason, you MUST** fill out the Air Gap Measurement Work Sheet (appendix M) and contact OET immediately at 301-713-2897 extension 183 or 191. If the position of the sensors has been changed, the system cannot be turned on again without applying the new offsets in the database.

**Next, contact the CIL/SIL** and have them perform a communications check using the IP modem. They will connect to the system and get a PORTS tag, which shows that the system is operating. They will also check to see that GOES data are being received. Do not leave the site without performing these communications checks.

**Last, call CORMS** and tell the operator that you have finished servicing the system, you have had the CIL/SIL check the IP and GOES transmissions, and you are ready to leave the site. CORMS will check to make sure they are receiving the data. On the checklist, record the CORMS operator's name, along with the time and date.

**If additional information or expertise is required,** please refer to the Air Gap Technical Expert Help (Go To/Call List), which can be found in appendix N.



	<h2 style="margin: 0;">Annual Inspection Checklist for Air Gap System with Laser</h2>		REV 2.0 09/22/2010
Station Name	<input style="width: 100%;" type="text"/>	Station Number	<input style="width: 100%;" type="text"/>
Field Party Chief	<input style="width: 100%;" type="text"/>	Date Inspected	<input style="width: 100%;" type="text"/>
Field Party	<input style="width: 100%;" type="text"/>		
<i>Comments:</i>			
<input style="width: 100%; height: 100%;" type="text"/>			
<b><u>Pre- Inspection</u></b>			
Contact Bridge Authority	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
Advise CORMS 301-713-2540 (system off)	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
<b><u>System Inspection</u></b> (Visual inspection of all components for damage, corrosion, cleaning of sensors)			
<input type="checkbox"/> Air Gap sensor, mount and cables	<input type="checkbox"/> Laser sensor, mount and cables	<input type="checkbox"/> DCP enclosure and mount	
<input type="checkbox"/> Antennas, mounts and cables	<input type="checkbox"/> Solar panels, mounts and cables	<input type="checkbox"/> Grounding cable	
<input type="checkbox"/> Cleaning of Air Gap green face	<input type="checkbox"/> Cleaning of Laser window	<input type="checkbox"/> Laser desiccant replaced	
Air Gap Battery voltage reading <input style="width: 50px;" type="text"/>	Laser Battery voltage reading <input style="width: 50px;" type="text"/>	<input type="checkbox"/> DCP desiccant Replaced	
<input type="checkbox"/> Xpert OS Upgraded?	Xpert OS Version Number	<input style="width: 50px;" type="text"/>	
Has the Air Gap or Laser Sensor been moved or adjusted ? If yes fill out the Air Gap Measurement Work Sheet and contact OET <input type="checkbox"/> immediately at 301-713-2897 ext 183 or 191 Do Not contact CORMS to turn on the system until you have received the OK from OET			
OET Contact (used only if the sensors have been moved)	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
Communication Check from CIL/SIL	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
Advise CORMS 301-713-2540 (system on)	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
<i>Comments:</i>			
<input style="width: 100%; height: 100%;" type="text"/>			
<input type="button" value="Print Form"/>		<input type="button" value="Reset Form"/>	

Figure 3-36. Sample air gap AI checklist.

### **3.7 Determining Low Steel and Laser Offsets**

To obtain an accurate air gap value, measure the distance from the face of the Miros microwave sensor to the underside of low steel. Also measure the distance between the face of the Miros microwave sensor and the LTI laser sensor to obtain a second value that ensures an accurate comparison between the two sensors.

#### **DEFINITIONS**

**Miros zero** – The green face of the Miros sensor.

**Laser zero** – The flat end of the ULS housing (the end with the lenses).

**Low steel** – The lowest permanent structural component of the bridge at the location of the air gap sensor. This does not include suspended objects such as navigation lights.

**Low steel offset** – The vertical distance between the Miros zero and low steel, measured during deployment.

**Laser offset** – The vertical distance between the LTI laser zero and the Miros microwave zero, measured during deployment.

Measure the distance between low steel and the face of the Miros microwave sensor. Check with the bridge engineer to determine low steel at the location of the sensor. You may not be able to make a direct measurement, carefully measure in sections to determine the value. Enter this value in the worksheet provided in appendix M. Examples of the worksheets are also shown in figs. 3-37 and 3-38. A fillable PDF version can be obtained from the CIL/SIL. Take a set of photographs that show low steel and, in the space provided on the worksheet, include a description of where and how the measurement was taken.

Measure the distance between the face of the Miros microwave sensor and the front or flat end of the LTI laser sensor housing. Enter this value in the worksheet. Use the worksheet that shows the LTI laser sensor in correct location (above or below the Miros microwave sensor). Examples of both worksheets are found in appendix M.

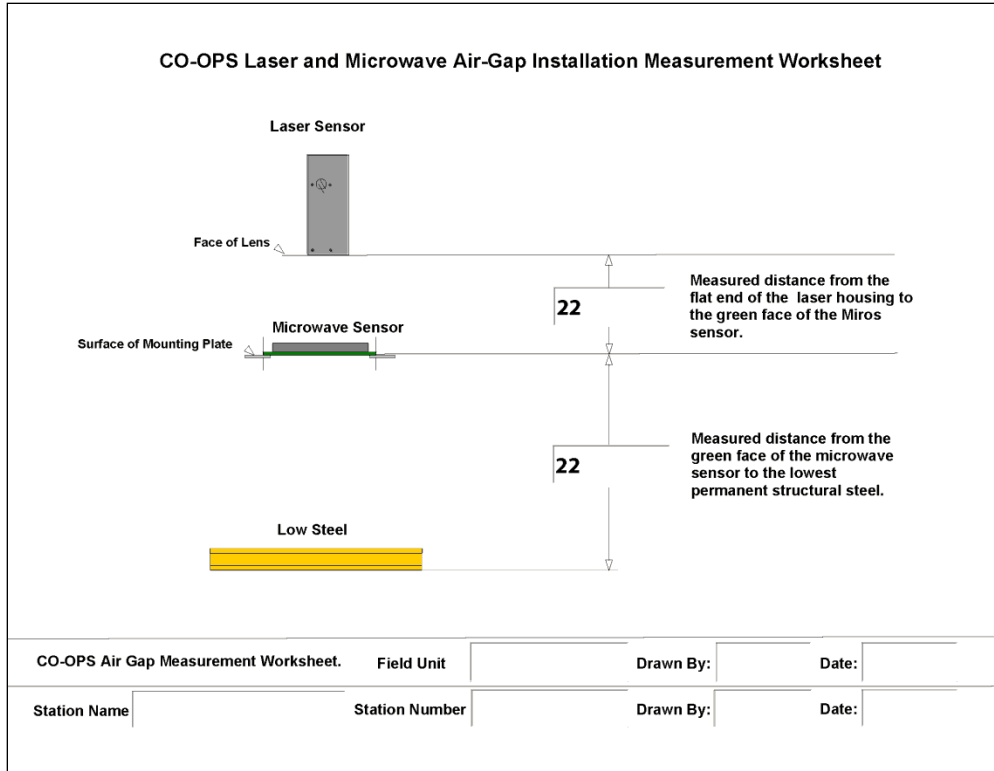


Figure 3-37. Measurement sheet used when laser sensor is installed above microwave sensor

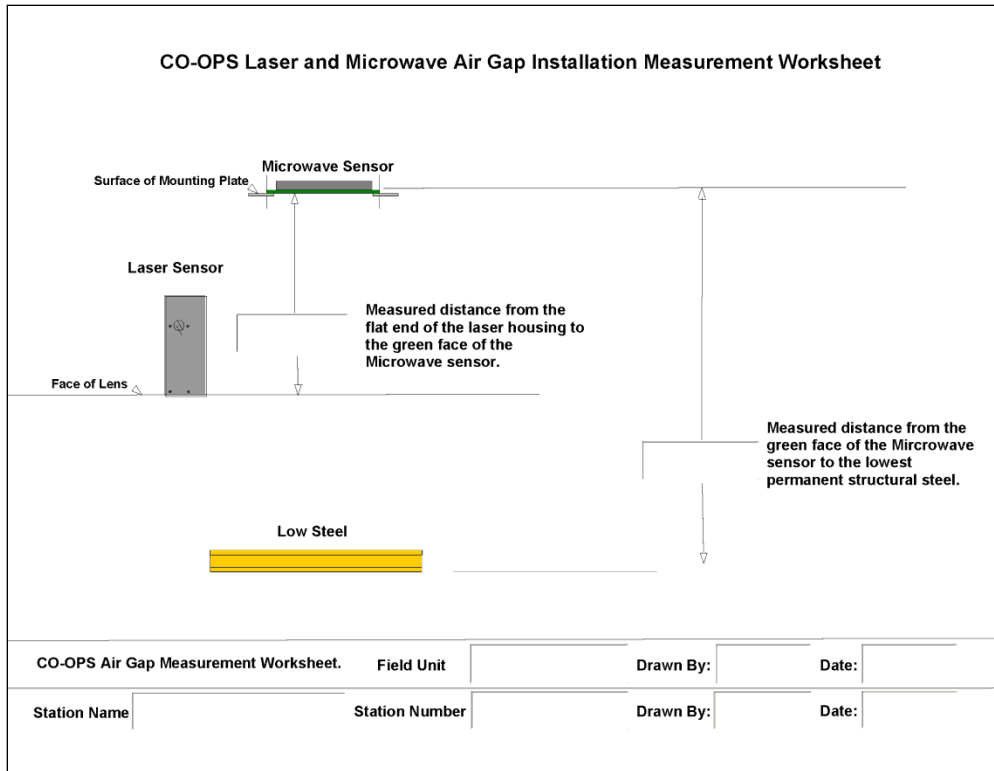


Figure 3-38. Measurement sheet used when laser sensor is installed below microwave sensor.

## **References**

NOS Tide Station User's Manual, Sutron Corporation, September 2004

[www.sutron.com](http://www.sutron.com)

Miros User Manual, Miros Microwave Rangefinder Technical Handbook, October 2002

[www.miros.no](http://www.miros.no)

LTI User Manual, Laser Technology, Inc. ULS Hardware/Software Interface Specification, 1<sup>st</sup> Edition, 2005

[www.lasertech.com](http://www.lasertech.com)

Sutron User Manual, Sutron Xpert Operations and Maintenance Manual, June 2010

[www.sutron.com/downloads.htm](http://www.sutron.com/downloads.htm)

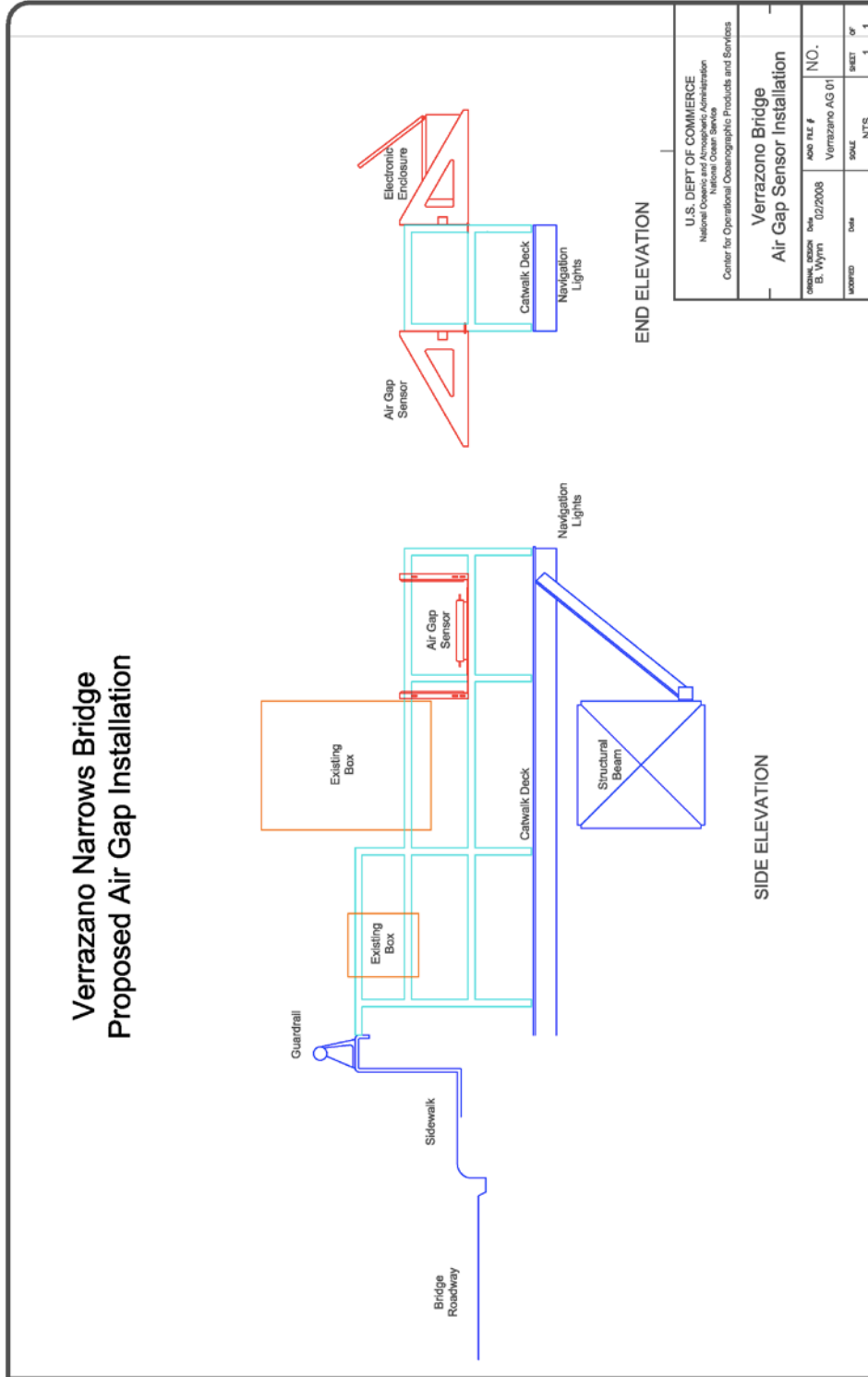
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- Appendix N** Air Gap Technical Expert Help (Go To/Call List)

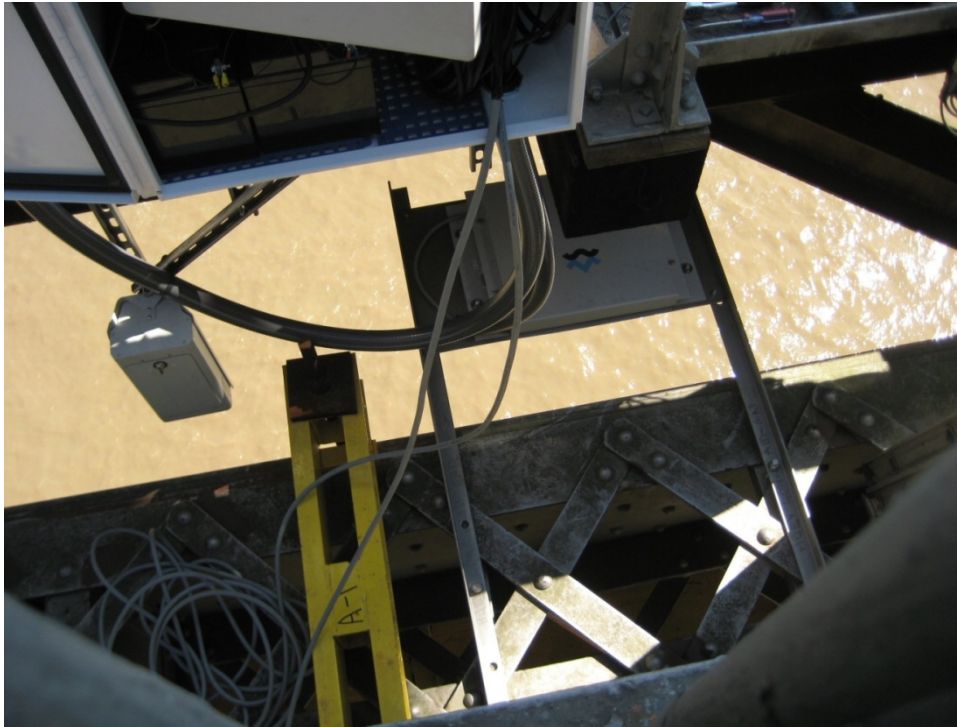


# Appendix A Air Gap Mounting Diagrams

## Verrazano-Narrows Bridge



**Huey Long Bridge**



**I-210 Bridge**



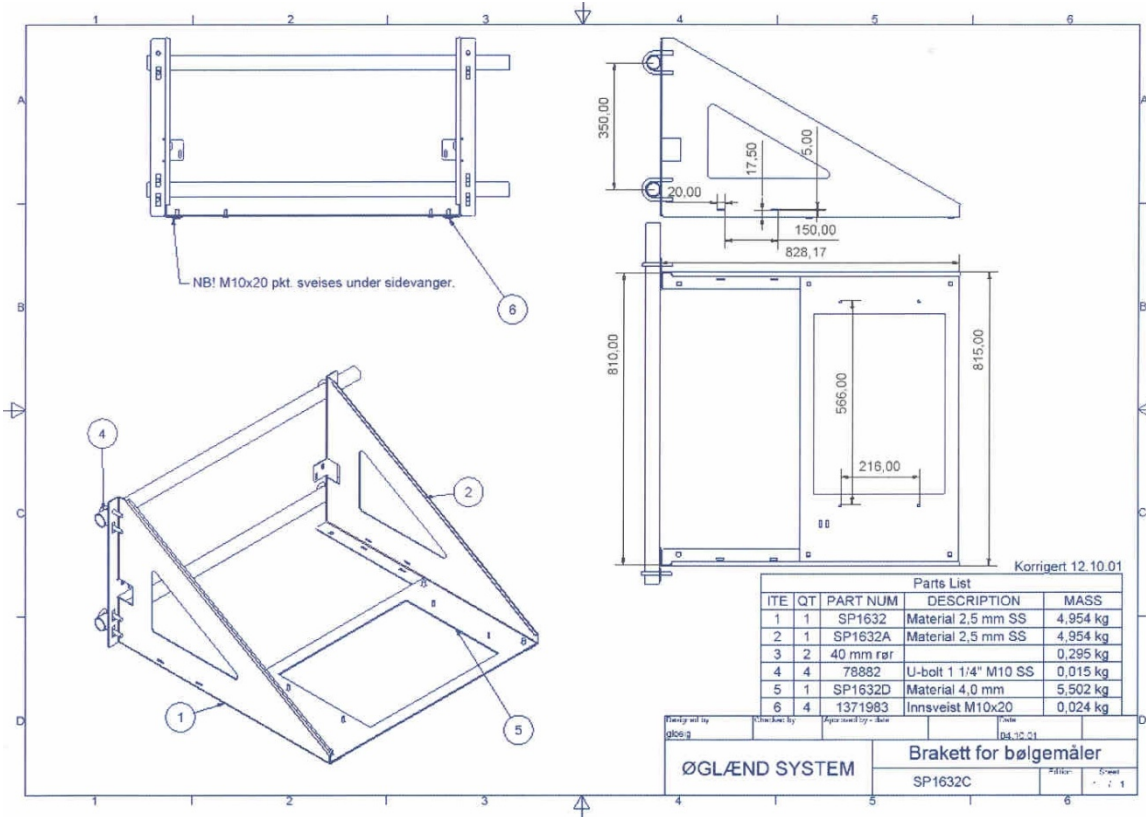
**I-210 Bridge**





**Crescent City Connector**



**Miros Mounting Bracket for Crescent City (New Orleans, Louisiana)**



# Appendix B Air Gap Inspection and Acceptance Checklist

	<b>Inspection and Acceptance Checklist for Miros Microwave Sensor</b>		REV 1.2 09/28/2010
Sensor Model Number <input style="width: 60px;" type="text"/>	Sensor Serial Number <input style="width: 60px;" type="text"/>	Inspection Date <input style="width: 60px;" type="text"/>	
Testers Name <input style="width: 200px;" type="text"/>		2nd Tester (if any) <input style="width: 180px;" type="text"/>	
<p><i>System Inspection</i> Visual inspection of Sensor for damage, check for parts and paperwork</p> <p> <input type="checkbox"/> Shipping package                          <input type="checkbox"/> Manual Included                          <input type="checkbox"/> Cable Inspection                          <input type="checkbox"/> Housing Inspection                 </p> <p>Comments: <input style="width: 650px; height: 30px;" type="text"/></p>			
<p><i>System Testing</i> check parameter settings, run range test, run zero test ( use Procomm or Hyperterm)</p> <p> <input type="checkbox"/> Communication check. Power up system and confirm you are able to "talk " to the system                 </p> <p> <input type="checkbox"/> System Parameter check. Compare setting in the sensor with those in the Manual and with the CO-OPS standard setting. Record differences in the comments section below. Change sensor setting to match the CO-OPS standard setting                 </p> <p> <input type="checkbox"/> Mount system on Test Range with the target at 10 meters and run for 24 hours. Perform tstc and tstd reports at start and end of test. Test results should be saved and included with this checklist                 </p> <p> <input type="checkbox"/> Change target from 10 to 20 meters and run for 24 hours. Perform tstc and tstd reports at start and end of test. Test results should be saved and included with this checklist                 </p> <p> <input type="checkbox"/> Change target from 20 to 40 meters and run for 24 hours. Perform tstc and tstd reports at start and end of test. Test results should be saved and included with this checklist                 </p> <p> <input type="checkbox"/> Change target from 40 to 60 meters and run for 24 hours. Perform tstc and tstd reports at start and end of test. Test results should be saved and included with this checklist                 </p> <p> <input type="checkbox"/> Remove sensor from range and mount unit on the Crane Test Platform; Lift platform 4 meters and measure the distance between the Miros zero point on the platform and the ground. Record distance below                      Record sensor reading using Procomm or Hyperterm. Record reading below.                 </p> <p>                     Miros Zero Point Reading: <input style="width: 60px;" type="text"/>                          Miros Sensor reading: <input style="width: 60px;" type="text"/>                          Difference: <input style="width: 60px;" type="text"/> </p> <p>This completes the Laboratory portion of the Miros I&amp;A Checkout. The next step is the Crane Test</p> <p>Comments: <input style="width: 650px; height: 60px;" type="text"/></p>			
<input type="button" value="Print Form"/>		<input type="button" value="Reset Form"/>	

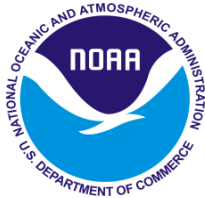


# Appendix C

# Test Plan

## Over-Water Crane Hoist Test Procedure for Air Gap Radar Range Sensors

Warren Krug  
October 2010



**noaa** National Oceanic and Atmospheric Administration

---

U S. DEPARTMENT OF COMMERCE  
National Ocean Service  
Center for Operational Oceanographic Products and Services



