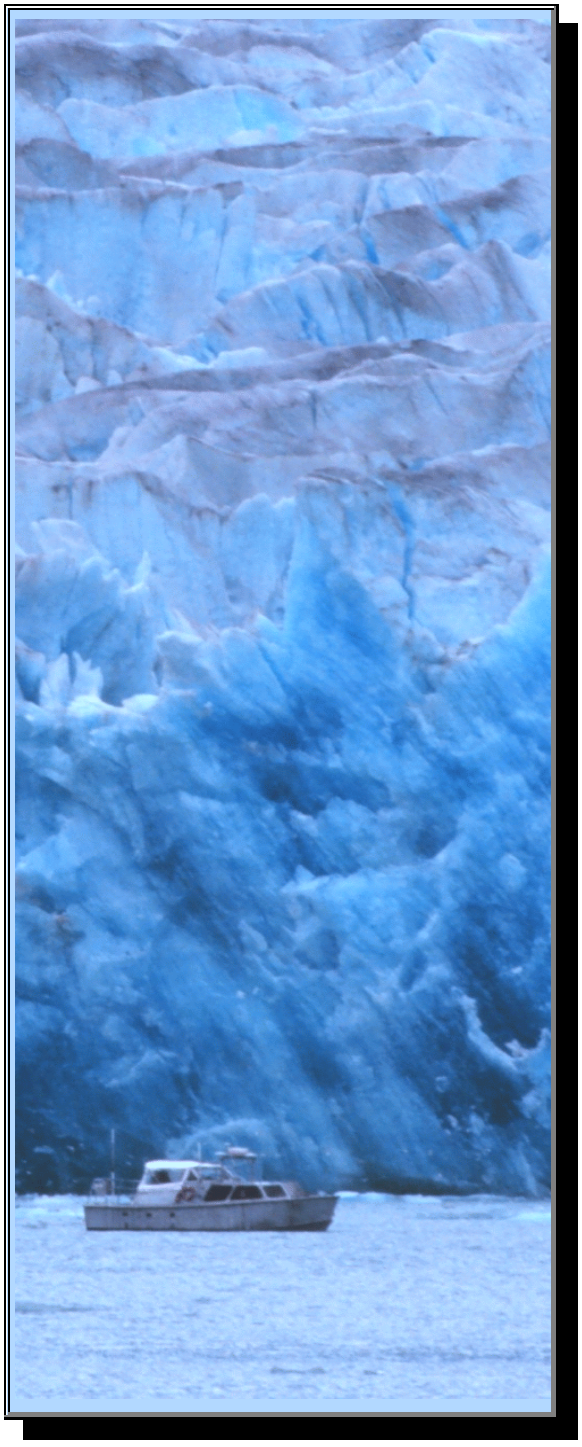


USERS GUIDE FOR 8210 WATER LEVEL GAUGE FOR HYDROGRAPHIC SURVEYING APPLICATIONS

(Installation and Operation)

Prepared by
Pacific Regional Office of
Field Operations Division and
Requirements and Development Division
of
Center for Operational Oceanographic Products and Services
National Ocean Service
National Oceanic and Atmospheric Administration

January 2001

TABLE OF CONTENTS

BACKGROUND INFORMATION AND GENERAL DESCRIPTION

The 8210 Hydrographic Water Level Gauge was developed to replace the 8200 Digital Water Level Gauge. The new gauge consists of a Sutron 8210 Data Collection Platform (DCP) with a GOES transmitter and a built-in pressure manifold and flow meter assembly and is incased in a Pelican model 1200 equipment case. The new gauge is designed to allow the lid to be opened in inclement weather without endangering the electronics inside the case. The 8210 is equipped with a GOES radio transmitter to transmit tidal data to NOS headquarters at Silver Spring, Maryland, via GOES satellite through the National Environmental Satellite and Data Information Service (NESDIS) facility at Wallops Island, for quality control and analyses.

The development of the 8210 hydrographic water level gauge is a continuing improvement process of development of Sutron 8200 gauges which were used in the past for hydrographic survey applications, and cooperative efforts from the Requirements and Development Division (RDD) at Silver Spring, Maryland, the Pacific Regional Office (PRO) at Seattle, Washington, of the Field Operations Division (FOD) both of the Center for Operational Oceanographic Products and Services (CO-OPS), the NOAA Ship Rainier, and the Sutron Corporation. Close interaction among all parties involved has resulted in measurement system modifications by taking into account suggestions and comments from the field user, and maintaining the measurement performance and system compatibility required for data analysis.

Figure 1: **8210 Hydrographic Water Level Gauge**

The hydro gauge measures tides utilizing back pressure from a bubblier orifice installed just below the lowest observed water level. The back pressure is measured using a ParoScientific Pressure Sensor (PAROS) that is installed parallel with the bubbler tube. The pressure and feed are controlled with a constant differential flow controller. The flow rate is adjusted using a flow control needle valve and a flow meter. Gas connections to and from the tide gauge utilize quick connect snap lock fittings that close when the connection is removed. This keeps a positive pressure inside the manifold assembly at all times.

The Pelican case lid is vented through a small hole drilled into the lid. This allows the PAROS sensor to compensate for changes in barometric pressure outside the case. The lower compartment uses a bidirectional purge valve that will open when there is a pressure change of one psi or more either inside or outside the case. This will protect the gauge from exploding in the event of a gas leak in the lower compartment and will depressurize the case when transported by aircraft.

General procedures on system installation and operation are summarized in this document. Each gauge enclosure contains a few pages of brief operating instructions summarized from this manual which provide information regarding setup parameters for the Sutron 8210 DCP, a log sheet for recording field visits, operational problems and/or services such as battery replacement, etc.

Main Parts

The hydro gauge components are mounted on three panel sections. The 8210 main section contains the 8210 electronics board and the GOES transmitter. The interconnect section contains the interconnect board, the RS-232 connector, and the two waterproof fuse holders. The gas purging section holds the PAROS pressure sensor, a net envelope used for holding bags of dehumidification packets, and the plumbing for the gas purging system.

Fuses

There are two AGC 6 amp fuses on the front panel of the tide gauge. One is connected to the battery line, and the other is connected to the solar panel. The 8210 electronics panel has two additional fuses, one is in a fuse holder which provides power to the GOES radio transmitter, and the other is on the interconnect board.

INTRODUCTION TO THE 8210 HYDRO GAUGE

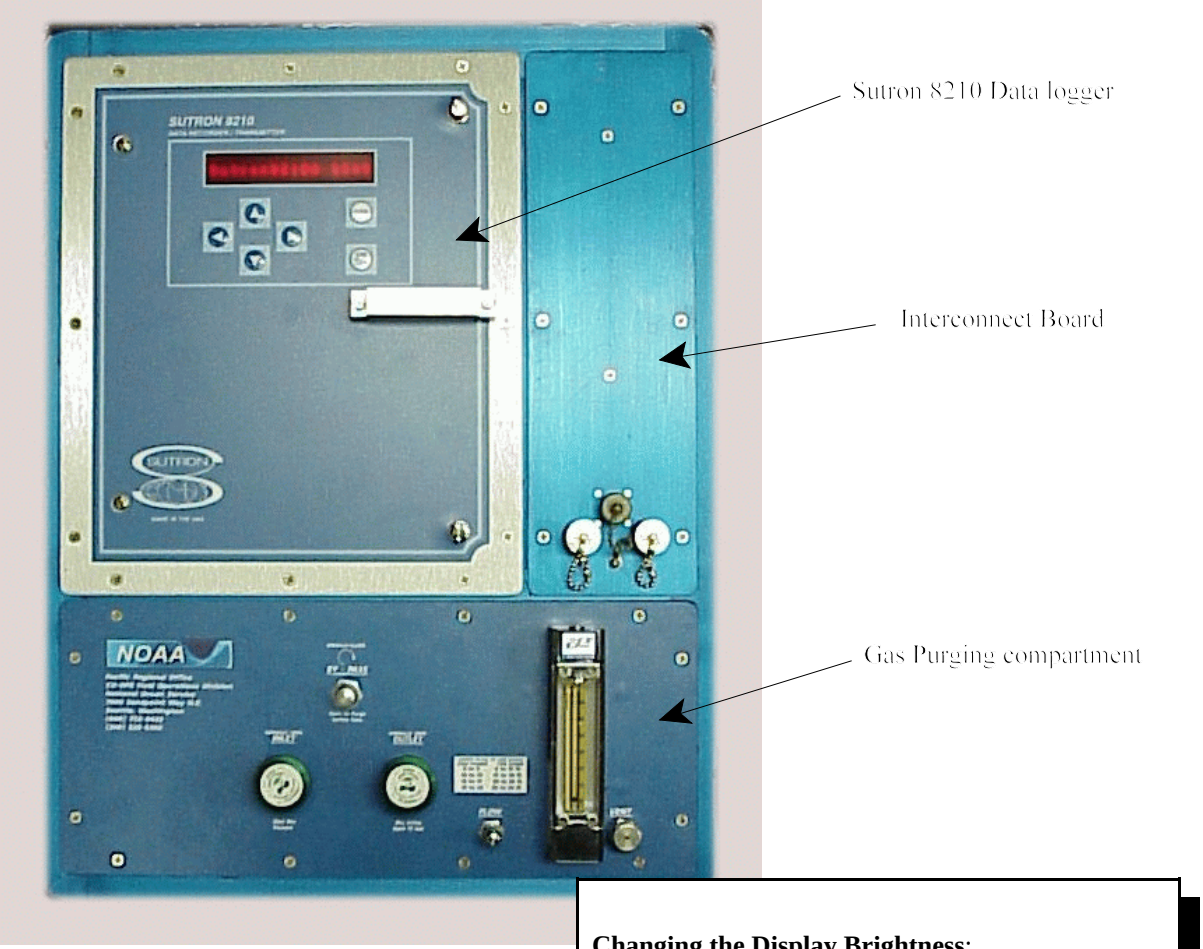


Figure 2: Front Panel of 8210 Hydro Gauge

Changing the Display Brightness:
The brightness of the display can be changed by pressing the "SET" button when the message Sutron 8210 GS49 is displayed The best time to do this is immediately after turning the display on. Each time "SET" is pressed the brightness will change.

Outer Case

The case is an O-ring sealed, water resistant, durable plastic case. Though it is not designed to do so, it will float if dropped overboard. The power connector is a four-pin water resistant connector which connects to the battery boxes. The 8210 gauge uses two 12-volt 26 Amp Hr batteries. The batteries are connected in parallel with a four-conductor 5-foot cable. Each battery box has two connectors wired in parallel, either will provide power to the 8210. The remaining connector is used to daisy-chain the batteries together and on the last battery case connect to the 20-watt solar panel to the 8210 using a 20-foot four-conductor cable. The Antenna connector is a type "N" female connector. All of the connectors have protective caps.

This cap should cover the connectors whenever the connectors are not used.

