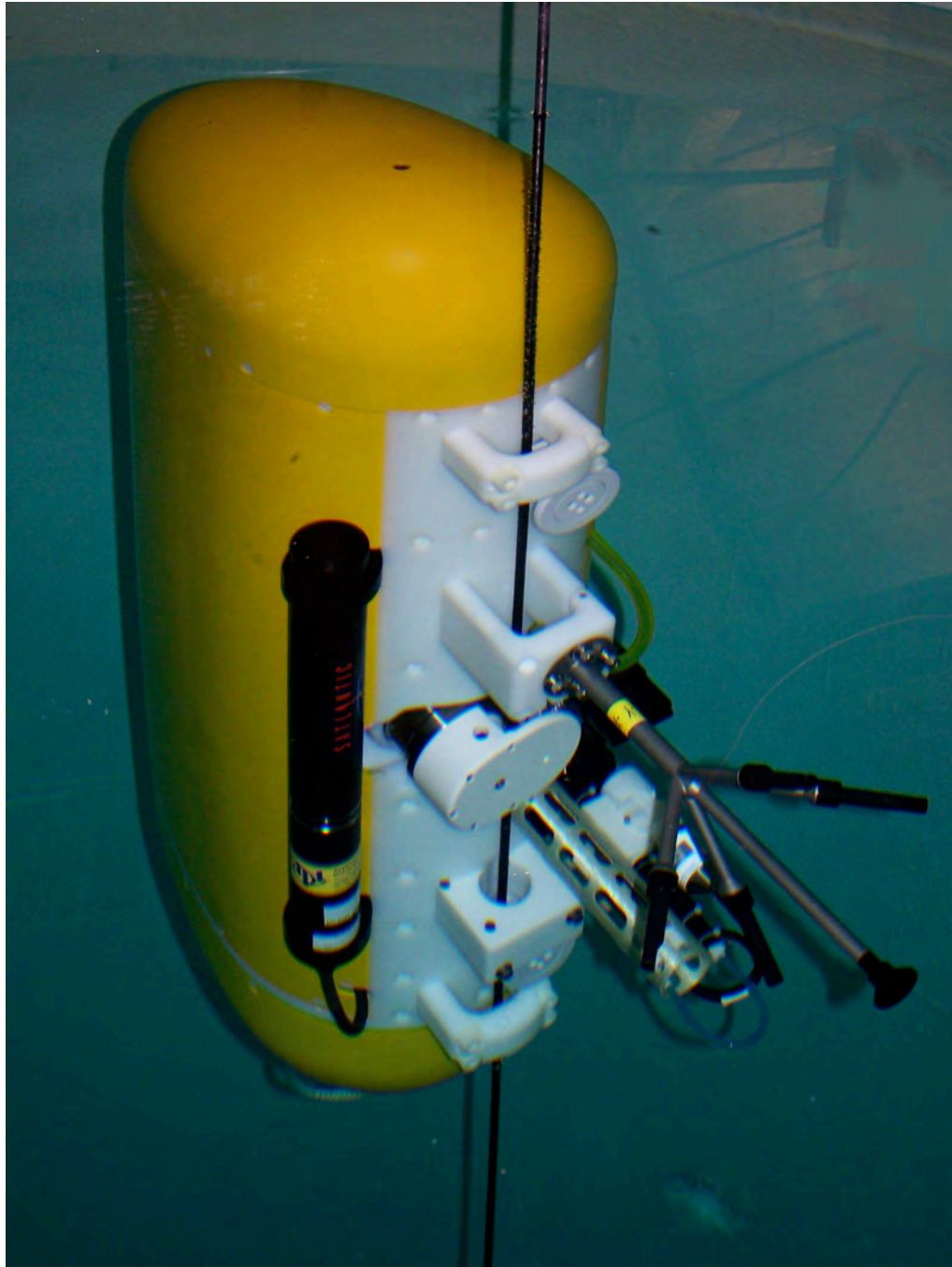


Profilers Samplers Flotation



mclanelabs.com

McLane Moored Profiler User Manual



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Tel: +1 (508) 495-4000

mclane@mclanelabs.com

Skype: [mclane_research](https://www.skype.com/en/contacts/mclane_research)

www.mclanelabs.com

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Chapter 1

MMP Introduction

This user manual describes the operation and maintenance of the McLane Moored Profiler (MMP), an autonomous, wire crawling instrument that collects time-series, in situ data at user defined depths. Read this manual and keep a copy as a reference if you plan on using an MMP. McLane user manuals are updated frequently and the current version can always be downloaded from our website.

User Key

This user manual contains the following symbols that call attention to information:



Note

This symbol indicates information and tips that are helpful for operating the instrument.



Important

This symbol indicates information that could affect key product operations.



Caution

This symbol indicates information that must be followed to prevent instrument damage or user injury.

Customer Resources

McLane Research Laboratories is on the Web at <http://www.mclanelabs.com> or via email at mclane@mclanelabs.com. The [MMP pages](#) on the McLane website contain links to documentation including Technical Bulletins, and scientific papers that describe the development and use of the MMP.

Technical Support

When contacting McLane for technical support, please provide the following:

- Firmware version and MMP serial number. Serial number is printed on a label attached to the controller housing and serial number also displays on the Main Menu screen.
- A description of the problem.
- Any relevant capture files (deployment setup, offload data, and so on – capturing all your communications is critical for successful technical support).

MMP Training

McLane Research Laboratories also offers a 1-2 day MMP training course at our facility free of charge with the purchase of a new Profiler. Participants conduct trial deployments and work directly with members of the McLane engineering staff. Conducting trial deployments is a beneficial way to learn system operations before actual field deployments. For more [product training](#) information refer to mclanelabs.com.

Chapter 2

System Description

System Overview

Topics Covered:

- Sensors
- Profiling Modes
- System Components (frame, front plate, skin, buoyancy, cable retainers, motor housing, drive wheel, controller housing, end caps, o-rings, drive motor, mooring wire, toolkit).
- Electronics
- Battery

The McLane Moored Profiler (MMP) is a subsurface, wire crawling instrument that is powered from a 240Ah lithium battery. An extended battery option can provide a total 360Ah of power if needed. The MMP travels along a fixed mooring cable at a nominal speed of 25cm/sec (a 33cm/sec and 10cm/sec drive system are optional). Sampling schedules and profile patterns can include the full depth of the water column down to 6,000 meters. Year long deployments are possible depending on profile frequency, depth, and power requirements of installed sensors.

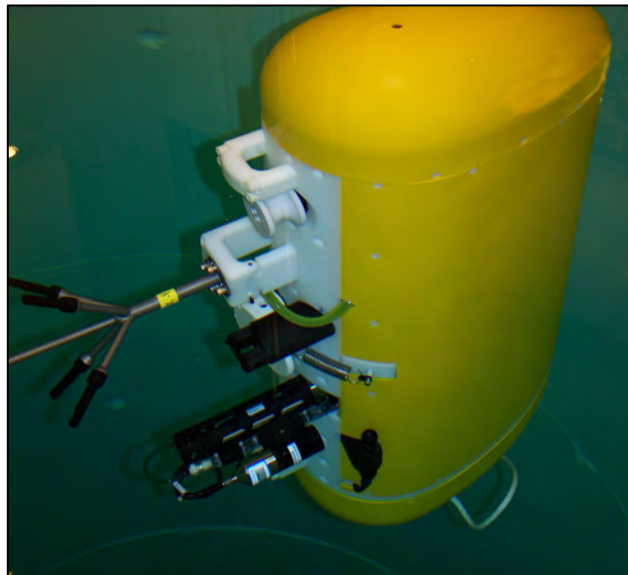


Figure 2-1: MMP

Sensors are user-selected based on the scientific needs of the project. Other software used with the MMP includes:

- Deployment Planner, a Windows program that provides a way to program a deployment by defining reusable profiles and patterns.
- Unpacker, a Windows program that unpacks binary data files into readable format.
- Inductive communications, an optional feature that for near real-time data transfer (this option requires a customer-supplied surface package).

Sub-Surface Deployment

For best results, deploy the MMP at least 30-50m below the surface. Deployments at more shallow depths are possible but will affect Profiler performance.



A minimum 500lbs (227kg) of mooring tension must also remain on the cable at all times for Profiler movement. Neutral buoyancy (achieved through careful ballasting) is also required for deployment.

See Chapter 7 in this User Manual “Deployment and Recovery”, for more information about the Profiler mooring.

Sensors

Sensors are selected by the customer based on the data required. Minimally, the Profiler must have a Conductivity, Temperature, Depth sensor (CTD). Installed sensors are either self-logging or non-self-logging (these sensor types are explained below).

Deploying the MMP requires an understanding of the installed sensors. Sensors are explained in detail in a separate User Manual, the “Profiler Integrated Sensors and Communications Interface User Manual”. This User Manual was included on the Profiler’s USB drive. A copy can also be downloaded at our website www.mclanelabs.com.

Logging Mode	Self-Logging	Non-Self-Logging
Where	Data is recorded to the sensor’s own internal memory.	Data is recorded to the Profiler controller.
When	Data is recorded during the sensor warm-up and warm-down periods, and during the profile.	Data is recorded only during the profile (not during sensor warm-up or warm-down periods).
Rate	Data is recorded at the native rate of the sensor.	Data is recorded only at the Stop Check Interval rate.
Stored Where	Data is transferred to the Profiler at the end of each profile and stored by the Profiler as a separate file (Cxxxxxxx.DAT, Axxxxxxx.DAT, and so on).	Data is stored by the Profiler in the Engineering file (Exxxxxxx.DAT).

The Profiler sampling rate is affected by how many non-self-logging sensors are installed. Refer to the “Profiler Integrated Sensors and Communications Interface User Manual” for specific sensor sample rates. If the sensor’s sample rate is adjustable, this rate is set in the Configuration Menu.

CTD and Pressure Stops

The Profiler polls the CTD at the Stop Check Interval for depth to confirm that the programmed pressure stops are reached. The minimum value for the Stop Check Interval is 2 seconds, but this time can be longer depending on the sensor suite installed. The number and type of sensors the system must poll can increase the duration as much as 8 seconds. While a given sensor may have an internal rate of 1Hz, the Profiler will sample at a slower rate.

MMP Line Drawing

The MMP Line Drawing shown next illustrates the mechanical design and construction of a standard MMP with an example CTD and an example ACM installed. Since installed options can differ, this example reflects only one of the many possible sensor options and configurations. Refer to the Profiler Integrated Sensors and Communications Interface User Manual for more specific details about the mechanical integration of the sensors installed on your Profiler.