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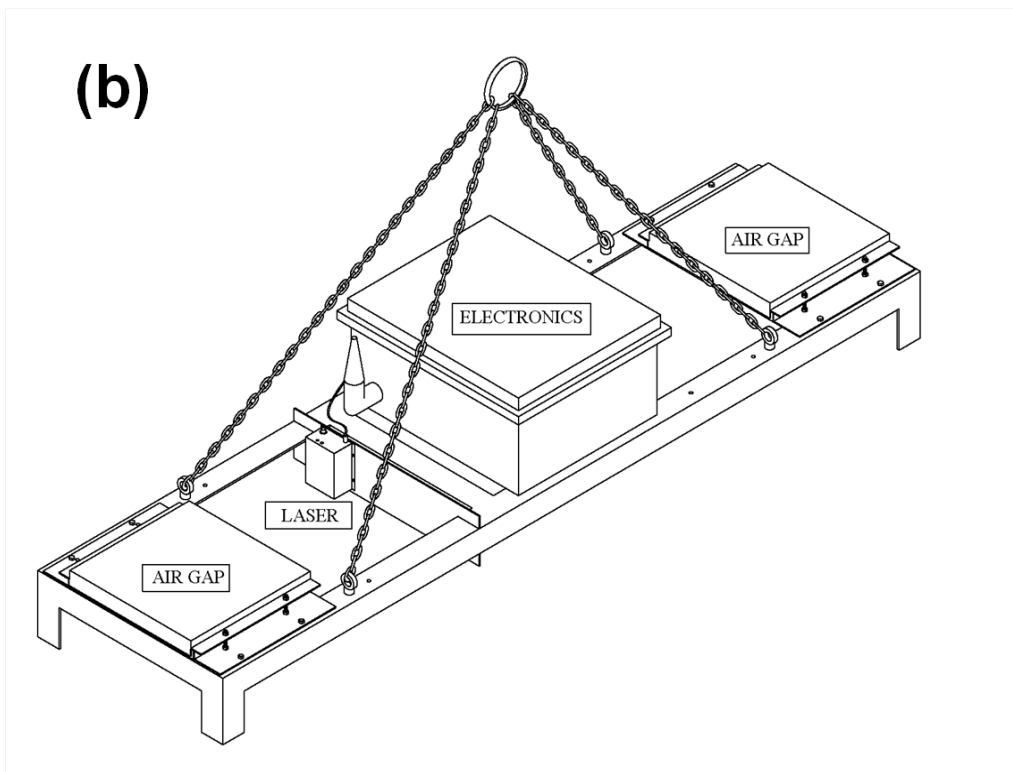
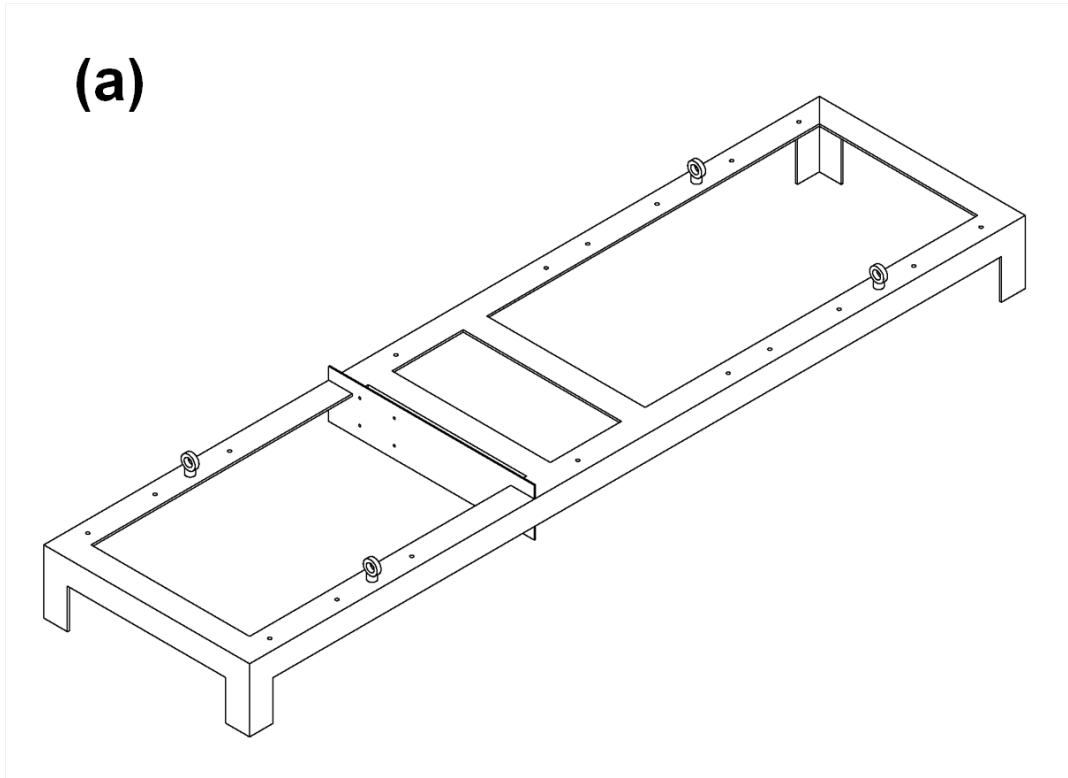
## **1.0 Introduction**

The following describes the procedure for conducting over-water crane hoist tests on radar range sensors used to measure clearance under bridges in CO-OPS operational air gap systems. It is recommended that this test be conducted on all sensors prior to field deployment and all test results analyzed and reported prior to operational deployment. The test setup involves mounting several radar range sensors and one laser range sensor in a single platform to orient all sensors aiming downward relative to the same horizontal reference plane. The platform is then suspended from a crane cable. The test procedure involves using the crane to position the platform of sensors over a body of water, then lifting and lowering the platform to create a series of different sensor-to-water ranges. Analysis of the resulting range records measured by sensors is conducted to achieve the following objectives:

- Conduct a basic qualitative comparison of range measured by all sensors (radar and laser) to confirm that sensors are measuring reasonable values.
- Record sensor return signals at a series of different heights and observe measured range time series to ensure that each radar sensor is adequately processing reflected signals from the water surface.
- Determine the difference between coincident laser and radar sensor measurements as a function of sensor-to-water range, and use the results to determine a laser-radar offset to be applied to operational measurements (previous results have shown that such an offset is always present and can vary across different radar sensors)

## **2.0 Test Setup**

Figure C-1 shows two drawings of a rectangular frame used for mounting multiple radar sensors and a laser sensor for a crane test: (a) one drawing of the frame without sensors mounted and (b) another with two Miros radar sensors and a Laser Technology, Inc. laser sensor (frame was created for use in previous, similar testing). The frame allows multiple sensors to be mounted and positioned to aim downward, with all sensors leveled to the same horizontal reference plane. The frame also allows crane hoist chains to be attached as shown in (b). Depending on the particular test conducted, the frame can accommodate several different sensor combinations. Therefore, for each test conducted, it is critical to record a sketch on the test log sheet to show sensor configuration and specify the location of different sensors by adding serial numbers to the sketch. The blank frame drawing shown in fig. C-1 (a) is also included on the test log sheet for this purpose. Also, the vertical separation between each range sensor installed in the mount and some constant reference point on the mount is measured and recorded (these values are used to derive physical sensor-to-sensor offsets. For example, when the sensors in the frame include multiple radar sensors and one laser sensor, these measurements can be the vertical distance from the face of the laser lens to the flat planar antenna of each Miros radar sensor.



**Figure C-1.** Drawing of range sensor mount (a) without any sensors installed and (b) with sensors installed and crane lift chains attached.

An electronics box, which contains a Sutron Data Collection Platform (DCP), is included on the sensor mount as shown in fig. C-1 (b). All sensors are interfaced with this DCP and configured to record 1-Hz range measurements—each sensor to a separate .log file. An individual sensor’s log file should be 5 MB in size and log file names should contain two letters to specify sensor brand name and contain sensor serial number (fig. C-2).

**Figure C-2.** Information included in sensors’ log file.

<b>Sensor Brand</b>	<b>Sensor Serial Number</b>	<b>Resulting name of log file on DCP</b>
Miros	032325	Mi032325.log
Laser	1976	La1976.log
Design Analysis	00012	Da00012.log

Each sensor’s individual log file is exported from the DCP after the test and used to generate results described in the test objectives outlined in section 1. The DCP is equipped with a wireless IP modem so that it can be accessed remotely from a laptop to ensure that all sensors are logging data throughout the test.

***Metro Machine Corporation Crane Facility***

Previously, CO-OPS has used cranes at Metro Machine Corporation, located on the Elizabeth River in Norfolk, to perform similar radar testing. It is recommended that arrangements for future crane testing be made with Metro Machine personnel in advance so that testing is scheduled on a not-to-interfere basis. Arrangements should be scheduled a minimum of two weeks in advance and should include a weather contingency date. There is a \$500.00 per day charge for the use of the crane, which includes the operator and radioman. The following contacts at Metro Machine were used to arrange previous tests during July 2010:

Jim Lott  
email: [jlott@memach.com](mailto:jlott@memach.com)  
phone: (757) 494-0711

Mike Hinton  
email: [mhinton@memach.com](mailto:mhinton@memach.com)  
phone: (757) 543-6801

***Note on Safety Equipment***

During crane hoist testing, personnel must comply with all CO-OPS Field Facility Safety Rules and NOAA Safety Rules. NOAA and CO-OPS safety procedures require that hard hats, safety reflective vests, flotation vests, and safety shoes be worn by all persons at all times while on

piers. Hard copies of this safety information can be found in the CO-OPS Chesapeake facility library or on the CO-OPS common drive [folder](#), Field\_Safety\_Manual, and on the Chesapeake common drive in a folder called Field\_Safety\_Manual.



### **3.0 Test Procedure**

Prior to conducting the test, record qualitative weather observations on the test log sheet. Once radar and laser sensors are installed in the mount, suspended from a crane lift cable, and positioned over water, the test procedure involves recording range measurements at a series of discrete ranges above the water surface. First, position the sensor test platform at approximately 5 meters (m) above the water surface and collect measurements at a series of discrete ranges nominally spaced 10 m apart—from 5 m to 80 m but not more than 85 m above the water surface (or to the crane’s maximum lift height). At each nominal range, the sensor platform is kept in place to allow the sensors to collect range measurements for a minimum of 10 minutes. Use the crane to position sensors at a particular measurement height. If there are any visual signs of significant sensor platform motion (such as swaying, rocking, etc.), do not record the measurement start time of the 10 minute period until the platform appears to come to rest. This process of collecting measurements spaced 10 m apart for 10 minute periods is repeated on the descent. Note that exact distances at 10-m increments are not required, and the crane operator is not required to spend a significant amount of time making small adjustments to achieve precise positioning.

Once the platform is positioned at a discrete measurement height and the platform comes to rest, the starting and ending times of the 10-minute measurement periods must be clearly recorded in the specified location in the following test log sheets. Hand recorded measurement start and stop times must be in sync with GMT time recorded in DCP data log files.

For tests involving the Miros radar sensor, at the 5-m and 85-m measurement levels ‘tstc’ and ‘tstd’ tests are performed to record sensor return signals. This is accomplished by remotely interfacing the DCP and sensors with a laptop via the IP modem.

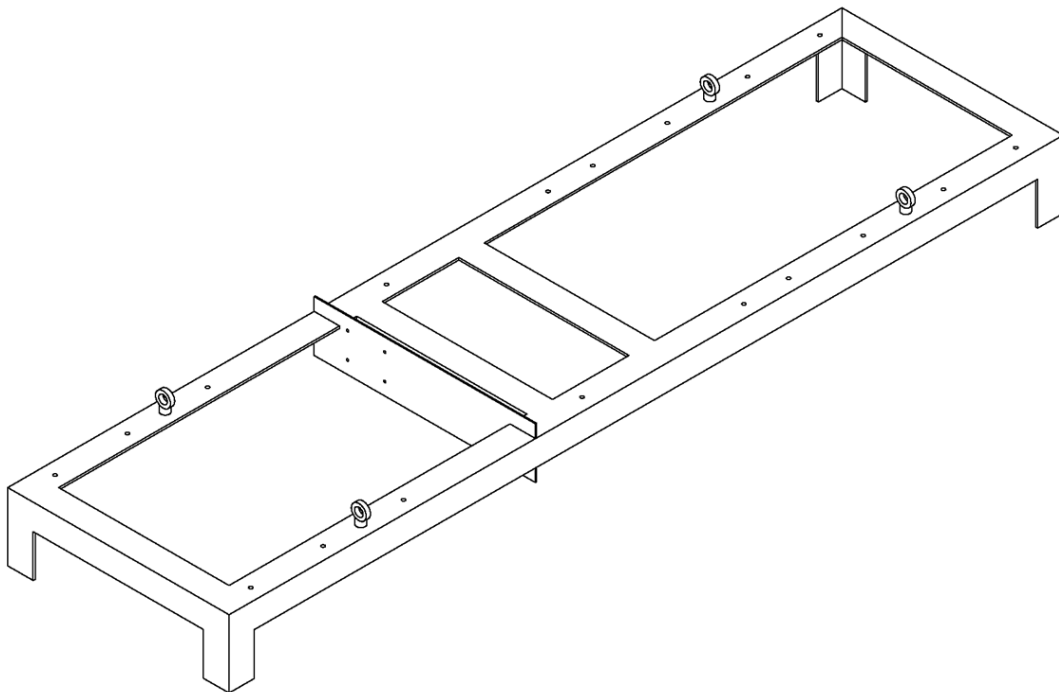


## Radar/Laser Crane Test Log Sheet

Date: \_\_\_\_\_ Observers: \_\_\_\_\_

Location: \_\_\_\_\_

**Sensor Mount Diagram** (add a brief sketch of all sensors installed in the mount and include serial numbers on the sketch to provide info on sensor orientation).



### Radar-Laser Physical Offsets

(hand measured vertical separations between sensors in mount)

Radar Model and Serial #	Radar-Laser Vertical Offset (cm)	Notes on measurement reference locations

## Weather Conditions at Test Site Log Sheet

Air Temp \_\_\_\_\_

Wind Speed \_\_\_\_\_ Direction \_\_\_\_\_

DCP type and s/n: \_\_\_\_\_ DCP OS \_\_\_\_\_

Crane test DCP software version \_\_\_\_\_

IP telephone number: \_\_\_\_\_ IP Address: \_\_\_\_\_

Miros Sensor # 1 s/n \_\_\_\_\_ Range: \_\_\_\_\_

DCP Log Name: \_\_\_\_\_

Miros Sensor # 2 s/n \_\_\_\_\_ Range: \_\_\_\_\_

DCP Log Name: \_\_\_\_\_

Miros Sensor # 3 s/n \_\_\_\_\_ Range: \_\_\_\_\_

DCP Log name: \_\_\_\_\_

Laser Sensor s/n \_\_\_\_\_ Range: \_\_\_\_\_

DCP Log Name: \_\_\_\_\_

DA Sensor#1 s/n \_\_\_\_\_ Range: \_\_\_\_\_

DCP Log Name \_\_\_\_\_

***NOTE: All event-recorded test event times must be in sync with GMT time of DCP logs.***

## 5-Meter Miros System Tests

Miros # 1 tstc File name: \_\_\_\_\_ Time of Test \_\_\_\_\_

Miros # 1 tstd File name: \_\_\_\_\_ Time of Test \_\_\_\_\_

Miros # 2 tstc File name: \_\_\_\_\_ Time of Test \_\_\_\_\_

Miros # 2 tstd File name: \_\_\_\_\_ Time of Test \_\_\_\_\_

## Upward Lift Test Log Sheet

**Start Time (GMT):** \_\_\_\_\_  
(time system is lifted off the barge and moved to the test location)

**Set sensor frame at 5 meters above the water**

**Times are start of 15 minute measurement time to end of 15 minute measurement time**

**5 m start time:** \_\_\_\_\_ **5 m end time:** \_\_\_\_\_

**10 m start time:** \_\_\_\_\_ **10 m end time:** \_\_\_\_\_

**20 m start time:** \_\_\_\_\_ **20 m end time:** \_\_\_\_\_

**30 m start time:** \_\_\_\_\_ **30 m end time:** \_\_\_\_\_

**40 m start time:** \_\_\_\_\_ **40 m end time:** \_\_\_\_\_

**50 m start time:** \_\_\_\_\_ **50 m end time:** \_\_\_\_\_

**60 m start time:** \_\_\_\_\_ **60 m end time:** \_\_\_\_\_

**70 m start time:** \_\_\_\_\_ **70 m end time:** \_\_\_\_\_

**80 m start time:** \_\_\_\_\_ **80 m end time:** \_\_\_\_\_

**85 m start time:** \_\_\_\_\_ **85 m end time:** \_\_\_\_\_

**Stop Time:** \_\_\_\_\_ (same as 85m end time)

## 85-Meter Miros System Tests

**Miros # 1 tstc File name:** \_\_\_\_\_ **Time of Test** \_\_\_\_\_

**Miros # 1 tstd File name:** \_\_\_\_\_ **Time of Test** \_\_\_\_\_

**Miros # 2 tstc File name:** \_\_\_\_\_ **Time of Test** \_\_\_\_\_

**Miros # 2 tstd File name:** \_\_\_\_\_ **Time of Test** \_\_\_\_\_

## **Downward Lowering Test Log Sheet**

**80 m start time:** \_\_\_\_\_

**80 m end time:** \_\_\_\_\_

**70 m start time:** \_\_\_\_\_

**70 m end time:** \_\_\_\_\_

**60 m stop time:** \_\_\_\_\_

**60 m end time:** \_\_\_\_\_

**50 m start time:** \_\_\_\_\_

**50 m end time:** \_\_\_\_\_

**40 m start time:** \_\_\_\_\_

**40 m end time:** \_\_\_\_\_

**30 m start time:** \_\_\_\_\_

**30m end time:** \_\_\_\_\_

**20m start time:** \_\_\_\_\_

**20 m end time:** \_\_\_\_\_

**10 m start time:** \_\_\_\_\_

**10 m end time:** \_\_\_\_\_

**5 m start time:** \_\_\_\_\_

**5 m end time:** \_\_\_\_\_

**End of test time** (time the system is lowered on to the barge):

**Additional Test Notes:**

## Appendix D

### Xpert Software Setup for Miros and LTI Sensors

#### XPERT Software

Using Xterm connect to the system and from the main screen fig. D-1, click on the **FILE TRANSFER** button on the right side.

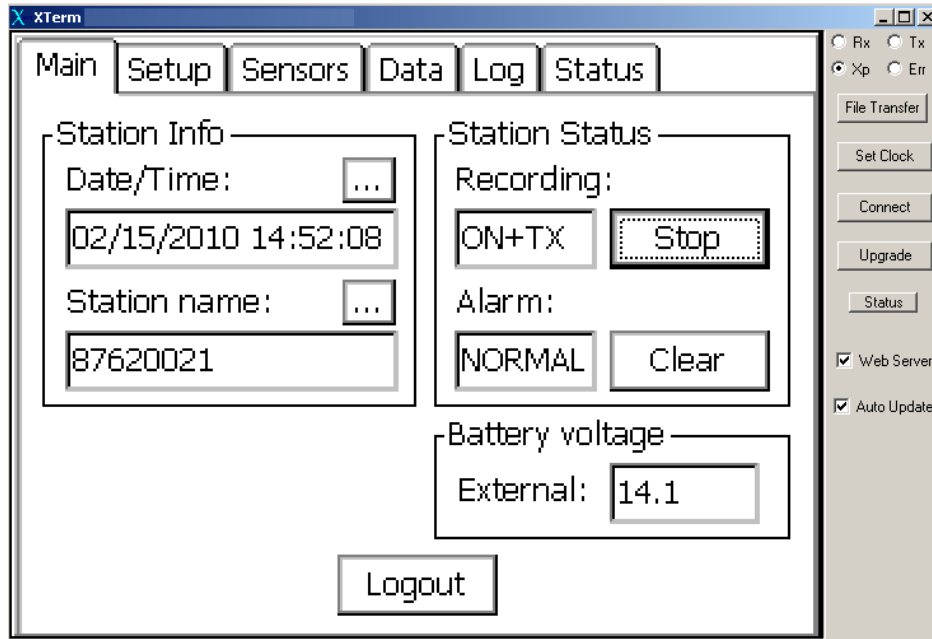
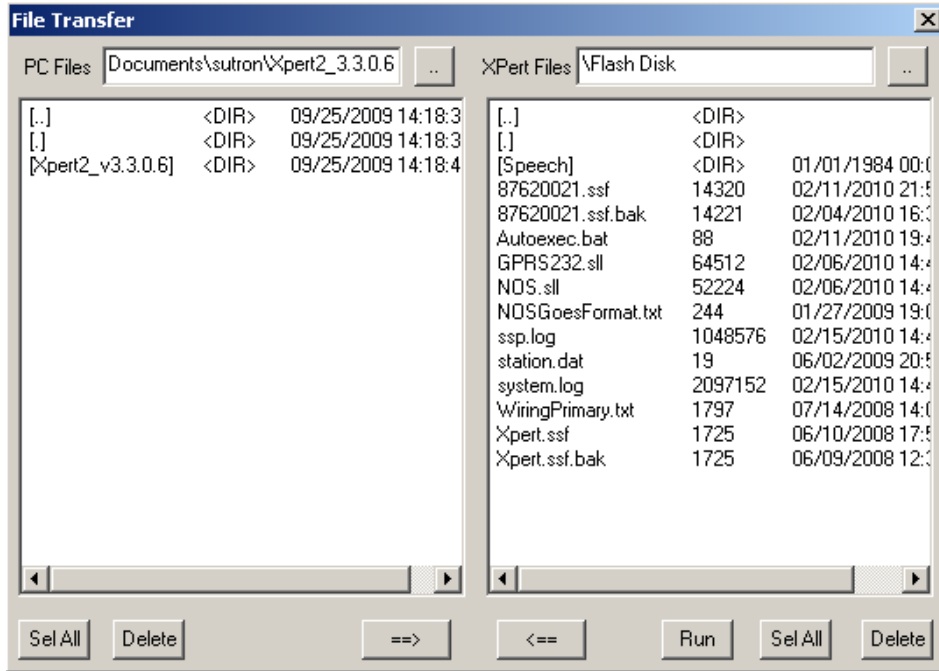


Figure D-1

This will bring up the File Transfer screen (fig. D-2).



**Figure D-2**

You should see the following files on the right side section of the screen:

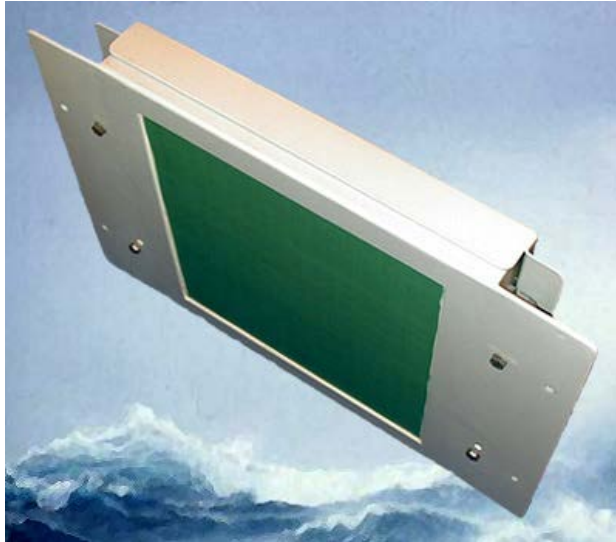
<b>File Name</b>	<b>Function</b>
87620021.ssf	Station setup file. The file name will be the station name for your station and contains all the setup information the DCP needs to set the other files, create log files and set up the Satlink
87620021.ssf.bak	A backup version of the above (87620021.ssf) file.
Autoexec.bat	Sets the COM ports and starts the Xpert software.
GPRS232.sll	RS232 setup file. Sets the port being used to communicate with the Miros and laser sensors. See page C-6 for additional information.
NOS.ssl	Formats the data that is transmitted via GOES and the PORTS tag.
NOSGOES format.txt	Allows the user to set the order of the data being transmitted via GOES and the PORTS tag.
SSP.log	The log that all the data is stored on.
Station.dat	This files stores the station name (number) and sets the screen contrast.
System.log	Logs all system actions including error and warnings. A good troubleshooting tool if a system error is suspected.
WiringPrimary.txt	A list of the wiring connections for the system. Not on all systems.
Xpert.ssf ....	The basic Xpert software. Should only be used when advised by the CIL/SIL.
Xpert.ssg.bak	A backup copy of the above (Xpert.ssf) file.

In older operating systems there was a file called Users.dat. This file contained the users' names, passwords and other information. Due to security concerns this file is no longer stored on the Flash Disk or viewable via Xterm or the command line. It is loaded during system setup and testing. Additional users can be added as before by selecting the USERS section of the Setup menu. For additional information contact the CIL.

## **Miros Air Gap Sensor (Radar)**

### **Sensor description**

The Miros Range Finder is a radar-based water level sensor. Typically the unit is fastened under a bridge deck to measure the distance from the bridge to the water surface. Range Finders are capable of accurately measuring distances up to 85 meters. A typical Range Finder sensor is illustrated in fig. D-3. The sensor head is approximately 2 ft × 2 ft × 4 in.



**Figure D-3**

### **Sensor Installation**

The Miros sensor is installed external to the Tide Station enclosure. Follow installation procedures as recommended by the manufacturer to suspend the sensor head from the bridge structure. Make sure the area within the sensor's cone of measurement is free of obstructions. Extend the serial interface cable from the sensor to RS232 termination card inside the enclosure. Use one of the pre-punched holes in the lower left side of the enclosure to admit the cable. Seal around the cable with an appropriate packing gland or sealing material.

## Sensor Wiring

NOS standard wiring for the Miros microwave sensor is to connect the RS232 termination card to COM 3, as illustrated in fig. D-4.

