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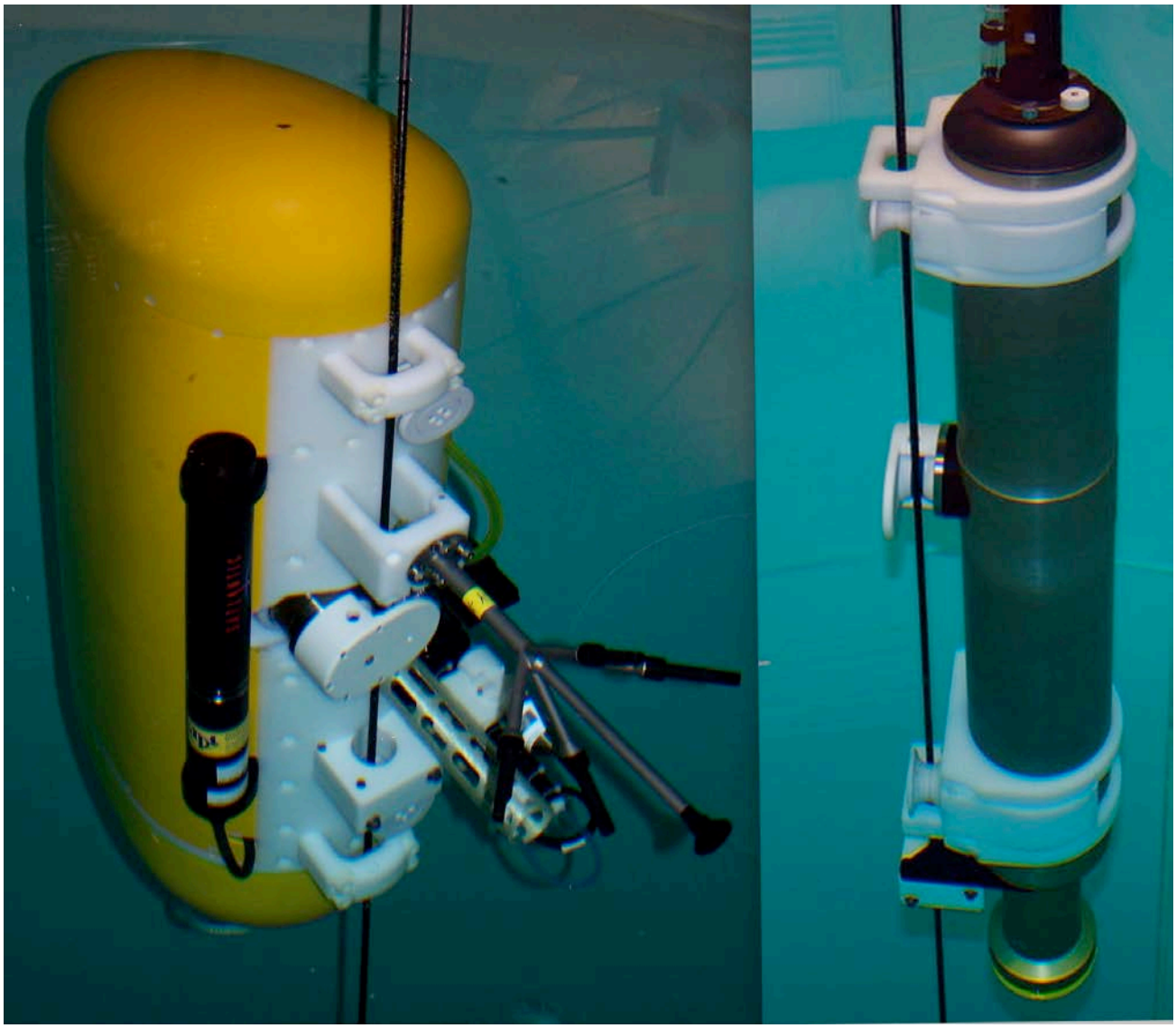
Profiler Integrated Sensors & Communications Interface

User Manual



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MMP Integrated Sensors and Communications

The MMP requires a Conductivity, Temperature, Depth (CTD) sensor to control profiler movement and profiling duration. Many other optional integrated sensors are available. McLane also integrates new sensors upon customer request.

Installed sensors affect battery drain and ballast calculations. Contact McLane (www.mclanelabs.com) for further information.

Each integrated sensor and the inductive communications options are explained in the following chapters:

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User Key

This user manual contains the following keys to call attention to information:

	**Note**	Information of special note such as proper battery installation.
	**Important**	Information to take caution such as handling of bulk head connectors.
	**Caution**	Information to prevent serious conditions such as loss of data.

Chapter 1
Sea-Bird CTD Sensors – General Information

The Profiler requires a Conductivity, Temperature, Depth sensor (CTD) to control profile duration and depth. The 52MP CTD is the default CTD enabled on the Profiler. Other CTD sensors are also available. This section provides information common to the 52MP CTD and the 41CP CTD. The 41CP CTD is installed only on the Ice Tethered Profiler (ITP). For more information about Sea-Bird CTD sensors, refer to the Sea-Bird Electronics website (www.seabird.com) or contact Sea-Bird.

Correct sensor orientation is critical. Completely review sensor-specific mechanical instructions in each section of this Chapter and consult Sea-Bird before disassembling sensor components.

Protecting Sea-Bird CTD Water Outlet Cells

The Sea-Bird sensor cells have protective caps that cover the water intake port and the T-shaped water outlet. Keep these protective caps in place until deployment to prevent contamination by airborne particulates. The water intake port has a TC Duct that keeps the water measured by the temperature sensor the same as the water that passes through the cell. Contamination can coat the cell walls and change sensor calibration.

Flushing before and after deployment keeps the cell clean and facilitates wetting the conductivity cell electrodes. Use a dilute solution of Triton X-100 (approximately 1 part Triton to 50 parts deionized water).

Testing Sea-Bird CTD Sensors

When Bench Testing with the Sea-Bird CTD sensors use a closed loop of tubing to connect the intake and exhaust ports.

Using Bench Test Options

The main Bench Tests and 52MP/41CP CTD Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors.

1. From the main Profiler Menu, type *5* at the prompt to display the Bench Tests Menu.

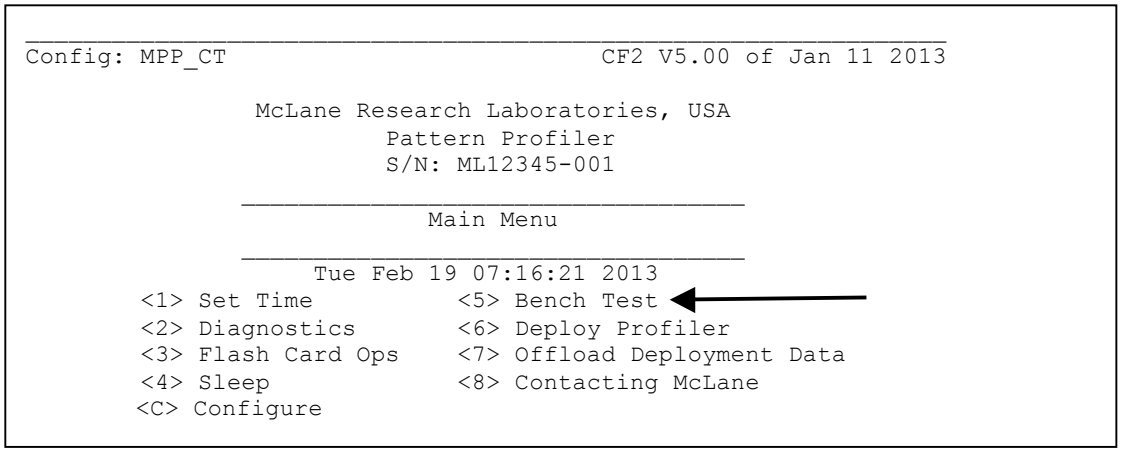


Figure 1-1: Profiler Main Menu

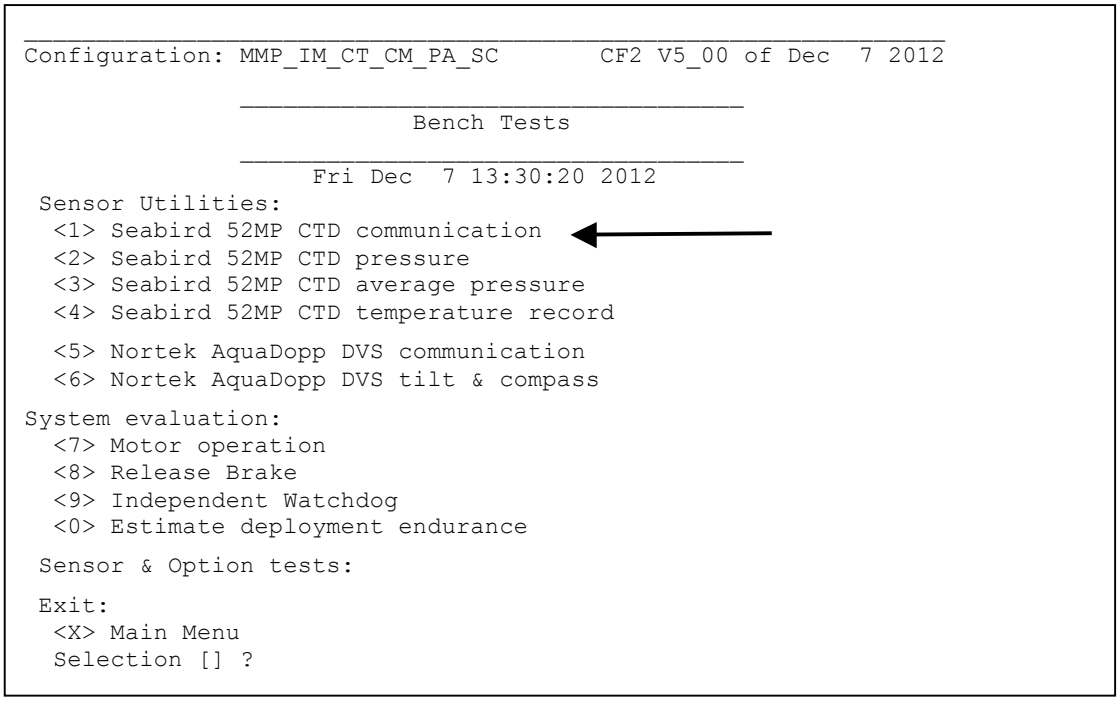


Figure 1-2: Profiler Bench Tests Menu

The sensor-specific Bench Tests menus are the same for the Sea-Bird 52MP and 41CP CTD sensors. The examples shown in this section feature the 52MP CTD.

2. From the Bench Tests menu, type *1* at the prompt to display the Seabird 52MP/41CP CTD Bench Test Menu (Figure 1-3).

3. Type *1* to connect directly with the 52MP/41CP CTD.

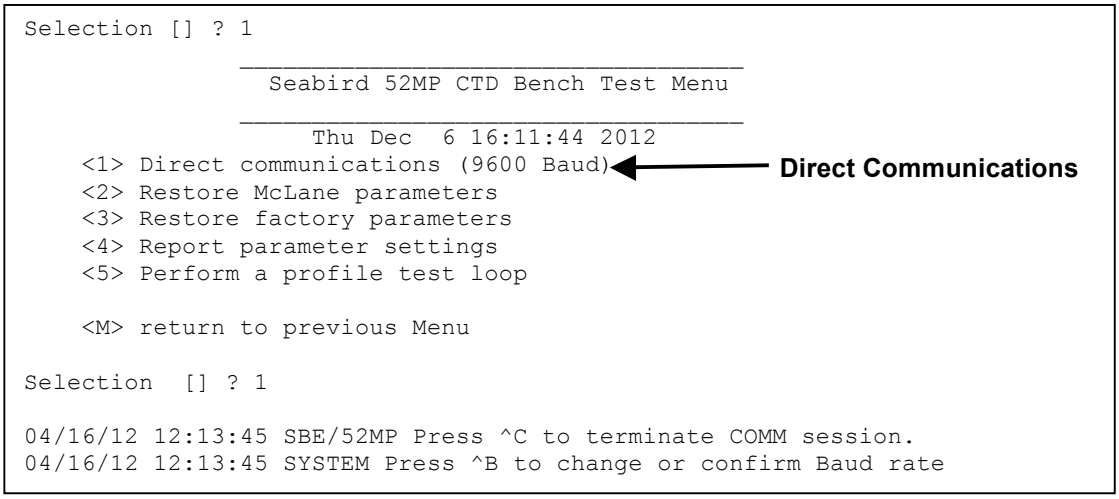


Figure 1-3: 52MP CTD Bench Test Menu

The Profiler communicates with the Sea-Bird CTD at 9600 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 1-4). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
************************************************************

-Êûx-òÄ-fûx-`¸ò6x-Ê‡-ò-ûfxf6òx¯Ü6ò-òÄ-Ê¯¯


04/23/14 12:50:37 SBE/52MP ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 1-4: Baud Rate Communication Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu displays the Baud Rate menu (Figure 1-5). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013
                ____________________________________
                         Pattern Profiler
                        Select new Baud rate
                ____________________________________
                     Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 1-5: Baud Rate Menu

Direct Sensor Connection

Once connected directly to the CTD, typing commands at the command prompt provides additional sensor information.

```
Selection  [] ? 1
01/11/13 13:47:03 SBE/52MP Press ^C to terminate COMM session.
01/11/13 13:47:04   SYSTEM Press ^B to change or confirm Baud rate.

01/11/13 13:47:04 SBE/52MP 9.6 kBaud communication channel opened.
01/11/13 13:47:04 SBE/52MP Powered on.
************************************************************
SBE 52 MP 2.4  <-- 52MP CTD
S>DS
SBE 52 MP 2.4  SERIAL NO. 0107
DO installed = no
stop profile when pressure is less than = -100.0 decibars
automatic bin averaging when p < -100.0 disabled
number of samples = 304
number of bins = 0
top bin interval = 10
top bin size = 10
top bin max = 100
middle bin interval = 50
middle bin size = 50
. . .  <-- Display shortened for brevity
S>slp
S> [^C]
************************************************************
01/11/13 13:48:08 SBE/52MP Powered off.
01/11/13 13:48:08 SBE/52MP 9.6 kBaud communication channel closed.
```

Figure 1-6: Option <1> 52MP CTD Direct Communications

```
Selection  [] ? 1
04/22/14 16:10:20 SBE/41CP 9.6 kBaud communication channel opened.
04/22/14 16:10:20 SBE/41CP Powered on.
************************************************************
SBE 41CP-IDO McLane V 3.0  <-- 41CP CTD
S>ds
SBE 41CP-IDO McLane V 3.0  SERIAL NO. 5556
firmware compilation date: 4 February 2010
stop profile when pressure is less than = -100.0 decibars
automatic bin averaging at end of profile disabled
number of samples = 81
number of bins = 0
top bin interval = 10
top bin size = 10
top bin max = 100
middle bin interval = 50
middle bin size = 50
. . .  <-- Display shortened for brevity
S> [^C]
************************************************************
04/22/14 16:10:27 SBE/41CP Powered off.
04/22/14 16:10:27 SBE/41CP 9.6 kBaud communication channel closed.
```

Figure 1-7: Option <1> 41CP CTD Direct Communications

Restore McLane and Factory Settings

Option <2> and <3> from the SBE 52MP/ 41CP Bench Test menu restore the McLane or Seabird factory settings. Figure 1-8 shows a reset of the McLane-defined parameters. Using option <2> requires typing the password *McLane*.

```
       Selection  [M] ? 2  Password: mclane

14:58:37 SBE/52MP communication channels opened.
14:58:37 SBE/52MP powered ON.
14:58:37 SBE/52MP sending command []. ..
14:58:37 SBE/52MP sending command []. .
14:58:38 SBE/52MP sending command [pcutoff= -100.0]. .
14:58:38 SBE/52MP sending command [initprofile]. .
14:58:39 SBE/52MP sending command [ds].
.........................................

14:58:40 SBE/52MP was able to restore McLane parameters.

14:58:40 SBE/52MP powered OFF.
14:58:40 SBE/52MP power-down delay .....................
14:58:45 SBE/52MP communication channels closed.
```

Figure 1-8: Option <2> Restore McLane Settings

Option <3> 'Restore factory parameters' (not shown) restores the configuration parameters delivered with the 52MP CTD. Using option <3> requires the password *factory*.

The firmware requires the Sea-bird CTD parameters configured by McLane. Changing settings, or resetting to the factory settings prevents the CTD from working correctly with the Profiler.

Display Current Settings

Option <4> displays the current SBE 52MP/41CP CTD settings.

```
         Selection  [M] ? 4

14:58:54 SBE/52MP press ^C to terminate COMM session.
14:58:55 SBE/52MP communication channels opened.
14:58:55 SBE/52MP powered ON.
************************************************************

14:58:55 SBE/52MP executing scripted commands. Please wait...

14:58:55 SBE/52MP sending command [ds].

S>

14:58:56 SBE/52MP completed scripted commands.

14:58:56 SBE/52MP press ^C to terminate COMM session.

SBE 52 MP 1.1a  SERIAL NO. 0007
stop profile when pressure is less than = -100.0 decibars
automatic bin averaging when p < -100.0 disabled
number of samples = 0
number of bins = 0
top bin interval = 10
top bin size = 10
top bin max = 100
middle bin interval = 50
middle bin size = 50
middle bin max = 1000
bottom bin interval = 100
bottom bin size = 100
do not include two transition bins
oxygen frequency multiplier = 0.25
S>

S> [^C]
************************************************************

14:59:08 SBE/52MP powered OFF.
14:59:08 SBE/52MP power-down delay .....................
14:59:13 SBE/52MP communication channels closed.
```

Figure 1-9: Option <4>Report Parameter Settings

Perform Profile Test Loop

Option <5> runs a profile test loop. This test simulates an automated sensor verification and a 5 minute profile.

```
Selection  [] ? 5

11/28/12 12:37:00 SBE/52MP Automated verification of sensor settings.

11/28/12 12:37:01 SBE/52MP 9.6 kBaud communication channel opened.

11/28/12 12:37:01 SBE/52MP Powered on.

11/28/12 12:37:01 SBE/52MP Sending command [qs].

11/28/12 12:37:02 SBE/52MP Sending command []. . .

11/28/12 12:37:03 SBE/52MP Sending command [ds]. ..............

11/28/12 12:37:04 SBE/52MP Identified as V2.4, S/N 106.

11/28/12 12:37:04 SBE/52MP Sending command [outputctdo=n]. .

11/28/12 12:37:04 SBE/52MP Sending command [outputctdoraw=n]. .

11/28/12 12:37:05 SBE/52MP Sending command [pcutoff= -100.0]. .

11/28/12 12:37:05 SBE/52MP Sending command [initprofile]. .

11/28/12 12:37:06 SBE/52MP Sending command [ds]. ..............

11/28/12 12:37:07 SBE/52MP Powered off.

11/28/12 12:37:07 SBE/52MP Power-down delay .....................

11/28/12 12:37:12 SBE/52MP 9.6 kBaud communication channel closed.

11/28/12 12:37:13   SYSTEM Deleting C0000000.DAT.

1 file(s) erased

Press ^C to exit the loop
```

Figure 1-10: Option <5> Perform Profile Test Loop

Additional Sensor-Specific Test Options

From the main Bench Tests menu additional sensor testing options can be selected for pressure and temperature averages.

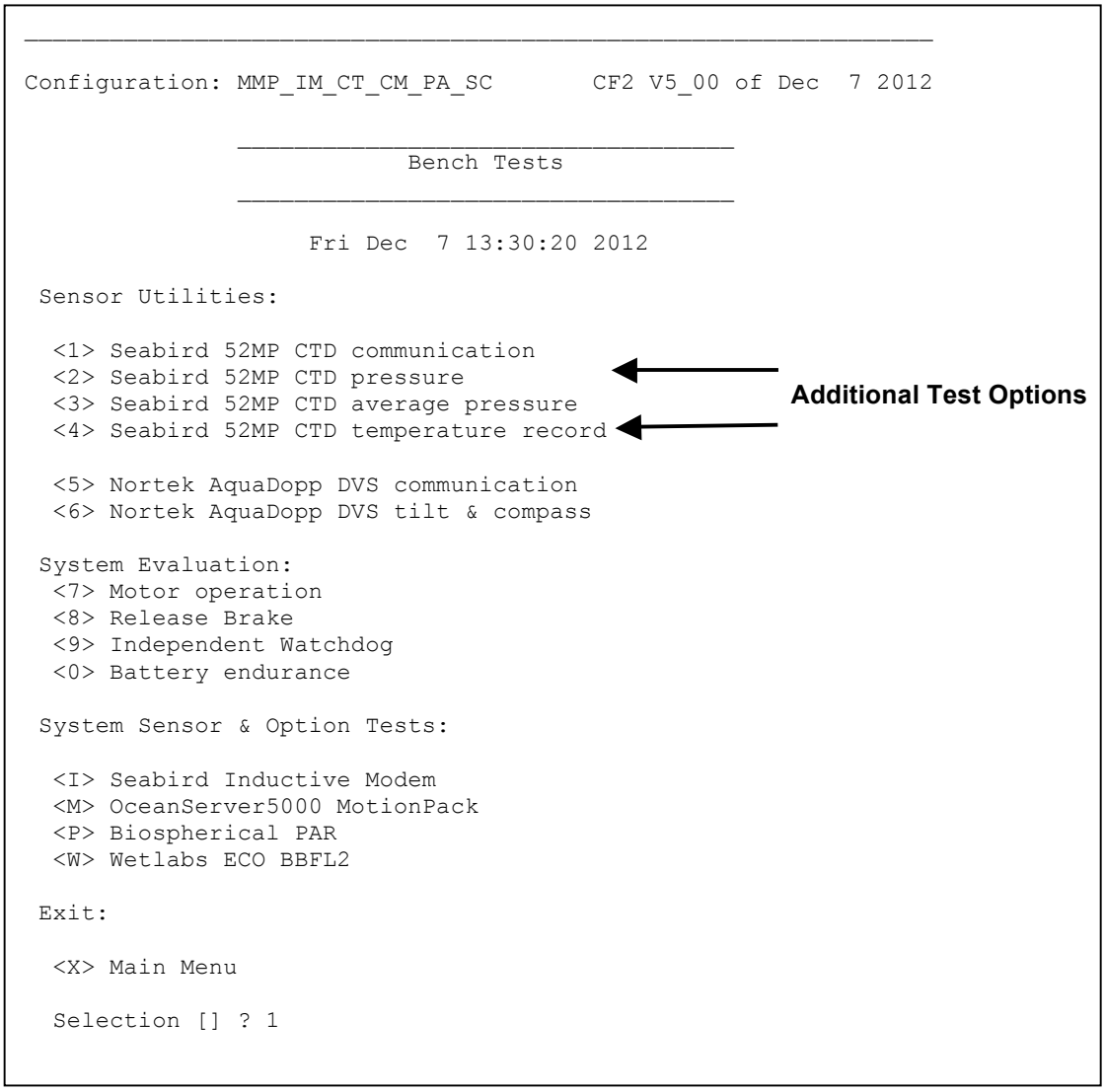


Figure 1-11:Main Bench Tests Menu

Display 52MP/41CP CTD Pressure

Option <2> from the main Bench Tests menu displays the current CTD pressure.

```
Selection [] ? 2


04/21/14 14:59:45 SBE/52MP pressure = -0.110 dbar.


Press any key to continue.
```

Figure 1-12:Option <5> Display SBE 52MP CTD Pressure

Display 52MP/41CP CTD Average Pressure

Option <3> from the main Bench Tests menu displays a user-selected number of pressure measurements. The measurements are then averaged.

```
Selection [] ? 3

Enter number of measurements to average (2-5000) [100] ? 3


04/21/14 15:00:03 SBE/52MP Pressure 1 of 3 = -0.120 dbar.


04/21/14 15:00:06 SBE/52MP Pressure 2 of 3 = -0.130 dbar.


04/21/14 15:00:09 SBE/52MP Pressure 3 of 3 = -0.130 dbar.


04/21/14 15:00:09 SBE/52MP Pressure = -0.127 dbar, averaged over 3
samples.

Press any key to continue.
```

Figure 1-13:Option <3> Display and Average Pressure Settings

Display 52MP/41CP CTD Temperature

Option <4> from the main Bench Tests menu sets a number of temperature readings to record and the measurement interval. The firmware wakes from Suspend mode at the set interval and takes a temperature reading. The measurements are then averaged after the specified number of readings are taken. When the user wakes the firmware, the temperature readings and average can be displayed.

```
  Selection [] ? 4

Enter number of measurements (1-1000) [   3] ?

Enter measurement interval [sec] (20- 600) [ 300] ? 20

04/21/14 15:01:25   SYSTEM Temperature record will finish at 04/21/14
15:02:40.

04/21/14 15:01:25 SBE/52MP Powered on.

04/21/14 15:01:30 SBE/52MP Identified as V3.0, S/N 5556 with IDO.

04/21/14 15:01:31  +24.2926 ∞C

04/21/14 15:01:44   SYSTEM Suspended until 04/21/14 15:01:51 ... Awake

04/21/14 15:01:55  +24.3163 ∞C

04/21/14 15:02:08   SYSTEM  Sleeping until 04/21/14 15:02:11 ...

04/21/14 15:02:15  +24.3360 ∞C
04/21/14 15:02:28   SYSTEM  Sleeping until 04/21/14 15:02:31 ...

04/21/14 15:02:40 SBE/52MP Averaged 3 of 3 requested temperature samples.

04/21/14 15:02:40   SYSTEM Suspended ... .

Enter ^C now to wake up ...  [^C]

Display temperature record [Y] ?  [^C]  <-------- Display record
```

Figure 1-14:Option <4> Record and Average Temperature

The Sea-Bird documentation is included with the sensor. Refer to this documentation for sensor-sepcific calibration details used for processing unpacked data.

Notes

Section 1.1
Sea-Bird 52MP CTD Sensor with MMP

The Sea-Bird 52MP CTD is a conductivity, temperature, depth sensor that can also include an optional Sea-Bird 43F Dissolved Oxygen sensor. For more information about the 52MP CTD sensor, refer to the Sea-Bird Electronics website (www.seabird.com) or contact Sea-Bird.

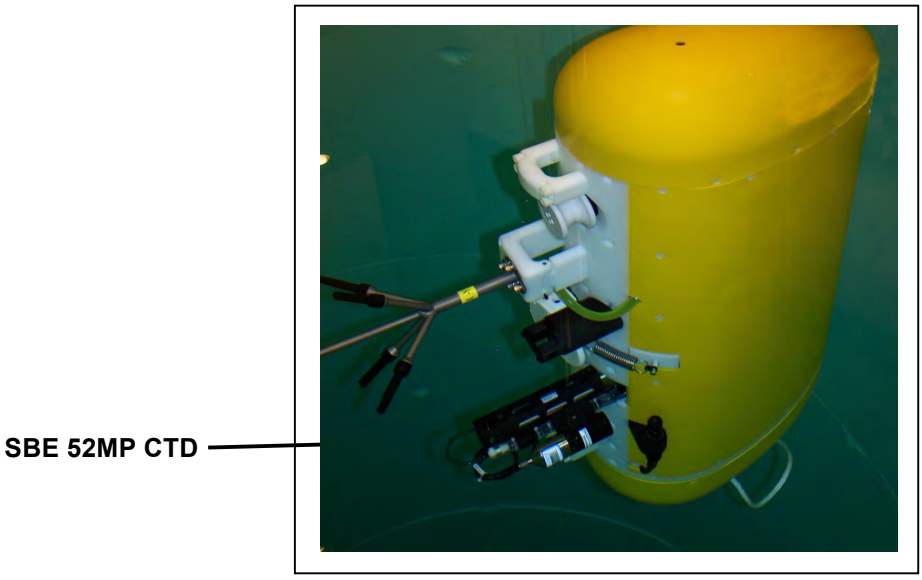


Figure 1.1-1: MMP with Sea-Bird 52MP CTD

Mount and orient the 52MP CTD so the intake and exhaust are on the same horizontal plane.

Sea-Bird 43F IDO with 52MP CTD on MMP

The Sea-Bird 43F Dissolved Oxygen sensor is a polarographic membrane sensor that can be optionally integrated on the MMP with the Sea-Bird 52MP CTD.

It is critical to keep the 43F IDO from freezing temperatures during shipment, deployment, recovery and storage. Exposure to temperatures below freezing can cause damage to the sensor.

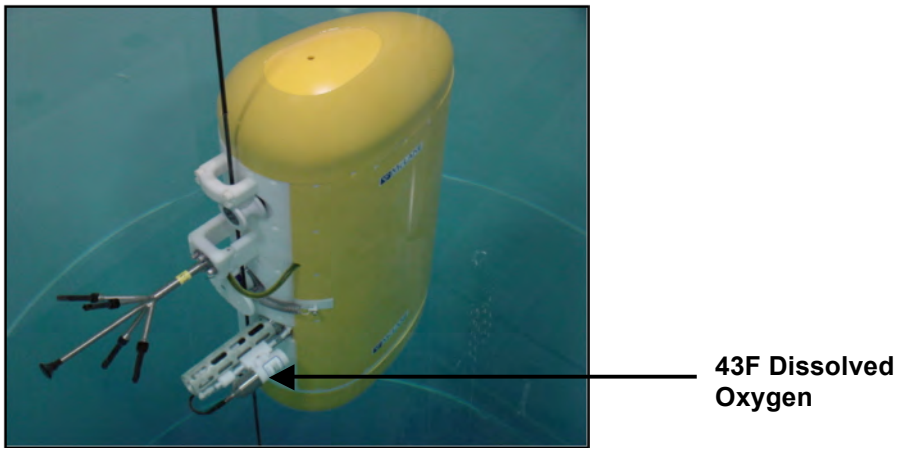


Figure 1.1-2: SBE 52MP CTD with 43F Dissolved Oxygen

Collecting Data with the Sea-Bird 52MP CTD

A sample unpacked CTD file is shown in Figure 1.1-3. The columns display Conductivity, Temperature and Depth. The hz column displays zeros if the Sea-Bird 43F dissolved oxygen sensor option is not installed.

```
Profile 7

  mmho/cm   Celsius     dbars    hz

   0.9126   16.3126     0.740   2310
   0.9114   16.3133     0.750   2327
   0.9104   16.3141     0.750   2331
   0.9099   16.3147     0.750   2332
   0.9097   16.3157     0.750   2328
   0.9100   16.3158     0.750   2327
   0.9104   16.3147     0.750   2321
   0.9107   16.3142     0.750   2318
   0.9109   16.3143     0.750   2314
   0.9110   16.3148     0.750   2309
   0.9109   16.3144     0.750   2301
   0.9107   16.3143     0.750   2296
   0.9105   16.3149     0.750   2290
   0.9103   16.3148     0.750   2286
   0.9101   16.3153     0.750   2278
   0.9100   16.3149     0.740   2274
   0.9100   16.3150     0.740   2269
   0.9100   16.3159     0.750   2262
```

Figure 1.1-3: Unpacked 52MP CTD File with 43F Oxygen Data

Configuring the Firmware to Use the 52MP CTD

The Profiler System Configuration menu specifies the active sensors. To enable a Sea-Bird 52MP CTD, complete the following steps:

1. From the Main Menu type *c* and enter the password *con*.
2. Select <1> for the CTD Port. The CTD Selection menu displays.

```
_____________________________________________________________________
Config: MPP_CT_CM_TU                    CF2 V5.22 of Apr 28 2015

                 _____________________________________
                          Pattern Profiler
                        System Configuration
                 _____________________________________
                      Tue May 26 15:13:05 2015

 System Parameters:
  <0> Battery capacity               240 Ah

Sensor Suite:

Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED <-- CTD Port

Port J5:ACM
  <2> Falmouth Scientific 3d ACM+ --- ENABLED

      Port J6:IMM
  <I> Telemetry

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <J> Wetlabs ECO FLBBCD
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2
  <Y> Wetlabs ECO FLBB2K
  <@> Wetlabs FLNTURTD

      Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR

      Port J7:TRB
  <T> Seapoint IR Turbidity --------- ENABLED @ 5 samp/avg, Autogain

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack

      Port J5i:SER
  <K> ProOceanus CO2

Exit:
  <X> Save changes    <^C> Cancel changes
```

Figure 1.1-4: System Configuration Menu

3. Select the installed CTD.

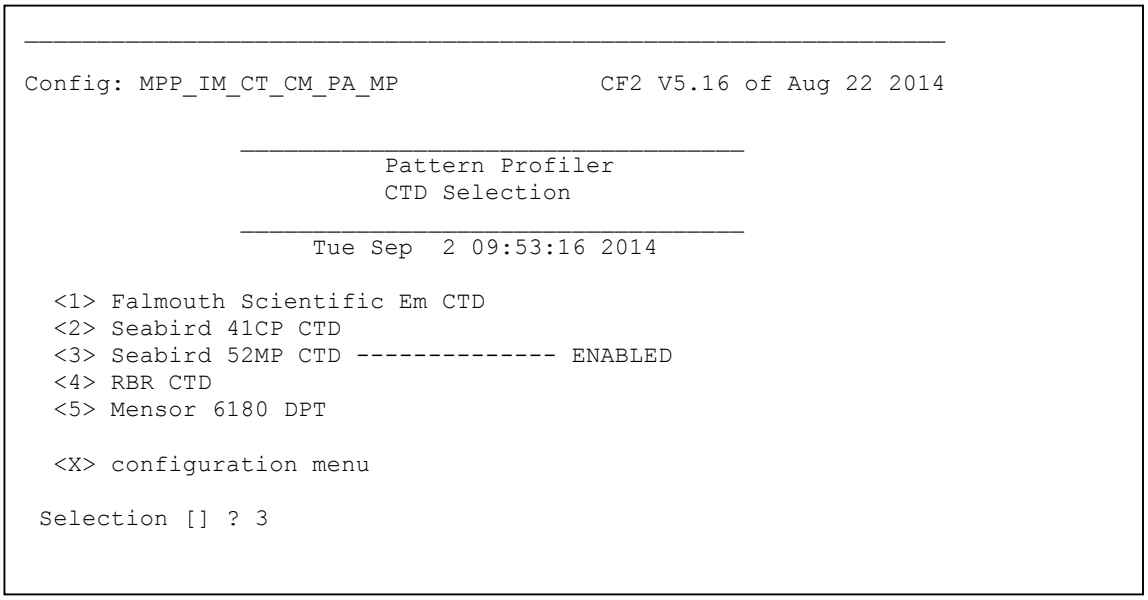


Figure 1.1-5: CTD Selection

Removing the 52MP CTD from the MMP

A releasable polyethylene support strut on the MMP body provides easier installation and removal of the Sea-Bird 52MP CTD. When removing the 52MP CTD from the MMP, use the photos and steps that follow as a guide.

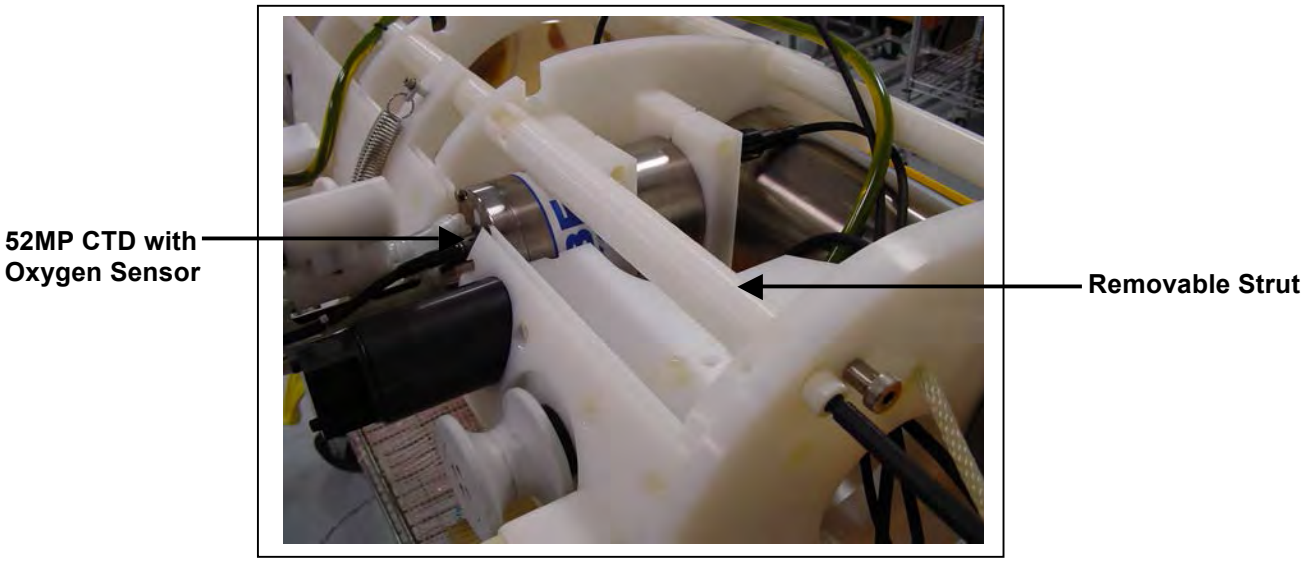


Figure 1.1-6: 52MP CTD and Removable Strut

1. Remove the MMP skin.

2. Turn the strut so that the notch faces up as shown in Figure 1.1-7.

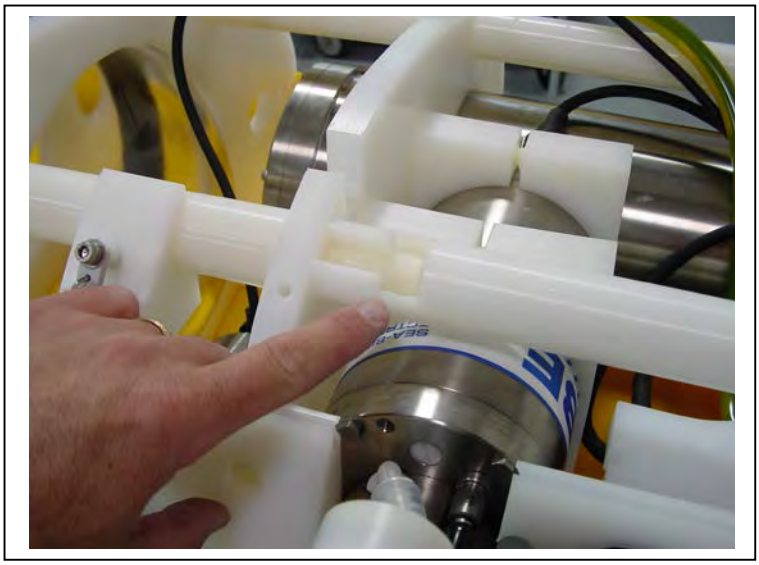


Figure 1.1-7: Strut with Notch Facing Up

3. Using a 3/8" Hex Driver, remove the socket cap screw from the bottom of the strut.

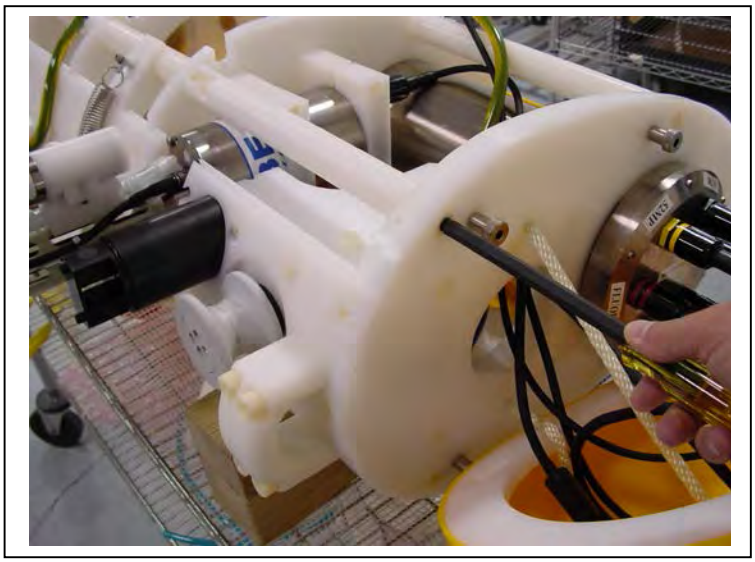


Figure 1.1-8: Remove Socket Cap Screw

4. Lift the strut up to remove the CTD.

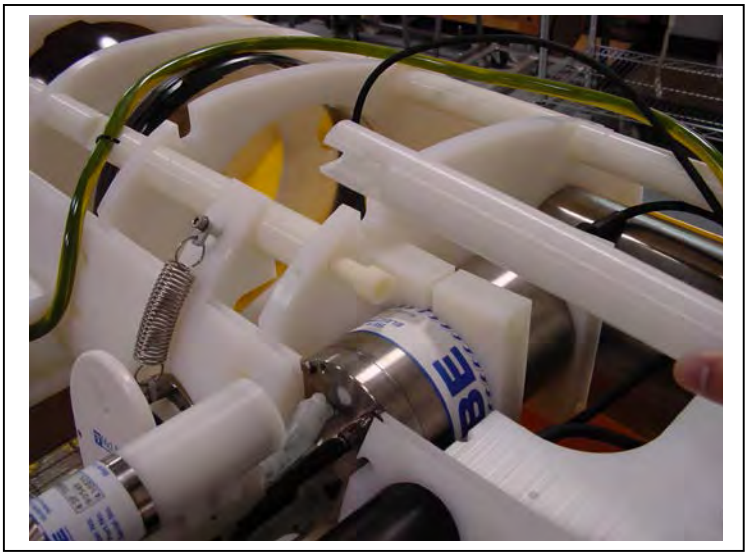


Figure 1.1-9: Removing the Strut

5. Using an Allen wrench, remove the mounting screws (ensure that the sensor is supported).

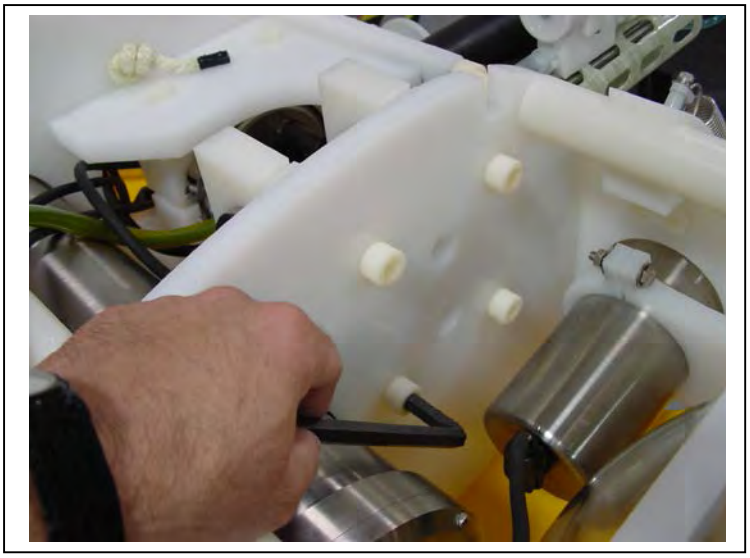


Figure 1.1-10: Loosening the Mounting Plate Screw

6. Carefully lift the 52MP CTD from the sensor mount (shown in Figure 1.1-11).

Figure 1.1-11: Lifting the CTD from the Sensor Mount

7. Unplug the bulkhead connector and remove the cable.

Figure 1.1-12: Unplugging the Bulkhead Connector

8. Reverse steps 1-7 to install the 52MP CTD.

Notes

Section 1.2
Sea-Bird 41CP CTD with ITP

The Sea-Bird 41CP CTD is a conductivity, temperature, depth sensor integrated with the Ice Tethered Profiler (ITP). The 41CP CTD can include an optional Sea-Bird Integrated Dissolved Oxygen (IDO) sensor. For more information about the 41CP CTD sensor, refer to the Sea-Bird Electronics website (www.seabird.com) or contact Sea-Bird.

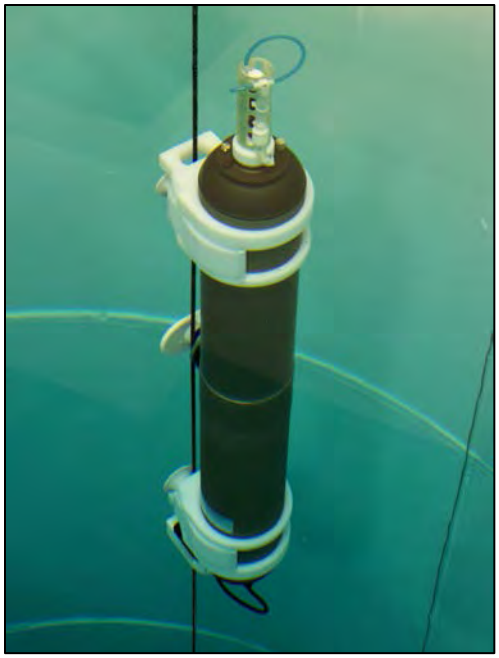


Figure 1.2-1: ITP with Sea-Bird 41CP CTD

The 41CP CTD is installed only on the Ice Tethered Profiler (ITP).

Sea-Bird IDO with 41CP CTD on Ice Tethered Profiler

The Sea-Bird 41CP Integrated Dissolved Oxygen sensor is a polarographic membrane sensor that can be optionally integrated on the ITP with the Sea-Bird 41CP CTD.

It is critical to keep the 41CP-IDO from freezing temperatures during shipment, deployment, recovery and storage. Exposure to temperatures below freezing can cause damage to the sensor.