8210 Water Level Gauge Side View

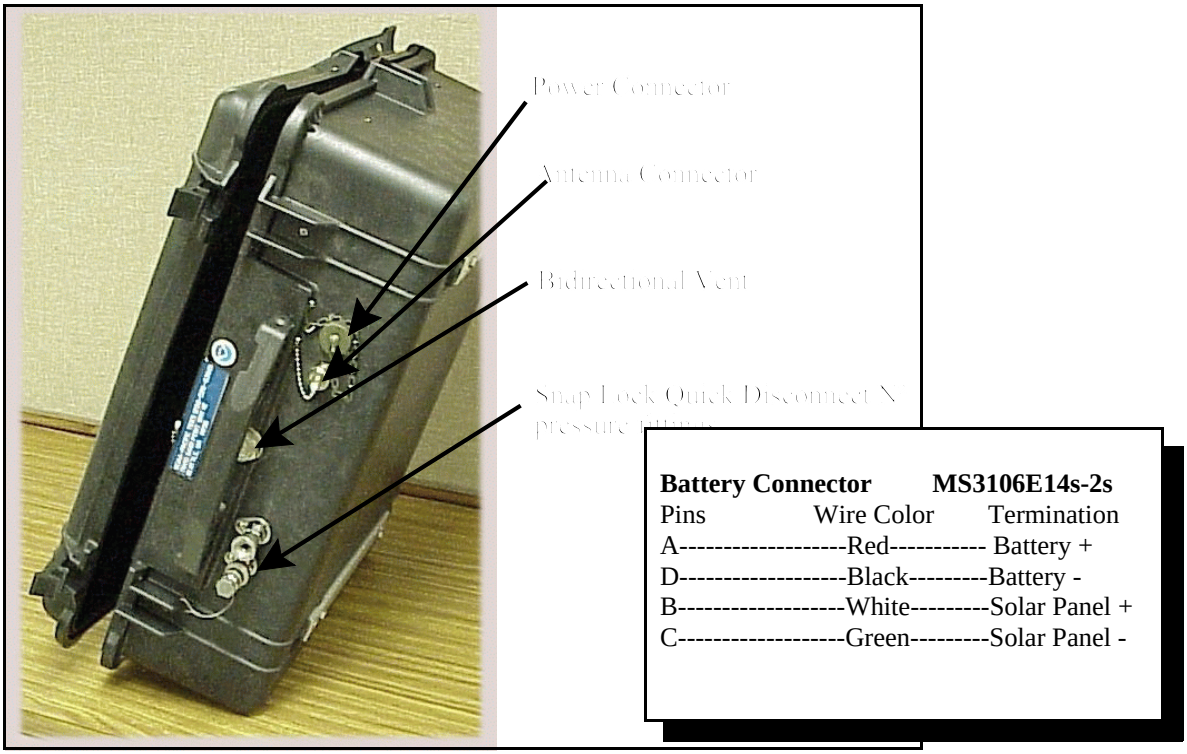


Figure 3: Side view of the 8210 gauge

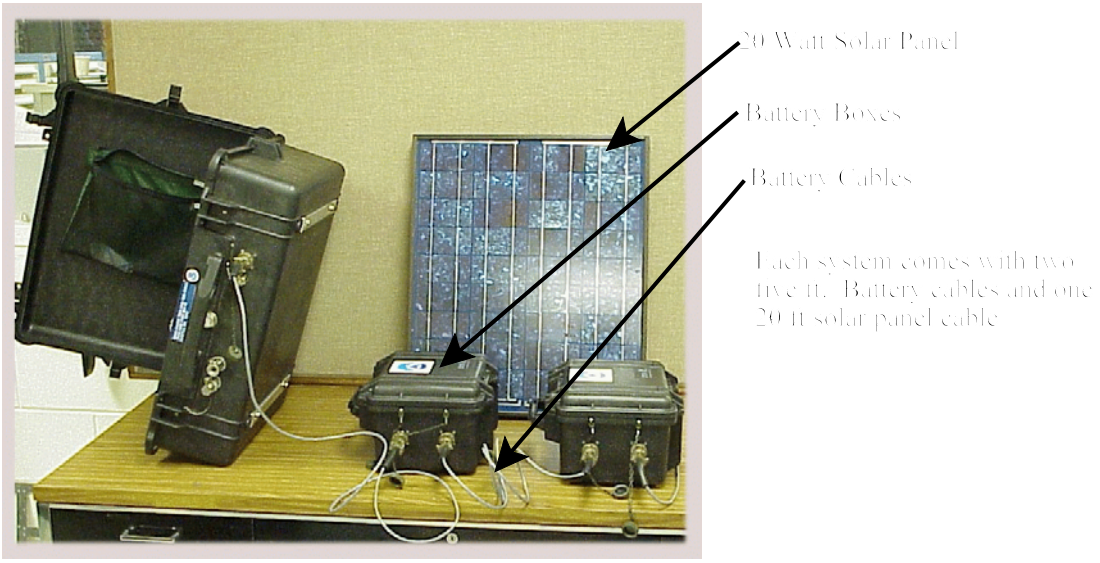


Figure 4: Batteries and Connections

The Pressure control panel.

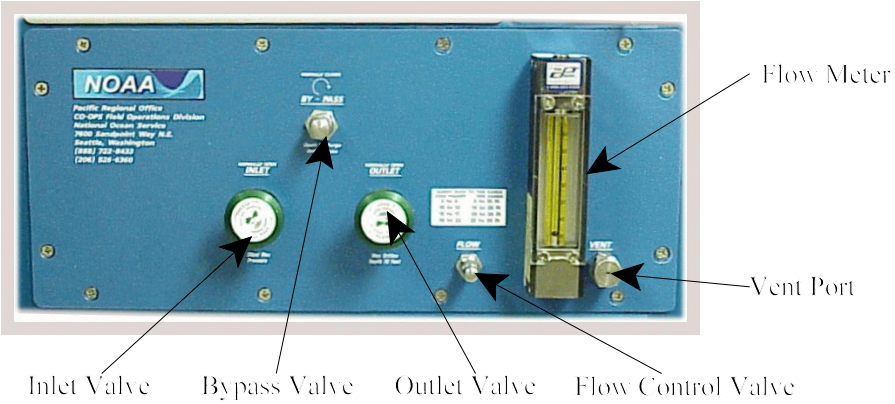


Figure 5: Front of pressure control panel

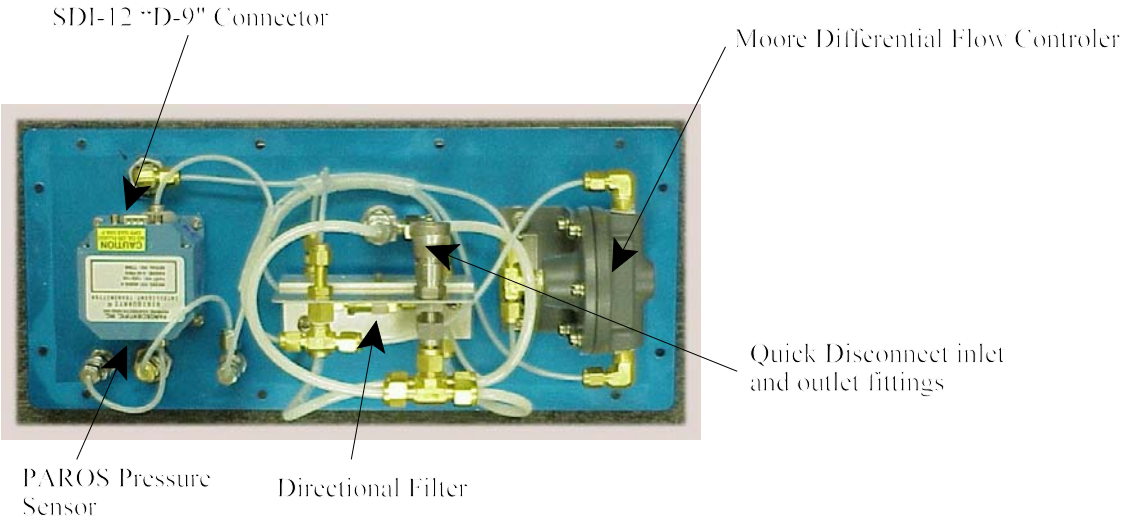


Figure 6: Back view of pressure control unit

Valves

The Inlet valve is used to open and close the gas flow to the orifice. It is normally open and would be closed when changing the nitrogen cylinder.

- A bypass valve is provided to shunt around the manifold assembly. This valve is used to quickly purge the water out of the bubbler tube and is closed during data collection.

- The outlet valve is used to open and close the gas line to the orifice. It is normally open

and is used when moving or changing the bubbler tubing.

- The Flow control valve is used to control the gas flow rate. The greater the tidal range, the larger the required flow. The 8210 tide gauge must be in the upright position to set the flow rate. Once the flow rate is set with it's needle valve, the gauge can be positioned at any angle.

Differential Flow Controller

The Moore constant differential flow controller is used in conjunction with an external needle valve to provide constant volume flow rate over a continually adjustable flow range.

System Tie-Down

The 8210 water level tide gauge can be operated laying flat on its back. The only time this gauge needs to be in an upright position is to set the flow rate as stated above. Several attachment points are available on the bubbler system enclosure for tie-downs at the field site. Metal brackets are provided with each system which can be bolted to each corner on the rear of the enclosure. A carrying handle is located at the right side of the enclosure. Looping cable through this handle on the side would provide a tie-down point for the enclosure. Locks should be used to secure the gauge and can also be used for tide down points.

Electrical and Pressure Connections

All external connections are located near the handle of the enclosure. Connection of the tide gauge to the nitrogen supply and to the orifice line during deployment requires the use of Swagelok® quick disconnect fittings. The orifice fitting uses a red male fitting with a stainless steel Swagelok® tube fitting on the other end. A 3/4 and 11/16-inch wrench is required to tighten this fitting. Nitrogen supply hose is provided with a female quick disconnect fitting attached to it.

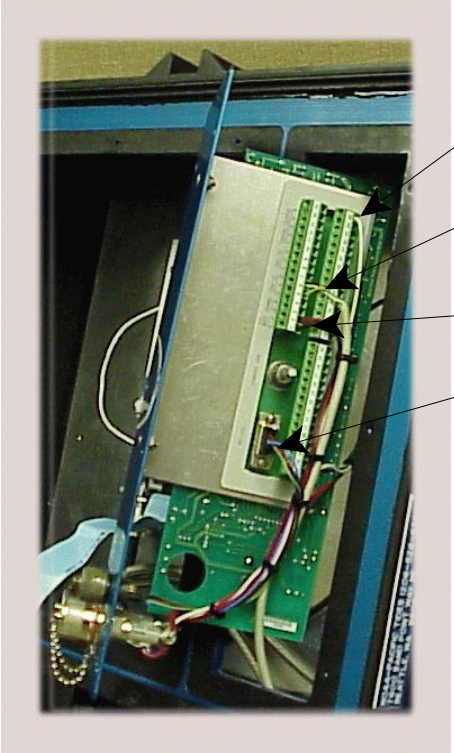
Caution: ***Excessive torque in making these connections must be avoided. See Appendix C instructions and drawing of Swagelok® fittings.***

Note the difference between new installation (one and one-quarter turns past finger tight for 1/4-inch and larger tubing sizes) and re-tightening (only one-quarter turn past finger tight).

Caution: ***Tightening beyond these points will damage the mating surfaces, and result in a gas leak.***

The polyethylene orifice tubing could be extended or repaired by joining two pieces using a Swagelok® Splice fitting. In order to avoid leaks, be sure that the tubing ends are cut square and smooth, and the tubing is free from scratches in the area that will be inserted into the fitting.