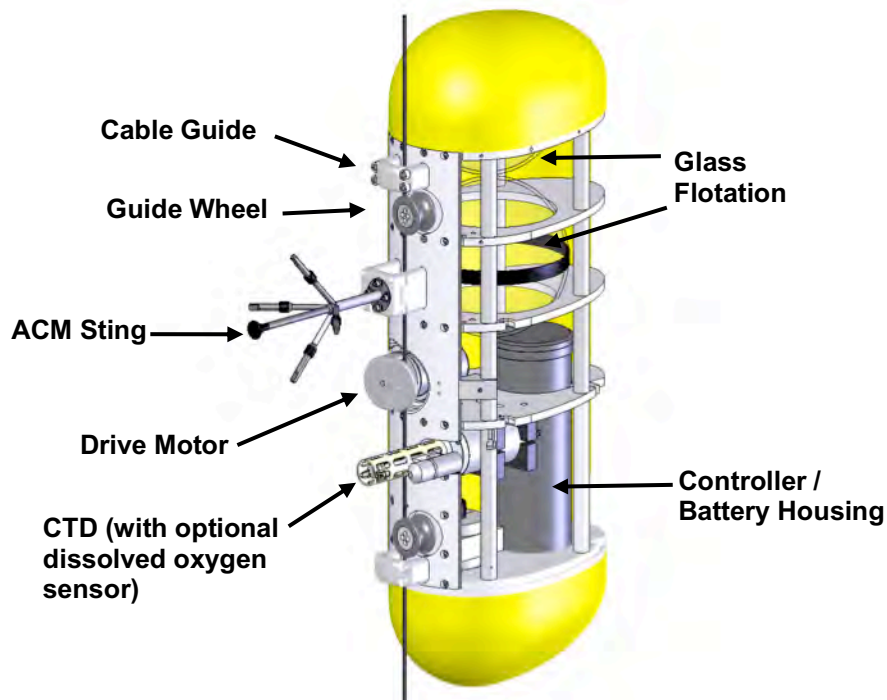


Figure 2-2: MMP Line Drawing

Profiling Modes

The MMP has Standard, Patterned and Adaptive profiling modes. The Profiler is shipped with the mode already set in the Advanced Interface menu. A description of profiling modes and deployment suitability is provided below.

Profiling Mode	Deployment Requirements	Other Considerations
Standard	For a deployment that only requires simple travel up and down the mooring wire, defined by upper and lower pressure limits, profile schedules, and operating parameters.	<p>All profiles have the same shallow and deep end points, and time between profiles is fixed throughout the deployment.</p> <p>Single profiles, paired profiles (up followed immediately by down) and burst profiles can be programmed.</p> <p>Programming is done in the Profiler firmware.</p>
Patterned	For a deployment that requires a more flexible profiling plan. Shallow and deep pressure stops can be different per profile, intervals can be user defined, and profiling parameters can differ.	<p>Each individual profile can have different shallow and deep pressure stops. Intervals can be programmed to increase or decrease profiling frequency over the time of the deployment.</p> <p>When scientifically important conditions are expected (eg. seasonally), profiling can occur more frequently. Profiling can be programmed for less frequent data casts during less active conditions. Stationary profiles are also possible.</p> <p>Programming is done in the Deployment Planner Windows program and transferred to the Profiler firmware.</p>
Adaptive	The deployment does not require pre-programmed deployment parameters. Profiler movement is triggered instead by commands received via inductive modem through a customer-supplied external controller with real-time communications.	<p>The Profiler waits for commands from the external controller, reports the results, and waits for the next commands.</p> <p>There are no pre-programmed deployment parameters in this profiling mode.</p> <p>Adaptive profiling mode requires significant customer-supplied infrastructure on the mooring, extensive testing, and further integration. Contact mclane@mclanelabs.com to discuss adaptive profiling deployments.</p>

System Components

Frame

The standard MMP frame (Figure 2-3) is made from white, ultra high molecular weight polyethylene (UHMW) and high density polyethylene (HDPE), designed for strength without a buoyancy penalty. The faired skin and end caps are shaped for low drag performance.



The MMP skin is abrasion-resistant. However, use care during handling. The skin and frame can be damaged by dragging or drop speeds over two knots.

Front Plate

The front plate is the primary structural frame member. Oval ribs mounted on the inner side of the plate extend to the back of the Profiler. The structure is stiffened with four columns of frame spacer posts. Two braces maintain the right angle between the front plate and ribs.

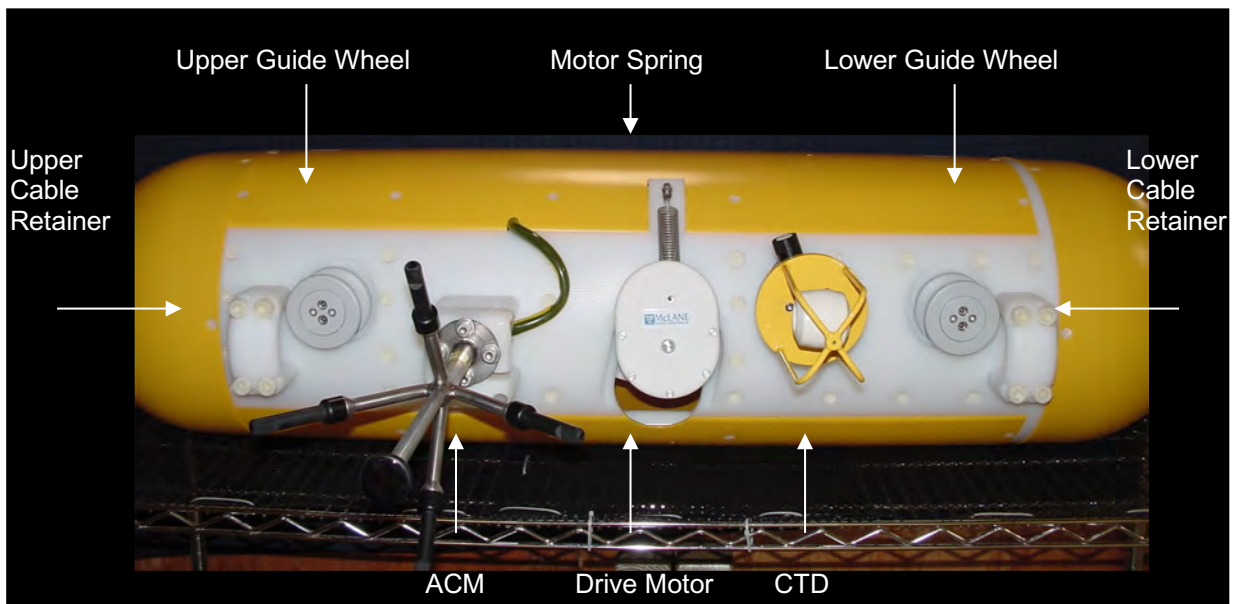


Figure 2-3 MMP Front Plate (Sample View)

Skin

The faired skin and end caps are high-visibility yellow, medium density polyethylene. The shape of the MMP and attachment position on the mooring cable make the Profiler self-aligning.

The leading edge of the skin is recessed in a groove machined in the edge of the front plate. Installing or removing the drive motor and sensors can require removing the skin or mounting brackets from the port side of the MMP. Sensor-specific mounting components are explained in the Profiler Integrated Sensors and Communications Interface User Manual.

To access the interior of the MMP, remove the skin from the frame by loosening the screws and lifting the skin off the ribs.

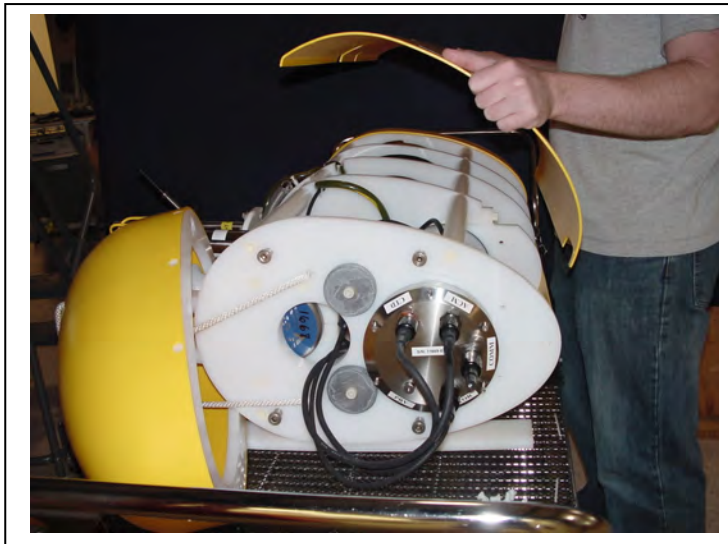


Figure 2-4: Removing the Skin from the MMP Port Side

Profiler Buoyancy

The standard MMP has two glass spheres mounted in the frame which provide 20kg (44lbs) of buoyancy to balance the weight of the pressure housings and their contents. The MMP must be ballasted for neutral buoyancy for successful movement. See the, “Deployment Programming and Preparation” chapter in this User Manual for more information about buoyancy and ballasting.



After each deployment, inspect the glass spheres for signs of fatigue caused by repeated pressure cycling. Contact McLane (www.mclanelabs.com) for glass inspection guidelines.

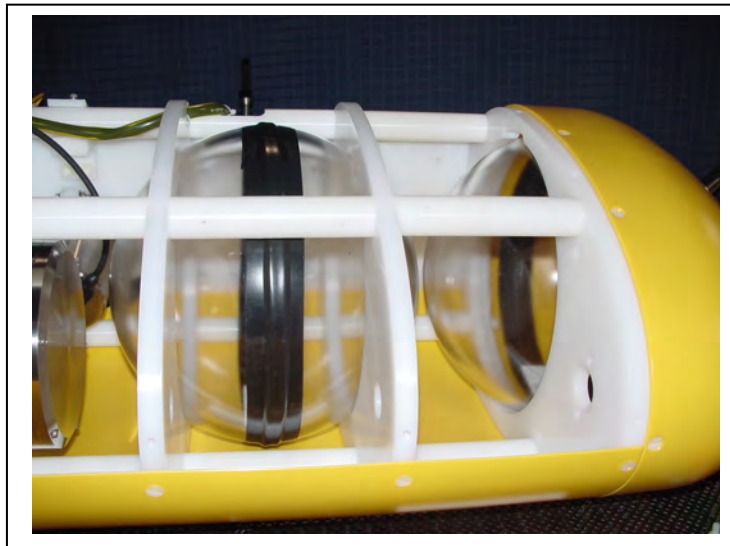


Figure 2-5: Glass Spheres

Cable Retainers

Cable retainers secure the MMP to the mooring cable. Each retainer is secured to the front plate with four socket head nylon cap screws. The retainers support the MMP weight during recovery when it is suspended in air and the free flooding skin is filled with water. The retainers are also designed to withstand the snap loads that can occur during launch and recovery.