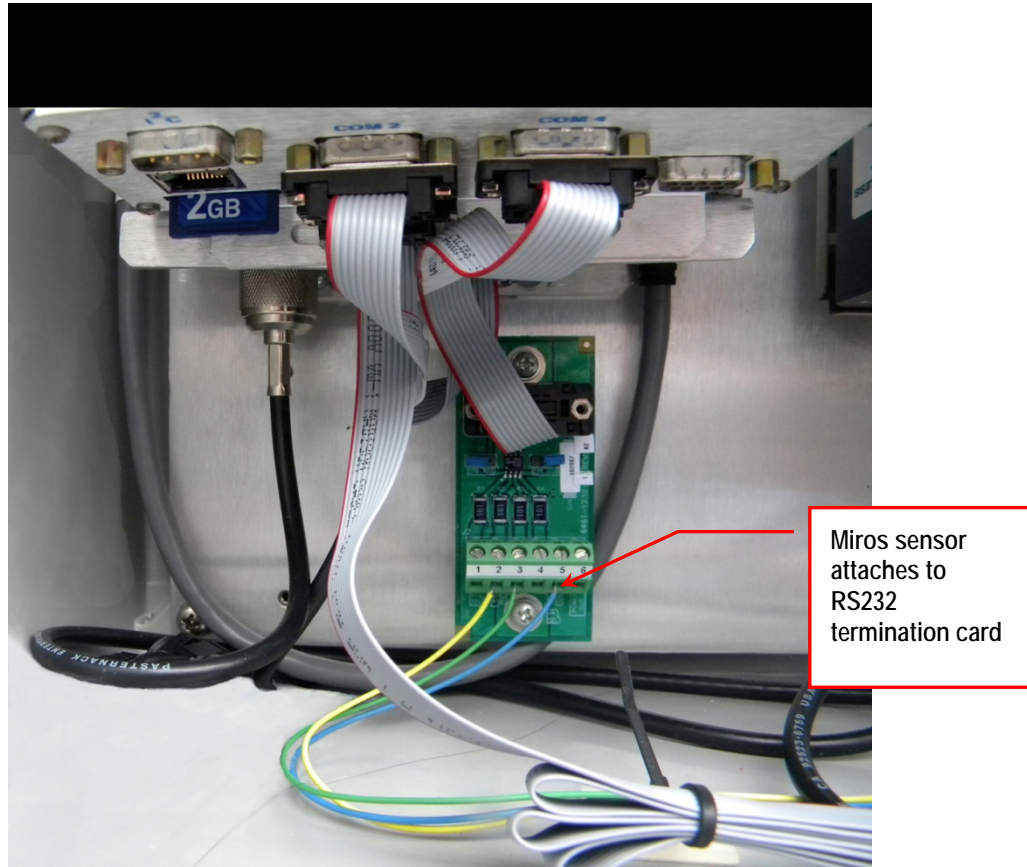


Figure D-4

## Xpert Software Setup

### General Sensor Setup

The Miros sensor uses the GPRS232.ssf, which can be found in the Extra ssf directory that is included with the Xpert OS software and can be copied onto the Xpert's Flash Disk. Figure D-5 illustrates the Miros setup.

The GPRS232 block opens the appropriate serial port and reads data from the sensor. The GPRS232 block is sampled by a DQAP block that performs averaging according to the NOS standard. DQAP does a two-pass average, where the average is computed, outliers are removed (those values over 3 standard deviations from the computed mean), and the average is recomputed. The DQAP block provides four outputs. These outputs are the DQAP average, the standard deviation, the outlier count, and the sample count. The

average, standard deviation, and outlier count are incorporated in the self-timed GOES transmissions.

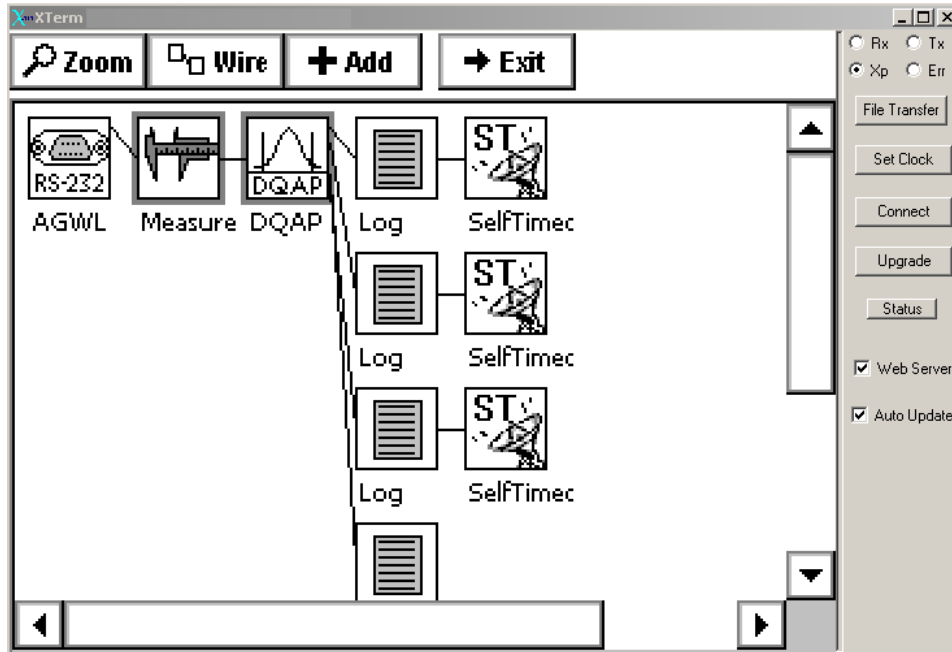


Figure D-5

### Specific Setup Properties

Select the COM port that the sensor is wired to, normally the Miros is connected to COM 3 with a baud rate of 9600, no parity, 8 bits and 1 stop bit. The timeout should be set to 6000. Figure D-6 shows the GPRS232 block setting.

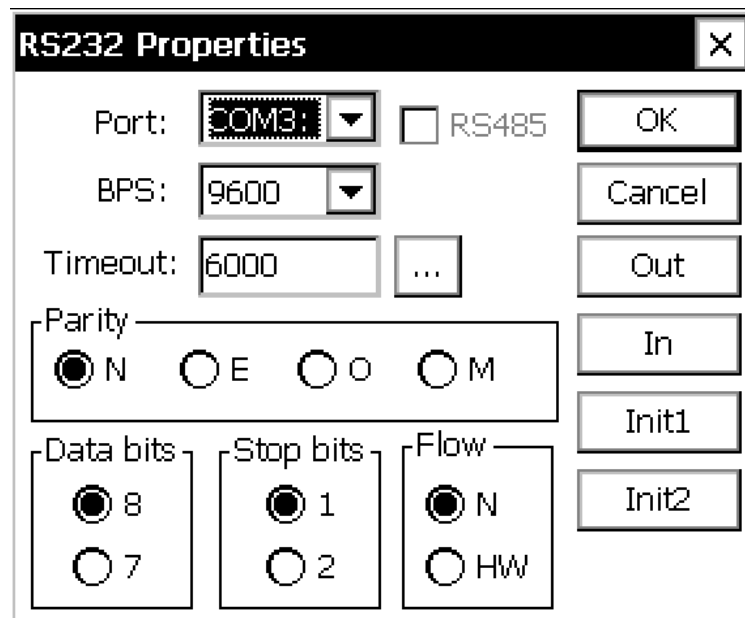


Figure D-6

The GPRS232 block can send custom commands through the selected COM port to the sensor. When the Miros polling command, GV, is sent, the sensor will respond with a reading. Pressing the **OUT** button will bring up the Outbound Message screen and should be set up as shown in fig. D-7. Clicking the **OK** button will save the setting and return you to the RS232 Property screen.

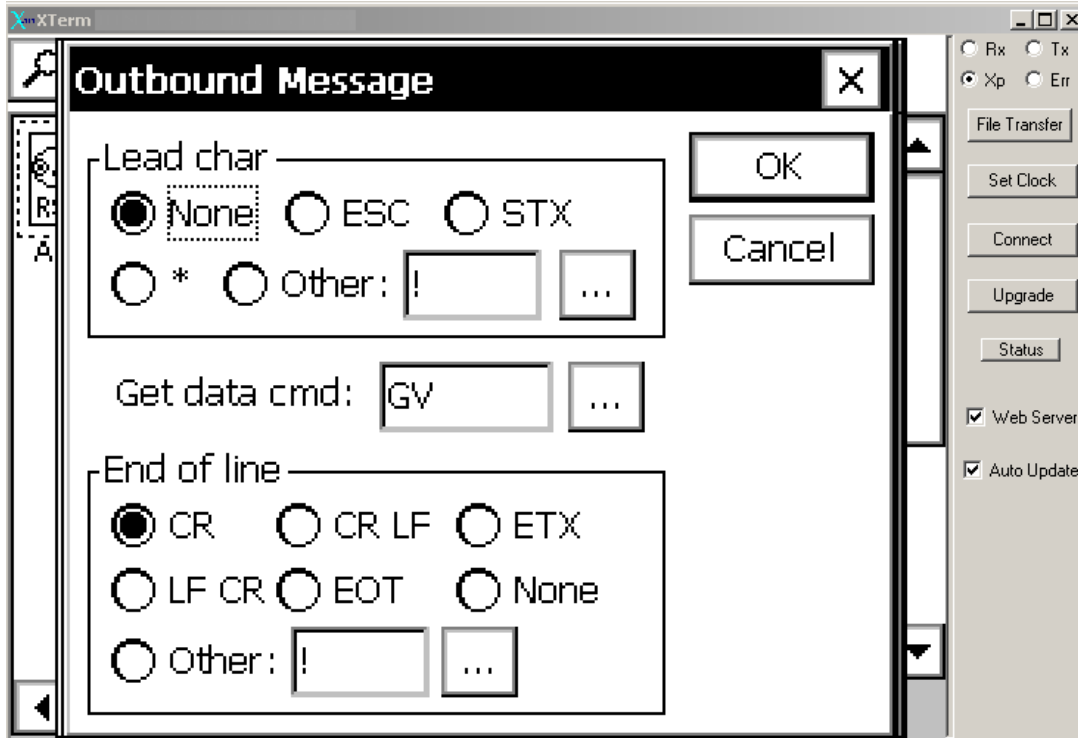
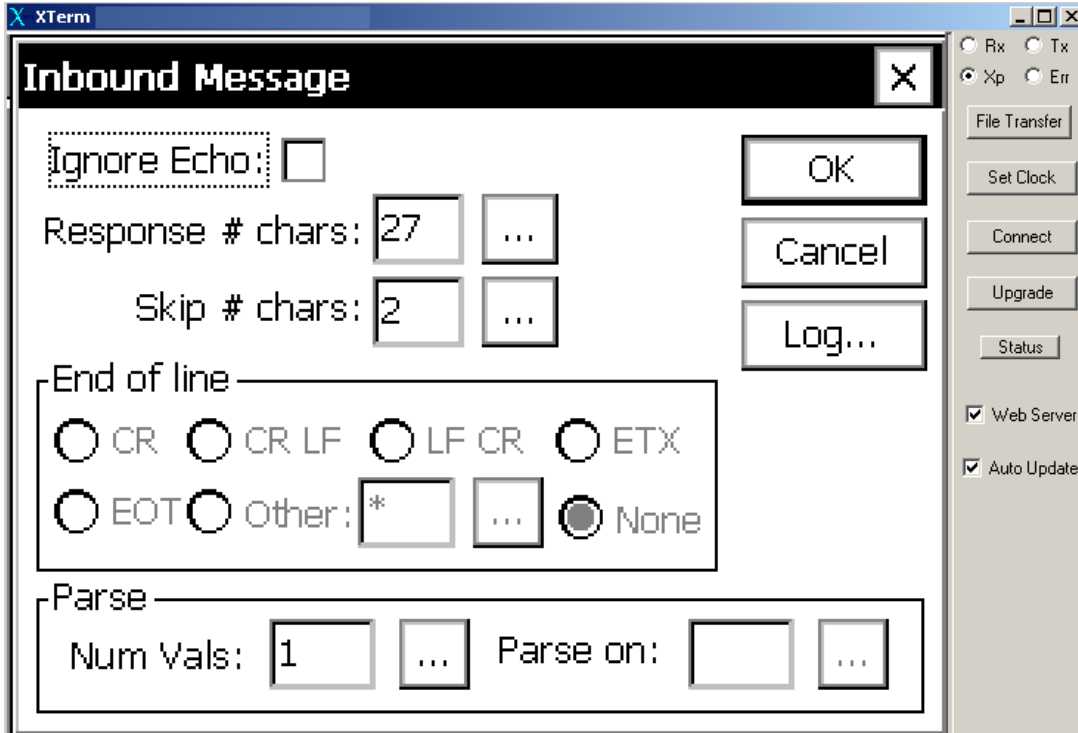


Figure D-7

There is also an Inbound Message portion to the GPRS232 block. Pressing IN on the RS232 Property screen will display the Inbound Message screen. Figure D-8 shows the setups needed for this screen. Please note that these setups are only for the Miros. The GPRS232 block is used in several applications and care should be taken when making changes to this screen. Click the **OK** button to save the setting and return to the RS232 Property screen.



**Figure D-8**

The GPRS232 block can send up to 10 commands to the attached sensor when Recording is started from the Main Xpert screen. Each command is sent with the same End of Line as set in Outbound Message screen in fig. D-9. For the Miros sensor, the command SER0 is sent to set the sensor to the polled mode. Click the **OK** button (fig. D-9) to save the setting and return to the RS232 Property screen.

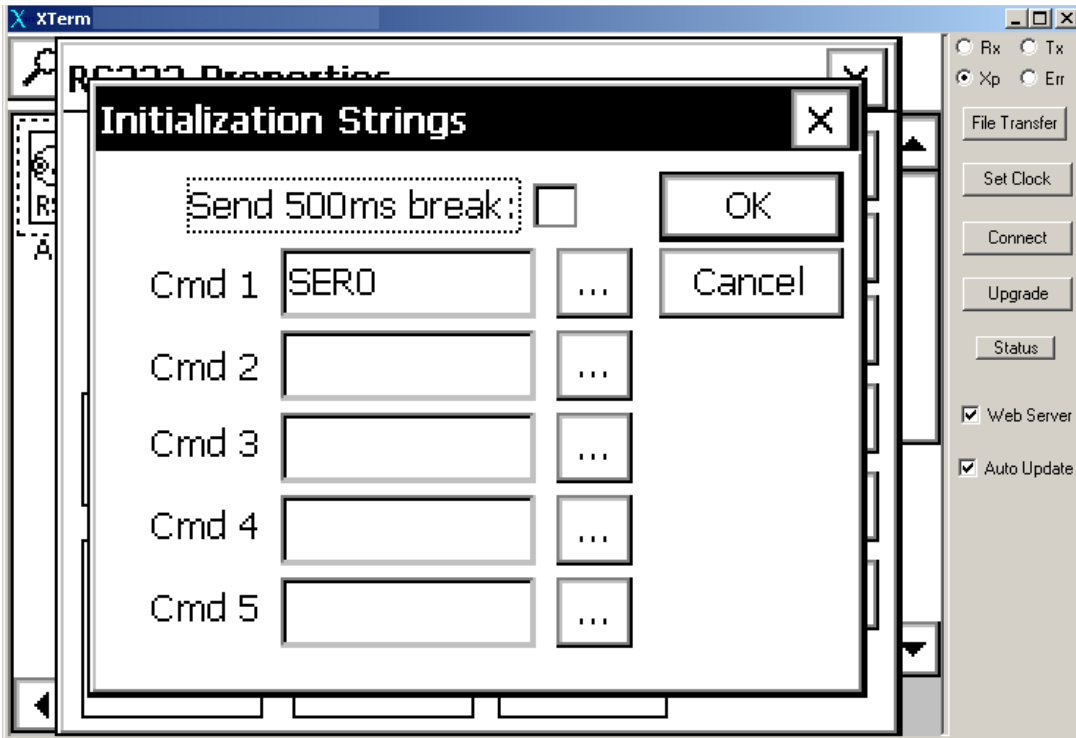


Figure D-9

## **Universal Laser Sensor (ULS)**

### **Sensor Description**

The Laser Technology, Incorporated Universal Laser Sensor (ULS), shown in fig. D-10, is relatively small (see wristwatch on the left in fig. D-10), and boasts a “cooperative target” (highly reflective) range of over one mile. The maximum cooperative target resolution is 1 mm. The sensor is powered by 12Vdc and consumes 170 mA(maximum).



**Figure D-10**

The sensor has serial digital, 4-20 ma and analog outputs. Refer to the Laser Technology Web site, [www.lasertech.com](http://www.lasertech.com) , for additional information and specifications.

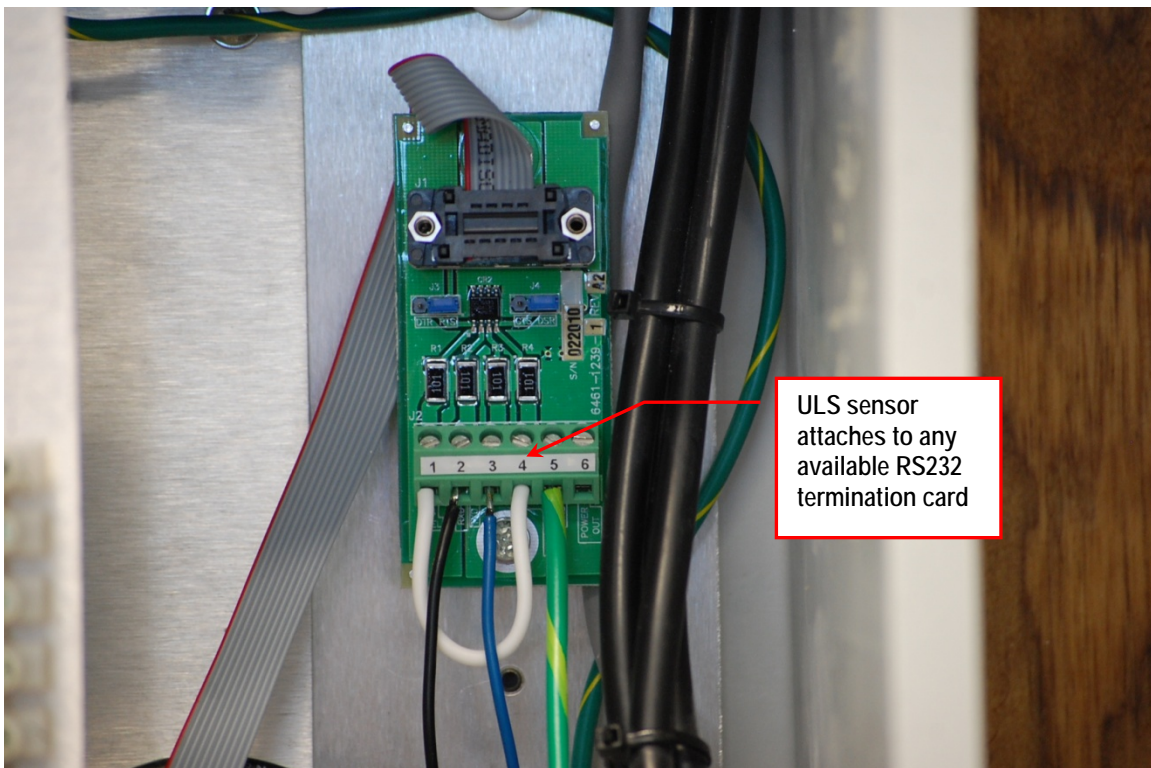
### **Sensor Installation**

The ULS is installed external to the tide station enclosure. The sensor mounts vertically, using #8 screws in the slotted back plate. National Ocean Service incorporates a bubble level on top of the case (left view, fig. D-10) to assist in setting the vertical alignment. The black bracket on the side of the case provides an optional optical sight. The design incorporates a bright red laser pointer that can be used to align the sensor on a specific location or target. The pointer is turned on and off by specific commands issued through the serial interface. Refer to table D-1 (page D-13).

Follow installation procedures as recommended by the manufacturer to suspend the sensor head from the bridge structure. Make sure the area within the sensor's line of sight to the water surface is free of obstructions. Extend the serial interface cable from the sensor to the RS232 termination card inside the enclosure. Use one of the pre-punched holes in the lower left side of the enclosure to admit the cable. Seal around the cable with an appropriate packing gland or sealing material.

### **Sensor Wiring**

NOS standard wiring for the LTI laser sensor is to connect the RS232 termination card to COM 4, as illustrated in fig. D-11.



**Figure D-11**

## **Xpert Software Setup**

### **ULS Setup**

The ULS, unlike a simple analog temperature sensor, is not ready for use directly out of the box. The sensor offers multiple output types, as well as a variety of adjustments and settings to enhance signal performance and flexibility, all of which may or may not be needed.

You can change sensor behavior by issuing commands to the sensor through the RS232 serial configuration port. You may use either a dedicated Microsoft Windows application provided with the sensor or a serial communications program such as Hyperterm or Procomm. A special command is provided to make changes permanent by writing them to the sensor's Flash memory. The serial configuration port is set up for 9600 bps, no parity, 8-bits, and 1 stop bit. (9600, N, 8, 1).

Several ULS parameters are critical for proper operation. Table D-1 lists the critical parameters that **MUST** be checked before a sensor can be deployed. Note that NOS standard practice is to set up the sensor in the lab prior to deployment. Field personnel do not normally need to worry about the sensor settings.

Table D-1

Command	Function	Approved Settings	Notes
\$AB	Average Bounds in Picoseconds	3000	
\$AF	4-20 ma Fault Current Value	xxx	Not used if CL=0
\$AT	Fault Timeout for 4-20 ma Current Loop	xxx	Not used if CL=0
\$AW	Averaging Weight	100	
\$BH	Bin Threshold	64	Not used if MM=1
\$BR	Config Port Baud Rate	9600	
\$BR,1	Output Port Baud Rate	9600	
\$BS	Bin Size	3	Not used if MM=1
\$CE	Cosine	0 off	
\$CG	Check Gate	1	Enable
\$CL	4-20ms Current Loop On/Off	0	Off
\$CO	Continuous Measurement Output Mode	0	Off
\$CT	Current Trip Threshold	30	Not used if MM=1
\$CV	Cosine Value	xxx	Not used if CE=0
\$DD	Dithering	0	Off
\$DM	Display Mode	2	Distance and Intensity
\$DR	Dampening	xxx	Not used if OP=0
\$DS	Dampening	xxx	Not used if OP=0
\$EG	Enable Gate	6	Enables short and long gates
\$FA	First, Last, Most and All	0	First
\$FL	Cooperative Filter	0	Non cooperative target
\$FT	Flyer Trap	0	Not used if MM=1
\$IL	Initial Lock	6000	
\$LA	Detection Mode	0	Not used if MM=1
\$LG	Long Gate	85	Long gate set to 85 meters
\$MA	Measurement Auto Start On/Off	1	On, Sensor is measuring at power up
\$MM	Measurement Mode	1	Set to averaging
\$MO	Measurement Output Port	0	Data outputting to configuration port
\$MP	Minimum Pulse Width Rejection	0	Disabled
\$MU	Measurement Units	1	Output in meters
\$MX	Maximum False Pulses	5	Not used if MM=1
\$OF	Unit Offset	0	No offset entered
\$OP	Output Processing	0	Off

Command	Function	Approved Settings	Notes
\$PA	Pointer Autostart On/Off	0	Off
\$PF	PRF Rate	4,000	
\$PL	Power Level	0	High level
\$PO	Pulses/Measure	4,000	
\$PT	Pointer On/Off	0	Pointer is off
\$SG	Short Gate	40	Short gate set to 40 meters
\$TB	Time Between Events	0	Not used if MM=1
\$TP	Trip Point	0	Not used if MM=1
\$TT	Trip Point Time Out	106ae	Hex value within 25 counts of 106
\$UA	Unit Address	xxx	Not used when in RS232 mode
\$US	Unit Status	7	Read only
\$WT	Windowing Time Out	xxx	Not used if OP=0
\$WV	Windowing Error Range Value	xxx	Not used if OP=0
\$XP	Maximum Pulse Width Rejection	xxx	Not used if OP=0
\$BM	Data Request		Data is send to output port
\$SU	Saves Settings		Save settings
\$ST	Stops the sensor and places it in the command mode.		Set sensor to command mode
\$GO	Starts the sensor. Use \$BM to get data.		Starts the sensor
			A \$ must precede the command to be accepted

Note carefully the settings for Short Gate and Long Gate. These parameters have the potential to prevent the sensor from operating. Make sure that the gate settings match your physical location. Be absolutely sure to save any changes you make to the settings in table D-1 by using the \$SU command.

The PRF and Pulses/Measurement parameters are also critical. These parameters have most likely been set to something else at the factory. Check them and make sure they are correct.