Wiring and Connections



SDI-12 to D9 pin Connector

Pin	Wire Color	D9 Connector Female
5	Yellow	5 Signal and Power Ground
6	White	9 Power 6 to 16 VDC @15ma
7	Brown	2 SDI-12 Data

RS-232	ITT Cannon MS3112E-10-6S	Wire Color
	A	Not used
2	B	TXD Red
3	C	RXD Green
4	D	DSR Blue

Figure 7: Interconnect board

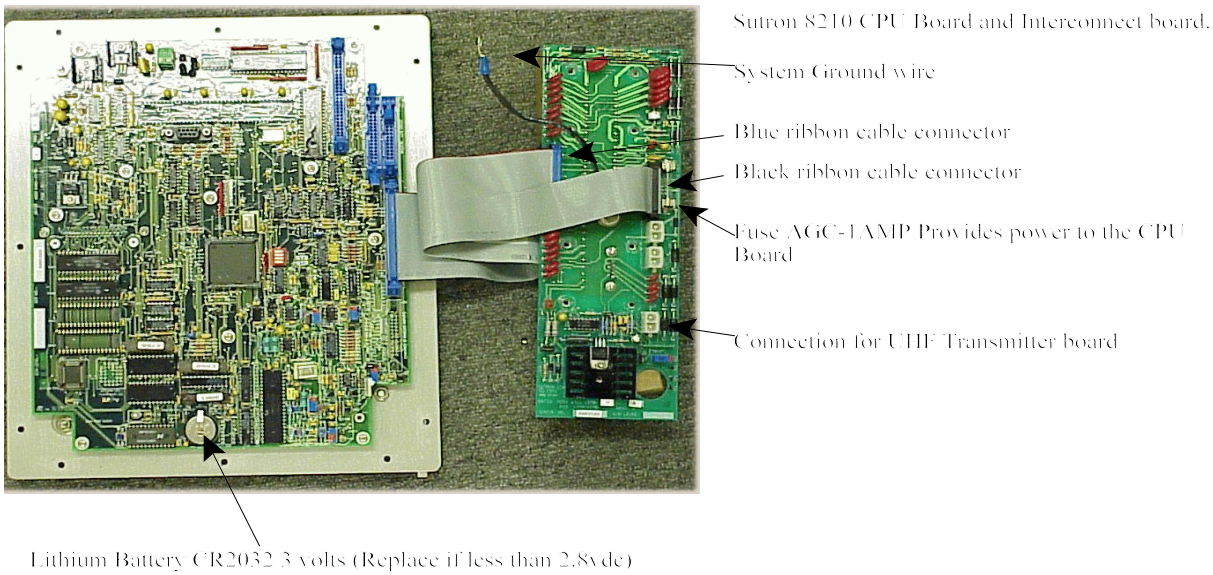


Figure 8: Interconnect and CPU Board

GOES Radio Transmitter

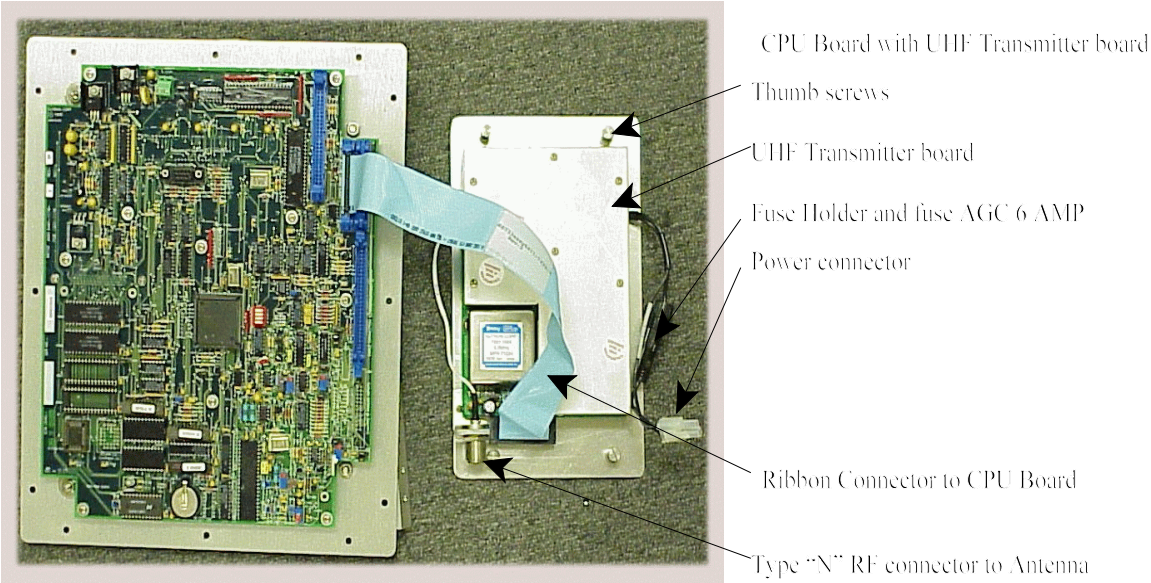
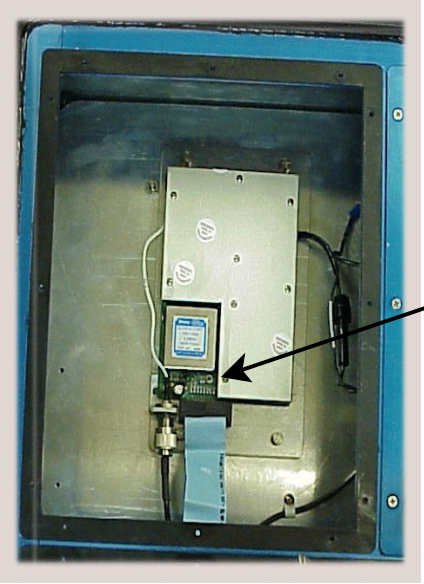


Figure 9: GOES Transmitter and CPU Board



The Photo on the left shows the GOES Transmitter mounted in the 8210

Hydrographic water level gauge. It has it's own backing plate and is fastened to the back plate with four thumb screws. A type "N" connector connects the external RF cable to the transmitter assembly. A ribbon cable connects the transmitter directly to the motherboard, which is mounted just above the transmitter.

Transmitter fail-safe reset buton

Figure 10: GOES transmitter installed

GOES Radio Fail-safe

The fail-safe circuitry is designed to prevent transmitters from jamming a channel. The fail-safe limits both the length of transmissions and the time between consecutive transmissions. The fail-safe circuit is normally reset from either the front panel, a laptop computer, or by the push-buttons on the front panel of the 8210. To reset the fail-safe from the front panel or PC, you must go to the Main Menu\Recording field. If this field includes "FT" the fail-safe is tripped. To reset the fail-safe condition, press "SET" or "R" in the PC menu several times until the "FT" is deleted. Normally what you will see on the display is recording status "OFF&FT" and it will toggle to "OFF". Typically you will not have to reset the transmitter with the reset switch in the GOES transmitter board.

Nitrogen supply

The nitrogen supply connection uses a 1/4-inch stainless steel Swagelok® quick disconnect fitting. If the new gas supply hose (Swagelok® fittings on both ends) is used, it will require installation of a female quick disconnect fitting and a hose-to-pipe fitting to the nitrogen regulator. No other hose or fitting should be used.

Orifice connection

The orifice connection is a 1/4-inch stainless steel quick disconnect Swagelok® fitting to a 3/8-inch tube fitting. If connection of the orifice tubing is a new installation, it will require turning the ferrule cap one and one-quarter turns past finger tight. It is preferable to make this "new installation" by using a spare or old 3/8-inch Swagelok® fitting to swage the ferrules onto the bubbler tubing; then connecting this pre-swaged tubing to the enclosure fitting would only require one-quarter turn past finger tight. This would prevent damaging the expensive quick disconnect fitting by over stressing its threads.

Laptop connection

For the initial installation, it is not necessary to connect the laptop computer. However, when the computer is used for data retrieval, it connects to the gauge via the round ITT Cannon connector on the interconnect board cover using the same cable used to communicate with the Sutron 9000 DCP. One cable is provided with each 8210. The other end of the cable connects to the "Serial COM Port" connector located on the back of the computer.

PT06A-10-6P (SR)		RS-232 D-9 Pin Connector
a	System Ground	Shield — NC
b	TXD	White — 2
c	RXD	Orange — 3
d	DSR	Green — 4
e	Data Ground	Black — 5
f		RED — 8 Not Used

Batteries

The two 12-volt 26-Amp Hr rechargeable batteries, which power the gauge, will operate the gauge for approximately 90 days. When the battery voltage drops below 12.0 volts, it should be replaced with a freshly charged battery. If the battery voltage drops below 9.5 volts, the system will fail to operate. Note that allowing a lead acid battery to operate close to being completely discharged (< 11 volts) reduces its life ultimately.

A gel-cell battery has a life expectancy of 5 years. Batteries older than 5 years must be replaced. All new batteries should be marked with the date they were put into service.

The internal lithium RAM backup battery that is located on the CPU board inside the chassis of the 8210, has a minimum life of one year, and should be replaced if the voltage is less than 2.8 volts. The Pacific Regional Office of CO-OPS tests this battery prior to each field season.

START-UP

Sutron 8210 Data Collection Platform

The 8210 Data Collection Platform should be configured for measurement and recording prior to deployment in the field. Thus, the only steps that will be required for the 8210 to start logging data during system installation in the field are (a) install the nitrogen cylinder and orifice, (b) connect the batteries, (c) check the system date and time, and (d) insure that recording is on.

1. To connect the batteries, connect the battery cable connectors to both the battery boxes and the 8210. They should form a chain starting with the solar panel, to the first battery box, to the second battery box, and then to the 8210. The 8210 should power up and perform a self-test as soon as power is applied. Even though the gauge will work with one battery box attached, generally, two battery boxes are recommended for data collection use with each 8210 DCP.

2. The date and time of the 8210 should be checked and reset if necessary. Press "*ON/OFF*" button to activate the display. Press the "DOWN" arrow twice to display the date. If the date needs to be changed, press the "SET" button then use the "UP", "DOWN", "LEFT", "RIGHT" arrows and the "SET" button to adjust the date. Once the date has been set, press the "DOWN" to display the time and adjust it if necessary using the same technique as for the date. The time should be referenced to UTC (Universal Coordinated Time or Greenwich Mean Time) and must be set to the correct second. UTC time is 8 hours ahead of Pacific Standard Time, 9 hours ahead of Alaska Standard Time, and 5 hours ahead of Eastern Standard Time.

3. Verify that 8210 has recording enabled by pressing the "DOWN" arrow once after setting the time. The display should indicate "Recording ON & TX". If recording is off, press, "SET" to enable recording. If the 8210 had some part of the system set up changed, recording will automatically be set to off.

Bubbler Control Unit

The following steps describe start-up procedures for the bubbler control unit; valve identifications correspond to labels on this unit.

1. Before opening the nitrogen cylinder valve, make sure that the bubbler outlet valve is OPEN and the inlet valve is CLOSED. The bypass valve should be open until the

bubbler line is clear of water. Also, this will protect the pressure sensor from over-pressure damage if the feed pressure is set too high. The pressure regulator adjustment should be set to minimum pressure (turned fully counterclockwise).

2. Open nitrogen cylinder valve; set regulator to the normal operating pressure of 18 psi, or when purging a long bubbler lines, it may be expeditious to increase the low pressure feed 20 or 30 psi. **Never set it to pressures above 35psi**.

3. Open bubbler inlet valve and purge orifice line with the bypass valve open. The bubbler tube should clear rapidly. When the bubbler line is clear, lower the low pressure feed to 18 psi, then close the bypass valve.

4. Set the flow rate with the flow control valve. The required flow rate depends on the tide range and the length of the tubing at the deployment site. The table below provides the theoretical minimum flow rate for a given tidal range and tubing length.

TABLE 1

Minimum Gas flow Rate (cc per minute)
at 18 psi regular setting

	Tubing length (meters)				
Tidal Range	100 m	200 m	400 m	800 m	1600 m
2 m	0.5	0.8	1.5	2.8	5.5
4 m	0.9	1.6	2.9	5.6	10.9
6 m	1.4	2.4	4.4	8.4	16.4
8 m	1.8	3.2	5.8	11.2	21.9
10 m	2.3	3.9	7.3	14.0	27.3

For the tubing length used in most of the circumstances the following gas flow rates are recommended. For tide ranges of less than 4.5 m (15 ft), the flow rate should be set to 5 cc/minute. For tide ranges of 4.5 - 6 m (15 to 20 ft), set the flow rate to 6 to 7 cc/minute; for 6 - 7.5 m (20 to 25 ft) tide ranges, use a flow rate of 7 to 9 cc/minute; and for 7.5 m - 10.5 m (25 to 35 ft) tide ranges, use a flow rate of 10-12 cc/minute.

8210 Gauge GOES Capability

The 8210 gauge shall be operated with a GOES antenna at all installations. CO-OPS has assigned Continuously Operating Real Time Monitoring (CORMS) system personnel to monitor hydrographic water level data quality, once CO-OPS has been informed of a gauge installation. Unless station location is such that the satellite horizon is blocked by mountains, buildings, or heavy forests, then an exception can be granted by the ship's Operations Officer / Team Leader. It is the responsibility of the ship, or field party, to inform RDD / Manoj Samant (301) 713-2897 ext 190, so that an alternative plan can be established to acquire and process the data. Also, when hydrographic water level data is not transmitted, the data quality cannot be monitored and the risk of ensuring good water level data collection during hydrographic survey operations rests with the Captain of the ship. Remember, Hydro data without tidal data is of no value whatsoever and generally cannot be processed.

A tiny basic program FMTPARO3.BAS needs to be uploaded in the 8200 for the GOES satellite capability to work for data transmission.