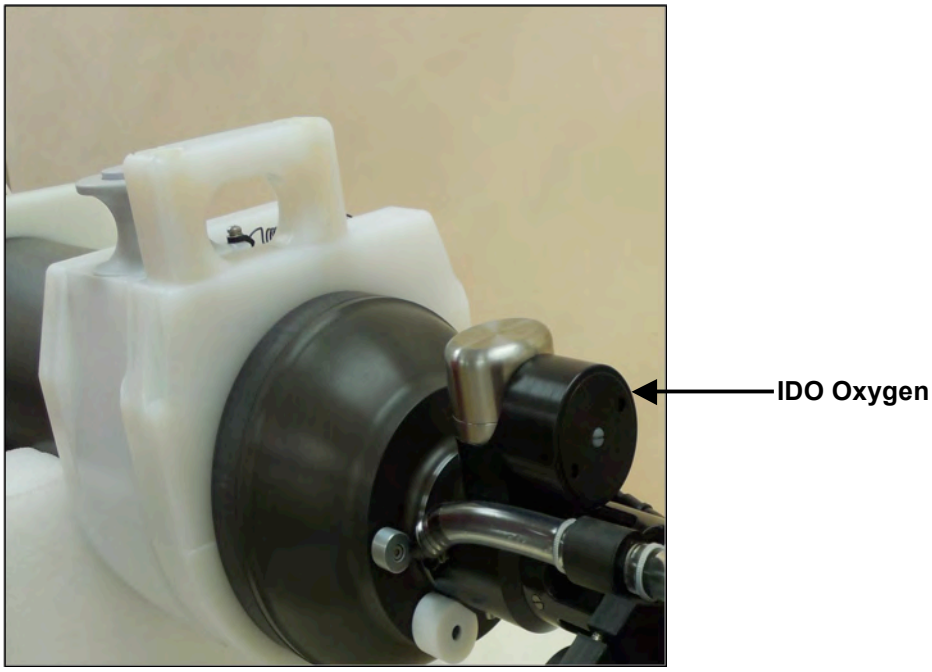


Figure 1.2-2: ITP 41CP CTD with Integrated Dissolved Oxygen

Collecting Data with the Integrated Dissolved Oxygen Sensor

If the IDO sensor is integrated with the 41CP CTD, the CTD file displays the measurement in hz (Figure 1.2-3). If integrated dissolved oxygen is not installed the hz column contains 0.

```
Profile 7


  mmho/cm   Celsius     dbars    hz

   1.7994   17.9822    11.710  20294
   1.7995   17.9855    11.700  20401
   1.7990   17.9874    11.710  20490
   1.7990   17.9884    11.710  20481
   1.7991   17.9920    11.710  20482
   1.7992   17.9933    11.710  20497
   1.7994   17.9938    11.700  20493
   1.7988   17.9937    11.700  20496
   1.7992   17.9929    11.730  20494
   1.7996   17.9926    11.710  20543
   1.7992   17.9920    11.710  20568
   1.7994   17.9919    11.710  20549
   1.7992   17.9917    11.710  20530
   1.7990   17.9915    11.710  20540
   1.7997   17.9916    11.710  20575
   1.7993   17.9917    11.710  20590
   1.7990   17.9918    11.720  20565
   1.7994   17.9918    11.710  20585
   1.7995   17.9924    11.700  20576
```

Figure 1.2-3: Unpacked 41CP CTD File with Integrated Dissolved Oxygen Data

Configuring the Firmware to Use the 41CP Sea-Bird CTD

The Profiler System Configuration menu specifies the active sensors. To enable a Sea-Bird 41CP CTD, complete the following steps:

1. From the Main Menu type *c* and enter the password *con*.
2. Select <1> for the CTD sensor Port. The CTD Selection menu displays.

```
_____________________________________________________________________
Config: MPP_CT_CM_TU                      CF2 V5.22 of Apr 28 2015

                  ___________________________________
                            Pattern Profiler
                          System Configuration
                  ___________________________________
                       Tue May 26 15:13:05 2015

 System Parameters:
  <0> Battery capacity               240 Ah

Sensor Suite:

Port J9:CTD
  <1> Seabird 41CP CTD -------------- ENABLED <-- 41CP CTD

Port J5:ACM
  <2> Falmouth Scientific 3d ACM+ --- ENABLED

      Port J6:IMM
  <I> Telemetry

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <J> Wetlabs ECO FLBBCD
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2
  <Y> Wetlabs ECO FLBB2K
  <@> Wetlabs FLNTURTD

      Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR

      Port J7:TRB
  <T> Seapoint IR Turbidity --------- ENABLED @ 5 samp/avg, Autogain

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack

      Port J5i:SER
  <K> ProOceanus CO2

Exit:
  <X> Save changes    <^C> Cancel changes
```

Figure 1.2-4: System Configuration Menu with Sensor Selections

3. Select the installed CTD.

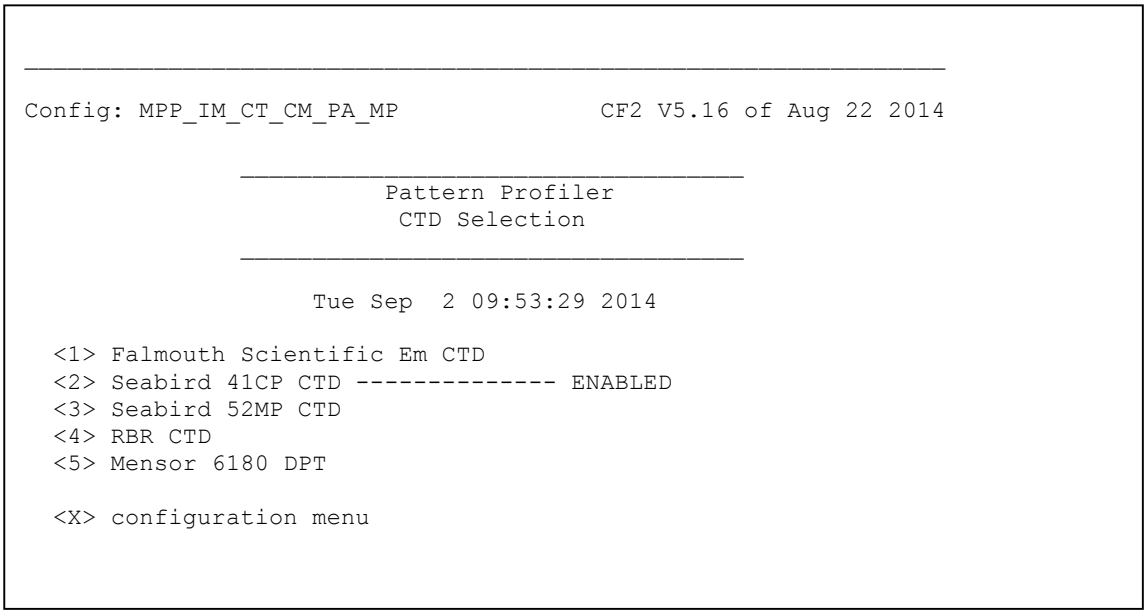


Figure 1.2-5: CTD Selection

Configuring the Firmware to Use the IDO Sensor

A setting on the System Configuration menu flags whether IDO is enabled.

1. From the Main Menu type *c* and enter the password *con.*
2. Select <1> for the CTD Sensor Port.
3. Select <2> for the 41CP CTD and then type *Y* to enable the IDO.
4. Select <X> to exit and save the entry.

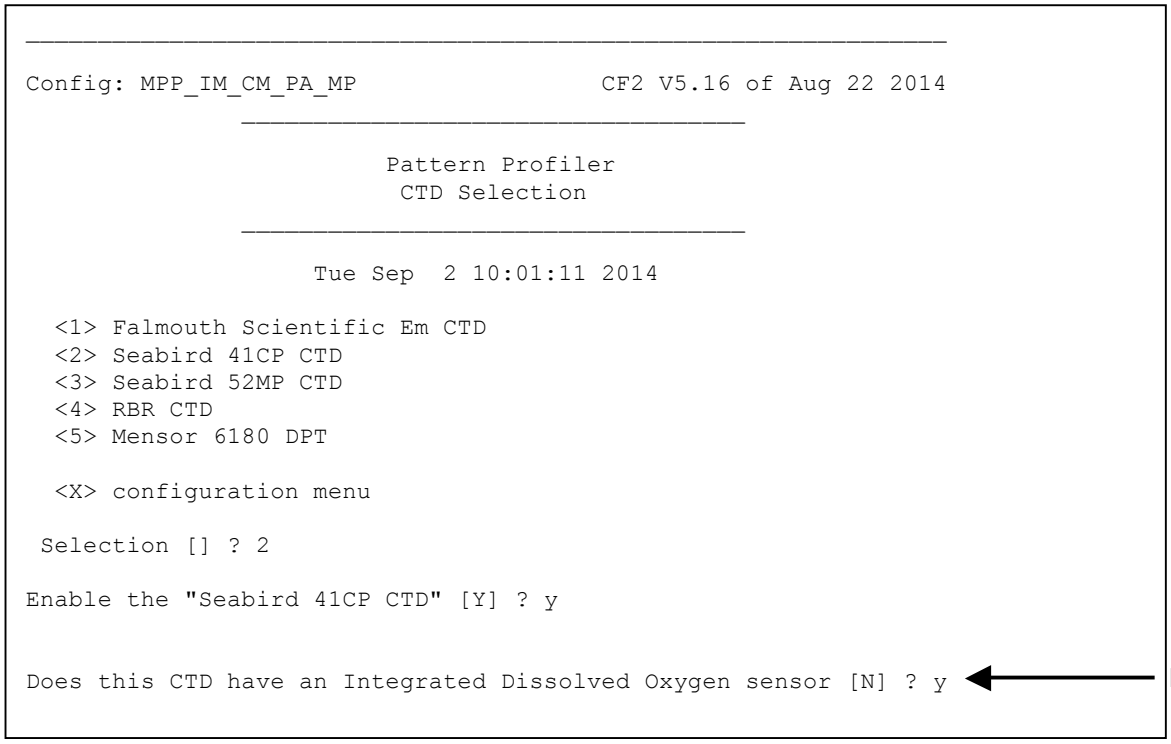


Figure 1.2-6: SBE 41CP CTD Integrated Dissolved Oxygen Prompt

Introduction
MMP Integrated Sensors and Communications

The MMP requires a Conductivity, Temperature, Depth (CTD) sensor to control profiler movement and profiling duration. Many other optional integrated sensors are available. McLane also integrates new sensors upon customer request.

Installed sensors affect battery drain and ballast calculations. Contact McLane (www.mclanelabs.com) for further information.

Each integrated sensor and the inductive communications options are explained in the following chapters:

Chapter Contents	
Chapter	**Sensor**
1	Sea-Bird CTD Sensors – General Info
1.1	Sea-Bird 52MP CTD with MMP
1.2	Sea-Bird 41CP CTD with ITP
2	Aanderaa Optode Sensors – General Info
2.1	Aanderaa Model 4330F Optode
2.2	Aanderaa Model 3830
3	Nortek Aquadopp ACM Sensors – General Info
3.1	Aquadopp Model II ACM
3.2	Aquadopp Model HR ACM
4	Falmouth Scientific ACM+ Sensor
5	Nobska MAVS ACM Sensor
6	Wet Labs Optical Sensors – General Info
6.1	Wet Labs BBFL2
6.2	Wet Labs FLBB(RT)/D
7	Ostar OceanServer MotionPack Sensor
8	Satlantic SUNA Sensor

Sensors Chapter Contents	
9	Biospherical PAR Sensors
9.1	Biospherical PAR QSP-2200
9.2	Biospherical PAR QCP-2300
10	Seapoint Turbidity/Fluorometer Sensors
11	Inductive Communications
11.1	Sea-Bird IMM
11.2	RBR MLM

User Key

This user manual contains the following keys to call attention to information:

	**Note**	Information of special note such as proper battery installation.
	**Important**	Information to take caution such as handling of bulk head connectors.
	**Danger**	Information to prevent serious conditions such as loss of data.

Chapter 2
Aanderaa Optode Sensors

Aanderaa Optode sensors measure dissolved oxygen. MMP Release v5.00 firmware and higher support the Aanderaa Optode models 4835, 4330 and 4330F. MMP Release v3.16 and higher support the Aanderaa Optode model 3830. For more information about these sensors, refer to the Aanderaa website (www.aanderaa.com) or contact Aanderaa.

Some Aanderaa models return more data fields than others. The Profiler looks at only the first five data fields (Model, Serial Number, Oxygen, Saturation and Temperature).

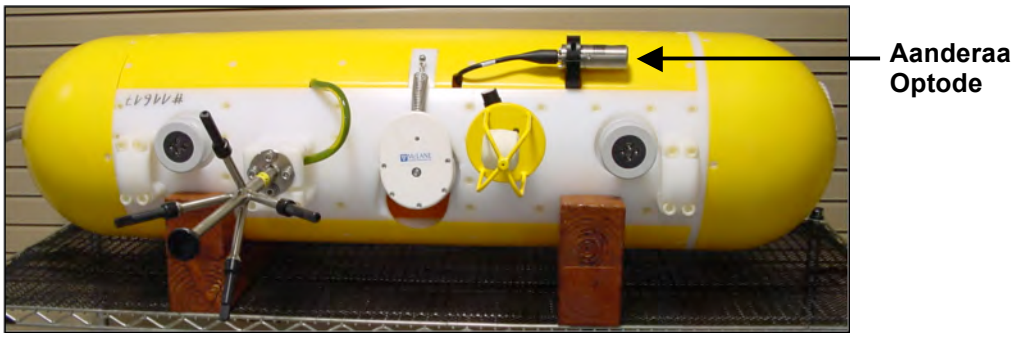


Figure 2-1: MMP with Aanderaa Optode – Side View

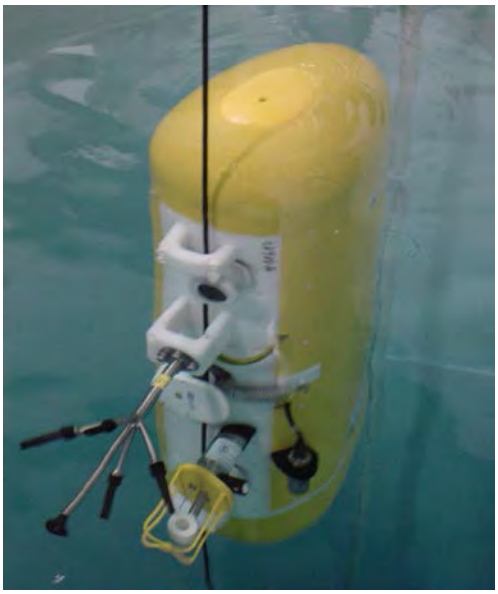


Figure 2-2: Profiling MMP with Aanderaa Optode

Collecting Data with the Aanderaa Optode

Optode data is logged in the Engineering File as shown in Figure 2-3. When the Optode is disabled or switched off (as during ramp up), the columns contain '0.00'. If there is no data collected within 5 seconds, the Optode automatically powers off to conserve battery energy.

Profile 16

Sensors were turned on at 11/14/2013 00:00:02
Vehicle began profiling at 11/14/2013 00:02:03

Optode Data

Date	[mA]	[V]	[dbar]	Oxygen[uM]	Optode Temp[C]	CHL	NTU	Temperature	
11/14/2013 00:02:03	0	11.9	0.000	0.00	0.00	1548	1980		546
11/14/2013 00:02:10	75	11.9	0.000	0.00	0.00	1553	2002		546
11/14/2013 00:02:16	30	11.9	0.000	0.00	0.00	1555	2016		546
11/14/2013 00:02:22	27	11.9	0.000	0.00	0.00	1558	2027		545
11/14/2013 00:02:28	26	11.9	0.000	0.00	0.00	1559	2033		546
11/14/2013 00:02:39	25	11.9	0.500	277.08	16.41	1558	2033		545
11/14/2013 00:02:46	26	11.9	0.490	276.65	16.41	1559	2038		545
11/14/2013 00:02:53	26	11.9	0.500	277.08	16.41	1560	2042		545
11/14/2013 00:03:02	26	11.9	0.570	276.85	16.41	1560	2043		545
11/14/2013 00:03:09	25	11.9	0.610	276.72	16.41	1560	2046		545
11/14/2013 00:03:18	26	11.9	0.530	276.39	16.42	1561	2048		545

Figure 2-3: Engineering Data with Aanderaa Optode Oxygen and Temperature Data

The Optode data collection interval is the same as the MMP firmware 'stop check interval' setting. Due to the time required for the Optode to collect data, the Stop Check Interval should not be set below 4 seconds if the Aanderaa Optode is enabled.

Configuring the Firmware to Use the Aanderaa Optode

The Profiler System Configuration menu specifies the active sensors. To enable an Aanderaa Optode, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure.*
2. Select <O> for the Aanderaa Optode and then type *Y* to enable the sensor.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP           CF2 V5.12 of Feb 11 2014
                 _____________________________________
                          Pattern Profiler
                        System Configuration
                 _____________________________________
                      Tue Mar 11 15:37:44 2014
 System Parameters:
  <0> Battery capacity               240 Ah

 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

      Port J5:ACM
  <2> Nortek AquaDopp DVS ----------- ENABLED AquaDopp-2

      Port J6:IMM
  <I> Telemetry --------------------- ENABLED IMM @ 1200 baud

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode------------- ENABLED <-- Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2

Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR -------------- ENABLED @ 5 samp/avg
      Port J7:TRB
  <T> Seapoint IR Turbidity

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED

      Port J5i:SER
  <K> ProOceanus CO2

 Exit:
  <X> Save changes    <^C> Cancel changes
Selection [] ?  [^C]
```

Figure 2-4: System Configuration Menu

Using Bench Test Options

The main Bench Tests and Aanderaa Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only the options available to installed sensors.

1. From the main Profiler Menu, type *5* at the prompt to display the Bench Tests Menu.

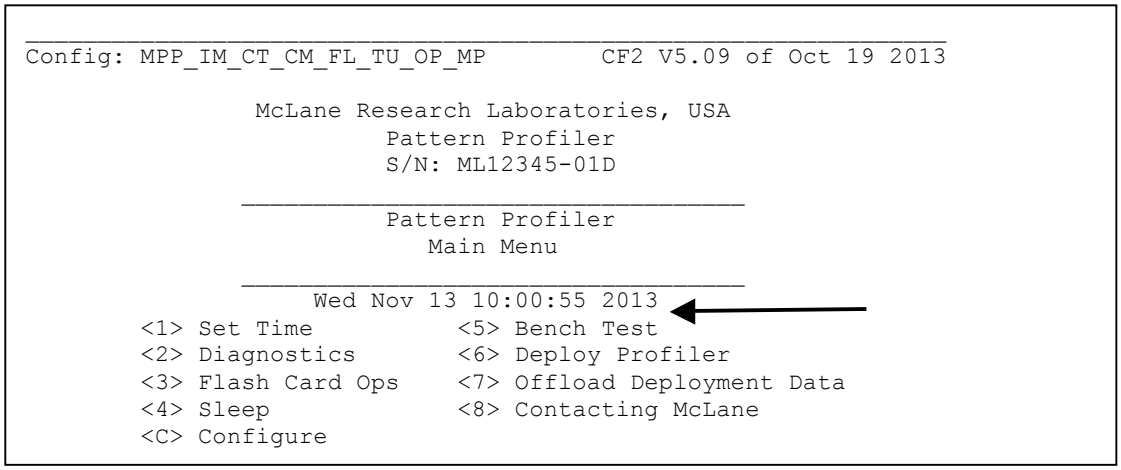


Figure 2-5: Profiler Main Menu

```
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.09 of Oct 19 2013

                  Pattern Profiler
                    Bench Tests

                Wed Nov 13 10:06:19 2013
 Sensor Utilities:
 <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Falmouth Scientific 3d ACM+ communication
  <6> Falmouth Scientific 3d ACM+ tilt & compass

 System Evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <0> Estimate deployment endurance
  <D> Detailed schedule
  <S> Recover schedule

 System Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <L> Wetlabs ECO FLBB(RT)/D
  <M> OceanServer5000 MotionPack
  <O> Aanderaa Optode

 Exit:
```

Figure 2-6: Profiler Bench Tests Menu

The sensor-specific Bench Tests menus are the same for the Aanderaa models integrated with the Profiler . The examples shown in this section feature the 4330F Optode.

2. From the Bench Tests menu, type O at the prompt to display the AAND/OPT Bench Test menu.

3. Type *1* to connect directly with the Aanderaa Optode.

```
Configuration: MMP_IM_CT_CM_OP_PA       CF2 V5_00 of Aug 29 2012


                AAND/OPT Bench Test Menu

                Wed Aug 29 16:41:36 2012

    <1> Direct communications (9600 Baud)
    <2> Perform a profile test loop          <-- Direct Communications

    <M> return to previous Menu
Selection  [] ? 1
08/29/12 12:13:45 AAND/OPT Press ^C to terminate COMM session.
08/29/12 12:13:45 SYSTEM Press ^B to change or confirm Baud rate
```

Figure 2-7: Aanderaa Optode Bench Tests Menu

The Profiler communicates with the Aanderaa at 9600 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 2-8). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
**************************************************************

-Êûx-òÄ-fûx-`¸ò6x-Ê‡-ò-ûfxf6òx¯Ü6ò-òÄ-Ê¯¯


04/23/14 12:50:37 AAND OPT ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 2-8: Baud Rate Communication Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu displays the Baud Rate menu (Figure 2-9). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the Profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013
                 ___________________________________
                          Pattern Profiler
                         Select new Baud rate
                 ___________________________________
                      Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 2-9: Baud Rate Menu

Direct Sensor Connection

Once connected directly to the Optode, typing commands at the command prompt provides additional sensor information. For all three Aanderaa Optode models, the Profiler firmware reads only the first five data fields (model number, serial number, oxygen concentration, oxygen saturation and oxygen temperature) and ignores any other trailing fields. During direct communications with the sensor, the additional trailing fields display. However, these fields are ignored by the Profiler.

Figure 2-10 shows direct connection with the 4330F Optode. Figure 2-11 shows direct connection with the 3830 Optode.

```
      Selection  [M] ? 1

08/29/12 16:41:43 AAND/OPT Press ^C to terminate COMM session.
08/29/12 16:41:44 AAND/OPT Communication channels opened.
08/29/12 16:41:44 AAND/OPT Powered on.
************************************************************
4330F    1086    234.355    89.486    24.181    29.595    29.595    35.644    6.049
520.2    523.6    25.9
4330F    1086    234.381    89.496    24.181    29.594    29.594    35.627    6.033
520.1    524.6    25.9
4330F    1086    234.694    89.616    24.181    29.579    29.579    35.599    6.020
520.1    523.2    25.9
4330F    1086    234.685    89.613    24.181    29.580    29.580    35.594    6.014
520.1    522.3    25.9
4330F    1086    234.924    89.704    24.181    29.569    29.569 [^C]
************************************************************

08/29/12 16:41:51 AAND/OPT Powered off.
08/29/12 16:41:51 AAND/OPT Communication channels closed.
```

Figure 2-10: Aanderaa 4330F Optode Direct Communications

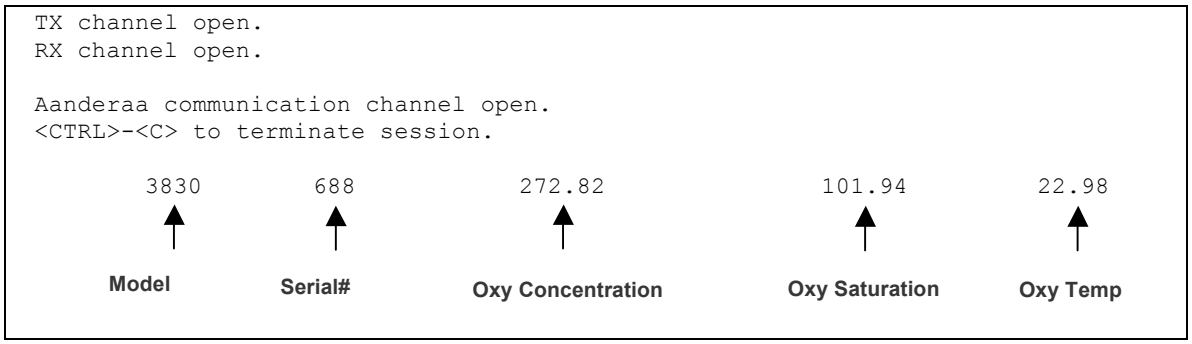
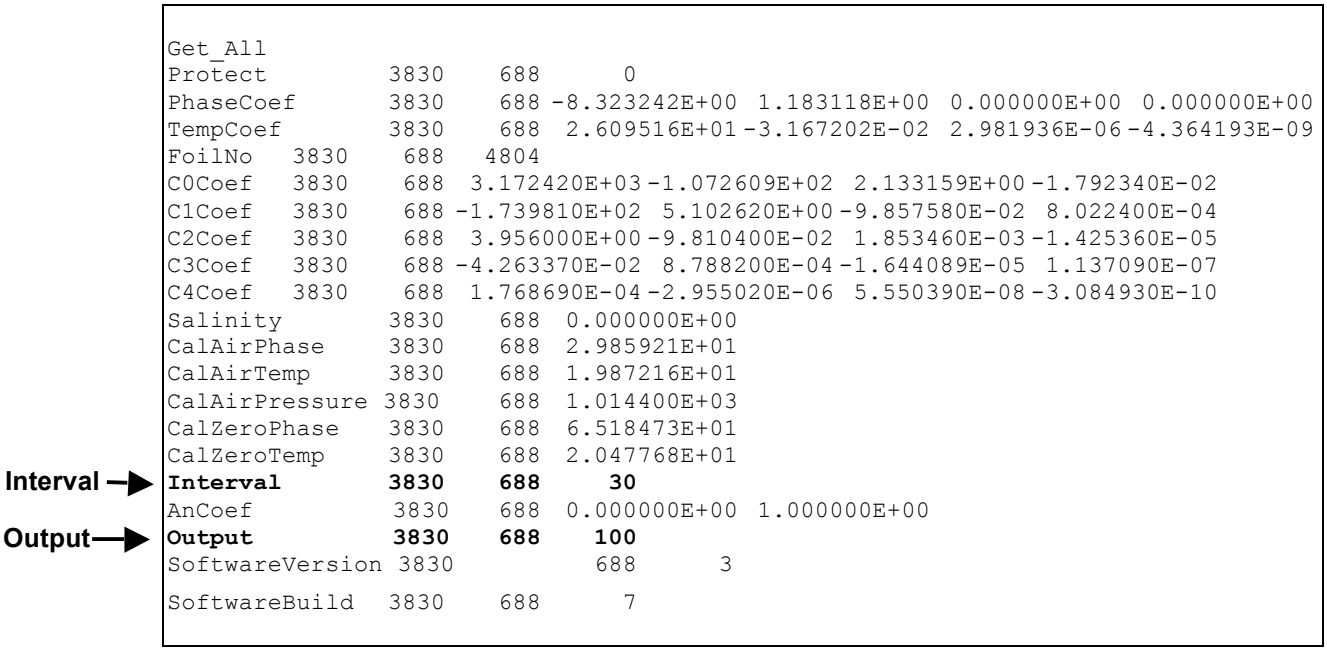


Figure 2-11: Aanderaa 3830 Optode Direct Communications

1. Type *Get_All* to display Optode settings as shown in Figure 2-12. Verify the following settings: Interval = 30 and Output = 100.




```
Get_All
Protect         3830    688      0
PhaseCoef       3830    688 -8.323242E+00  1.183118E+00  0.000000E+00  0.000000E+00
TempCoef        3830    688  2.609516E+01 -3.167202E-02  2.981936E-06 -4.364193E-09
FoilNo   3830    688   4804
C0Coef   3830    688  3.172420E+03 -1.072609E+02  2.133159E+00 -1.792340E-02
C1Coef   3830    688 -1.739810E+02  5.102620E+00 -9.857580E-02  8.022400E-04
C2Coef   3830    688  3.956000E+00 -9.810400E-02  1.853460E-03 -1.425360E-05
C3Coef   3830    688 -4.263370E-02  8.788200E-04 -1.644089E-05  1.137090E-07
C4Coef   3830    688  1.768690E-04 -2.955020E-06  5.550390E-08 -3.084930E-10
Salinity        3830    688  0.000000E+00
CalAirPhase     3830    688  2.985921E+01
CalAirTemp      3830    688  1.987216E+01
CalAirPressure 3830    688  1.014400E+03
CalZeroPhase    3830    688  6.518473E+01
CalZeroTemp     3830    688  2.047768E+01
Interval        3830    688     30
AnCoef          3830    688  0.000000E+00  1.000000E+00
Output          3830    688    100
SoftwareVersion 3830          688      3
SoftwareBuild   3830    688      7
```

Figure 2-12: Verifying Optode Settings

Refer to the Aanderaa documentation for other valid direct commands.

2. Type [CTRL]-[C] to return to the Bench Tests menu.

Perform Profile Test Loop

Option <2> runs a profile test loop. This test simulates an automated sensor verification and a 5 minute profile.

```
       Selection  [M] ? 2

 Enter StopCheck interval in seconds [15] (4-60) [15] ? 4

08/29/12 16:42:01 AAND/OPT M#4330, S#1086, 234.13 Oxygen, 24.18 Temperature.
08/29/12 16:42:06 AAND/OPT M#4330, S#1086, 234.31 Oxygen, 24.18 Temperature.
08/29/12 16:42:11 AAND/OPT M#4330, S#1086, 234.10 Oxygen, 24.18 Temperature.
08/29/12 16:42:16 AAND/OPT M#4330, S#1086, 234.33 Oxygen, 24.18 Temperature.
08/29/12 16:42:21 AAND/OPT M#4330, S#1086, 234.09 Oxygen, 24.18 Temperature.
[^C]
```

Figure 2-13: Option <2> Perform Profile Test Loop

Due to the time required for the Optode to collect data, the Stop Check Interval should not be set below 4 seconds if the Aanderaa Optode is enabled.

Notes

Chapter 3
Nortek Aquadopp ACM Sensors – General Info

The Nortek Aquadopp Acoustic Doppler Current Meter (ACM) sensor collects doppler acoustic current measurements. The MMP firmware supports two models of the Aquadopp sensor, the Aquadopp II and the AquaPro (HR). This section provides information common to both the HR and Aquadopp II ACM sensors. For more information about these sensors, refer to the Nortek website (www.nortekusa.com) or contact NortekUSA.

Aquadopp II

MMP Release v5.00 firmware and higher support the Aquadopp II sensor. The Aquadopp II is integrated as a standard self-logging sensor. The data is stored locally on the sensor in a file named Axxxxxxx.DAT during profiling, and transferred to the MMP controller at the end of the profile. If Aquadopp II data is available, file offload is through inductive communications. Data can then be unpacked to a text file using the McLane Unpacker software. See the 'Unpacking Deployment Data' chapter in the MMP User Manual for more about unpacking deployment data.

AquaPro HR

AquaPro (HR) integration is a prototype implementation on the MMP. The AquaPro (HR) is a customized interface and does not follow the standard conventions of MMP sensor interactions.

Contact McLane for details before planning a deployment with an AquaPro (HR) sensor. The AquaPro (HR) is a self-logging sensor (stores all data on the sensor) however, the AquaPro (HR) does not transfer data to the MMP controller at the end of the profile. The data stored on the AquaPro (HR) must be manually retrieved after deployment recovery.

Configuring the Firmware to Use the Aquadopp Sensors

The Profiler System Configuration menu specifies the active sensors. To enable an Aquadopp sensor complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*.
2. Select <2> for the Nortek Aquadopp and then type a selection to enable the Aquadopp model. Type *Y* to enable the sensor.

```
Config: MPP_IM_CT_CM_PA_SC_MP           CF2 V5.12 of Feb 11 2014
                  Pattern Profiler
                 System Configuration
               Tue Mar 11 15:37:44 2014
 System Parameters:
  <0> Battery capacity              240 Ah
 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED
      Port J5:ACM
  <2> Nortek AquaDopp DVS ----------- ENABLED AquaDopp-2
      Port J6:IMM
  <I> Telemetry --------------------- ENABLED IMM @ 1200 baud
      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2 ------------- ENABLED
Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR -------------- ENABLED @ 5 samp/avg
      Port J7:TRB
  <T> Seapoint IR Turbidity
      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer
      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED
      Port J5i:SER
  <K> ProOceanus CO2
 Exit:
  <X> Save changes    <^C> Cancel changes
  Selection [] ?  [^C]

Enable the "Nortek AquaDopp DVS" [Y] ?
Select 1 = AquaDopp-HR, 2 = AquaDopp-II (1-2) [0] ? 2 <---- Aquadopp Model
```

Figure 3-1: Type 1 or 2 to Enable the Aquadopp Sensor

Section 3.1
Nortek Aquadopp II ACM Sensor

MMP Release v5.00 firmware and higher supports the Nortek Aquadopp II Acoustic Doppler Current Meter (ACM). The ACM file for each profile contains the first Aquadopp record ('*ANNNNNNN.DAT*' where '*N*' is the profile number).

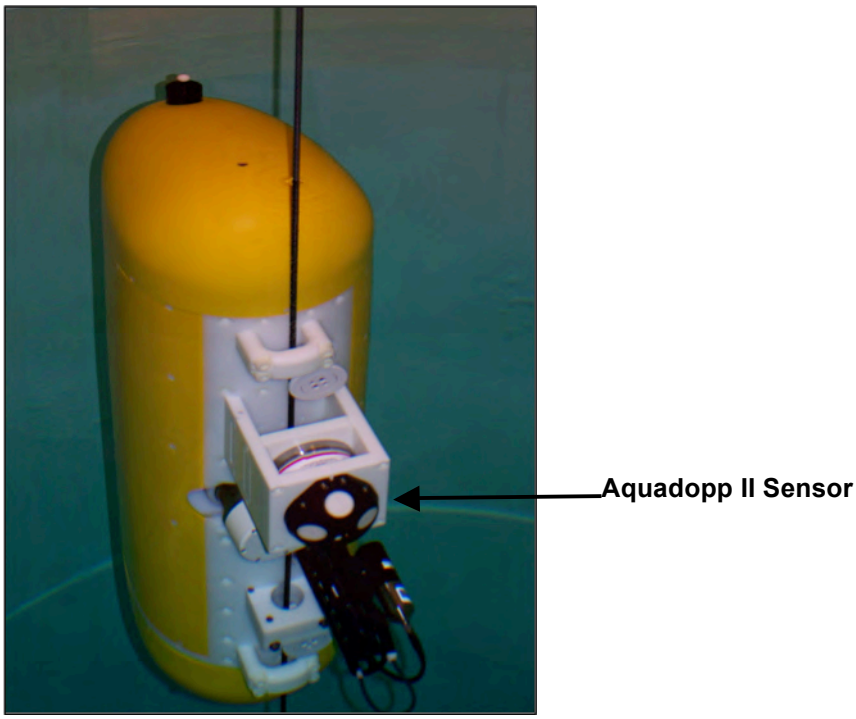


Figure 3.1-1: MMP with Aquadopp II Sensor

Aquadopp II Data Details

Aquadopp II data is logged in the ACM file ('*ANNNNNNN.DAT*" where '*N*' is the profile number). Files stored on the MMP controller flash card are binary files. The examples that follow show the text format created by the Profiler Unpacker. See the 'Unpacking Deployment Data' chapter in the MMP User Manual for more about unpacking deployment data.

```
Profile 2
MM-DD-YYYY HH:MM:SS      Sndm/s       TmpC     Heading    Pitch    Roll      magnHx  magnHy  magnHz
12-07-2012 16:30:16.000  1500.0000    17.6400  342.6000   0.4000   0.3000    -460    65      193
12-07-2012 16:30:16.500  1500.0000    17.6400  342.6000   0.4000   0.3000    -460    65      193
12-07-2012 16:30:17.000  1500.0000    17.6400  342.1000   0.4000   0.2000    -460    65      190
12-07-2012 16:30:17.500  1500.0000    17.6400  342.1000   0.4000   0.2000    -460    65      190
12-07-2012 16:30:18.000  1500.0000    17.6400  342.3000   0.3000   0.3000    -460    64      190
12-07-2012 16:30:18.500  1500.0000    17.6400  342.3000   0.3000   0.3000    -460    64      190
.  .  .
12-07-2012 16:35:10.500  1500.0000    17.6400  342.1000   0.4000   0.3000    -460    65      190
```

Figure 3.1-2: MMP with Aquadopp II Data (screen 1 of 3)

```
Beams  Cells  Beam1  Beam2  Beam3  Beam4 Beam5 Vel[0,0]  Vel[1,0]  Vel[2,0]  Vel[3,0]
 4      1       1      2      3      4     0     1.32030   0.31160   0.89480   0.45590
 4      1       1      2      3      4     0     1.33630   0.02960   0.91070   0.00270
 4      1       1      2      3      4     0     0.91700   0.02480   0.94530   0.00540
 4      1       1      2      3      4     0     2.15710  -0.01220   0.94610   0.00300
 4      1       1      2      3      4     0     2.07930  -0.01710   0.92470   0.00130
 4      1       1      2      3      4     0     2.13280   0.00210   0.94890   0.00360
.  .  .
 4      1       1      2      3      4     0     1.49030   0.00020  -0.00210   0.03870
```

Figure 3.1-3: MMP with Aquadopp II Data (screen 2 of 3)

```
Amp[0,0]   Amp[1,0]   Amp[2,0]     Amp[3,0]     Corr[0,0]    Corr[1,0]    Corr[2,0]      Corr[3,0]
071        045        044          043          023          009          032            011
073        123        098          112          016          096          075            097
073        103        097          103          015          070          071            091
073        100        098          101          016          063          071            091
072        099        099          101          004          065          069            094
072        097        099          100          009          067          078            094
.  .  .
072        107       100           089          032          093          078            034
Profile 2
  AquaDopp2 turned on at 12/07/2012 16:30:02
  AquaDopp2 turned off at 12/07/2012 16:35:15097
```

Figure 3.1-4: MMP with Aquadopp II Data (screen 3 of 3)

Data Column Definitions

The section that follows details the full (non-reduced) Aquadopp II data ACM files. The column names provided by McLane are included with a description of represented units and human readable names.

Heading	Parameter	Units	Comments
MM-DD-YYYY	Date	Month-Day-Year format	
HH:MM:SS	Time	Hour-Minute-Second.Fractional Second format	
Sndm/s	Speed of Sound Constant	m/s	Speed of Sound Constant
TmpC	Temperature	ºC	
Heading	Sensor & Profiler Heading	Degrees	
Pitch	Sensor & Profiler Pitch	Degrees	Positive Bow Up
Roll	Sensor & Profiler Roll	Degrees	Positive Starboard Down
magnHx	Magnitude Vector		Instrument X direction magnetometer value
magnHy	Magnitude Vector		Instrument Y direction magnetometer value
magnHz	Magnitude Vector		Instrument Z direction magnetometer value
Beams	Number of Beams Enabled for the profile		3 for Upward Profiles 3 for Downward Profiles 4 for Stationary Profiles
Cells	Number of Cells per Beam		Fixed at 1
Beamx	Transducer Mapping to data fields for Velocity, Amplitude and Correlation data		Beam5 is not used in this sensor. Always set to zero.
Vel[x-1, 0]	Beam Velocities	mm/s	Beam Velocity for the transducer mapped to the corresponding Beam number.
Amp[x-1, 0]	Beam Amplitude	Counts	Return signal amplitude for the transducer mapped to the corresponding Beam number.
Corr[x-1, 0]	Beam Correlation	%	A measure of signal quality. See Nortek User Guide for more information

Aquadopp II Beam Configuration

Physical sensor /beam orientation is important and corresponds with the data mapped in the ACM files. Mount the Aquadopp II so that the arrow points to the top of the Profiler as shown in Figure 3.1-5.

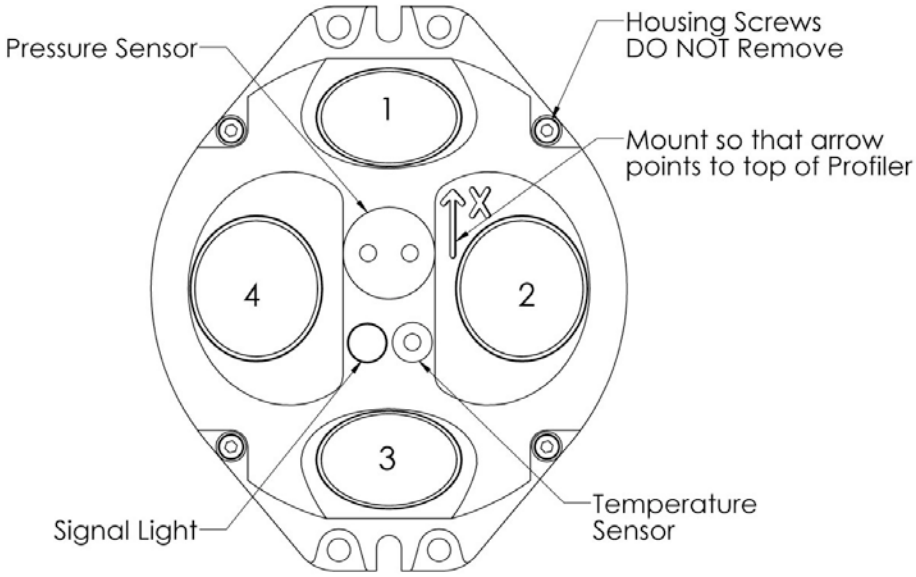


Figure 3.1-5: Aquadopp II Sensor Orientation

Transducer Mapping

The Aquadopp II provides for mapping a physical transducer to a specific "beam" within the dataset. The MMP controller will command the use of a specific set of beams to use depending on the profiling direction as shown below:

Profiling Direction	Beam 1	Beam 2	Beam 3	Beam 4
Up	ON	ON	OFF	ON
Down	OFF	ON	ON	ON
Stationary	ON	ON	ON	ON

The Aquadopp II data contains a field for Beam 5 which is not used on this sensor.

The value in each row for these columns specifies which physical beam (in this case 1-4) is mapped to that dataset beam. Below is an example and its interpretation

The example below shows the case for a downward traveling profile.

Beams	Cells	Beam1	Beam2	Beam3	Beam4	Beam5
3	1	2	3	4	0	0

The first and second columns ("Beams" and "Cells") indicate there are 3 beams active (first column), with 1 cell in each beam (second column).

Data from physical beam 2 (this should be one of the horizontally oriented beams) is contained in the first data field (i.e. Beam1), data from physical beam 3 in the second data field (Beam2), and physical beam 4 in the third data field (Beam3). Beam4 is zero indicating it is not used in this profile.

Data Reduction and Data Decimation

Data file reduction takes place within the Profiler firmware based on commands sent from the Surface Controller. Compressed Aquadopp II data files must be parsed using the file AQUADOPP.CFG. Data file decimation sets the number of data records the surface controller retrieves upon request. Appendix A in this User Manual ' Inductive File Transmission Protocol' explains more about data file reduction, data decimation and Profiler Inductive commands.

Aquadopp ACM Data Reduction with Inductive Communications

MMP Release v5.07 firmware provides AquaDopp II ACM data file reduction which allows the user to reduce the data fields the AquaDopp II collects/transmits inductively. The reduced file has a .DEC file extension. For example, A00000099.DAT reduction file would be A00000099.DEC. Included fields are stored in the .DEC file in order. Data field configuration is defined in AQUADOPP.CFG which is stored on the Profiler's CompactFlash disk. See the 'Inductive Communications' chapter in this User Manual for more information.

White space between the comma separated digits in the AQUADOPP.CFG configuration are optional.

The field reduction is specified by a configuration file that is stored on the Profiler's CompactFlash disk. This file must be named AQUADOPP.CFG. The contents of AQUADOPP.CFG file are used to determine which fields in the full AquaDopp2 DAT record will be stored in the reduced DEC file.

Any line in this file that starts with a pound-sign character (#) will be treated as a comment and is ignored. The first line that does not start with a pound-sign is taken to be a comma-separated list of flags that indicate whether or not to include a particular field in the reduced DEC file. A '1' indicates the field should be included. A '0' indicates it should not be included.

An example of AQUADOPP.CFG contents follows. This example also represents the default behavior, if the CFG file is missing, corrupt or unreadable. (The default reduced size is approximately 25% of the original full DAT file; e.g., a ~400kb DAT file results in a ~100kb DEC file.)

_____

```
# Lines, like this one, that start with the pound-sign are ignored.
# The following line has the names of each field, in the order expected by the Profiler's
reduction routine. The user can edit or eliminate this line as desired.
# Time, SoundSpeed, TempC, Heading, Pitch, Roll, magX, magY, magZ, Beams, Cells, Beam1, Beam2, Beam3,
Beam4, Beam5, Vscale, Vel0, Vel1, Vel2, Amp0, Amp1, Amp2, Cor0, Cor1, Cor2
1,     0,     1,      1,     1,    1,    0,    0,    0,     0,     0,     0,     0,     0,     0,
0,    1,   1,    1,    1,    1,    1,
1,  0, 0,  0
# The scanning routine stops parsing after it sees any line that does not start with a
pound-sign, so anything goes after the above line.
# The above comma-separated flags will be scanned to determine whether or not to include
that particular field in the reduced output. White space is optional.
# Any included fields are stored in the DEC file in the exact order shown in the above
list. Reordering the commented names has no effect, other than cosmetically.
```

_____

The following table contains the names, in order, of each possible field to include, the number of bytes it will occupy in the DEC file if included, and the type of variable to expect.

Note : In the tables below **F = field; B = bytes; T = type**

F	Time	Sound Speed	Temp°C	Heading	Pitch	Roll	mag X	Mag Y	Mag Z	Beams	Cells	Beam 1	Beam 2	Beam 3	Beam 4	Beam 5
B	6	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
T	ubyte	uint	int	uint	int	int	int	int	int	ubyte	ubyte	ubyte	ubyte	ubyte	ubyte	ubyte

F	Vscale	Vel0	Vel1	Vel2	Amp0	Amp1	Amp2	Cor0	Cor1	Cor2
B	1	2	2	2	1	1	1	1	1	1
T	byte	int	int	int	ubyte	ubyte	ubyte	ubyte	ubyte	ubyte

The variable types are described as follows:

type	name	bytes
byte	signed byte	1
ubyte	unsigned byte	1
uint	unsigned integer	2
int	signed integer	2
ulong	unsigned long integer	4

Using Bench Test Options

The main Bench Tests and Aquadopp Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors.

1. From the main Profiler Menu type *5* at the prompt to display the Bench Tests menu.

```
_____________________________________________________________________
Config: MPP_IM_CT                        CF2 V5.14 of Jun  2 2014
                McLane Research Laboratories, USA
                          Pattern Profiler
                          S/N: ML13145-071

                _____________________________________
                          Pattern Profiler
                             Main Menu

                _____________________________________
                     Fri Jun  6 13:20:13 2014

 <1> Set Time          <5> Bench Test
 <2> Diagnostics       <6> Deploy Profiler
 <3> Flash Card Ops    <7> Offload Deployment Data
 <4> Sleep             <8> Contacting McLane
 <C> Configure

 Selection [] ?
```

Figure 3.1-6: Profiler Main Menu

```
_____________________________________________________________________
Config: MPP_IM_CT                        CF2 V5.14 of Jun  2 2014

                _____________________________________
                          Pattern Profiler
                            Bench Tests

                _____________________________________
                     Fri Jun  6 13:20:17 2014

 CTD utilities:
  <1> Seabird 41CP-IDO CTD communication
  <2> Seabird 41CP-IDO CTD pressure
  <3> Seabird 41CP-IDO CTD average pressure
  <4> Seabird 41CP-IDO CTD temperature record

  <5> Nortek AquaDopp DVS communication
  <6> Nortek AquaDopp DVS tilt & compass

 System evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <D> Detailed schedule
  <S> Recover schedule

 Sensor & Option tests:

  <I> Seabird Inductive Modem
 Exit:
```

Figure 3.1-7: Profiler Bench Tests Main Menu

2. From the main Bench Tests menu type *5* at the prompt to display the Nortek Aquadopp Bench Test Menu.

3. Type *1* to connect directly with the Aquadopp.

```
  Selection [] ? 5

_____________________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP           CF2 V5.12 of Feb 11 2014

                _____________________________________
                          Pattern Profiler
                       AQUADOPP Bench Test Menu
                _____________________________________
                       Tue Mar 11 15:39:47 2014

    <1> Direct communications (19200 Baud)
    <2> restore McLane parameters
    <3> restore Factory parameters
    <4> Report parameter settings
    <5> Perform a profile test loop
    <6> Set sampling rate (1 Hz)
    <7> Set AquaDopp clock
    <8> Read AquaDopp clock
    <9> Erase sensor data

    <M> return to previous Menu
```

Figure 3.1-8: Aquadopp Bench Test Menu

The Profiler communicates with the Aquadopp II at 19200 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 3-1-9). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
****************************************************************

-Êûx-òÄ-fûx-`¸ò12x-Ê‡-ò-ûfxf12òx¯Ü12ò-òÄ-Ê¯¯


04/23/14 12:50:37 SBE/52MP ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 3.1-9: Baud Rate Communication Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu displays the Baud Rate menu (Figure 3-1-10). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the Profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013
                ____________________________________
                         Pattern Profiler
                        Select new Baud rate
                ____________________________________
                     Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 3.1-10: Baud Rate Menu

Direct Connection to the Aquadopp

1. Type *1* to connect directly with the Aquadopp ACM.

```
Selection  [] ? 1

01/02/13 14:03:56 AQUADOPP 19.2 kBaud communication channel opened.
01/02/13 14:03:56 AQUADOPP Powered on. . ...
01/02/13 14:03:57 AQUADOPP Sending command [ID]. .
01/02/13 14:03:57 AQUADOPP Identified as V2020, S/N 100014.
01/02/13 14:03:57 AQUADOPP Powered off.
01/02/13 14:03:57 AQUADOPP 19.2 kBaud communication channel closed.


01/02/13 14:03:59 AQUADOPP Press ^C to terminate COMM session.
01/02/13 14:04:00   SYSTEM Press ^B to change or confirm Baud rate.

01/02/13 14:04:00 AQUADOPP 19.2 kBaud communication channel opened.
01/02/13 14:04:00 AQUADOPP Powered on.
************************************************************
AQUADOPP2 - NORTEK AS.
Version 2020 (McLane)(Dec 14 2012 11:25:13)
COMMAND MODE
OK
ID
AQUADOPP2,100014
```

Figure 3.1-11: Option <1> Direct Communications with the Aquadopp

Restore Factory Settings

Options <2> and <3> from the Aquadopp Bench Test menu (Figure 3.1-12) restore the McLane or Nortek factory settings on the Aquadopp sensor. This option is for the Aquadopp II. The Aquadopp (HR) is configured directly. Using option <2> requires the password *mclane*. Using option <3> also requires a password. Contact McLane before resetting to the factory parameters.