Figure 2-6: Cable Retainer and Guide Wheel

Motor Housing and Drive Wheel

The motor is driven in clockwise and counterclockwise rotation for up and down profiling directions. During stationary profiles or between profiles, a dynamic brake is applied which supports several pounds of positive or negative buoyancy. In free wheel mode, the motor is not driven by the battery and offers no resistance (other than friction) to external torque. The motor is automatically in free wheel mode during launch to reduce slip related wear of the drive wheel.

The motor is connected to and powered from the controller housing. The direct current (DC) brushed motor and gearbox operate in air within the titanium housing. The motor is magnetically coupled to the drive wheel. The magnetic coupling also serves as a clutch to prevent motor damage should the Profiler encounter an obstruction.

The components of the drive wheel are machined from titanium and PBT (polybutylene terephthalate, a polyester). The drive shaft is supported by two all-ceramic bearings. The portion of the drive surface in contact with the mooring cable is coated with urethane. The urethane has favorable wear properties and increases the level of torque that can be applied by the motor without slip. Operators should inspect the urethane for visible wear after each deployment and have the drive wheel resurfaced or replaced by McLane when necessary. The drive wheel wet side assembly with magnet is shown in Figure 2-7.

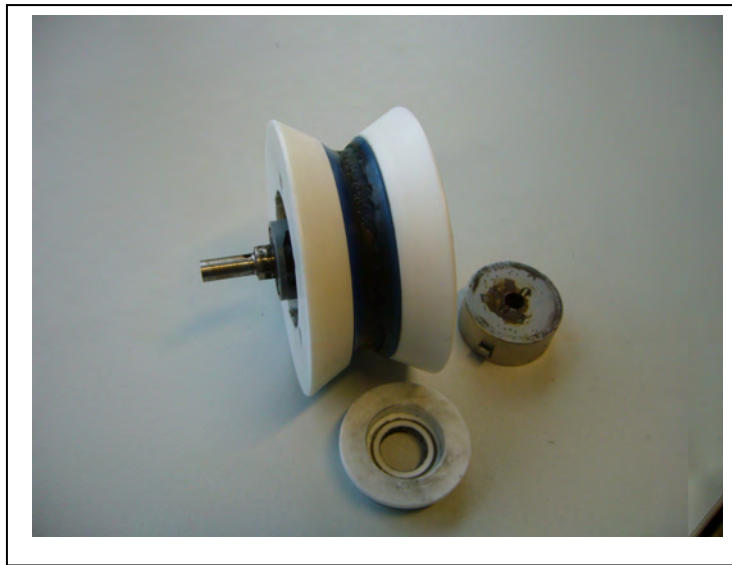


Figure 2-7: Drive Wheel with Magnet ('Wet Side')

Controller Housing

The MMP controller housing is a titanium housing rated to a depth of 6,000m. The housing holds the electronics.

End Caps and O-Rings

Each end cap includes two 70 durometer Buna-N round section o-rings (2-256 and 2-253) and one 90 durometer backup ring (8-253). O-rings and surfaces should be regularly cleaned with isopropyl alcohol. O-rings should be lubricated with provided Parker O-Lube and replaced when necessary. The toolkit has spare o-rings. More o-rings can be purchased from McLane.



O-ring maintenance and correct placement is critical to keep the controller housing sealed from water intrusion. Incorrect o-ring placement results in cracks or splits that could affect the o-ring seal and cause water damage to the controller. Water damage from incorrectly placed or maintained o-rings could void the MMP warranty.

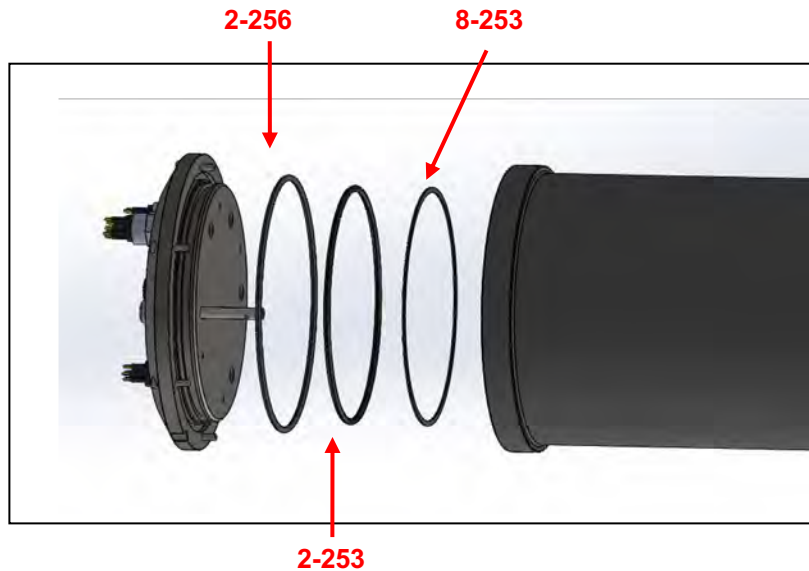


Figure 2-8: Controller Housing Top End Cap with O-Ring Seals

The end cap bulkhead connectors are labeled for the COM port, Motor, Pressure Relief Value (PRV) and each installed sensor. Two clamps (the rear portions of the two lowermost ribs of the frame) secure the controller housing to the frame, held in place by two socket head nylon cap screws that are accessible only when the skins are removed. The housing has an orientation notch to ensure proper alignment of the controller housing.

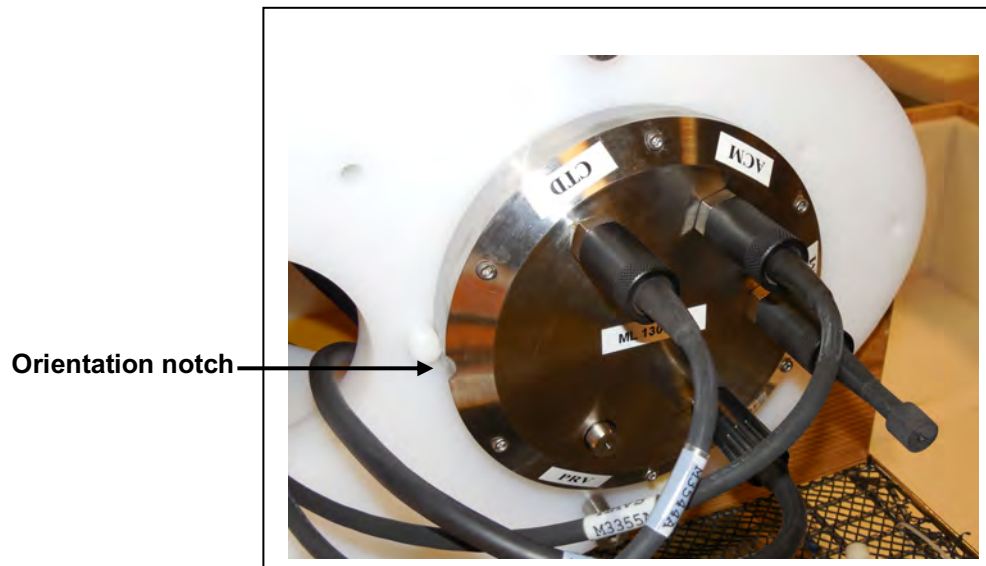


Figure 2-9: MMP Controller Housing End Cap w/Orientation Notch

Drive Motor

The drive motor assembly is suspended from the frame in a bracket. The pivoting bracket has two rotational degrees of freedom and allows the drive wheel to pass over small obstructions on the mooring cable. The drive wheel is pulled against the cable by a spring, providing traction on the mooring cable. The actual load limit depends on local environmental conditions and can vary.



Maintaining 500lbs (227kg) of tension on the mooring cable at all times is necessary for proper frictional coupling between the drive wheel and mooring cable, which produces the Profiler traction.

Mooring Wire

Guide wheels for the cable are located next to each of the cable retainers. NILSPIN 3x19 polyurethane jacketed oceanographic wire is recommended for MMP deployments. The user must determine the appropriate diameter for the mooring design. Larger diameter cables can be accommodated with a custom drive wheel design. Contact mclane@mclanelabs.com for more information.

Profiler Toolkit

Each MMP is shipped with a toolkit that contains the necessary tools, materials and devices to use the instrument. The toolkit and contents are referred to throughout this User Manual, and should remain with the instrument at all times.



Figure 2-10: Toolkit



The Profiler toolkit in Figure 2-10 is shown only as an example. Do not use the photo to compare with your actual toolkit contents.

Electronics

The Profiler firmware runs on the Persistor CF2 microcontroller. Older Profiler systems use the TattleTale 8 (TT8) microcontroller, which is discontinued. Most of this User Manual can apply to both current and older McLane instruments. However, significant firmware, hardware, and procedural changes were made to the Profiler with the CF2 microcontroller and some user manual sections will not apply to older systems.



Contact mclane@mclanelabs.com for information about upgrading from the TT8 to the CF2 microcontroller. McLane recommends this upgrade. We offer only limited support on devices that use the TT8 microcontroller.

Profiler electronics include the following components:

Controller board	MMP motherboard, CF2 based controller, and compact flash card.
Cables	COM cable connects the Profiler to an external computer. Electronics cables connect the controller to the motors. Sensor cables connect sensors to the electronics.
Communications	Serial and (optional) inductive communications provide transfer of data from the Profiler.
Sensor sampling	<p>Sensor types are self logging (record data internally and transfer to the Profiler at the end of each profile) and non-self logging record data at the “check-stop” and stores on the Profiler compact flash card in the Engineering file (Exxxxxxx.DAT).</p> <p>Supported sensors include CTD, fluorometry, dissolved oxygen, PAR, optical backscatter, turbidity, CO₂, methane, and nutrients. For a full list of sensor, see the Profiler Integrated Sensors reference document.</p> <p>See the Profiler Integrated Sensors and Communications Interface Manual for detailed information about supported sensors.</p>
Watchdog circuit	A real-time clock chip that sends periodic interrupt requests to the microcontroller. An unacknowledged request signals the microcontroller to restart. The watchdog is powered by the battery and also has a short-term independent power source that can last in the event of an interrupted power supply.