Caution: ***Operating this gauge with the GOES transmitter on without terminating the antenna cable connector with either a GOES Antenna or a 50 ohm resistive load can damage the Transmitter*****.**

SITE VISITS

Staff Observations

The 8210 bubbler gauge stores in its log the water level and battery voltage reading for each 6-minute measurement referenced to UTC. Therefore, when making staff-gauge comparisons during periodic site visits, time should be recorded referenced to UTC along with the staff reading. Note that UTC time is 8 hours ahead of Pacific Standard Time and 5 hours ahead of Eastern Standard Time. Data are recorded in the digitized bubbler at 0, 6, 12, etc., minutes past the hour. Staff readings should be made as close as possible to these times. To view the recorded data from the 8210, use the "NEWEST" display option to provide the gauge measurements that correspond to the staff observations.

Caution: ***Do not use the "LIVE READINGS" from the 8210 for staff comparisons; this does not reflect the actual measurement of water level being recorded in the system. Staff observations should be made independent of verification checks in the 8210. This will avoid confusion.***

Battery Check

The 8210 external battery voltage should be checked using the 8210 display viewed from the "VIEW DATA", "NEWEST READINGS", "BATTERY" selection from the menu structure. If the battery voltage is below 12 volts, it should be replaced with a freshly charged battery.

Removing power from the 8210 should not change setting in the data logger.

Data Retrieval

Data from the internal memory of the 8210 should be uploaded to the external computer during each site visit. The following sections on "Data Retrieval" and "Data Display" describe the data upload and display procedures. In order to see "flat spots" or other indications of problems in the orifice/bubbler hose, the retrieved data should be displayed, checked, and plotted on the computer prior to leaving the station.

Data Retrieval - Direct Connection

Water level data should be retrieved during each visit to the field site, using a laptop computer and a Sutron program called "8210.EXE". This program provides for general communications between the laptop and the 8210. Its data upload option creates a file on the laptop in a directory called 8210/Data which contains the retrieved data in a compressed binary format. This data can subsequently be displayed using another Sutron software package, "LOGPLOT.EXE", as described in the next section.

The data upload option saves the retrieved data in a file on the laptop's hard disk and assigns a file name based on the 8210 serial number combined with the start month and start day of the data dump, using a "log" extension. But, one can rename the data file later. Always name a log file with eight-digit station and dcp# and three-digit log extension. For more than one log file from a particular station, change the three-digit extension as lg1, lg2, etc., as appropriate. For example, a data dump from a 8210 from station number 9414290 and dcp # 1 should be renamed as "94142901.log".

The following are the directions for direct connection data retrieval:

- Turn on the laptop. When the laptop has completed booting, run the DOS program 8210.exe**.** This program enables the laptop to communicate with the 8210. Connect the data cable to the round Cannon connector labeled (RS-232) at the lower portion of the inside upper right panel of the tide gauge, which is normally covered by a weather-tight cap.

- The other end of the data cable connects to the serial port on the computer (a 9-pin sub-D male on most laptops; a 25-pin sub-D male on older PC's, which will require a 9-pin male to 25-pin female adaptor). The computer serial port must be set for COM1, as the Sutron software will only communicate through COM1.

- When you are hooked up and ready to start, execute 8210.exe. The program will boot-up and in about 5 seconds, the main screen of the 8210 will appear.

- Go to (U) Upload/Download data. The default Transfer Protocol is now YMODEM. It's best to leave this as is. Make sure the date is the date of the data you want; otherwise change it using the (D) command. Then select (S) Send to Serial Port. A screen will pop up at this point showing some download preparation activity. The download should ensue and finish by itself.

- When data collection has finished correctly, press the OK button that will be displayed. The upload/download data screen will be showing as Completed at the bottom of the screen along with the file size. You can now decode this data using Logprn.exe.

Data Display - Direct Connection

Data uploaded to a disk can be displayed in the form of a screen plot with a program "LOGPLOT.EXE", also written by Sutron. This program reads the compressed binary data file created by "TW8210.EXE", allows selection of parameters to be displayed, and allows selection of scaling on the vertical axis. The following steps demonstrate how to generate the screen plot on the laptop computer.

Run the file **"LOGPLOT.exe".** The program will prompt for the data file to be graphed such as **"94142901" <Enter>**, where "94142901" is the name of the data file to be plotted. It is not necessary to include the file extension (.log). The screen will display the measured parameters available to be plotted.

Press <cursor down> **<Enter>**. This selects PAROS water level data to be plotted.
Press **<P>** to initiate plotting. The program will request a y-axis minimum value.
Type **0 <Enter>**. The program will next request a y-axis maximum value.
Type **50 <Enter>**. The program will display a graph of the tide in meters, with the horizontal axis being date and time.

With this software you can change the time scale which is plotted by typing <**1**> for one day, <**2**> for two days, etc., <**W**> for a week and <**M**> for a month of data.

The tide height scale can be changed manually or, if the plot is re-initiated, the software will automatically select a vertical scale based on the data range:
Press **<Enter>**. This will bring back the parameter selection screen.
Press **<P>**. The program will request a minimum value (it will display the actual minimum found in the data file).
Press **<Enter>**. The program will request a maximum value (it will display the actual maximum found in the data file).
Press **<Enter>**. The program will display a graph with an expanded vertical scale depending on the actual minimum and maximum values in the data file.

To exit the "LOGPLOT" program, press **<Esc>**.

The screen plot can be printed on a printer. To do this, the DOS program "GRAPHICS.COM" must be run before running the "LOGPLOT" software. This program has been included in the laptop startup program (autoexec.bat). While the plot is displayed, press **<print_screen>.** On some computers, you must press both the **<Shift>** and the **<print_screen>** keys simultaneously; on others, pressing **<print_screen>** alone is adequate.

Sutron-Authored Programs

Two other Sutron-authored programs are provided on the laptop that can be run from DOS prompt which may by helpful in examining the data. The two programs are LOGPRN.exe and LOGSTAT.exe.

LOGPRN.EXE converts the compressed binary ".LOG" data file into ASCII file (".PRN" extension) to allow import into a spreadsheet program. When the program is run, the file name should be followed with " /z", example ("94142901 /z"). These options will insert zeros for non-recorded data.

LOGSTAT.EXE reads the compressed binary (".LOG") file and displays daily statistics such as maximum, minimum, mean, and number of data points on the computer screen.

PCMI Card Reader

The data from the 8210 can be quickly retrieved using a PCMI card to temporarily hold the data so that it can be read later with a laptop computer. The advantage of this method is that it is fast, easy and does not require additional equipment such as a laptop computer in the field. The 8210 is programmed to use a static RAM memory card up to Two Megabites in size. Anything larger than that will not work.

Caution: ***It is not recommended that the PCMI card slot be opened in the field especially if it is raining. The exposed slot can allow water into the lower electronics compartment and its pins are easily damaged by water.***

Caution: ***Always put the protective cover over the card slot when it is not in use.***

Downloading Data to a Ramcard (PCMCIA)

Note: Only a static Ramcard with up to, but not greater than, two megabytes of memory will work with the 8210.

Note: A static ramcard requires an internal battery. This card is not intended for long term storage of data or system setups.

Have a PCMCIA card (ramcard) ready for downloading. Make sure all previous data has been copied elsewhere and removed. To erase it completely, scroll down to DUMP DATA, then press right arrow once, then scroll down to Erase Ramcard. Press **SET**, and you will see messages "Erasing Ramcard" followed by "**Complete**". If there is data on the Ramcard and there is space for more data, the Ramcard function will simply append the new data to the existing data as a new log file. Hence, if the appending of a file is not desired, then make sure the old data on the ram card is erased prior to recording new data.

To Download

Insert the Ramcard in its slot. Power the display on and scroll down to Dump Data. Then right arrow once and then down until you see Rampack. With "**Ramcard**" displayed, press **Set**, and if it downloaded correctly, you should see the message "**Complete # Bytes** where # signifies number of bytes. If you see “Ram Error”, you should first try erasing the Ramcard, or if that fails, try a different Ramcard.

To View Data

Copy the downloaded file which will be called Ramcard.crd to your 8210 directory which should contain the various Sutron utilities including Ramcard.exe. From a DOS prompt execute **Ramcard.exe/X**. This will extract the logfile(s) to the 8210 directory. Just executing Rampack.exe will just show you the files without extracting them. Once you have the logfiles, you can use logprn and logplot to view the data.

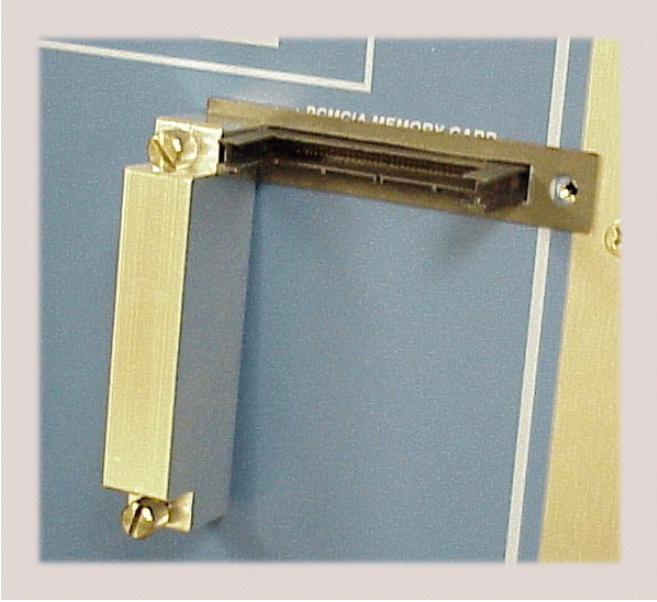
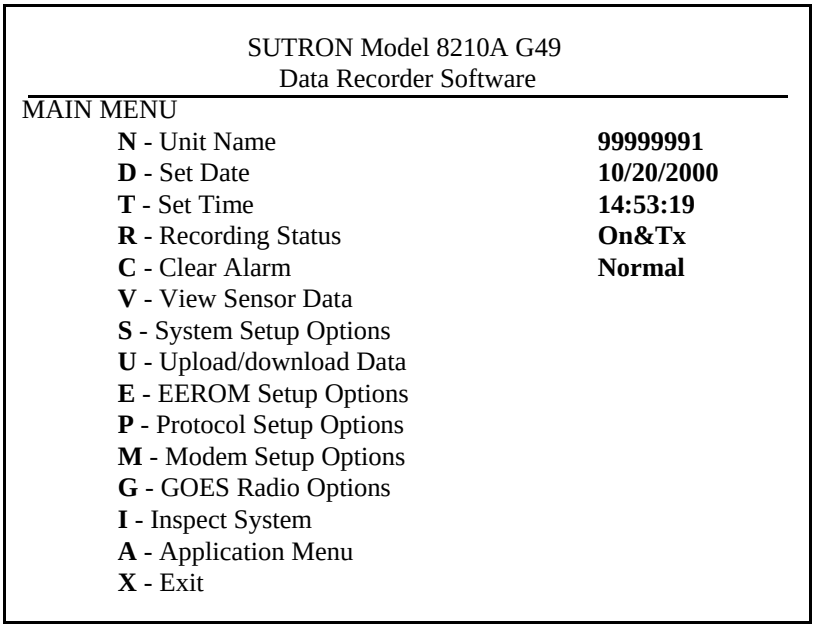


Figure 11: PCMI Slot

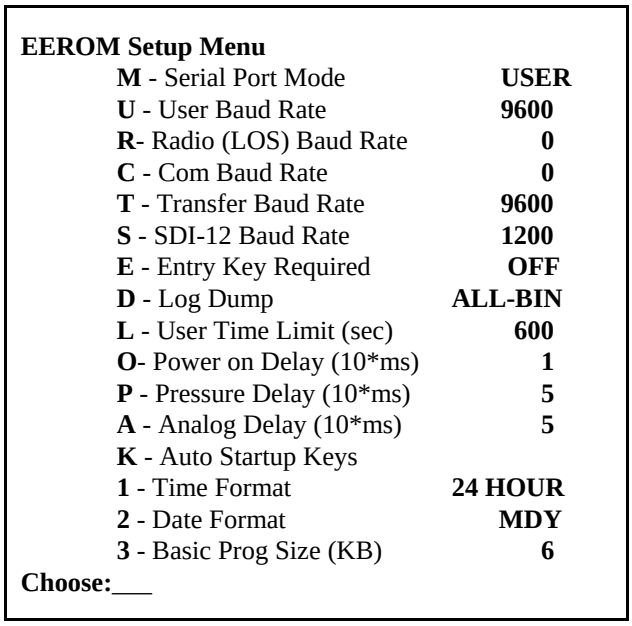
8210 MENUS



"Unit Name" is the station number assigned to the location of the tide equipment when it is deployed. It needs to be changed each time the equipment is setup in a new location.