```
Selection  [] ? 2  Password: ******

01/02/13 14:04:18 AQUADOPP 19.2 kBaud communication channel opened.
01/02/13 14:04:18 AQUADOPP Powered on. . ...
01/02/13 14:04:18 AQUADOPP Sending command [ID]. .
01/02/13 14:04:19 AQUADOPP Identified as V2020, S/N 100014.
01/02/13 14:04:19 AQUADOPP Sending command [SETDEFAULT,ALL]. .
01/02/13 14:04:19 AQUADOPP Sending command [SETINST,BR=19200,RS=232,LED=1]. .
01/02/13 14:04:20 AQUADOPP Sending command
[SETPLAN,MICP=1,CP=0,DICP=0,VD=1,MV=10,SA=35,BURST=1,MIBURST=0]. .
01/02/13 14:04:21 AQUADOPP Sending command
[SETPLAN,DIBURST=0,SV=1500,FN="TELEMETRYFILE.BIN",SO=0]. .
01/02/13 14:04:23 AQUADOPP Sending command
[SETTM,SD=1,SA=1,CD=1,PD=1,TV=1,TA=1,TC=1,TVBT=0,TABT=0,TCBT=0,TDBT=0]. .
01/02/13 14:04:24 AQUADOPP Sending command
[SETCP,NC=01,CS=0.5,BD=0.3,CY="BEAM",PL=0,AI=1,DF=0]. .
01/02/13 14:04:25 AQUADOPP Sending command
[SETBURST,NC=1,NB=0,CS=0.23,BD=0.15,CY="BEAM",PL=-9]. .
01/02/13 14:04:27 AQUADOPP Sending command
[SETBURST,SR=2,NS=1024,VR=5.00,VP=1.00,DF=2,NPING=1]. .
01/02/13 14:04:28 AQUADOPP Sending command [BOARDSENSSET,22,4]. .
01/02/13 14:04:28 AQUADOPP Sending command [CALSAVE]. .
01/02/13 14:04:29 AQUADOPP Sending command [SAVE,ALL]. .
01/02/13 14:04:30 AQUADOPP Powered off.
01/02/13 14:04:30 AQUADOPP 19.2 kBaud communication channel closed.

01/02/13 14:04:30 AQUADOPP Was able to restore McLane parameters.
```

Figure 3.1-12: Option <2> Restore McLane Parameters

The Aquadopp II parameters are specific to the settings configured by McLane. Changing or resetting to the factory settings prevents the Aquadopp II from working correctly with the Profiler..

Display Sensor Settings

Option <4> (available for the Aquadopp II only) from the AquaDopp Bench Test menu displays the current Aquadopp parameters.

```
Selection  [] ? 4

01/02/13 14:04:35 AQUADOPP 19.2 kBaud communication channel opened.
01/02/13 14:04:35 AQUADOPP Powered on. . ...
01/02/13 14:04:36 AQUADOPP Sending command [ID]. .
01/02/13 14:04:36 AQUADOPP Identified as V2020, S/N 100014.

01/02/13 14:04:36 AQUADOPP Sending command [GETCLOCK]. .
01/02/13 14:04:37 AQUADOPP 2013,1,2,11,54,42.

01/02/13 14:04:37 AQUADOPP Sending command [GETINST]. .
01/02/13 14:04:37 AQUADOPP 19200,232,1.

01/02/13 14:04:37 AQUADOPP Sending command [GETPLAN]. ..
01/02/13 14:04:37 AQUADOPP 1,0,0,1,10,35,1,0,0,1500,TELEMETRYFILE.BIN,0,0.

01/02/13 14:04:37 AQUADOPP Sending command [GETTM]. .
01/02/13 14:04:38 AQUADOPP 1,1,1,1,1,1,1,0,0,0,0.

01/02/13 14:04:38 AQUADOPP Sending command [GETCP]. ..
01/02/13 14:04:38 AQUADOPP 1,0.50,0.30,BEAM,0.00,1,0.00000,0.00,0.

01/02/13 14:04:38 AQUADOPP Sending command [GETBURST]. ..
01/02/13 14:04:38 AQUADOPP 1,0,0.23,0.15,BEAM,-9.00,2,1024,5.00,1.00,2,1.

01/02/13 14:04:38 AQUADOPP Sending command [GETUSER]. .
01/02/13 14:04:39 AQUADOPP 0.00,0.00,0,0,0.

01/02/13 14:04:39 AQUADOPP Powered off.
01/02/13 14:04:39 AQUADOPP 19.2 kBaud communication channel closed.
```

Figure 3.1-13: Option <4> Report Parameter Settings

Perform Profile Test Loop

Option <5> (available for the Aquadopp II only) from the Aquadopp Bench Test menu runs a profile test loop. This test simulates an automated sensor verification and a 5 minute profile, as shown in Figure 3.1-14.

```
Selection  [] ? 5

Enter minutes per profile (1-60) [5] ? 2

Automatically cycle through sampling rates [N] ?

01/02/13 14:06:14 AQUADOPP Automated verification of sensor settings.
01/02/13 14:06:14 AQUADOPP 19.2 kBaud communication channel opened.
01/02/13 14:06:14 AQUADOPP Powered on. . ...
01/02/13 14:06:15 AQUADOPP Sending command [ID]. .
01/02/13 14:06:15 AQUADOPP Identified as V2020, S/N 100014.

 Format the AquaDopp disk? [N] ? n
 Erase AquaDopp data [N] ? y  ARE YOU SURE [N] ? y

01/02/13 14:06:21 AQUADOPP Sending command [ERASE,CODE=9999]. .
01/02/13 14:06:22 AQUADOPP All data erased.
01/02/13 14:06:23 AQUADOPP Clock write 01/02/2013 14:06:23.
01/02/13 14:06:23 AQUADOPP Sending command
[SETCLOCK,MONTH=01,DAY=02,YEAR=2013,HOUR=14,MINUTE=06,SECOND=23]. .
01/02/13 14:06:24 AQUADOPP Sending command [GETCLOCK]. .
01/02/13 14:06:24 AQUADOPP Clock reads 01/02/2013 14:06:23.

01/02/13 14:06:24 AQUADOPP Sending command [SETDEFAULT,ALL]. .
01/02/13 14:06:25 AQUADOPP Sending command [SETINST,BR=19200,RS=232,LED=1]. .
01/02/13 14:06:26 AQUADOPP Sending command
[SETPLAN,MICP=1,CP=0,DICP=0,VD=1,MV=10,SA=35,BURST=1,MIBURST=0]. .
01/02/13 14:06:27 AQUADOPP Sending command
[SETPLAN,DIBURST=0,SV=1500,FN="TELEMETRYFILE.BIN",SO=0]. .
01/02/13 14:06:28 AQUADOPP Sending command
[SETTM,SD=1,SA=1,CD=1,PD=1,TV=1,TA=1,TC=1,TVBT=0,TABT=0,TCBT=0,TDBT=0]. .
01/02/13 14:06:30 AQUADOPP Sending command
[SETCP,NC=01,CS=0.5,BD=0.3,CY="BEAM",PL=0,AI=1,DF=0]. .
01/02/13 14:06:31 AQUADOPP Sending command
[SETBURST,NC=1,NB=0,CS=0.23,BD=0.15,CY="BEAM",PL=-9]. .
01/02/13 14:06:32 AQUADOPP Sending command
[SETBURST,SR=2,NS=1024,VR=5.00,VP=1.00,DF=2,NPING=1]. .
01/02/13 14:06:33 AQUADOPP Sending command [BOARDSENSSET,22,4]. .
01/02/13 14:06:34 AQUADOPP Sending command [CALSAVE]. .
01/02/13 14:06:35 AQUADOPP Sending command [SAVE,ALL]. .
01/02/13 14:06:35 AQUADOPP Powered off.
01/02/13 14:06:36 AQUADOPP Power-down delay .....................
01/02/13 14:06:41 AQUADOPP 19.2 kBaud communication channel closed.
01/02/13 14:06:41   SYSTEM Deleting A0000000.DAT

Press ^C to exit the loop
```

Figure 3.1-14: Option <5> Perform a Profile Test Loop

Set Sampling Rate

Option <6> (available for the Aquadopp II only) from the AquaDopp Bench Test menu sets the sampling rate.

```
       Selection  [] ? 6


Enter new sampling rate (1|2|4|8|10 Hz) (1-10) [10] ? 5

Invalid AQUADOPP sampling rate: 5  <-- Aquadopp rate must be 1, 2, 4, 8 or 10

Enter new sampling rate (1|2|4|8|10 Hz) (1-10) [5] ? 2
. . .
```

Figure 3.1-15: Option <6> Set Sampling Rate

If a rate other than the allowed rate is typed, the firmware displays an error message.The sampling rate ranges from 1-10 to accommodate other ACM's. However, the Aquadopp accepts only sampling rates of 1, 2, 4, 8, 10 Hz as indicated on the display.

Manual Aquadopp Clock Reset

Option <7> (not shown) (available for the Aquadopp II only) from the Aquadopp Bench Test menu provides a way to manually reset the Aquadopp clock to the Profiler real-time clock (RTC). Before each profile, the Profiler firmware automatically sets the Aquadopp clock to the Profiler. This option provides a way to manually perform the clock reset for testing purposes.

Selecting <8> from the Aquadopp Bench Test Menu displays the Aquadopp clock reading.

```
Selection  [] ? 8

12/07/12 13:19:46 AQUADOPP 19.2 kBaud communication channel opened.
12/07/12 13:19:46 AQUADOPP Powered on. . ..
12/07/12 13:19:47 AQUADOPP Sending command [ID]. .
12/07/12 13:19:47 AQUADOPP Identified as V2018, S/N 100003.
12/07/12 13:19:47 AQUADOPP Sending command [GETCLOCK]. .
12/07/12 13:19:47 AQUADOPP Clock reads 12/07/2012 13:19:47.

12/07/12 13:19:47 AQUADOPP Powered off.
12/07/12 13:19:47 AQUADOPP 19.2 kBaud communication channel closed.
```

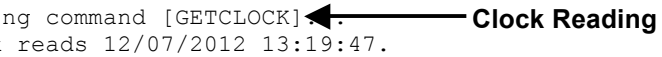


Figure 3.1-16: Option <8> Read AquaDopp Clock

Erase Sensor Data

Option <9> (available for the Aquadopp II only) from the Aquadopp Bench Test Menu (not shown) provides a way to manually clear the data from the Aquadopp SD storage card. At the start of each deployment, the Profiler firmware automatically commands the Aquadopp to erase the data stored internally. This option provides a manual way to clear the data from the Aquadopp internal storage for testing purposes. Selecting <M> returns to the previous menu.

Aquadopp Heading, Pitch and Roll

Option <6> from the main Bench Test Menu (Figure 3.1-17) 'Nortek Aquadopp DVS Tilt & Compass' provides heading, pitch and roll output which can be used to perform a spin test.

Power of 11V or greater is required for bench testing the Aquadopp DVS tilt & compass.

```
  Selection [] ? 6

 Displays Heading, Pitch & Roll outputs
 for use while mounting the ACM pressure housing.

 Press ^C to terminate operation.

01/03/13 15:59:49 AQUADOPP 19.2 kBaud communication channel opened.
01/03/13 15:59:49 AQUADOPP Powered on. . ...
01/03/13 15:59:50 AQUADOPP Sending command [ID]. .
01/03/13 15:59:50 AQUADOPP Identified as V2020, S/N 100017.
01/03/13 15:59:50 AQUADOPP Sending command [ERASE,CODE=9999]. .
01/03/13 15:59:51 AQUADOPP Sending command [SETBURST,SR=1]. .
01/03/13 15:59:51 AQUADOPP Sending command [SETPLAN,VD=0,SO=1]. .
01/03/13 15:59:52 AQUADOPP Sending command [START]. .

  DATE     TIME    HEADING     TX     TY    MagX    MagY    MagZ

01/03/13 15:59:53     2.9   10.4   -1.9    -510     -30     148 .
01/03/13 15:59:54     0.0    8.9   -3.7    -510     -33     149 .
01/03/13 15:59:55    15.3    9.3   -1.2    -510     -73     141 .
01/03/13 15:59:56    35.7    8.2    0.6    -507    -124     110 .
01/03/13 15:59:57    55.4    9.5    3.0    -504    -163      50 .
01/03/13 15:59:58    80.1   14.6   11.1    -505    -136     -80 .
01/03/13 15:59:59    89.2   16.6   19.0    -507     -81    -131 .
01/03/13 16:00:00   107.0    6.0   17.6    -516     -45    -110 .
01/03/13 16:00:01   133.5   -0.9   13.4    -509     -42    -142 .
01/03/13 16:00:02   176.8   -0.2    2.5    -484      10    -218 .
01/03/13 16:00:03   198.9   -0.8   -1.7    -495      54    -190 .
01/03/13 16:00:04   234.8    4.5   -5.6    -479     156    -178 .
01/03/13 16:00:05   256.6    5.6    5.5    -471     236     -93 .
01/03/13 16:00:06   297.3   10.4    6.5    -487     221      -6 .
01/03/13 16:00:07   325.5    1.6    7.0    -498     152     118 .
01/03/13 16:00:08   350.4    9.5   12.3    -495     147     138 .
01/03/13 16:00:09    10.7    4.5    5.8    -513      16     155 .
01/03/13 16:00:10    27.1    5.3   -3.2    -495    -133     160 .
01/03/13 16:00:11     9.6    7.0   -4.1    -509     -73     152  [^C]

01/03/13 16:00:12 AQUADOPP Sending command [@@@@@@].
01/03/13 16:00:12 AQUADOPP Sending command [K1W%!Q].
01/03/13 16:00:12 AQUADOPP Sending command [K1W%!Q]. .
01/03/13 16:00:13 AQUADOPP Sending command [MC].
01/03/13 16:00:13 AQUADOPP Powered off.
01/03/13 16:00:13 AQUADOPP Power-down delay .....................
01/03/13 16:00:18 AQUADOPP 19.2 kBaud communication channel closed..
```

Figure 3.1-17: Bench Tests Menu Option <6> Aquadopp DVS Tilt & Compass

Inserting the Mooring Cable in the Aquadopp II Hinge Plate

The Mooring Wire is inserted in the Aquadopp II hinge plate prior to deployment.

1. Place the MMP in a sling or other supported surface and remove the Top skin.
2. Using a hex driver, remove the four plastic screws from the Aquadopp II hinge plate.

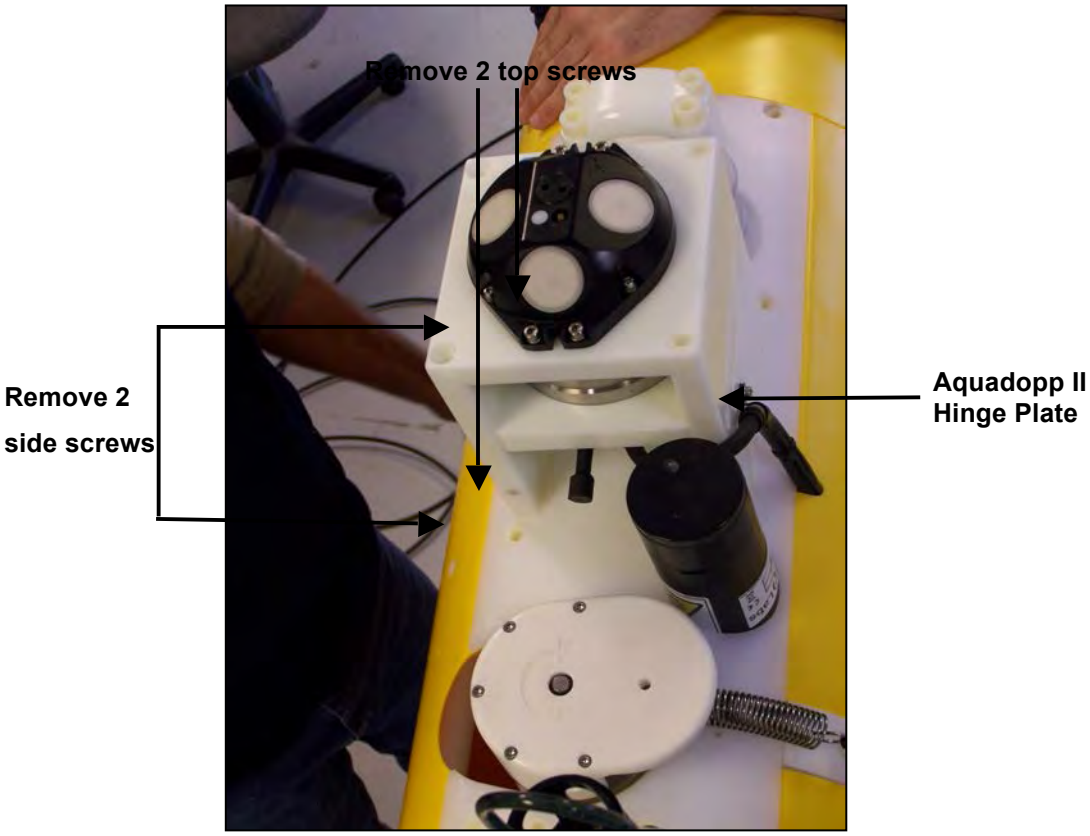


Figure 3.1-18: Remove Four Plastic Screws

3. With the screws removed, swing the hinge plate open.

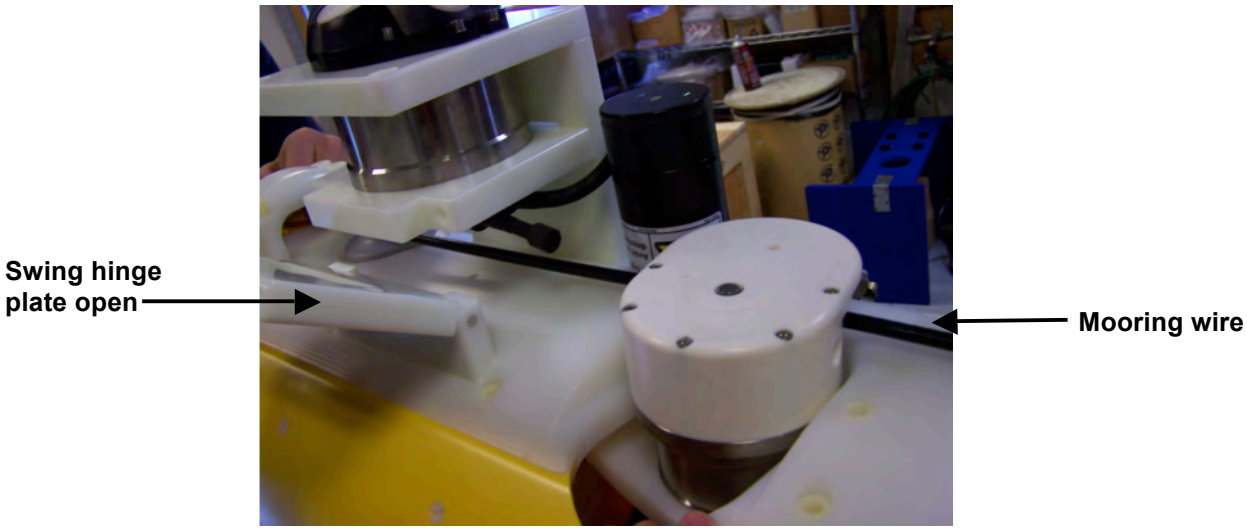


Figure 3.1-19: Positioning the Mooring Wire

4. Position the mooring wire under the Aquadopp II and through to the cable guide.

5. Close the hinge and re-secure the four plastic screws.

Removing the Aquadopp II from the MMP

To disconnect and remove the Aquadopp II from the Profiler, complete the following steps:

1. Lay the MMP on its side on a stable surface and remove the Top skin.
2. Using a hex driver, loosen only the four outer screws that connect the sensor to the hinge plate mount and slide the Aquadopp II from the hinge plate.

Do not remove any other screws, they will disassemble the sensor.

3. Using an Allen Wrench, (included in the toolkit), remove the screws from the Aquadopp II hinge plate and remove the plate.

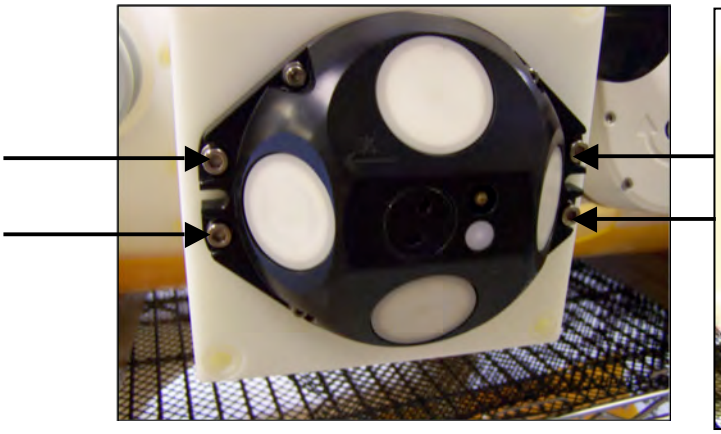


Figure 3.1-20: Loosen Four Screws

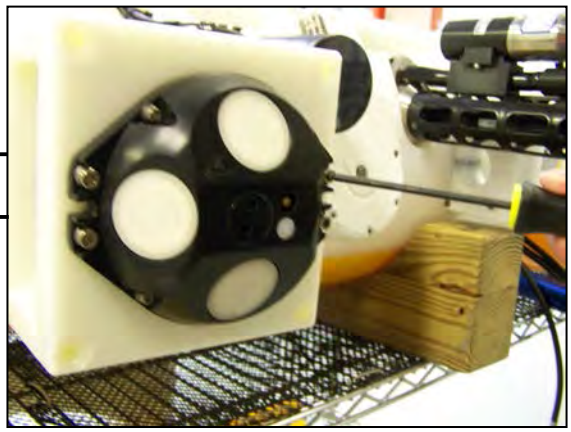


Figure 3.1-21: Unscrew from Hinge Plate

4. Using an Allen wrench, loosen the four screws that secure the Aquadopp II at the back of the hinge plate mount.
5. Detach the bulkhead connector from the Aquadopp II.

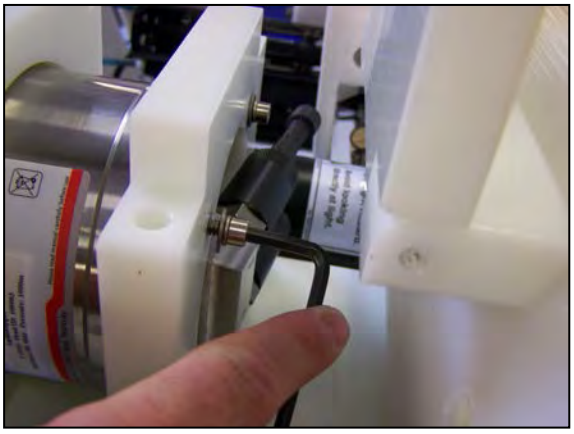


Figure 3.1-22: Loosen Back Screws

Figure 3.1-23: Detach Bulkhead Connector

6. Slide the Aquadopp II out the front of the mount.

Connecting the Aquadopp II Sensor

To re-install the Aquadopp II sensor, complete the following steps:

1. Slide the Aquadopp II back into the hinge plate mount.
2. Connect the bulkhead connector. The profiler cable plugs into the connector labeled ‘R’. The dummy plug connects to the slot labeled ‘E’.

Figure 3.1-24: Reconnect Bulkhead Connector

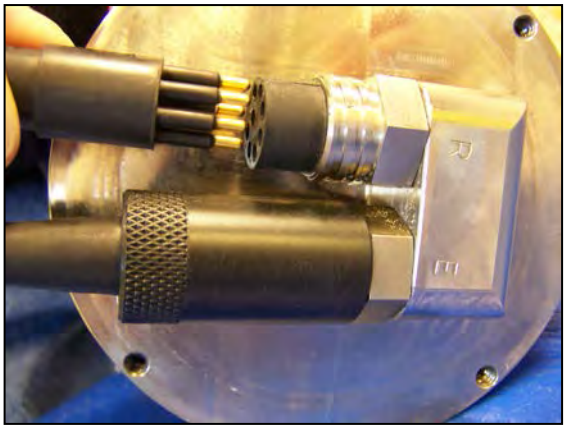


Figure 3.1-25: Connect Bulkhead Connector

3. Secure the screws that fasten the Aquadopp II to the hinge plate mount.
4. Tighten the screws that secure the hinge plate mount to the MMP.

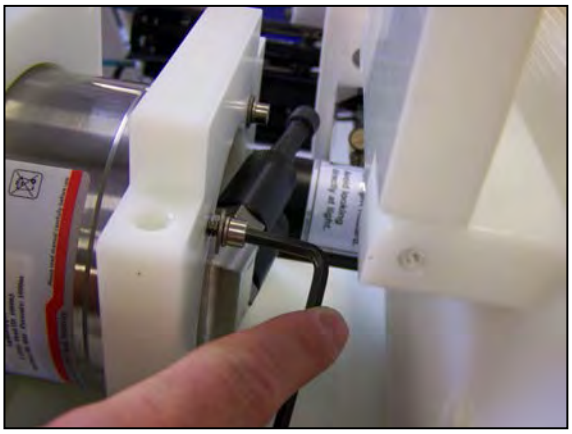


Figure 3.1-26: Tighten Back Screws

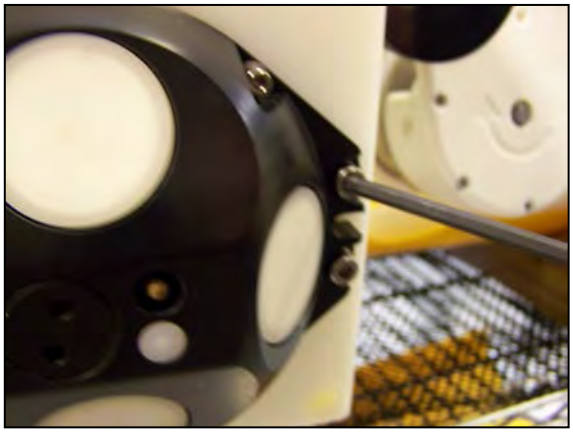


Figure 3.1.27: Secure to Hinge Plate

Figure 3.1.28: Tighten Hinge Plate Screws

5. Tighten the screws that secure the hinge plate mount to the MMP.
6. Re-attach MMP skin.

Notes

Section 3.2
AquaPro HR ACM Sensor

The Nortek AquaPro (HR) integration is a prototype implementation on the MMP. The AquaPro (HR) is a customized interface and does not follow the standard conventions of MMP sensor interactions. Although support for this sensor was first available in v4.18, continued development of this sensor integration has required firmware changes on both the MMP controller and the AquaPro. Contact McLane for details before planning a deployment with an AquaPro series sensor. Aquadopp HR stores all data on the sensor and does not transfer data to the MMP controller at the end of the profile. The data stored on the AquaPro (HR) must be retrieved after deployment recovery. Contact Nortek for instructions for retrieval and processing of the data file(s).

The user configures Aquadopp HR directly. Refer to the Nortek Aquadopp HR/Pro/DW documentation for more detailed instructions about sensor configuration.

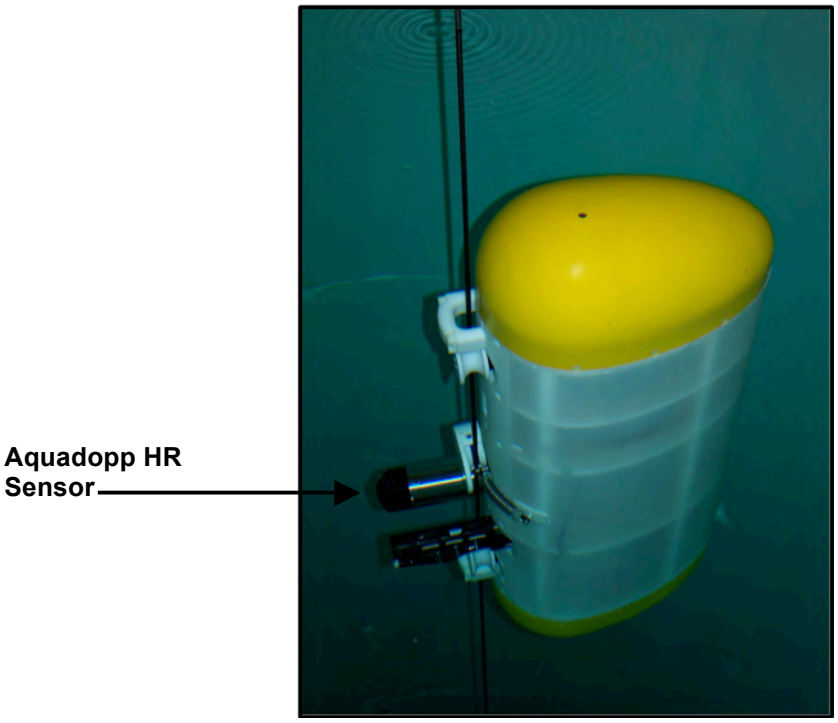


Figure 3.2-1: MMP with Aquadopp HR Sensor

Using Bench Test Options

The main Bench Tests and Aquadopp HR Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors.

1. From the main Profiler Menu type *5* at the prompt to display the Bench Tests Menu.

```
Config: MPP_IM_CT                        CF2 V5.14 of Jun  2 2014
                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML13145-071

                         Pattern Profiler
                            Main Menu

                      Fri Jun  6 13:20:13 2014

 <1> Set Time          <5> Bench Test
 <2> Diagnostics       <6> Deploy Profiler
 <3> Flash Card Ops    <7> Offload Deployment Data
 <4> Sleep             <8> Contacting McLane
 <C> Configure

 Selection [] ?
```

Figure 3.2-2: Profiler Main Menu

```
Config: MPP_IM_CT                        CF2 V5.14 of Jun  2 2014

                         Pattern Profiler
                           Bench Tests

                      Fri Jun  6 13:20:17 2014
CTD utilities:
 <1> Seabird 41CP-IDO CTD communication
 <2> Seabird 41CP-IDO CTD pressure
 <3> Seabird 41CP-IDO CTD average pressure
 <4> Seabird 41CP-IDO CTD temperature record

 <5> Nortek AquaDopp DVS communication
 <6> Nortek AquaDopp DVS tilt & compass

System evaluation:
 <7> Motor operation
 <8> Set Brake
 <9> Independent Watchdog
 <D> Detailed schedule
 <S> Recover schedule

Sensor & Option tests:

 <I> Seabird Inductive Modem
Exit:
```

Figure 3.2-3: Profiler Bench Tests Main Menu

2. From the main Bench Tests menu type *5* at the prompt to display the Nortek Aquadopp Bench Test Menu.

3. Type *1* to connect directly with the Aquadopp.

```
  Selection [] ? 5
_____________________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP           CF2 V5.12 of Feb 11 2014
                 ___________________________________
                          Pattern Profiler
                       AQUADOPP Bench Test Menu
                 ___________________________________
                       Tue Mar 11 15:39:47 2014

    <1> Direct communications (19200 Baud)
    <2> restore McLane parameters
    <3> restore Factory parameters
    <4> Report parameter settings
    <5> Perform a profile test loop
    <6> Set sampling rate (1 Hz)
    <7> Set AquaDopp clock
    <8> Read AquaDopp clock
    <9> Erase sensor data

    <M> return to previous Menu
```

Figure 3.2-4: Aquadopp Bench Test Menu

The Profiler communicates with the Aquadopp (HR) at 9600 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 3-2-5). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
****************************************************************

-Êûx-òÄ-fûx-`¸ò30x-Ê‡-ò-ûfxf30òx¯Ü30ò-òÄ-Ê¯¯


04/23/14 12:50:37 SBE/52MP ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 3.2-5: Baud Rate Communication Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu displays the Baud Rate menu (Figure 3-2-6). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the Profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013
                ____________________________________
                        Pattern Profiler
                       Select new Baud rate

                ____________________________________
                     Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 3.2-6: Baud Rate Menu

Direct Connection to Aquadopp HR

1. Type *1* to connect directly with the Aquadopp.

```
Selection  [M] ? 1

14:15:40 AQUADOPP Communication channels opened.
14:15:40 AQUADOPP Powered on. .....
14:15:41 AQUADOPP Sending command [ID]. .
14:15:42 AQUADOPP Identified as V3.11, AQD 9340.
14:15:42 AQUADOPP Powered off.
14:15:42 AQUADOPP Power-down delay ......................
14:15:47 AQUADOPP Communication channels closed.

14:15:48 AQUADOPP Press ^C to terminate COMM session.
14:15:48 AQUADOPP Communication channels opened.
14:15:48 AQUADOPP Powered on.

************************************************************



HR-AQUAPRO

NORTEK 2010

Version 3.11

Command mode

[^C]
```

Figure 3.2-7: Option <1> Aquadopp Communications

Halt Data Logging

Option <2> from the Aquadopp Bench Test Menu halts data logging, to manually return the Aquadopp to command mode (the Aquadopp has two modes - Command and Logging). During the "Automated Sensor Verification" the Aquadopp is set to logging mode. Each time the Aquadopp powers on, the mode last in continues.

This option requires the password *mclane*. This command is password protected to avoid accidentally disabling the Aquadopp logging.

```
Selection  [M] ? 2  Password: mclane


14:15:31 AQUADOPP Communication channels opened.
14:15:31 AQUADOPP Powered on. .....
14:15:32 AQUADOPP Sending command [ID]. .
14:15:32 AQUADOPP Identified as V3.11, AQD 9340.
14:15:32 AQUADOPP Powered off.
14:15:32 AQUADOPP Power-down delay ......................
14:15:37 AQUADOPP Communication channels closed.
```

Figure 3.2-8: Option <2> Halt Data Logging

Manual Aquadopp Clock Reset

Option <3> (not shown) from the Aquadopp Bench Test menu provides a way to manually reset the Aquadopp clock to the Profiler real-time clock (RTC). Before each profile, the Profiler firmware automatically sets the Aquadopp clock to the Profiler. This option provides a way to manually perform the clock reset for testing purposes.

Selecting <4> from the Aquadopp Bench Test Menu displays the Aquadopp clock reading.

```
Selection  [M] ? 4

14:16:02 AQUADOPP Communication channels opened.
14:16:03 AQUADOPP Powered on. .....
14:16:04 AQUADOPP Sending command [ID]. .
14:16:04 AQUADOPP Identified as V3.11, AQD 9340.
14:16:05 AQUADOPP Reading clock as 05/10/11 14:15:56.  <-- Aquadopp Clock Reading
14:16:05 AQUADOPP Powered off.
14:16:05 AQUADOPP Power-down delay ......................
14:16:10 AQUADOPP Communication channels closed.
```

Figure 3.2-9: Option <4> Read Clock

Perform Profile Test Loop

Option <5> from the Aquadopp Bench Test menu performs a profile test loop. This test simulates an automated sensor verification and a 5 minute profile.

```
       Selection  [M] ? 5

14:16:13 AQUADOPP Automated verification of sensor settings.
14:16:13 AQUADOPP Communication channels opened.
14:16:13 AQUADOPP Powered on. .....
14:16:15 AQUADOPP Sending command [ID]. .
14:16:15 AQUADOPP Identified as V3.11, AQD 9340.
14:16:15 AQUADOPP Sending command [SC].
14:16:15 AQUADOPP Setting clock to 05/10/11 14:16:15. .
14:16:17 AQUADOPP Reading clock as 05/10/11 14:16:16.

 Erase ALL AquaDopp data? Are you sure (Yes/No) [N] ? y

14:16:21 AQUADOPP Sending command [FO]. .
14:16:24 AQUADOPP Erased data.
14:16:24 AQUADOPP Sending command [SR]. .
14:16:27 AQUADOPP Started data logging.
14:16:27 AQUADOPP Powered off.
14:16:27 AQUADOPP Power-down delay .....................
14:16:32 AQUADOPP Communication channels closed.

Press ^C to exit the loop

14:16:33 AQUADOPP Preparing for profile 0.
14:16:34 AQUADOPP Identified as V3.11, AQD 9340.
14:16:39 AQUADOPP 14:16:35 11.1Vb 20.2∞C 300.9H 27.1P 24.7R.
14:16:39 AQUADOPP Acquiring for 30 seconds.

14:17:16 AQUADOPP Data logging halted.
14:17:16 AQUADOPP Opening A0000000.DAT for profile 0.
14:17:16 AQUADOPP Writing 2 byte header for profile 0.
14:17:17 AQUADOPP Writing 440 byte data block for profile 0.
14:17:17 AQUADOPP Writing 448 byte trailer for profile 0.
14:17:17 AQUADOPP Closing A0000000.DAT for profile 0.
14:17:18 AQUADOPP Test profile 0 succeeded.
Press ^C to exit the loop

14:17:18 AQUADOPP Preparing for profile 1.
14:17:19 AQUADOPP Identified as V3.11, AQD 9340.
14:17:24 AQUADOPP 14:17:20 11.1Vb 20.2∞C 301.0H 27.1P 24.7R.
14:17:24 AQUADOPP Acquiring for 30 seconds.

. . .
```

Figure 3.2-10: Option <5> Perform a Profile Test Loop

Aquadopp Heading, Pitch and Roll

Option <6> from the main Bench Test Menu 'Nortek Aquadopp DVS Tilt & Compass' provides heading, pitch and roll output for performing a spin test.

Power of 11V or greater is required for bench testing the Aquadopp DVS tilt & compass.

```
    Selection  [M] ? 6

 Displays Heading, Pitch & Roll outputs
 for use while mounting the ACM pressure housing.

 Press ^C to terminate operation.

14:14:36 AQUADOPP Communication channels opened.
14:14:36 AQUADOPP Powered on. .....
14:14:37 AQUADOPP Sending command [ID]. .
14:14:38 AQUADOPP Identified as V3.11, AQD 9340.
14:14:38 AQUADOPP Sending command [ST]. .

14:14:42 AQUADOPP 269.8 Heading, 27.2 Pitch, 24.7 Roll.
14:14:45 AQUADOPP 269.8 Heading, 27.2 Pitch, 24.7 Roll.
14:14:49 AQUADOPP 270.0 Heading, 27.2 Pitch, 24.8 Roll.
14:14:52 AQUADOPP 270.1 Heading, 27.1 Pitch, 24.7 Roll.
14:14:56 AQUADOPP 270.1 Heading, 27.1 Pitch, 24.7 Roll.
14:14:59 AQUADOPP 270.4 Heading, 27.2 Pitch, 24.7 Roll.
14:15:02 AQUADOPP 282.0 Heading, 27.1 Pitch, 24.7 Roll.
14:15:05 AQUADOPP 301.1 Heading, 27.1 Pitch, 24.7 Roll.
14:15:09 AQUADOPP 301.0 Heading, 27.2 Pitch, 24.6 Roll.
14:15:12 AQUADOPP 301.0 Heading, 27.2 Pitch, 24.7 Roll.

14:15:14 AQUADOPP Sending command [@@@@@@K1W%!Q].
.................................

14:15:15 AQUADOPP Sending command [MC]. .
14:15:15 AQUADOPP Powered off.
14:15:16 AQUADOPP Power-down delay ......................
14:15:21 AQUADOPP Communication channels closed.
```

Figure 3.2-11: Bench Tests Menu Option <6> Aquadopp DVS Tilt & Compass

Chapter 4
Falmouth Scientific ACM+ Sensor

The Falmouth Scientific Inc. acoustic current meter (ACM+) sensor is configurable to measure current velocity in 2 horizontal dimensions (2d) (north/south and east/west) and a third measurement during up/down motion (3d). The sensor has four "sting" fingers that extend at a 45º angle away from a central post. For more information, refer to the Falmouth Scientific Inc. website (www.falmouth.com) or contact Falmouth Scientific, Inc.

Figure 4-1: MMP with FSI ACM +

Sensor orientation is important. The ACM+ sting must point into the water flow for correct measurement.

Collecting Data with the FSI ACM+

A sample unpacked 3d ACM+ file is shown in Figure 4-2.

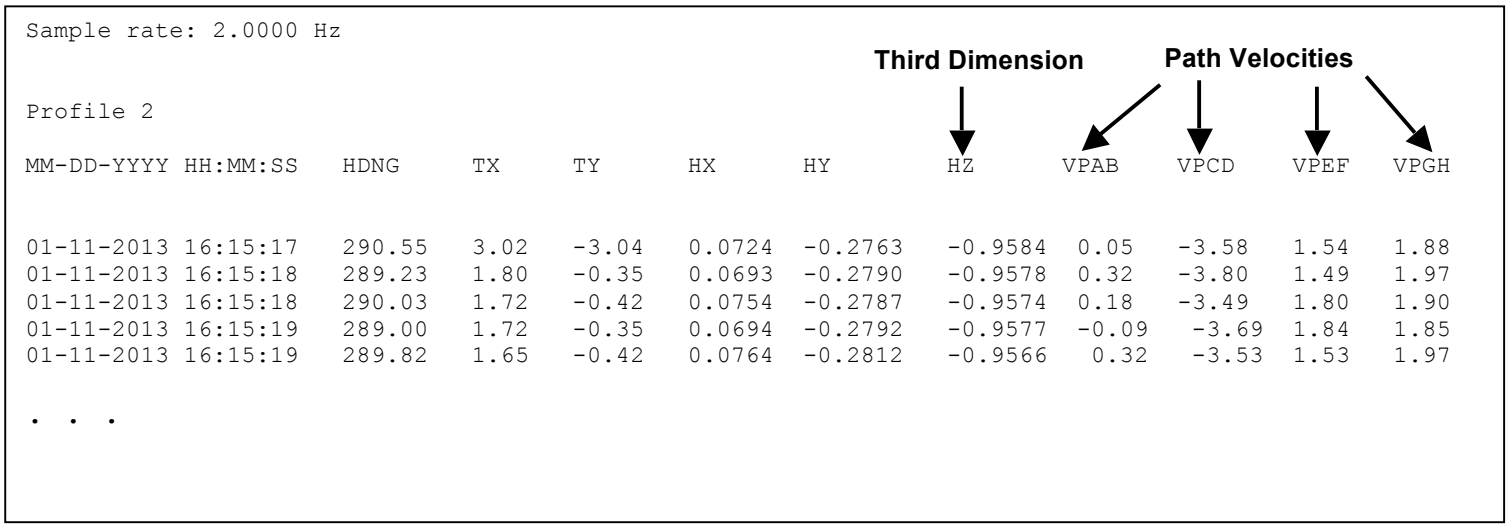


Figure 4-2: FSI ACM+ Data

Configuring the Firmware to Use the FSI ACM+ Sensor

The MMP System Configuration menu specifies the active sensors. The Profiler firmware supports settings for both 2d and 3d FSI ACM+ measurements. To enable an FSI ACM+, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*. Select <2> Falmouth Scientific 3d ACM+ and then type *Y* to enable the sensor.
2. Select [X] to exit and save the entry.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.09 of Oct 19 2013
                 ____________________________________
                          Pattern Profiler
                        System Configuration
                 ____________________________________
                      Wed Nov 13 10:05:02 2013
 System Parameters:
  <0> Battery capacity               240 Ah
  <I> Telemetry ---------------------- ENABLED IMM @ 1200 baud

 Sensor Suite:

Connector J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

Connector J5:ACM
  <2> Falmouth Scientific 3d ACM+ --- ENABLED  <-- FSI ACM 3d

Connector J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

Connector J7:TRB
  <T> Seapoint IR Turbidity

Connector J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode --------------- ENABLED
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2

Connector J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D -------- ENABLED
  <P> Biospherical PAR

Connector J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED

Connector J5i:SER
  <K> ProOceanus CO2

 Exit:
```

Figure 4-3: System Configuration Menu

Using Bench Test Options

The main Bench Tests and FSI ACM+ Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options the are available to installed sensors.

1. From the main Profiler Menu, type *5* at the prompt to display the Bench Tests Menu.

```
Config: MPP_CT                          CF2 V5.00 of Jan 11 2013

                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-001

                            Main Menu

                     Tue Feb 19 07:16:21 2013
        <1> Set Time          <5> Bench Test
        <2> Diagnostics       <6> Deploy Profiler
        <3> Flash Card Ops    <7> Offload Deployment Data
        <4> Sleep             <8> Contacting McLane
        <C> Configure
```

Figure 4-4: Profiler Main Menu

```
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013

                          Pattern Profiler
                            Bench Tests

                       Fri Jan 11 13:40:04 2013
 Sensor Utilities:
  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Falmouth Scientific 3d ACM+ communication
  <6> Falmouth Scientific 3d ACM+ tilt & compass

 System Evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <0> Battery endurance
  <D> Detailed schedule
  <S> Recover schedule

 System Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <L> Wetlabs ECO FLBB(RT)/D
  <M> OceanServer5000 MotionPack
  <O> Aanderaa Optode

 Exit:
```

Figure 4-5: Profiler Bench Tests Menu

The sensor-specific Bench Tests menus are the same for the FSI 3d and 2d ACM settings. The examples shown in this section feature the ACM+.

2. From the main Bench Tests menu, Type *5* at the prompt to display the Falmouth Scientific 3d (or 2d) ACM+ Bench Test Menu.
3. Type *1* to connect directly with the ACM+.

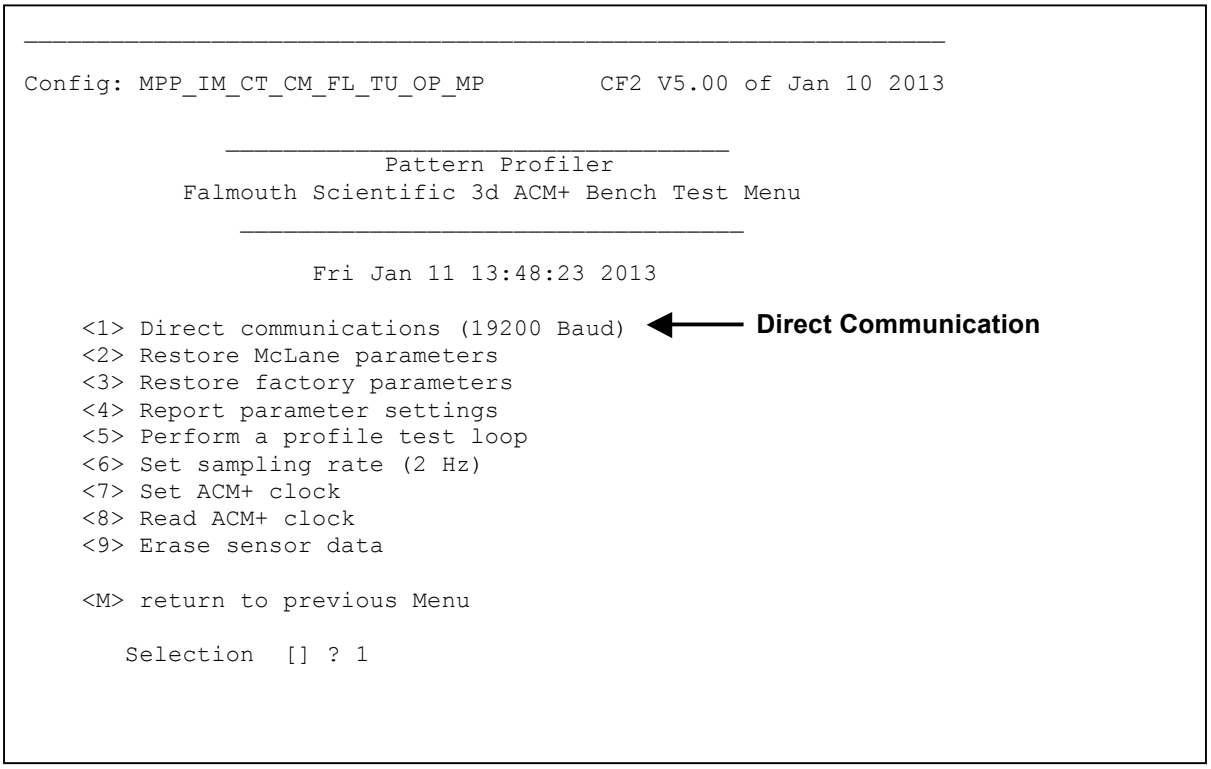


Figure 4-6: ACM+ 3d Bench Tests Menu

The Profiler communicates with the FSI ACM+ at 19200 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 4-7). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
************************************************************

-Êûx-òÄ-fûx-`¸ò6x-Ê‡-ò-ûfxf6òx¯Ü6ò-òÄ-Ê¯¯


04/23/14 12:50:37 SBE/52MP ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 4-7: Baud Rate Communication Error Examples

```
_____________________________________________________________________

Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013

                 ___________________________________
                          Pattern Profiler
                        Select new Baud rate
                 ___________________________________

                      Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session

       Selection  [] ? g
```

Figure 4-8: Baud Rate Menu

Direct Sensor Connection

Once connected directly with the ACM+, typing commands at the command prompt provides additional sensor information.

```
Selection    [] ? 1
1/11/13 13:48:34 FSI/ACM+ Press ^C to terminate COMM session.

01/11/13 13:48:34   SYSTEM Press ^B to change or confirm Baud rate.

01/11/13 13:48:35 FSI/ACM+ 19.2 kBaud communication channel opened.

01/11/13 13:48:35 FSI/ACM+ Powered on.

************************************************************
starting...

3DACM+ Acoustic Current Meter
Falmouth Scientific Inc.
(c) 2009-2012 All Rights Reserved

FW Version v3.20

S/N : 1024
USER ID : ML12936-02D
RS232 serial connection
Memory Card Initialized
Current RTC date/time    :  2013-01-11 13:40:18
RTC TEMP = 17.50 C

 Logging Ops Set
 TILT is ON
COMP is ON
Fingers DOWN
O>
O>run
Running,
Fingers DOWN
Tilt function is ON Compass function is ON
Logging Ops Set

Continuous Ops Cleared
2013-01-11 13:40:43.5,  -2.59,  -45.00, -0.1848,  0.9828,  0.0009,  -
15.21,  7.38,  -50.25,  -27.29
2013-01-11 13:40:45.0,   -2.75,  -45.00, -0.1850,  0.9827,  0.0009,  -
14.17,    7.24,  -49.49,  -28.02
2013-01-11 13:40:46.0,   -2.35,  -45.00, -0.1850,  0.9827,  0.0010,  -
14.78,    7.24,  -48.85,  -28.77
. . .
```

Display shortened for brevity

Figure 4-9 3D ACM+ Communications

Restore McLane and Factory Settings

Option <2> and <3> from the Falmouth Scientific 3d ACM+ Bench Tests menu restore the McLane or FSI factory settings on the ACM+ sensor. Using option <2> requires the password *McLane* (the first three characters *MCL* can also be typed). Using option <3> (not shown) also requires a password. Contact McLane before resetting to the factory parameters.

```
       Selection  [] ? 2  Password: ***

01/11/13 14:01:20 FSI/ACM+ 19.2 kBaud communication channel opened.
01/11/13 14:01:20 FSI/ACM+ Powered on. .. .....
01/11/13 14:01:22 FSI/ACM+ Identified as V3.20, S/N 1024. ......
01/11/13 14:01:22 FSI/ACM+ Sending command [ECHO=ON]. .
01/11/13 14:01:22 FSI/ACM+ Sending command [USRID=ML12936-02D]. .
01/11/13 14:01:23 FSI/ACM+ Sending command [SRATE=2]. .
01/11/13 14:01:23 FSI/ACM+ Sending command [ERASE]. .
01/11/13 14:01:23 FSI/ACM+ Sending command [LOG=ON]. .
01/11/13 14:01:23 FSI/ACM+ Sending command [VBOSE=ON]. .
01/11/13 14:01:24 FSI/ACM+ Sending command [COPS=OFF]. .
01/11/13 14:01:24 FSI/ACM+ Sending command [VEL=ON]. .
01/11/13 14:01:24 FSI/ACM+ Sending command [COMP=ON]. .
01/11/13 14:01:25 FSI/ACM+ Sending command [TILT=ON]. .
01/11/13 14:01:25 FSI/ACM+ Sending command [TSTMP=ON]. .
01/11/13 14:01:25 FSI/ACM+ Sending command [HDNG=ON]. .
01/11/13 14:01:25 FSI/ACM+ Sending command [TX=ON]. .
01/11/13 14:01:26 FSI/ACM+ Sending command [TY=ON]. .
01/11/13 14:01:26 FSI/ACM+ Sending command [HX=ON]. .
01/11/13 14:01:26 FSI/ACM+ Sending command [HY=ON]. .
01/11/13 14:01:26 FSI/ACM+ Sending command [HZ=ON]. .
01/11/13 14:01:26 FSI/ACM+ Sending command [VPATH=ON]. .
01/11/13 14:01:27 FSI/ACM+ Sending command [SAVE]. .

01/11/13 14:01:27 FSI/ACM+ Powered off.

01/11/13 14:01:27 FSI/ACM+ 19.2 kBaud communication channel closed.

01/11/13 14:01:28 FSI/ACM+ Was able to restore McLane parameters.
```

Figure 4-10: <2> Restore McLane Parameters

The firmware requires the settings configured by McLane. Changing settings, or resetting to the factory settings prevents the FSI 3D ACM+ sensor from working correctly with the profiler.