## Xpert Software Setup

The ULS uses the RS232 block, so make sure the GPRS232.sll is loaded on the Xpert Flash Disk.

The RS232 block issues commands to the sensor and reads the serial data from the sensor. The ULS is configured to output two serial values. The first value is the range (distance from the sensor to the water surface), and the second value is the signal intensity.

The ULS block is sampled by a DQAP block that performs averaging according to the NOS standard. DQAP does a two-pass average in which the average is computed, outliers are removed (those values over 3 standard deviations from the computed mean), and the average is recomputed (figs. D-12 and D-13). The DQAP block provides four outputs. These outputs are the DQAP average, the standard deviation, the outlier count, and the sample count. For ULS applications the average, standard deviation, and outlier count are logged.

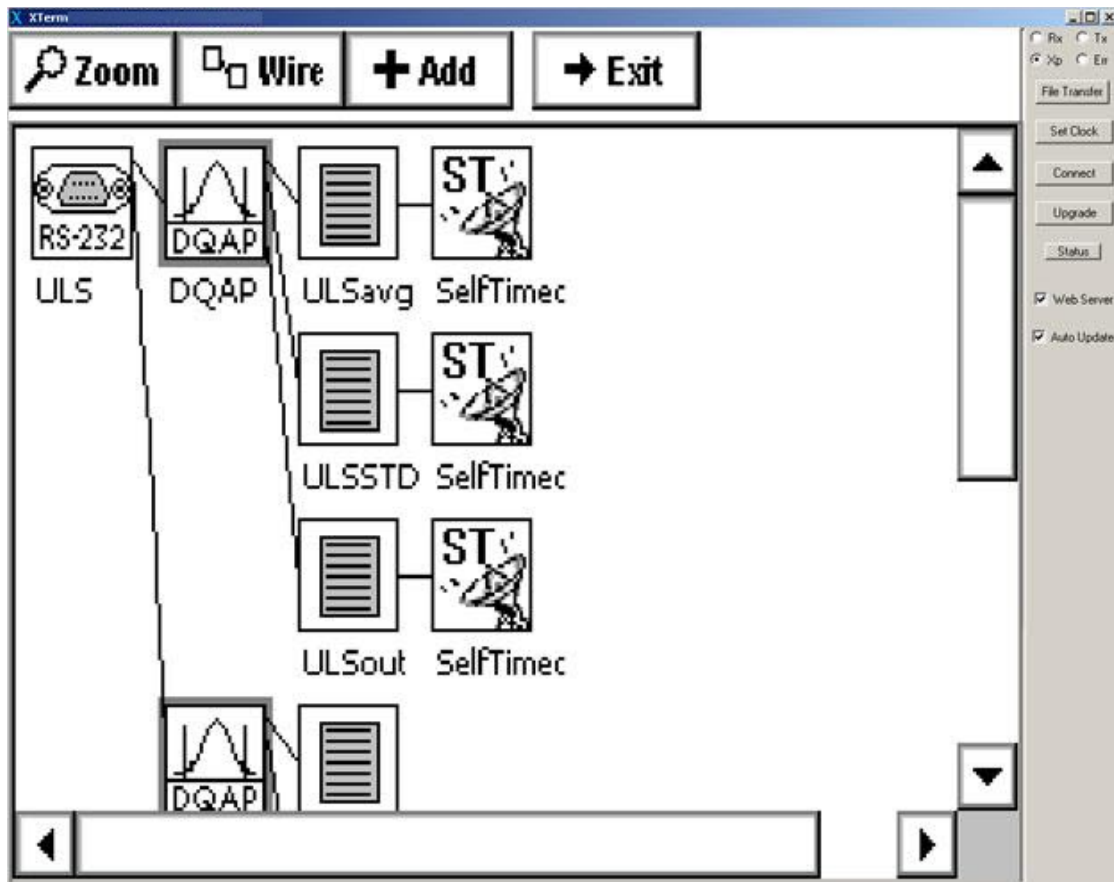


Figure D-12

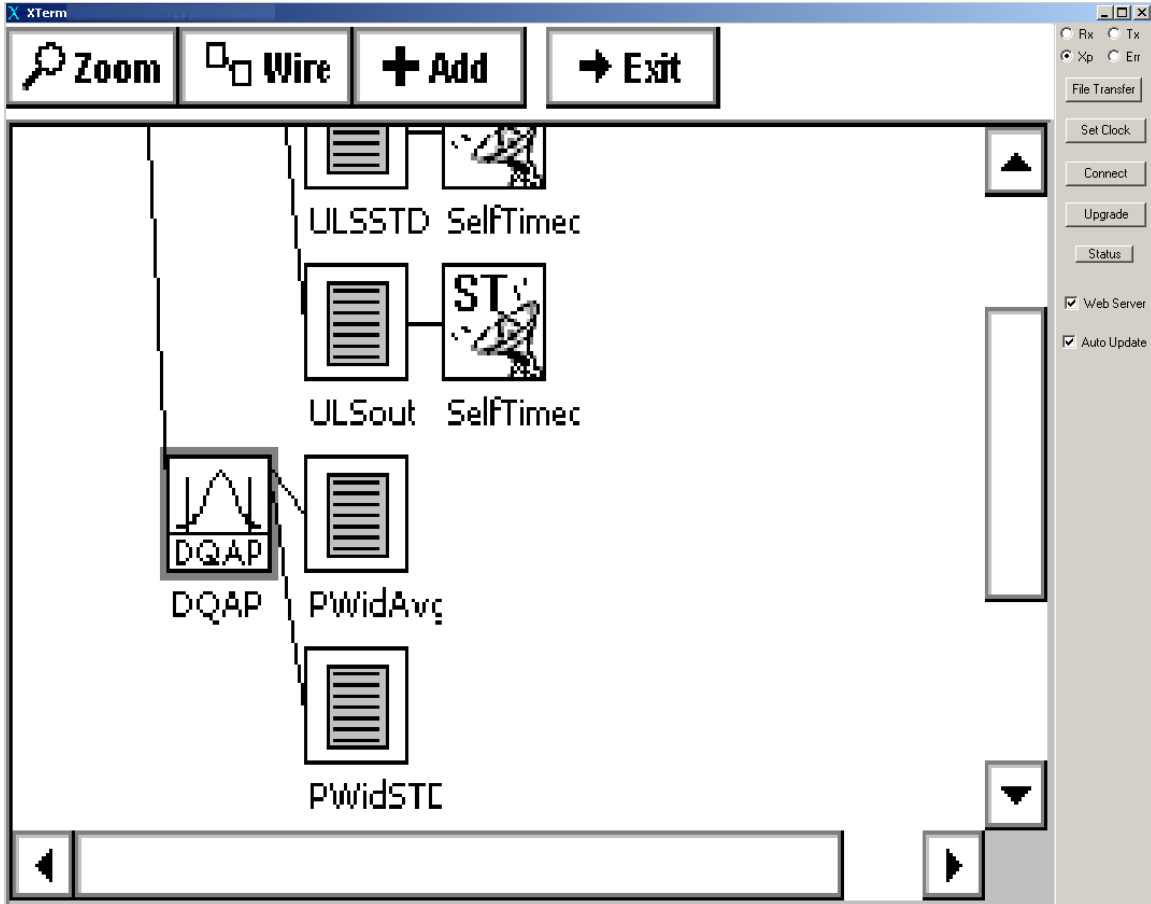


Figure D-13

### Specific Setup Properties

Generally, you should not need to modify the properties provided in the setups. If properties must be modified, they will most likely be associated with the RS232 block settings. The most common change is the serial port that the ULS is connected to. Normally COM 4 is used for the ULS sensor. See the following paragraphs and figures for information about how to change the settings.

NOS standard wiring for the LTI laser sensor is to connect the RS232 termination card to COM 4, as illustrated in fig. D-14.

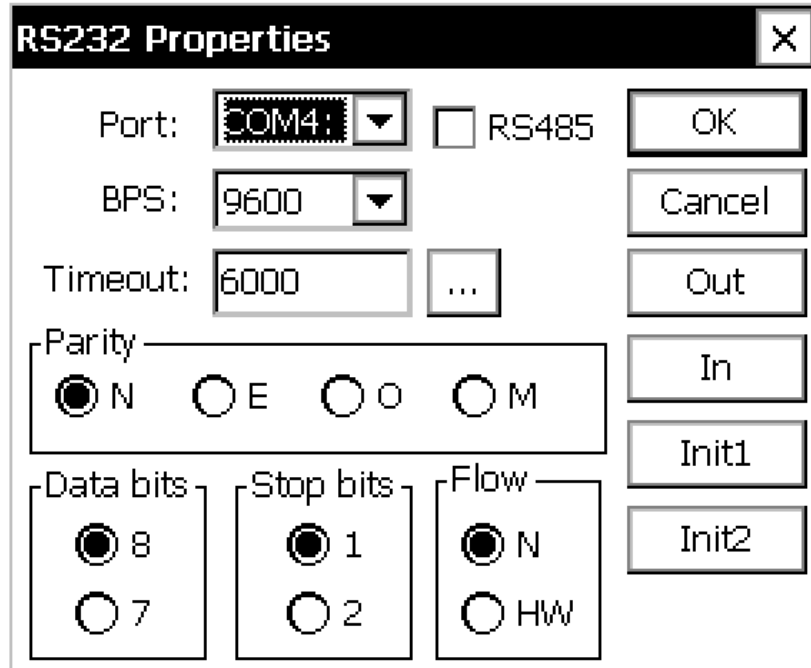


Figure D-14

Figures D-15 and D-16 illustrate the **In and Out** settings for the ULS. The ULS echoes the input command and requires that four (4) characters be skipped. The returned data values are separated by commas. The ULS uses carriage returns (CR) to terminate commands and responses. The **Get Data** command is **\$BM**.

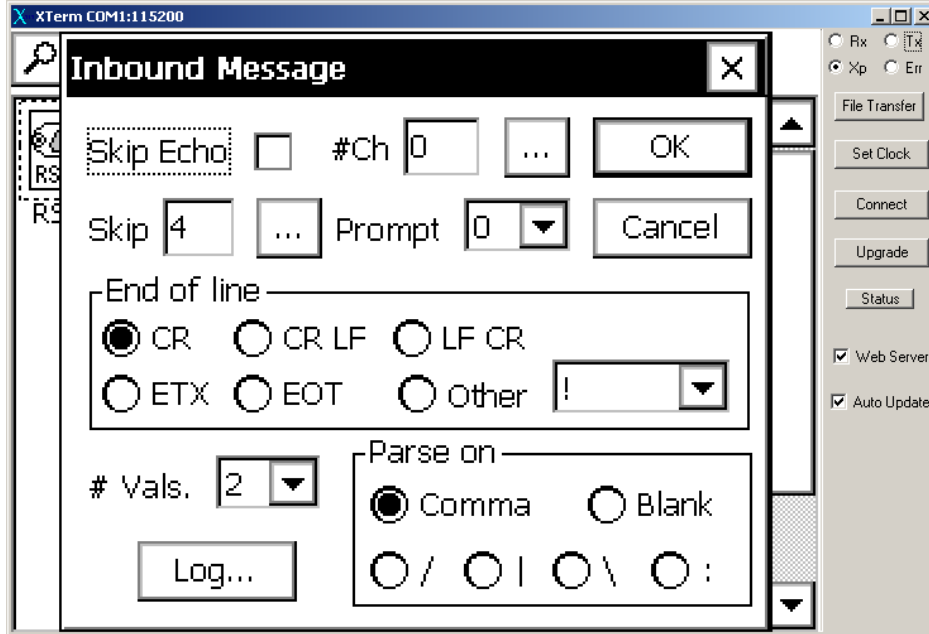


Figure D-15

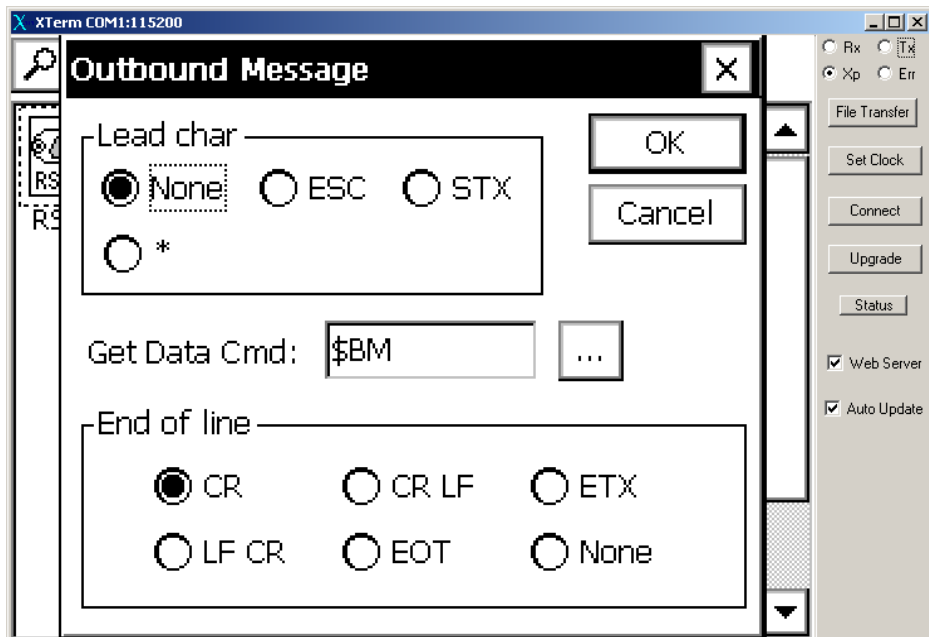


Figure D-16

The RS232 block provides INIT (Initialization) capability for a serial sensor. However, only 10 initialization commands can be issued. The setup includes initialization for the critical parameters listed in table D-2. Examples are shown in figs. D-17 and D-18. For additional information, refer to Table D-1.

**Table D 2**

<b>ULS Parameter</b>	<b>Command</b>	<b>Required Value</b>
Stop	\$ST	
Continuous Operation	\$CO	0
Dithering	\$DD	0
Measurement Mode	\$MM	1
Measurement Units	\$MU	1
PRF Rate	\$PF	4000
Power Level	\$PL	0
Pulses/Measure	\$PO	4000
Saves User Settings	\$SU	
Starts Sensor	\$GO	

Figure D-17 illustrates the Initialization settings incorporated into the RS232 block of the standard setup.

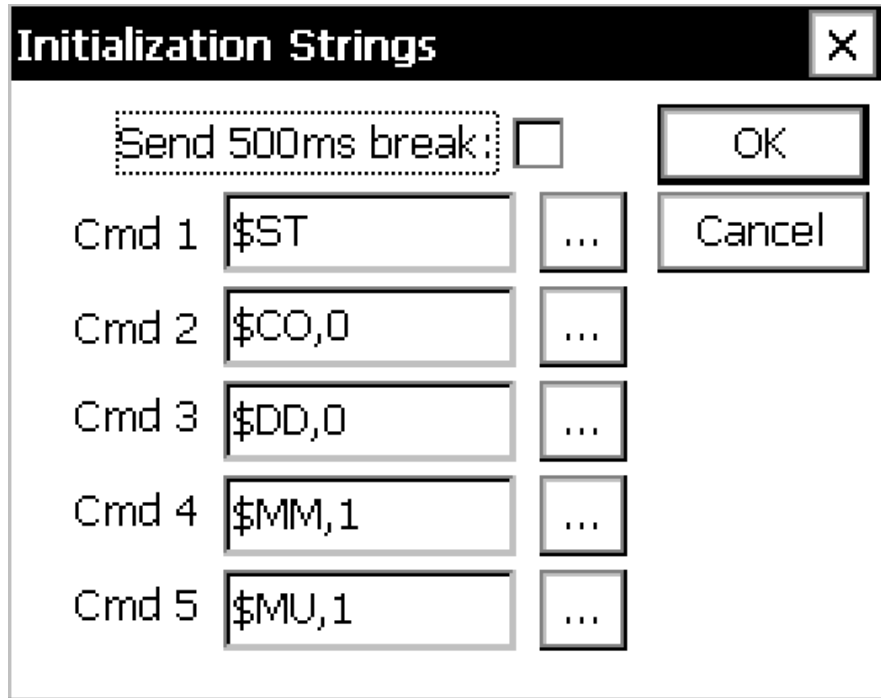


Figure D-17

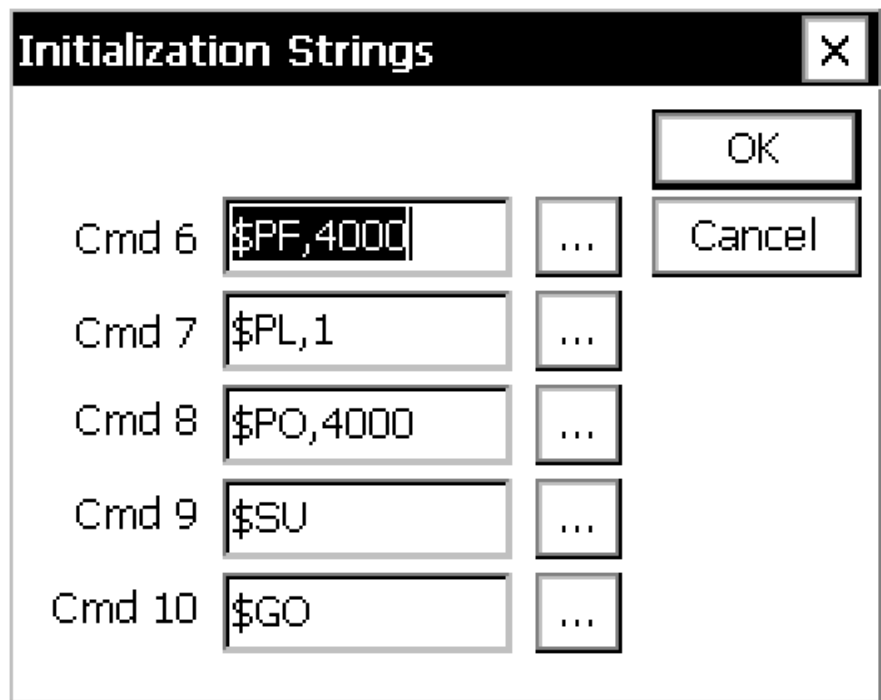


Figure D-18

## Appendix E

### Instructions for Loading GOES Settings into the Xpert DCP

The Satlink is programmed through the DCP by entering the required parameters under the **Setup** tab from the Main screen. You will need the following items:

- A computer or laptop with a RS232 port or a USB-to-serial adapter
- Sutron Xterm software
- GOES setting information

Connect the computer to the DCP via a RS232 cable. Start Xterm and set the system as shown in fig E-1. You may need to change the Com Port if your computer does not have a serial port. Select the correct Com Port for the USB port that has the serial adapter. You will get an error message if an incorrect port is selected.

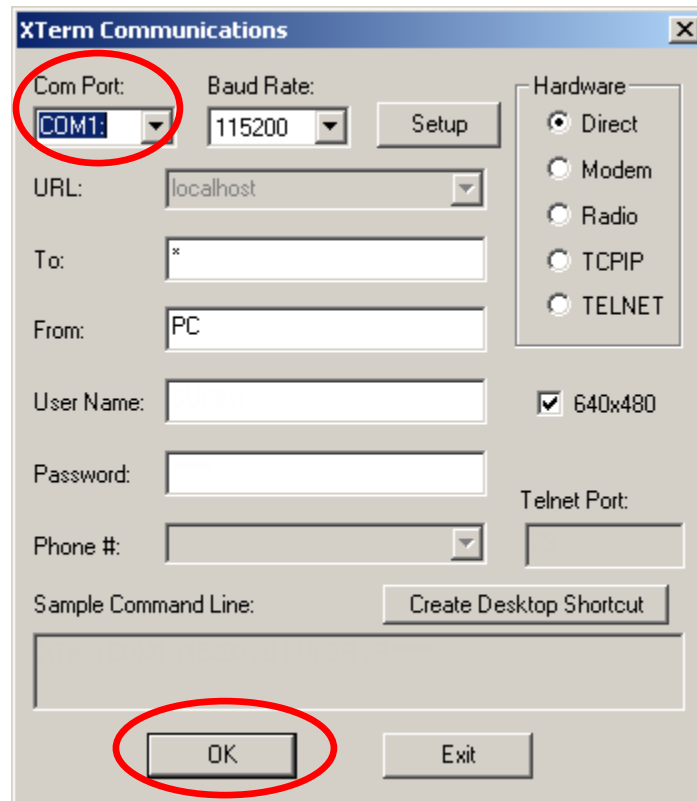
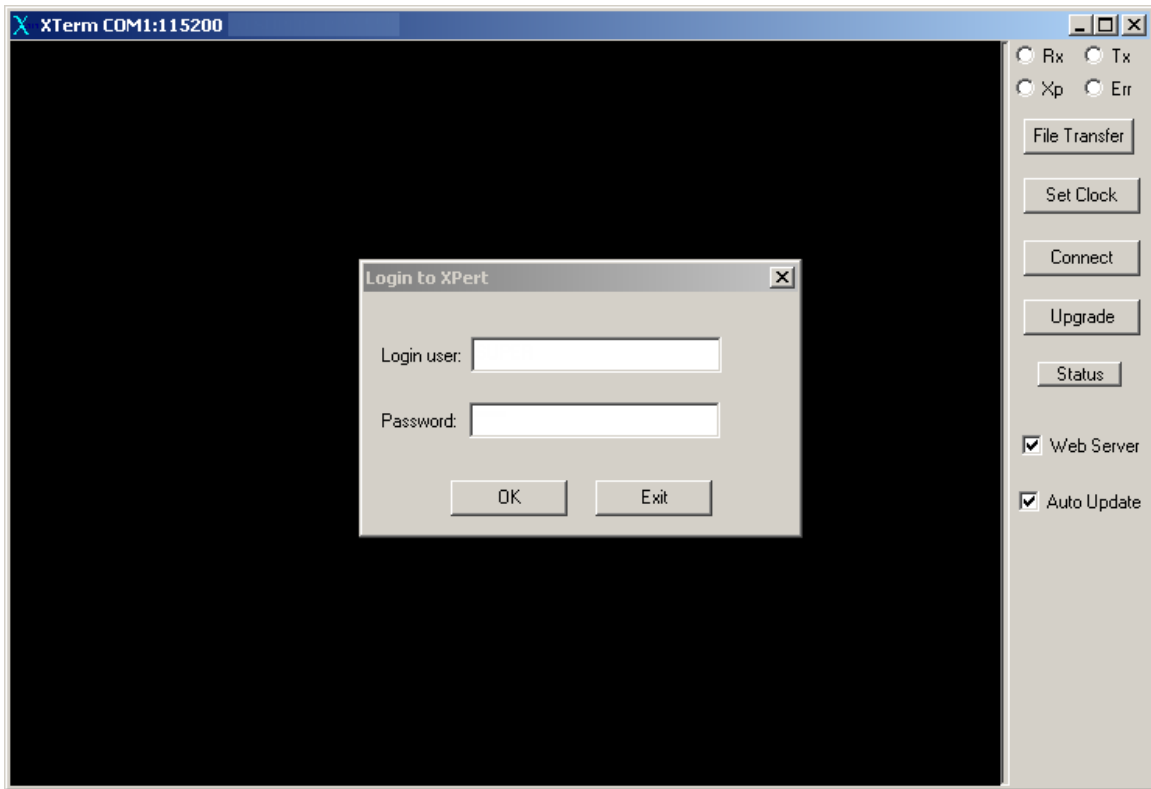


Figure E-3

Click the OK button, and the screen will change as shown in fig. E-2. Click OK to login to the system and then select **Setup Access** (fig. E-3). You may have to change the

password to login. If you have selected the wrong Com Port, you will get an error. Change the Com Port number and try again.