Caution: *If Recording Status is ON& TX the UHF Radio is transmitting. A 50Ω resistor, or an antenna must be attached to the RF connector on the side of the gauge. (See GOES Radio Setup Menu below to toggle the transmitter off.)*

The Figure above is the Main Menu of the 8210. To select a menu item, type the letter from the menu and change appropriately, e.g., one can change the unit name , date, time, or to toggle the recording and transmitter on or off.



User time limit sets the amount of time that the user can stay on line, until they are kicked off. To reconnect, press F10 if TS8210 is the communications program being used, or remove the RS-232 connector from the 8210, or from the back of your computer, and then reconnect it. This will return you to the main menu.

The system setup menu is used to configure each sensor that has been enabled normally. All

sensor are configured in the lab. Each Item is selected in order when configuring the gauge.

System Setup Menu

M- Measurement Schedules
E- Enable Sensors
C- Configure Sensors
A- Alarm Options
B- Basic Program
P- Change Password
I- Init Setup
Z- Zero Counters

Choose: ___

Measurement Schedules

M - Measurement Interval	**00:06:00**
I - Sampling Interval	**00:00:08**
T - Measurement Time	**00:07:40**
S - Sampling Time	**00:04:30**
P- Switched Power Time	**00:04:30**
A - Samples to Average	**22**
L - Measurement per Log	**1**
B - Basic Run Interval	**00:06:00**
R - Basic Run Time	**00:00:00**
O - Switched Power Options	**OFF**

Choose: ___

Enable Sensors:
The 8210's GOES transmissions are formatted by a "Tiny Basic" program. This program requires certain sensors be enabled and no others. The screen below shows the required sensors. The PAROS sensor can be seen by selecting the [M]ore option.

Note: The Sensors that are enabled are preceded with an *. The required enabled sensor for this gauge are #BUF, Outliers, Deviation, Battery, and by selecting [M]ore you see the SDI0-1 which was renamed and selected for PAROS sensor.

[SELECT SENSORS]

CHOOSE [U]p [D]OWN [L]eft [R]ight [ENTER] [N]ame [M]ore:

Analog1	**Counter3**	**WindDir4**	**Ground**	**INP2**
Analog2	*#BUF	WaterLevel	Reference	INP3
Analog3	Frequency	*Outliers	Amplifer	INP4
Analog4	Frequency1	*Deviation	Optional	INP5
Analog5	Frequency2	Serial	GoesClock	INP6
Analog6	Frequency3	*Battery	Out1	INP7
Analog7	Frequency4	Sft8500	Out2	INP8
Analog8	WindSpeed1	Rain	Out3	INP9
Pressure	WindSpeed2	Og100	Out4	INP10
Encoder1	WindSpeed3	Org700	Out5	INP11
Encoder2	WindSpeed4	Timer1	Out6	INP12
Counter	WindDir1	Timer2	Out7	
Counter1	WindDir2	DataPack	Out8	
counter2	WindDir3	Excitation	INP1	

Configure Sensors

>#BUF
Outliers
Deviation
Battery
PAROS

```
Configuration
        M - Measure                OFF
        L - Log                    OFF
        A - Average                OFF
        I - Interval           00:00:00
Calibration
        V - Value                513.000
        S - Slope                 1.0000
        O - Offset               00.0000
        E - Elevation                  0
        R - RightDigits                0
```

>#BUF
Outliers
Deviation
Battery
PAROS

```
Configuration
        M - Measure                OFF
        L - Log                     ON
        A - Average                OFF
        I - Interval           00:00:00
Calibration
        V - Value            Current Value
        S - Slope                 1.0000
        O - Offset               00.0000
        E - Elevation                  0
```

>#BUF
Outliers
Deviation
Battery
PAROS

```
Configuration
        M - Measure                OFF
        L - Log                     ON
        A - Average                 ON
        I - Interval           00:00:00
Calibration
        V - Value                ___.____
        S - Slope                 1.0000
        O - Offset               00.0000
        E - Elevation                  0
        R - RightDigits                3
```

>#BUF
Outliers
Deviation
Battery
PAROS

Configuration	
M - Measure	**ON**
L - Log	**ON**
A - Average	**OFF**
I - Interval	**00:00:00**
Calibration	
V - Value	**12.805**
S - Slope	**1.0000**
O - Offset	**00.0000**
E - Elevation	**0**
R - RightDigits	**2**

>#BUF
Outliers
Deviation
Battery
PAROS

Configuration	
M - Measure	**OFF**
L - Log	**ON**
A - Average	**ON**
I - Interval	**00:00:00**
Calibration	
V - Value	___.____
S - Slope	**1.0000**
O - Offset	**00.0000**
E - Elevation	**0**
R - RightDigits	**3**

GOES Radio Setup Menu

T- Transmit Mode		**Basic**
S - Satellite ID		**XXXX:XXXX**
I - International		**OFF**
F - Format	(ST)	**BINARY**
C - Carrier	(ST)	**SHORT**
1 - Channel	(ST)	**XXX**
2 - TX Time	(ST)	**01:46:05**
3 - TX Rate	(ST)	**03:00:00**
4 - # Data Items / TX	(ST)	**31**
5 - Data Time	(ST)	**00:00:00**
6 - Data Interval	(ST)	**00:06:00**
R - Random Setup Menu		

Choose:___

Note: By Toggling "T" for Transmit Mode The GOES Transmitter can be turned off when it is not required. This will prevent damaging the transmitter when no antenna or 50 ohm load can be attached.

NOTE: The “current value” is an instantaneous sensor reading.

In the above example, the GOES Radio is setup to transmit using Platform ID or “Satellite ID of XXXX:XXXX on channel XXX at 1:46:05 GMT every 3 hours. Traditionally these parameters are assigned to the gauge and not to the station location; hence, need not be changed. However, in the event that a gauge has failed during operation, it has been determined that the new gauge would use the same Platform ID. This is the menu that would be used to make the appropriate changes. Each of the 8210 water level gauges has been assigned a unit number and specific GOES parameters such as platform ID, channel, transmit time, etc. Generally, when a gauge fails, and replacement gauge is installed, the replaced gauge’s platform ID, channel, transmit time are used.

APPENDIX A
GUIDELINES FOR OPERATION AND DOCUMENTATION OF HYDRO GAGES WITH GOES CAPABILITY

Hydrographic field parties shall follow the following guidelines:

Transmitting data using GOES

It is critical that these lines of communications and that timing factors be considered in the field planning. Lack of advance notification may cause a delay in the permission to start transmissions or the possible loss of data during the first few days of data collection.

1. Assignment of platform IDs and station numbers for tide station installations:

In general, unless the platform IDs have been pre-assigned, a request in writing, by fax or via telephone, for a platform ID for each gauge scheduled to collect and transmit data by GOES is required and should be submitted at least 1 month prior to the start of the hydro survey. The request must include the station number, name, and latitude and longitude of each upcoming installation. If an exact station location is unknown and no station number has been assigned, provide the name of the general area and an approximate latitude and longitude of the project area. The request will be forwarded to Wallops Island for platform ID assignment and Radio Frequency Authorization. A response is usually made within 2 weeks, at which time the installation log sheets will be faxed to the appropriate field party.

In cases where platform IDs have been pre-assigned to data collection platforms (DCPs), such as Sutron 8210 hydro gauges, the field party needs to provide information such as location and the appropriate gauge number (and the corresponding platform ID). For new station installations, request the assignment of station numbers as stated above.

2. Record and documentation requirements:

Prior to the start of data transmission at a site, confirm the gauge platform ID, related transmission parameters such as channel and transmit time, station installation date, gauge and all sensor serial numbers, by faxing the Next Generation Water Level Measurement System (NGWLMS) Site Report and Field Tide Note to RDD. This facilitates the configuration of that station in the Data Processing and Analysis Subsystem (DPAS) prior to the receipt of the first data transmission before the beginning of the hydro operations.

CAUTION: Failure to provide advance confirmation, as stated in Section 2 above, may result in the loss of transmitted data until the station is configured in DPAS.

3. Removal of tide stations and reinstallation of gauges:

Always contact RDD and inform in advance the date of removal of a hydro gauge. Generally, the data collection efforts are monitored, and if a platform transmission ceases from a particular site, then it would be difficult to judge whether the loss of transmission is caused by malfunction of a gauge or actual removal.

If an installed gauge at an original site is to be removed and reinstalled at a different site, then the following additional information shall be provided at least 1 month prior to the reinstallation of that gauge at the new site provide:

Station number, name, and expected date of removal of the existing gauge.
Station number, name, latitude, longitude, and expected date of installation of the gauge at the new location.

NOTE: If the new location is uncertain, but within a specified area, provide an estimated latitude and longitude to the nearest minute.

If deemed necessary, a new installation log sheet will be issued, as appropriate, with the same GOES ID and different related parameters, such as pointing angle of the antenna. The new log sheet will then be faxed to the field party requesting the information. Otherwise, all other information remains the same except for the station number, name, latitude and longitude.

CAUTION: Transmission of data by GOES requires advance planning and absolute certainty regarding the documentation requirements. Please follow these guidelines and all should go well. If there are any questions or help needed, please contact the following personnel.

East Coast Hydro Operations
Thomas F. Landon
Tel.: 301/713-2897 x191
E-mail: Thomas.Landon@noaa.gov
Fax: 301/713-4465 or 4435

West Coast Hydro Operations
Manoj R. Samant
Tel.: 301/713-2897 x190
E-Mail: Manoj.Samant@noaa.gov
Fax: 301/713-4465 or 4435

Common Address:
Requirements and Development Division
1305 East West Highway, SSMC4
Station 6409 for Tom Landon
Station 6350 for Manoj Samant
Silver Spring, MD 20910

APPENDIX B
8210 SOFTWARE NAVIGATION

The 8210 DCP is used with the Hydro gauges. For configuration information other than shown below, please contact the Requirements and Development Division, N/OPS1 at 301/713-2897.

The front panel of the 8210 allows the user to navigate, view, and change the programming variables.
[ON/OFF] Turns unit display/program on and off and deletes current data input entry when pressed during programming.
[Set] Opens and closes an input variable data field (an open or empty field is indicated by a flashing display).