System Files

The flashcard stores the system files. The flashcard also contains a time history of interrupt requests and other exceptions sent to or detected by the microcontroller. Depending on whether the Profiler

has been deployed and which sensors are installed, there are a number of engineering files also stored on the flashcard.

System Files	Description
AUTOEXEC.BAT	Batch file that automatically executes the Profiler firmware during startup.
FIRMWARE	For example: D:\PROFILER.PXE.

Examples of other files stored on the flashcard are listed below. A complete list of flashcard files is documented in Appendix B ‘Unpacked Files’ in this User Manual.

Other Files	Description
IRQ_XCPT.LOG	Time history of interrupts.
DEPLOY.DAT	Deployment settings.
PROFILES.DAT	Profile count which is the number of the last profile in the deployment.
LASTSENT.DAT	If the Inductive Modem option is used this file is the last inductive data file transmitted to the Profiler firmware. This file is -1 if the Inductive Modem option is not used.

The Profiler electronics communicate using RS-232 serial communications and a terminal emulator, McLaneTerm. See Chapter 4 in this User Manual. “Getting Started” for more information about McLaneTerm, a program that is provided with the system and must be installed on the computer that will connect to the Profiler. A communications cable included in the toolkit connects the Profiler controller with a computer. Computers that do not have a built-in RS-232 serial port use a USB to RS-232 converter that is also included in the toolkit.

Computer COM Setup

Connection Style 1: Computers with Built-in Serial Port



Connection Style 2: Computers with USB, no Serial Port



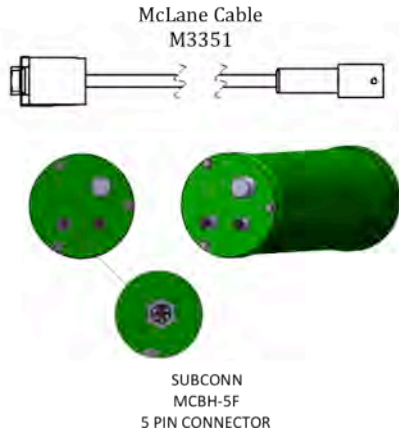
Figure 2-11: USB Communications

Communications Bulkhead Connector Styles

The communications cable bulkhead connector is a 5-pin MCBH style. Some older instruments may have a 3-pin XSG style bulkhead connector.

COM Cable Setup

Cable Style 1: Subconn 5-pin connector



Cable Style 2: Impulse 3-pin connector

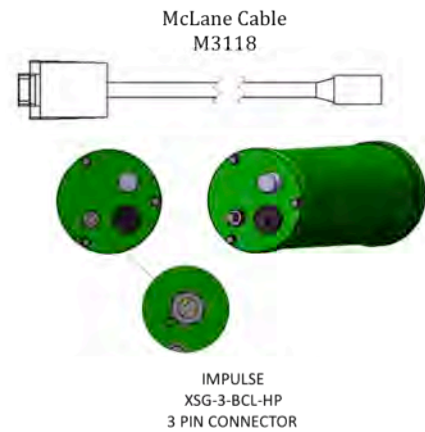


Figure 2-12: Cable Connector Styles

COM Cable Wiring

The current model MMP uses an Impulse 5-pin MCBH-5-M for the communications connector. Older MMP models use the Impulse 3-pin RMG-3-FS connector. Wiring diagrams for both communications connector types are included below.

3 and 5-Pin COM Connectors

The wiring diagram for the Impulse RMG-3-FS to DB-9 and MCIL-5-MP to DB-9 is shown below. The pin numbering specified by Impulse is also shown for the mating bulkhead connector. There are no pin numbers printed on the connector itself.

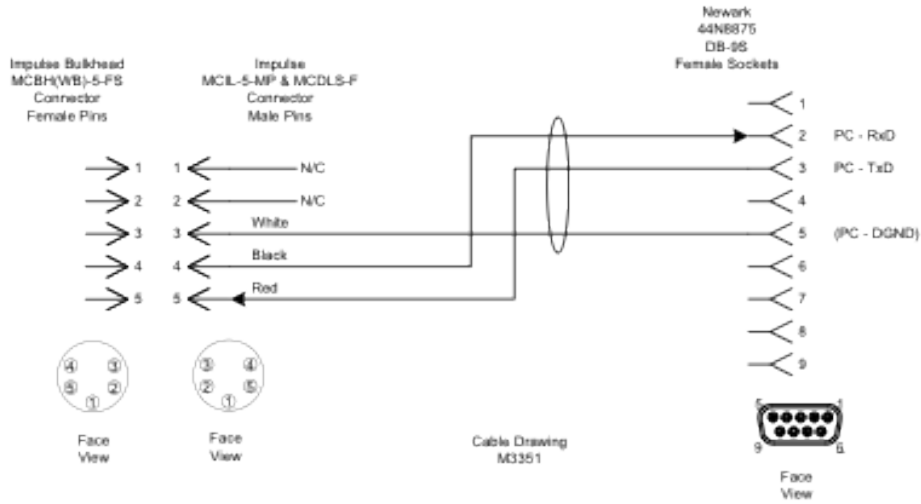


Figure 2-13: COM Connector Diagram (5-Pin)

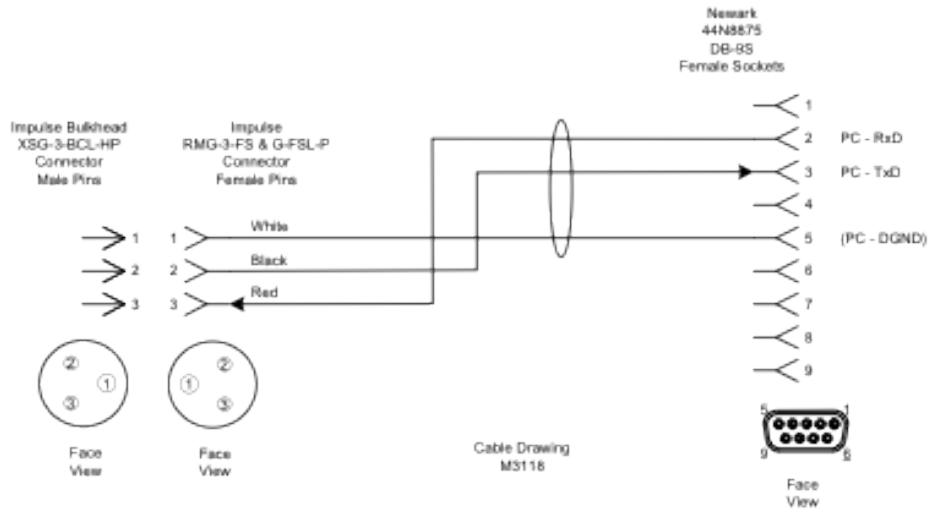


Figure 2-14: COM Connector Diagram (3-Pin)



Figure 2-15: 5-Pin and 3-Pin COM Connectors

Battery

The battery is a Lithium battery pack, DD type cells Lithium Sulfuryl Chloride chemistry, non-rechargeable. This battery requires hazardous good shipping. An additional half battery option is available that adds 50% more battery capacity.

See chapter 4, 'Getting Started' for details on connecting the battery.

Notes

Chapter 3

MMP Deployment Description

Topics Covered:

- Programming Deployment Parameters
- Deployment Start and profiling Action
- Ending a Deployment

Deployment Overview

An MMP deployment requires programming the initial dive setting and parameters that control profiling depths and frequency. Deployment programming can be done using Standard or Patterned profiling mode. An overview of what occurs in a deployment is provided in this Chapter. The user-programmable deployment parameters for Standard and Patterned profiling are described in detail in chapter 6 ‘Deployment Programming and Preparation’.

Programming Deployment Parameters – Patterned Profiling

A separate Windows application called Deployment Planner is the deployment programming method for Pattern profiling mode. The Deployment Menu for Patterned profiling has fewer options than the Standard profiling Deployment Menu. Patterned profiling consists of a deployment schedule that can contain up to 12 reusable patterns. Each pattern can have up to 100 different profiles. The Deployment Planner defines deployment settings and provides endurance estimates. The schedule is saved as a single file, SCHEDULE.DPL. This file is loaded into the Profiler via direct communication or flashcard, and can be re-used on other profilers and/or deployments.

Programming Deployment Parameters – Standard Profiling

Standard profiling mode provides a menu for programming deployment parameters directly in the profiler serial communications interface. A summary description of parameters is provided next.

- **Start setting:** The start parameter defines the start of Profile 0 (dive 0) which begins the deployment.
- **Schedule and Stops settings:** Schedule and Stops settings control profile timing. Profiles can be scheduled individually or in up-down pairs. Pressure stops (recorded by the CTD) define limits that end a profile.
- **Enabled sensors and options:** Enabled sensors and options display for only active sensors and contain sensor-specific parameters that can be changed.

- **Endurance estimates:** Endurance estimates calculate the expected number of profiles and an estimated battery expiration. The estimate adjusts each time a deployment parameter is changed.

Deployment Start and Profiling Actions

The process of starting a deployment and the programmed profiles occurs after deployment programming. The deployment start process is the same whether Patterned or Standard profiling mode is used. An overview of the deployment profiling actions is included below.

1. Program the deployment (Chapter 6 of this User Manual has detailed steps for programming either a patterned or standard deployment).
2. Complete the final step of the deployment to place the microcontroller into Suspend (Sleep) mode for a user-defined time interval or until the scheduled start time occurs. This allows for mooring setup and Profiler launch.
3. The profiler 'wakes' from Sleep mode at the programmed dive zero start time and performs a descent to the bottom of the programmed depth range.
4. Profile 1 begins at its separately scheduled time.
5. The sensors power on for a warm up period (default is 2 minutes) at the scheduled start time of each profile, and log data autonomously during the profile.

Some sensors are self-logging, while other sensors transfer collected data to the Profiler via digital (RS232, RS485) or analog connectors. The MMP records engineering data and status from non-self logging sensors.

6. Profiling stops when shallow/deep pressure or profile time limit (the end of the programmed profiling range) is detected.
7. Sensors continue to log internally for a warm down period (default is 2 minutes). After warm down and data logging the data is transferred to the Profiler flash card.