**Figure E-4.**

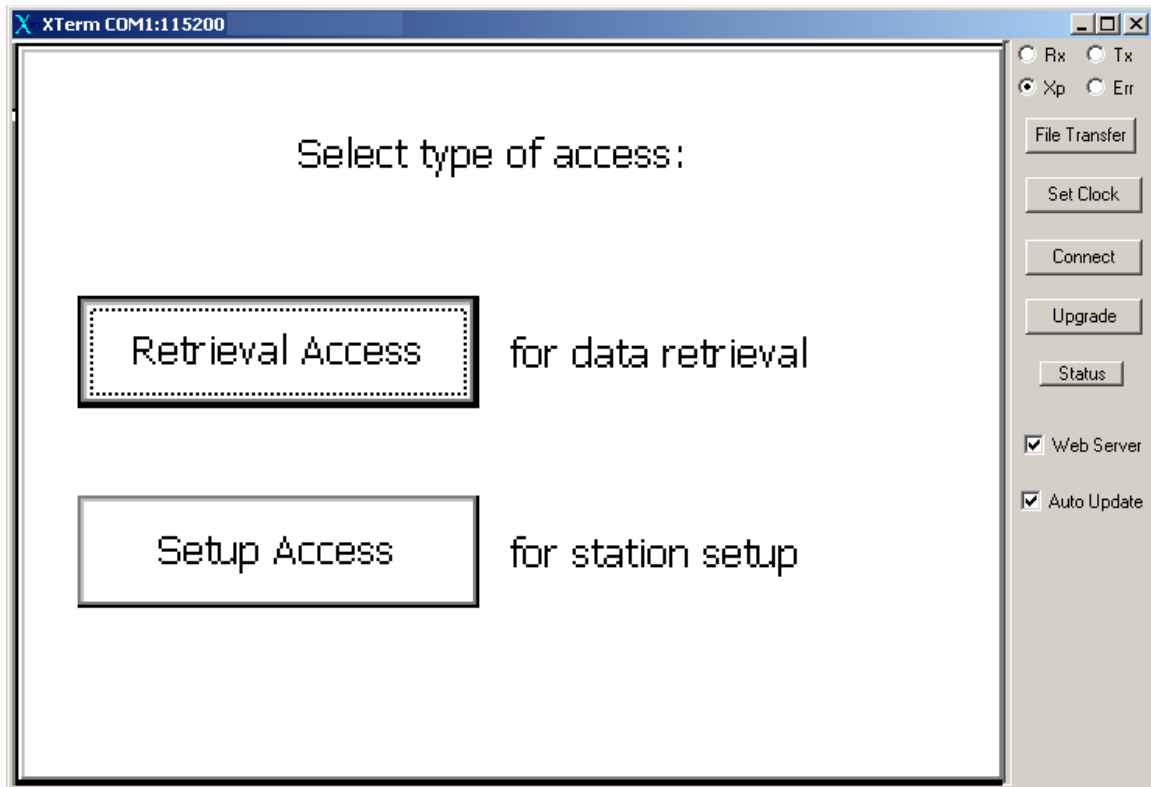


Figure E-5.

Click the **Stop** button to turn off the **Recording**. After the **Recording** has been stopped, click the **Setup** tab as shown in fig.E-4.

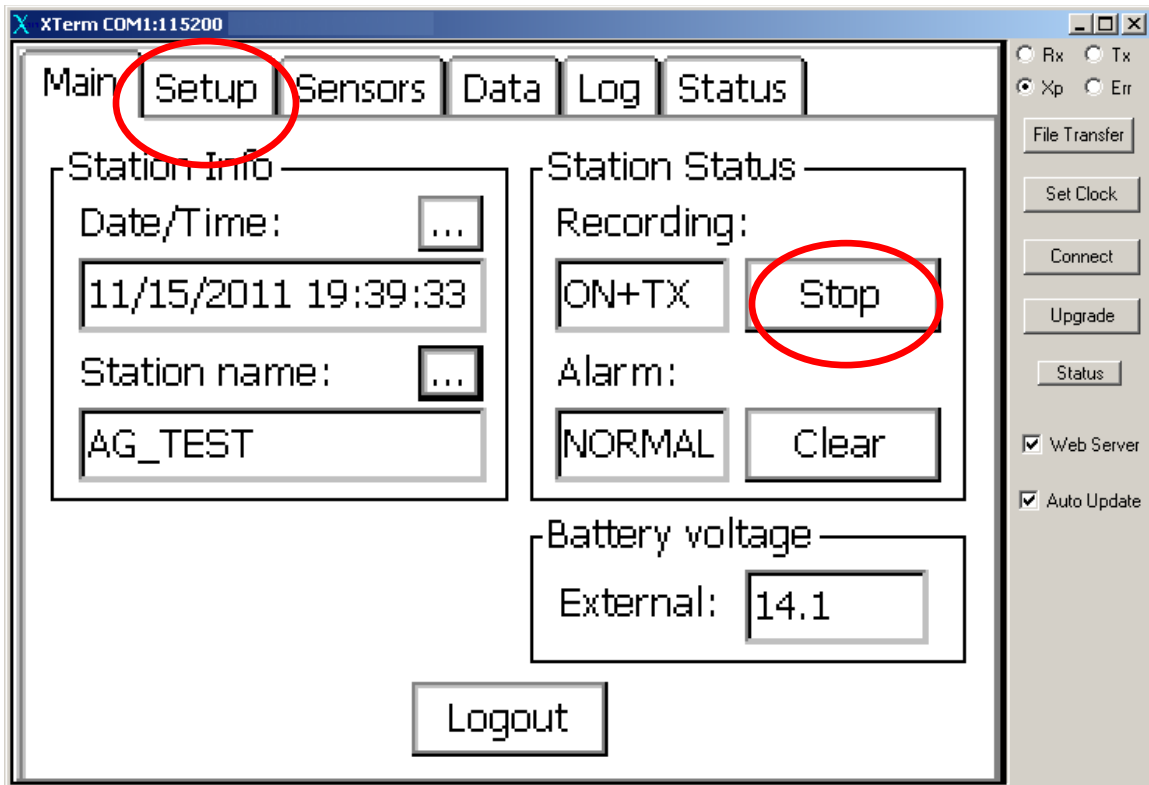


Figure E-6.

Click the + sign next to Satlink (fig. E-5); the line will expand as shown in fig. E-6.

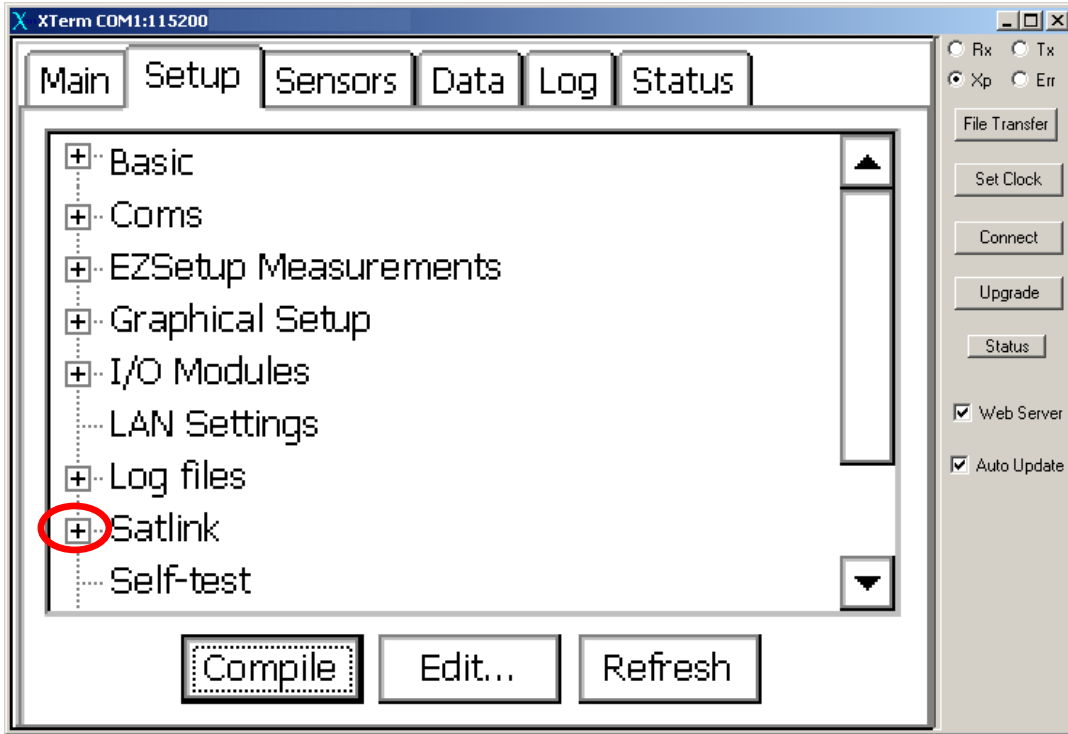


Figure E-7.

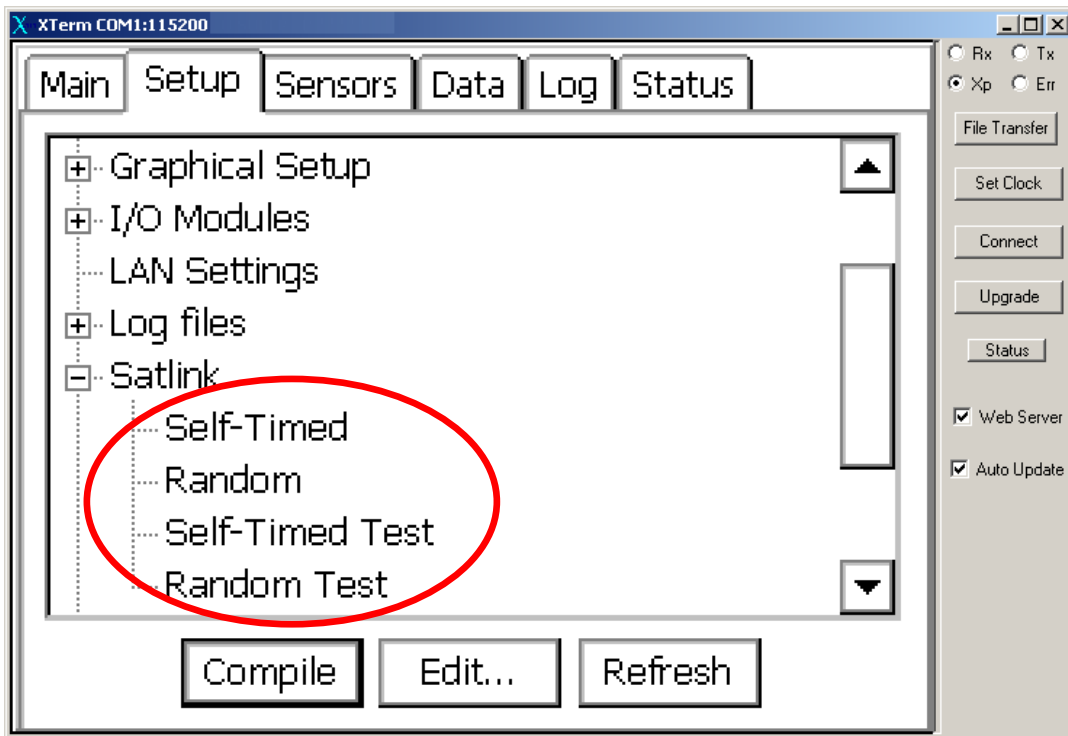
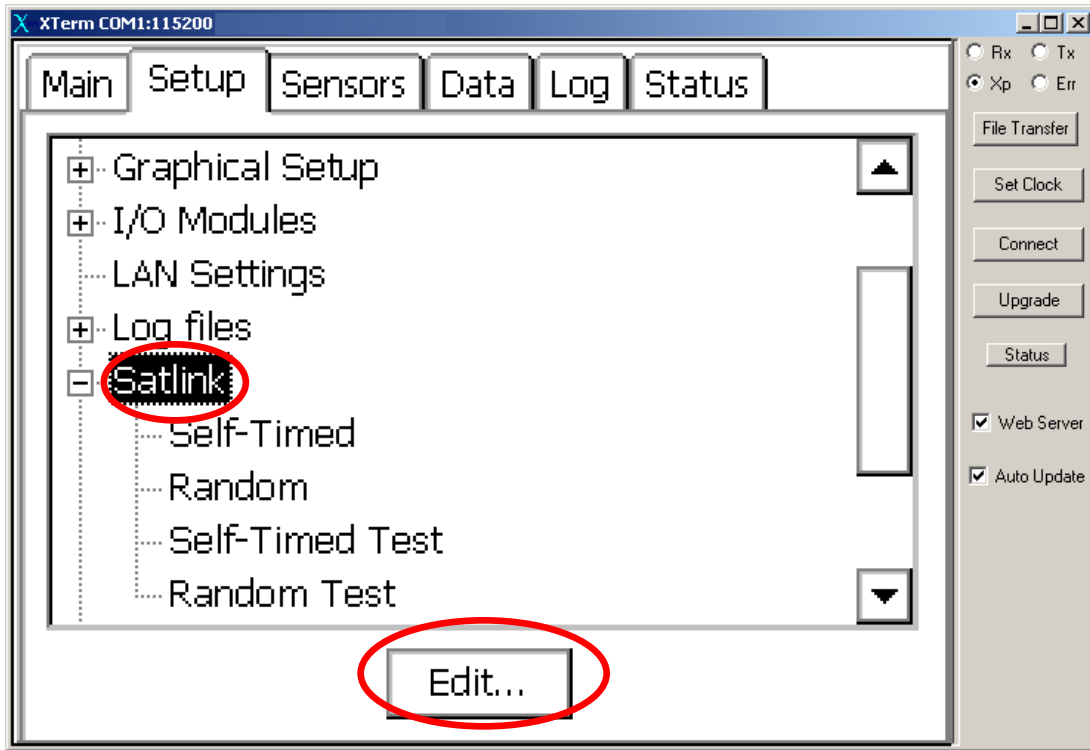


Figure E-8.

Click **Satlink** to highlight it and then click **Edit** as shown in fig. E-7.



**Figure E-9.**

You will now see the **Satlink Properties** screen (fig. E-8). Type in the **Satellite ID number** (this is also called the GOES ID). The Com Port is normally set for COM2; do not change this unless instructed to by the CIL/SIL. The **Local Time Offset** should be set to 0 (zero). Check the **Initialize Satlink** box and click the OK button. The screen will close and bring you back to the **Setup** screen with the expanded **Satlink** line (fig. E-9). Click the + next to **Satlink** if needed.

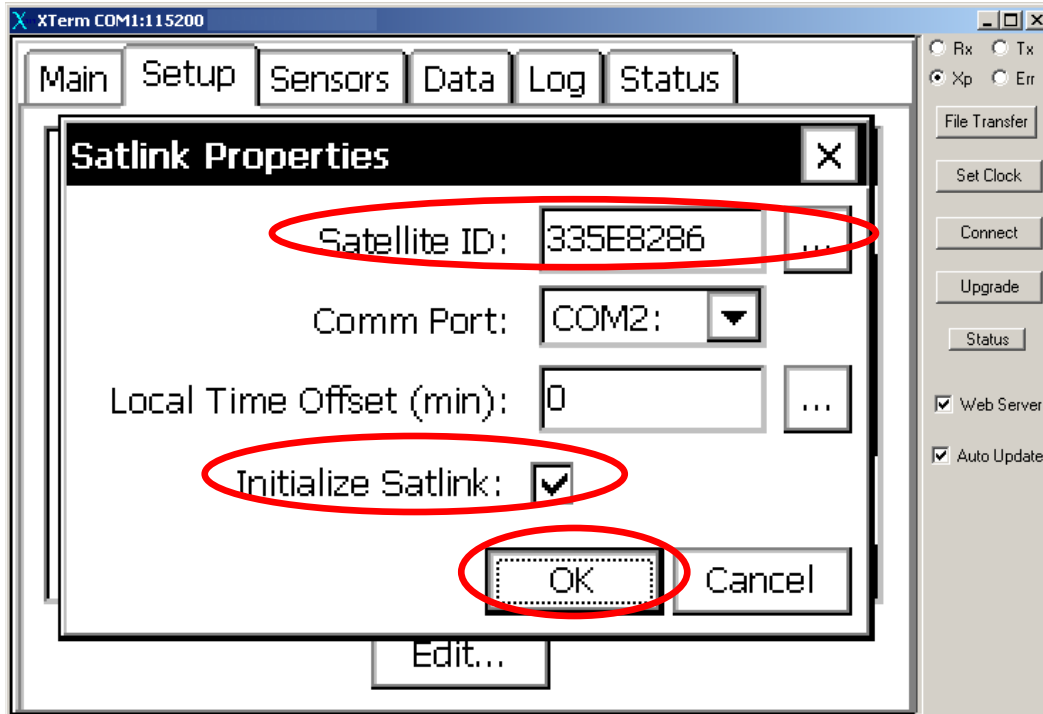


Figure E-10.

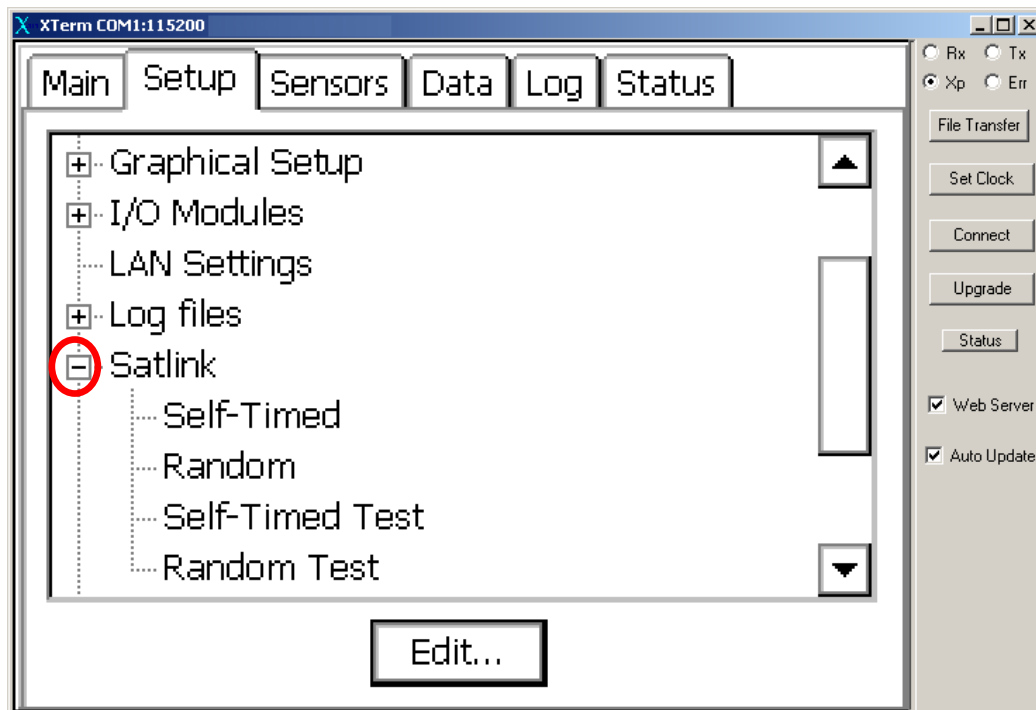
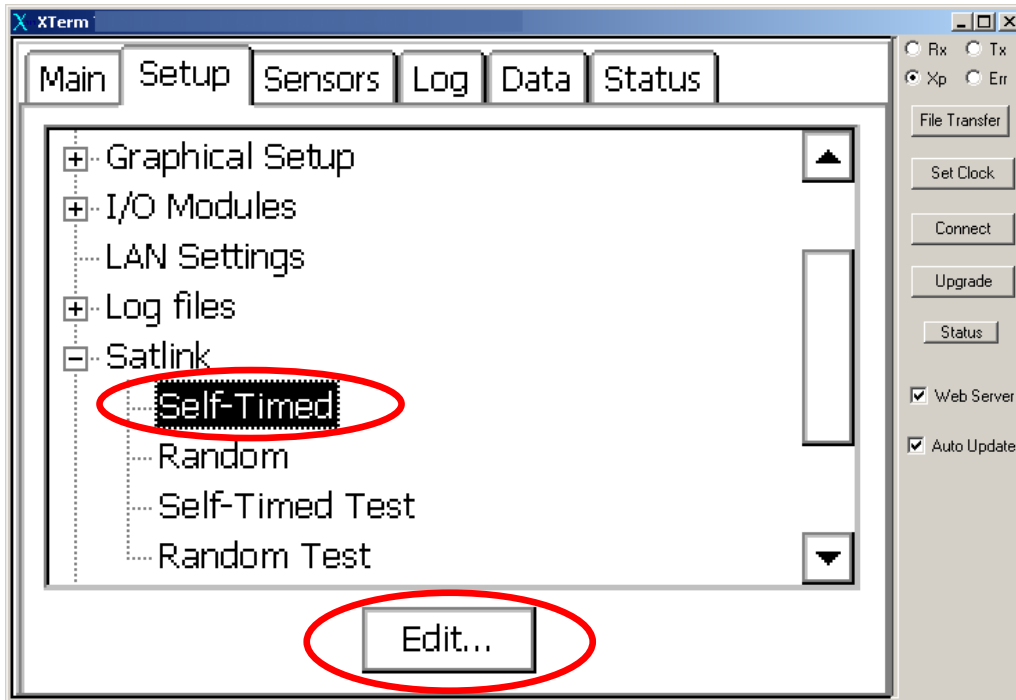


Figure E-11.

Click **Self-Timed** to highlight it and then click the **Edit** button as shown in fig. E-10.



**Figure E-12.**

You will now see the **Self-Timed Properties** screen (fig. E-11). Type in the **Channel** number, transmission time (**Time**), the interval (**Rate**) and the transmission **Window**. Set the **Num Vals** to 1, **Format** to NOS and the **Type** to 300pbs. Click the **Enable Self-Timed** box and then click the OK button. DO NOT click on any other boxes on this screen. The screen will close and bring you back to the **Setup** screen with the expanded **Satlink** line (fig. E-12).

Click the **Main** Tab on the top of the screen, which will bring you back to the **Main** page (fig. E-13). The changes you made were automatically saved when you exited the **Setup** page. Click the **Start** button under **Recording** to begin recording. Log out of the system and close Xterm.

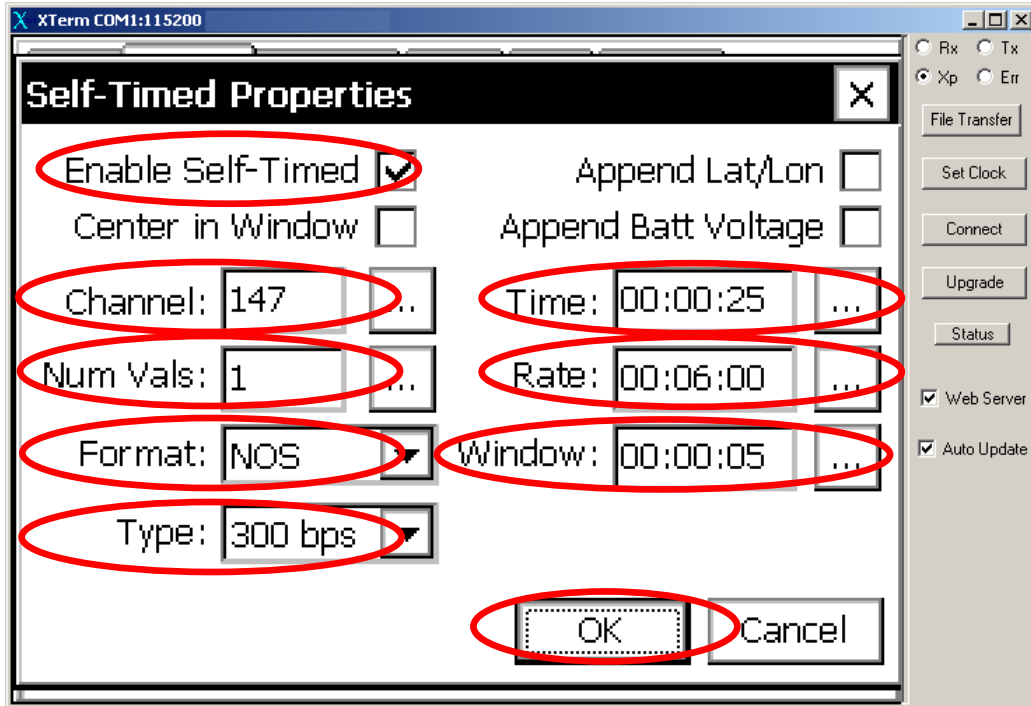


Figure E-13.