Display Current Settings

Option <4> displays the current FSI 3D ACM+ settings.

```
Selection  [] ? 4

01/11/13 13:50:15 FSI/ACM+ 19.2 kBaud communication channel opened.
01/11/13 13:50:15 FSI/ACM+ Powered on. .. .....
01/11/13 13:50:17 FSI/ACM+ Identified as V3.20, S/N 1024. ......
01/11/13 13:50:18 FSI/ACM+ Sending command [RCFG]. ................

VER=3.20

Current RTC date/time    :  2013-01-11 13:41:59
RTC TEMP = 17.75 C
Current DDATE yyyy-mm-dd :  2012-12-14
Current DTIME   hh:mm:ss :  11:35:25
Wake time/date passed
ITIME: 00:00:00
OTIME: 00:00:00

Averaging Interval: 00:00

CRC=OFF
VEL=ON
COMP=ON
TILT=ON
NRML=ON
SRATE=2.0000Hz

id,avn,ave,avu,aspd,avdir,atlt,TSTMP,ctd,hdng,batt,vx,vy,vz,TX,TY,HX,HY,HZ,vn,ve
,vu,stemp,sv,spres,aux1,aux2,VPATH  43

LOG=ON

Address ops clear

COPS=OFF

OPEN MODE Keyboard Idle Time = 5 Minutes
O>

Press any key to continue.

01/11/13 13:50:23 FSI/ACM+ Sending command [RCAL]. ........................
S/N=1024
VER=3.20

CDATE=26NOV12
USER ID=ML12936-02D
```

Figure 4-11: <4> Report Parameter Settings (screen 1 of 2)

```
LAT=41.6586685
LON=-70.6105270
DECL= 0.0000000
ABOF=-1.083200e+00
CDOF=-1.638578e+00
EFOF=8.051894e-01
GHOF=1.997222e+00
ABSL=1.000000e+00
CDSL=1.000000e+00
EFSL=1.000000e+00
GHSL=1.000000e+00
K1=4.960472e-01
K2=-2.982793e-01
K3=0.000000e+00
K4=0.000000e+00
K5=4.876101e-01
K6=-2.937588e-01
K7=0.000000e+00
K8=0.000000e+00
T0=0.000000e+00
SAL=0.000000e+00
DBAR=0.000000e+00
STOFF=0.000000e+00
STSLP=9.675000e-03
VELXS=0.000000e+00
ZHX=-6.988999e+02
ZHY=5.435000e+01
ZHZ=6.565000e+01
T11=1.657487e-04
T21=-5.302293e-07
T12=9.749364e-07
T22=1.528757e-04
T13=-1.218257e-06
T23=-1.148897e-06
T31=2.149869e-06
T32=5.860501e-07
T33=1.565859e-04
DEX=0.000000e+00
DEY=0.000000e+00
DEZ=0.000000e+00
O>

Press any key to continue.

01/11/13 13:50:29 FSI/ACM+ Powered off.
01/11/13 13:50:29 FSI/ACM+ 19.2 kBaud communication channel closed.
```

Figure 4.12: <4> Report Parameter Settings (screen 2 of 2)

Perform Profile Test Loop

Option <5> (not shown) runs a profile test loop. This test simulates an automated sensor verification and 5 minute profile.

Set Sampling Rate

Option <6> from the ACM+ Bench Test Menu changes the sensor sampling rate. The default sampling rate is 2Hz.

```
Selection  [] ? 6

Enter new ACM+ sampling rate (1-10) [4] ? 3
_____________________________________________________________________

Config: MMP_CT_CM                       CF2 V5.13 of Apr 16 2014
                 ____________________________________
                          Standard Profiler
              Falmouth Scientific 3d ACM+ Bench Test Menu
                 ____________________________________
                       Thu Apr 17 13:58:45 2014

    <1> Direct communications (19200 Baud)
    <2> restore McLane parameters
    <3> restore Factory parameters
    <4> Report parameter settings
    <5> Perform a profile test loop
    <6> Set sampling rate (3 Hz)  <-- Sampling Rate Changed to 3Hz
    <7> Set ACM+ clock
    <8> Read ACM+ clock
    <9> Erase sensor data
```

Figure 4-13: <6> Set Sampling Rate

Manual ACM+ Clock Reset

Option <7> (not shown) from the ACM+ Bench Test menu provides a way to manually reset the ACM+ clock to the Profiler real-time clock (RTC). Before each profile, the Profiler firmware automatically sets the Aquadopp clock to the Profiler clock. This option provides a way to manually perform the clock reset for testing purposes.

Selecting <8> (not shown) from the ACM+ Bench Test Menu displays the ACM+ clock reading.

Erase Sensor Data

Option <9> (not shown) from the ACM+ Bench Test Menu provides a way to manually clear the data from the ACM+ SD storage card. At the start of each deployment, the Profiler firmware automatically commands the ACM+ to erase the data stored internally. This option provides a manual way to clear the data from the ACM+ internal storage for testing purposes. Selecting <M> returns to the previous menu.

Additional Sensor-Specific Test Options

From the main Bench Tests menu additional options can be selected for heading, pitch and roll output. This data can be used to perform a spin test.

```
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013

                  Pattern Profiler
                    Bench Tests

                Fri Jan 11 13:40:04 2013
 Sensor Utilities:
  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Falmouth Scientific 3d ACM+ communication
  <6> Falmouth Scientific 3d ACM+ tilt & compass
 System Evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <0> Battery endurance
  <D> Detailed schedule
  <S> Recover schedule
 System Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <L> Wetlabs ECO FLBB(RT)/D
  <M> OceanServer5000 MotionPack
  <O> Aanderaa Optode
 Exit:
<X> Main Menu
```

Additional Test Option

Figure 4-14: Main Bench Tests Menu

FSI 3D ACM+ Tilt and Compass

Option <6> from the main Bench Tests menu provides heading, pitch and roll output.

```
Selection [] ? 6
 Expecting FSI/ACM+ at 19200 baud. Change [N] ?

01/11/13 13:51:29 FSI/ACM+ 19.2 kBaud communication channel opened.
01/11/13 13:51:30 FSI/ACM+ Powered on.
************************************************************
01/11/13 13:51:30 FSI/ACM+ Executing scripted commands. Please wait...
 starting...

3DACM+ Acoustic Current Meter
Falmouth Scientific Inc.
(c) 2009-2012 All Rights Reserved
FW Version v3.20
S/N : 1024

USER ID : ML12345-02D
RS232 serial connection
Memory Card Initialized
Current RTC date/time    :  2013-01-11 13:43:13
RTC TEMP = 17.75 C
 Logging Ops Set
TILT is ON
COMP is ON
Fingers DOWN
O>
01/11/13 13:51:36 FSI/ACM+ ERROR! Didn't receive expected response from [
] command.
01/11/13 13:51:36 FSI/ACM+ Completed scripted commands.
01/11/13 13:51:36 FSI/ACM+ Press ^C to terminate COMM session.
01/11/13 13:51:36   SYSTEM Press ^B to change or confirm Baud rate.
    DATE     TIME      HEADING       TX       TY       HX       HY       HZ
O>
O>
O>run
Running,
Fingers DOWN
Tilt function is ON Compass function is ON
Logging Ops Set
Continuous Ops Cleared

2013-01-11 13:43:34.0,   -2.59,  -45.00, -0.1847,  0.9828,  0.0008,  -14.36,
7.35,  -49.62,  -28.13

2013-01-11 13:43:36.5,   -2.35,  -45.00, -0.1847,  0.9828,  0.0012,  -13.90,
7.21,  -50.85,  -29.14
.  .  .
 [^C]
************************************************************
01/11/13 13:52:00 FSI/ACM+ Powered off.
01/11/13 13:52:00 FSI/ACM+ 19.2 kBaud communication channel closed.
```

Figure 4-15: Option <6> Falmouth Scientific 3d ACM+ tilt & compass

Installing the ACM+ Sting and Attaching to the Mooring Cable

The Profiler ships with the FSI ACM+ sting secured inside the crate. Before deploying the Profiler, the ACM+ sting must be oriented and attached to the hinged bracket extending forward of the MMP body. The hinged bracket swings out of the way when the mooring cable is inserted and allows the cable to pass beneath.

The ACM bracket aligns the ACM+ sensor and mooring cable on the center line to properly position the MMP for taking measurements in relatively undisturbed flow. The ACM+ fingers are labeled +X, +Y, -X, -Y for orientation. An off-center alignment introduces a left-right bias in the flow measurement because the sting is not symmetrically aligned with the flow streamlines around the body of the MMP.

Installing the ACM+ Sting

1. Place the MMP in a sling or other supported surface on its side and remove the MMP skin.

2. Mount the sting with the -Y finger up. After the sting base plate is placed and the four bolts are finger-tightened (Figure 4-16), twist the sting and align it with the +Y and -Y fingers on a vertical plane and the +X and -X fingers on a horizontal plane.

Figure 4-16: Tighten ACM+ Sting

3. Lay the oil-filled cable through the slot in the port side of the MMP skin and along the grooves in the frame ribs and spacer posts and thread through the narrow slot in the hinged bracket. Do not force the cable immediately adjacent to the sting base plate through the slot.

The oil filled cable connecting the ACM+ sting to the ACM+ electronics housing is fragile. Gently maneuver this cable. Do not pull on or introduce a tight bend in the cable and avoid crimping the outer tube. Damage to the cable must be repaired by the manufacturer..

4. Release enough cable from the interior of the MMP so that the sting base plate is 15cm (6”) from the slot.
5. Squeeze the cable gently with two fingers, aligning the interior wires so that they do not cross over each other, and slide the cable through the slot.
6. Re-attach screws to secure ACM+ sting. The hinged bracket is attached so that the sting will rest in position when the MMP is on the starboard (right) side.
7. Coil excess cable inside the Profiler and secure the cable to the hinged bracket with a plastic tie-wrap (Figure 4-17). Securing cable minimizes contact with the mooring cable running inside the bracket. The corner of the bracket has a hole to attach the tie-wrap. Reattach the MMP skin.

Figure 4-17: Secure Excess Cable

Inserting the Mooring Cable

1. Place the MMP in a sling or other supported surface on its side.
2. Using a hex driver, loosen the socket head nylon cap screws from the ACM+ hinged bracket.

When securing and orienting the ACM+, place the MMP starboard (right) side down (with the McLane label visible on the drive motor). This position prevents the ACM+ sting from pivoting down when loosening the cap screws that secure the hinged mounting bracket.

3. Lift the hinged bracket and swing the ACM+ sting out of the way.

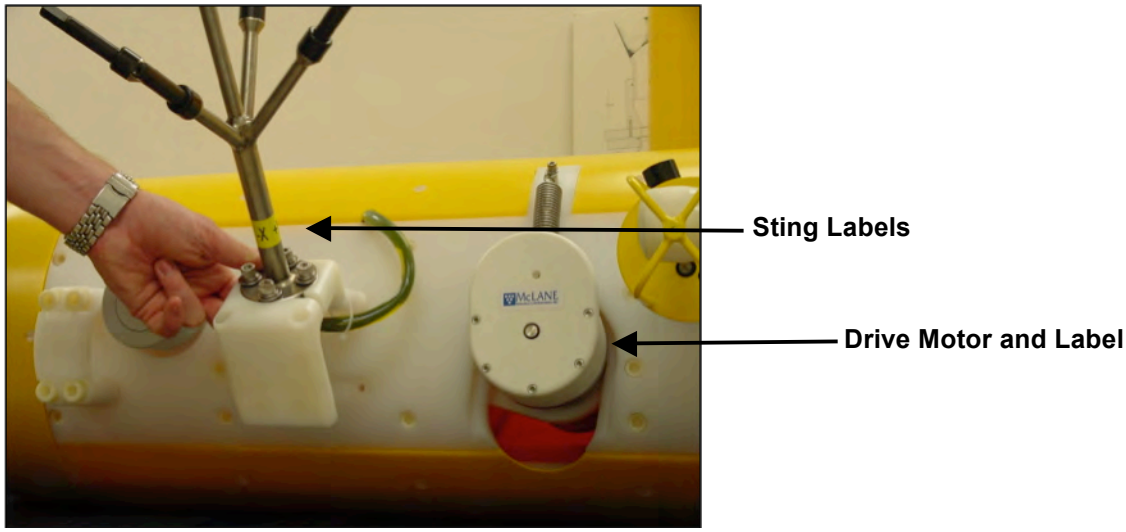


Figure 4-18: Releasing Hinged Mounting Bracket

4. Insert the mooring cable through the hinged bracket.
5. Reattach and tighten the socket head nylon cap screws to the hinged bracket.

Removing the ACM+ Electronics Housing

If it is necessary to remove the ACM+ electronics housing, complete the following steps:

1. Remove the port (left) side of the MMP skin
2. Move other sensors such as the CTD out of the way.
3. Unscrew the two socket head nylon cap screws securing the ACM+ clamp to the angle brace and remove the clamp and ACM+ housing together.
4. Loosen the four, recessed, socket head nylon cap screws to release the ACM+ housing from the clamp.

Figure 4-19: Correct Positioning of ACM+ Electronics Housing

Reinstalling the ACM+ Electronics Housing

To reinstall the ACM+ electronics housing, complete the following steps:

1. Locate the milled depression in the top face of the end cap. The depression may be hidden under a label or there may be a label with an arrow indicating its location or direction. The ACM+ electronics housing should be mounted so that the depression points towards the front of the profiler.
2. Locate the mounting holes in the clamp to determine its orientation relative to the MMP frame.
3. Place the housing in the clamp and twist it to orient the milled depression to the front face of the clamp.
4. Tighten the clamp and reinstall the clamp/housing assembly.

Chapter 5
Nobska MAVS ACM Sensor

MMP Release v3.31 firmware and higher supports the Nobska Modular Acoustic Velocity Sensor (MAVS) Acoustic Current Meter (ACM). The MAVS is a self-logging sensor. Contact Nobska (www.nobska.net) for more information about the MAVS ACM sensor, firmware menus and communications protocol.

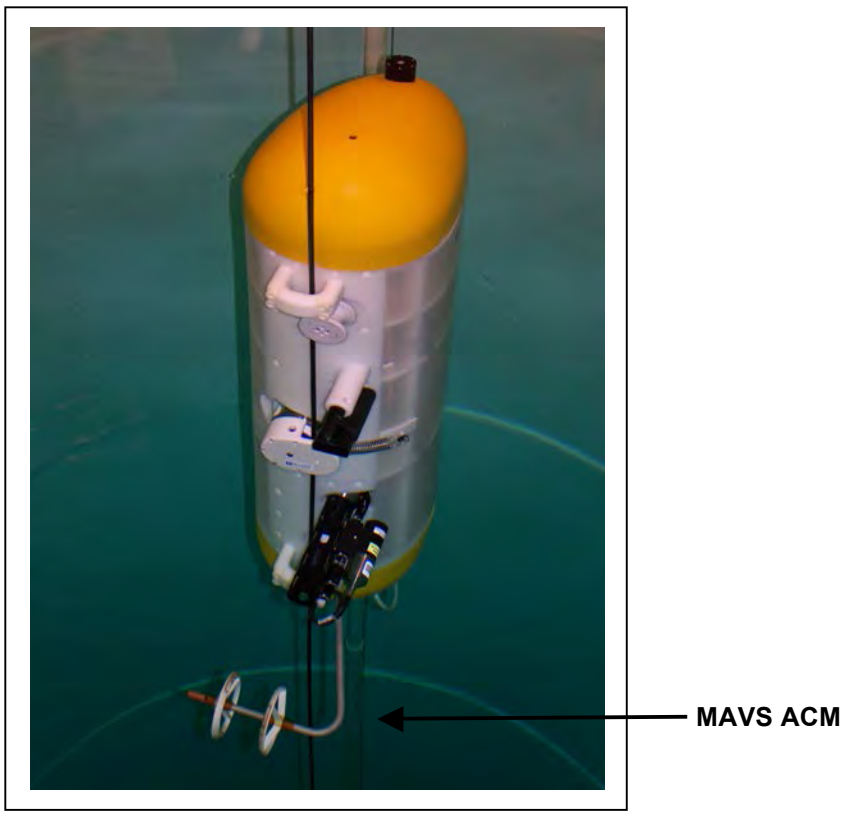


Figure 5-1: MMP with MAVS ACM

Collecting Data with the Nobska MAVS ACM

When a profile starts, the MMP communicates with the MAVS and begins MAVS ACM data collection. At the end of each profile, the MMP communicates with the MAVS again to retrieve collected ACM data.

The MAVS user documentation contains information about the MAVS communications protocol.

```
Profile 3
    pth0      pth1      pth2      pth3        MX        MY        MZ         P         R
    -0.6      -1.0      -0.6       0.0     -0.07     -0.20     -0.98       0.9       0.5
    -0.7      -0.6      -0.4      -0.1     -0.08     -0.18     -0.98       0.8       0.5
    -0.7      -0.5      -0.3       0.0     -0.08     -0.18     -0.98       0.8       0.4
    -0.7      -0.5      -0.3       0.1     -0.07     -0.20     -0.98       0.8       0.5
    -0.6      -0.7      -0.4       0.0     -0.07     -0.20     -0.98       0.8       0.5
    -0.7      -0.7      -0.2       0.1     -0.08     -0.20     -0.98       0.8       0.4
    -0.7      -0.7      -0.3       0.0     -0.07     -0.20     -0.98       0.8       0.5
    -0.8      -0.7      -0.4       0.2     -0.07     -0.22     -0.97       0.8       0.4
    -0.7      -0.7      -0.3       0.1     -0.07     -0.20     -0.98       0.8       0.5
    -0.7      -0.7      -0.6       0.1     -0.07     -0.20     -0.98       0.8       0.4
    -0.6      -0.7      -0.3       0.1     -0.07     -0.22     -0.97       0.8       0.5
. . .                                                          Display shortened for brevity
    -0.8      -0.7       0.1       0.1     -0.31     -0.21     -0.93       0.7       0.5
    -1.1      -0.8      -0.3      -0.4     -0.29     -0.19     -0.94       0.8       0.4
    -0.8      -0.8      -0.1       0.0     -0.31     -0.19     -0.93       0.9       0.4
    -0.5      -0.4       0.2       0.2     -0.30     -0.19     -0.93       0.7       0.5
    -1.1      -1.1      -0.4      -0.4     -0.31     -0.19     -0.93       0.8       0.5
    -1.0      -0.8      -0.3      -0.2     -0.30     -0.21     -0.93       0.8       0.5
    -0.6      -0.6       0.0       0.0     -0.31     -0.19     -0.93       0.7       0.5
    -0.9      -0.5       0.1      -0.1     -0.31     -0.19     -0.93       0.8       0.5
 Profile 3
  ACM turned on at 06/21/2013 16:01:36
  ACM turned off at 06/21/2013 16:06:48
```

Figure 5-2: MAVS ACM Data

If the MAVS fails to communicate with the Profiler, the deployment continues but no data is logged for the MAVS.

Configuring the Firmware to Use the MAVS ACM

The MMP System Configuration menu specifies the active sensors. The MAVS sensor version must also be specified. Contact Nobska (www.nobska.net) with questions about your MAVS firmware version. To enable a MAVS ACM, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*. Select <2> Nobska MAVS ACM and then type *Y* to enable the sensor.
2. Select *X* to exit and save the entry.

```
_____________________________________________________________________
Config: MMP_CT_CM                        CF2 V5.03 of May  8 2013

                  ____________________________________
                           Standard Profiler
                          System Configuration
                  ____________________________________
                       Fri Jun 21 11:35:54 2013

 System Parameters:
  <0> Battery capacity               240 Ah
  <D> File Deletion
  <I> Inductive Telemetry

 Sensor Suite:

Connector J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

Connector J5:ACM
  <2> Nobska MAVS ACM --------------- ENABLED mavs41p0 <-- Nobska MAVS

Connector J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

Connector J7:TRB
  <T> Seapoint IR Turbidity

Connector J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <W> Wetlabs ECO BBFL2

Connector J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR

Connector J4i:SER
  <M> OceanServer5000 MotionPack

 Exit:

  <X> Save changes    <^C> Cancel changes
Selection [] ? 2

Enable the "Nobska MAVS ACM" [Y] ?
Select 1 = 41p0, 2 = 41p1, 3 = 41t1, 4 = 41t2 (1-4) [0] ? 1 <-- MAVS Firmware ver
```

Figure 5-3: System Configuration Menu

Using Bench Test Options

The main Bench Tests and Nobska MAVS Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options the are available to installed sensors.

1. From the main Profiler Menu, type *5* at the prompt to display the Bench Tests Menu.

```
Config: MPP_CT                          CF2 V5.00 of Jan 11 2013

                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-001

                            Main Menu

                      Tue Feb 19 07:16:21 2013
        <1> Set Time          <5> Bench Test
        <2> Diagnostics       <6> Deploy Profiler
        <3> Flash Card Ops    <7> Offload Deployment Data
        <4> Sleep             <8> Contacting McLane
        <C> Configure
```

Figure 5-4: Profiler Main Menu

```
Config: MMP_CT_CM                       CF2 V5.03 of May  8 2013

                         Standard Profiler
                            Bench Tests

                      Fri Jun 21 11:37:48 2013

 Sensor Utilities:

  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Nobska MAVS ACM communication
  <6> Nobska MAVS ACM tilt & compass

 System Evaluation:
  <7> Motor operation
  <8> Release Brake
  <9> Independent Watchdog
  <0> Estimate deployment endurance

 System Sensor & Option Tests:

 Exit:
  <X> Main Menu
```

Figure 5-5: Profiler Bench Tests Menu

2. From the main Bench Tests menu, type *5* at the prompt to display the Nobska MAVS Bench Test menu.

3. Type *1* to connect directly with the Nobska MAVS ACM.

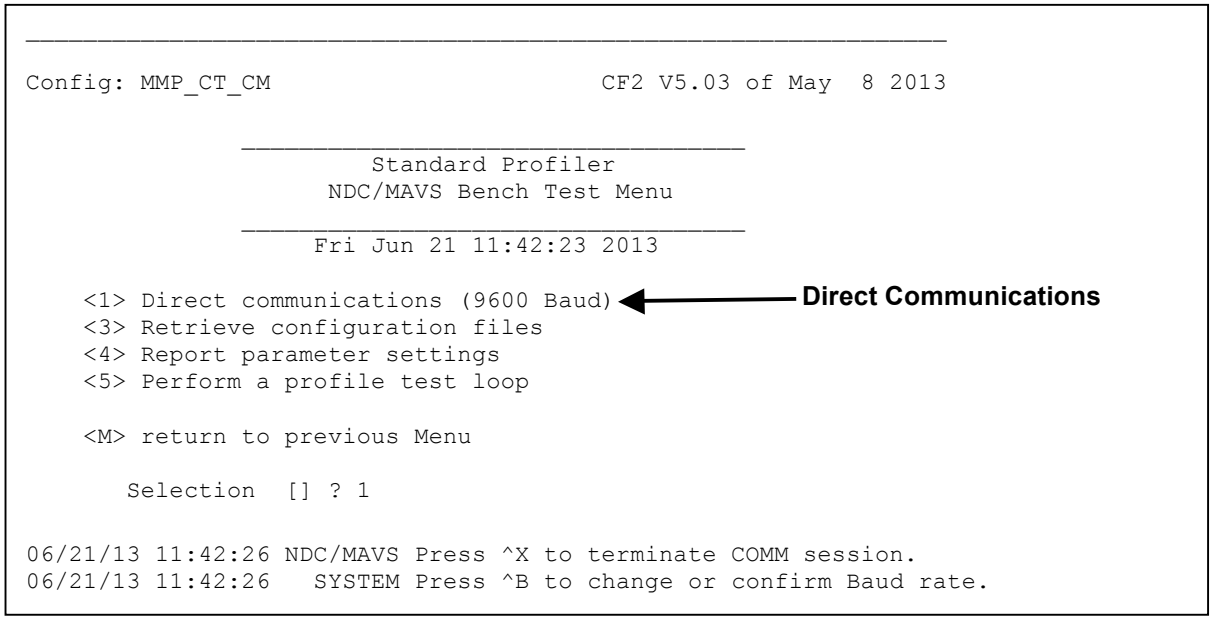


Figure 5-6: Nobska MAVS Bench Tests Menu

The Profiler communicates with the MAVS ACM at 9600 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 5-7). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
****************************************************************

-Êûx-òÄ-fûx-`¸ò6x-Ê‡-ò-ûfxf6òx¯Ü6ò-òÄ-Ê¯¯


04/23/14 12:50:37 NDC/MAVS ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 5-7: Baud Rate Communication Error Examples

```
E_____________________________________________________________________

Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013

                 ____________________________________
                          Pattern Profiler
                         Select new Baud rate
                 ____________________________________

                      Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session

       Selection  [] ? g
```

Figure 5-8: Baud Rate Menu

Direct Sensor Connection

Once connected directly to the MAVS, the MAVS firmware menus display (Figure 5-9). The MAVS Manual contains information about the MAVS communication protocol.

Pressing [CTRL]-[C] within 5 seconds is required to control the MAVS firmware and prevent autonomous MAVS operations from starting. Typing [CTRL]-[X] exits from the MAVS ACM Menus and returns to the MMP firmware. Typing [CTRL]-[S] from the Profiler MAVS Bench Test routines exits to the MAVS Bench Tests menu.

```
06/21/13 11:42:27 NDC/MAVS 9.6 kBaud communication channel opened.
06/21/13 11:42:27 NDC/MAVS Powered on.
************************************************************
 Sizing flash card (~2 seconds / 100 Mbytes) . . . done.
 1024.295 Mbyte flash card installed
 1024.262 Mbyte currently free

 File system can accommodate   4091 data files
 Initializing . . . done.
 Loading system configuration information  . . . done.
 Loading deployment definition information . . . done.
 Loading deployment history information  . . . . done.
 Setting Moored Profiler Mode  . . . . . . . . . done.
 Storing system configuration information  . . . done.
 Storing deployment definition information . . . done.
 The MAVS4 operating system is
 initialized and running.

 Type <CTRL>-<C> within 5 seconds
 to assert operator control.

  5 seconds
  4 seconds
  3 seconds
  2 seconds
  1 seconds [^C]
  0 seconds

 Checking power supply . . . done.
 Current clock time:  01/01/1970  00:00:14

 Change time & date (Yes/No) [N] ?
            Nobska Development Corp.
                    MAVS-4
        Modular Acoustic Velocity Sensor
                   Model  4
         Version: mavs41p0.c S/N: 10305

       …ÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕª
       ∫             Main Menu             ∫
       »ÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕÕ°
             Thu Jan  1 00:00:18 1970

       <1> Set Time          <5> Bench Tests
       <2> Flash Card Ops    <6> Deploy System
       <3> Calibration       <7> Offload Data
       <4> Low Power Sleep   <8> Contact Nobska

         Selection 5
```

Figure 5-9: Nobska MAVS Direct Communications

Retrieve Configuration Files

Option <3> (not shown) from the MAVS Bench Tests menu copies the MAVS configuration files to the Profiler that are necessary for the Profiler Unpacker.

Report Parameter Settings

Option <4> from the MAVS Bench Tests menu displays the current MAVS parameters.

```
Selection  [] ? 4

07/01/13 12:16:27   SYSTEM Verifying MAVS ...

07/01/13 12:16:28 NDC/MAVS 9.6 kBaud communication channel opened.
07/01/13 12:16:28 NDC/MAVS Powered on.
07/01/13 12:16:28 NDC/MAVS Initializing ... ......................
07/01/13 12:16:41 NDC/MAVS Sending [^C] 3 times. ....
07/01/13 12:17:02 NDC/MAVS Sending command [N]. . ... ......
07/01/13 12:17:02 NDC/MAVS Identified as mavs41p0, S/N 10305.
07/01/13 12:17:02 NDC/MAVS Powered off.
07/01/13 12:17:02 NDC/MAVS Power-down delay .....................
07/01/13 12:17:07 NDC/MAVS 9.6 kBaud communication channel closed.
```

Figure 5-10: Nobska MAVS Direct Communications

Perform Profile Test Loop

Option <5> from the Nobska MAVS Bench Tests menu runs a profile test loop. This test simulates an automated sensor verification and a 5 minute profile.

Additional Sensor-Specific Test Options

From the main Bench Tests menu Option <6> displays the heading, pitch and roll output. This data can be used to perform a spin test.

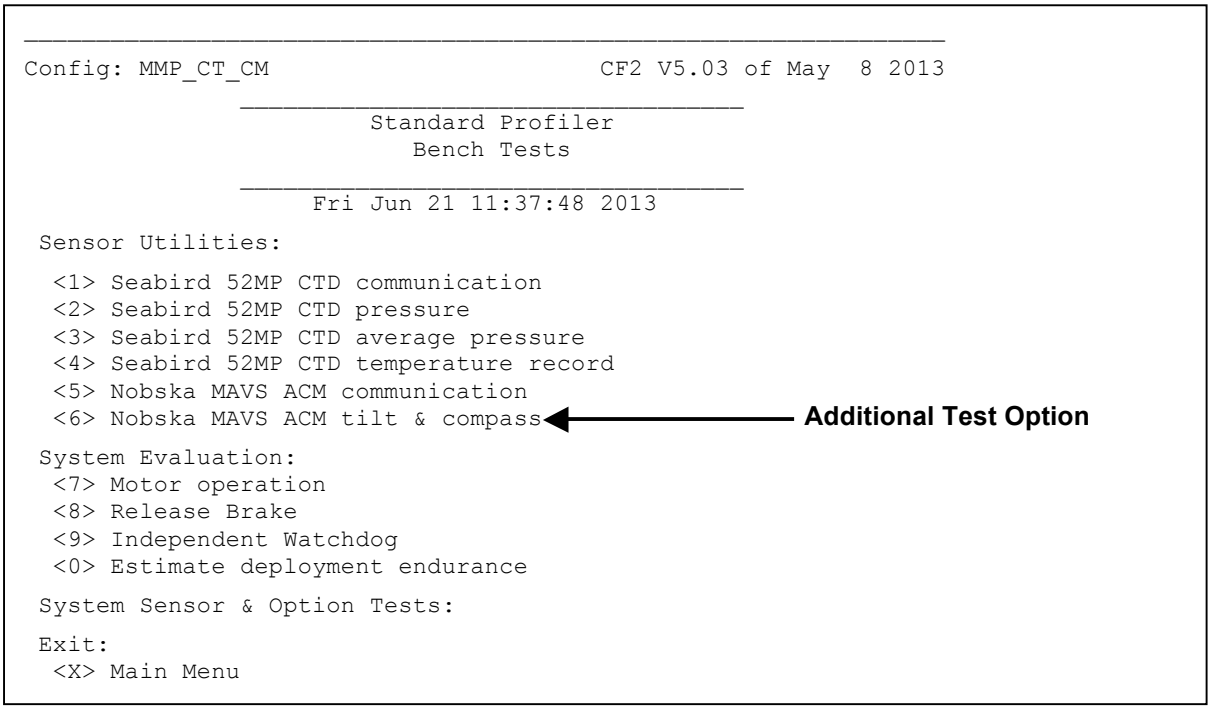


Figure 5-11: Main Bench Tests Menu

Nobska MAVS ACM Tilt and Compass

Compass/tilt options must be performed in the MAVS firmware menus as shown in Figure 5-11.

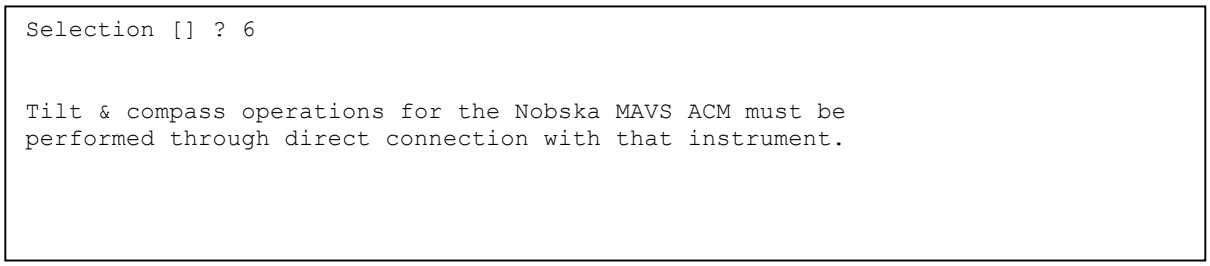


Figure 5-12: Tilt/Compass Options must be performed in MAVS Firmware

Chapter 6
Wet Labs Optical Sensors – General Information

Wet Labs optical sensors collect a combination of optical measurements. Many sensitivity ranges can be ordered. There are many configurations available of similar units which result in different Model numbers. If you have questions about your specific model, consult the Wet Labs documentation that is included for your sensor.

Sensor Calibration

Wet Labs includes Calibration sheets with each sensor. Refer to the sensor-specific calibration information for guidelines.

This chapter explains integration with Wet Labs sensors as follows:

Chapter Contents	
Section 6.1	Wet Labs BBFL2
Section 6.2	Wet Labs FLBB(RT/D) or FLBBCD
Section 6.3	Wet Labs C-Star

The Wet Labs ECO series sensors (for example, BBFL2, FLBB(RT/D), FLBBCD) have a similar configuration and interface screens. Consult your Wet Labs documentation for unit-specific parameters.

Configuring the Firmware to Use the Wet Labs Optical Sensors

The Profiler System Configuration menu specifies the active sensors. To enable a Wet Labs Optical sensor, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*.
2. Select an option to enable a Wetlabs sensor and then type *Y* to enable the sensor.

```
_____________________________________________________________________
Config: MPP_CT_FL_OP                    CF2 V5.24 of Oct 21 2015

                 ___________________________________
                           Pattern Profiler
                         System Configuration
                 ___________________________________
                      Thu Oct 22 09:33:36 2015
 System Parameters:
  <0> Battery capacity               240 Ah

 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

      Port J5:ACM
  <2> No ACM selected

      Port J6:IMM
  <I> Telemetry

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <J> Wetlabs ECO FLBBCD ------------ ENABLED
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2
  <Y> Wetlabs ECO FLBB2K
  <@> Wetlabs FLNTURTD

      Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR
  <$> WetLabs CST Transmissometer --- ENABLED @ 36 avg, ~0.99 Hz

      Port J7:TRB
  <T> Seapoint IR Turbidity

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack

      Port J5i:SER
  <K> ProOceanus CO2
  <#> Aanderaa Optode --------------- ENABLED

 Exit:

  <X> Save changes    <^C> Cancel changes

 Selection [] ? x
```

Figure 6-1: System Configuration Menu

Using Bench Test Options

The main Bench Tests and Wet Labs Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors.

1. From the main Profiler menu type *5* at the prompt to display Bench Tests Menu.

```
Config: MPP_CT                          CF2 V5.00 of Jan 11 2013

                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-001

                            Main Menu

                      Tue Feb 19 07:16:21 2013
        <1> Set Time          <5> Bench Test
        <2> Diagnostics       <6> Deploy Profiler
        <3> Flash Card Ops    <7> Offload Deployment Data
        <4> Sleep             <8> Contacting McLane
        <C> Configure
```

Figure 6-2: Profiler Main Menu

```
Configuration: MMP_IM_CT_CM_PA_SC       CF2 V5_00 of Nov 27 2012

                            Bench Tests

                       Wed Nov 28 14:49:11 2012
 Sensor Utilities:
  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Nortek AquaDopp DVS communication
  <6> Nortek AquaDopp DVS tilt & compass
 System Evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <0> Estimate deployment endurance
 Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <M> OceanServer5000 MotionPack
  <P> Biospherical PAR
  <W> Wetlabs ECO BBFL2
 Exit:
  <X> Main Menu
              Selection  ? w
```

Figure 6-3: Profiler Bench Tests Menu

The sensor-specific Bench Tests menus are the same for the Wetlabs Optical sensors unless noted.

2. From the Bench Tests menu, type an option at the prompt to display the Wet Labs Bench Test menu (Figure 6-4).

3. Type *1* to connect directly with the Wet Labs Optical Sensor.

```
Config: MPP_IM_CT_CM_PA_SC_MP           CF2 V5.12 of Feb 11 2014

                  Pattern Profiler
                WL/BBFL2 Bench Test Menu

                Tue Mar 11 15:43:56 2014

    <1> Direct communications (19200 Baud)
    <2> Perform a profile test loop

    <M> return to previous Menu

Selection  [] ? 1

03/11/14 15:43:58 WL/BBFL2    Enter "!!!!!" (w/o quotes) to get sensor's
attention.

03/11/14 15:43:59 WL/BBFL2    Press ^C to terminate COMM session.
03/11/14 15:43:59   SYSTEM    Press ^B to change or confirm Baud rate.
```

Figure 6-4: Wet Labs BBFL2 Bench Test Menu

```
Config: MPP_CT_FL_OP                    CF2 V5.24 of Oct 16 2015

                  Pattern Profiler
          WetLabs CST Transmissometer Bench Test Menu


                Tue Oct 20 10:42:25 2015

 <1> Direct communications (19200 Baud) <-- Direct Communications
 <2> Perform a profile test loop
 <3> Set number of samples averaged (36 avg, ~0.99 Hz)
 <4> Offload C-Star data files

 <M> return to previous Menu

 Selection [] ?
```

Figure 6-5: Wet Labs C-Star Bench Test Menu

The Profiler communicates with the Wet Labs Sensors at 19200 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 6-6). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
****************************************************************

-Êûx-òÄ-fûx-`¸ò5x-Ê‡-ò-ûfxf5òx¯Ü5ò-òÄ-Ê¯¯


04/23/14 12:50:37 SBE/52MP ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 6-6: Baud Rate Communication Error Examples

```
Expecting WL/BBFL2 + at 19200 baud. Change [N] ? y

_____________________________________________________________________

Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013

                ____________________________________
                         Pattern Profiler
                        Select new Baud rate
                ____________________________________

                     Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session

       Selection  [] ? g
```

Figure 6-7: Baud Rate Menu

Direct Sensor Connection

Once connected directly to the Wet Labs Optical sensor, typing commands at the command prompt provides additional sensor information. Figure 6-8 shows direct communication with the BBFL2 model. Figure 6-9 shows direct communication with the FLBB(RT)/D which works the same as the FLBBCD model.

```
Selection  [] ? 1

03/11/14 15:43:58 WL/BBFL2    Enter "!!!!!" (w/o quotes) to get sensor's
attention.

03/11/14 15:43:59 WL/BBFL2    Press ^C to terminate COMM session.
03/11/14 15:43:59   SYSTEM    Press ^B to change or confirm Baud rate.


03/11/14 15:44:00 WL/BBFL2    19.2 kBaud communication channel opened.

03/11/14 15:44:00 WL/BBFL2    Powered on.

************************************************************

03/11/14      12:43:27      700    4130   695    1904   460    4130   541
03/11/14      12:43:29      700    4130   695    1904   460    4130   540
03/11/14      12:43:30      700    4130   695    1905   460    4130   540
03/11/14      12:43:31      700    4130   695    1904   460    4130   539
03/11/14      12:43:32      700    4130   695    1905   460    4130   540
.  .  .  <-------------------------------------- Display shortened for brevity

03/11/14      12:43:41      700    58     695    55     460    49     538
03/11/14      12:43:42      700    61     695    55     460    65     538

03/11/14      12:43:43      700    59     695    54     460    57     538
 [^C]

************************************************************

03/11/14 15:44:19 WL/BBFL2    Powered off.
03/11/14 15:44:19 WL/BBFL2    19.2 kBaud communication channel closed.
```

Figure 6-8: <1> BBFL2 Direct Communications

In the FLBB(RT)/D example shown next, the third and fifth columns display the wavelength settings on the specific sensor model (refer to the Wet Labs manual for more information). Time and Date columns display '9s' as these columns are only placeholders. The last column displays the Temperature if this option is enabled on the sensor. Otherwise, the last column displays placeholder data (Figure 6-9).

```
       Selection  [M] ? 1

09:48:53  WL/FLBB Enter "!!!!!" (w/o quotes) to get sensor's attention.

 Expecting  WL/FLBB at 19200 baud. Change (Yes/No) [N] ?

09:48:55  WL/FLBB Press ^C to terminate COMM session.
09:48:56  WL/FLBB Communication channels opened.
09:48:56  WL/FLBB Powered on.
*****************************************************************
                 Fluorescence wave-length   CHL  Turb wave-length   NTU   Temp (if option is installed)

99/99/99     99:99:99     695    56      700    78     547
99/99/99     99:99:99     695    56      700    79     547
99/99/99     99:99:99     695    55      700    78     546
99/99/99     99:99:99     695    56      700    78     546
99/99/99     99:99:99     695    55      700    77     546
99/99/99     99:99:99     695    54      700    77     546
99/99/99     99:99:99     695    54      700    78     546
99/99/99     99:99:99     695    55      700    85     546
99/99/99     99:99:99     695    55      700    80     546
99/99/99     99:99:99     695    54      700    690    546
99/99/99     99:99:99     695    2248    700    4130   545
99/99/99     99:99:99     695    2570    700    4130   545
99/99/99     99:99:99     695    4109    700    4130   545
99/99/99     99:99:99     695    4130    700    4130   545
. . .

99/99/99     99:99:99     695    53      700    76     532
99/99/99     99:99:99     695    55      700    75     532
99/99/99     99:99:99     695    54      700    75     532
99/99/99     99:99:99     695    53      700    77     532

!!
Ser FLBBRTD-2350
Ver FLNTU 4.08
Ave 30
Pkt 900

!!
$mnu

!!!!
$mnu
 [^C]
************************************************************************
10:05:00  WL/FLBB Powered off.
10:05:00  WL/FLBB Communication channels closed.
```

Figure 6-9: Direct Communication with the FLBB(RT)/D

Perform Profile Test Loop

Option <2> performs a profile test loop as shown in Figure 6-10. The test simulates an automated sensor verification and a 5 minute profile.

```
               Selection  ? 2

                     Scat Chlr CDOM


11/28/12 14:49:24 WL/BBFL2 4130 1950 4130.
11/28/12 14:49:24   SYSTEM Suspending until 11/28/12 14:49:35 ... Awake

11/28/12 14:49:40 WL/BBFL2 4130 1956 4130.
11/28/12 14:49:40   SYSTEM Suspending until 11/28/12 14:49:50 ... Awake

11/28/12 14:49:54 WL/BBFL2 4130 1956 4130.
11/28/12 14:49:54   SYSTEM Suspending until 11/28/12 14:50:05 ... Awake

11/28/12 14:50:09 WL/BBFL2 4130 1951 4130.
11/28/12 14:50:09   SYSTEM Suspending until 11/28/12 14:50:20 ... Awake
```

Figure 6-10: Option <2> Perform Profile Test Loop

Installing the Optical Wet Labs Sensors in the Mounting Space

Both the FLBB(RT)/D, FLBBCD and BBFL2 models are installed and removed using the same procedure. The Wet Labs FLBB(RT)/D and FLBBCD sensors are supported on the Profiler by a custom bracket that must be correctly positioned and tightened.

To install the Wet Labs BBFL2, complete the steps in section 6.1. To install the Wet Labs FLBB(RT/D) or FLBBCD, complete the steps in section 6.2. To install the Wet Labs C-Star, complete the steps in Section 6.3.

Figure 6-11: BBFL2 Model- Installed

Notes

Section 6.1
Wet Labs BBFL2 Sensor

MMP firmware release version 4.13 and higher supports the Wetlabs BBFL2 Optical sensor. The BBFL2 collects a combination of Scatter, Chlorophyll Fluorometer counts and CDOM Fluorometer counts. For additional information about the Wet Labs BBFL2 sensor, refer to the Wet Labs web site (www.wetlabs.com) or contact Wet Labs.