Arrow Keys use:	**Right Arrow:**	Takes the user one step forward.
	Down Arrow:	Takes the user one step down.
	Up Arrow:	Takes the user back to the previous reading.
	Left Arrow:	1- takes the user to head of group. 2 - takes the user back to beginning.
UNIT ID:		Set the unit ID to read Station & DCP#. e.g. "Assigned Site ID Number 94546521"
DATE:	(**MMDDYY**)	Set to the current date in Greenwich, England GMT Date.
TIME:	(**GMT**)	Must be set to the nearest second. (**Correct time setting is critical**.)
RECORDING:	(**ON/OFF**)	Must be set to **ON** if data is to be logged in 8210. Will automatically switch off when changes are made to programming. When a transmitter is enabled, the display will read **ON&TX**

ALARM: **Normal**

VIEW DATA:---------Live Readings--------#BUF
Outliers
Deviation
Battery
PAROS **(Do not try to read live PAROS readings as this may lockup the 8210)**

Newest Readings-----#BUF
Outliers
Deviation
Battery
PAROS

Oldest Reading-------#BUF

Outliers
Deviation
Battery
PAROS

Alarm Status

SYSTEM SETUP: Measurement Schedule-

Measurement Interval	**00:06:00**
Sample Interval	**00:00:08**
Measurement Time	**00:07:40**
Sample Time	**00:04:30**
Pwr. Time	**00:04:30**
# Samples/set	**022**
Measurement/log	**001**
Baslnt	**00:06:00**
BasTim	**24:00:00**
Pwr Mode	**OFF**

Enable Sensors-------#BUF (ON/OFF)---- __ __ __
Outliers (**ON**/OFF)-----__ **Lg** __
Deviation (**ON**/OFF)----- __ **Lg** __
Battery (**ON**/OFF)----- Me Lg __
PAROS (**ON**/OFF)------**___Lg Av**

Configure Sensors

#BUF----------

Measure	OFF
Log	OFF
Average	OFF
Interval	00:00:00
Value ____	(live reading)
Slope	0001.00
Offset	00.000
Right Digits	(0)
Elevation	(0)

Outliers---------

Measure	OFF
Log	ON
Average	OFF
Interval	00:00:00
Value ____	(live reading)
Slope	0001.00
Offset	00.000
Elevation	(0)
Right Digits	(0)

Deviation------Measure OFF

Log ON
Average OFF
Interval 00:00:00
Value ____ (live reading)
Slope 0001.00
Offset 00.000
Elevation (0)
Right Digits (3)

Battery---------Measure ON
Log ON
Average OFF
Interval 00:00:00
Value ____ (live reading)
Slope 0001.00
Offset 00.000
Elevation (0)
Right Digits (2)

PAROS--------Measure OFF
Log ON
Average ON
Interval 00:00:00
Value ____ (live reading)
Slope 0001.00
Offset 00.000
Elevation (0)
Right Digits (3)

Alarm Options--------**#BUF**----------Enable OFF
Groups 000
Control OFF
1-High Alarm OFF
1-Low Alarm OFF
3-ROC Alarm OFF
Alarm Limits
High Limit 0.000
Low Limit 0.000
ROC Level 0.000
DeadBand 0.000
Alarm Phrases
Prefix (Name) 0

Suffix (Units) 0

Outliers--------Enable OFF
Groups 000
Control OFF
1-High Alarm OFF
1-Low Alarm OFF
3-ROC Alarm OFF
Alarm Limits
High Limit 0.000
Low Limit 0.000
ROC Level 0.000
DeadBand 0.000
Alarm Phrases
Prefix (Name) 0
Suffix (Units) 0

Deviation------Enable OFF
Groups 000
Control OFF
1-High Alarm OFF
1-Low Alarm OFF
3-ROC Alarm OFF
Alarm Limits
High Limit 0.000
Low Limit 0.000
ROC Level 0.000
DeadBand 0.000
Alarm Phrases
Prefix (Name) 0
Suffix (Units) 0

Battery---------Enable OFF
Groups 000
Control OFF
1-High Alarm OFF
1-Low Alarm OFF
3-ROC Alarm OFF
Alarm Limits
High Limit 0.000
Low Limit 0.000
ROC Level 0.000
DeadBand 0.000
Alarm Phrases

Prefix (Name) 0
Suffix (Units) 0

PAROS-------- Enable GOES
Groups 000
Control OFF
1-High Alarm OFF
1-Low Alarm OFF
3-ROC Alarm OFF
Alarm Limits
High Limit 0.000
Low Limit 0.000
ROC Level 0.000
DeadBand 0.000
Alarm Phrases
Prefix (Name) 0
Suffix (Units) 0

Basic Program — Puts user in the programing mode do not go there (Type Quit to EXIT)
Change Password----------Password — Not Used * See NOTE:1
Init Setup — Clears all Programing
Zero Counter — Clears Error Counters

DUMP DATA----------Start MM/DD/YY
Auto Dump Off
RAM Card — (pressing "Set" will automatically start data dump to the RAM Card .)
Serial Port — (pressing "Set" will automatically start data dump to the serial port.)
Read Card Setup — (Used to up-load system program from RAM Card.)
Write Card Setup — (Will send the current system setup to the RAM Card.)
Erase RAM Card — (Will clear all information on the RAM Card.)

GOES Setup----------Transmit Mode — Basic (Will enable the transmitter on and off)
Satellite ID _____ — (Set the GOES ID Number assigned to this unit.)
International OFF
Format BINARY
Carrier SHORT
Channel _____ — (Set the channel number assigned the GOES

ID number above.)

TX Time _____ (Set the time that is assigned the GOES ID number above.)

TX Rate 03:00:00 (Set the time interval between transmittons.)

Data Items/TX 31

Data Time 00:00:00

Data Interval 00:06:00

RANDOM SETUP

EEROM SETUP-------Serial Rate USER

User Rate 9600

Radio (LOS) 0 (Line of sight radio not used in the gauge.)

Com Rate 0 (Data Modem not used in this gauge.)

Transfer Rate 9600

SDI Rate 1200

Enter Reqd OFF

Log Dump All Bin

Time Limit (6000) (Sets the amount of time the display will remain on.)

Power Delay (1)

Press Delay (5)

Analog Delay (5)

Autokey _____

Tim fmt 24Hour

Date fmt M/D/Y

Basic size (6)

PROTOCOL----------Master (Not used)

Carrier Delay (7)

Reply Delay (0)

ACK Delay (*100*)

TN Rate 00:00:00

TA Rate 00:00:00

Retry In 00:00:00

Retries (3)

INSPECT SYSTEM--Perform Self Test

Display Status

Clear Status

Enter SDI-12 Cmd. (Can be used to command the SDI-12 sensor.)

Talk to Modem

GOES Radio Test-----(S)elftest

(R) andom

(I)nfo to Sutron (This test, formats a message

and transmits it on channel 151)

Monitor SSP
Production Test

* **NOTE 1:**.....Do NOT SET A PASSWORD

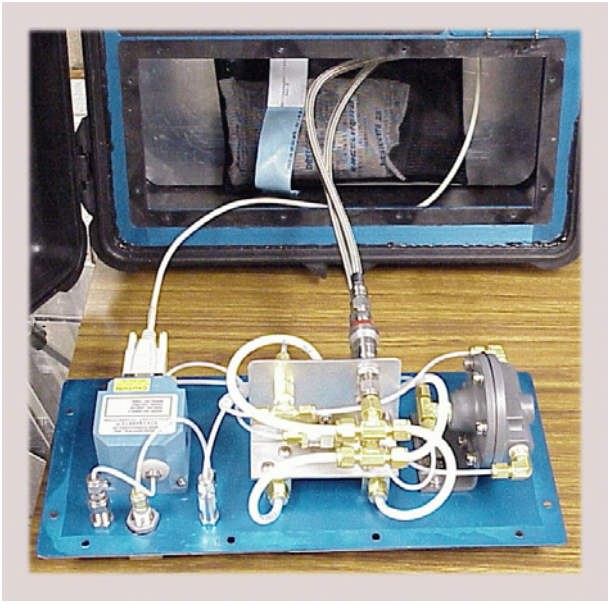
"Change password" is used to set an access password for the 8210 In the "System Setup Menu". Up to 5 letters may be entered to specify the password. When the password is blank it is disabled and the system will not prompt for the password. When the password is not blank the 8200 will prompt for the password when you first try to use a setup menu. If the password is entered correctly you will have access to all of the 8200 setup menus. You will not need to enter the password again until the display is turned off or you log off if using a PC or modem.

If you forget the password it can be initialized to blank (disabled) by pressing the down arrow key while powering up the 8200. If the message "password INIT" flashes on the screen the operation was done correctly.

***NOTE 2:**

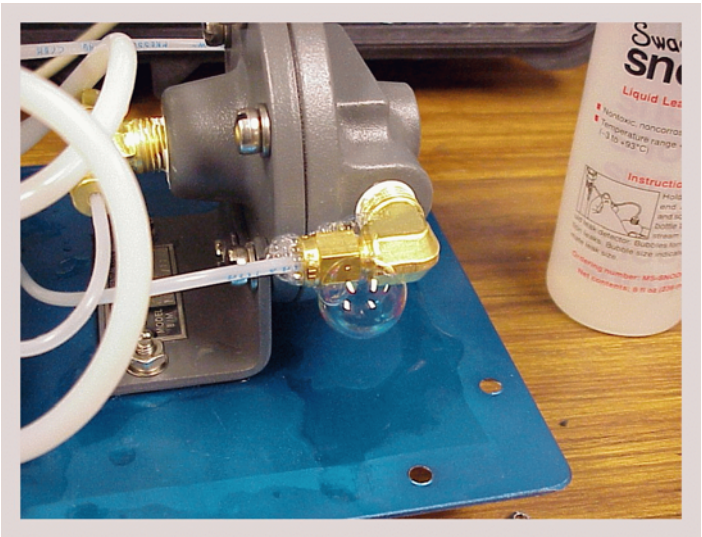
"Slope" and "Offset" are determined in the lab through calibration. If the PAROS Sensor is being used, it is internaly calabrated, and there would be no other Slope or Offset required.

APPENDIX C
PROBLEMS WITH EQUIPMENT OR STATIONS DATA



This Photo shows the Pressure control unit extended for leak testing note that the control unit has been twisted 180° to permit access to the fittings. Do not forget to check two fitting that are still inside the case at end of the medial braided hoses.

Figure 12: Pressure Control Unit Leak Testing



Note the bubbles forming around this fitting. Swagelok® "Snoop®" is a solution specially formulated to form bubbles around leaking fittings. A mix if one or two drops of Vicks Intensive Care hand lotion in a pint of water could be used if Snoop® in not available.