The interval of sensor logging before motion start and after motion stop provides data for use during post-processing to correct for sensor drift.

8. The profile completes when the firmware closes the sensor and engineering data files.
9. The firmware enters Sleep mode and waits for the next scheduled profile. Subsequent profiles are numbered sequentially (1, 2, 3) and follow the programmed schedule.

Conditions such as an obstacle blocking the mooring cable can be detected during a profile and may trigger changes in profiling action.

10. The MMP continues to profile until the deployment is terminated.

Ending a Deployment

1. The system ends a deployment if the user types three [CTRL]-[C] termination sequences or if the battery falls below 7.5 V.
2. After ending a deployment, the firmware places the microcontroller in Sleep mode.



Never disconnect power to stop an underway deployment. Disconnecting power during deployment can corrupt open data files.

Chapter 4

Getting Started

Topics Covered:

- Connecting to a computer.
- Installing and configuring McLaneTerm terminal emulation software on a computer.
- Powering up the Profiler.
- Communicating with the Profiler.
- Waking a Profiler from low power sleep mode.

To complete the steps in this chapter, **you will need** the McLaneTerm software and McLaneTerm User Manual that shipped with the instrument.

Connecting the Profiler to a Computer

Communicating with your instrument requires installing and configuring the terminal emulation program McLaneTerm, and connecting the communications cable to the computer.

Connecting to a Computer

Locate the COM cable (in the instrument's toolkit) that connects the instrument and a computer. Determine whether the computer has a built-in serial port. Built-in serial ports are preferred for connection with your instrument. However, a USB to RS-232 adaptor is included in the toolkit for connection to computers without built-in serial ports. The adaptor is a DS_US232R-10(R-100/500) adaptor cable (manufactured by FTDI Ltd).



Figure 4-16: Communications Cable and USB to RS-232 Adapter

Troubleshooting the USB Adaptor

The USB adaptor has LED indicator lights for transmitting and receiving data. Typing any key in terminal emulation should be indicated by the LED. If no LED light flashes on keystrokes, you may have selected the incorrect COM Port.

Installing and Configuring McLaneTerm

McLaneTerm is a terminal emulation program for Microsoft Windows and Mac OSX platforms used to communicate serially with McLane instruments. With McLaneTerm, you can interact with your McLane instrument's text based interface while it is connected to a serial port on your computer. McLaneTerm replaces the terminal emulation tools MotoCross (for CF2) and CrossCut (for TT8).



Creating capture files of all commands and responses with your McLane instrument is a customer best practice that is critical for successful technical support.

To follow this section, you will need the McLaneTerm software and McLaneTerm User Manual that was included on the instrument's USB drive. McLaneTerm software and the User Manual can also be downloaded at our website www.mclanelabs.com.

- McLaneTerm uses standard Windows and Mac OSX automatic installation programs. Follow the McLaneTerm User Manual if you need instructions to install McLaneTerm on a computer.
- In the McLaneTerm User Manual, follow the sections “Settings” and “Using Commands” to properly setup McLaneTerm software.
- When communication with your McLane instrument is established, proceed to the section that follows next in this User Manual “Powering up the Profiler”.



McLaneTerm system requirements: Windows® 7 or higher / Mac OS X version 10.7 (Lion) or higher.

Powering up the Profiler

Connecting the battery is the only way to power on the profiler electronics. This step requires opening the controller housing. The controller housing contains the electronics and lithium battery and includes a pressure relief valve (PRV). Be sure to perform this procedure in a dry area and familiarize yourself with steps for using the Pressure Relief Valve.

Opening the Controller Housing

The Pressure Relief Valve opens automatically at a pressure differential greater than 10psi. Attention and care should be taken in maintaining, operating, and opening the pressure housing. The valve can be manually released prior to opening the controller housing.

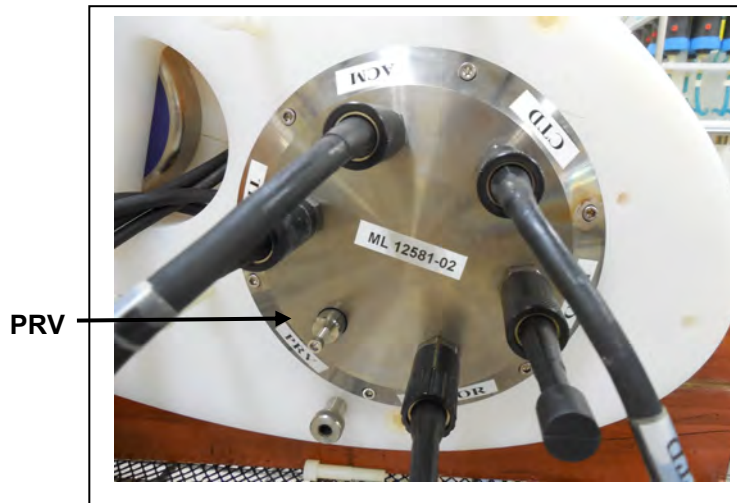


Figure 4-2: Controller End Cap, with PRV



Observe safety precautions including removing personnel and objects from the path of the end-cap when performing either of these procedures.

1. Disconnect the cables from the end cap.
2. Screw an 8-32 bolt into the threaded hole in the end of the Pressure Relief Valve.
3. Slowly pull on the pressure relief valve to release any vacuum or built-up pressure in the housing.



Figure 4-3: Releasing PRV

4. Loosen each end cap bolt a few turns at a time in a star pattern.
5. If the end cap separates from the housing as you loosen the bolts, this could indicate a possible pressure buildup inside of the housing. Stop loosening bolts and continue to gently pull on the pressure relief valve.
6. Remove and place the end cap hardware somewhere safe.
7. Gently pry the end cap from the housing cylinder.

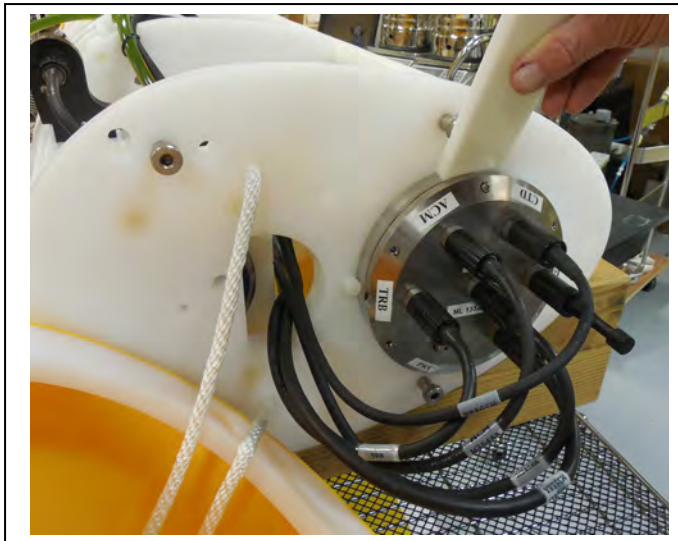


Figure 4-4: Prying End Cap From Pressure Cylinder

Connecting Battery

Connect the main battery connector on the electronics stack, there are two battery connectors each on opposite sides of the motherboard. Either side can be used whether connecting two batteries for the Extended MMP or a single battery for the Standard MMP.

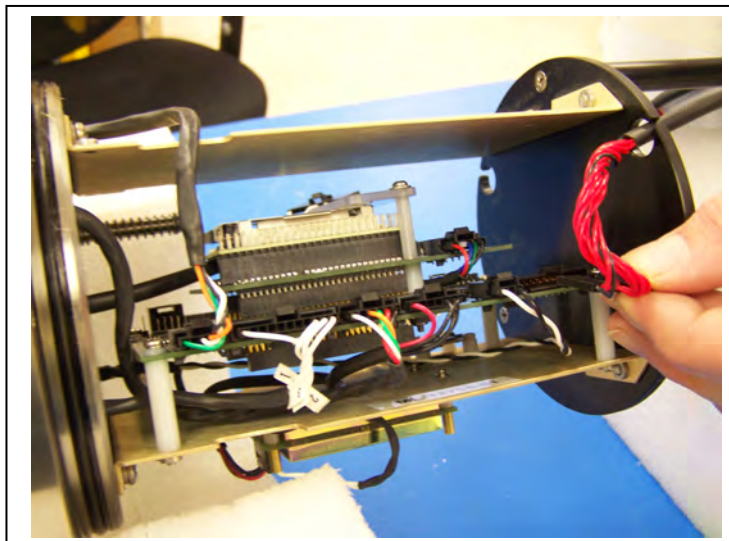


Figure 4-17: Connecting the Battery

System Start up

Once the battery is connected and the terminal emulation software is installed, communication with the profiler firmware can be made.

1. Find the communications cable provided in the toolkit.
2. Connect the DB9 end of the communication cable to the computer communication port configured in McLaneTerm.
3. Align the bulkhead connection pins on the COM cable to the bulkhead connector on the MMP end cap, push the bulkhead in place on the controller end cap.
4. On the computer, open a properly configured McLaneTerm window. Ensure that the COM settings (active COM port & COM port settings) are correct.
5. With COM cable in place and McLaneTerm open and configured, plug the battery into the MMP electronics board. A 30 second count down appears, an autonomous deployment countdown and can be interrupted by entering [CTRL]-[C].
6. Enter [CTRL]-[C] in McLaneTerm. If the computer setup procedures were completed correctly, the Main Menu, a system clock confirmation message, or a system in Sleep/Suspended mode will print to the screen.
7. Slide the end cap back into the cylinder and close the controller housing, ensuring that the o-rings are correctly seated to prevent water leakage.
8. Secure the end cap with the six (6) bolts and tighten with a hex driver (included in the Toolkit). Do not over-tighten the bolts.

Power up sequence

When the battery is connected, the power up sequence occurs and will not repeat unless the firmware is re-booted. Disconnecting the power and then reconnecting after 5 to 10 seconds will perform a “cold” reboot and allow capacitors to fully discharge. Exiting the firmware and then manually re-starting the program performs a “warm” re-boot, which will not reset the RTC.

During the power up, the firmware does the following (in order):

- Checks for successful firmware initialization.
- Prompts to set the RTC (real-time clock).