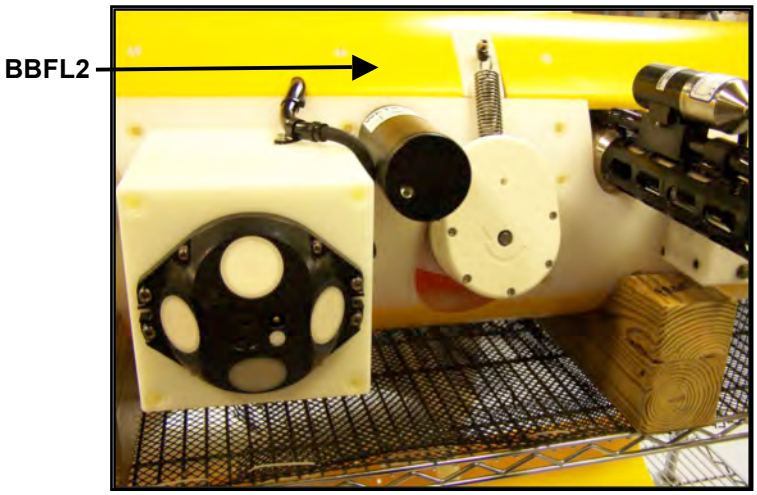


Figure 6.1-1: MMP with BBFL2 Installed – Side View

Collecting Data with the BBFL2

A sample unpacked Engineering file with BBFL2 data is shown below.

```
Profile 2

 Sensors were turned on at  12/07/2012 16:30:02
 Vehicle began profiling at 12/07/2012 16:32:02

Date,                [mA], [V],    [dbar],      Par[mV],     scatSig,     chlSig,      CDOMSig

12/07/2012 16:32:02 -30,   12.1,  0.800,       10.80,       70,          53,          99

12/07/2012 16:32:08 -29,   12.1,  0.800,       12.80,       70,          52,          101

12/07/2012 16:32:14 -30,   12.1,  0.800,       13.80,       71,          53,          100

12/07/2012 16:32:19 -30,   12.1,  0.790,       14.00,       69,          55,          100

12/07/2012 16:32:25 -30,   12.1,  0.800,       17.40,       71,          54,          99

12/07/2012 16:32:31 -30,   12.1,  0.800,       11.40,       70,          53,          101


 Ramp exit:    SMOOTH RUNNING
 Profile exit: STATIONARY EXPIRED

 Vehicle motion stopped at 12/07/2012 16:33:07
 Sensor logging stopped at 12/07/2012 16:35:15
```

Figure 6.1-2: ENG File with BBFL2 Data

Section 6.2
Wet Labs FLBB(RT)/D or FLBBCD Sensor

MMP firmware release version 4.30 and higher supports the Wet Labs FLNTRD/FLBB(RT)/D sensors, optical combination sensors that record fluorometer, turbidity and (if installed) temperature measurements. Firmware Release 5.19 and higher supports the FLBBCD, an optical sensor that records chlorophyll, backscatter and fluorescence in a single data stream.

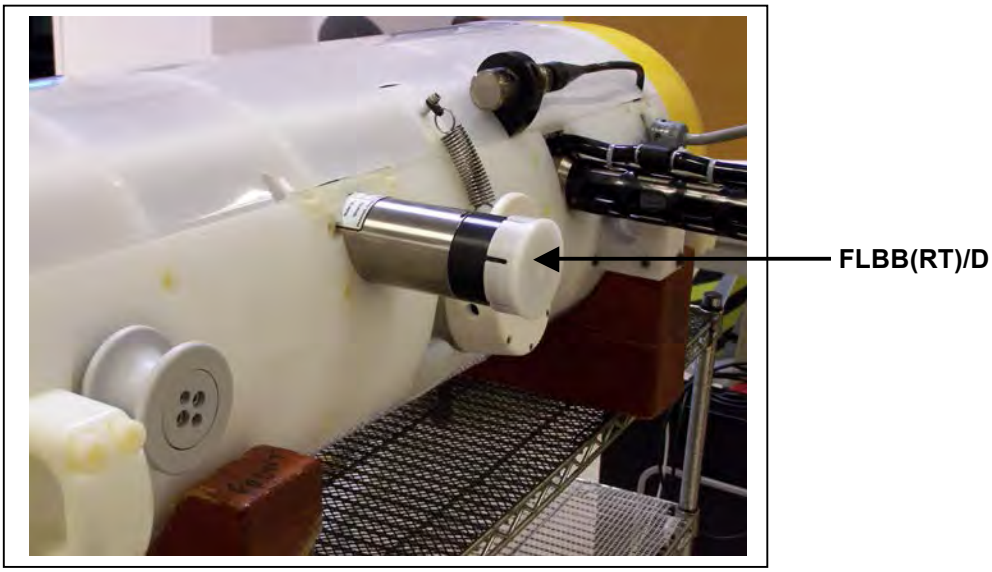


Figure 6.2-1: MMP with FLBB(RT)/D Installed

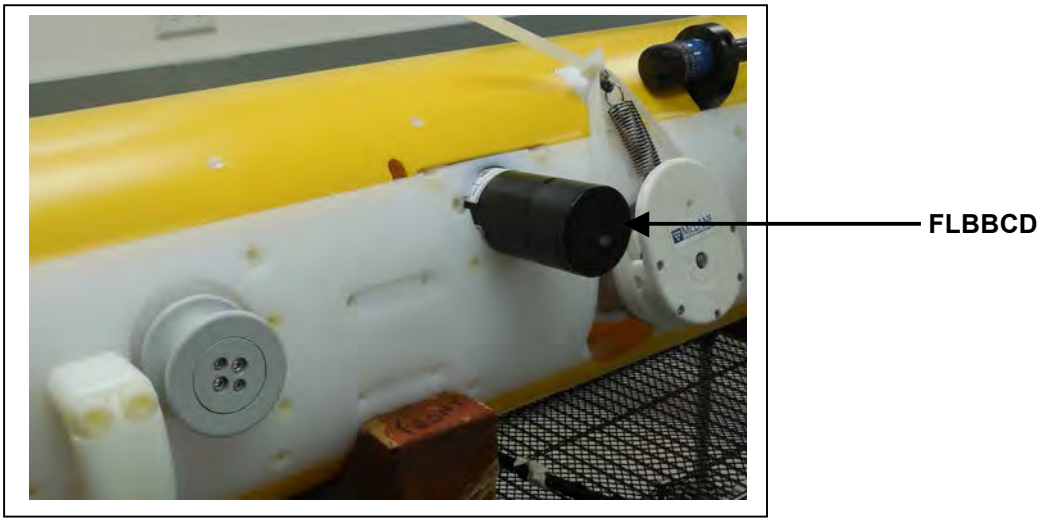


Figure 6.2-2: MMP with FLBBCD Installed

Collecting Data with the FLBB(RT)/D

A sample unpacked Engineering file is shown in Figure 6.2-3. The temperature data displays in thermistors. When the optional FLBB(RT)/D temperature is not installed, the temperature data is not used.

```
Profile 0

Sensors were turned on at  07/21/2011 15:14:31
Vehicle began profiling at 07/21/2011 15:16:16
```

FLBB(RT)/D Data

Date	Time	[mA]	[V]	[dbar]	CHL	NTU	Temperature
07/21/2011	15:16:17	-8		0.00	3864	4130	540
07/21/2011	15:16:22	30	11.5	0.000	3866	4130	539
07/21/2011	15:16:27	33	11.5	0.000	3865	4130	539
07/21/2011	15:16:32	33	11.5	0.000	3866	4130	539
07/21/2011	15:16:37	33	11.5	0.000	3864	4130	539
07/21/2011	15:16:42	33	11.5	0.000	3864	4130	539
07/21/2011	15:16:47	33	11.5	-0.140	3861	4130	539
07/21/2011	15:16:56	32	11.5	-0.150	3861	4130	539
07/21/2011	15:17:05	33	11.5	-0.130	3862	4130	539
07/21/2011	15:17:14	32	11.5	-0.120	3860	4130	539
07/21/2011	15:17:23	32	11.5	-0.130	3859	4130	539
07/21/2011	15:17:32	32	11.5	-0.120	3857	4130	538
07/21/2011	15:17:41	32	11.5	-0.150	3858	4130	538
07/21/2011	15:17:50	32	11.5	-0.160	3858	4130	538
07/21/2011	15:17:59	32	11.5	-0.170	3858	4130	538
07/21/2011	15:18:08	32	11.5	-0.200	3858	4130	538
07/21/2011	15:18:17	32	11.5	0.000	3860	4130	538

```
Ramp exit:     SMOOTH RUNNING
Profile exit:  TIMER EXPIRED

Vehicle motion stopped at 07/21/2011 15:18:24
Sensor logging stopped at 07/21/2011 15:20:34
```

Figure 6.2-3: Engineering File, FLBB(RT)/D Fluorometer, Turbidity and Temperature Data

Collecting Data with the FLBBCD

A sample unpacked Engineering file with FLBBCD data is shown in Figure 6.2-4.

Profile 2

Sensors were turned on at 10/22/2015 11:00:02
Vehicle began profiling at 10/22/2015 11:02:01

FLBBCD Data

Date	[mA]	[V]	dbar]	Oxygen[uM]	Optode Temp[C]	Chl	bb	CDOM
10/22/2015 11:02:01	0	11.1	0.000	0.00	0.00	54	101	84
10/22/2015 11:02:05	90	11.0	0.000	0.00	0.00	55	106	85
10/22/2015 11:02:09	136	11.0	0.000	0.00	0.00	57	105	87
10/22/2015 11:02:12	186	10.9	0.000	0.00	0.00	53	98	83
10/22/2015 11:02:16	187	10.9	0.000	0.00	0.00	52	97	81
10/22/2015 11:02:19	181	10.9	0.000	0.00	0.00	53	97	87
10/22/2015 11:02:23	176	10.9	0.000	0.00	0.00	51	94	84
10/22/2015 11:02:26	176	10.9	0.000	0.00	0.00	50	94	83
10/22/2015 11:02:30	182	10.9	0.000	0.00	0.00	52	93	84
10/22/2015 11:02:40	181	10.9	3.430	164.90	18.07	50	84	89
10/22/2015 11:02:48	165	10.9	4.270	164.98	18.06	51	84	88
10/22/2015 11:02:56	165	10.9	5.120	164.85	18.06	54	82	86
10/22/2015 11:03:04	151	10.9	5.960	164.86	18.06	53	80	84
10/22/2015 11:03:12	155	10.9	6.800	164.61	18.05	53	84	85
10/22/2015 11:03:20	158	10.9	7.640	164.61	18.05	53	79	85
10/22/2015 11:03:28	153	10.9	8.490	164.58	18.05	51	80	86
10/22/2015 11:03:36	147	10.9	9.320	164.49	18.04	52	82	85
10/22/2015 11:03:44	149	10.9	10.170	164.49	18.04	51	82	86

Ramp exit: SMOOTH RUNNING
Profile exit: BOTTOM PRESSURE

Vehicle motion stopped at 10/22/2015 11:03:45
Sensor logging stopped at 10/22/2015 11:05:52

Figure 6.2-4: Engineering File, FLBBCD Chlorophyll, Backscatter and Fluorescence Data

Installing the FLBB(RT)/D or FLBBCD in the Mounting Space

To install the Wet Labs FLBB(RT)/D or FLBBCD sensor, complete the following steps.

1. With the MMP skin removed, connect the sensor cable and place the Wet Labs sensor in the mounting space.

Figure 6.2-.5: Connecting the Sensor Cable

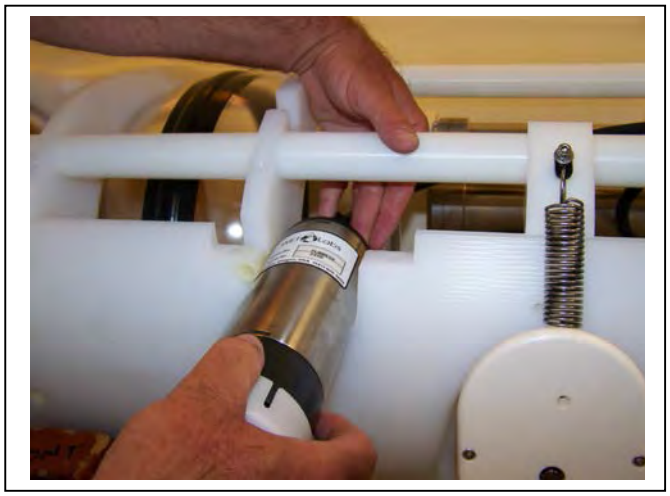


Figure 6.2-6: Placing the Sensor in the Mount

2. Place the white plastic mounting support over the Wet Labs sensor.
3. Using a hex driver, secure the two plastic screws.
4. Replace the MMP skin.

Figure 6.2-7: Placing the Mounting Support

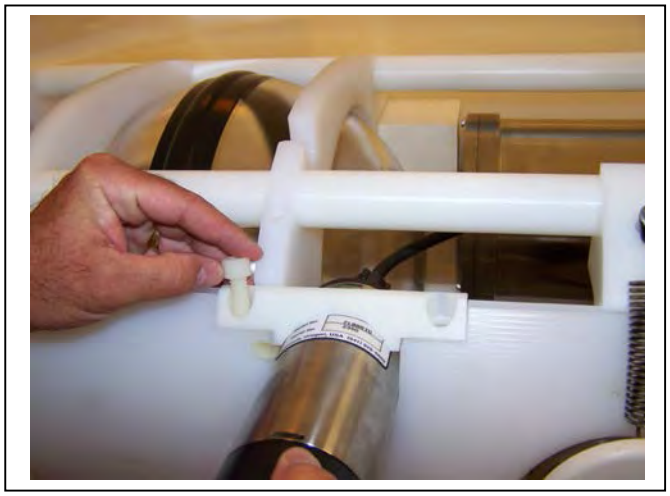


Figure 6.2-8: Securing the Mounting Support

Section 6.3
Wet Labs C-Star Sensor

MMP firmware release version 5.24 and higher supports the Wet Labs C-Star sensor, a transmissometer available in multiple wavelengths that records light beam transmittance. The Wet Labs documentation provided with the C-Star includes a calibration sheet. Refer to this sheet for information specific to your C-Star.

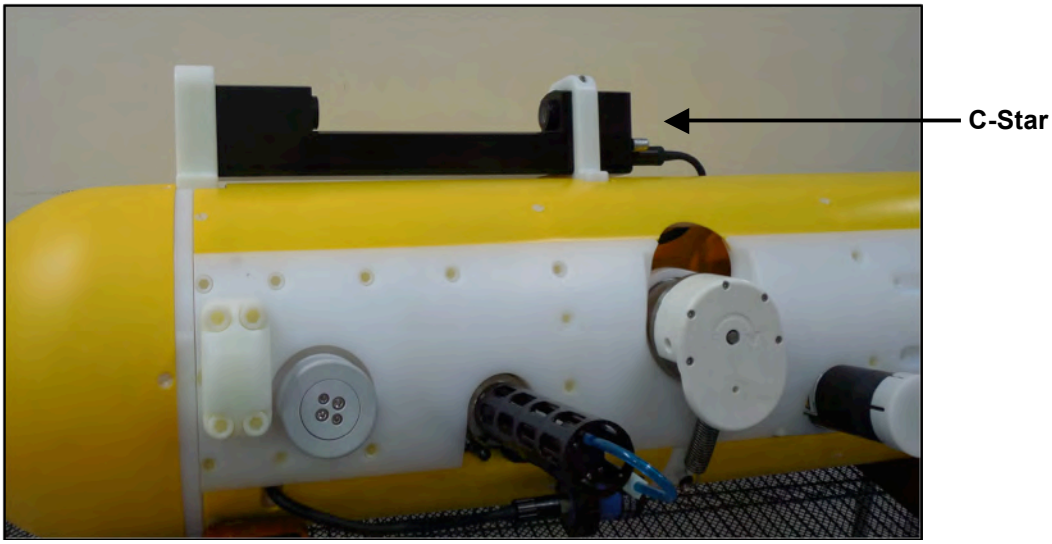


Figure 6.3-1: MMP with C-Star Installed

During system initialization, the firmware makes three attempts to confirm that the C-Star is connected. If the third attempt to confirm connection fails, the deployment continues without logging C-Star files.

C-Star Configuration and Samples Per Average

The Profiler System Configuration menu specifies the active sensors. The C-Star samples per average can also be changed on this screen. Valid entries are between 30 – 150 (the default is 36). The data collection speed (in Hz) changes based on samples per average. If the C-Star is already enabled, Samples per Average can be changed by typing *$* and typing *N* at the prompt to disable the C-Star. The next prompt allows entry of samples per average.

```
Config: MPP_CT_FL_OP                    CF2 V5.24 of Oct 21 2015

                    Pattern Profiler
                  System Configuration

                Thu Oct 22 09:33:36 2015
 System Parameters:
  <0> Battery capacity              240 Ah

 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

      Port J5:ACM
  <2> No ACM selected

      Port J6:IMM
  <I> Telemetry

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <J> Wetlabs ECO FLBBCD ------------ ENABLED
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2
  <Y> Wetlabs ECO FLBB2K
  <@> Wetlabs FLNTURTD

      Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR
  <$> WetLabs CST Transmissometer --- ENABLED @ 36 avg, ~0.99 Hz <----

      Port J7:TRB
  <T> Seapoint IR Turbidity

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack

      Port J5i:SER
  <K> ProOceanus CO2
  <#> Aanderaa Optode --------------- ENABLED

 Exit:
  <X> Save changes    <^C> Cancel changes
 Selection [] ? x
```

Figure 6.3-2: Configure C-Star - Sample Averaging

C-Star Data Details

C-Star data is logged in a 'T' file for each profile. During sensor warm-up and motor ramp, data is collected and averaged at the sampling rate defined on the Configuration menu. The sensor powers off during sensor warm down.

```
Profile 3

  s/n   ref   sig   raw       beam therm
 1739 11161 13095 14109      0.353   532
 1739 11148 13081 14108      0.353   532
 1739 11140 13071 14108      0.353   532
 1739 11133 13065 14108      0.353   532
 1739 11129 13059 14107      0.353   531
 1739 11125 13055 14107      0.353   531
 1739 11122 13051 14107      0.353   531
 1739 11120 13048 14105      0.354   531
 1739 11117 13046 14107      0.353   531
 1739 11115 13044 14108      0.353   531
 1739 11114 13041 14105      0.354   531
 1739 11112 13039 14106      0.353   531
 1739 11111 13038 14105      0.354   531
 1739 11110 13037 14106      0.353   531
. . .
1739 11079 13010 14112      0.352   529
 1739 11079 13010 14112      0.352   529
 1739 11079 13010 14112      0.352   529
 1739 11079 13010 14112      0.352   529
 1739 11079 13010 14112      0.352   529
 1739 11079 13010 14112      0.352   529
 1739 11079 13010 14112      0.352   529

 Profile 3

  C-STAR turned on at 10/16/2015 12:41:29
  C-STAR turned off at 10/16/2015 12:53:55

  744 samples at ~1.00 Hz
```

Display shortened to save space

Figure 6.3-3: 'T' File C-Star Data

Using C-Star Bench Test Options

The main Bench Tests and Wet Labs Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors. Type *$* to display the Wet Labs C-Star Bench Tests menu.

```
Config: MPP_CT_FL_OP                    CF2 V5.24 of Oct 16 2015

                    Pattern Profiler
                      Bench Tests

                    Tue Oct 20 10:42:20 2015
 CTD utilities:
  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record

 System evaluation:
  <7> Motor operation
  <8> Release Brake
  <9> Independent Watchdog
  <D> Detailed schedule
  <S> Recover schedule

 Sensor & Option tests:
  <J> Wetlabs ECO FLBBCD
  <#> Aanderaa Optode
  <$> WetLabs CST Transmissometer

 Exit:

  <X> Main Menu

 Selection [] ? $
```

Figure 6.3-4: Profiler Bench Tests Menu

```
Config: MPP_CT_FL_OP                    CF2 V5.24 of Oct 16 2015

                    Pattern Profiler
           WetLabs CST Transmissometer Bench Test Menu


                    Tue Oct 20 10:42:25 2015

 <1> Direct communications (19200 Baud)
 <2> Perform a profile test loop
 <3> Set number of samples averaged (36 avg, ~0.99 Hz)
 <4> Offload C-Star data files

 <M> return to previous Menu

 Selection [] ?
```

Figure 6.3-5: Wet Labs C-Star Bench Tests Menu

Direct Sensor Connection

Typing *1* from the WetLabs CST Transmissometer Bench Test Menu connects directly with the C-Star sensor. The Profiler communicates with the Wet Labs Sensors at 19200 baud. Once direct connection is established, typing commands at the command prompt provides additional sensor information. Figure 6.3-6 shows direct communication with the C-Star.

```
Selection [] ? 1

10/20/15 10:41:53 WL/FLBCD    Enter "!!!!!" (w/o quotes) to get sensor's
attention.

10/20/15 10:41:53 WL/FLBCD    Press ^C to terminate COMM session.

10/20/15 10:41:53   SYSTEM    Press ^B to change or confirm Baud rate.

10/20/15 10:41:54 WL/FLBCD    19.2 kBaud communication channel opened.

10/20/15 10:41:54 WL/FLBCD    Powered on.

************************************************************

!21!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Ser FLBBCD2K-4069
Ver TripletD 4.07
Ave 19
Pkt 0

!!!!!!!!! [^C]

************************************************************

10/20/15 10:41:59 WL/FLBCD    Powered off.

10/20/15 10:41:59 WL/FLBCD    19.2 kBaud communication channel closed.

10/09/15 12:40:20 WL/Cstar    Powered off.
10/09/15 12:40:20 WL/Cstar    19.2 kBaud communication channel closed.
```

Figure 6.3-6: <1> C-Star Direct Communications

Perform Profile Test Loop

Option 2 performs a profile test loop as shown in Figure 6.3-7. The test simulates an automated sensor verification and a 5 minute profile.

```
Selection [] ? 2
 Enter profile duration in minutes (1-60) [5] ? 1
 Enter stop-check interval in seconds (2-60) [15] ? 2
10/20/15 10:42:36 WL/Cstar    Automated verification of sensor settings.

10/20/15 10:42:36 WL/Cstar    19.2 kBaud communication channel opened.
10/20/15 10:42:37 WL/Cstar    Powered on. ..
10/20/15 10:42:38 WL/Cstar    Sending command [!!!!!]. ... .
10/20/15 10:42:39 WL/Cstar    Powered off.
10/20/15 10:42:39 WL/Cstar    Power-down delay ......................
10/20/15 10:42:44 WL/Cstar    19.2 kBaud communication channel closed.
 Press ^C to exit the loop.
10/20/15 10:42:44 WL/Cstar    Preparing for profile 0.
10/20/15 10:42:45 WL/Cstar    Initializing logging ...
10/20/15 10:42:45 WL/Cstar    19.2 kBaud communication channel opened.
10/20/15 10:42:45 WL/Cstar    Powered on. ..
10/20/15 10:42:47 WL/Cstar    Opening 00000\T0000000.DAT for profile 0.
10/20/15 10:42:48 WL/Cstar    Writing 2 byte header for profile 0.
10/20/15 10:42:48 WL/Cstar    Logging initialized.
10/20/15 10:42:48 WL/Cstar    Acquiring for 1 minute, with a 2 second StopCheck interval.
10/20/15 10:42:51 WL/Cstar    1739 s/n, 11127 ref, 13188 sig, 14249 raw,  0.313 beam, 537 therm.
10/20/15 10:42:53 WL/Cstar    1739 s/n, 11117 ref, 13176 sig, 14248 raw,  0.313 beam, 537 therm.
[^C]
10/20/15 10:42:53 WL/Cstar    Halting profile 0.
10/20/15 10:42:53 WL/Cstar    Halting logging ...
10/20/15 10:42:53 WL/Cstar    Logging halted.
10/20/15 10:42:54 WL/Cstar    Dumping data to disk for profile 0.
10/20/15 10:42:54 WL/Cstar    Writing 22 byte trailer for profile 0.
10/20/15 10:42:54 WL/Cstar    Closing 00000\T0000000.DAT for profile 0.
10/20/15 10:42:54 WL/Cstar    Powered off.
10/20/15 10:42:54 WL/Cstar    19.2 kBaud communication channel closed.
10/20/15 10:42:54 WL/Cstar    Test profile 0 succeeded. 6 samples
```

Figure 6.3-7: <2> C-Star Profile Test Loop

Set Samples Averaged

Option <3> changes the number of samples to average. Use this option to see how different sampling rates affect the processing speed (in Hz) of C-Star data collection. Type *3* and the password *set* to change the number of samples to average.

```
_____________________________________________________________________

Config: MPP_CT_FL_OP                    CF2 V5.24 of Oct 30 2015
                 ____________________________________
                           Pattern Profiler
             WetLabs CST Transmissometer Bench Test Menu
                 ____________________________________
                      Fri Nov  6 17:20:35 2015

 <1> Direct communications (19200 Baud)
 <2> Perform a profile test loop
 <3> Set number of samples averaged (36 avg, ~0.99 Hz)
 <4> Offload C-Star data files

 <M> return to previous Menu

 Selection [] ? 3  Password: ***

11/06/15 17:20:41 WL/Cstar 19.2 kBaud communication channel opened.
11/06/15 17:20:41 WL/Cstar Powered on. ..
Enter Cstar samples to average (30-150) [36] ? 30

11/06/15 17:20:45 WL/Cstar Sending command [!!!!!]. .....
11/06/15 17:20:46 WL/Cstar Sending command [$ave 30]. ...
11/06/15 17:20:46 WL/Cstar Sending command [$sto]. .
11/06/15 17:20:47 WL/Cstar Powered off.
11/06/15 17:20:47 WL/Cstar Power-down delay ......................
11/06/15 17:20:52 WL/Cstar 19.2 kBaud communication channel closed.
```

Figure 6.3-8: <3> Set Number of Samples Averaged

Offload C-Star Data Files

Option <4> from the WetLabs CST Transmissometer Bench Test Menu offloads the C-Star data files.

```
Selection [] ? 4

11/06/15 17:20:55   SYSTEM Reading PROFILES.DAT ... done.

 Enter the first profile to offload (0-141) [0] ? 140
  Enter the last profile to offload (140-141) [141] ? 140

************************************************************

Profile 140
C-Star serial #1739
Averaged samples 30

  ref   sig   raw    beam therm
11288     0     0  99.999   542
11275     0     0  99.999   542
11267     0     0  99.999   542
11260     0     0  99.999   542
11255     0     0  99.999   541
11251     0     0  99.999   541
11248     0     0  99.999   541
11245     0     0  99.999   541
11242     0     0  99.999   541
11240     0     0  99.999   541
11238     0     0  99.999   541
. . .
11176     0     0  99.999   535
11175     0     0  99.999   535
11175     0     0  99.999   535
11175     0     0  99.999   535
11175     0     0  99.999   535
11175     0     0  99.999   535
11175     0     0  99.999   535
11175     0     0  99.999   535

Profile 140

C-Star turned  on at 11/06/2015 17:05:44
C-Star turned off at 11/06/2015 17:18:31
920 samples at ~1.20 Hz

************************************************************

Press any key to continue.
```

Figure 6.3-9: <4> Offload C-Star Data Files

Installing the C-Star in the Mounting Space

The MMP skin has mounting inserts for the top and bottom clamps that hold the C-Star. To attach the C-Star and mounting clamps, complete the following steps.

1. Place the MMP skin with the C-Star cable facing up.
2. Place the plastic bottom clamp in the MMP skin insert.

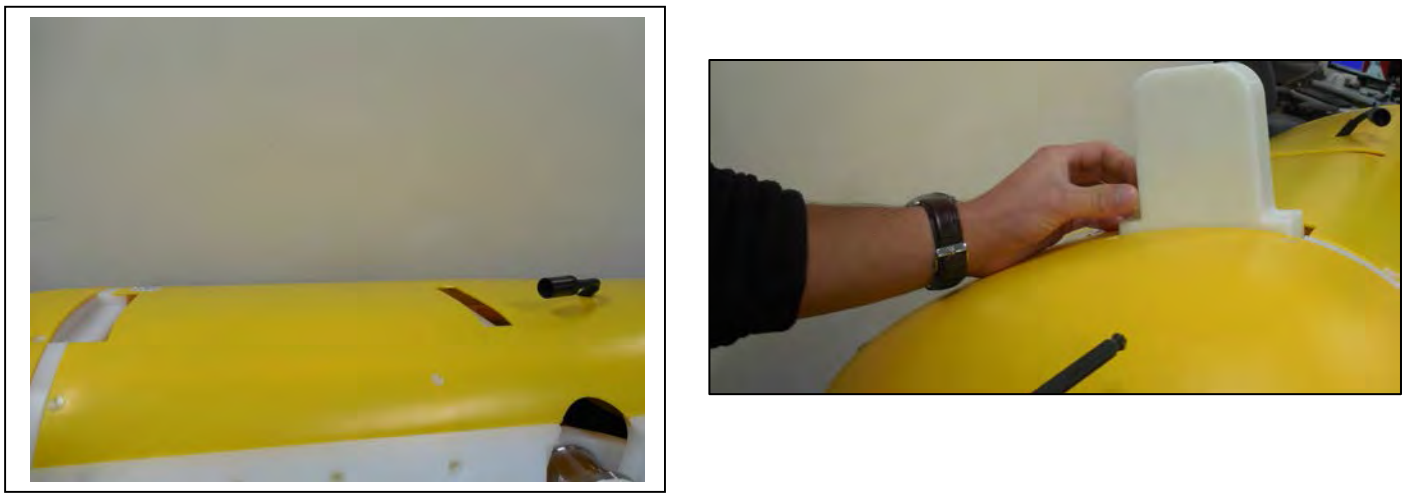


Figure 6.3-10: Installing Bottom Clamp

3. Using a 5/16” hex driver (provided in the toolkit), tighten the two nylon screws on each side of the bottom clamp.
4. Gently insert the C-Star in the plastic mounting clamp.

Figure 6.3-11: Tightening Nylon Screws

Figure 6.3-12: Inserting the C-Star

5. Insert nylon screws on both sides of the top clamp and tighten the clamp to the MMP body with a 5/16” hex driver (included in the toolkit).

Figure 6.3-13: Securing Top Clamp

Figure 6.3-14: Tighten Top Clamp Nylon Screws

6. Tighten the the top clamp around the C-Star using a 3/16” hex driver.
7. Connect the C-Star sensor cable to the C-Star bulkhead connector. The cable will ship inside the MMP.

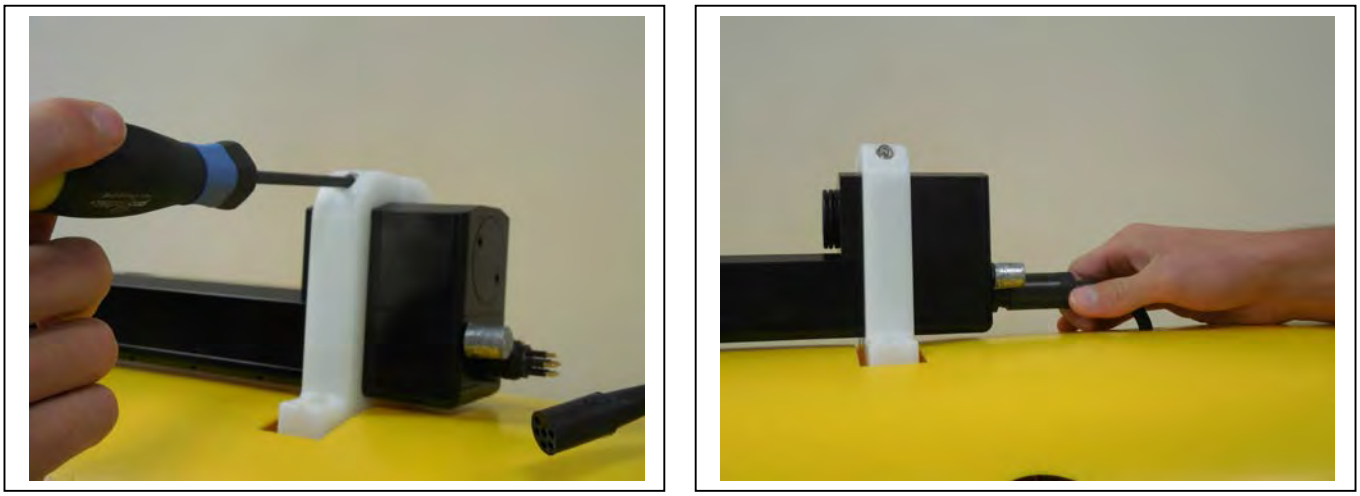


Figure 6.3-15: Tighten Top Clamp and Connect Bulkhead

Removing the C-Star from the MMP

To remove the C-Star from the MMP, complete the following steps:

1. Remove the two 3/8-16” nylon screws from the top clamp to release it from the MMP body.
2. Gently pull the C-STAR (with the top clamp still attached) away from the body, and up from the bottom clamp.
3. If necessary for storage and transportation, remove the two 3/8-16” nylon screws from the bottom clamp as well. The top clamp is tightened with a single 1/4-20 screw.

Notes

Chapter 7
Ostar OceanServer MotionPack Sensor

MMP Release v5.00 firmware and higher supports the Ostar OceanServer5000. The OceanServer 5000 sensor board is installed on the controller electronics stack. The OceanServer samples heading, pitch and roll position with acceleration in the X, Y, and Z axes. Pressure recorded by the installed CTD is also reported. For additional information about the OceanServer5000 MotionPack sensor, refer to the Ocean Server Technology web site (www.ocean-server.com) or contact OceanServer.

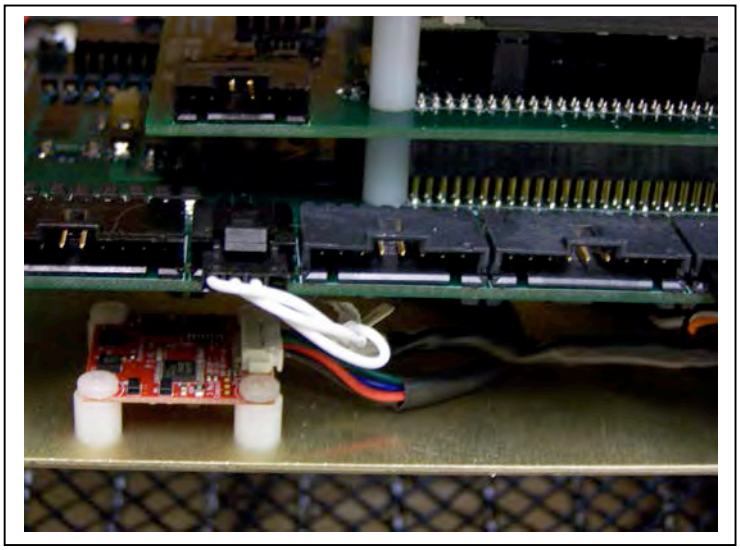


Figure 7-1: Motion Sensor on MMP Electronics Stack

Collecting Data with the OceanServer MotionPack

MotionPack Data is logged in an 'M' file for each profile. During warm-up and ramp, 2 samples/second are collected. During the rest of the profile, including warm-down, 1 sample/sec is collected. The Profile Unpacker unpacks the 'M' file with the CTD, ENG, ACM and other data files.

The MotionPack collects 3 axis Magnetic Field and 3 axis Acceleration readings (X, Y, Z) and the Magnetic Vector and Accelerated Vector Lengths. The Pressure column records the depth for each measurement as reported by the CTD. Azimuth heading, pitch and roll readings are in degrees. The Temperature is the internal board temperature in degrees Celsius.

```
Profile 2
Time,               Pres, Azim, Pitch, Roll, Temp,Vmag,  Xmag,  Ymag,  Zmag,  Vacc, Xacc, Yacc,   Zaac
12/07/2012 16:30:19,0.80, 310.2,1.1,  -0.3,  7.6, 303.00,-135.54,138.06,233.18,1.003,0.019,-0.006,1.003
12/07/2012 16:30:20,0.80, 306.9,1.2,  -0.6,  7.7, 302.88,-135.38,138.05,233.14,1.004,0.021,-0.010,1.004
12/07/2012 16:30:20,0.80, 306.9,1.2,  -0.6,  7.7, 303.07,-135.69,138.07,233.19,1.006,0.020,-0.011,1.006
12/07/2012 16:30:21,0.80, 310.0,1.2,  -0.4,  7.8, 302.96,-135.70,138.01,233.07,1.006,0.020,-0.007,1.006
. . .
```

Figure 7-2: 'M' File Motion Pack Data

Configuring the Firmware to Use the OceanServer MotionPack

The Profiler System Configuration menu specifies the active sensors. To enable an OS5000 MotionPack, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*. Select <M> OceanServer5000 MotionPack and then type *Y* to enable the sensor.

2. Select <M> OceanServer5000 MotionPack and then type *Y* to enable the sensor.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP           CF2 V5.12 of Feb 11 2014

                 ___________________________________
                          Pattern Profiler
                        System Configuration
                 ___________________________________
                      Tue Mar 11 15:37:44 2014
 System Parameters:
  <0> Battery capacity               240 Ah

 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

      Port J5:ACM
  <2> Nortek AquaDopp DVS ----------- ENABLED AquaDopp-2

      Port J6:IMM
  <I> Telemetry --------------------- ENABLED IMM @ 1200 baud

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2 ------------- ENABLED

Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR -------------- ENABLED @ 5 samp/avg

      Port J7:TRB
  <T> Seapoint IR Turbidity

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED   <-- OS5000 MotionPack

      Port J5i:SER
  <K> ProOceanus CO2

 Exit:
  <X> Save changes    <^C> Cancel changes

  Selection [] ?  [^C]

Enable the "Nortek AquaDopp DVS" [Y] ?
Select 1 = AquaDopp-HR, 2 = AquaDopp-II (1-2) [0] ? 2
```

Figure 7-3: System Configuration Menu with Sensor Selections

Using Bench Test Options

The main Bench Tests and OceanServer Bench Tests menus provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors.

1. From the main Profiler Menu, type '5' at the prompt to display the Profiler Bench Tests Menu.

```
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.09 of Oct 19 2013
                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-01D

                         Pattern Profiler
                            Main Menu

                      Wed Nov 13 10:00:55 2013
        <1> Set Time           <5> Bench Test
        <2> Diagnostics        <6> Deploy Profiler
        <3> Flash Card Ops     <7> Offload Deployment Data
        <4> Sleep              <8> Contacting McLane
        <C> Configure
```

Figure 7-4: Profiler Main Menu

```
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.09 of Oct 19 2013

                         Pattern Profiler
                           Bench Tests

                      Wed Dec 19 13:44:33 2012
 Sensor Utilities:
  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
 System Evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <0> Battery endurance
  <D> Detailed schedule
  <S> Recover schedule
 System Sensor & Option Tests:
  <M> OceanServer5000 MotionPack
 Exit:
```

Figure 7-5: Profiler Bench Tests Menu

2. From the Profiler Bench Tests menu, type *M* at the prompt to display the OceanServer Bench Test menu.

3. Type '1' to connect directly with the OceanServer MotionPack.

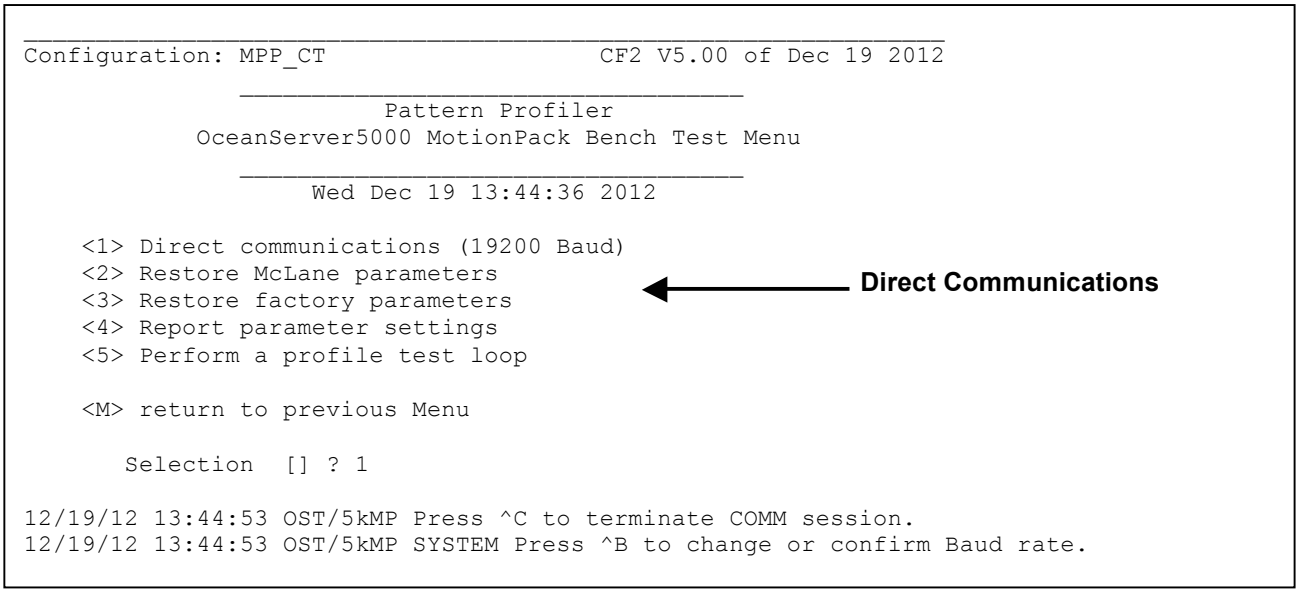


Figure 7-6: OceanServer MotionPack Bench Tests Menu

The Profiler communicates with the OceanServer at 19200 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 7-7). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
****************************************************************

-Êûx-òÄ-fûx-`¸ò6x-Ê‡-ò-ûfxf6òx¯Ü6ò-òÄ-Ê¯¯


04/23/14 12:50:37 AAND OPT ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 7-7: Baud Rate Communications Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu displays the Baud Rate menu (Figure 7-7). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the Profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013
                 ___________________________________
                          Pattern Profiler
                         Select new Baud rate
                 ___________________________________
                       Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 7-8: Baud Rate Menu

Direct Sensor Connection

Once connected directly to the OceanServer, typing commands at the command prompt provides additional sensor information. Figure 7-9 shows direct connection with the OceanServer.

```
12/19/12 13:46:29 OST/5kMP 19.2 kBaud communication channel opened.
12/19/12 13:46:30 OST/5kMP Powered on.
************************************************************
173.7,-88.4,0.0,16.5,364.11,-310.20,19.77,189.64,1.023,-1.023,0.027,-0.002

173.7,-88.4,0.0,16.5,364.12,-310.15,19.84,189.71,1.022,-1.022,0.026,-0.002

173.7,-88.4,0.0,16.6,364.08,-310.14,19.82,189.66,1.022,-1.022,0.028,-0.002

173.7,-88.4,0.0,16.7,364.00,-310.08,19.80,189.62,1.022,-1.022,0.026,0.000

173.7,-88.4,0.0,16.8,364.03,-310.11,19.81,189.62,1.022,-1.021,0.027,-0.001
...
73.7,-88.4,0.0,17.4,363.75,-309.76,19.86,189.64,1.021,-1.021,0.027,-0.002

173.7,-88.4,0.0,17.3,363.71,-309.74,19.86,189.61,1.021,-1.021,0.027,-0.002
 [^C]
************************************************************
12/19/12 13:46:48 OST/5kMP Powered off.
12/19/12 13:46:48 OST/5kMP 19.2 kBaud communication channel closed.
```

Figure 7-9: Option <1> OceanServer Direct Communications

.

Restore McLane and Factory Settings

Option <2> and <3> from the MotionPack Bench Tests menu restore the McLane or OceanServer factory settings on the MotionPack sensor. Using option <2> requires the password *mclane*. Using option <3> (not shown) also requires a password. Contact McLane before resetting to the factory parameters.

```
Selection  [] ? 2  Password: ***


12/19/12 13:52:46 OST/5kMP 19.2 kBaud communication channel opened.
12/19/12 13:52:46 OST/5kMP Powered on. .
12/19/12 13:52:49 OST/5kMP Sending command [V]. . . .
12/19/12 13:52:49 OST/5kMP Identified as V2.6, S#25828. ..
12/19/12 13:52:49 OST/5kMP Sending command [R]. . ..
12/19/12 13:52:49 OST/5kMP Sending command [1]. . . .
12/19/12 13:52:49 OST/5kMP Sending command [*]. . ..
12/19/12 13:52:49 OST/5kMP Sending command [8]. . .
12/19/12 13:52:50 OST/5kMP Sending command [X]. . ..
12/19/12 13:52:50 OST/5kMP Sending command [495]. . .
12/19/12 13:52:50 OST/5kMP Sending command [E]. . ......
12/19/12 13:52:50 OST/5kMP Sending command [3]. .
12/19/12 13:52:50 OST/5kMP Was able to restore McLane parameters.
12/19/12 13:52:50 OST/5kMP Powered off.
12/19/12 13:52:50 OST/5kMP Power-down delay .....
12/19/12 13:52:52 OST/5kMP 19.2 kBaud communication channel closed.
```

Figure 7-10:Option <2> Restore McLane Parameters

The firmware requires settings configured by McLane. Changing settings, or resetting to the factory settings prevents the MotionPack sensor from working correctly with the profiler.

Display Current Settings

Option <4> displays the current MotionPack parameters.

```
Selection  [] ? 4

12/19/12 13:53:41 OST/5kMP Identified as V2.6, S#25828.
12/19/12 13:53:41 OST/5kMP Parameter settings.
--------
FW_Version=V2.6-4

FW_Date=3-Nov-10

Serial_number=000025828

Test_date=08 Aug 11

Output_Format=8

Acclerometer=2

Display_Fields=495

HW_Mounting_Pos=3

Baud_Rate=3
Set-Reset_Rate=200

Output_Rate=1

Averaging=4

AD_Update_Rate=3

lifeskip=8

Euler=4

MaxG=2
--------
Press any key to continue.
```

Figure 7-11: Option <4> Report Parameter Settings

Perform Profile Test Loop

Option <5> performs a profile test loop. This test simulates an automated sensor verification which begins with a display of the parameters and 5 minute profile.

```
_____________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP           CF2 V5.17 of Sep 16 2014
                  ___________________________________
                            Pattern Profiler
              OceanServer5000 MotionPack Bench Test Menu
                  ___________________________________
                       Thu Sep 18 10:39:34 2014
 <1> Direct communications (19200 Baud)
 <2> restore McLane parameters
 <3> restore Factory parameters
 <4> Report parameter settings
 <5> Perform a profile test loop

 <M> return to previous Menu

 Selection [] ? 5

09/18/14 10:39:37 OST/5kMP Automated verification of sensor settings.
09/18/14 10:39:41 OST/5kMP Identified as V2.6, S#24112.
09/18/14 10:39:41 OST/5kMP Parameter settings.

--------
FW_Version=V2.6-4
FW_Date=3-Nov-10
Serial_number=000024112
Test_date=06 Feb 13
Output_Format=8
Acclerometer=2
Display_Fields=495
HW_Mounting_Pos=5
Baud_Rate=3
Set-Reset_Rate=100
Output_Rate=2
Averaging=4
AD_Update_Rate=3
lifeskip=8
Euler=4
MaxG=2
--------

09/18/14 10:39:43   SYSTEM Next profile scheduled for 09/18/14 10:40:00.
09/18/14 10:39:43   SYSTEM Suspended until 09/18/14 10:40:00 ... Awake
```

Figure 7-12:Option <5> Perform Profile Test Loop screen 1 of 2

```
_____________________________________________________________

10/09/12 13:12:02   SYSTEM Awake at 10/09/12 13:12:02. Press ^C to exit the loop
10/09/12 13:12:02   SYSTEM Prepping for profile 0.

10/09/12 13:12:02   SYSTEM  Initializing OST/5kMP logging pointers.
10/09/12 13:12:06 OST/5kMP  Identified as V2.6, S#25828.

10/09/12 13:12:06 OST/5kMP  Opening M0000000.DAT for profile 0.
10/09/12 13:12:06 OST/5kMP  Writing 2 byte header for profile 0.
10/09/12 13:12:06 OST/5kMP  Closing M0000000.DAT for profile 0.
10/09/12 13:12:06 OST/5kMP  Acquiring to 30 dbar, with a 15 second stop-check interval.
10/09/12 13:12:06   SYSTEM  1 minute warmup.
10/09/12 13:12:07   SYSTEM  Waiting until 10/09/12 13:13:06. ... Continuing

10/09/12 13:13:10   SYSTEM   "Diving" ...

10/09/12 13:13:29 OST/5kMP    C27.3, P6.5, R-0.1, T19.6, Vm179.9, Va1.0, 3.75 dbar.
10/09/12 13:13:44 OST/5kMP    C27.3, P6.5, R-0.1, T19.9, Vm179.8, Va1.0, 7.50 dbar.
10/09/12 13:13:59 OST/5kMP    C27.4, P6.5, R-0.1, T20.1, Vm179.6, Va1.0, 11.25 dbar.
10/09/12 13:14:14 OST/5kMP    C27.5, P6.4, R-0.1, T20.3, Vm179.6, Va1.0, 15.00 dbar.
10/09/12 13:14:29 OST/5kMP    C27.4, P6.4, R-0.1, T20.5, Vm179.2, Va1.0, 18.75 dbar.
10/09/12 13:14:44 OST/5kMP    C27.4, P6.4, R-0.1, T20.6, Vm179.2, Va1.0, 22.50 dbar.
10/09/12 13:14:59 OST/5kMP    C27.4, P6.4, R-0.1, T20.7, Vm179.2, Va1.0, 26.25 dbar.
10/09/12 13:15:14 OST/5kMP    C27.4, P6.4, R-0.1, T20.8, Vm179.1, Va1.0, 30.00 dbar.