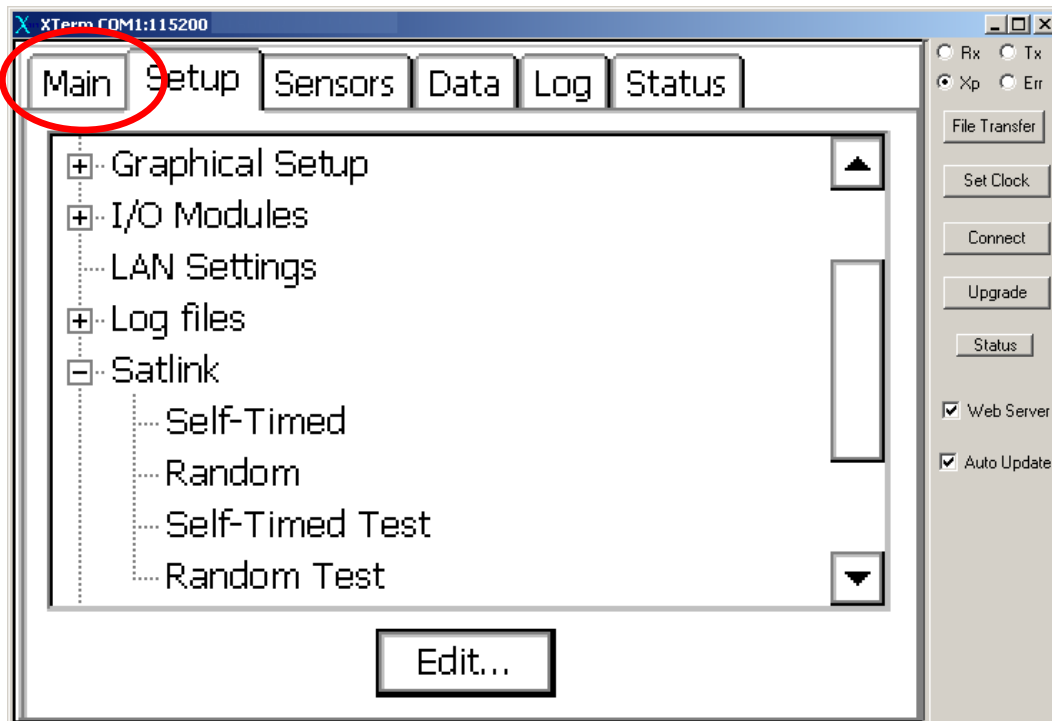


Figure E-14.

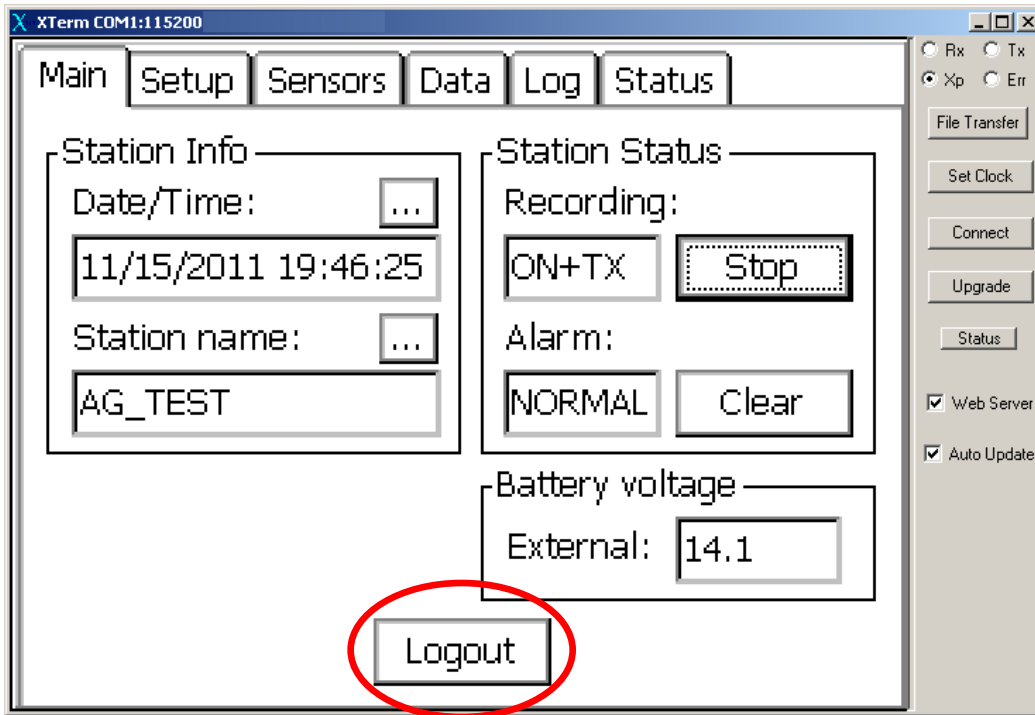
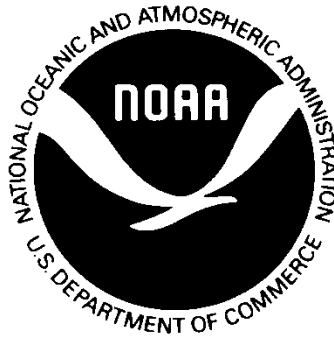


Figure E-15.

## **Appendix F CO-OPS Bridge Clearance Site Reconnaissance Procedures**



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National Ocean Service  
National Oceanic and Atmospheric Administration**

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## **1. Introduction**

The National Ocean Service (NOS), Center for Operational Oceanographic Products and Services (CO-OPS), operates a number of short and long term monitoring systems. CO-OPS provides the infrastructure, science, and technical expertise to monitor, assess, and disseminate coastal oceanographic and Great Lakes products and services necessary to support NOS missions of environmental stewardship, assessment, and prediction; safe navigation; and hazard mitigation.

In order to support the NOS and CO-OPS missions, new bridge clearance stations are regularly required. The best method for assembling the information needed to install these stations is a reconnaissance. The primary objective of the reconnaissance is to determine the optimal location and configuration for data collection platforms (DCP), antennas, sensors, and support components. For a Bridge Clearance station, recovering historic bench marks and scouting locations for setting new bench marks is also essential. The reconnaissance consists of personnel visiting the site sufficiently far in advance of site preparation to:

- Locate an acceptable site.
- Obtain measurements and information necessary to design the station.
- Arrange for any permits/license agreements required.
- Arrange for utilities.
- Prepare a cost estimate and work schedule.
- Allow time for the procurement and fabrication of special support components (if necessary).

If possible, property owners should be contacted in advance to obtain oral or written permission to use or modify the site, otherwise, meet with the property owner as soon as site is visited. An advance letter of permission, permit, security clearance, or some other written instrument may be required by the owner. A license agreement may have to be executed before any work can be done. Even if the site is an existing NWLON station, some advance notice may be required or appreciated by the owner.

Accurate measurements and information is best obtained onsite. The locale can be investigated to determine which particular site will best accommodate the preliminary design and all the other site requirements. Any special installation requirements, such as explosion proof conduit can also be determined through discussions with local authorities.

Once the reconnaissance information is collected and a report issued, the design is finalized, and a cost estimate and installation schedule can be determined.

## **2. Background**

NOS is a Federal agency devoted to exploring, understanding, conserving, and restoring the Nation's coasts and oceans. NOS promotes safe navigation, supports coastal communities, sustains coastal habitats, and mitigates coastal hazards. NOS

balances environmental protection with economic prosperity and leads the effort to ensure that our Nation's coastal areas remain safe, healthy and productive.

CO-OPS establishes standards for the acquisition and processing of water level, bridge clearance and current data; collects and documents user requirements that serve as the foundation for all resulting program activities; designs new and/or improved oceanographic observing systems; develops software to improve data processing capabilities; maintains and operates oceanographic observing systems; performs operational data analysis/quality control; produces/disseminates oceanographic products; and archives the resulting oceanographic data.

A bridge clearance station is a standalone system that collects, stores, and transmits the bridge clearance or air gap from the low steel of a bridge to the water. The primary requirement of a station is to accurately measure bridge clearance information with low power consumption, high reliability, and defined accuracy. The typical station includes a microwave sensor mounted with a clear view of the water, a redundant laser sensor and a data collection platform with Geostationary Operational Environmental Satellite (GOES) transmitter and rechargeable batteries. The station also includes sensors that measure air temperature inside the DCP enclosure and at the microwave sensor. At most locations power is provided by the bridge lighting system; however in some cases solar panels are required. The sensor should be located at the midpoint of the navigation channel or the highest point of the bridge roadway and is determined during the PORTS requirement assessment meetings.

### **3. Bridge Clearance System Equipment**

- DCP with GOES
- DCP enclosure
- Microwave sensor
- Laser sensor
- Sensor and enclosure mounts
- Air Temperature Probes (2)
- Solar Panel (if needed)
- Step Down transformer (if needed)
- GOES antenna
- IP or Radio modem and antenna

### **4. Equipment Needed for Reconnaissance**

The following equipment, forms, and information is needed to perform a complete reconnaissance:

- Digital Camera/Videotape Recorder
- Published Bench Mark Sheet
- NGS Datasheets for area
- Shovel/digging implement
- Metal detector

- Sample License Agreement/Letter of Permission
- Weighted measuring tape
- Wooden measuring tape
- Engineering sketch pad
- Inclinator
- Carpenters level or plumb bob
- Hand-held GPS
- IP modem, battery and antenna
- Hand held Laser
- Compass
- Chart section
- Site Reconnaissance Field Notes form (appendix A)

## **5. Office Information**

After the site has been selected for the installation of the bridge clearance station, the first step is to gather all relevant information. In some cases, the site has an existing or historic water level station nearby and office files can be consulted for much of the information. To find out if an historic water level station exists, consult the Index of Water Level Stations at [http://www.co-ops.nos.noaa.gov/station\\_index\\_map.shtml](http://www.co-ops.nos.noaa.gov/station_index_map.shtml).

Program requirements may also provide some direction. Contact the bridge operator; this could be the local state DOT office or Bridge Authority. Explain the need of the bridge clearance system and its use in safe navigation with the local Port or Pilots group. You may need to provide them with written information on the project before obtaining permission to go on the bridge. Make sure to ask about required safety equipment that is needed for the bridge recon. If the bridge does not have a walkway, a lane closure may be needed. Ask the bridge operator when the next closure is planned and arrange your visit at that time. The system should be installed on the South or West side of the bridge so that there is a clear view of the sky for the GOES and GPS systems as well as the solar panels if needed. Explain to the bridge operator the need to inspect the correct side of the bridge. You may be required to provide a safety vessel during the inspection or pay for the lane closure, the bridge operator should be able to provide the names of companies that can provide these services.

If there is a historical site, assemble as much of the following information as possible:

- Tidal datums and bench mark elevations.
- To Reach statement and bench mark recovery notes.
- Support structure and harbor bottom elevations.
- Support structure plan and sun transit.
- Environmental data.
- Instrument shelter and utilities description.
- GOES transmission information (azimuth and elevation).
- Solar incidence.
- Ancillary sensor(s) requirements.

To Reach statements and bench mark recovery notes are needed to find the historic site and recover as many historic bench marks as possible. This information can be found on the CO-OPS published bench mark sheet web page

<http://tidesandcurrents.noaa.gov/stations.html?type=Bench+Mark+Data+Sheets>.

Datasheets retrieved from the NGS web site are essential for replacing destroyed historic marks and for providing a connection to the North American Vertical Datum of 1988 (NAVD88). The web site is [http://www.ngs.noaa.gov/cgi-bin/ds\\_radius.prl](http://www.ngs.noaa.gov/cgi-bin/ds_radius.prl).

The GOES satellite antenna azimuth and elevation angles are required to select an antenna site free of obstructions that may interfere with the transmission. GOES satellite azimuths are referenced in true degrees. If a compass is used to position the antenna, the local magnetic declination must be applied.

Solar incidence is needed to provide the proper orientation and elevation of the solar panel to provide maximum charging voltage.

Requirements for ancillary sensors should be determined in advance to allow adequate lead time for site preparation configuration and installation.

## **6. Site Visit**

After compiling all information possible in the office, it is time to visit the site. Setup a meeting with the bridge operator and arrange for the safety vessel or other required support.

Record all information on the Site Reconnaissance Field Notes form in appendix A. Ask permission to take pictures of the site.

Following receipt of owner permission, perform the following measurements at the structure:

- Using the laser measure from the man cage or roadway barrier to the water surface
- Time of man cage or roadway barrier to water surface measurement
- Distance from the man cage or roadway barrier to the low steel
- Size of the man cage
- Size of all railing
- Size of roadway barriers
- Distance to power source
- IP Testing. Set up the IP and contact the shop to make a test connection to the unit. The shop will provide you with the RSSI reading which should be recorded on Site Reconnaissance Field Notes form

Record contact information for the following individuals:

- Facility owner
- Local contact – the person who must be notified whenever the station is visited.

Make the following observations:

- Sky clearance in the direction of the GOES antenna and solar panels.
- GPS latitude/longitude of station & bench mark locations. Record position to the thousandths of a second.

Take digital photographs of the following:

- Proposed location of the bridge clearance sensor
- Proposed location of DCP
- Recovered bench marks
  - Bench mark faces
  - At least two distance photos from different directions showing landmarks in the background
  - Locations for new marks

## **7. Documentation**

Submit the following documentation upon completion of the reconnaissance:

- Site Reconnaissance Field Notes
- Bench Mark recovery notes
- All digital photos of the bridge, proposed sensor and DCP locations, and proposed bench mark installation locations if insufficient marks recovered.
- Site view drawing showing proposed sensor and DCP locations; North directional arrow; recovered bench marks; proposed bench mark install location



**National Oceanic and Atmospheric Administration**  
**National Ocean Service**  
**Center for Operational Oceanographic Products and Services**  
**Bridge Clearance**  
**Site Reconnaissance Field Notes**



GENERAL SITE INFORMATION			
Station Number	Station Name	Date	
Project Name	Station Type	Permanent; Temporary; PORTS:	
Site Name	Site Location		
	City	County	State Zip code
How To Reach			
Property Owner: Address: Phone: Cell Phone: Fax:		Local Contact: Address: Phone: Cell Phone: Fax:	
Communications or Agreements Made To Date			Contact dates? Letter, phone or meeting? Details of Discussion? Follow-up needed? MOU or permits needed?
SITE DESCRIPTION		GEOGRAPHIC/OCEANIC DESCRIPTION	
Facility	Public; Private; Accessibility	Geographic & Hydraulic Features	Open Coast; Sheltered Harbor; Bay; Sound; Marsh  Tide Range; Wave Height; Currents
Support Structure	Man cage, open beam, concrete barriers, guard rail with or without a fence. Open or closed bridge structure.	Test Reading	Hand held laser readings and time of readings. Include distance from low steel if known. Location of laser unit
Power	AC, type and voltage Solar, type of mounts	IP Tests	RSSI reading
		Proposed Sensor & DCP Locations	
INSTRUMENTATION		SUPPORT STRUCTURES	
Data Collection Platform To Be Installed		Type Of mount needed	
Sensor(s) To Be Installed		Nearby water level stations (name, station number and distance from site)	

TOOLS/SUPPLIES	
<b>Special Tools or Equipment Required</b>	Boat Generator Welder
<b>Supply List</b>	Lumber Hardware Pipes
<b>Nearby Supplies/Services</b>	
VERTICAL CONTROL/BENCHMARKS	
<b>Level Procedures to be Performed</b>	2nd Order, Class 1 3rd Order, Class 1 Other
<b>Bench Marks (Designation/Stamping/Mark Type/Setting/Stability Code)</b>	# Recovered # to be Installed Estimated length of run Quality of Bench Marks GPS Suitability
SERVICES/UTILITIES	
<b>Telephone Requirements</b>	# of lines required Origination Point Length of run Overhead/trench Estimated cost Type of cable Type of conduit
<b>Telephone Company Info</b>	Name Number Mail Address Contact
<b>Electrical Requirements</b>	# of lines required Origination Point Length of run Overhead/trench Estimated cost Type of cable Type of conduit
<b>Electrical Contractor Info</b>	Name Number Mail Address Contact
<b>Other Contractors Info</b>	Marine Concrete Diving Welding Price quotes received
<b>Additional Information</b>	



## Appendix G Air Gap Tool Kit

<b>Air Gap Tool Kit</b>					
<b>Open/Box Wrenches:</b>	<b>Quantity</b>	<b>Hex Key (Allen wrenches)</b>	<b>Quantity</b>	<b>Pliers:</b>	<b>Quantity</b>
5/16"	2	.050"	2	Diagonal ( wire cutter)	1
3/8"	2	1/16"	1	Long nose	1
7/16"	2	5/64"	1	Slip joint	1
1/2"	2	3/32"		Arc joint (channel lock)	1
7/16"		7/64"		Vice Grips	1
9/16"	2	1/8"			
5/8"	1	9/64"	1	<b>Flat Head Screwdrivers:</b>	
11/16"	2	5/32"	1	1/8"	2
3/4"	1	3/16"	1	1/4"	1
6 mm	1	7/32"		5/16"	1
8 mm	2	1/4"			
10 mm	2	5/16"	1	<b>Phillips Screwdrivers:</b>	
11 mm	2	3/8"	1	#0	2
12 mm	2	2mm	1	#1	1
13 mm	1	2.5mm		#2	1
14 mm	1	3mm	1		
		4mm	1	<b>Crescent Wrenches:</b>	
<b>Sockets:</b>		5mm	1	6"	1
5/16"	1	6mm	1	8"	1
3/8"	1	8mm	1	12"	1
7/16"	1	10mm	1		
1/2"	1		1	<b>Other Items</b>	
7/16"	1	<b>Nut Drivers:</b>	1	Small knife	1
9/16"	1	3/16"	1	Electrical tape	1
5/8"	1	1/4"	1	Splicing tape (note 3)	1
11/16"	1	5/16"	1	Hammer	1
3/4"	1	11/32"	1	Rubber mallet	1
6mm	1	3/8"	1	Wire stripper	1
8mm	1	1/2"	1	Ty-Raps (small, med.large)	30 ea
10mm	1	5mm	1	Tape measure	1
11mm	1	6mm	1	Electronic hand level (note 1)	1
12mm	1	7mm	1	Volt meter	1
13mm	1	8mm	1	Liquid wrench (small can)	1
14mm	1	9mm	1	Markers	2
		10mm	1	DeWalt Kit (note2)	1
		11mm	1	Wire terminal crimp tool	1
		12mm	1	Assorted wire terminal crimps	1set
				Coax cable crimp tool kit (note 4)	1
				Gas powered soldering pencil ( note 5)	1
				Assorted fuses 1,3,5,8 amps	1kit
<b>Notes</b>					
1- Craftman 10 or 24 " Digital Laser Trac Level					
2- Battery powered drill, saw kits					
3- Scotch 3M 130C tape					
4- Hanlong Industrail HT-330K					
5- Weller Portasol Series					



## **Appendix H**

### **DCP Modifications Required for Air Gap Systems**

The data collection platform (DCP) used in air gap applications is based on the NOS Hydro platform with the following hardware modifications:

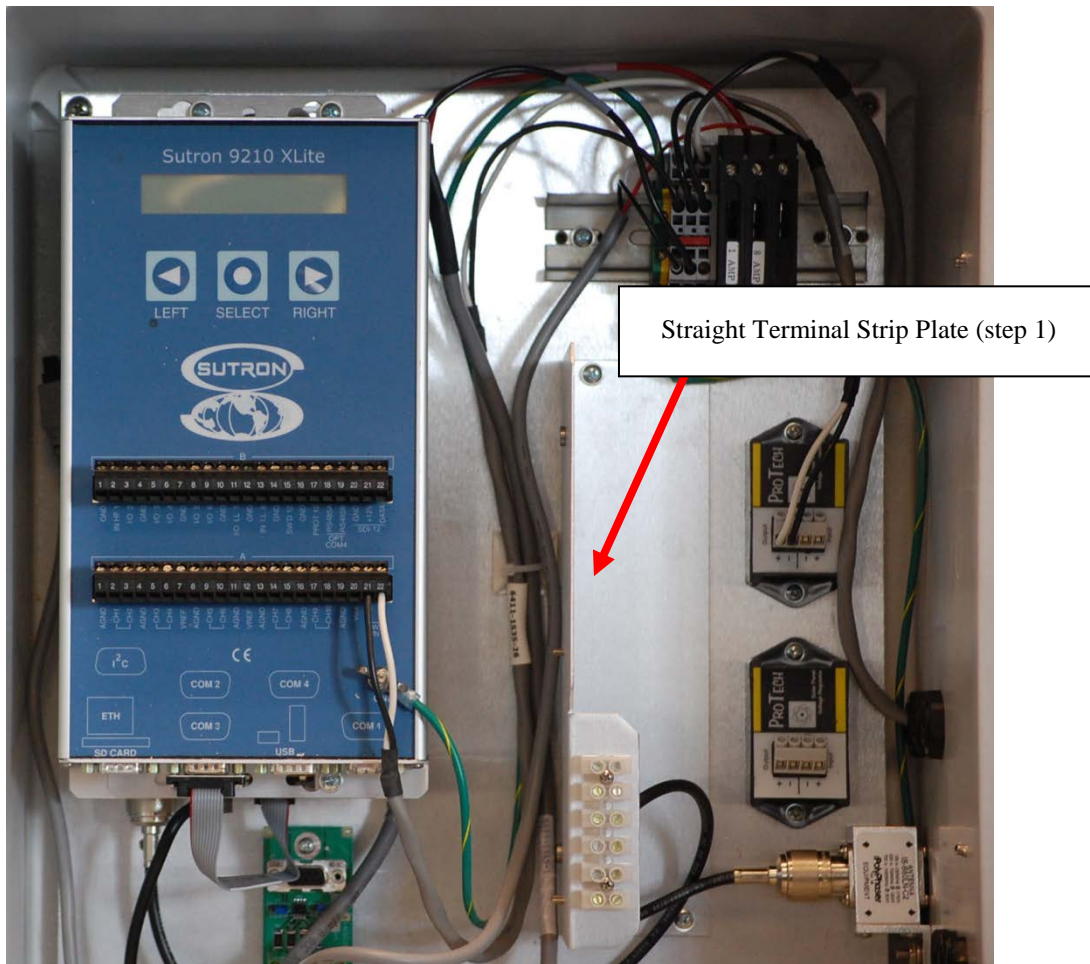
- Additional fuse holders for the microwave and laser sensors
- A second terminal strip used by the laser sensor for power and communications
- A second PolyPhaser used by the IP modem to provide static and lightning protection

The following parts are needed to make the required modifications:

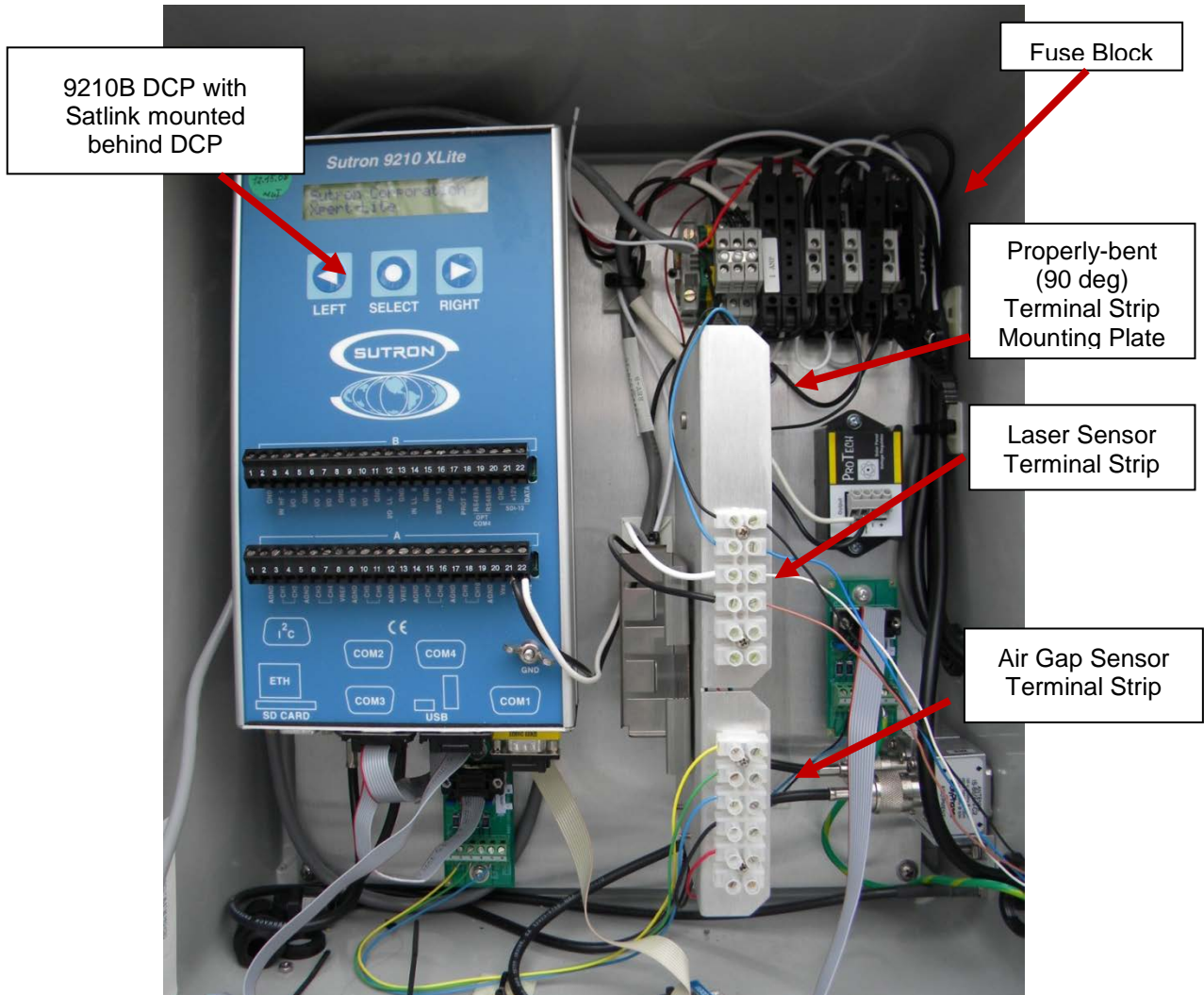
- Fuse holders - AB 1492-H \
- Connection blocks
- DIN railing (may not be needed if the existing rail is long enough)
- Assorted insulated hookup wire
- Battery-to-fuse cable - Belden #M8471
- Fuses (2 A)
- Terminal strip
- PolyPhaser model - IS-B50LN-C2

### **Terminal Strip Plate Modifications**

1. Remove the existing terminal strip plate, (see fig. G-1) and remove the terminal strip so it does not get damaged during the modification.
2. Bend the upper section of the plate so it matches the existing bent portion as shown in fig. G-2.
3. Drill holes as required to mount the second terminal strip.
4. Remount the original terminal strip.
5. Reinstall the terminal strip plate.