- Displays the profiling history for informational purposes.

```

D:PROFILER
-----
CF2-MPP-5.00 R9 L2.0 U304 5_00.c compiled Jan 3 2013 at 00:50
S/N ML12345-67D Pattern Profiler
© 1999-2013 McLane Research Laboratories. All rights reserved.
-----
The "Pattern Profiler" MPP operator interface is now running.
Type ^C within 30 seconds to assert control and initialize system.
28 seconds [^C]
Clock reads 01/03/13 12:42:04. Change it [N] ? y

Enter date as mm/dd/yy or mm/dd/yyyy, time as hh:mm:ss
Enter correct time [01/03/2013 12:42:13] ? 01/03/2013 12:42:32
Clock reads 01/03/13 12:42:32. Change it [N] ?

01/03/13 12:42:35 SYSTEM Checking FlashCard ... done.
01/03/13 12:42:35 SYSTEM 35 files found on disk.
01/03/13 12:42:36 SYSTEM Capture is disabled.
01/03/13 12:42:36 SYSTEM D:CAPTUR*.TXT size is ~0.00 MB of 8.1 MB max.

01/03/13 12:42:36 SYSTEM Reading D:ODOMETER.DAT ... done.
01/03/13 12:42:36 SYSTEM History: 67.41 motor hours, 891 meters.
01/03/13 12:42:36 SYSTEM Hardware: Rev-D. Motor OpAmp offset: 31mA.

01/03/13 12:42:37 SYSTEM Watchdog initialized.
01/03/13 12:42:37 SYSTEM Watchdog alarm IRQ has been activated.
01/03/13 12:42:37 SYSTEM Setting watchdog clock ... done.

01/03/13 12:42:37 SYSTEM Loading URAO ... done.
01/03/13 12:42:37 SYSTEM Initializing sensors ..... done.
01/03/13 12:42:37 SYSTEM Sizing CompactFlash ... done.
01/03/13 12:42:38 SYSTEM CompactFlash: 0.6 MB used, 986.6 MB free, 987.2 MB size.
01/03/13 12:42:38 SYSTEM Backup battery measures 3.2V.
01/03/13 12:42:38 SYSTEM Main battery measures 12.0V.
01/03/13 12:42:38 SYSTEM Loading schedule information ...
01/03/13 12:42:39 SYSTEM Loading SCHEDULE.DPL.
01/03/13 12:42:39 SYSTEM Scheduled dive zero time is 12/14/12 11:55:00.
01/03/13 12:42:39 SYSTEM Filling in schedule years ... done.
01/03/13 12:42:39 SYSTEM Loaded SCHEDULE.DPL.
01/03/13 12:42:39 SYSTEM Generating SCHEDULE.TXT ... done.

```

Figure 4-6: System Initialization

Establishing Communication with the Firmware

1. After system initialization, press [CTRL]-[C] to control the firmware. If the Profiler firmware is in Sleep (Suspend) mode, pressing [CTRL]-[C] three times (with three second pauses between each press) is required to display the Main Menu, or click the Wake button on McLaneTerm.



Disconnect the main battery before shipping to prevent electrical system damage during transit. Before disconnecting power, press [CTRL]-[C] to return to the Main Menu and put the Profiler in Sleep (suspend) mode.

Troubleshooting Communication with your Instrument

If the MMP firmware does not respond when connected to McLaneTerm, use these steps to troubleshoot:

- Confirm the battery is connected to the profiler.
- Verify the correct Communications Port # is defined in McLaneTerm.

Waking the Profiler from Low Power Sleep Mode

The profiler will enter a low power mode if it sits idle for more than 20 minutes. To wake the system from this suspended state, hold down [CTRL]-[C]. After five seconds of holding down [CTRL]-[C] (or using the Wake up button on McLaneTerm), the Main Menu will display (Figure 4-7).

If [CTRL]-[C] is held down for more than five seconds and nothing happens, check the previous sections of this chapter to make sure procedures were followed correctly.

```
Config: MPP_IM_CT                                     CF2 V5.36

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

                -----
                Pattern Profiler
                Main Menu

                -----
                Fri Jul 19 13:34:28 2019

<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 [] ? ?
07/19/2019 14:02:13  SYSTEM Suspended ... ?
Enter ^C now to wake up ... [^C]
```

Figure 4-7: Main Menu

Powering Off the Profiler

To power off the Profiler, complete the following steps:

1. Return to the Main Menu.
2. Select option <4> 'Sleep' from the Main Menu.
3. Disconnect the main lithium battery pack.

Notes

Chapter 5

User Interface

This chapter introduces the user interface including the Main and Configuration Menus, and explains some basic functions of the MMP menu driven user interface. Both standard and patterned profiling modes are available in a single firmware version.

Main Menu

The Main Menu automatically displays after firmware initialization. The profiling mode (patterned or standard) is indicated in the header by **MPP** (patterned profiling) or **MMP** (standard profiling). Enabled sensors and firmware version also display at the top of each firmware screen.

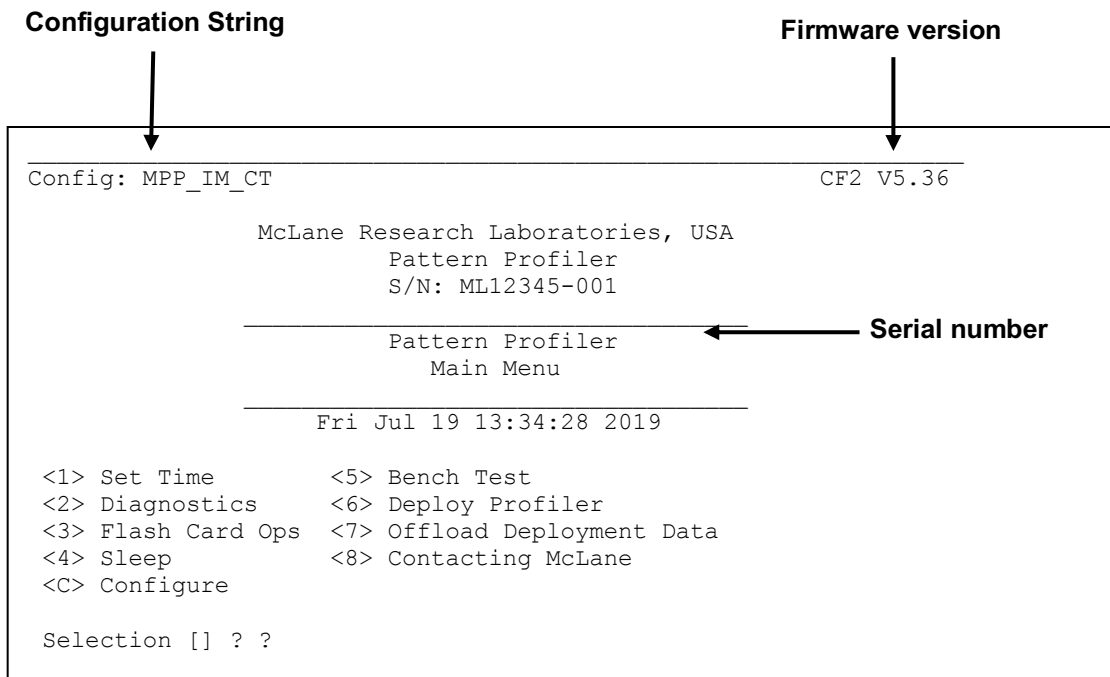


Figure 5-1: MMP Main Menu

- **Configuration String:** The configuration string indicates the current instrument configuration. The configuration string in Figure 5-1 indicates the MMP is configured for Patterned Profiling mode and has the following sensors installed; Inductive Modem, ACM, CTD, Fluorometer, MotionPack, Optode, and Turbidity.
- **Firmware Version:** The currently running firmware is displayed on the top right corner of the main menu.
- **Serial Number:** The McLane Serial Number can be found on the Main Menu and should be included in all system inquiries to McLane Research Labs.

<1> Set Time

Option <1> ‘Set Time’ sets the real time clock (RTC). The watchdog clock (WDC) automatically synchronizes to the RTC. A Colon (:), space, or slash (/) can be used as field separators.

McLaneTerm also has a tool bar icon for setting the time.

```
Selection [ ] ? 1
Enter date as mm/dd/yy or mm/dd/yyyy, time as hh:mm:ss
Enter correct time [01/18/2018 12:03:10] ? 01/18/2018 12:03:35
Clock reads 01/18/2018 12:03:35. Change it [N] ?
01/18/2018 12:03:36  SYSTEM Setting watchdog clock ... done.
```

Figure 5-2: Set Time

<2> Diagnostics

Option <2> ‘Diagnostics’ is a scrolling display of status information including the RTC, WDC, battery voltage and motor current (mA). A new battery generates approximately 11.6 V but drops to 10.8 V after some use and stabilizes for most of the usable battery life.

A sample Diagnostics display is shown next. Typing ‘X’, ‘x’, or [CTRL]-[C] exits from Diagnostics and returns to the Main Menu.

The RTC and WDC should be the same. Motor current should be ~ 0mA.

```
Selection [ ] ? 2
Press ^C to exit, or any other key to pause|continue.
Real-time clock      Watchdog clock      Battery  Motor
01/18/2018 11:59:45, 01/18/2018 11:59:45,  11.8V,  0mA
01/18/2018 11:59:46, 01/18/2018 11:59:46,  11.8V,  0mA
01/18/2018 11:59:47, 01/18/2018 11:59:47,  11.8V,  0mA
01/18/2018 11:59:48, 01/18/2018 11:59:48,  11.8V,  0mA
[^C]
```

Figure 5-3: Diagnostics

Battery Warnings

The battery voltage provides information about the battery. A new battery reads above 11 V. After the initial high readings, the battery voltage will remain near 10.8 V until ~90% of the available energy in the battery has been used. Replace the battery if the reading is below 10.0 V which indicates that at least 90% of the lithium battery capacity is used. A battery voltage below 7.5 V indicates a drained battery.

Low battery output voltage triggers operator warning messages. If battery output of the lithium battery is below 10.0 V, a caution message displays during the exit from Diagnostics suggesting battery replacement before deployment.

```
Battery voltage is abnormally low. Check/replace
main battery pack before deploying system.

Press any key to continue.
```

Figure 5-4: Low Battery Voltage

If the output of the lithium battery is below 7.5 V, a warning message and a single status line displays. Diagnostics automatically terminates and returns to the Main Menu.

```
Main battery is extremely low and should be replaced
before running diagnostics.

RTC: 01/28/2006 16:35:46   WDC: 01/28/2006 16:35:46   6.8 Vb   0 mA

Battery voltage is abnormally low. Check/replace
main battery pack before deploying system.

Press any key to continue.
```

Figure 5-5: Replace Battery

<3> Flash Card Ops

Option <3> Flash Card Ops accesses the files on the flash card through a DOS-like interface called PicoDOS.