10/09/12 13:15:14   SYSTEM   Found stop at 30 dbar.
10/09/12 13:15:14   SYSTEM   1 minute warmdown.
10/09/12 13:15:14   SYSTEM   Waiting until 10/09/12 13:16:14. ... Continuing

10/09/12 13:16:17 OST/5kMP  Opening M0000000.DAT for profile 0.
10/09/12 13:16:17 OST/5kMP  Writing 64 byte trailer for profile 0.
10/09/12 13:16:17 OST/5kMP  Closing M0000000.DAT for profile 0.

10/09/12 13:16:18 OST/5kMP test profile 0 succeeded
```

Figure 7-13:Option <5> Perform Profile Test Loop screen 2 of 2

Notes

Chapter 8
Satlantic SUNA Sensor

MMP Release v4.15 and higher supports the Satlantic SUNA sensor. The SUNA collects nitrate data which is recorded in an 'S' file (*SNNNNNNN*.DAT for each profile). For additional information, refer to the Satlantic web site (www.satlantic.com/suna) or contact Satlantic.

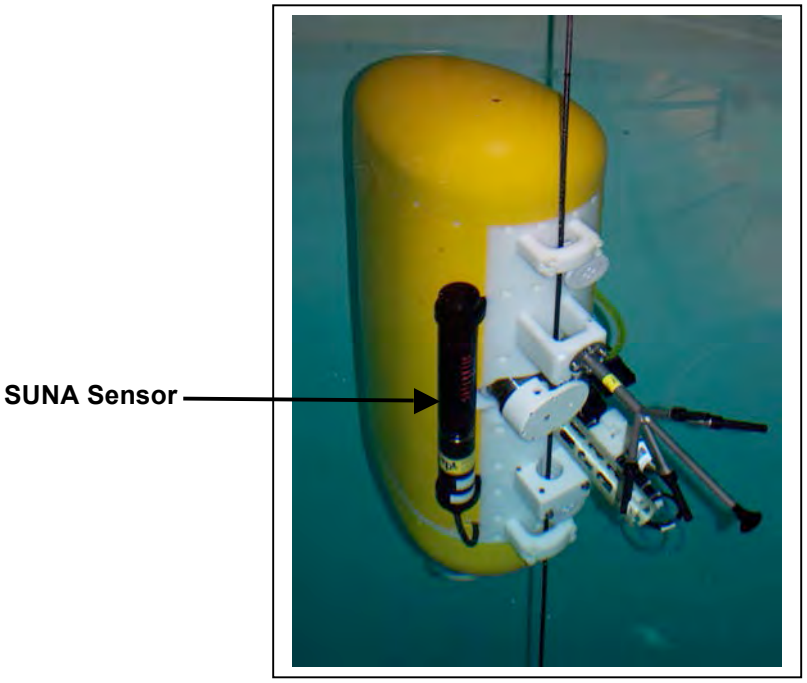


Figure 8-1: MMP with SUNA Sensor

Collecting Data with the SUNA

SUNA data is logged in the 'S' file. ('*SNNNNNNN.DAT*" where 'N' is the profile number). Five nitrate measurements are collected during each stop check. One 'dark' frame is recorded for reference. Four 'light' frames of nitrate data are then recorded. The stop check data displays only the last 'light' frame (the nitrate sample), measured as milligrams per liter.

Unpacked SUNA data is shown next in Figure 8-2.

```
Profile 6

Instrument Timefield NitrateUM NitrateMG FitError LampT SpecT LampTime  Hum Vlt12 VltRg VltMn SpecAv DarkAv  Ch001  Ch002
Ch003  Ch004  Ch005  Ch006  Ch007  Ch008  Ch009  Ch010  Ch011  Ch012  Ch013  Ch014  Ch015  Ch016  Ch017  Ch018  Ch019
Ch020  Ch021  Ch022  Ch023  Ch024  Ch025  Ch026  Ch027  Ch028  Ch029  Ch030  Ch031  Ch032  Ch033  Ch034  Ch035  Ch036
Ch037  Ch038  Ch039  Ch040  Ch041  Ch042  Ch043  Ch044  Ch045  Ch046  Ch047  Ch048  Ch049  Ch050  Ch051  Ch052  Ch053
Ch054  Ch055  Ch056  Ch057  Ch058  Ch059  Ch060  Ch061  Ch062  Ch063  Ch064  Ch065  Ch066  Ch067  Ch068  Ch069  Ch070
Ch071  Ch072  Ch073  Ch074  Ch075  Ch076  Ch077  Ch078  Ch079  Ch080  Ch081  Ch082  Ch083  Ch084  Ch085  Ch086  Ch087
Ch088  Ch089  Ch090  Ch091  Ch092  Ch093  Ch094  Ch095  Ch096  Ch097  Ch098  Ch099  Ch100  Ch101  Ch102  Ch103  Ch104
Ch105  Ch106  Ch107  Ch108  Ch109  Ch110  Ch111  Ch112  Ch113  Ch114  Ch115  Ch116  Ch117  Ch118  Ch119  Ch120  Ch121
Ch122  Ch123  Ch124  Ch125  Ch126  Ch127  Ch128  Ch129  Ch130  Ch131  Ch132  Ch133  Ch134  Ch135  Ch136  Ch137  Ch138
Ch139  Ch140  Ch141  Ch142  Ch143  Ch144  Ch145  Ch146  Ch147  Ch148  Ch149  Ch150  Ch151  Ch152  Ch153  Ch154  Ch155
Ch156  Ch157  Ch158  Ch159  Ch160  Ch161  Ch162  Ch163  Ch164  Ch165  Ch166  Ch167  Ch168  Ch169  Ch170  Ch171  Ch172
Ch173  Ch174  Ch175  Ch176  Ch177  Ch178  Ch179  Ch180  Ch181  Ch182  Ch183  Ch184  Ch185  Ch186  Ch187  Ch188  Ch189
Ch190  Ch191  Ch192  Ch193  Ch194  Ch195  Ch196  Ch197  Ch198  Ch199  Ch200  Ch201  Ch202  Ch203  Ch204  Ch205  Ch206
Ch207  Ch208  Ch209  Ch210  Ch211  Ch212  Ch213  Ch214  Ch215  Ch216  Ch217  Ch218  Ch219  Ch220  Ch221  Ch222  Ch223
Ch224  Ch225  Ch226 CkSum

SATSDB0052   148.723  0.000000  0.000000 0.000000  27.1  25.0   436212  4.9  0.00  5.46 11.59    849    849    851    872
855    853    825    843    835    858    869    834    832    860    837    858    880    871    863    844    839
878    873    841    840    877    858    859    861    855    852    850    835    886    876    864    859    845
827    825    830    876    871    853    823    842    874    868    870    865    815    787    859    853    850
867    851    832    857    855    830    843    826    823    823    839    871    883    848    834    827    831
859    849    839    872    839    866    827    818    861    869    849    837    842    839    857    863    865
866    852    841    844    859    861    840    842    831    843    861    870    867    877    889    877    842
826    842    837    836    869    864    865    851    854    834    849    844    850    875    847    827    861
846    842    877    863    833    849    853    845    857    857    839    833    852    832    841    873    864
832    840    842    853    836    817    843    843    857    843    828    833    861    858    850    867    837
835    843    847    833    841    839    869    841    842    871    873    861    876    854    843    853    863
824    851    857    851    849    839    828    857    865    844    855    869    849    865    843    843    880
879    820    831    835    845    865    862    848    853    826    838    827    865    861    856    843    861
846    857    824    867    841    831    819    857    863    864    853    832    875    861    833    843    851
841    849    852  0x60

SATSLB0052   152.035  2.152976  0.030156 0.000004  26.3  25.1   436213  6.0 12.06  5.52 10.99  21308    843    858    887
859    855    873    893    867    913    920    897    896    893    962    1279   1999   3386   5477   7861   9913
11413  12382  13016  13490  13970  14507  15219  16080  17097  18255  19540  20883  22333  23716  24907  25930  26716
27135  27203  26909  26368  25681  24873  24069  23463  23021  22776  22683  22881  23280  23851  24631  25709  27004
28445  30041  31817  33645  35530  37306  39037  40514  41748  42584  42967  42996  42485  41590  40348  38827  37181
35567  33842  32283  30840  29569  28476  27576  26803  26167  25736  25436  25267  25226  25297  25495  25771  26218
26747  27350  27939  28633  29372  30142  30901  31537  32069  32464  32711  32668  32465  31991  31350  30450  29425
28401  27261  26115  25039  24044  23122  22301  21586  20963  20438  19998  19680  19443  19234  19188  19175  19211
19389  19621  19952  20325  20799  21316  21900  22554  23270  24012  24737  25527  26326  27090  27835  28557  29236
29741  30275  30692  30999  31173  31232  31133  30887  30602  30144  29603  28972  28307  27598  26899  26132  25416
24614  23811  23097  22452  21819  21217  20679  20167  19703  19265  18862  18496  18120  17739  17394  17107  16788
16528  16300  16096  15905  15785  15635  15565  15514  15466  15467  15483  15505  15614  15626  15649  15655  15697
15707  15652  15646  15600  15575  15605  15591  15584  15545  15492  15479  15450  15402  15337  15256  15153  15034
14884  14749  14578  14377  14158  13885  13675  13423  13143  12890  12599  12331  12052  11786  11518  11214  10854
10559  10285  10053  0x2c

SATSLB0052   153.332  1.813990  0.025408 0.000002  26.3  25.1   436215  5.7 12.12  5.49 10.99  21265    843    900    915
913    905    899    873    875    886    876    891    884    868    972    1278   1998   3386   5455   7842   9921
11406  12373  12986  13443  13939  14471  15187  16022  17037  18189  19519  20868  22273  23625  24871  25927  26678
```

Figure 8-2: 'S' File SUNA Data

Configuring the Firmware to Use the SUNA

The Profiler System Configuration menu specifies the active sensors. The number of light sample frames captured per Stop Check can be changed from this menu. The sampling time varies based on how many frames are captured. To enable the SUNA, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*.
2. Select <N> for the Satlantic SUNA and then type *Y* to enable the sensor.
3. The setting for Frames per stop check displays next to the SUNA option.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP_NI               CF2 V5.12 of Feb 11 2014

                 ___________________________________
                           Pattern Profiler
                         System Configuration
                 ___________________________________
                      Tue Mar 11 15:37:44 2014
 System Parameters:
  <0> Battery capacity               240 Ah

 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

      Port J5:ACM
  <2> Nortek AquaDopp DVS ----------- ENABLED AquaDopp-2

      Port J6:IMM
  <I> Telemetry --------------------- ENABLED IMM @ 1200 baud

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA  1 Dk, 3 Lt Enabled <----------
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2 ------------- ENABLED

Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR -------------- ENABLED @ 5 samp/avg

      Port J7:TRB
  <T> Seapoint IR Turbidity

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED

      Port J5i:SER
  <K> ProOceanus CO2

 Exit:
  <X> Save changes    <^C> Cancel changes

  Selection  [X] ? N
Enable the Satlantic SUNA Nitrate (Yes/No) [N] ? y
Number of frames per stop-check (1 to 4) ? 3
```

Figure 8-3: System Configuration Menu

Conducting pre-deployment *in-situ* SUNA timing tests is recommended to check response time. Collecting more data frames at stop check requires a longer SUNA response time and increases the length of each check stop interval. The desired stop check interval time must be balanced with the number of SUNA frames recorded for each stop check. SUNA response time also varies accoding to nitrate concentration. Example: to record 3 frames, the SUNA response time is approximately 15 seconds (5 + (3 * frames)

4. Specify the number of data frames to capture (from 1 to 4) at each stop check interval and type *X* to exit and save the entry.

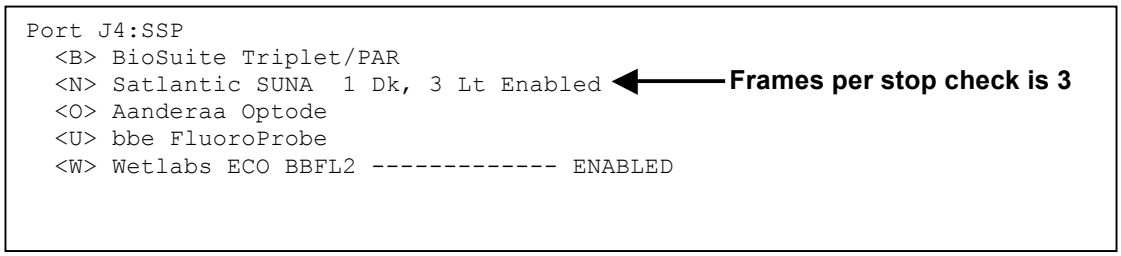


Figure 8-4: Frames per Stop Check

The Dark frame is a SUNA reference frame. This number is 1 and cannot be changed.

Using Bench Test Options

The main Bench Tests and SUNA Bench Tests menu provide options to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options available to the installed sensors.

1. From the Profiler Main Menu, type '5' to display the Profiler Bench Tests Menu.

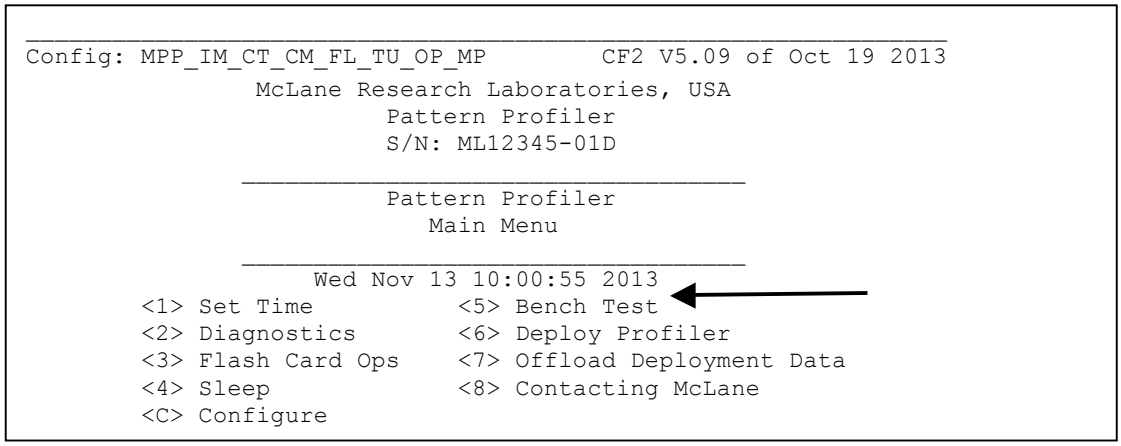


Figure 8-5: Profiler Main Menu

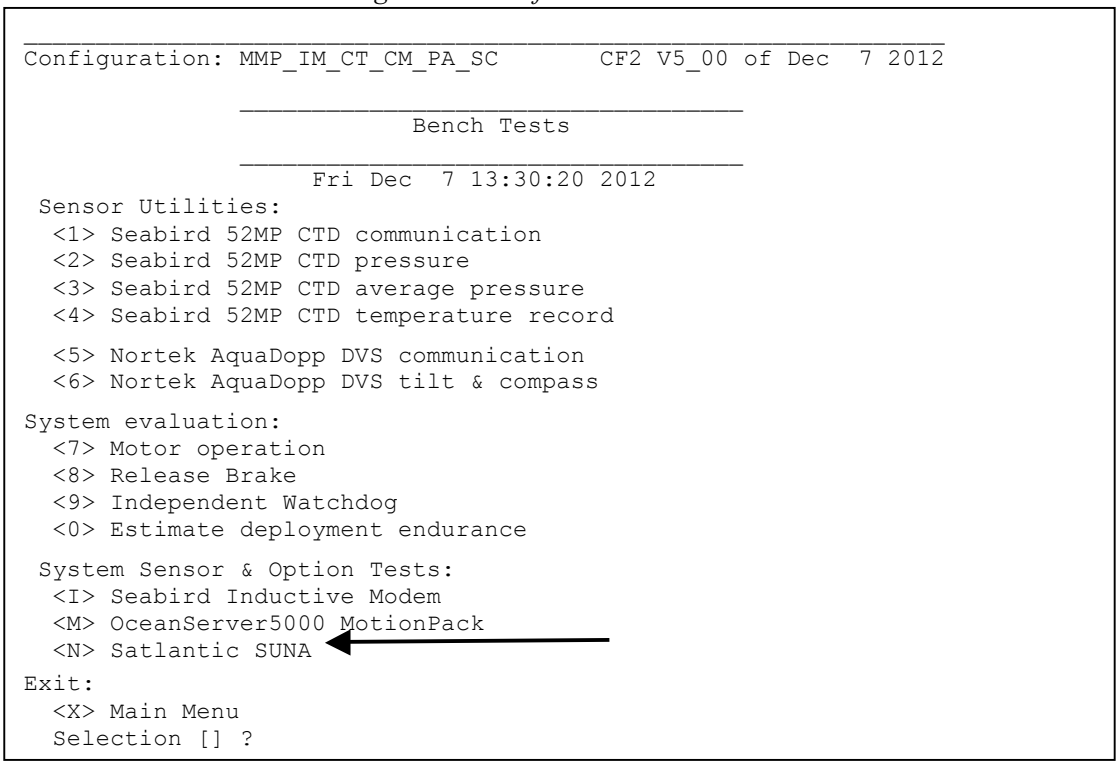


Figure 8-6: Profiler Bench Tests Menu

2. From the main Bench Tests menu, type *N* at the prompt to display the SAT/SUNA Bench Test menu.

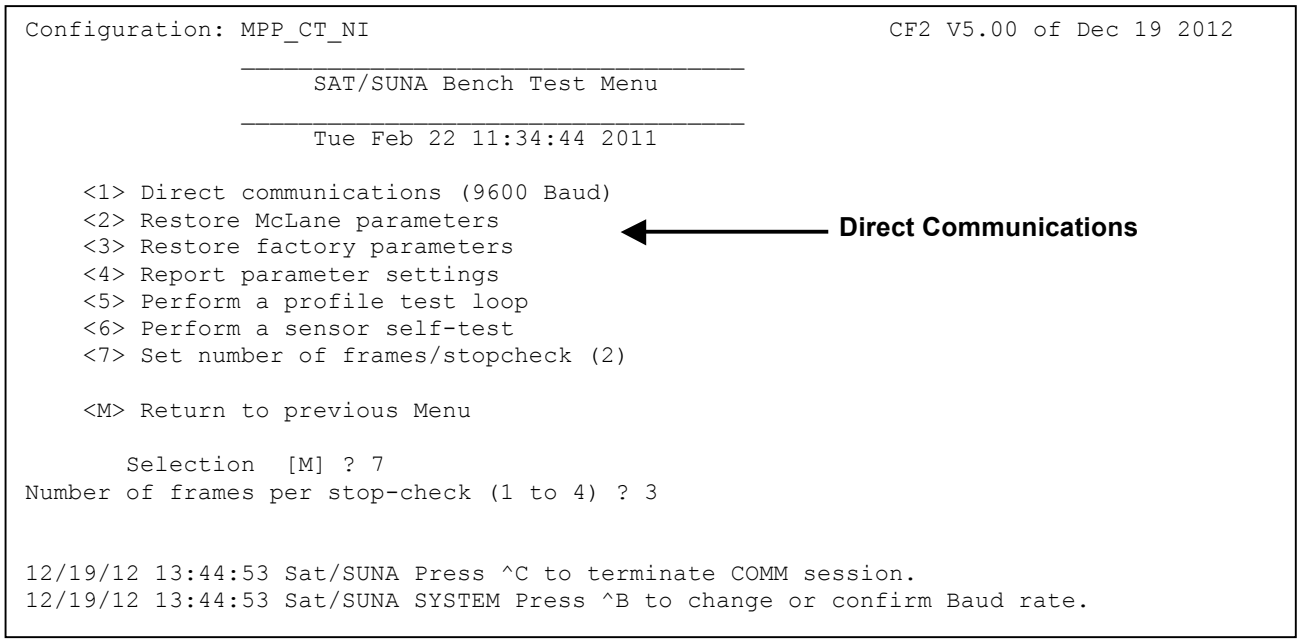


Figure 8-7: SUNA Bench Test Menu

The Profiler communicates with the SUNA at 9600 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 8-8). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
************************************************************

-Êûx-òÄ-fûx-`¸ò8x-Ê‡-ò-ûfxf8òx¯Ü8ò-òÄ-Ê¯¯


04/23/14 12:50:37 AAND OPT ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 8-8: Baud Rate Communication Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu displays the Baud Rate menu (Figure 8-9). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013

                ___________________________________
                         Pattern Profiler
                       Select new Baud rate
                ___________________________________
                     Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 8-9: Baud Rate Menu

Direct Sensor Connection

Once connected to the SUNA, typing commands at the command prompt provides additional sensor information.

1. Type *1* to connect directly with the SUNA.

```
Selection  ? 1

Press ^C to terminate Sat/SUNA session

14:40:43 Sat/SUNA communication channels opened..
14:40:43 Sat/SUNA powered ON.
*****************************************************************

SUNA V1
Submersible Ultraviolet Nitrate Analyzer
Satlantic Inc.
Firmware Version: 1.7.1    (Aug 28 2009, 14:46:06)

Reset source: BROWNOUT
Temperature sensors:
       Lamp housing: FOUND
       Spectrometer: FOUND
RS-232 POLLED MODE
CMD?
```

Figure 8-10: Option <1> Direct Communications with SUNA

Restore McLane and Factory Settings

Option <2> and Option <3> from the SUNA Bench Test menu provide a way to restore the McLane or Satlantic factory settings on the SUNA. Using option <2> requires typing the password *mclane*. Using option <3> (not shown) also requires a password. Contact McLane before resetting factory parameters.

```
Selection  ? 2   Password:  *****
14:41:03 Sat/SUNA communication channels opened..
14:41:03 Sat/SUNA powered ON. . ......................

14:41:10 Sat/SUNA sending [$] command. . ................. .....
14:41:11 Sat/SUNA sending [$Conf SetOpMode POLLED] command. ... .. .
14:41:12 Sat/SUNA sending [$Conf SetTFMode FULL_BINARY] command. ... .. .
14:41:13 Sat/SUNA sending [$Conf SetWaterType salt] command. ... .. .

14:41:14 Sat/SUNA was able to restore McLane parameters.

14:41:14 Sat/SUNA powered OFF.
14:41:14 Sat/SUNA power-down delay ......................
14:41:19 Sat/SUNA communication channels closed..

  Exit:
    <M> Main Menu
```

Figure 8-11: Option <2> Restore McLane Parameters

The profiler firmware requires the SUNA parameters configured by McLane. Changing these settings, including resetting to the factory settings will prevent the SUNA from working correctly with the profiler.

Display Current Settings

Option <4> displays the current SUNA settings.

```
Selection  ? 4

14:41:21 Sat/SUNA communication channels opened..
14:41:21 Sat/SUNA powered ON. . ......................

14:41:28 Sat/SUNA current parameter settings.

FirmwareVersion:  1.7.1

Identify Pkg:     61835
Identify Cal:     21054
LampTime:         134828
GetSNum:          0052
GetBaud:          38400
GetOpMode:        POLLED
GetTFMode:        FULL_BINARY
GetFMTime:        60
GetIntPeriod:     400
GetBLOrder:       Linear
GetFitMin:        217.0
GetFitMax:        240.0
GetNtrDACMin:     -5.000000
GetNtrDACMax:     100.000000
GetLFrames:       1790
GetDFrames:       10
GetWaterType:     salt


14:41:39 Sat/SUNA powered OFF.
14:41:39 Sat/SUNA power-down delay ......................
14:41:44 Sat/SUNA communication channels closed..

  Exit:
    <M> Main Menu
```

Figure 8-12: Option <4> Report Parameter Settings

Perform Profile Test Loop

Option <5> performs a profile test loop. This test simulates an automated sensor verification and a 5 minute profile. The predefined 5 minute test time allows 2 minutes for sensor warm up, 1 minute for simulated profiling and 2 minutes for sensor warm down.

```
Selection  ? 5
14:45:29 Sat/SUNA Automated verification of sensor settings.
14:45:29 Sat/SUNA communication channels opened..
14:45:29 Sat/SUNA powered ON. . ......................
14:45:36 Sat/SUNA powered OFF.
14:45:36 Sat/SUNA power-down delay .....................
14:45:41 Sat/SUNA communication channels closed..
Press ^C to exit the loop
14:45:42 Sat/SUNA prepping for profile.
14:45:42 Sat/SUNA communication channels opened..
14:45:42 Sat/SUNA powered ON. . ......................
14:45:49 Sat/SUNA opening file S0000000.DAT for profile 0.
14:45:49 Sat/SUNA writing 4 byte header for profile 0.
14:45:50 Sat/SUNA communication channels closed..
14:45:50 Sat/SUNA performing 20 "stop-checks" at 15 second intervals (5
minutes).
Sat/SUNA profile 0, "stop-check" 1:
14:45:50 Sat/SUNA communication channels opened..
14:45:50 Sat/SUNA acquiring 1 reference sample.
14:45:50 Sat/SUNA sending [DATA] command. . .
14:45:51 Sat/SUNA writing 511 byte block for profile 0. .
14:45:51 Sat/SUNA sending [LON] command. . .
14:45:53 Sat/SUNA acquiring 4 nitrate samples.
14:45:54 Sat/SUNA sending [DATA] command. . .
14:45:54 Sat/SUNA writing 511 byte block for profile 0. .
14:45:55 Sat/SUNA sending [DATA] command. . .
14:45:56 Sat/SUNA writing 511 byte block for profile 0. .
14:45:56 Sat/SUNA sending [DATA] command. . .
14:45:57 Sat/SUNA writing 511 byte block for profile 0. .
14:45:57 Sat/SUNA sending [DATA] command. . .
14:45:58 Sat/SUNA writing 511 byte block for profile 0. .
14:45:58 Sat/SUNA sending [LOFF] command. . .
14:45:58 Sat/SUNA communication channels closed..0.009866 mg/L nitrate
. . .
14:50:51 Sat/SUNA halting profile.
14:50:51 Sat/SUNA writing 519 byte trailer for profile 0.
14:50:52 Sat/SUNA closing file S0000000.DAT for profile 0.
14:50:52 Sat/SUNA communication channels opened..
14:50:52 Sat/SUNA powered OFF.
14:50:52 Sat/SUNA power-down delay .....................
14:50:58 Sat/SUNA communication channels closed..

Sat/SUNA test profile 0 succeeded
Press ^C to exit the loop
```

Figure 8-13: Option <5> Perform a profile test loop

Perform Sensor Self Test

Option <6> performs a SUNA self test to verify SUNA operation.

```
Selection  ? 6

Press ^C to terminate Sat/SUNA session
14:44:43 Sat/SUNA communication channels opened..
14:44:44 Sat/SUNA powered ON.
************************************************************
SUNA V1
Submersible Ultraviolet Nitrate Analyzer
Satlantic Inc.
Firmware Version: 1.7.1    (Aug 28 2009, 14:46:06)

Reset source: BROWNOUT
Temperature sensors:
       Lamp housing: FOUND
       Spectrometer: FOUND
RS-232 POLLED MODE
CMD? $
SUNA V1
Submersible Ultraviolet Nitrate Analyzer
Satlantic Inc.
Firmware Version: 1.7.1    (Aug 28 2009, 14:46:06)
Type '$Help' for a list of available commands.
Note:commands are case insensitive.

SUNA> $SelfTest  <-- Profiler firmware executes scripted command for SUNA self test to run
*** SUNA DIAGNOSTICS ***
Erasing LOG file, if present...OK
TEST 1 (7.695 s): Memory ... wrote: 19345 read: 19345 OK
TEST 2 (8.008 s): External SRAM ........ Bytes: 32768 Errors: 0 OK
TEST 3 (9.117 s): Temperature Sensor (Lamp Housing)... 25.813 C OK
TEST 4 (9.965 s): Temperature Sensor (Spectrometer)... 25.563 C OK
TEST 5 (10.816 s): Input voltage (VMAIN) ... 11.71 V OK
. . .
$Ok
SUNA> $reboot
$Ok
SUNA V1
Submersible Ultraviolet Nitrate Analyzer
Satlantic Inc.
Firmware Version: 1.7.1    (Aug 28 2009, 14:46:06)
Reset source: WATCHDOG
Temperature sensors:
       Lamp housing: FOUND
       Spectrometer: FOUND
RS-232 POLLED MODE
CMD? [^C]  <-- User types [CTRL]-[C] to terminate session
************************************************************
14:45:21 Sat/SUNA powered OFF.
14:45:21 Sat/SUNA power-down delay .....................
14:45:27 Sat/SUNA communication channels closed..
```

Figure 8-14: Option <6> SUNA Self Test

Option <7> (not shown) provides the option to change the Frames per Stop check as on the System Configuration menu,

Installing the SUNA in the Sensor Mounting Brackets

The SUNA sensor is removed from the MMP for shipment and must be re-installed prior to deployment. To install the SUNA, complete the following steps:

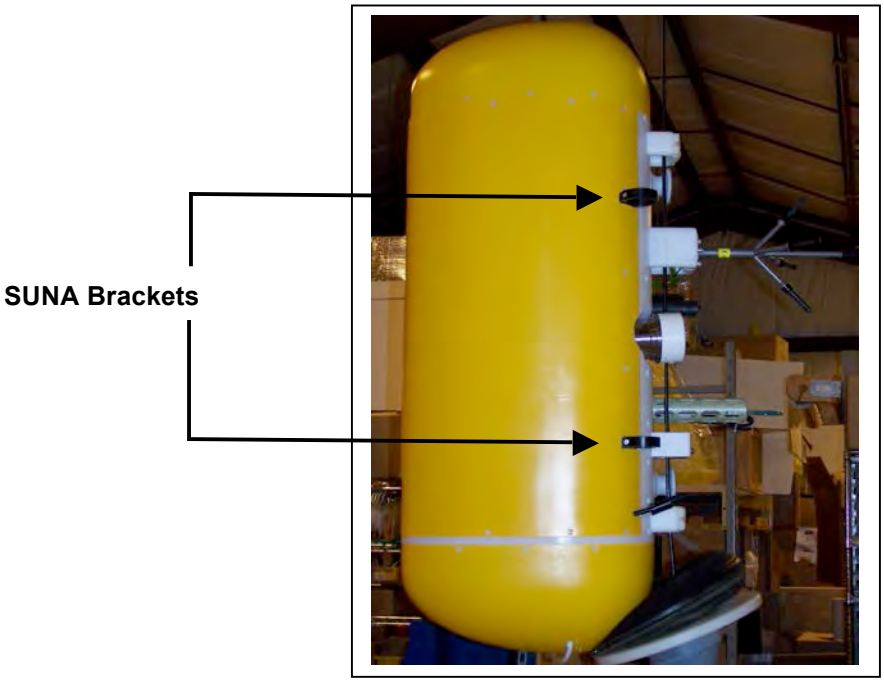


Figure 8-15: MMP with SUNA Sensor

1. Slide the SUNA into the top and bottom mounting brackets on the MMP.

Figure 8-16: Sliding the SUNA into the Sensor Brackets

2. Using the provided hex driver, tighten the bottom and top mounting bracket screws (Figure 8-17 and 8-18). Connect the 5-pin connector (Figure 8-19 and 8-20).

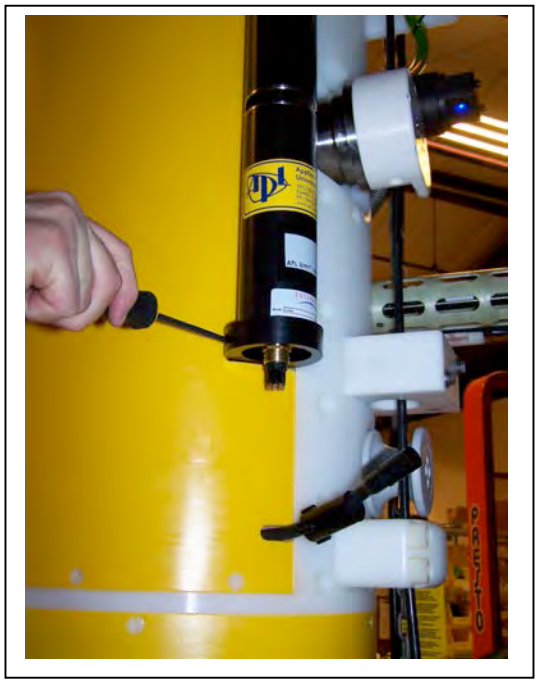


Figure 8-17 and Figure 8-18: Tightening Bottom and Top Mounting Screws

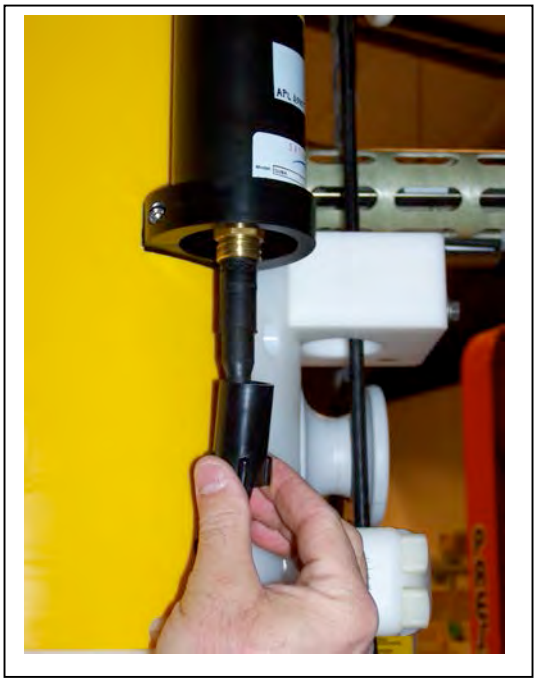


Figure 8-19 and Figure 8-20: Connect the 5-pin connector

3. Connect the opposite end of the cable (not shown) to the 8-pin connector on the controller housing marked SUNA.

Figure 8-21: Completed SUNA Installation

Figure 8-21 shows the completed SUNA installation.

The SUNA also has a test cable for direct connection to the sensor. This cable is incuded in the Profiler shipment.

Chapter 9
Biospherical Par Sensor

The Biospherical PAR is a single-channel (analog) sensor that measures Irradiance (Photosynthetically Active Radiation). Calculating irradiance with PAR data requires using the Calibration sheet provided with the sensor. This section provides information common to both the QSP-2200, QSP-2300, QCP-2200 and QSP-2300 Par sensors. The PAR Q-series sensors are mechanically integrated with the MMP in the same manner. The MMP may not be shipped with the PAR sensor installed. See the instructions in this section for connecting and installing the PAR sensor. For more information about these sensors, refer to the Biospherical Instruments, Inc. website (www.biospherical.com) or contact Biospherical Instruments, Inc.

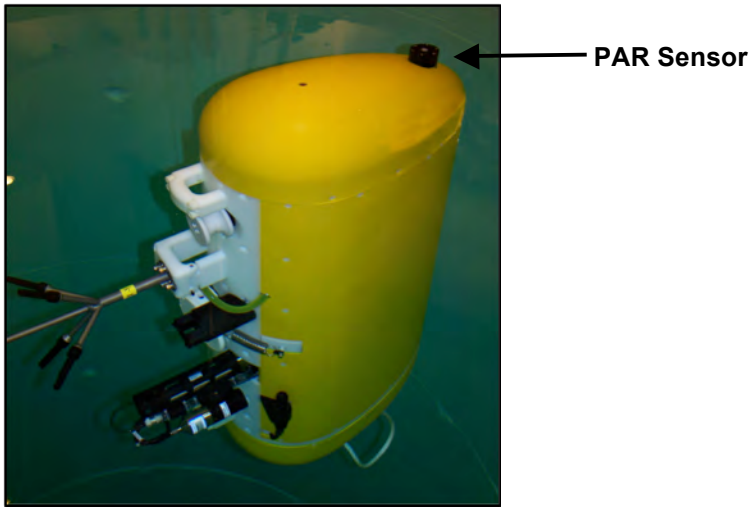


Figure 9-1: MMP with PAR Sensor

Collecting Data with the PAR

PAR data is logged as voltage and displayed in the Engineering File as Par mV, as shown next.

```
Profile 1
                                                    PAR
 Sensors were turned on at  12/07/2012 15:30:01      |
                                                     v
 Vehicle began profiling at 12/07/2012 15:32:01

Date,                    [mA],  [V],   [dbar],Par[mV],     scatSig,      chlSig,       CDOMSig

12/07/2012   15:32:01,    -2,    12.1,  0.000, 0.00,        66,           54,           98
12/07/2012   15:32:07,    55,    12.0,  0.000, 0.00,        68,           54,           100
12/07/2012   15:32:12,    166,   11.9,  0.000, 0.60,        67,           52,           101
12/07/2012   15:32:17,    193,   11.9,  0.000, 2.20,        71,           53,           100
12/07/2012   15:32:22,    185,   11.9,  0.000, 0.00,        69,           53,           99
12/07/2012   15:32:28,    175,   11.9,  0.000, 3.80,        67,           52,           100
12/07/2012   15:32:34,    217,   11.9,  5.760, 0.00,        67,           52,           99
12/07/2012   15:32:40,    159,   11.9,  4.030, 4.00,        65,           55,           101
12/07/2012   15:32:46,    141,   11.9,  2.290, 0.00,        70,           52,           99
12/07/2012   15:32:52,    129,   11.9,  0.670, 6.20,        68,           53,           102


 Ramp exit:    SMOOTH RUNNING

 Profile exit: TOP PRESSURE

 Vehicle motion stopped at 12/07/2012 15:33:00
 Sensor logging stopped at 12/07/2012 15:35:09
```

Figure 9-2: ENG File with PAR Data

PAR Calibration Sheet Example

The PAR output is voltage that is proportional. Models QCP-2200 and QSP-2200 are linearly proportional to the log of incident irradiance. Models QCP-2300 and QCP-2300 are proportional to the log of incident irradiance. The documentation from the sensor manufacturer includes a Calibration Sheet to calculate irradiance from PAR mV readings.

A sample Calibration sheet for the QCP-2300 is shown on the next page only for reference. Refer to the Calibration sheet specific to the installed PAR for calculating irradiance.

Calibration Date: 02/09/09 **Job No.:** L10177
Model Number: QCP2300
Serial Number: 70219
Operator: TPC
Standard Lamp: 91537(10/25/2006)
Operating Voltage Range: 6 to 15 VDC (+)

Note: The QCP2300 output is a voltage that is proportional to the log of the incident irradiance.
To calculate irradiance, use this formula:
Irradiance = Calibration factor * (10^Light Signal Voltage - 10^Dark Voltage)

Dry Calibration Factor: 3.04E+12 quanta/cm²·sec per volt 5.04E-06 µEinsteins/cm²·sec per volt
Wet Calibration Factor: 3.20E+12 quanta/cm²·sec per volt 5.31E-06 µEinsteins/cm²·sec per volt

Sensor Test Data and Results[2)]

Sensor Supply Current (Dark): 3.4 mA
Supply Voltage: 6 Volts
Lamp Integrated PAR Irradiance: 8.83E+15 quanta/cm²·sec 0.01467 µEinsteins/cm²sec
Immersion Coefficient: 0.95

Nominal Filter OD	Expected Transmission	Calibrated Trans.	Sensor Voltage	Expected Voltage	Voltage % Error	Measured Trans.	Transmission Error (%)	Test Irrad. (quanta/ cm²·sec)
No Filter	100%	100.00%	3.464	3.464	0%	100.00%	0.0	8.84E+15
0.3	50%	36.10%	3.023	3.022	0%	36.16%	-0.2	3.19E+15
0.5	32%	27.60%	2.910	2.905	0%	27.89%	-1.1	2.46E+15
1	10%	9.27%	2.448	2.431	1%	9.61%	-3.5	8.49E+14
2	1%	1.11%	1.546	1.509	2%	1.17%	-5.3	1.04E+14
3	0.10%	0.05%	0.421	0.192	55%	0.05%	-2.8	4.97E+12
RG780	0.00%	0.00%	0.016	0.016	0%	0.00%	-100.0	1.15E+11

Dark Before:	0.016	Volts
Light - No Filter Hldr.:	3.465	Volts
Dark After - NFH:	0.016	Volts
Average Dark	0.0161	Volts

Notes:
1. Annual calibration is recommended.
2) This section is for internal use and for more advanced analysis.

Configuring the Firmware to Use the PAR

The Profiler System Configuration Menu specifies the active sensors. Samples/average for the PAR can also be changed. To enable the PAR sensor, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*.
2. Select <P> Biospherical Par and then type *Y* to enable the sensor. Type <1> or <2> to select the PAR sensor model. Optionally enter a new 'samples to average' measurement between 1 and 100 and type *X* to exit and save.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_MP                 CF2 V5.16 of Aug 22 2014
               _____________________________________
                        Pattern Profiler
                      System Configuration
               _____________________________________
                   Mon Aug 25 15:00:43 2014
 System Parameters:
  <0> Battery capacity               240 Ah
 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED
      Port J5:ACM
  <2> Falmouth Scientific 2d ACM ---- ENABLED
      Port J6:IMM
  <I> Telemetry --------------------- ENABLED IMM @ 1200 Baud
      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA Nitrate
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2
      Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR
      Port J7:TRB
  <T> Seapoint IR Turbidity
      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer
      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED
      Port J5i:SER
  <K> ProOceanus CO2
 Exit:
  <X> Save changes    <^C> Cancel changes
 Selection [] ? p
Enable the "Biospherical PAR" [Y] ? y
Select 1 = QSP/QCP-2200, 2 = QSP/QCP-2300 (1-2) [1] ? 2
Enter number of measurements to average (1-100) [5] ? 10
```

Example: Averaging '10' causes the firmware to calculate a voltage average from 10 samples

Figure 9-3: System Configuration Menu

Using Bench Test Options

The Bench Tests menu provides an option to verify and change sensor settings prior to deployment. The main Bench Tests Menu displays only options the are available to installed sensors.

1. From the Profiler Main Menu, type *5* to display the Profiler Bench Tests Menu.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.09 of Oct 19 2013
                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-01D

                _____________________________________
                         Pattern Profiler
                            Main Menu

                _____________________________________
                     Wed Nov 13 10:00:55 2013
        <1> Set Time          <5> Bench Test
        <2> Diagnostics       <6> Deploy Profiler
        <3> Flash Card Ops    <7> Offload Deployment Data
        <4> Sleep             <8> Contacting McLane
        <C> Configure
```

Figure 9-4: Profiler Main Menu

```
_____________________________________________________________________
Configuration: MMP_IM_CT_CM_PA_SC       CF2 V5_00 of Dec  7 2012

                _____________________________________
                         Bench Tests

                _____________________________________
                     Fri Dec  7 13:30:20 2012
 Sensor Utilities:
  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record

  <5> Nortek AquaDopp DVS communication
  <6> Nortek AquaDopp DVS tilt & compass

System evaluation:
  <7> Motor operation
  <8> Release Brake
  <9> Independent Watchdog
  <0> Estimate deployment endurance

 System Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <M> OceanServer5000 MotionPack
  <P> Biospherical PAR

Exit:
  <X> Main Menu
  Selection [] ?
```

Figure 9-5: Profiler Bench Tests Menu

Direct Sensor Connection

1. From the main Profiler Bench Tests menu, type *P* Biospherical PAR.
2. Optionally change PAR samples to average for testing purposes.
3. Press [CTRL]-[C] to exit.

```
                  ____________________________________
                              Bench Tests
                  ____________________________________

                       Thu Dec  6 16:17:44 2012
 Sensor Utilities:

  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Nortek AquaDopp DVS communication
  <6> Nortek AquaDopp DVS tilt & compass

 System Evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <0> Battery endurance

 System Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <M> OceanServer5000 MotionPack
  <P> Biospherical PAR
  <W> Wetlabs ECO BBFL2

 Exit:

  <X> Main Menu

  Selection [] ? p

 Enter number of PAR samples to average (1-100) [5] ?

 Press ^C to exit, or any other key to pause|continue.


12/06/12 16:31:48  BII/PAR Powered on.
12/06/12 16:31:48  BII/PAR 0.0 mV, 12.6Vb.
12/06/12 16:31:49  BII/PAR 0.0 mV, 12.6Vb.
12/06/12 16:31:50  BII/PAR 1.2 mV, 12.7Vb.
12/06/12 16:31:51  BII/PAR 0.0 mV, 12.6Vb.   <-- PAR Analog Voltage
12/06/12 16:31:52  BII/PAR 0.0 mV, 12.6Vb.
12/06/12 16:31:53  BII/PAR 0.8 mV, 12.6Vb.
12/06/12 16:31:54  BII/PAR 1.4 mV, 12.6Vb.
12/06/12 16:31:55  BII/PAR 0.0 mV, 12.6Vb.
```

Figure 9-6: PAR Direct Communications

Connecting the PAR Sensor

To connect and install the PAR Q series sensors, complete the following steps (the QCP-2300 sensor is illustrated):

1. Connect the PAR sensor to the 4 pin bulkhead connector.
2. Gently slide the PAR sensor into the hole at the top of the MMP.

Figure 9-7: Connecting to the Bulkhead

Figure 9-8: Sliding in the PAR

3. Slide the white sensor clamp over the PAR and tighten the 8-32 socket cap screws.
4. Gently push the sensor clamp back into place.

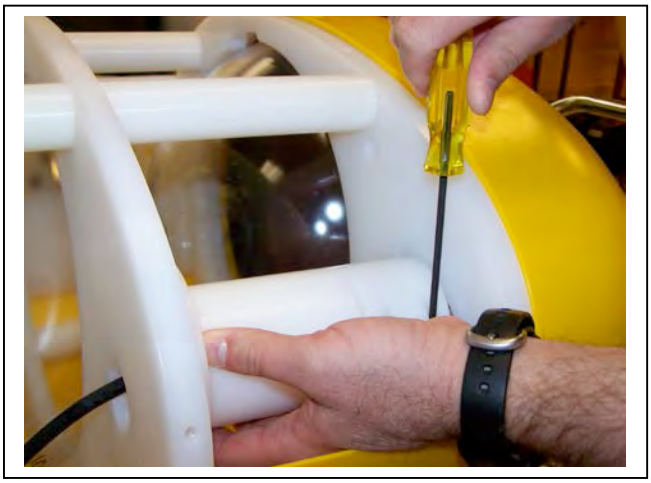


Figure 9-9: Securing the Sensor Clamp

Figure 9-10:Re-inserting the Clamp

5. Using a hex screwdriver, tighten the 3/1-16 x 1” long nylon socket cap screws.
6. Replace the MMP Skin.

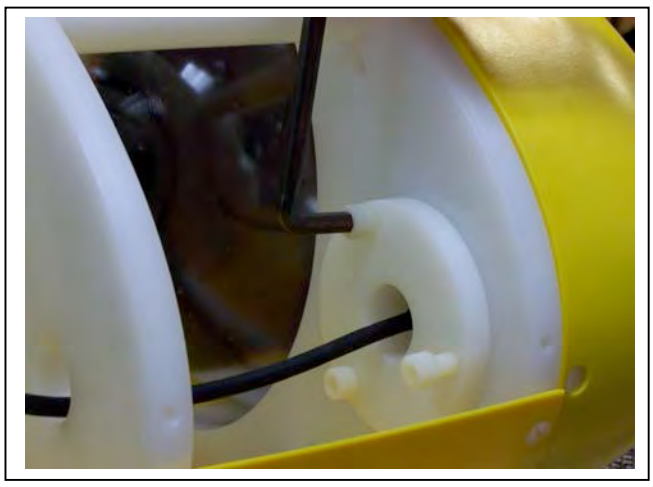


Figure 9-11: Tightening the Socket Cap Screws

Figure 9-12: PAR Sensor Installed

Removing the PAR Sensor

To disconnect and remove the PAR, complete the following steps:

1. Lay the MMP on its side on a stable surface and remove the Top skin.
2. Using a Hex driver (included in the toolkit), remove the 3/8-16 x 1” long nylon socket cap screws from the white PAR sensor clamp.
3. Loosen the sensor clamp.