Figure 13: Leaking Fitting

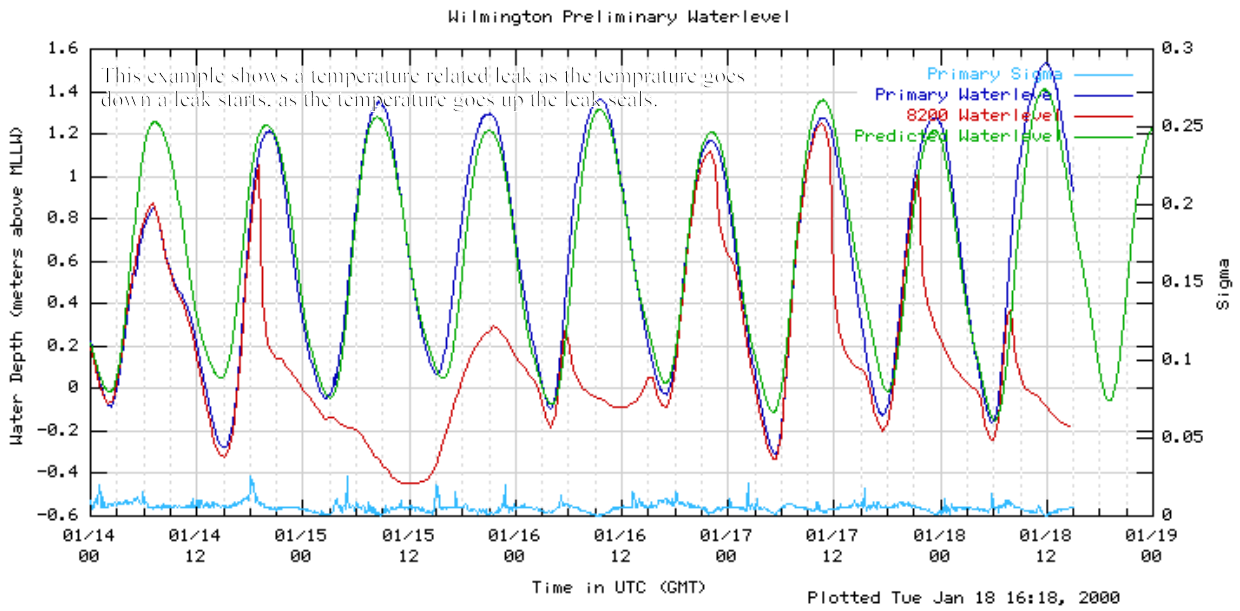
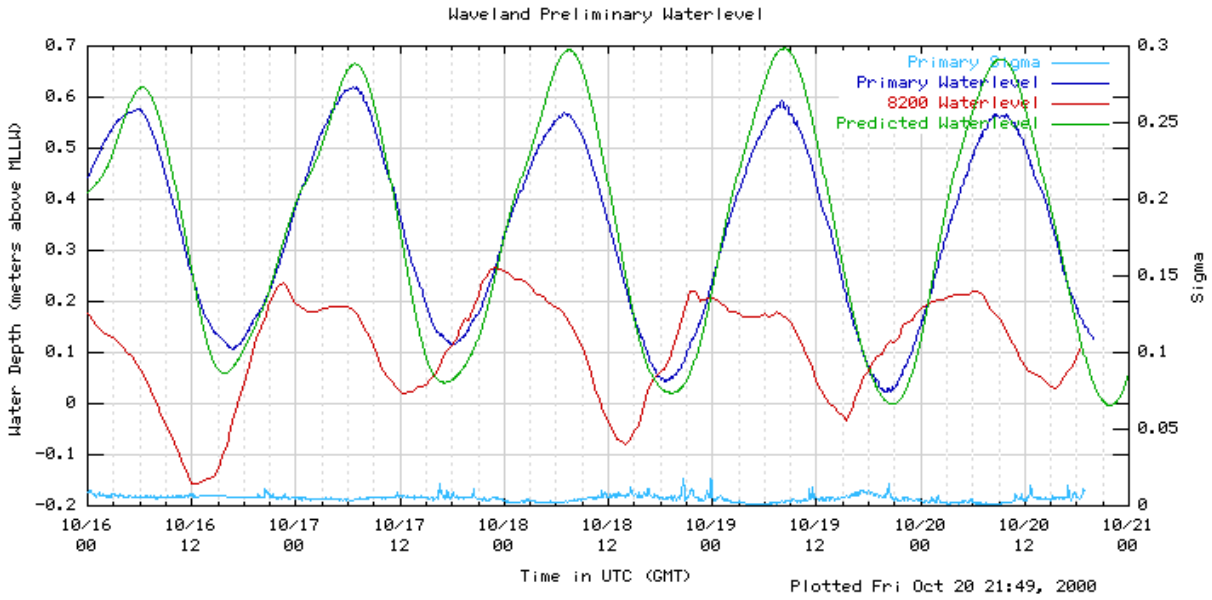
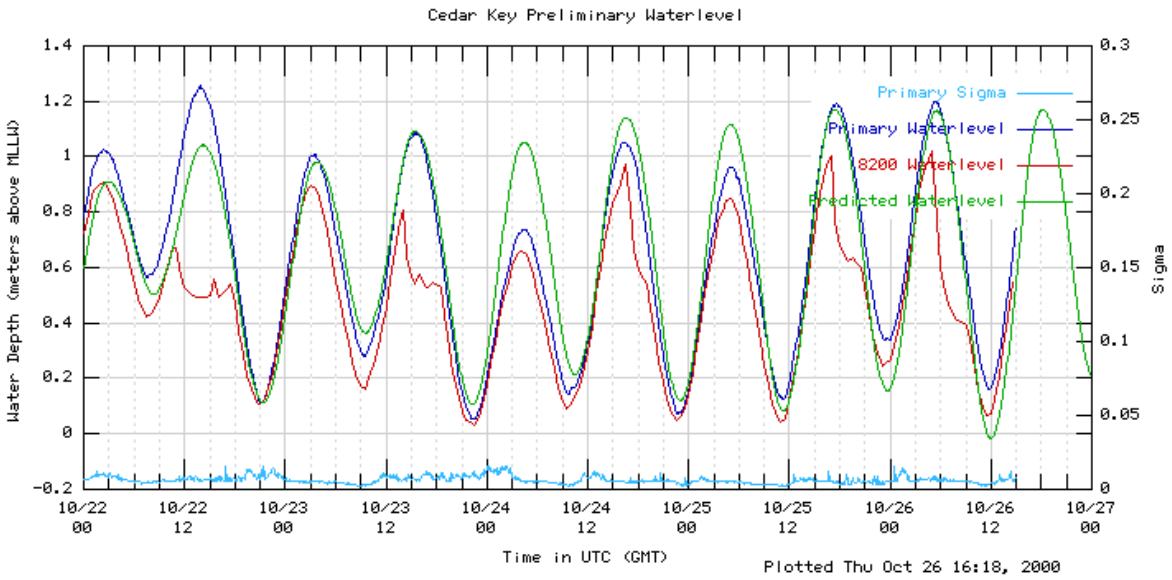


Figure 14: Shows data graphs, of tidal data and temperature sensors taken from a NWLON primary tidal station.

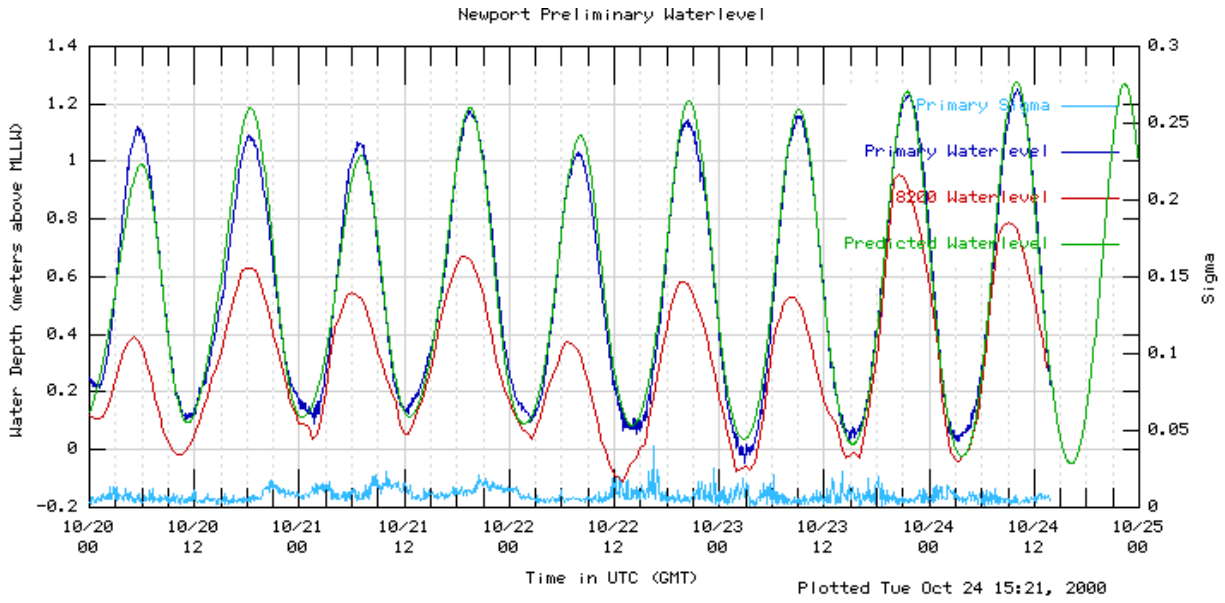
In the example above, the red tide curve is a bubbler type tide gauge. A leak starts and the pressure drops in the bubbler line. This loss of pressure will sometimes drop all the way to 0 psi. More often as the pressure drops, the leak will stop because the fitting is tight enough to hold the lower pressure, but not tight enough to contain a higher pressure associated with higher tides. As the pressure increases, the leak recurs again starting the process over and over again. A leak will sometimes only manifests itself in cold weather. As the temperature drops as shown in the lower graph, the plastic bubbler tubing shrinks faster than metal fitting causing a leak. The best way to avoid temperature related leaks is to check the gauge before the orifice is installed. The 8210 tide gauge has self-closing quick disconnect fittings on both the input and output of the gauge. By connecting the input to a nitrogen tank and over-pressurize the system to 36 psi, then turn off the valve on the nitrogen tank and wait 15 to 30 minutes. Check for any loss of pressure. If there is a loss of pressure look for the leak by removing the pressure control unit. It should be noted that the 8210 motherboard must be removed before removing the pressure control unit. Use a leak detection liquid like Snoop®, and look for the formation of bubbles around the leaking joint. Tighten that joint and test again. Figure 12 and 13 on back page show the leak testing of the pressure control unit.



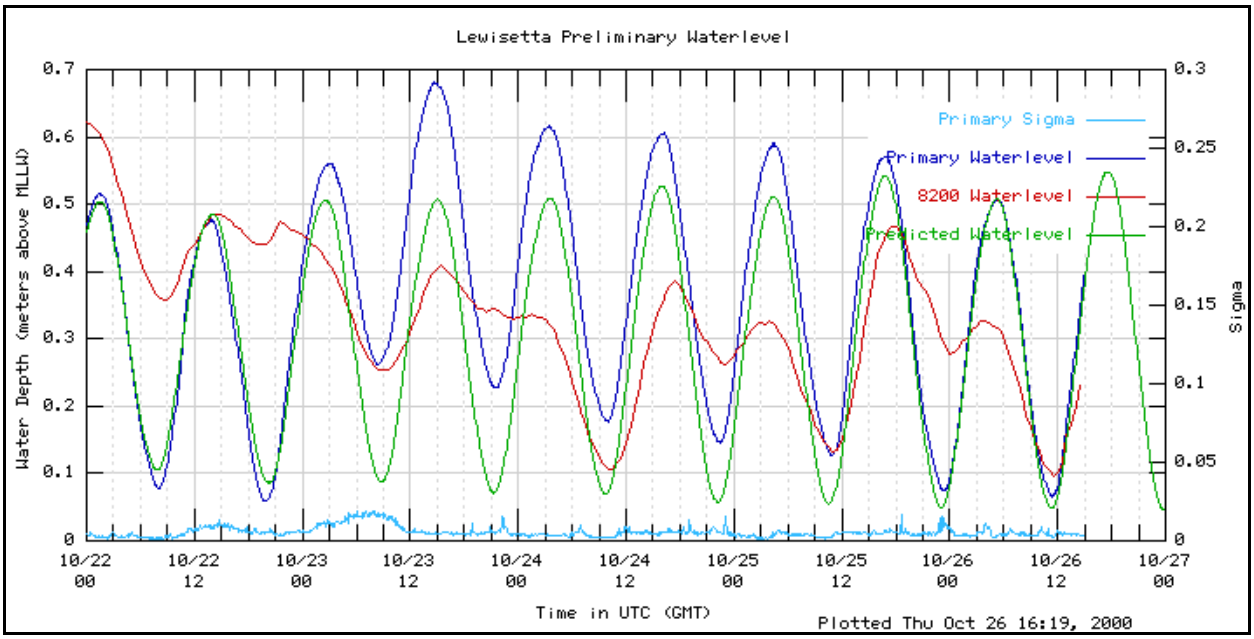
The Waveland water level example shows an tide station that has run out of gas notice how there is still a rise and fall of water levels but it dose not track the predicted and acoustic measurements.



The Cedar Key data graph shows a leaking fitting probably in the manifold assembly. As the pressure increases the leak starts, and then pressure drops, and then as pressure builds again the leak opens again.



In this example for Newport News data graph either the tank pressure is getting low or the low pressure feed is not great enough to follow the full tidal range. There just is not enough pressure



to push the bubble out of the end of the orifice.

APPENDIX D
TROUBLESHOOTING GUIDE

In most cases, if there is a problem with a tide gauge that is not easily resolved, call Pacific Regional Office, and get assistance from one of the technicians.

Display will not light	1. Battery discharged or worn out. Check battery voltage for the display to light. It needs to be greater than 9.5 volts. For the system to work correctly, the battery should be greater than 12.0 volts. 2. Check the solar panel or external charger. 3. The system may be resetting. This could take several minutes. 4. Check fuses. The battery fuse on the cover to the interconnect board and on the interconnect board is a fuse that supplies power to the 8210 CPU board.
Display is too dim.	To change the display brightness, press the "SET" key when the display is at the top of the MAIN MENU.
No data in the log (missing data)	Recording is OFF in the main menu. Turn recording to ON. If there is data from one or the other sensor, check in the configure sensor to see if the LOG option is switched on for the sensor that is not logging data. If the log shows no PAROS data, change-out the tide gauge, and return it to Seattle.
8210 loosing clock time when the battery is disconnected	Make sure the RAM battery on the CPU board is >2.6 volts. Check the battery jumper near the RAM batttery, it should be on.
System runs for a short time and then resets	Possible low battery voltage. If problem persists return unit to factory.