**Figure H-1**

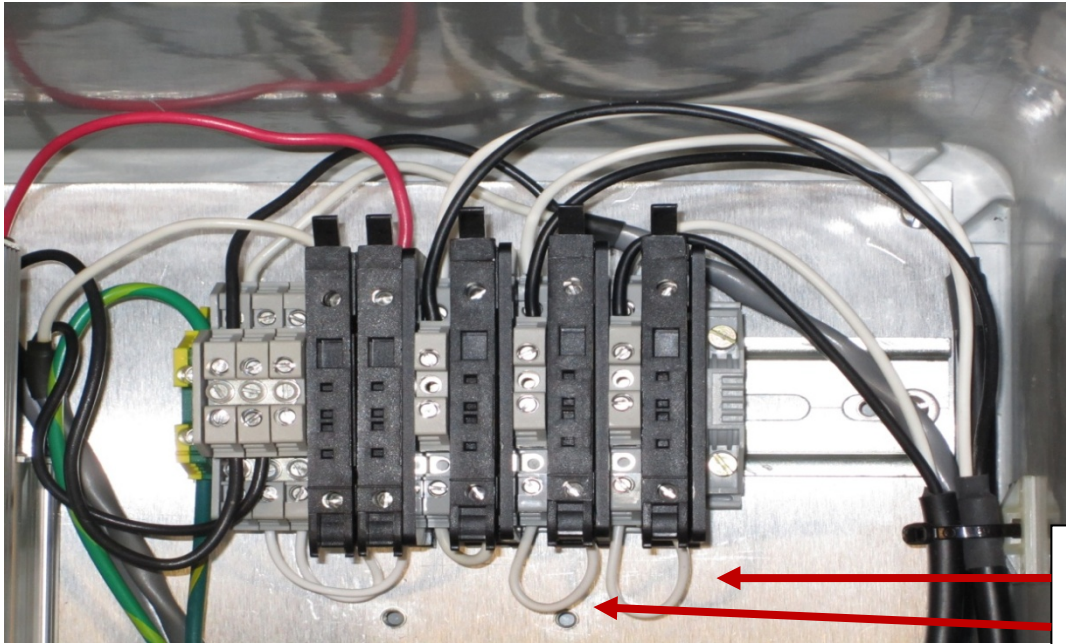


**Figure H-2**

**Fuse Block Modifications**

1. Disconnect the ground wires on the fuse block, as well as those that come from the solar regulator, DCP, and Satlink. Mark each cable as to its location so it can be properly connected in step 14. Do not remove the white connecting wires that run from the fuse holders to the connection blocks at this time.
2. Remove the fuse block and DIN rail from the backing board. Depending on when the system was built, there are 2 or 3 screws holding the DIN rail to the backing board. There is a screw on each end of the rail and one under a fuse holder in the middle of the block. Loosen the end blocks and carefully slide them and the fuse holders to one side to access the third screw. Mark the location of the screw on the edge of the DIN rail.

3. Remove the end block on the right side. Remove the white wire from the first fuse holder on the right, and then remove this fuse holder.
4. Move the remaining end block and fuse holders to the far left side of the DIN rail. Tighten the end block screws.
5. Slide a new connection block on the rail from the right side. Push the block so it is snug against the existing fuse holder but does not block the space required to insert the middle screw.
6. Slide the fuse holder you just removed on the rail from the right side. Push the holder so it is snug against the connection block you just installed but does not block the space required to insert the middle screw.
7. Reconnect the white wire you removed in step 3 to the bottom connection of the new fuse holder. If needed, replace this wire with a longer one.
8. Repeat steps 5 and 6 for the two other connection blocks and fuse holders.
9. Reinsert the end block removed in step 3 so the package looks the same as in fig G-3.
10. Remount the package using the screws removed in step 2.
11. Push back the fuse holders; connection blocks, and end block so all parts are tight against each other. Tighten down the end block screws.
12. Add white hookup wire from the bottom connection of each fuse holder to the connection block just to the left as shown in fig. G-3 and fig. G-4 (power wiring).
13. Using the Battery-to-Fuse cable (Belden #M8471), wire the fuses for the IP and sensors as shown in fig. G-3 and fig. G-4 (power wiring).
14. Reconnect the wires from the solar regulator, DCP, Satlink, and ground wires that you removed and marked in step 1 (see fig. G- 3 and fig. G-4).



New White Hookup Wire (Step 12)

Figure H-3

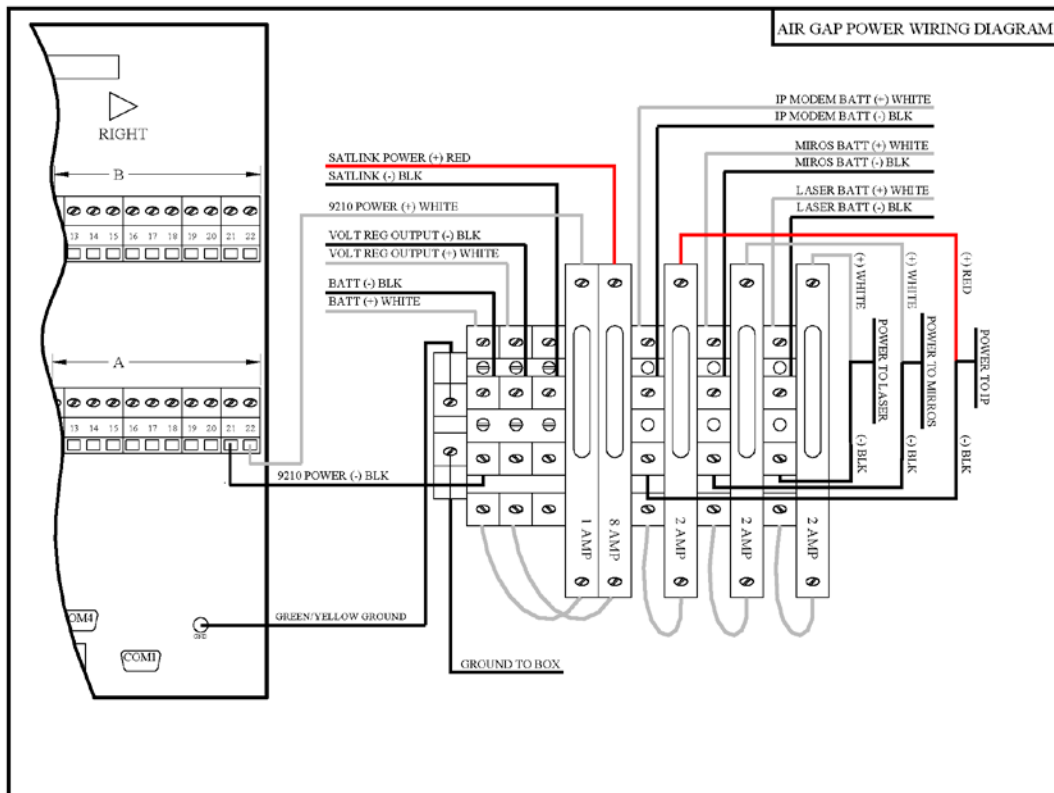
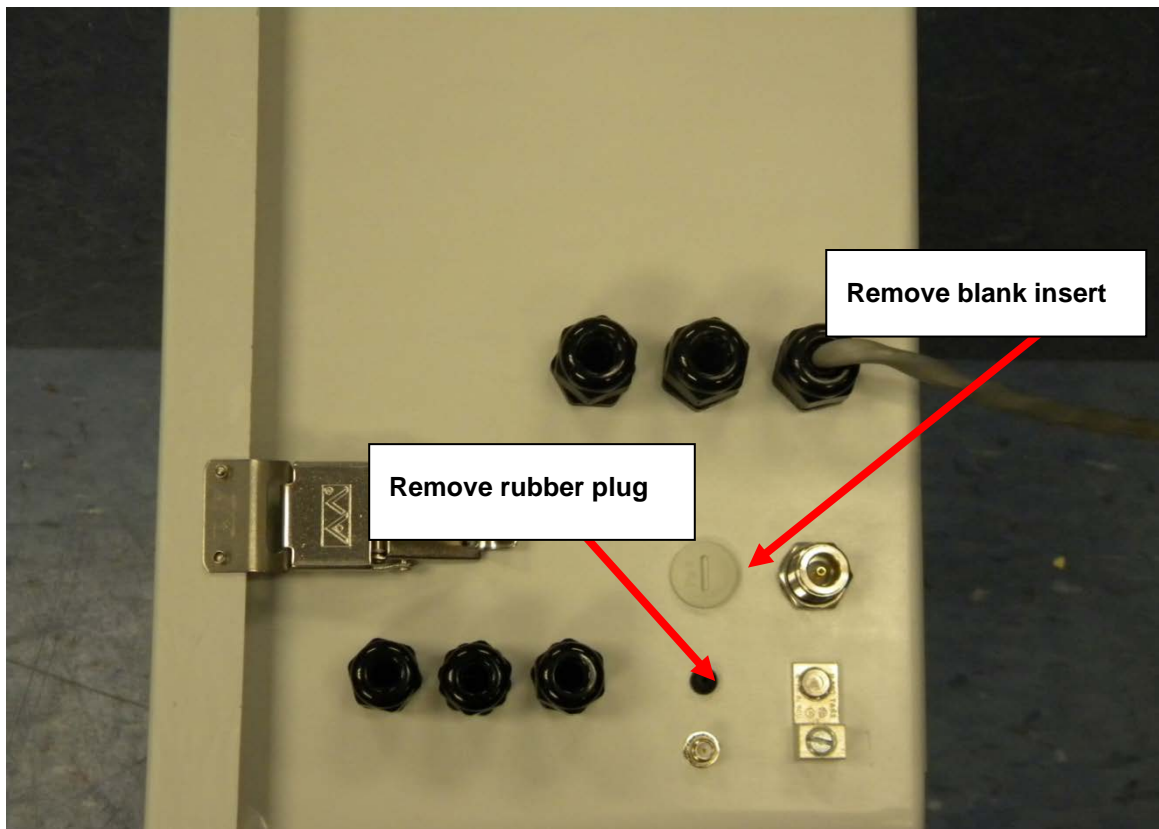


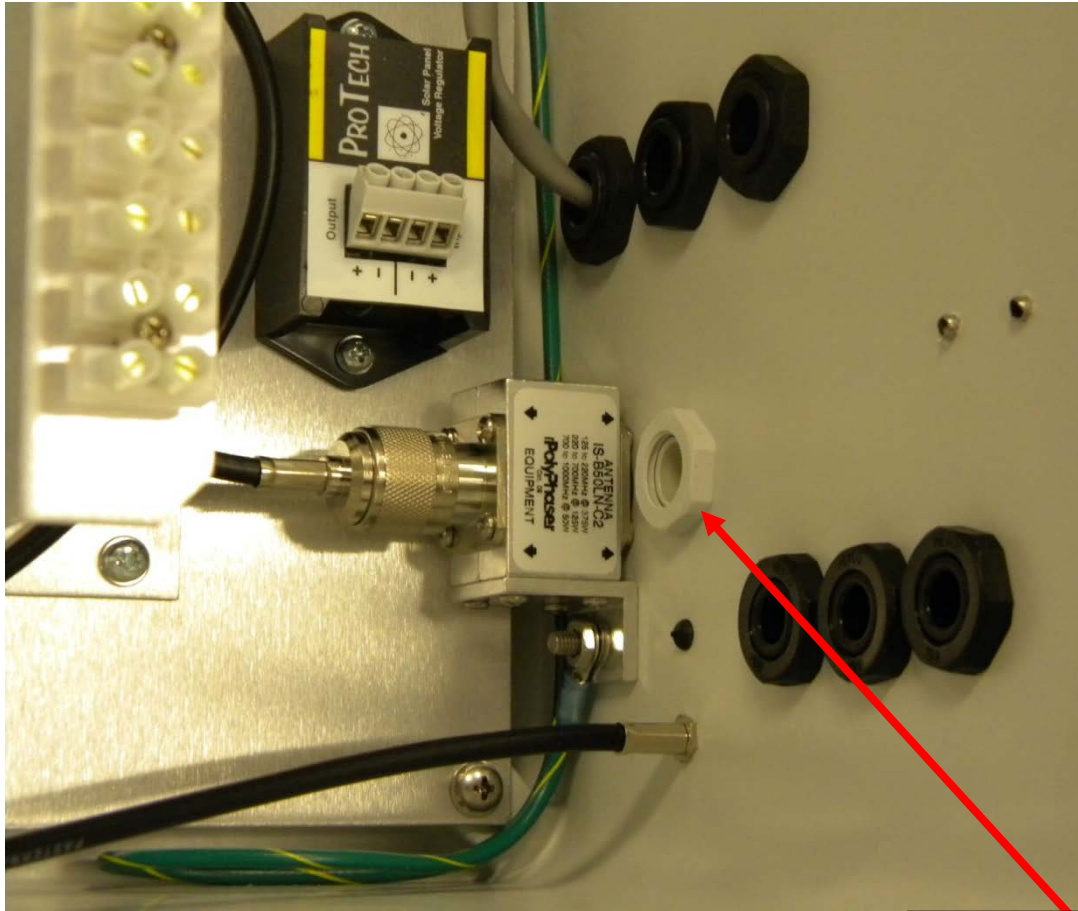
Figure H-4

### **PolyPhaser Installation**

1. The second PolyPhaser is installed next to the existing unit located on the lower right side of the grey Hydro box.
2. Remove the blank insert cover located just in front of the existing PolyPhaser and the rubber plug below the cover (fig. G-5).
3. Insert the new PolyPhaser in the hole from the inside of the box (fig.G-6). Make sure you install the O-ring, (see the paperwork included in the PolyPhaser package). Rotate the PolyPhaser so the hole on the mounting plate aligns with the hole on the side of the box. Insert the screw and one washer from the outside of the box but do not install the other washers or nut.
4. Install the large nut and washer on the PolyPhaser; tighten the nut.
5. Install a short ground cable on the screw, install the washers and nuts, and then tighten. Connect the other side of the ground cable to the ground point located next to the existing PolyPhaser. (fig. G-7 and fig. G-8).
6. Check and tighten all connections and fasteners as needed.

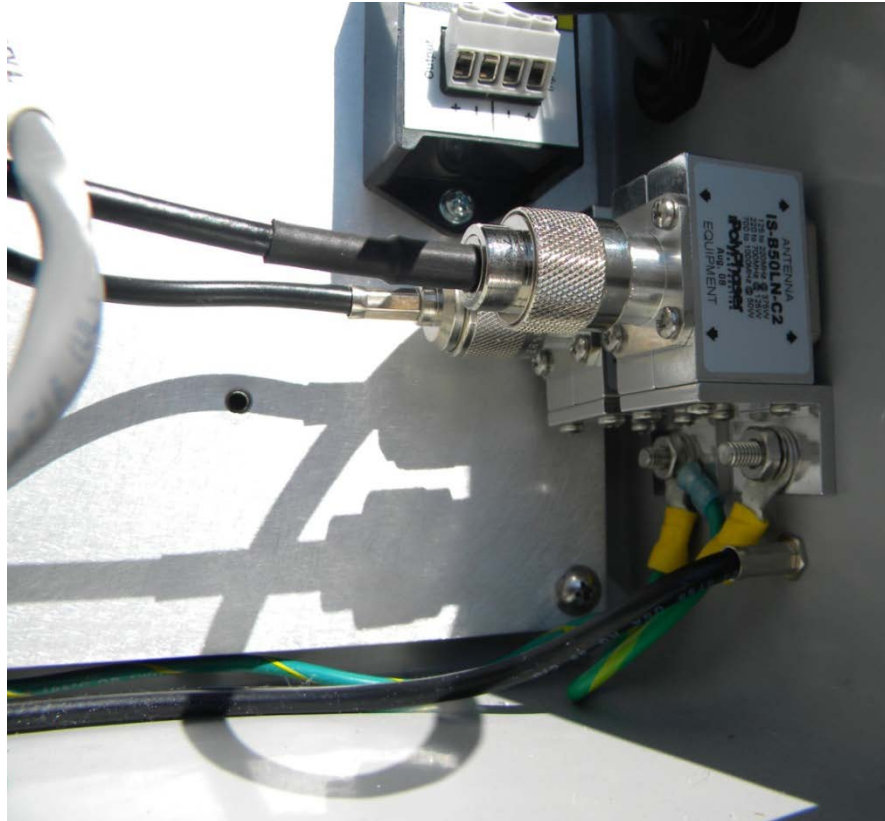


**Figure H-5**

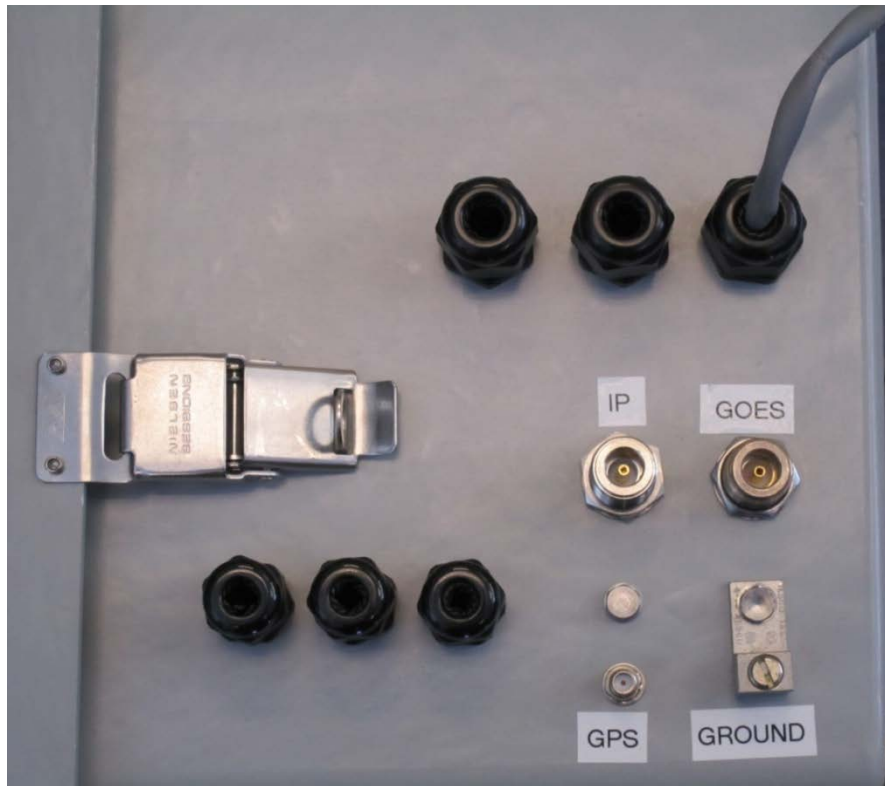


**Figure H-6**

New PolyPhaser  
Location (step 3)