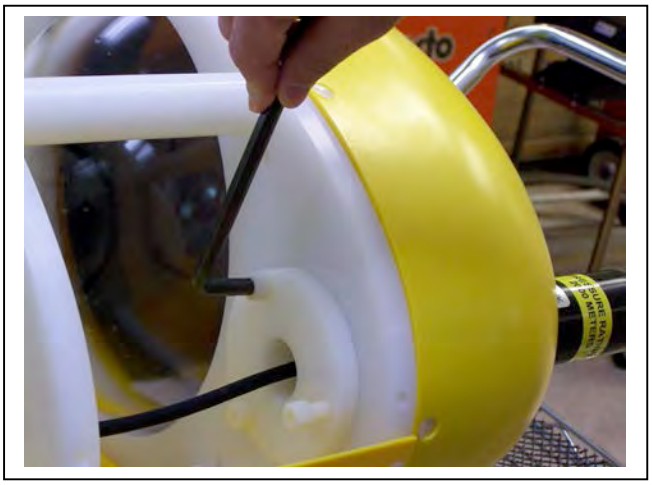


Figure 9-13: Unscrewing the Socket Cap Screws

Figure 9-14: Loosening the Sensor Clamp

4. Pull the sensor clamp out to expose the two 8-32 socket cap screws.
5. Using a screwdriver, loosen the 8-32 socket cap screws that hold the sensor in the clamp.

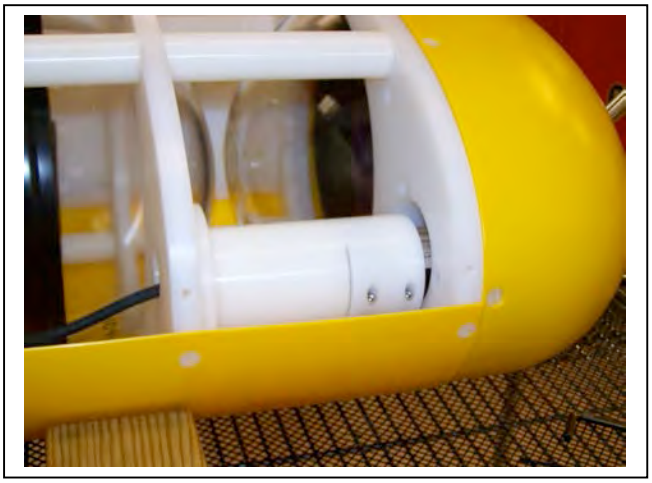


Figure 9-15: Pulling Out the Sensor Clamp

Figure 9-16: Loosening the Clamp Screws

6. While holding the PAR securely, gently pull the sensor out from the top of the MMP.
7. Remove the PAR from the bulkhead connector.

Figure 9-17: Pulling Out Sensor Clamp

Figure 9-18: Removing Bulkhead Connector

8. Cap the PAR sensor when not in use.

Figure 9-19: Placing the Cap on the PAR

Notes

Section 9.1
PAR QSP-2200 Sensor

MMP firmware release versions 5.00 and above support the Biospherical Instruments Inc QSP-2200 PAR. This irradiance sensor is depth-rated to 2000 meters. The QSP-2200 is a scalar irradiance sensor which produces an analog voltage output that is directly proportional to the incident irradiance upon the sensing plane of the collector.

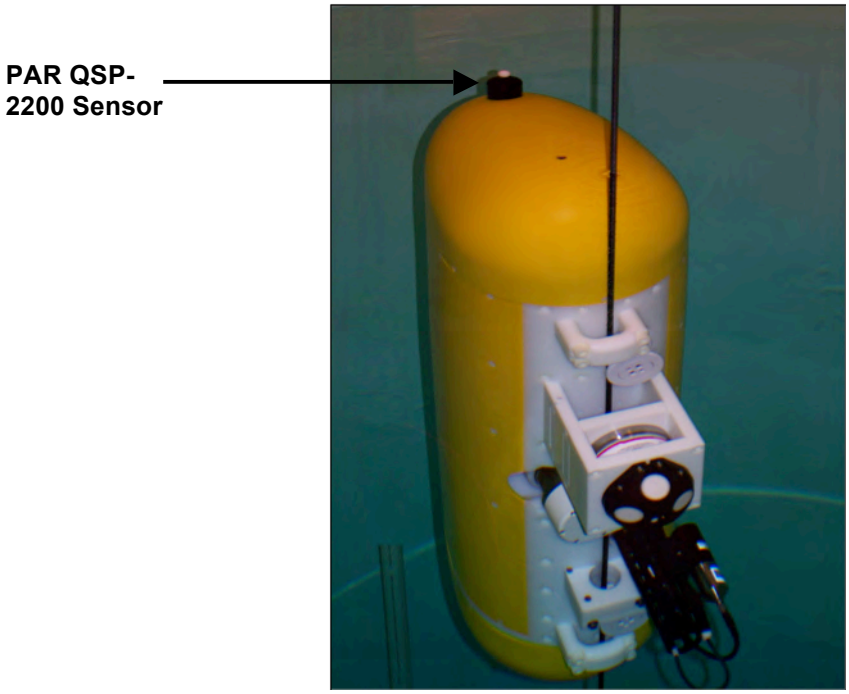


Figure 9.1-1: PAR QSP-2200 Sensor

Calculating irradiance with PAR data requires using the Calibration sheet provided with the sensor.

Notes

Section 9.2
PAR QCP-2300 Sensor

MMP Release versions 4.09 or 4.20 and above support the Biospherical Instruments Inc QCP-2300 PAR. This irradiance sensor is depth-rated to 2000 meters. The model QCP-2300 is designed for use with commercially available CTD's and dataloggers that require an analog voltage as signal input.

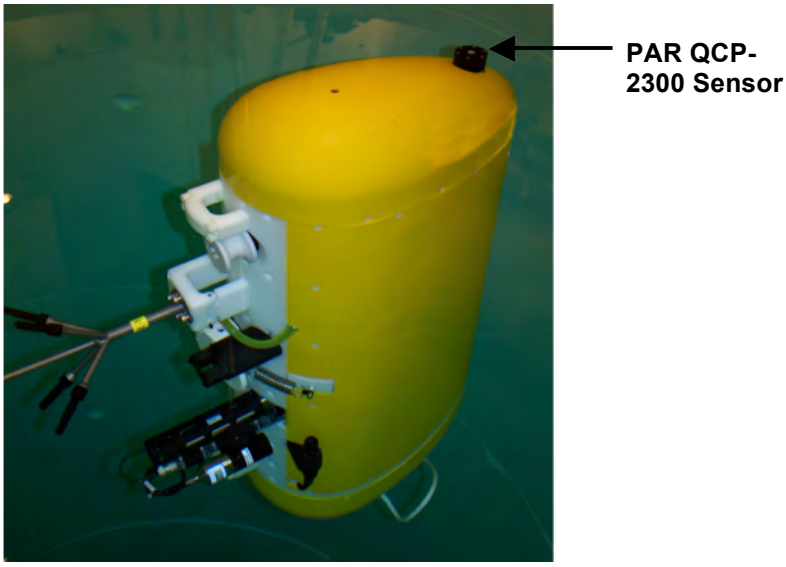


Figure 9.2-1: MMP with PAR QCP-2300 Sensor

Calculating irradiance with PAR data requires using the Calibration sheet provided with the sensor.

Notes

Chapter 10
Seapoint Turbidity/Fluorometer – General Info

The Seapoint Turbidity Meter detects light scattered by particles suspended in water. The Seapoint Chlorophyll Fluorometer (SCF) is a high-performance, low power instrument for in situ measurements of chlorophyll.

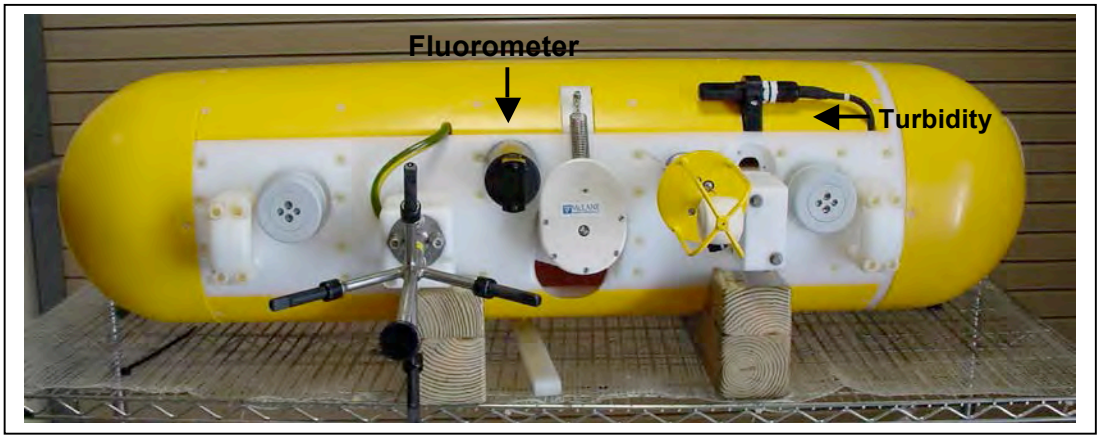


Figure 10-1: MMP with Turbidity and Fluorometer Sensors

Collecting Data with the Turbidity Sensor

Seapoint Turbidity data is logged as voltage and displayed in the Engineering File, as shown next.

```
 Profile 2

 Sensors were turned on at  05/21/2014 08:43:25

 Vehicle began profiling at 05/21/2014 08:45:02

    Date      Time     [mA]    [V]    [dbar]    Turb[mV]   Gain   Oxygen[uM]     Optode
Temp[C]

 05/21/2014 08:45:02    -19   11.5      0.000     1338.60      1     16014.64          0.00
 05/21/2014 08:45:17     40   11.5      0.000     1338.80      1     16014.64          0.00
 05/21/2014 08:45:31     40   11.5      0.010     1339.40      1       259.20         21.93
 05/21/2014 08:45:46     39   11.5      0.010     1339.80      1       259.33         21.93

 05/21/2014 08:46:01     39   11.5      0.000     1340.20      1       259.41         21.93

 Ramp exit:     SMOOTH RUNNING
 Profile exit:  TIMER EXPIRED

 Vehicle motion stopped at 05/21/2014 08:46:05
 Sensor logging stopped at 05/21/2014 08:48:08
```


Figure 10-2: ENG File with Turbidity Data

Configuring the Firmware to Use Turbidity/Fluorometer Sensors

The Profiler System Configuration Menu specifies the active sensors.. To enable the Turbidity or Fluorometer sensors, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*.
2. Select <T> Seapoint Turbidity or <E> Seapoint CHL Fluorometer and then type *Y* to enable the sensor.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP_NI               CF2 V5.12 of Feb 11 2014
                 ___________________________________
                           Pattern Profiler
                         System Configuration
                 ___________________________________
                       Tue Mar 11 15:37:44 2014
 System Parameters:
  <0> Battery capacity               240 Ah
 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED
      Port J5:ACM
  <2> Nortek AquaDopp DVS ----------- ENABLED AquaDopp-2
      Port J6:IMM
  <I> Telemetry --------------------- ENABLED IMM @ 1200 baud
      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA  1 Dk, 3 Lt ----------- ENABLED
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2 ------------- ENABLED
Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR --------------
      Port J7:TRB
  <T> Seapoint IR Turbidity ------------- ENABLED @ 3 samp/avg
      Port J8:FLR
  <E> Seapoint CHL Fluorometer ------------- ENABLED
  <F> Wetlabs CDOM Fluorometer
      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED
      Port J5i:SER
  <K> ProOceanus CO2
 Exit:
  <X> Save changes    <^C> Cancel changes
    Selection [] ? t
Enter number of measurements to average (1-100) [10] ? 3
```

Figure 10-3: System Configuration Menu

Using Bench Test Options

The Bench Tests menu provides an option to verify and change sensor settings prior to deployment. The main Bench Tests menu displays only options that are available to installed sensors.

1. From the Profiler Main Menu, type 5 to display the Profiler Bench Tests Menu.

```
_____________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.09 of Oct 19 2013
                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-01D

                _____________________________________
                         Pattern Profiler
                            Main Menu

                _____________________________________
                     Wed Nov 13 10:00:55 2013
        <1> Set Time           <5> Bench Test
        <2> Diagnostics        <6> Deploy Profiler
        <3> Flash Card Ops     <7> Offload Deployment Data
        <4> Sleep              <8> Contacting McLane
        <C> Configure
```

Figure 10-4: Profiler Bench Tests Menu

```
_____________________________________________________________
Configuration: MMP_IM_CT_CM_PA_SC       CF2 V5_00 of Dec  7 2012

                _____________________________________
                          Bench Tests

                _____________________________________
                     Fri Dec  7 13:30:20 2012
 Sensor Utilities:
  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Nortek AquaDopp DVS communication
  <6> Nortek AquaDopp DVS tilt & compass
System evaluation:
  <7> Motor operation
  <8> Release Brake
  <9> Independent Watchdog
  <0> Estimate deployment endurance
 System Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <E> Seapoint CHL Fluorometer
  <T> Seapoint IR Turbidity
Exit:
  <X> Main Menu
  Selection [] ?
```

Figure 10-5: Profiler Main Menu

Direct Sensor Connection

1. From the main Profiler Bench Tests menu, type *T* Seapoint Turbidity.
2. Optionally change samples to average for testing purposes.
3. Press [CTRL]-[C] to exit.

```
                  ____________________________________
                              Bench Tests
                  ____________________________________

                       Thu Dec  6 16:17:44 2012
 Sensor Utilities:

  <1> Seabird 52MP CTD communication
  <2> Seabird 52MP CTD pressure
  <3> Seabird 52MP CTD average pressure
  <4> Seabird 52MP CTD temperature record
  <5> Nortek AquaDopp DVS communication
  <6> Nortek AquaDopp DVS tilt & compass

 System Evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <0> Battery endurance

System Sensor & Option Tests:
  <I> Seabird Inductive Modem
  <E> Seapoint CHL Fluorometer
  <T> Seapoint IR Turbidity

 Exit:

  <X> Main Menu

  Selection [] ? t

       Set Turbidity Sensor Gain:

         <A> Automatic
         <1> Fixed  1X
         <2> Fixed  5X
         <3> Fixed 20X
         <4> Fixed 100X

         Selection  [A] ? a


 Enter number of measurements to average (1 to 100) ? 3

 Press ^C to exit, or any other key to pause|continue.
```

Figure 10-6: Set Turbidity Gain

```
05/21/2014 13:51:54  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:51:56  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:51:57  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:51:58  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:51:59  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:00  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:01  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:02  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:03  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:04  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:05  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:06  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:07  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:08  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:09  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:10  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:11  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:12  Turbidity: 100.37 FTU 4015 mV, 20X  Battery: 11.1 V
05/21/2014 13:52:14  Turbidity: 114.47 FTU 1145 mV, 05X  Battery: 11.1 V
05/21/2014 13:52:15  Turbidity: 114.43 FTU 1144 mV, 05X  Battery: 11.1 V
05/21/2014 13:52:16  Turbidity: 112.47 FTU 1125 mV, 05X  Battery: 11.1 V
. . .
05/21/2014 13:52:30  Turbidity: 349.67 FTU  699 mV, 01X  Battery: 11.1 V
05/21/2014 13:52:31  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:33  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:34  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:35  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:36  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:37  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:38  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:39  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
05/21/2014 13:52:40  Turbidity:   0.00 FTU    0 mV, 100X  Battery: 11.1 V
```

Display shortened for brevity

Figure 10-7: Turbidity Direct Communications

Turbidity/Fluorometer Shared Bulkhead Implementation

If both of these sensors are installed on the Profiler, the implementation may share a single bulkhead As shown in Figures 10-8 the MMP End Cap with a 12-pin center MCBH bulkhead connector is wired to both the Fluorometer and Turbidity Sensors.

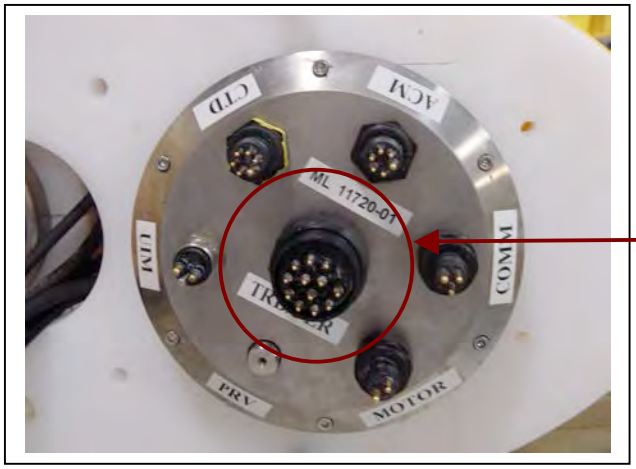


Figure 10-8: MMP with Turbidity and Fluorometer MCBH Connector

Notes

Chapter 11
Inductive Communications

The inductive communications option can transmit deployment files near real-time. This option requires a customer-supplied surface controller package. The following inductive communications coils are integrated with the Profiler firmware and hardware:

- Sea-Bird IMM (1200 baud rate inductive telemetry)
- RBR MLM (4800 baud rate inductive telemetry)

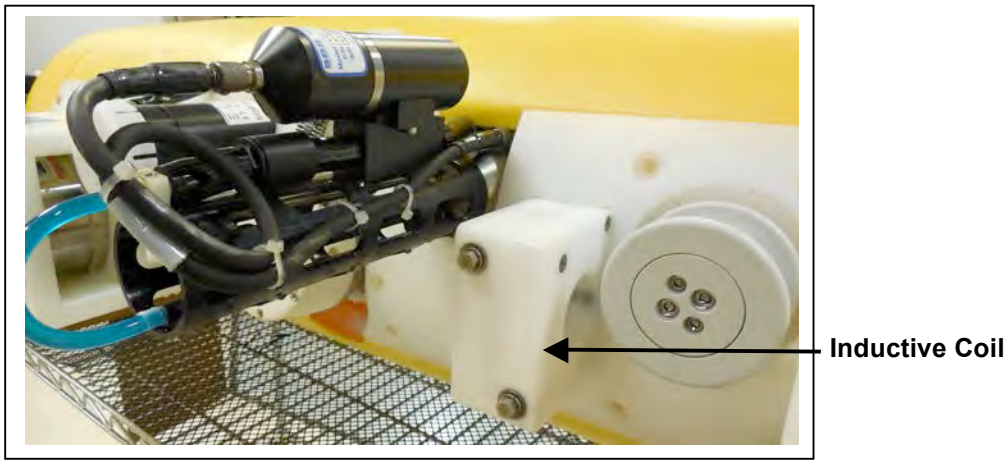


Figure 11-1: Inductive Coil

Regardless of Inductive Modem model, the Profiler firmware use the same Transmission Protocol. Refer to Appendix A in this User Manual, 'Inductive File Transmission Protocol' for details about inductive commands. The Sea-Bird UIM is an obsolete inductive modem. This inductive option is documented in Appendix B in this User Manual 'Sea-Bird UIM'.

This chapter describes the inductive options in the order below.

Inductive Communications Chapter Contents	
Section	**Topic**
11.1	Sea-Bird Inductive Model Module (IMM)
11.2	RBR Mooring Line Modem (MLM)

Patterned profiling is a deployment programming method available through a McLane application called Deployment Planner. This programming method also has inductive settings. Refer to the section on Deployment Planner in the MMP User Manual for more detailed information about inductive profiles and the Deployment Planner.

Configuring the Firmware to Use Inductive Communications

The Profiler System Configuration menu specifies the active sensors. To enable Inductive Telemetry, complete the following steps:

1. From the Main Menu type *c* and enter the password *configure*.

2. Select <I>. An option to select the type of inductive telemetry displays.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_PA_SC_MP_NI                CF2 V5.12 of Feb 11 2014

                  _____________________________________
                           Pattern Profiler
                         System Configuration

                  _____________________________________
                       Tue Mar 11 15:37:44 2014
 System Parameters:
  <0> Battery capacity               240 Ah

 Sensor Suite:
      Port J9:CTD
  <1> Seabird 52MP CTD -------------- ENABLED

      Port J5:ACM
  <2> Nortek AquaDopp DVS ----------- ENABLED AquaDopp-2

      Port J6:IMM
  <I> Telemetry --------------------- ENABLED IMM @ 1200 baud

      Port J4:SSP
  <B> BioSuite Triplet/PAR
  <N> Satlantic SUNA  1 Dk, 3 Lt Enabled
  <O> Aanderaa Optode
  <U> bbe FluoroProbe
  <W> Wetlabs ECO BBFL2 ------------- ENABLED

Port J10:SPR
  <L> Wetlabs ECO FLBB(RT)/D
  <P> Biospherical PAR -------------- ENABLED @ 5 samp/avg

      Port J7:TRB
  <T> Seapoint IR Turbidity

      Port J8:FLR
  <E> Seapoint CHL Fluorometer
  <F> Wetlabs CDOM Fluorometer

      Port J4i:SER
  <H> ProOceanus CH4
  <M> OceanServer5000 MotionPack ---- ENABLED

      Port J5i:SER
  <K> ProOceanus CO2

 Exit:
  <X> Save changes    <^C> Cancel changes

Selection [X] ? i
Enable the "Inductive Telemetry" [Y] ?

Select 1 = UIM, 2 = IMM, 3 = MLM (1-3) [0] ? 2  <-- Inductive Settings
```

Figure 11-2: Select Telemetry Type

Notes

Section 11.1
Sea-Bird Inductive Model Modem (IMM)

Profiler firmware versions 4.16/4.26 and higher support the Sea-Bird IMM board (with an inductive coupler around the mooring wire. A surface controller with a Sea-Bird IMM board (the SIMM) is also required for this option. This section describes SIMM/UIMM functions.

Regardless of Inductive Modem, the Profiler Firmware uses the same Transmission Protocol. Refer to Appendix A in this User Manual, 'Inductive File Transmission Protocol' for details about inductive commands.

Figure 11.1-1: Sea-Bird IMM Modem

Advanced Interface Options – Inductive Communications

The options that display on the Advanced Interface menu are sensor-dependent. When Inductive Communications are active, several options display for Inductive Communications settings. Advanced Interface settings are critical controls for inductive communications performance. Carefully review the option definitions provided in this section or contact McLane (www.mclanelabs.com) for more information.

Menu commands with "IMM" refer specifically to the Seabird IMM (Inductive Modem Module) and are only available if the Seabird IMM is attached and enabled. Command descriptions with "IM" refer generically to all Profiler inductive modem hardware variations.

```
_____________________________________________________________
Configuration: MPP_IM_CT                CF2 V5.00 of Jan  3 2013
                 ____________________________________
                          Pattern Profiler
                        Advanced Interface
                 ____________________________________
                      Fri Jan  4 11:07:35 2013
  <0> FullSpeed                  0.250 dbar/sec
  <1> PR Threshold               0.045 dbar/sec
  <2> PR TimeThreshold             180 seconds
  <3> Sensor warmup                120 seconds
  <4> Sensor warmdown              120 seconds

  <5> FSI/CTD Bytes/Second          17 bytes/sec
  <6> SBE/41CP Bytes/Second          9 bytes/sec
  <7> SBE/52MP Bytes/Second         11 bytes/sec
  <8> FSI/ACM Bytes/Second          33 bytes/sec

  <D> Display verbose messages     YES
  <H> History reset
  <M> profiling Mode           PATTERN
  <N> adjust profile couNter        -1
  <P> caPture file enabled          NO

  <F> IMM use Force capture line   YES
  <K> IM ACK/NAK reply timer       100 seconds
  <L> IM Listening loop timer       40 seconds
  <S> IMM configure Surface modem   NO
  <W> IMM send Wakeup tone         YES
  <X> Save any changes    <^C> Discard changes
```

IMM and Inductive Options

Figure 11.1-2: Inductive Telemetry Settings on the Advanced Interface Menu

IMM Use Force Capture Line

Option <F> issues a forced capture line to the modem. If set to 'Yes', the modem will use the line regardless of whether noise is present. If this is 'No', the modem will not use the line until it detects the line is free.

```
Selection  [X] ? f

IMM use Force capture line (Yes/No) [N] Yes
```

Figure 11.1-3: IMM use Force Capture Line

IM ACK/NAK Reply Timer

Option <K> sets the number of seconds the profiler firmware waits for a reply/response from the modem after each data packet is sent. If the maximum number of seconds are exceeded, the firmware goes to the next reply/response attempt. After a total of three attempts, the firmware moves to the next data packet. The default is 100 seconds. The timer can be changed to between 30 and 300 seconds.

IM Listening Loop Timer

Option <L> sets the number of seconds the profiler listens for the inductive modem command from the surface controller. The profiler waits the number of specified seconds for three separate attempts. After a third attempt where no surface command is detected the profiler advances to the next profile. The default is 40 seconds. The timer can be changed to between 30 and 300 seconds.

IMM Configure Surface Modem

Option <S> displays for inductive communications only if Patterned Profiling is the profiling mode. If the entry is 'Yes' the Profiler firmware automatically configures the surface controller modem. If the value is 'No' the Profiler will not configure the surface controller modem. This option requires the password *surface*.

IMM Send Wakeup Tone

Option <W> controls whether or not the Profiler sends a wakeup signal to the surface controller. Some surface packages may not require a wakeup tone.

Using Bench Test Options

The main Bench Test and Inductive Modem Bench Test menus provide options to verify and change inductive settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors.

1. From the main Profiler Menu, type *5* at the prompt to display the main Bench Tests Menu.

```
Config: MPP_CT                          CF2 V5.00 of Jan 11 2013

                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-001

                            Main Menu

                      Tue Feb 19 07:16:21 2013
        <1> Set Time          <5> Bench Test
        <2> Diagnostics       <6> Deploy Profiler
        <3> Flash Card Ops    <7> Offload Deployment Data
        <4> Sleep             <8> Contacting McLane
       <C> Configure
```

Figure 11.1-4: Profiler Main Menu

```
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.13 of May 05 2014

                           Pattern Profiler
                             Bench Tests

                      Tue May  6 09:01:52 2014

 CTD utilities:
  <1> Seabird 41CP CTD communication
  <2> Seabird 41CP CTD pressure
  <3> Seabird 41CP CTD average pressure
  <4> Seabird 41CP CTD temperature record

 System evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <D> Detailed schedule
  <S> Recover schedule

 Sensor & Option tests:
  <I> Seabird Inductive Modem

 Exit:
Selection [] ? m
```

Figure 11.1-5: Profiler Bench Tests Menu

2. From the main Bench Tests menu, type ***I*** at the prompt to display the Seabird IMM Bench Test Menu (Figure 11.1-6).

3. Type *1* to connect directly with the IMM.

```
_____________________________________________________________________

Config: MPP_IM_CT                        CF2 V5.13 of May 15 2014
                  ____________________________________
                             Pattern Profiler
                Seabird Inductive Modem Bench Test Menu
                  ____________________________________

                       Tue May 27 11:30:32 2014

 <1> Direct communications (9600 Baud) <-------- Direct Communications
 <2> restore McLane parameters
 <3> restore Factory parameters
 <4> Report parameter settings
 <5> Single transaction
 <6> Telemetry session

 <M> return to previous Menu

Selection [] ? 1


05/27/14 11:31:19  SBE/IMM    Press ^C to terminate COMM session.
05/27/14 11:31:19   SYSTEM    Press ^B to change or confirm Baud rate.

05/27/14 11:31:20  SBE/IMM    9.6 kBaud communication channel opened.
05/27/14 11:31:20  SBE/IMM    Powered on.
```

Figure 11.1-6: IMM Bench Test Menu

.

The Profiler communicates with the Sea-Bird IMM at 9600 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 11.1-7). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
************************************************************

-Êûx-òÄ-fûx-`¸ò10x-Ê‡-ò-ûfxf10òx¯Ü10ò-òÄ-Ê¯¯


04/23/14 12:50:37 SBE/52MP ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 11.1-7: Baud Rate Communication Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu (Figure 11.1-6) displays the Baud Rate menu (Figure 11.1-8). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the Profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013
                 _____________________________________
                          Pattern Profiler
                         Select new Baud rate
                 _____________________________________
                       Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 11.1-8: Baud Rate Menu

Direct Sensor Connection

Once connected directly to the IMM, typing commands at the command prompt provides additional sensor information.

```
Selection [] ? 1

05/27/14 11:31:19  SBE/IMM    Press ^C to terminate COMM session.
05/27/14 11:31:19   SYSTEM    Press ^B to change or confirm Baud rate.

05/27/14 11:31:20  SBE/IMM    9.6 kBaud communication channel opened.
05/27/14 11:31:20  SBE/IMM    Powered on.

************************************************************
<PowerOn/>
IMM>getsd
<StatusData DeviceType='SBE90554 IMM' SerialNumber='70002367'>
<HostID>Host ID not set</HostID>
<EventSummary numEvents='7'/>
<Power><TransmitVoltage>9.1</TransmitVoltage></Power>
<SampleDataSummary NumSamples='0' TotalLen='0' FreeMem='16384'/>
<HostFileSummary Len='0' CRC='0xFFFFFFFF'/>
<LineStatus>BUSY</LineStatus>
</StatusData>
<Executed/>
IMM>getcd
<ConfigurationData DeviceType='SBE90554 IMM' SerialNumber='70002367'>
<Settings ConfigType='2'
DebugLevel='2'
BaudRate='9600'
HostID='Host ID not set'
GdataStr='GDATA'
HostPrompt='x'
ModemPrompt='IMM>'
DeviceID='1'
EnableHostFlagWakeup='0'
EnableHostFlagConfirm='0'
EnableHostFlagTerm='0'
EnableSerialIMMWakeup='1'
EnableHostPromptConfirm='1'
EnableHostServeOnPwrup='0'
EnableAutoIMFlag='1'
EnablePrompt='1'
EnableHostWakeupCR='1'
EnableHostWakeupBreak='0'
EnableEcho='0'
EnableSignalDetector='1'
EnableToneDetect='0'
EnableFullPwrTX='0'
EnableBackSpace='1'
EnableGDataToSample='0'
EnableStripHostEcho='0'
EnableBinaryData='1'
```

Figure 11.1-9: IMM Direct Communications (screen 1 of 2)

```
SerialType='1'
TermToHost='254'
TermFromHost='255'
SerialBreakLen='5'
MaxNumSamples='40'
GroupNumber='0'
THOST0='0'
THOST1='5'
THOST2='3000'
THOST3='12000'
THOST4='100'
THOST5='5'
TMODEM2='3000'
TMODEM3='18000'
TMODEM4='100'
/>
</ConfigurationData>
<Executed/>
IMM>gethd
<HardwareData DeviceType='SBE90554 IMM' SerialNumber='70002367'>
<Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>
<HardwareVersion>41420H</HardwareVersion>
<HardwareVersion>PCB Type 3, 10345B</HardwareVersion>
<MfgDate>2014-03-05</MfgDate>
<FirmwareVersion>1.14 Jan 13 2012 16:32:44</FirmwareVersion>
<FirmwareLoader>MSP LOADER RS232 57.6K 2007-02-08</FirmwareLoader>
</HardwareData>
<Executed/>
IMM> [^C]
************************************************************

05/27/14 11:31:36  SBE/IMM    Powered off.
05/27/14 11:31:36  SBE/IMM    9.6 kBaud communication channel closed.
```

Figure 11.1-10: IMM Direct Communications (screen 2 of 2)

Restore McLane and Factory Settings

Option <2> and <3> from the Seabird Inductive Modem Bench Test menu restores the McLane or Sea-Bird factory settings. Figure 11.1-11 shows a reset of the McLane-defined parameters. Using option <2> requires typing the password *mcl*.

```
Selection [] ? 2  Password: ***

06/03/14 09:45:04  SBE/IMM    9.6 kBaud communication channel opened.

06/03/14 09:45:04  SBE/IMM    Powered on.
06/03/14 09:45:04  SBE/IMM    Sending command [\r\n].
06/03/14 09:45:19  SBE/IMM    Sending command [SETDEBUGLEVEL=2]. .


06/03/14 09:45:20  SBE/IMM    Sending command [SETTERMFROMHOST=255].
06/03/14 09:45:20  SBE/IMM    Sending command []. . .
06/03/14 09:45:20  SBE/IMM    Sending command []. . .
06/03/14 09:45:20  SBE/IMM    Sending command [SETModemPrompt=IMM>]. . .
06/03/14 09:45:21  SBE/IMM    Sending command [SETDebugLevel=2]. . .
06/03/14 09:45:22  SBE/IMM    Sending command [SETDeviceID=1]. . .
06/03/14 09:45:22  SBE/IMM    Sending command [SETEnableAutoIMFlag=1]. . .
06/03/14 09:45:23  SBE/IMM    Sending command [SETEnableBackSpace=1]. . .
06/03/14 09:45:23  SBE/IMM    Sending command [SETEnableBinaryData=1]. . .
06/03/14 09:45:24  SBE/IMM    Sending command [SETEnableEcho=0]. . .
06/03/14 09:45:25  SBE/IMM    Sending command [SETEnableFullPwrTX=0]. . .
06/03/14 09:45:25  SBE/IMM    Sending command [SETEnableGDataToSample=0].
. .
  .  .  .
06/03/14 09:45:43  SBE/IMM    Sending command [SETTMODEM4=100]. . .
06/03/14 09:45:44  SBE/IMM    Sending command [SETSerialType=1]. ..... .
06/03/14 09:45:44  SBE/IMM    Sending command [SETSerialType=1]. . .
06/03/14 09:45:46  SBE/IMM    Sending command [].
06/03/14 09:45:46  SBE/IMM    Sending command []. .
06/03/14 09:45:46  SBE/IMM    Sending command [SETBaudRate=9600]. ..... .
06/03/14 09:45:47  SBE/IMM    Sending command [SETBaudRate=9600]. . .
06/03/14 09:45:48  SBE/IMM    Sending command [].
06/03/14 09:45:49  SBE/IMM    Sending command [].
06/03/14 09:45:49  SBE/IMM    Was able to restore McLane parameters.
06/03/14 09:45:49  SBE/IMM    Powered off.
06/03/14 09:45:49  SBE/IMM    Power-down delay .........
06/03/14 09:45:51  SBE/IMM    9.6 kBaud communication channel closed.
```

Figure 11.1-11: Option <2> Restore McLane Settings

Option <3> 'Restore factory parameters' (not shown) restores the configuration parameters delivered with the SBE Inductive Modem. Option <3> requires the password factory.

The firmware requires the Sea-Bird parameters configured by McLane. Changing settings, or resetting to the factory settings prevents the IMM from working correctly with the Profiler.

Display Current Settings

Option <4> 'Report Parameter Settings' is active only for the RBR MLM inductive modem. See Section 11.2 in this User Manual for more information about the RBR Inductive Modem.

```
Config: MMP_IM_CT_CM                    CF2 V5.15 of Jun 17 2014

                  Standard Profiler
             Seabird Inductive Modem Bench Test Menu

                  Mon Jun 23 12:54:53 2014

 <1> Direct communications (9600 Baud)
 <2> restore McLane parameters
 <3> restore Factory parameters
 <4> Report parameter settings
 <5> Single transaction
 <6> Telemetry session

 <M> return to previous Menu

 Selection [] ? 4

06/23/14 12:54:56  SBE/IMM NOTICE! ReportParameterSettings() has not been
implemented.
```

Figure 11.1-12: Option <4> Report Parameter Settings

Single Transaction

Option <5> displays a single inductive file transmission.

```
Selection [] ? 5

06/03/14 09:45:57  SBE/IMM    9.6 kBaud communication channel opened.
06/03/14 09:45:57  SBE/IMM    Powered on.
06/03/14 09:45:57  SBE/IMM    Sending command [\r\n].
06/03/14 09:46:12  SBE/IMM    Sending command [SETDEBUGLEVEL=2]. .
06/03/14 09:46:13  SBE/IMM    Sending command [SETTERMFROMHOST=255]. .
06/03/14 09:46:13  SBE/IMM    Sending command []. .
06/03/14 09:46:13  SBE/IMM    Sending command []. .
06/03/14 09:46:13  SBE/IMM    Sending command [GETCD].
.............................. .
06/03/14 09:46:17  SBE/IMM    Sending command [FORCECAPTURELINE]. .
06/03/14 09:46:18  SBE/IMM    Sending command [SENDWAKEUPTONE]. ...
06/03/14 09:46:22  SBE/IMM    Sending command [#G0:@@@MMP/ML13198-07/001/01]. .
06/03/14 09:46:23  SBE/IMM    Sending command [RELEASELINE]. .
06/03/14 09:46:24  SBE/IMM    Sending command [PWROFF]. .
06/03/14 09:46:25  SBE/IMM    Listening attempt 1 of 3.
06/03/14 09:46:32  SBE/IMM    Received [REQNEW] command.
06/03/14 09:46:33   SYSTEM    Sending PROFILES.DAT.
06/03/14 09:46:33   SYSTEM    Sending 52 bytes of packet 0 (metadata) ...
06/03/14 09:46:33   SYSTEM    Waiting for ACK|NAK . . . Received ACK
06/03/14 09:46:35   SYSTEM    Sending 4 bytes of file data.
06/03/14 09:46:35   SYSTEM    Sending 12 bytes of packet 1 (hdr+data) ...
06/03/14 09:46:35   SYSTEM    Waiting for ACK|NAK . . . Received ACK
06/03/14 09:46:37   SYSTEM    Sending 8 bytes of packet 2 (crc) ...
06/03/14 09:46:38   SYSTEM    Uploaded 4 bytes in 3 seconds. ~1 CPS.
06/03/14 09:46:38  SBE/IMM    Processed [REQNEW] command.
06/03/14 09:46:43  SBE/IMM    Received [REQNEW] command.
06/03/14 09:46:44   SYSTEM    Sending ENDOFDAT.DAT.
06/03/14 09:46:45  SBE/IMM    Processed [REQNEW] command.
06/03/14 09:46:49  SBE/IMM    Received [REQEOD] command.
06/03/14 09:46:49   SYSTEM    Sending ENDOFDAT.DAT.
06/03/14 09:46:50  SBE/IMM    Processed [REQEOD] command.
06/03/14 09:46:51  SBE/IMM    Powered off.
06/03/14 09:46:51  SBE/IMM    Power-down delay .........
06/03/14 09:46:53  SBE/IMM    9.6 kBaud communication channel closed.
```

Figure 11.1-13: Option <5>Single Transaction

Telemetry Session

Option <6> provides a test telemetry session.

```
Selection [] ? 6

 Enter session interval in seconds [5] (0-86400) [0] ?
 Enter the first profile to send [0] (0-9999) [0] ? 0
 Enter the starting value of ProfileCounter [0] (0-9999) [0] ? 0

05/27/14 11:31:51   SYSTEM    Creating PROFILES.DAT ... done.
05/27/14 11:31:52   SYSTEM    Creating LASTSENT.DAT ... done.
05/27/14 11:31:52   SYSTEM    Renaming E???????.DAX .... done.
05/27/14 11:31:52   SYSTEM    Renaming S???????.DAX .... done.
05/27/14 11:31:52   SYSTEM    Updating PROFILES.DAT ... done.
05/27/14 11:31:53   SYSTEM    E0000000.DAT exists.
05/27/14 11:31:53   SYSTEM    Creating E0000001.DAT from E0000000.DAT.
05/27/14 11:31:53   SYSTEM    Copying E0000000.DAT to E0000001.DAT.

E0000000.DAT

       1 file(s) copied
05/27/14 11:31:53   SYSTEM    C0000000.DAT exists.
05/27/14 11:31:53   SYSTEM    Creating C0000001.DAT from C0000000.DAT.
05/27/14 11:31:53   SYSTEM    Copying C0000000.DAT to C0000001.DAT.

C0000000.DAT

       1 file(s) copied

05/27/14 11:31:54   SYSTEM    IM session 1 will begin at 05/27/14 11:31:52.Awake
05/27/14 11:31:54   SYSTEM    Waking and proceeding.
05/27/14 11:31:54   SYSTEM    Starting IM session 1.
05/27/14 11:31:55  SBE/IMM    9.6 kBaud communication channel opened.
05/27/14 11:31:55  SBE/IMM    Powered on.
05/27/14 11:31:55  SBE/IMM    Sending command [\r\n].
. . . <-- Display shortened for brevity

05/27/14 11:37:19  SBE/IMM    Sending command [SETDEBUGLEVEL=2]. ..
05/27/14 11:37:20  SBE/IMM    Sending command [SETTERMFROMHOST=255]. .
05/27/14 11:37:20  SBE/IMM    Sending command [].
05/27/14 11:37:20  SBE/IMM    Sending command [].
05/27/14 11:37:20  SBE/IMM    Sending command [GETCD].
.............................  [^C]
05/27/14 11:37:24   SYSTEM    Command attempt 2 of 3.
05/27/14 11:37:24  SBE/IMM    Powered off. [^C]
05/27/14 11:37:24  SBE/IMM    9.6 kBaud communication channel closed.
```

Figure 11.1-14: Option <6> Telemetry Session

Offloading Last Sent Data

Offload Logging Files is a screen display of files that the Profiler records during the deployment. Option <5> 'Last sent' displays the last Inductive file transmitted to the Profiler firmware.

```
_____________________________________________________________

Config: MPP_IM_CT_CM                    CF2 V5.10 of Nov  4 2013


                  _____________________________________
                            Pattern Profiler
                       Offload Logging Files Menu
                  _____________________________________
                       Tue Jan  7 09:47:09 2014

Select log to offload:
 <1> PROFILES.DAT
 <2> DEPLOY.DAT
 <3> IRQ_XCPT.LOG
 <4> Profile Termination Log
 <5> Last sent
 <6> Deployment Termination Condition

 <M> previous Menu

 Selection [] ? 5

01/07/14 09:47:10   SYSTEM Reading LASTSENT.DAT ... done.

Oldest profile transmitted is -1

Press any key to continue.
```

Figure 11.1-15: Option <5> Last Sent

Sea-Bird SIMM/UIMM Communication Session Overview

Below is an overview of a communication session between the SIMM, the UIMM, and the Profiler.

1. The sequence begins with the SIMM powered off.
2. At the completion of a profile, the Profiler powers on the UIMM.
3. The UIMM takes control of the inductive line
4. The UIMM sends a Wakeup tone to wake the SIMM
5. The Profiler sends an identification string to the SIMM via the UIMM.
6. The SIMM takes control of the inductive line.
7. The Profiler listens to the UIMM for commands transmitted by the SIMM.
8. If a command is received within the allowed time period:
    a. If the command is to terminate the session, go to step 9.
    b. If no command is received within the allowed time period, go to step 9.
    c. Otherwise, process the command and go to step 7.
9. The Profiler terminates the session and continues its programmed deployment.
10. The SIMM releases the inductive line.

Sea-Bird IMM Communication Session Command Sequence

The next section describes technical details of the telemetry session including sample command transmission sequences, and data formats. The file transmission protocol is listed in Appendix A 'Inductive File Transmission Protocol' in this User Manual.

The Wakeup/Identification/Listen pattern repeats three times. If no commands are received after the third attempt, the Profiler terminates the session and continues the programmed deployment.

- Step 1 – Wakeup–Profile completion Profiler powers on the UIMM. Sends Wakeup tone and identification through the UIM to the SIMM (see table shown next).
- Step 2 – Identification–IMM receives the Wakeup/Identification messages.
- Step 3 – Listen–Profiler begins the transmission session by listening for commands for three 40 second cycles. If no commands are received after the third attempt, the Profiler terminates the session and continues the programmed deployment.
- Step 4 – Begin Transmission Session – Profiler receives an inductive file transmission protocol command (see Appendix A in this User Manual).

Identification Messages: Wakeup/Identification	
SIMM Received messages	**Description**
WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED	Generated by Profiler's UIMM for ~5 seconds if 'send wakeup tone' is enabled.
@@@MMP/ML12345-67/001/01	ID generated by Profiler contains: @@@MMP/SerialNumber/MooringID/UIMM-DeviceID

.

Sea-Bird IMM Sample Transmission Session

During the three 40 second listening attempts, the SIMM can respond by capturing the inductive line (CAPTURELINE or FORCECAPTURELINE) and then sending commands to the UIMM. If addressed correctly, the UIMM passes the commands to the Profiler. For example, if the SIMM wants to request the latest un-transmitted file the following would occur.

Options on the Advanced Interface Menu (Figure 11.1-2) set the number of seconds the Profiler listens for the inductive modem command and for the ACK/NAK reply from the surface controller. The Listening Loop default is 40 seconds. The ACK/NAK Reply Timer default is 100 seconds.The timer can be changed to between 30 and 300 seconds.

1. The SIMM sends a #*dd*REQNEW command to the MMP (where *dd* is the UIMM's DeviceID.) The command REQNEW is passed to the Profiler by the UIMM.
2. The Profiler responds by sending the next file available from the files collected since the last successful transmission. The data is sent in packets and the transaction process requires the surface to acknowledge receipt of each packet. If no new file exists, an End-of-Data packet is sent. The Profiler waits for another command.
3. The SIMM responds to each packet with a REQACK or a REQNAK, depending on whether the packet was received correctly.
4. After the last packet has been sent and acknowledged, the Profiler sends a Cyclical Redundancy Check (CRC) packet that contains only a packet header (no data content). This packet does not expect an acknowledgement.
5. If the SIMM wants to request the next un-transmitted file, the process begins again at step 1.
6. When the SIMM is finished requesting files, a #nnREQEOD command transmits, causing the Profiler to immediately terminate the session and continue its programmed deployment. Alternatively, not issuing any further commands causes the Profiler to eventually time-out at the end of three listening loops and continue its programmed deployment.

Data Format for File Transmission

When a file is requested, the Profiler first sends a metadata packet for the file. The packet is structured as follows:

```
typedef struct
{
        char fileName[13];          // 12.3 filespec, plus a space
        char profileEndTime[20];    // “mm dd yyyy hh mm ss”, plus a space
        char mooringID[4];          // %03d, plus a space
        char byteCount[12];                 // %11ld, plus a space
        char term[2];                       // “>”
} metaDataStruct;
```

Figure 11.1-16: File Metadata Packet

Except for the term field, which is a NULL terminated string, the other fields in the structure are all terminated by a trailing white space.

An example of a metadata packet: E0000000.DAT 07 28 2011 08 50 48 001 88 >

The metadata packet for a particular file is followed by one or more data packets and a final CRC packet. Each of these packets is prefaced with a packet header structured as follows:

```
typedef struct
{
        char dataHdr[4];    // "DAT" or “CRC”, plus a space
        short byteCount;    // 2 bytes. Bytes in the whole packet;
                                    // these 8 bytes, plus the packet size
        short CRC;                  // A 16bit CCITT standard CRC.
} packetHeader;
```

Figure 11.1-17: Packet Header Structure

The dataHdr field is terminated by a white space.