GOES Transmitter will not Transmit	1. Using an external through-line watt meter, check forward power to the antenna or resistive load. There should be approximately 7-10 watts of power. 2. Check reflected power. There should be less than 2.5 watts 3. Using an ohm meter, check the resistance from the center pin of the antenna connector to the threaded shell of the same connector. It should have a DC resistance of less than 3 ohms. 4. Check the battery voltage. The battery should drop only 0.5 volts when the radio is transmitting. The battery voltage must be greater than 10.5 volts and less than 14.9 volts for the transmitter to work. 5. Check the battery connection in the battery box. Make sure it is tight. Check the connecters. Make sure they are tight. 6. Look along the path of the GOES antenna. See if it is pointing at a mountain, building, or trees. Any of these could block the signal from reaching the satellite. 7. Make to sure fail-safe has not tripped. Use system status display to check or look at recording status. It will say "ON&FT" if the fail-safe is tripped. To reset the fail-safe using the front panel, go to the recording status and press SET until the FT goes away. There is also a hardware reset on the GOES transmitter board near the ribbon cable. By momentarily pressing this button, the fail-safe should reset. 8. Check the fuse to the GOES transmitter board. There is an in-line fuse on the power cable to the GOES transmitter.
Can not transfer data to the PCMI (RAM) card	The RAM or Static PCMI data card has an internal battery. Check this battery. It should be greater that 2.8 volts.

Fuses

There are several fuses protecting the 8210 water-level gauge. The following list shows all the voltage protection devices for this unit. Fuses designated RVx are thermal fuses and automatically reset when they cool off. They cannot be changed in the field.

1. Interconnect board	F1	1amp 3AG	12V to CPU board
	RV1, RV3	60ma	RS85 protectioon
	RV2	.45 amp	SDI-12 port +12V
2. CPU	RV1	.66amp	J1 pin 1 Aux +12V protection
	RV2	.66amp	Switched +12 V protection
3. GOES module	In Line	5 amp 3AG	+12 to Radio
4. Top panel interconnect	Fuse left	6amp 3AG	Solor panel fuse
5. Top panel interconnect	Fuse Right	6amp 3AG	Batttery Fuse.

Antennas

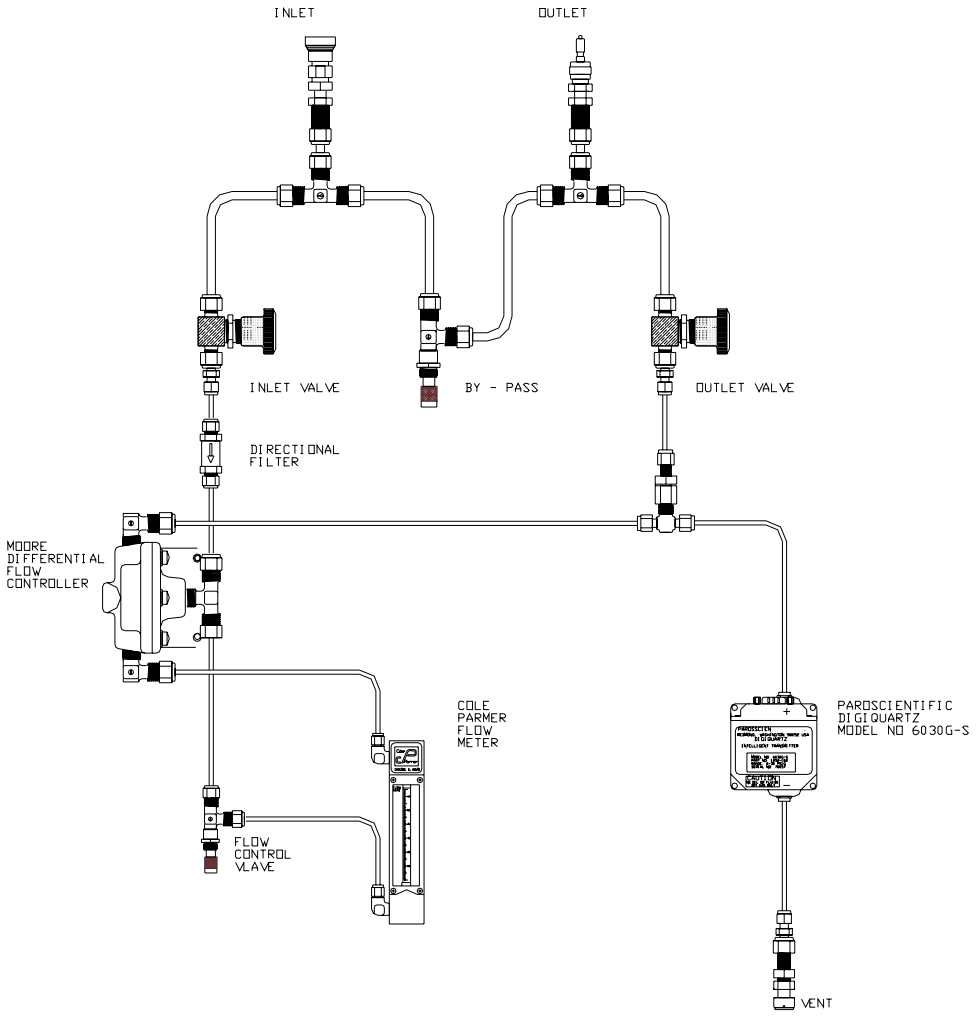
There are two types of antennas that may be encountered in the field. The first is the Yaggi type, which is a highly directional antenna that has a typical power gain of 9 to 12 dB. About the only thing needed to be said about gain, is that effective power is doubled every 3 dB. In other words, the signal at the receiver will be twice as strong if the antenna has a gain of 3 dB. This is due to the concentration of power created by the tightness of the beam from the antenna. A typical Yaggi antenna has a beam of (20˚) degrees.

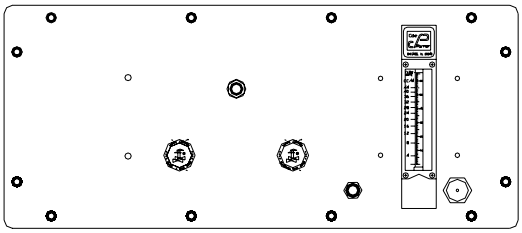
The most common type of antenna that NOS uses is the flat plate antenna. This antenna has a very wide beam (96˚) and a gain of 3 dB. With a beam this wide, obstructions that are some distance away have little effect on the signal quality. The primary concern is that there should be a clear view of the satellite. If the satellite is behind a mountain, ship, or building, there is little chance that the signal will get through. In addition to keeping any objects out of the direct line-of-sight path to the satellite, maintain at least a meter (3 feet) clearance on each side. It is also a good idea to maintain a distance of 1 meter (3 feet) from any other antennas. If the roof of the building is made of fiberglass, the antenna can be mounted inside.

A two-inch pipe works well to mount the antenna on. Typically, we use a 10-foot section, a "T" coupling, and a 6-foot section to mount the antenna and solar panels. The "T" junction is used to secure the pipe to the side of the tide house.

Antenna Testing	Mod 14 antennas are designed to read a dead short to dc voltages. This can be seen by connecting an ohm meter from the outer shell of the antenna connector to the inter pin of the same connector. This should read less then 1 ohm. When you test the antenna resistance in the field, it is best to disconnect the coaxial cable from the front of the hydro gauge. Measure from the center pin to the outer shell of the coaxial connector on the cable. This resistance is dependent on the length of the total coaxial cable that you are using. However, the total resistance should be less than 3 ohms. If the resistance is greater than 3 ohms, the antenna should be replaced or repaired. The resistance is due to corrosion either between the connection of the two internal antenna plates or in the coaxial cable and/or its connectors. Extremely high resistance is caused by a broken connection between the two plates. To test the antenna, remove it from the coaxial cable, and measure the resistance again.
Antenna Cables and Connectors	NEVER coil the antenna cable. This will make the RF signal induce a magnetic field around the coil. When the field collapses into the cable, the induced signal cancels the transmitted signal distorting the data quality. Antenna connectors will be wrapped with "Scotch 130c Linerless Rubber Splicing Tape"; then the connector is wrapped with "Scotch 33" Black Electrial Tape; then painted with "Scotch Coat". This proved, from years of experience on the ships, to prevent any water from getting into the connectors. The type of tape used is very important regarding connectors' ability to withstand extreme temperature changes.

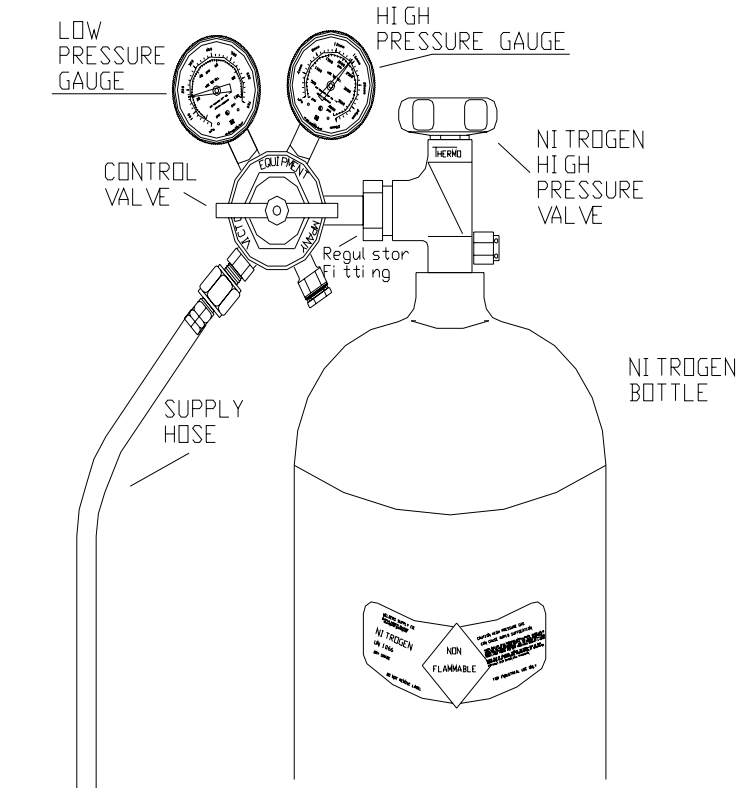
APPENDIX E
PNEUMATIC CONNECTIONS





TOLERANCE		DESCRIPTION	
		PACIFIC OPS SECT.	
DWG JDR	11/00	PNEUMATIC CONNECTIONS	
CHK			
APVD		DWG NO. F0B00051	REV
ISSUE		SCALE	SH OF

Appendix F
CHANGING THE NITROGEN TANK



INSTRUCTIONS TO CHANGE NITROGEN CYLINDER

1. CLOSE THE NITROGEN HIGH PRESSURE VALVE CLOCKWISE
2. TURN THE CONTROL VALVE COUNTER CLOCK-WISE UNTIL IT IS REMOVED FROM THE NITROGEN REGULATOR. THE CONTROL VALVE MAY BE A GREEN KNOB INSTEAD OF THE "T-HANDLE" SHOWN
3. REMOVE REGULATOR WITH 12" WRENCH TURNING COUNTER CLOCK-WISE.
4. REPLACE THE NITROGEN BOTTLE. TORQUE THE REGULATOR FITTING HARD.
5. OPEN THE HIGH PRESSURE VALVE.
6. REPLACE THE CONTROL VALVE TURNING THE CONTROL VALVE CW SLOWLY UNTIL THE LOW PRESSURE INCREASES SLIGHTLY OR REACHES THE CORRECT LOW PRESSURE SETTING OF 30-35 SEE NOTE 2

NOTE:

1. DO NOT USE TEFLON TAPE ON THE REGULATOR FITTING. (THIS IS A METAL TO METAL HIGH PRESSURE SEAL)
2. IF LOW PRESSURE IS TOO HIGH TURN THE CONTROL VALVE COUNTER CLOCK-WISE AND WAIT UNTIL THE PRESSURE BLEEDS DOWN TO SET THE ADJUSTMENT TO THE CORRECT VALUE.