**Figure H-7**

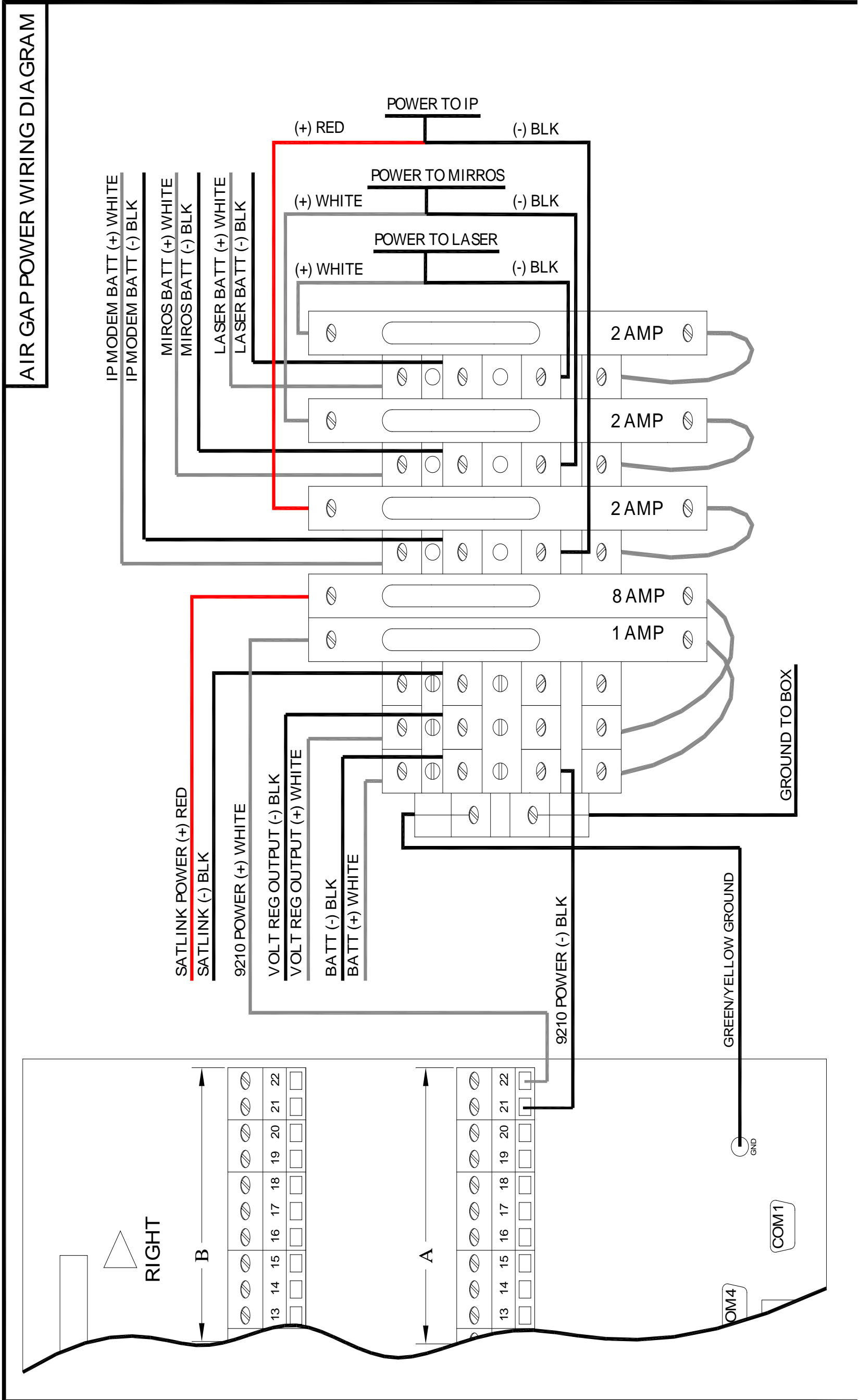


**Figure H-8**

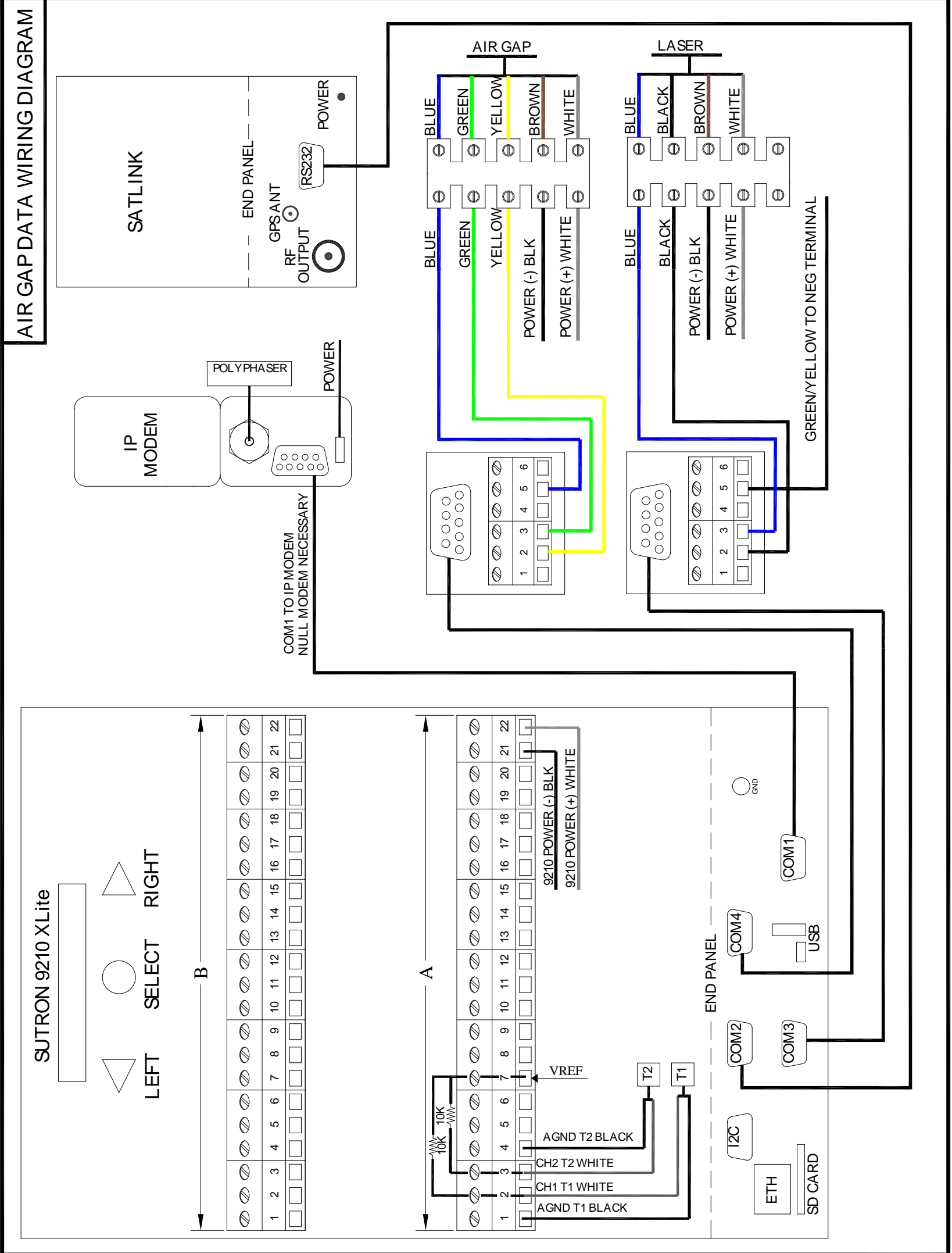
## **Appendix I**

# **Air Gap Power and Data Wiring Diagrams**











## Appendix J Miros Setup Sheets

### Station Setup Sheet for All Command

Factory Setting	Station Setting
min 100	
det 100.0 %	
wtc 4.7 sec	
win 1.0 m	
ser tout 5.0 sec 0	
freq 2 Hz	
htc 0.5 sec	
atc 59.5 sec	
ntc 0.0 sec	
top 1	
ch 2.0 50.0 m	
MIROS Altimeter SW ver. 6.4a	
Maximum range 50 m	
Ant. beam width 5 deg	

### Station Setup Sheet for Altconfig Command

Miros S/N _____ Location _____ Date _____	
Factory Setting	Station Setting
meas 375.0 mm/ch -885.0 mm	
Fft 256	
fft-time 226.44 msec	
tot-time 377.43 msec	
sweep-time 22.21 msec	
Range 50 m	
Ant 5 deg	
as-type 1	
as-gain 0.0 %	
as-offset 0 mV	



## Appendix K Procomm Scripts

### Get\_Laser\_Settings Script and the Log File It Produces

```

*****
;*
;* This procedure logs into a LTI Universal Laser Sensor, displays
;* and logs the settings. The script can be used when directly connected to the
;* sensor or through a telephone or IP modem.
;* A second script called Send_Laser_settings can be used to load approved settings
;* the Laser
;*          wkrug 12/01/09
;*
*****
proc main
  capture on          ;
  set capture file "Laser_settings" ;Opens the Capture file
  Usermsg "DownLoad Settings?" ;Waits for the Use's OK
  pause 5             ;Waits 5 seconds
  transmit "$BM^M"    ;Measurement
  pause 2;            ;Waits 2 seconds
  transmit "$ST^M"    ;Stop
  pause 2             ;
  transmit "$ID^M"    ;Software Version.
  pause 2             ;
  transmit "$AB^M"    ;Average Bounds in Picoseconds
  pause 2             ;
  transmit "$AF^M"    ;4-20 ma Fault Current Value
  pause 2             ;
  transmit "$AT^M"    ;Loop
  pause 2             ;
  transmit "$AW^M"    ;Averaging Weight
  pause 2             ;
  transmit "$BH^M"    ;Bin Threshold
  pause 2             ;
  transmit "$BR,0^M"  ;Config Port Baud Rate
  pause 2             ;
  transmit "$BR,1^M" ;Output Port Baud Rate
  pause 2             ;
  transmit "$BS^M"    ; Bin Size
  pause 2             ;
  transmit "$CE^M"    ; Cosine
  pause 2             ;
  transmit "$CG^M"    ;Check Gate
  pause 2             ;
  transmit "$CL^M"    ;4-20 ms Current Loop On/Off
  pause 2             ;
  transmit "$CO^M"    ;Mode
  pause 2             ;
  transmit "$CT^M"    ;Current Trip Threshold
  pause 2             ;
  transmit "$CV^M"    ;Cosine Value
  pause 2             ;

```

```
transmit "$DD^M"           ;Dithering
pause 2                    ;
transmit "$DM^M"           ;Display Mode
pause 2                    ;
transmit "$DR^M"           ;Dampening
pause 2                    ;
transmit "$DS^M"           ;Dampening
pause 2                    ;
transmit "$EG^M"           ;Enable Gate
pause 2                    ;
transmit "$FA^M"           ;First, Last Most and All
pause 2                    ;
transmit "$FL^M"           ;Cooperative Filter
pause 2                    ;
transmit "$FT^M"           ;Flyer Trap
pause 2                    ;
transmit "$IL^M"           ;Initial Lock
pause 2                    ;
transmit "$LA^M"           ;Detection Mode
pause 2                    ;
transmit "$LG^M"           ;Long Gate
pause 2                    ;
transmit "$MA^M"           ;Measurement Auto Start On/Off
pause 2                    ;
transmit "$MM^M"           ;Measurement Mode
pause 2                    ;
transmit "$MP^M"           ;Minimum Pulse Width Rejection
pause 2                    ;
transmit "$MU^M"           ;Measurement Units
pause 2                    ;
transmit "$MX^M"           ;Maximum False Pulses
pause 2                    ;
transmit "$OF^M"           ;Unit Offset
pause 2                    ;
transmit "$OP^M"           ;Output Processing
pause 2                    ;
transmit "$PA^M"           ;Pointer Autostart On/Off
pause 2                    ;
transmit "$PF^M"           ;PRF Rate
pause 2                    ;
transmit "$PL^M"           ;Power Level
pause 2                    ;
transmit "$PO^M"           ;Pulses/Measure
pause 2                    ;
transmit "$SG^M"           ;Short Gate
pause 2                    ;
transmit "$TB^M"           ;Time Between Events
pause 2                    ;
transmit "$TP^M"           ;Trip Point
pause 2                    ;
transmit "$TT,^M"          ;Trip Point Time Out
pause 2                    ;
transmit "$UA^M"           ;Unit Address
pause 2                    ;
transmit "$WT^M"           ;Windowing Time Out
pause 2                    ;
```

```
transmit "$WV^M"           ;Windowing Error Range Value
pause 2                    ;
transmit "$XP^M"           ;Maximum Pulse Width Rejection
pause 2                    ;
transmit "$SU^M"           ;Saves Settings
pause 2                    ;
transmit "$GO^M"           ; Starts the Sensor. Use $BM to get data.
pause 2                    ;
transmit "$BM^M"           ;Data Request
pause 2                    ;
Usermsg "Has Good Data been Received?" ;Wait for OK if the system displays good data
Usermsg "Download Completed" ; Download completed msg, wait for OK
capture off                ;
endproc
```

## **Log File the Get\_Laser\_Settings Script Produces**

\$BM,2.258,31603  
\$OK  
\$ID,ULS v1.0.5 09-26-06  
\$AB,3000  
\$AF,1.000  
\$AT,0.000  
\$AW,100  
\$BH,64  
\$BR,0,9600  
\$BR,1,9600  
\$BS,3  
\$CE,0  
\$CG,0  
\$CL,0  
\$CO,0  
\$CT,30  
\$CV,800  
\$DD,0  
\$DM,2  
\$DR,2,7.600  
\$DS,4  
\$EG,2  
\$FA,0  
\$FL,0  
\$FT,2500  
\$IL,6000  
\$LA,0  
\$LG,84.999  
\$MA,0  
\$MM,1  
\$MP,0  
\$MU,1  
\$MX,5  
\$OF,0.000  
\$OP,0  
\$PA,0  
\$PF,4000,1000,3000  
\$PL,0  
\$PO,2500,512  
\$SG,0.000  
\$TB,0  
\$TP,0.200  
\$TT,106a  
\$UA,48  
\$WT,0  
\$WV,0.000  
\$XP,6000  
\$OK  
\$OK  
\$BM,2.257,31421

**Send\_Laser\_Settings Script and the Log File It Produces**

```

*****
;*
;* This procedure sends the setup parameters to the Laser Tech ULS as listed
;* settings. The script can be used when directly connected to the sensor or
;* through a telephone or IP modem. A second script called Get_Laser_settings
;* can be used to download the Laser settings to a file
;*          wkrug 12/01/09
;*****
proc main
  capture on
  set capture file "Send_settings"
  Usermsg "Uploading Settings"
  pause 5
  transmit "$BM^M"
  pause 2
  transmit "$ST^M"
  pause 2
  transmit "$ID^M"
  pause 2
  transmit "$AB,3000^M"
  pause 2
  transmit "$AF,1^M"
  pause 2
  transmit "$AT,0^M"
  pause 2
  transmit "$AW,100^M"
  pause 2
  transmit "$BH,64^M"
  pause 2
  transmit "$BR,0,9600^M"
  pause 2
  transmit "$BR,1,9600^M"
  pause 2
  transmit "$BS,3^M"
  pause 2
  transmit "$CE,0^M"
  pause 2
  transmit "$CG,1^M"
  pause 2
  transmit "$CL,0^M"
  pause 2
  transmit "$CO,0^M"
  pause 2
  transmit "$CT,30^M"
  pause 2
  transmit "$CV,800^M"
  pause 2
  transmit "$DD,0^M"
  pause 2
  transmit "$DM,2^M"
  pause 2
  transmit "$DR,2,7.60^M"
  pause 2
  transmit "$DS,6^M"



```

```
pause 2 ;
transmit "$EG,6^M" ;Enable Gate
pause 2 ;
transmit "$FA,0^M" ;First, Last, Most and All
pause 2 ;
transmit "$FL,0^M" ;Cooperative Filter
pause 2 ;
transmit "$FT,0^M" ;Flyer Trap
pause 2 ;
transmit "$IL,6000^M" ;Initial Lock
pause 2 ;
transmit "$LA,0^M" ;Detection Mode
pause 2 ;
transmit "$LG,85^M" ;Long Gate
pause 2 ;
transmit "$MA,1^M" ;Measurement Auto Start On/Off
pause 2 ;
transmit "$MM,1^M" ;Measurement Mode
pause 2 ;
transmit "$MP,0^M" ;Minimum Pulse Width Rejection
pause 2 ;
transmit "$MU,1^M" ;Measurement Units
pause 2 ;
transmit "$MX,5^M" ;Maximum False Pulses
pause 2 ;
transmit "$OF,0.000^M" ;Unit Offset
pause 2 ;
transmit "$OP,0^M" ;Output Processing
pause 2 ;
transmit "$PA,0^M" ;Pointer Autostart On/Off
pause 2 ;
transmit "$PF,4000^M" ;PRF Rate
pause 2 ;
transmit "$PL,0^M" ;Power Level
pause 2 ;
transmit "$PO,4000^M" ;Pulses/Measure
pause 2 ;
transmit "$PT,0^M" ;Pointer On/Off
pause 2 ;
transmit "$SG,40^M" ;Short Gate
pause 2 ;
transmit "$TB,0^M" ;Time Between Events
pause 2 ;
transmit "$TP,0^M" ;Trip Point
pause 2 ;
transmit "$TT,106a0^M" ;Trip Point Time Out
pause 2 ;
transmit "$TT^M" ; TT sometime needs a second command
pause 2 ;
transmit "$UA,0^M" ;Unit Address
pause 2 ;
transmit "$WT,0^M" ;Windowing Time Out
pause 2 ;
transmit "$WV,0^M" ;Windowing Error Range Value
pause 2 ;
transmit "$XP,6000^M" ;Maximum Pulse Width Rejection
```

```
pause 2 ;
transmit "$SU^M" ;Saves the settings
pause 2 ;
transmit "$GO^M" ; Start it all up
pause 2 ;
transmit "$BM^M" ;Get a data reading
pause 2 ;
Usermsg "Have you Received Good Data?" ;Data check, wait for OK
pause 2 ;
Usermsg "Uploading Completed" ; Download completed msg, wait for OK
capture off ;
endproc
```



# Appendix L Air Gap Annual Inspection Checklist

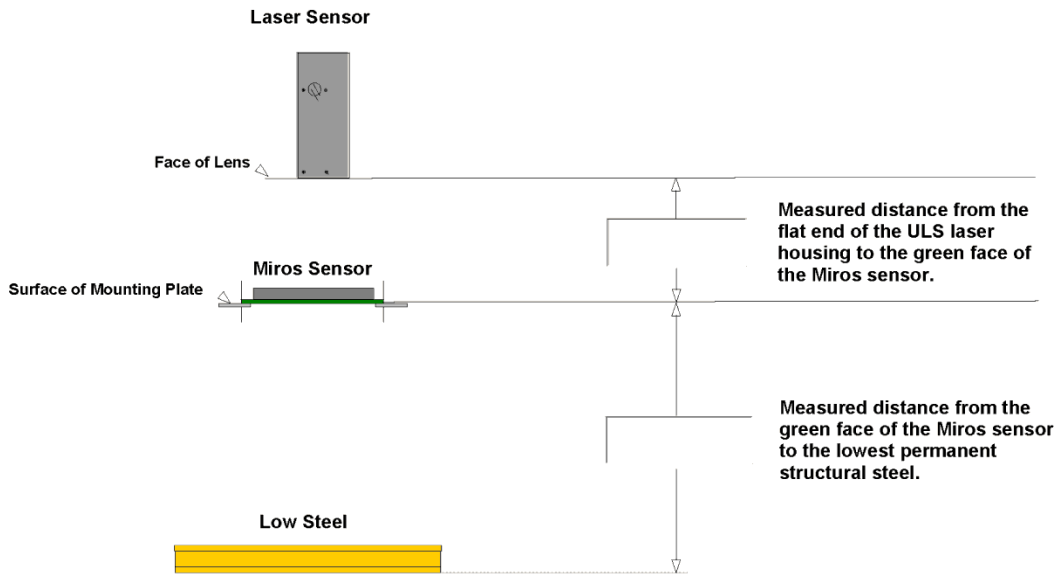
	<b>Annual Inspection Checklist for Air Gap System with Laser</b>		REV 2.0 09/22/2010
Station Name	<input style="width: 100%;" type="text"/>	Station Number	<input style="width: 100%;" type="text"/>
Field Party Chief	<input style="width: 100%;" type="text"/>	Date Inspected	<input style="width: 100%;" type="text"/>
Field Party	<input style="width: 100%;" type="text"/>		
<i>Comments:</i>			
<input style="width: 100%; height: 100%;" type="text"/>			
<b><u>Pre- Inspection</u></b>			
Contact Bridge Authority	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
Advise CORMS 301-713-2540 (system off)	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
<b><u>System Inspection</u></b> (Visual inspection of all components for damage, corrosion, cleaning of sensors)			
<input type="checkbox"/> Air Gap sensor, mount and cables	<input type="checkbox"/> Laser sensor, mount and cables	<input type="checkbox"/> DCP enclosure and mount	
<input type="checkbox"/> Antennas, mounts and cables	<input type="checkbox"/> Solar panels, mounts and cables	<input type="checkbox"/> Grounding cable	
<input type="checkbox"/> Cleaning of Air Gap green face	<input type="checkbox"/> Cleaning of Laser window	<input type="checkbox"/> Laser desiccant replaced	
Air Gap Battery voltage reading <input style="width: 50px;" type="text"/>	Laser Battery voltage reading <input style="width: 50px;" type="text"/>	<input type="checkbox"/> DCP desiccant Replaced	
<input type="checkbox"/> Xpert OS Upgraded?	Xpert OS Version Number	<input style="width: 50px;" type="text"/>	
<input type="checkbox"/> Has the Air Gap or Laser Sensor been moved or adjusted ? If yes fill out the Air Gap Measurement Work Sheet and contact OET immediately at 301-713-2897 ext 183 or 191 Do Not contact CORMS to turn on the system until you have received the OK from OET			
OET Contact (used only if the sensors have been moved )	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
Communication Check from CIL/SIL	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
Advise CORMS 301-713-2540 (system on )	(contact name, time and date)	<input style="width: 100%;" type="text"/>	
<i>Comments:</i>			
<input style="width: 100%; height: 100%;" type="text"/>			
<input type="button" value="Print Form"/>		<input type="button" value="Reset Form"/>	



# Appendix M

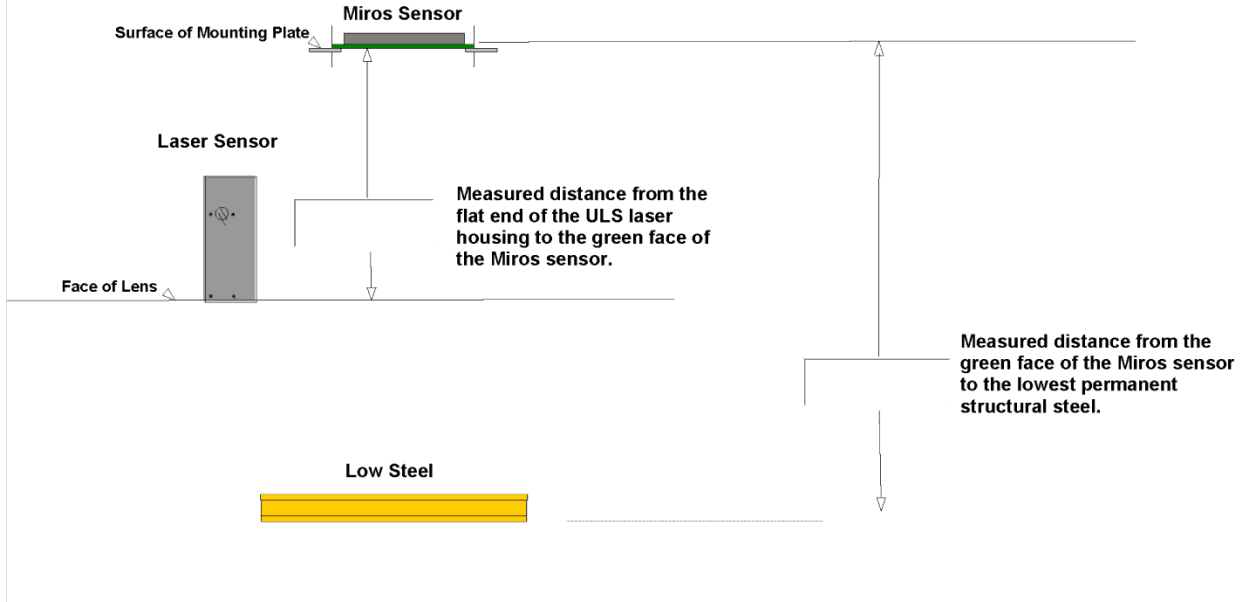
## CO-OPS Laser and Microwave Air Gap Installation Measurement Worksheets

CO-OPS Laser and Miros Air-Gap Installation Measurement Worksheet



CO-OPS Air Gap Measurement Worksheet.	Field Unit		Drawn By:		Date:	
Station Name		Station Number		Drawn By:		Date:

**CO-OPS Laser and Miros Air-Gap Installation Measurement Worksheet**



CO-OPS Air Gap Measurement Worksheet.	Field Unit		Drawn By:		Date:	
Station Name		Station Number		Drawn By:		Date:

## Appendix N

### Air Gap Technical Expert Help (Go To/Call List)

Field Crews and technicians are required to contact CORMS prior to commencing work on or at field stations. Contractors must also contact the Task Manager (TM) for your task. If the TM is unavailable the back-up TM should be contacted. The CORMS and TMs are responsible for directing problems to more specialized troubleshooting resources.

CORMS – 301-713-2540

Task Manager contact information is provided in the contract documents and during the kick-off meeting for that specific Task.

#### **General Contract Questions:**

Marty Welch, Contracting Officer Representative (COR) for CO-OPS

301-713-2897 x129

[Marty.Welch@noaa.gov](mailto:Marty.Welch@noaa.gov)

#### **Field Emergencies – Atlantic / Gulf of Mexico**

David Lane, AOB Chief

[David.Lane@noaa.gov](mailto:David.Lane@noaa.gov)

757-842-4444

Field Emergencies – Pacific

RolinMeyer, POB Chief

[Rolin.Meyer@noaa.gov](mailto:Rolin.Meyer@noaa.gov)

#### **Technical Equipment Issues**

Warren Krug – OSTEP

[Warren.Krug@noaa.gov](mailto:Warren.Krug@noaa.gov)

757-842-4424

Chris McGrath – CIL Team Lead

[Chris.McGrath@noaa.gov](mailto:Chris.McGrath@noaa.gov)

757-842-4400

Max Ivanov

[Max.Ivanov@noaa.gov](mailto:Max.Ivanov@noaa.gov)

757-842-4421

Before escalating a problem it is important to have as much information available prior to contacting a technical expert. Complete all SOP checklists and test and record / document symptoms / problems – be prepared to present a complete description of the problem, troubleshooting steps already performed, and the results of any diagnostic tests.

The Task Manager must always be notified when technical assistance is required. The COR and TM are the only CO-OPS personnel authorized to direct contractor work and activities. All other CO-OPS personnel provide guidance and advice only.

## Acronyms and Abbreviations

A	Ampere
dB	decibel
dBm	decibel referenced to 1milliwatt
C	Celsius
CD	compact disk
CIL	Chesapeake Instrument Laboratory
cm	centimeter
CO-OPS	Center for Operational Oceanographic Products and Services
CWFM	continuous wave frequency modulated
DAS	data acquisition system
dB	decibel
DCP	data collection platform
deg	degree
F	Fahrenheit
ft	feet
GMT	Greenwich Mean Time
GOES	geostationary operational environmental satellite
GHz	gigahertz
GB	gigabyte
GV	get value
Hz	hertz
kg	kilogram
in	inch
I/O	input/output
IP	Internet protocol
lb	pounds
LOS	line-of-sight
LTI	Laser Technology, Incorporated
m	meter
mA	milliamp
MB	megabyte
min	minute
mm	millimeters
mV	millivolts
mW	milliwatts
nJ	nanojoule
NOS	National Ocean Service
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
OSTEP	Ocean Systems Test and Evaluation Program
PRF	pulse firing rate
POC	point of contact
PORTS®	Physical Oceanographic Real-Time System
RAM	random access memory
SIL	Seattle Instrument Laboratory
ULS	Universal Laser Sensor
V	Volt
Vac	Volt alternating current
Vdc	Volt direct current
W	watt