Use caution with the Flash Card Operations Menu. Files including the firmware can be deleted.

```
Config: MPP_IM_CM_CT_MP_PA_SC                               CF2 V5.29

-----
                Pattern Profiler
                Flash Card Operations
-----
                Mon May 7 16:27:12 2018

<1> Flash card size/free
<2> List files
<3> Show profile count
<4> Delete all files
<5> Exchange flash cards
<6> Format flash card
<7> Command interface

<M> Main Menu
```

Figure 5-6: Option <3> Flash Card Operations

Option <1> Flash Card Size/Free

Option <1> from the Flash Card Operations menu measures the total capacity and remaining free space on the flash card and calculates the number of files that can be stored.

```
Selection [] ? 1

07/13/2018 14:52:27  SYSTEM Sizing CompactFlash ... done.

07/13/2018 14:52:27  SYSTEM CompactFlash: 337.4 MB used, 1.57 GB free, 1.89 GB
size.
07/13/2018 14:52:27  SYSTEM 38 files found on disk.

Press any key to continue.
```

Figure 5-7: Flash Card Operations <1> Flash card size/file

Option <2> List Files

Option <2> from the Flash Card Operations menu lists the files on the flash card. These include AUTOEXEC.BAT, the batch file that calls the firmware when power is applied to the Profiler and SCHEDULE.DPL if patterned profiling is active. Additional files for each profile are grouped in sub-directories. These files include the deployment definition parameters (DEPLOY.DAT), the current profile count (PROFILES.DAT), the interrupt request log (IRQ_XCPT.LOG), and the last profile number completely transmitted via inductive modem (LASTSENT.DAT). These binary files are processed by the on-board offload utility or the McLane Profile Data Unpacker program. Engineering, CTD, and ACM files and Deployment Planner .TXT files are also listed.

```
Selection [] ? 2

Volume in drive C is PROFILER529
Volume Serial Number is 5E3F-6301

Directory of C:\

AUTOEXEC.BAT                28  11-10-17  7:41p
SCHEDULE.DPL                10,880 11-10-17  7:41p
SCHEDULE.TXT                 2,112 07-13-18  2:34p
AQUADOPP.CFG                 1,026 11-10-17  7:41p
PROFILER.PXE                626,272 11-10-17  7:41p
DEPLOY.DAT                   304  11-10-17  7:41p
PROFILES.DAT                  4  05-04-18  6:01p
IRQ_XCPT.LOG                 25,212 05-04-18  8:19p
LASTSENT.DAT                  4  04-10-18  6:36a
FILELIST.TXT                103,580 05-04-18  6:52p
S0000000.DAT                 10,880 11-10-17  7:41p
00000 <DIR>                  11-12-17  5:00a
PROFILEA.LOG                  28  05-03-18  6:52p
PROFILEB.LOG                  28  05-03-18  9:52p
PROFILEC.LOG                  28  05-04-18 12:26a
PROFILED.LOG                  28  05-04-18  3:26a
PROFILEE.LOG                  28  05-04-18  6:52a
PROFILEF.LOG                  28  05-04-18  9:51a
PROFILEG.LOG                  28  05-04-18 12:26p
PROFILEH.LOG                  28  05-04-18  3:26p
PROFILEI.LOG                  28  05-04-18  6:52p
PROFILEJ.LOG                  28  05-03-18  3:26p
ERRORLOG.TXT                 489,732 07-13-18  2:35p
00500 <DIR>                  01-13-18  6:00p
01000 <DIR>                  03-17-18  6:01a

                22 file(s)          1,270,314 bytes

                3 dir(s)          1,680,601,088 bytes free

Press any key to continue.
```

Figure 5-8: Flash Card Operations <2> List Files

Option <3> Show Profile Count

Option <3> from the Flash Card Operations menu shows the profile count.

Option <4> Delete All Files

Option <4> from the Flash Card Operations menu deletes all files except for AUTOEXEC.BAT and SCHEDULE.DPL. Although deleting files is faster than formatting the flash card, formatting is recommended to ensure compatibility. This option requires the password *Del*.

Option <5> Exchange Flash Cards

Use option <5> from the Flash Card Operations menu if there is a need to swap the flash card without disconnecting the battery. Alternatively, swap the flash card by disconnecting the battery, inserting a new flash card and reconnecting the battery to re-boot the system.

Option <6> Format Flash Card

Use option <6> from the Flash Card Operations menu to properly format the flash card. The operation saves a copy of AUTOEXEC.BAT and SCHEDULE.DPL, formats the flash card and then copies AUTOEXEC.BAT and SCHEDULE.DPL back to the flash card. This operation requires more time than deleting all files from the flash card.

Option <7> Command Interface

Option <7> from the Flash Card Operations menu accesses a command line and is for use only with McLane assistance. This function allows McLane to perform low level operating system commands.

<4> Sleep

Option <4> 'Sleep' places the electronics in Sleep (Suspend) mode to suspend the drain of battery power. The MMP automatically enters this mode if left idle for 20 minutes. During Suspend mode, the firmware wakes every 20 minutes to check system status, display the time, and then return to Suspend mode. To wake the system and return to the Main Menu hold down [CTRL]-[C] until the system wakes up

```
Selection [] ? 4

07/22/2019 14:26:46   SYSTEM Suspended ...
```

Figure 5-9: Suspend/Sleep Mode

<5> Bench Test

Bench Test selections display based on the sensors that are enabled within the Configuration Menu of the MMP. Options are grouped into ‘Sensor Utilities’, ‘System Evaluation’ and ‘System Sensor & Option Tests’. For detailed information about Sensor Utilities see the sections in the Profiler Integrated Sensors and Communications Interface User Manual.

```
Config: MPP_IM_CT                                     CF2 V5.36
-----
                Pattern Profiler
                Bench Tests
-----
                Fri Jul 19 14:04:31 2019

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:

<X> Main Menu

Selection [] ?
```

Figure 5-10: Bench Tests



The options <D> ‘Detailed schedule’ and <S> ‘Recover schedule’ display only in Pattern Profiling mode.

<6> Deploy Profiler

Option <6> is for programming a deployment. Deployment parameters are stored in EEPROM (and on the flash card in non-volatile storage) and loaded at firmware startup. The parameters also reside in RAM while the battery remains connected. ‘Deployment Preparation’ in Chapter 6 of this User Manual describes deployment parameters in more detail.



In Patterned profiling mode, the deployment is programmed as part of a reusable pattern schedule in the Deployment Planner Windows application.

<7> Offload Deployment Data

Option <7> ‘Offload Deployment Data’ reads binary data from the flash card while the flash card is still in the Profiler. Use this option after Profiler recovery to connect the instrument to a computer, display the binary data that was collected and examine the profile count before removing the flash card from the Profiler. For detailed information about data offload options see Chapter 7 “Deployment and Recovery” in this User Manual.

<8> Contacting McLane

Option <8> Contacting McLane displays McLane contact information and includes the Profiler configuration, software version and serial number.

```
Selection [ ] ? 8

      McLane Research Laboratories, USA
      Falmouth Technology Park
      121 Bernard E. Saint Jean Drive
      East Falmouth, MA 02536-4444 USA

      Email: McLane@McLaneLabs.com
      Web: http://www.McLaneLabs.com
      Tel: 508-495-4000 Fax: 508-495-3333

      Configuration: MPP_IM_CT
      Source file: CF2-5_36.c01
      Electronics S/N: ML12345-001
      Compiled: Jun 11 2019 08:45
```

Figure 5-11: McLane Contact Information

Configuration Menu

McLane properly configures the MMP before shipping. The System Configuration Menu specifies the active sensors and allows users to disable a sensor or change sensor settings. Configuration parameters are briefly described next and in more detail in the Profiler Integrated Sensors and Communications Interface User Manual.

```
Config: MPP_CM_CT                               CF2 V5.36
-----
                Pattern Profiler
                System Configuration
-----
                Fri Jul 19 14:02:21 2019
System Parameters:
<0> Battery capacity                240 Ah

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

  Port J5:ACM
<2> No ACM selected
<!> Wetlabs ECO BBFL2

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

  Port J4:SSP
<B> BioSuite Triplet/PAR
<G> Wetlabs SeaOwl
<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
</> Wetlabs ECO BBFL2
<L> Wetlabs ECO FLBB(RT)/D
<P> Biospherical PAR
<$> WetLabs CST Transmissometer

  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
<%> Wetlabs ECO FLBBCD

  Port J5i:SER
<K> ProOceanus CO2
<#> Aanderaa Optode
Exit: <X> Save changes      <^C> Cancel changes
```

Figure 5-12: System Configuration Menu

System Parameter Options

Option <0> 'Battery capacity' changes the number used to calculate estimated battery expiration which displays as 'Estimated endurance' on the Deployment Menu. The standard battery energy used in the calculation is 240 Ah. The battery energy used in the calculation can be changed to a number between 10 and 1000.



The L24-1000 battery has 240 Ah of battery energy. Nominal endurance is used only to calculate an estimate based on other deployment factors and energy drain from installed sensors.

Sensor Suite Options



Sensor specific options are explained with the applicable sensor in the Profiler Integrated Sensors and Communications Interface User Manual.

Advanced Interface Menu

The Advanced Interface Menu allows experienced profiler users to change deployment settings. These menu options are sensor-dependent and a password is required. Profiler users with questions about the settings on this screen should contact mclane@mclanelabs.com.

On the Advanced Interface display, “IMM” menu options are the Seabird IMM (Inductive Modem Module). “IM” menu options refer generically to all Profiler inductive modem hardware. Both IMM and IM options are highlighted in yellow (Figure 5-13).