For data packets:

dataHdr will contain “DAT ” <- note trailing space
bytecount will be less than or equal to 4096
CRC will be for this packet’s data

For CRC packets:

dataHdr will contain “CRC ” <- note trailing space
bytecount will be 0
CRC will be cumulative for all the file’s data packets

Auxilliary Files

The following files are present during a Profiler deployment, and can be requested with REQFIL. Their contents can provide information about the deployment's progress and status:

PROFILES.DAT	a 4 byte index of the current profile
LASTSENT.DAT	a 4 byte index of the last profile successfully sent via REQNEW
DEPLOY.DAT	a complete definition of the current Profiler configuration
SCHEDULE.TXT	(for Pattern Profilers only) a complete listing of the current profile schedule

Sea-Bird Inductive Modem Module Configuration

Following are the McLane recommended configuration settings for the SIMM:

```
S>gethd
<HardwareData
DeviceType='SBE90554 IMM' SerialNumber='70001230'>
<Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>
<HardwareVersion>41420H.1</HardwareVersion>
<HardwareVersion>PCB Type 3, 10345B</HardwareVersion>
<MfgDate>2011-04-01</MfgDate>
<FirmwareVersion>IMM Ver 1.12</FirmwareVersion>
<FirmwareDate>Jun 15 2009</FirmwareDate>
<FirmwareLoader>MSP LOADER RS232 57.6K 2007-02-08</FirmwareLoader>
</HardwareData>
<Executed/>

S>getsd
<StatusData DeviceType='SBE90554 IMM' SerialNumber='70001230'>
<HostID>Host ID not set</HostID>
<EventSummary numEvents='718'/>
<Power><TransmitVoltage>9.0</TransmitVoltage></Power>
<SampleDataSummary NumSamples='0' TotalLen='0' FreeMem='16384'/>
<HostFileSummary Len='0' CRC='0xFFFFFFFF'/>
<LineStatus>IDLE</LineStatus>
</StatusData>
<Executed/>

S>getcd
<ConfigurationData DeviceType='SBE90554 IMM' SerialNumber='70001230'>
<Settings ConfigType='2'
DebugLevel='2'
BaudRate='9600'
HostID='Host ID not set'
GdataStr='GDATA'
HostPrompt='x'
ModemPrompt='S>'
DeviceID='0'
EnableHostFlagWakeup='0'
EnableHostFlagConfirm='0'
EnableHostFlagTerm='0'
EnableSerialIMMWakeup='1'
```

EnableHostPromptConfirm='1'
EnableHostServeOnPwrup='0'
EnableAutoIMFlag='1'
EnablePrompt='1'
EnableHostWakeupCR='1'
EnableHostWakeupBreak='0'
EnableEcho='1'
EnableSignalDetector='1'
EnableToneDetect='1'
EnableFullPwrTX='0'
EnableBackSpace='1'
EnableGDataToSample='0'
EnableStripHostEcho='0'
EnableBinaryData='1'
SerialType='1'
TermToHost='254'
TermFromHost='254'
SerialBreakLen='5'
MaxNumSamples='40'
GroupNumber='0'
THOST0='0'
THOST1='5'
THOST2='3000'
THOST3='12000'
THOST4='500'
THOST5='5'
TMODEM2='3000'
TMODEM3='18000'
TMODEM4='100'
/>
</ConfigurationData>
<Executed/>

S>

UIMM Configuration Settings

Following are the McLane recommended configuration settings for the UIMM:

```
IMM>gethd
<HardwareData
DeviceType='SBE90554 IMM' SerialNumber='70001231'>
<Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>
<HardwareVersion>41420H.1</HardwareVersion>
<HardwareVersion>PCB Type 3, 10345B</HardwareVersion>
<MfgDate>2011-04-01</MfgDate>
<FirmwareVersion>IMM Ver 1.12</FirmwareVersion>
<FirmwareDate>Jun 15 2009</FirmwareDate>
<FirmwareLoader>MSP LOADER RS232 57.6K 2007-02-08</FirmwareLoader>
</HardwareData>
<Executed/>

IMM>getsd
<StatusData DeviceType='SBE90554 IMM' SerialNumber='70001231'>
<HostID>Host ID not set</HostID>
<EventSummary numEvents='827'/>
<Power><TransmitVoltage>9.2</TransmitVoltage></Power>
<SampleDataSummary NumSamples='0' TotalLen='0' FreeMem='16384'/>
<HostFileSummary Len='0' CRC='0xFFFFFFFF'/>
<LineStatus>IDLE</LineStatus>
</StatusData>
<Executed/>

IMM>getcd
<ConfigurationData DeviceType='SBE90554 IMM' SerialNumber='70001231'>
<Settings ConfigType='2'
DebugLevel='2'
BaudRate='9600'
HostID='Host ID not set'
GdataStr='GDATA'
HostPrompt='x'
ModemPrompt='IMM>'
DeviceID='1'
EnableHostFlagWakeup='0'
EnableHostFlagConfirm='0'
EnableHostFlagTerm='0'
EnableSerialIMMWakeup='1'
EnableHostPromptConfirm='1'
EnableHostServeOnPwrup='0'
EnableAutoIMFlag='1'
EnablePrompt='1'
EnableHostWakeupCR='1'
EnableHostWakeupBreak='0'
```

```
EnableEcho='0'
EnableSignalDetector='1'
EnableToneDetect='0'
EnableFullPwrTX='0'
EnableBackSpace='1'
EnableGDataToSample='0'
EnableStripHostEcho='0'
EnableBinaryData='1'
SerialType='1'
TermToHost='254'
TermFromHost='255'
SerialBreakLen='5'
MaxNumSamples='40'
GroupNumber='0'
THOST0='0'
THOST1='5'
THOST2='3000'
THOST3='12000'
THOST4='100'
THOST5='5'
TMODEM2='3000'
TMODEM3='18000'
TMODEM4='100'
/>
</ConfigurationData>
<Executed/>

IMM>
```

Notes

Section 11.2
RBR Mooring Line Modem (MLM)

Version 4.35/4.45 and higher of the Profiler firmware supports RBR Mooring Line Modem (MLM) communication between the Profiler and a surface controller with an RBR Sub-Surface Modem board (the SSM). The surface controller connects to the SSM. For this inductive communications option, the Profiler integrates with an RBR Head End Modem (HEM) with an inductive coupler around the mooring wire.

Regardless of Inductive Modem, the Profiler Firmware uses the same Transmission Protocol. Refer to Appendix A 'Inductive File Transmission Protocol' for details about inductive commands.

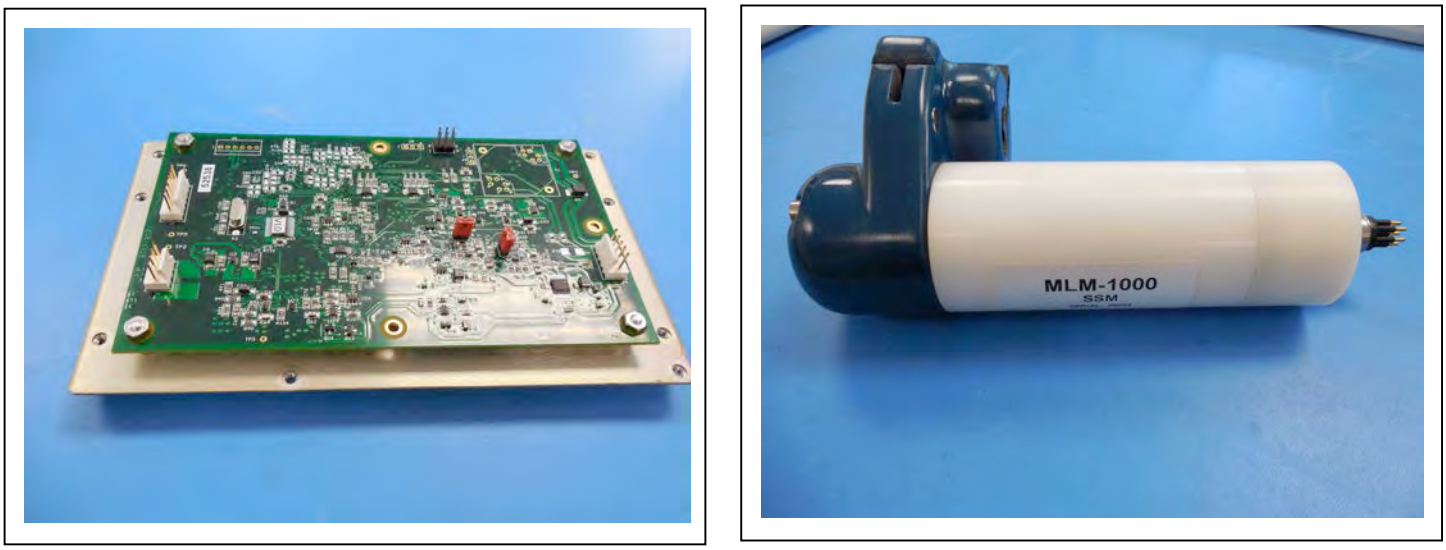


Figure 11.2-1: MLM Modem Electronics Board and Inductive Coil

Advanced Interface Options – Inductive Communications

The options that display on the Advanced Interface menu are sensor-dependent. When Inductive Communications are active, several options display for Inductive Communications settings. Advanced Interface settings are critical controls for inductive communications performance. Carefully review the option definitions provided in this section or contact McLane (www.mclanelabs.com) for more information.

Menu commands with "IMM" refer specifically to the Seabird IMM (Inductive Modem Module) and are only available if the Seabird IMM is attached and enabled. Command descriptions with "IM" refer generically to all Profiler inductive modem hardware variations.

```
Configuration: MPP_IM_CT                CF2 V5.00 of Jan  3 2013
                    Pattern Profiler
                   Advanced Interface
                 Fri Jan  4 11:07:35 2013
  <0> FullSpeed                   0.250 dbar/sec
  <1> PR Threshold                0.045 dbar/sec
  <2> PR TimeThreshold              180 seconds
  <3> Sensor warmup                 120 seconds
  <4> Sensor warmdown               120 seconds

  <5> FSI/CTD Bytes/Second           17 bytes/sec
  <6> SBE/41CP Bytes/Second           9 bytes/sec
  <7> SBE/52MP Bytes/Second          11 bytes/sec
  <8> FSI/ACM Bytes/Second           33 bytes/sec

  <D> Display verbose messages      YES
  <H> History reset
  <M> profiling Mode            PATTERN
  <N> adjust profile couNter         -1
  <P> caPture file enabled           NO

  <F> IMM use Force capture line    YES          <-- Inductive Options
  <K> IM ACK/NAK reply timer        100 seconds
  <L> IM Listening loop timer        40 seconds
  <S> IMM configure Surface modem    NO
  <W> IMM send Wakeup tone          YES
  <X> Save any changes     <^C> Discard changes
```

Figure 11.2-2: Inductive Telemetry Settings on the Advanced Interface Menu

Using Bench Test Options

The main Bench Test and Inductive Modem Bench Tests menus provide options to verify and change inductive settings prior to deployment. The main Bench Tests Menu displays only options that are available to installed sensors.

1. From the main Profiler Menu, type *5* at the prompt to display the Bench Tests Menu.

```
Config: MPP_CT                          CF2 V5.00 of Jan 11 2013

                McLane Research Laboratories, USA
                         Pattern Profiler
                         S/N: ML12345-001

                          Main Menu

                     Tue Feb 19 07:16:21 2013
        <1> Set Time          <5> Bench Test
        <2> Diagnostics       <6> Deploy Profiler
        <3> Flash Card Ops    <7> Offload Deployment Data
        <4> Sleep             <8> Contacting McLane
       <C> Configure
```

Figure 11.2-3: Profiler Main Menu

```
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.13 of May 05 2014

                          Pattern Profiler
                            Bench Tests

                     Tue May  6 09:01:52 2014

 CTD utilities:
  <1> Seabird 41CP CTD communication
  <2> Seabird 41CP CTD pressure
  <3> Seabird 41CP CTD average pressure
  <4> Seabird 41CP CTD temperature record

 System evaluation:
  <7> Motor operation
  <8> Set Brake
  <9> Independent Watchdog
  <D> Detailed schedule
  <S> Recover schedule

 Sensor & Option tests:
  <I> Seabird Inductive Modem

 Exit:
Selection [] ? m
```

Figure 11.2-4: Profiler Bench Tests Menu

2. From the main Bench Tests menu, type ***I*** at the prompt to display the RBR MLM Bench Test Menu (Figure 11.2-5).

3. Type *1* to connect directly with the MLM.

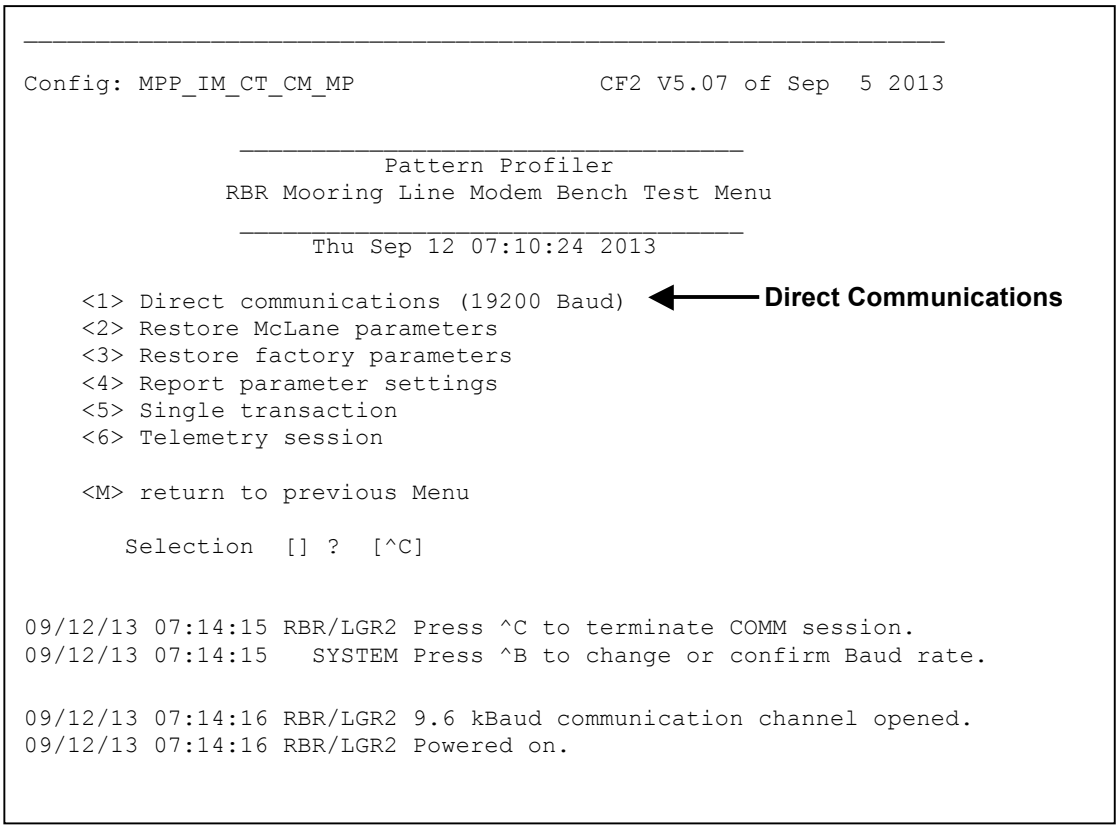


Figure 11.2-5: MLM Bench Test Menu

The Profiler communicates with the RBR MLM at 19200 baud. If this rate is changed (for example after sensor manufacturer servicing) communicating directly with the sensor displays unrelated characters or a communication error (Figure 11.2-6). Fix the error by changing the sensor to the baud rate the Profiler requires.

```
****************************************************************

-Êûx-òÄ-fûx-`¸ò31x-Ê‡-ò-ûfxf31òx¯Ü31ò-òÄ-Ê¯¯


04/23/14 12:50:37 SBE/52MP ERROR! Didn't receive prompt after [wake-up]
command finished.
```

Figure 11.2-6: Baud Rate Communication Error Examples

Typing [CTRL]-[B] from the sensor-specific Bench Tests menu (Figure 11.2-5) displays the Baud Rate menu (Figure 11.2-7). Use this menu option to temporarily connect at the sensor's current baud rate. Once connected to the sensor, change to the Profiler-required baud rate. Finally, exit the Baud Rate Menu to resume the communications session.

```
_____________________________________________________________________
Config: MPP_IM_CT_CM_FL_TU_OP_MP        CF2 V5.00 of Jan 10 2013
                 _____________________________________
                          Pattern Profiler
                         Select new Baud rate
                 _____________________________________
                       Fri Jan 11 13:48:30 2013
    <1> 1200
    <2> 2400
    <3> 4800
    <4> 9600
    <5> 19200
    <6> 38400
    <7> 57600

    <G> Go to COMM session
       Selection  [] ? g
```

Figure 11.2-7: Baud Rate Menu

Direct Sensor Connection

Once connected directly to the MLM, typing commands at the command prompt provides additional sensor information.

```
Selection  [] ? 1

 Expecting RBR/LGR2 at 9600 baud. Change [N] ?  [^C]

08/28/13 14:29:50 RBR/LGR2 Press ^C to terminate COMM session.
08/28/13 14:29:50   SYSTEM Press ^B to change or confirm Baud rate.

08/28/13 14:29:51 RBR/LGR2 9.6 kBaud communication channel opened.
08/28/13 14:29:51 RBR/LGR2 Powered on.

************************************************************

 [^C]

************************************************************
08/28/13 14:30:34 RBR/LGR2 Powered off.

08/28/13 14:30:34 RBR/LGR2 9.6 kBaud communication channel closed.
```

Figure 11.2-8: MLM Direct Communications

Restore McLane and Factory Settings

Option <2> and <3> (not shown) from the RBR MLM Bench Test menu restores the McLane or RBR factory settings. Using option <2> requires typing the password *mcl*.

Option <3> (not shown) 'Restore factory parameters' restores the configuration parameters delivered with the RBR Inductive Modem. Option <3> requires the password factory.

The firmware requires the RBR parameters configured by McLane. Changing settings, or resetting to the factory settings prevents the MLM from working correctly with the Profiler.

Display Current Settings

Option <4> 'Report Parameter Settings' displays the RBR MLM inductive modem settings.

```
Selection  [] ? 4

09/12/13 07:29:00  RBR/MLM 19.2 kBaud communication channel opened.
09/12/13 07:29:01  RBR/MLM Powered on.
09/12/13 07:29:02  RBR/MLM Sending command [].
09/12/13 07:29:02  RBR/MLM Sending command [A]. .
09/12/13 07:29:02  RBR/MLM Identified as V1.300, S#052538.
09/12/13 07:29:02  RBR/MLM Sending command [EE TPESCTO 10]. ..
09/12/13 07:29:03  RBR/MLM baud rate BAUD: 19200.
09/12/13 07:29:03  RBR/MLM sleep timeout (10ms) ZTO: 6000.
09/12/13 07:29:03  RBR/MLM transparent max chars before send TPMXC: 512.
09/12/13 07:29:04  RBR/MLM transparent send char enable TPSNDEN: 0.
09/12/13 07:29:04  RBR/MLM transparent char timeout (10ms) TPCTO: 25.
09/12/13 07:29:04  RBR/MLM transparent char timeout enable TPCTOEN: 1.
09/12/13 07:29:05  RBR/MLM transparent escape sequence TPESC:
x01,x02,x03,x04,x05,x06,x07,x08,x08,x07,x06,x05,x04,x03,x02,x01.
09/12/13 07:29:05  RBR/MLM transparent escape timeout (10ms) TPESCTO: 10.
09/12/13 07:29:06  RBR/MLM transparent escape timeout enable TPESCTOEN: 1.
09/12/13 07:29:06  RBR/MLM transparent request ack enable TPACK: 1.
09/12/13 07:29:06  RBR/MLM transparent display ack enable TPACKDSP: 1.
09/12/13 07:29:07  RBR/MLM transparent display nak enable TPNAKDSP: 1.
09/12/13 07:29:07  RBR/MLM modem open channel timeout (10ms) MDOCDUR:
6000.
09/12/13 07:29:07  RBR/MLM modem maximum retry count MDRTRY: 3.
09/12/13 07:29:08  RBR/MLM Powered off.
09/12/13 07:29:08  RBR/MLM Power-down delay .........
09/12/13 07:29:10  RBR/MLM 19.2 kBaud communication channel closed.
```

Figure 11.2-9: Option <4> Report Parameter Settings

Single Transaction

Option <5> (not shown) displays a single inductive file transmission.

Telemetry Session

Option <6> runs a test telemetry session.

```
Selection  [] ? 6

 Enter session interval in seconds [5] (0-86400) [0] ?
 Enter the first profile to send [0] (0-9999) [0] ?
 Enter the starting value of ProfileCounter [0] (0-9999) [0] ?

09/12/13 08:12:45   SYSTEM Creating PROFILES.DAT ... done.
09/12/13 08:12:45   SYSTEM Creating LASTSENT.DAT ... done.
09/12/13 08:12:46   SYSTEM Renaming E???????.DAX .... done.
09/12/13 08:12:46   SYSTEM Renaming M???????.DAX .... done.
09/12/13 08:12:46   SYSTEM Renaming S???????.DAX .... done.
09/12/13 08:12:46   SYSTEM Updating PROFILES.DAT ... done.
09/12/13 08:12:46   SYSTEM E0000000.DAT exists.
09/12/13 08:12:46   SYSTEM E0000001.DAT exists.
09/12/13 08:12:46   SYSTEM C0000000.DAT exists.
09/12/13 08:12:46   SYSTEM C0000001.DAT exists.
09/12/13 08:12:47   SYSTEM A0000000.DAT exists.
09/12/13 08:12:47   SYSTEM Creating A0000001.DAT from A0000000.DAT.
09/12/13 08:12:47   SYSTEM Copying A0000000.DAT to A0000001.DAT.

A0000000.DAT

1 file(s) copied

09/12/13 08:12:47   SYSTEM M0000000.DAT exists.
09/12/13 08:12:48   SYSTEM M0000001.DAT exists.
09/12/13 08:12:48   SYSTEM IM session 1 will begin at 09/12/13 08:12:46.
09/12/13 08:12:48   SYSTEM Waking and proceeding.
. . .  <-- Display shortened for brevity
09/12/13 08:23:39  RBR/MLM Listening attempt 1 of 3.
09/12/13 08:23:39  RBR/MLM Sending command [].
09/12/13 08:23:39  RBR/MLM Sending command [X 052571]. ..
09/12/13 08:23:43  RBR/MLM Sending command [.ee reset]. .
09/12/13 08:23:43  RBR/MLM Sending command [.ee tpsnden 0]. ..
09/12/13 08:23:44  RBR/MLM Sending command [.ee tpcto 25].  [^C]
09/12/13 08:23:44   SYSTEM Attempt 2 of 3.
09/12/13 08:23:44  RBR/MLM Sending command [].
09/12/13 08:23:45  RBR/MLM Sending command [SSM R].  [^C]
09/12/13 08:23:45   SYSTEM Attempt 2 of 3.
09/12/13 08:23:45  RBR/MLM ERROR! Didn't receive surface response - listening
attempt 1 of 3 failed.
09/12/13 08:23:45  RBR/MLM Listening attempt 2 of 3.
09/12/13 08:23:45  RBR/MLM ERROR! Didn't receive surface response - listening
attempt 2 of 3 failed.
09/12/13 08:23:45  RBR/MLM Listening attempt 3 of 3.
09/12/13 08:23:45  RBR/MLM ERROR! Didn't receive surface response - listening
attempt 3 of 3 failed.
09/12/13 08:23:45  RBR/MLM Powered off. [^C]
09/12/13 08:23:45  RBR/MLM 19.2 kBaud communication channel closed.
```

Figure 11.2-10: Option <6> Telemetry Session

Offloading Last Sent Data

Offload Logging Files is a screen display of files that the Profiler records during the deployment. Option <5> 'Last sent' displays the last Inductive file transmitted to the Profiler firmware.

```
_____________________________________________________________________

Config: MPP_IM_CT_CM                    CF2 V5.10 of Nov  4 2013

                _____________________________________
                          Pattern Profiler
                     Offload Logging Files Menu
                _____________________________________
                     Tue Jan  7 09:47:09 2014

Select log to offload:
 <1> PROFILES.DAT
 <2> DEPLOY.DAT
 <3> IRQ_XCPT.LOG
 <4> Profile Termination Log
 <5> Last sent
 <6> Deployment Termination Condition

 <M> previous Menu

 Selection [] ? 5

01/07/14 09:47:10   SYSTEM Reading LASTSENT.DAT ... done.

Oldest profile transmitted is -1

Press any key to continue.
```

Figure 11.2-11: Option <5> Last sent

RBR MLM Communication Session Overview

Below is an overview of a communication session between the Sub-Surface Modem (SSM), the Head End Modem (HEM), and the Profiler.

1. The sequence begins with the SSM sleeping.
2. At the completion of a profile, the Profiler powers on the HEM.
3. The HEM commands the paired SSM to enter transparent mode.
4. The Profiler sends an identification string to the SSM via the HEM.
5. The SSM can now send commands to the Profiler via the HEM.
6. The Profiler listens to the HEM for commands transmitted by the SSM for a specified amount of time. This amount is configurable in the Profiler's "Advanced Interface" from 30 to 300 seconds. The default is 40 seconds.
7. If a command is received within the allowed time period, process the command and go to step 6. If a command to terminate the session is received or no command is received within the allowed time period, go to step 8.
8. The Profiler terminates the session and continues its programmed deployment.
9. The SSM ends its session.

RBR MLM Communication Session Command Sequence

The next section describes technical details of the telemetry session including sample command transmission sequences, and data formats. The file transmission protocol is listed on Appendix A 'Inductive File Transmission Protocol' in this User Manual.

The Wakeup/Identification/Listen pattern repeats three times. If no commands are received after the third attempt, the Profiler terminates the session and continues the programmed deployment.

- Step 1 – Wakeup–Profile completion. Profiler powers on the MLM. Sends Wakeup tone/identification through the HEM to the SSM (see table shown next).
- Step 2 – Identification–SSM receives the Wakeup/Identification messages below.
- Step 3 – Listen–listens for commands for three 40 second cycles. Commands sent through the SSM/HEM system take the form COMMAND<RETURN>, where the entire command string is relayed to the Profiler. If no commands are received after the third attempt, the Profiler terminates the session and continues the programmed deployment.
- Step 4 – Begin Transmission Session– Profiler receives an inductive file transmission protocol command (see Appendix A in this User Manual).

Identification Messages: Wakeup/Identification	
SSM Received messages	**Description**
WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED WAKE-UP TONE DETECTED	Generated by Profiler's HEM for ~5 seconds if 'send wakeup tone' is enabled.
@@@MMP/ML12345-67/001/01	ID generated by Profiler contains: @@@MMP/SerialNumber/MooringID/HEM-DeviceID The identification string is sent, and the HEM remains on until Profile 0 (Dive Zero, the initial MMP dive) begins. The HEM then powers off and remains off until the next scheduled transmission session

To confirm the communications link, the HEM also powers on when the user commits to a deployment through the Profiler Deployment menu (Proceed with the deployment (Yes/No) [N]? Y).

The power on at Profile 0 is a verification feature only. During this period, the SSM communicates only with the HEM to confirm a proper link – for example, issuing commands to modify or retrieve certain HEM configuration settings. The Profiler firmware itself remains in Suspend Mode while waiting for Dive Zero, and does not listen, or respond, to the HEM until the deployment starts and a scheduled transmission session begins.

RBR MLM Sample Transmission Session

During the three 40 second listening attempts, the SSM can respond by sending various commands through the HEM to the Profiler. In the transparent mode established by the HEM when the session is initiated, everything the SSM transmits is passed verbatim to the Profiler, including any arguments for commands that require them, such as "REQFIL filename.ext".

The SSM can respond by capturing the inductive line (CAPTURELINE or FORCECAPTURELINE) and then sending various commands to the MLM. If addressed correctly, the MLM passes the commands to the Profiler. For example, if the SSM wants to request the latest un-transmitted file the following would occur.

Options on the Advanced Interface Menu set the number of seconds the Profiler listens for the inductive modem command and for the ACK/NAK reply from the surface controller. The Listening Loop default is 40 seconds. The ACK/NAK Reply Timer default is 100 seconds.The timer can be changed to between 30 and 300 seconds.

For example, if the SSM wants to request the latest un-transmitted file:

1. The SSM sends a REQNEW command to the Profiler. The command REQNEW is passed to the Profiler by the HEM.
2. The Profiler responds by sending the next file available from the files collected since the last successful transmission. The data is sent in packets and the transaction process requires the surface to acknowledge receipt of each packet. The length of time the Profiler will wait for a REQACK or REQNAK is configurable in the Profiler's "Advanced Interface" from 30 to 300 seconds. The default is 100 seconds. If the MMP has no new file to offer, it will reply with an End-of-Data packet and wait for another command.
3. The SSM responds to each packet with a REQACK or a REQNAK, depending on whether the packet was received correctly.
4. After the last packet has been sent and acknowledged, the Profiler sends a CRC packet that contains only a packet header (no data content). This packet does not expect an acknowledgement.

5. If the SSM wants to request the next un-transmitted file, the process begins again at step 1.

6. Otherwise, when the SSM is finished requesting files, it should send a REQEOD command. This causes the Profiler to immediately terminate the session and continue its programmed deployment. Alternatively, simply not issuing any further commands will cause the Profiler to eventually time-out at the end of three listening loops and continue its programmed deployment.

Example MLM Inductive Telemetry Session

ID generated by Profiler contains:

@@@MMP/ML12672-01/001/01	@@@MMP / SerialNumber / MooringID / IMM DeviceID
SSM command	HEM reply
REQNEW	E0000000.DAT 12 23 2010 08 00 42 001 1024 >
REQACK	DAT [binary file contents transmitted here]
REQACK	CRC [binary CRC transmitted here]
REQNEW	... etc as above ...

Data Format for File Transmission

When a file is requested, the Profiler first sends a metadata packet for the file. The packet is structured as follows:

```
typedef struct
{
char fileName[13];          // 12.3 filespec, plus a space
char profileEndTime[20];    // “mm dd yyyy hh mm ss”, plus a space
char mooringID[4];          // %03d, plus a space
char byteCount[12];                 // %11ld, plus a space
char term[2];                       // “>”
} metaDataStruct;
```

Figure 11.2-1: File Metadata Packet

Except for the term field, which is a NULL terminated string, the other fields in the structure are all terminated by a trailing white space.

An example of a metadata packet: “E0000000.DAT 07 28 2011 08 50 48 001 88 >” (not including the quotes) The metadata packet for a particular file is followed by one or more data packets and a final CRC packet. Each of these packets is prefaced with a packet header structured as follows:

```
typedef struct
{
char dataHdr[4];     // "DAT" or “CRC”, plus a space
short byteCount;     // 2 bytes. Bytes in the whole packet;
                                 // these 8 bytes, plus the packet size
short CRC;                       // A 16bit CCITT standard CRC.
} packetHeader;
```

Figure 11.2-2: Packet Header Structure

The dataHdr field is terminated by a white space.

For data packets:

dataHdr will contain “DAT ” <- note trailing space bytecount will be less than or equal to 4096 CRC will be for this packet’s data.

For CRC packets:

dataHdr will contain “CRC ” <- note trailing space bytecount will be 0 CRC will be cumulative for all the file’s data packets

Auxilliary Files

The following files are present during a Profiler deployment, and can be requested with REQFIL. Their contents can provide information about the deployment's progress and status:

PROFILES.DAT	a 4 byte index of the current profile
LASTSENT.DA	a 4 byte index of the last profile successfully sent via REQNEW
DEPLOY.DAT	a complete definition of the current Profiler configuration
SCHEDULE.T	(for Pattern Profilers only) a complete listing of the current profile schedule

Appendix A
Inductive File Transmission Protocol

Inductive Telemetry commands transmit deployment files and execute various other functions between the Profiler and a surface controller near real-time. These commands can be grouped into three types: File Commands, Control Commands, and Profiling Commands. Some sensors support File Decimation and/or Data File Reduction commands which can reduce the size of files.

File Decimation

The Profiler supports Data File Decimation for sensors with this function. Decimation determines how many data records the surface controller retrieves upon request. For example, a decimation value of 2 causes the Profiler firmware to retrieve one record then skip the next record. For a decimation value of 1, the Profiler firmware retrieves every record.

Data File Reduction

The Profiler supports data file reduction for sensors with this function, such as the Nortek Aquadopp II. The Aquadopp II allows the user to select which columns of data to include in a transmitted file. Profiler firmware v5.13 and higher supports both data reduction and file decimation for the Aquadopp II to select specific files and the columns within files for inductive transmissions.

Inductive Telemetry Commands

Regardless of inductive modem type, the Profiler commands have the same protocol. For Control commands, the request can display and/or change settings.

File Commands	
Command	**Profiler Action**
REQNEW	Send next available file in the list of files collected since the last successful transmission: 1. Profiler responds with a metadata packet and waits for acknowledgement. 2. SIMM acknowledges with REQACK. 3. Profiler responds with first data packet. 4. SIMM (Surface Inductive Modem Module) acknowledges with REQACK or REQNAK. a. If REQACK, Profiler possibly responds with next packet. b. If REQNAK, Profiler responds with the same packet again. 5. Any additional packets are sent and acknowledged similarly. 6. When data is exhausted, Profiler responds with a CRC packet. 7. Profiler does not expect, or wait for, acknowledgement. 8. Profiler returns to listening loop. During REQNEW: If 3 consecutive REQNAK replies are received, or if the Profiler hears nothing from the SIMM while waiting for acknowledgement, the Profiler abandons the requested file and returns to the listening loop. For 3 failed REQNEW attempts for a specific file: The file is renamed from DAT to DAX (for example, C0000XXX.DAT to C0000XXX.DAX) and taken out of the transmission queue. Further attempts to retrieve the file can be made at any time by specifically requesting it with REQFIL C0000123.DAX
REQDCN	*(Only for Decimation - Not supported by all sensors)* Send a decimated version of the next available file in the list of files collected since the last successful transmission using the same protocol as REQNEW.
REQFIL *filename.ext*	Send a specific file, if filename.ext exists on the flash card, using the same protocol as REQNEW. Failed attempts do not provoke file renaming.
REQDCF *filename.ext nnn*	*(Only for Decimation - Not supported by all sensors)* Send an nnn-th decimated version of the requested file, if *filename*.ext exists on the flash card, using the same protocol as REQNEW. Failed attempts, however, do not provoke file renaming. Not all sensor types support decimation.

File Commands	
Command	**Profiler Action**
REQDIR	Send a file containing a listing of all files on the flash card using the same protocol as REQNEW. The filename reported in the metadata packet comprises a current timestamp of the form YYMMDDHH.PDR (Year Month Day Hour). This can include ~ 1,100 files. The most recent REQDIR listing is saved in *filename*.DIR for possible offload via REQFIL [*filename*].dir
REQFDR *filename.ext*	Send a listing of the first file found on the flash card that matches filename.ext. The listing is in the format "FILENAME.EXT bbbbbbbbbb>", where bbbbbbbbbb is the file size displayed in ten digits. The Profiler does not expect, or wait for, acknowledgement.
REQACK	Acknowledge receipt of the current file packet and requests the next packet in the file.
REQNAK	Request retransmission of the current file packet.
REQTEK	Request "end transmission" for current file transfer and continue telemetry session.

If control commands are issued with no argument, the firmware returns the current parameter setting. Adding an argument to a control command changes the parameter. Examples of commands with and without arguments are provided below. The firmware terminates telemetry messages with the > character.

Control Commands	
Command	**Profiler Action**
REQCLK Example of parameter request: REQCLK Reply: ACKCLK *ClockTime*> Example with argument: Command: REQCLK 1433760561 Reply: ACKCLK 1433760561>	Request or set the Profiler's Real Time Clock in seconds. The argument for time is represented as seconds since 01/01/1970.
REQNUM Example of parameter request: REQNUM Reply: ACKNUM *ProfileNumber*> Example with argument: Command: REQNUM 0 Reply: ACKNUM 0>	Request or set the Profiler's current profile number. Minimum = 0, Maximum = 9999
REQACM Example of parameter request: REQACM Reply: ACKACM *SamplingRate*> Example with argument: Command: REQACM 02 Reply: ACKACM 02>	*(Only for Profilers with an enabled ACM that supports a variable sampling rate and firmware release version 5.0 or higher)* *For example, the FSI ACM + supports integer rates from 1 to 10, and the Norktek Aquadopp II supports integer rates of 1, 2, 4, 8, 10.* Allows a surface controller to request or reconfigure the sampling rate of an enabled ACM that supports a variable sampling rate in the middle of a deployment. After reconfiguring, following profiles in the deployment will be sampled at the new rate. Profiler accepts a new ACM sampling rate between 1 Hz and 10 Hz and responds with "ACMACM ss". Minimum = 1, Maximum = 10 (ACM model dependent) If the commanded rate is less than 1 or greater than 10, the Profiler continues to use the previous rate.

Control Commands	
Command	**Profiler Action**
REQDSP Example of parameter request: REQDSP Reply: ACKDSP *VerboseMode>* Example with argument: Command: REQDSP 1 Reply: ACKDSP 1>	Request or set the main UART verbose mode VerboseMode: 0=disable, 1=enable
REQWRM Example of parameter request: REQWRM Reply: ACKWRM *WarmUpSeconds WarmDownSeconds>* Example with argument: Command: REQWRM 30 30 Reply: ACKWRM 30 30>	Request or set the sensor warm-up and warm-down. Minimum =0, Maxiumum = 300. Default = 120
REQBAK Example of parameter request: REQBAK Reply: ACKBAK *Iterations Rate Time>* Example with argument: Command: REQBAK 2 45 60 Reply: ACKBAK 2 45 60>	Request or set the BackTrack Variables Iteration: Minimum = 1, Maximum = 5, Default = 3 Rate: Minimum =0, Maximum = 1000, Default = 45 (in dbar/second * 1000) Time: Minimum = 5, Maximum = 300, Default = 60 (in seconds)
REQRMP Example of parameter request: REQRMP Reply: ACKRMP *RampDuration>* Example with argument: Command: REQRMP 45 Reply: ACKRMP 45>	Request or set the ramp duration in seconds. Miminum = 2, Maximum = 90 Default = 30.
REQRST Example: Command: REQRST Reply: ACKRST> Command: REQRST Reply: ACKRST>	Reset the Profiler, if issued two times in a row with no other commands between.

Profiling Commands	
Command	**Profiler Action**
REQEOD	Terminate the telemetry session and power off the UIMM. The response to this command is a single metadata packet where the filename field contains "ENDOFDAT.DAT " The timestamp field reflects the Profiler's clock when the command was received. The bytecount field is 0. The Profiler does not expect, or wait for, acknowledgement of this packet.
REQUND Reply: ACKUND	*Only for Profilers with inductive charging option.* Clear the docking flag. Continue telemetry session.
REQPRF Example: REQPRF *DirectionStartTimeShallow DeepStopCheckTimeLimit ShallowErrDeepErr*	*Only for Adaptive Profilers with inductive charging option (not available in Standard or Pattern Profilers). See Adaptive Profiling documentation for details of this command.* Command profile setting.
REQSUS Example: REQSUS *SuspendUntil* Reply: ACKSUS *SuspendUntil*>	*Only for Adaptive (not available in Standard or Pattern Profilers). See Adaptive Profiling documentation for details of this command.* Suspend until some future clock time, then resume telemetry session.
REQCHG	*Only for Profilers with inductive charging option.* Go to charging dock
REQCNT	*Only for Adaptive Profilers with inductive charging option (not available in Standard or Pattern Profilers). See Adaptive Profiling documentation for details of this command.* If in charging mode, leave the dock. Continue with deployment.

Profiling Commands	
Command	**Profiler Action**
XMTSCH dd	*(Only for Pattern-Profilers. Not available in Standard or Adaptive profiling mode).* Prepare to receive a new schedule from a SIMM that has a DeviceID of dd. If the optional dd is not specified, the Profiler assumes the SIMM has a DeviceID of 00 (zero): 1. Profiler responds with XMTACK. 2. Profiler waits 30 seconds for the SIMM to release the inductive line. 3. Profiler configures the SIMM & UIMM for Xmodem use. 4. Profiler idles for 5 seconds to allow SIMM time to start an Xmodem1k-CRC send process. 5. Profiler starts an Xmodem1k-CRC receive process expecting to receive a new schedule file from a SIMM whose DeviceID is dd. 6. If successful, the new schedule is installed in the Profiler. 7. Profiler idles for 5 seconds to allow SIMM time to stop its Xmodem1k-CRC send process. 8. Profiler resets SIMM & UIMM for normal use. 9. Profiler goes back to listening loop.

Other Command Replies	
Command	**Profiler Action**
MMPERR <*invalidcommand*>	Response to an invalid command.
MMPRDY ClockTime .	*Only for MLM and DPC telemetry, not currently for IMM surface controller.* Ready for a command.

November 2015

Appendix B
Sea-Bird Underwater Inductive Modem (UIM)

Profiler firmware versions 3.10 and higher supports Sea-Bird UIM board (with an inductive coupler around the mooring wire). A surface controller with a Sea-Bird inductive modem link is required. For the inductive modem interface, the Profiler electronics stack contains a Sea-Bird UIM (Underwater Inductive Modem) board (SBE44 V1.8) with an inductive coupler around the mooring wire (a surface inductive modem and surface controller are also required for this option).

This section describes the communications sequence between the Profiler and the UIM. A detailed description of SIM/UIM protocols is also provided.

Regardless of Inductive Modem, the Profiler Firmware uses the same Transmission Protocol. Refer to Appendix A in this User Manual 'Inductive File Transmission Protocol' for details about inductive commands.

Figure B-1: Sea-Bird UIM Modem Electronics Board

Sea-Bird UIM Communication Session Overview

Below is a process overview of the communication session between the Surface Inductive Modem (SIM), the Underwater Inductive Modem (UIM) and the Profiler.

1. The sequence begins with the SIM powered off.
2. At the completion of a profile, the Profiler powers on the UIM.
3. The UIM sends a tone detect to wake the SIM.
4. The Profiler listens for commands transmitted by the SIM as the SIM performs a Cyclic Redundancy Check (CRC) to ensure that data transmitted is valid. If the CRC confirms valid data, the SIM sends the Profiler a command to 'send the next piece of data'. If the CRC detects invalid data, the SIM sends the Profiler a 'resend data' command.

The CRC calculated is a 16bit CCITT standard CRC.

5. The Profiler sends a null record after the last group of data to tell the SIM that the 'end of the data' has been reached.
6. The Profiler powers off the UIM and waits to perform the next profile.

When data transmission is complete, the SIM must be powered off before the next tone detect is sent or both the surface modem and the inductive modem will be in 'listening mode' simultaneously and cannot perform the communication sequence.

Sea-Bird UIM Communication Session Command Sequence

The next section describes technical details of the telemetry session including sample command transmission sequences, and data formats. The file transmission protocol is listed in Appendix A 'Inductive File Transmission Protocol' in this User Manual.

Commands sent through the SIM/UIM system always take one of two forms: #nnCOMMAND or bnnCOMMAND.

The nn is the UIM identification and is used by the UIM to identify whether a command is directed toward it. If the command is meant to be handled by the UIM, the COMMAND portion is relayed to the serial instrument (in this case the Profiler).

- The '#', indicates that the SIM and UIM are awaiting ASCII data terminated with a pre-defined termination character.
- The 'b', indicates that the SIM and UIM are awaiting binary data terminated by a transmission gap.

The timeouts are different for the two cases and are explained in the Sea-Bird documentation.

UIM Sample Transmission Session

This section provides a sample transmission session. To confirm the communications link, the UIM initially powers 'on' after 'V' (Verify and Proceed) is selected from the Profiler Deployment menu. The UIM remains on until Profile 0 (the initial Profiler dive) begins, then powers off and remains off until the next scheduled transmission session. This is a verification feature only. The Profiler firmware itself remains in Suspend Mode and does not listen or respond to the UIM until the scheduled transmission session.

1. The 'Tone detect' board attached to the SIM receives a tone and responds by setting its detect line (JP4 pin 2) low. The Profiler allows 40 seconds to receive a response from the surface. If no tone is received, the tone will be sent again a maximum of two more times (spaced 40 seconds apart). . The UIM should automatically generate a 4800 Hz tone for 2.5 seconds detectable by the Tone Detect board on the SIM. If the UIM tone is not sent (this occurs because the SBE44 was not specifically designed for the Profiler Inductive Modem interface), the Profiler initiates the wake-up tone to ensure that the SIM detect line is properly set.
2. The surface controller (SC) monitors the 'Tone detect' board tone detect line. Receipt of a tone indicates that the Profiler is ready to transmit data. The SC powers on the SIM and sends the necessary commands to upload the data.
3. The Profiler listens for 3 intervals of 40 seconds each for one of the recognized data upload commands.
4. When power is applied to the SIM board, the board sends a wake-up signal down the mooring wire (if the UIM is up and running the wake-up signal is ignored). If the UIM is not ready, this wake-up activates the UIM.

5. A transmit-receive-acknowledge sequence proceeds as follows until the Profiler has sent the entire file:

   - If the SC requires the newest data it relays a #nnREQNEW command to the Profiler (eg. #01REQNEW). The '#' defines the request to the UIM to transmit ASCII data with a termination character, configured as '>'; nn is the ID of the UIM attached to the Profiler; REQNEW is the command relayed by the UIM to the Profiler. Everything after the nn ID is relayed verbatim to the UIM, including the filename in the case of REQFIL.
   - The Profiler responds by sending the next file available from the files collected since the last successful transmission. If a limited number of files are stored and there is trouble transmitting, the oldest files may be deleted before they are transmitted. This risks the loss of the oldest data, but does not interfere with the algorithm which sends the next available data. The data is sent in packets (defined in the 'Data Format for File Transmission' section of this chapter) and the transaction process requires the surface to acknowledge receipt of each packet.

6. After the Profiler sends the entire data file, a CRC packet is sent that contains only a packet header (no data content).

If required, the SC can request transmission of a particular file by sending #nnREQFIL filename.ext (where filename.ext conforms to the 8.3 format). The Profiler will send the requested file (DOS) with the same protocol used to answer REQNEW.

7. If the SC requests a full directory listing of files on the flash card, (by sending a #nnREQDIR command) the Profiler responds by sending a listing of file names and file sizes as described in the 'File Transmission Protocol' section of this document.

8. If the Profiler has no data to offer it will reply with an EOD packet and wait for a command. The Profiler will terminate communications if a termination command is sent by the surface. The SC maintains primary control of the communication. Time-out thresholds are used as a backup. If no command is received the Profiler will time out after the third 40 second session.

9. If the SC is finished requesting data, and sends a #nnREQEOD command, the Profiler powers off the UIM and continues with the programmed deployment.

Control of Communication Session

Noise on the mooring cable could falsely trigger the Tone Detect board attached to the SIM (however, the UIM is powered on only during the communication transaction period at the end of a profile). The Profiler/UIM pair exclusively initiate a communication session. Once the session starts, the SC controls data transmission and the end of the communication session. The communication session will timeout in the absence of surface controller response.

Data Format for File Transmission

When a file or combination of files is requested, the Profiler first sends the metadata for the next file to be transmitted.

Mooring ID (a three position numeric identifier) is defined from the Deployment Menu and embedded in the metadata to identify files from multiple Profilers on the same mooring line.

The metadata structure is as follows:

```
typedef struct
{
 char   fileName[13];      // filename.ext - followed by white space
 char   profileEndTime[20]; // mm dd yyyy hh mm ss - followed "
 char   mooringID[4];      // ### - followed by "
 char   byteCount[12];      // ###### - followed by "
 char   term[2];
} metaDataStruct;
```

Figure B-2: File Metadata Packet

Each character field is terminated by a white space, rather than a null. The metadata for a single file is followed by a series of data packets and ends with an EOD packet. Each packet is prefaced with the packet header.

```
typedef struct
{
 char  dataHdr[4];   // "DAT", “CRC”
 short byteCount; // of whole pkt 8 + pktdatasize
 short CRC;      // CRC
} packetHeader;
```

Figure B-3: Packet Header Structure

The character field dataHdr is terminated by a white space. Immediately after the packet header, the packet content is transmitted. A “DAT” packet will contain up to 4KB of data; a

"CRC" packet will indicate that there are no more packets to be sent. There is no content for the CRC packet. The CRC value reported in this packet is the value for the entire file.

Sea-Bird Firmware and Settings for 4K Packets

SIM V2.8 (or later) and the UIM, SBE44 V1.9 (or later) support binary relay commands. The binary relay command works like the standard relay command except that all characters received by the SBE44 are relayed to the SIM and the relay termination character is ignored.

Settings for 4K Packets

The SIM and UIM settings in the transmission sequence scenario described in this Appendix are shown next. These settings were designed to effectively coordinate the communications relay and data packet transmission between the MMP, SIM and UIM. Guidelines for these settings are below.

- The UIM terminates Relay when the time since the last character the SBE44 receives exceeds the time specified by the RTERMMAX command (5500 msec default) or the time specified by the RTOTALMAX command (600 sec default).
- Relay is terminated by the SIM when the time since the last character received by the SIM is greater than the time specified by the BINARYGAP command (5000MSEC default) or the total time specified by the RELAYMAX command (600 SEC default) is exceeded.
- UIM command RTERMMAX must be greater than SIM command BINARYGAP.
- Setting the PONTONE command to 'Yes' should cause the UIM to send a wake up tone to the SIM upon power-up. If the wake-up tone is not sent, the MMP forces a tone detect that wakes up the SIM after 40 seconds.

SIM Settings

SBE 37 SURFACE MODEM V 2.8
wait time for dataNN response = 1000 msec
wait time for relay command response = 600 seconds
binary relay character timeout = 5000 msec
echo = yes
execute pwron command on powerup = no

RELAYMAX=600

BINARYGAP=5000

UIM Settings

SBE 44 UNDERWATER MODEM V 1.9
sensor baud rate = 9600
break character length = 1000 milliseconds
time out after 30 seconds without receiving a valid command
termination character is 62, char = >
Relay Command Settings:
relay termination characters = <CR><LF>
total time for response = 600 seconds
wait 0 milliseconds before sending the command
halt relay after a gap of 5500 milliseconds between characters
GDATA Command Settings:
total time for response = 30 seconds
wait 0 milliseconds before sending the command
halt acquisition after a gap of 1000 milliseconds between characters
GDATA command string = NO STRING
include gdata reply delay in datann reply
do not enable control line on power up
disable control line logic for relayed commands
disable control line logic for GDATA command
do not switch power to sensor on power up
disable switch power logic for relayed commands
disable switch power logic for GDATA command
send tone on powerup

!01TIMEOUT=30

!01RTOTALMAX=600

!01RTERMMAX=5500

!01GTERMMAX=1000

!01PONTONE=Y