Activate/Deactivate Sensors and Data Sent Inductively

Most sensors have the options to be deactivated during profiles, and added to or removed from the inductive modem offload queue. Options <7> and <8> allow the user to define these settings. Alternatively, these settings can be set using the inductive communication commands REQACT and REQQUE. For more information on configuring these setting inductively, see the Profilers Integrated Sensors and Comms Interface user manual.

```
Config: MPP_IM_CM_CT_FL_MP_NI_CO_TU                                CF2 V5.36

-----
                Pattern Profiler
                Advanced Interface
-----
                Wed Jul 31 10:41:12 2019
<0> full Speed                                0.250 dbar/sec
<1> pressure Rate threshold                    0.045 dbar/sec
<2> pressure rate Time limit                   10 seconds
<3> Sensor warmup                             2 seconds
<4> Sensor warmdown                           10 seconds
<7> Configure active sensors                   A-C--MNO--
<8> Configure offload queue                    A-C--MnO--

<A> Annunciate comm traffic                    NO
<B> Backtrack iterations                       2
<D> Display verbose messages                   NO
<F> IMM use Force capture                       YES
<G> Get pressure during ramp                   NO
<H> History reset
<I> Infinite deployment                        ENABLED
<J> use Slower uart clock                       YES
<K> IM ACK|NAK|ETK reply timer                 100 seconds
<L> IM Listening loop timer                     40 seconds
<M> profiling Mode                             PATTERN
<N> adjust profile couNter                      452
<P> caPture file enabled                       NO
<S> IMM configure Surface                       NO
<T> Terminate profile in ramp                   NO
<U> Ramp duration                              30
<W> IMM send Wakeup tone                       NO

<X> Save changes  <R> Reset factory defaults  <^c> Cancel changes
```

Figure 5-13: Advanced Interface Menu (Patterned Profiling)

Selecting option <7> displays the list of sensors installed on the system that can be activated/deactivated.

```
Selection [] ? 7

-----
Config: MPP_IM_CM_CT_FL_MP_NI_CO_TU                               CF2 V5.36
-----

                Pattern Profiler
                Configure Active Sensors
                -----
                Wed Jul 31 10:39:25 2019

Select installed sensors to be active during profiles:

<A> ACM ----- Active
<M> MotionPack ----- Active
<N> Nitrate ----- Active
<O> CO2 ----- Active

<+> Activate all
<-> Activate none

<X> Save changes      <^c> Cancel changes

Selection [] ? +
```

Figure 5-14: Advanced Interface Option 7

Selecting option <8> displays the list of sensors that can be added to, or removed from the inductive modem offload queue.

```
Config: MPP_IM_CM_CT_FL_MP_NI_CO_TU                               CF2 V5.36
-----

                Pattern Profiler
                Configure Offload Queue
                -----
                Wed Jul 31 10:40:10 2019

Select active sensors to queue for new offloads:

<A> ACM ----- Queued
<C> CTD ----- Queued
<M> MotionPack ----- Queued
<N> Nitrate ----- Queued
<O> CO2 ----- Queued

<+> Queue all
<-> Queue none

<X> Save changes      <^c> Cancel changes
```

Figure 5-15: Advanced Interface Option 8

In Figure 5-16, five sensors are configured (A, C, M, N, O) and four are queued to send data in inductive transmissions (ACMO). The lowercase “n” in ‘Configure offload queue’ means Nitrate (N) data is not transmitted in the inductive queue.

```

Config: MPP_IM_CM_CT_FL_MP_NI_CO_TU                CF2 V5.36

-----
                Pattern Profiler
                Advanced Interface
-----
                Wed Jul 31 10:41:12 2019
<0> full Speed                                0.250 dbar/sec
<1> pressure Rate threshold                   0.045 dbar/sec
<2> pressure rate Time limit                  10 seconds
<3> Sensor warmup                             2 seconds
<4> Sensor warmdown                           10 seconds
<7> Configure active sensors                   A-C--MNO--
<8> Configure offload queue                   A-C--MnO--
-----
<A> Annunciate comm traffic                   NO
<B> Backtrack iterations                       2
<D> Display verbose messages                  NO
<F> IMM use Force capture                      YES
<G> Get pressure during ramp                   NO
<H> History reset
<I> Infinite deployment                       ENABLED
<J> use Slower uart clock                     YES
<K> IM ACK|NAK|ETK reply timer                100 seconds
<L> IM Listening loop timer                    40 seconds
<M> profiling Mode                            PATTERN
<N> adjust profile couNter                    452
<P> caPture file enabled                      NO
<S> IMM configure Surface                     NO
<T> Terminate profile in ramp                 NO
<U> Ramp duration                             30
<W> IMM send Wakeup tone                      NO

<X> Save changes  <R> Reset factory defaults  <^c> Cancel changes

```

Upper case = Active/ in offload queue

Lower case = Active/not in offload queue

Figure 5-16: Advanced Interface

Notes

Chapter 6

Deployment Programming and Preparation

Profiler operations include deployment programming and pre-deployment preparation. Topics covered:

- Ballasting.
- Programming a deployment (two modes, patterned and standard).
- Final deployment operations (closing and sealing the controller housing, attaching the profiler to a mooring wire).

Ballasting

Accurate ballasting is critical to Profiler operation. Ballasting requires precise measurements of the MMP air weight and water weight in water of some known density. The measured weights along with an empirical ballasting calculation determine the appropriate amount of ballast required for neutral buoyancy at the Profiler deployment site. A new MMP is ballasted before shipment, and the appropriate quantity of lead ballast for the initial deployment is based on in situ density and deployment defined pressure information provided by the customer. The completed ballast sheet is provided with the files on the customer USB drive. Ballast sheet calculations must be performed for each new deployment.



The Profiler lift capacity is dependent upon the strength of the coupling between the drive wheel and the mooring cable. If the Profiler becomes trapped against one of the stops because it is too heavy, data will be collected from only a single depth.

The required weight of lead ballast can be calculated for a particular deployment if the density, pressure, and temperature of the water at the neutral point of the planned profile are known.



Any weight change must be considered in the ballast calculation. Variables that affect ballast include adding sensors, replacing glass spheres, changing the main battery pack or swapping existing sensors. Contact McLane for ballast re-calculation assistance.

Understanding the Ballast Sheet

The ballast spreadsheet is a password protected Microsoft Excel® sheet. The user can edit the necessary cells for deployment parameters and battery weight. The sheet is protected to help prevent unintended changes to calculations and constants. A detailed description of ballast calculations and a sample ballast sheet are included in the section that follows.

The deployment parameters on the ballast sheet are in situ pressure, temperature, salinity, and density of water at the planned neutral depth for the deployment. That density may be available directly or it may be calculated, using an equation of state for seawater, from measurements of pressure, temperature, and salinity at the neutral depth.

To avoid exceeding the lift capacity of the profiler at the deep and shallow limits of travel, the ballast calculation should make the MMP neutrally buoyant at the mid-point of the profile. Maintaining neutral buoyancy at the mid-point also reduces drive train losses, which increases endurance.

The neutral depth is generally the mid-point of the planned profile. The MMP is less compressible than seawater, so buoyancy increases as it profiles down and decreases as it profiles up.

McLane Moored Profiler Ballast Sheet

Version 1.3

Project:
 Date Ballasted:
 MMP S/N:
 MMP Electronics S/N:
 CTD S/N:
 ACM S/N:
 Glass Sphere #1 S/N:
 Glass Sphere #2 S/N:
 MMP Software Version:

McLane Deep
17-Dec-18
12345-01
CF2 12121
SBE52MMP s/n 115 Ver MP2.3
FSI ACM+ s/n 1026 Ver 3.20
111977
111959
5.33

Deployment Defined Values (Given By User)

Deployment (Neutral) Pressure (in db):	1254.8
Deployment (Neutral) Temperature (in °C):	2.567
Deployment (Neutral) Salinity (pss):	34.453
Deployment (Neutral) Density (in g/cc):	1.0333
Deployment Site Latitude:	not given
Deployment Site Longitude:	not given
Deployment Date:	not given
Recovery Date:	not given

Measured Weights (note: water weights are to 1g accuracy and air weights are to 10g accuracy)

MMP Air Weight w/o battery (in g):	73210
Tare Water Weight (includes test battery air weight) (in g):	6933
MMP+Tare Water Weight (in g):	534
Lithium Battery Air Weight (in g):	8020

Calculated Values and Ballasting Constants

1 - MMP Water Weight (in g):	1621
2 - Ballast Tank Water Temperature (in °C):	16.2
3 - Water Density (from table in g/cc):	0.998935
4 - MMP Volume (in cc)	79693.85
5 - MMP Compressibility Constant (in cc/db)	0.3
6 - MMP Volume Change @ Deployment Pres. (in cc):	376.44
7 - MMP Volume @ deployment Pres. (in cc):	79317.41
8 - MMP Volume Temp. Correction Const. (in cc/°C):	6
9 - Temperature Difference (in °C):	13.633
10 - MMP Volume Change @ Deployment Temp.(in cc):	81.798
11 - MMP Volume @ Deployment Temp. & Pres.(in cc):	79235.61
12 - Calculated Air Weight for Neutral MMP @ Deployment Pressure (in g):	81874.16
13 - Weight Difference (in g):	644.16
14 - Ballast Weight (in g):	516
15 - Average Motor Current Difference from Previous Deployment (in mA):	122
16 - Effective Motor Current Change for Neutrally Bouyant MMP (in mA):	61
17 - Ballast Air Weight Correction based on 4 g/mA Effective Motor Current (in g):	244
18 - Ballast Water Weight Correction based on density of lead (in g):	221
19 - Corrected Ballast Weight (in g):	737

NOTE: Ballasted based on field data, 65mA HEAVY therefore remove 260g **256**
Ballasted 12/17/18 light 61mA add 244g **500**

Notes:

Item 15 is calculated as Average Down Profile Motor Current - Average Up Profile Motor Current
 If ballast is added to pressure housing item 19 is ballast air weight.
 If ballast is added outside the pressure housing item 19 is ballast water weight.

Additional Sensors:

Wetlabs FLBBRTD s/n 2934 ver flntu4.08
 Aanderaa Optode 4330F s/n 1105 Ver 4.5.6
 SBE IMM 90554.1 s/n 70001765 ver 1.14

Detail of Calculations

The Ballast Spreadsheet (Excel file) performs the necessary calculations automatically after data is entered. The calculations are described below.

Measured Weights (note: water weights are to 1g accuracy and air weights are to 10g accuracy)	
MMP air weight w/o battery (in g) _____	<i>Weight of MMP in air with battery and lead removed</i>
Tare water weight (includes test battery air weight) (in g) _____	<i>The MMP is buoyant in fresh water (and seawater), so a tare weight is required to fully submerge it for the water weight measurement. The water weight of the lead tare weight is measured using a digital scale ($\pm 1g$ accuracy)</i>
MMP + Tare Water Weight (in g) _____	<i>Weight of MMP, battery and ballast lead submerged in water</i>
Lithium Battery Air Weight (in g) _____	<i>Check and update your battery weight each time a new battery is installed</i>

Calculated Values and Ballasting Constants	
1 - MMP Water Weight (in g)	<i>This is calculated as (Item C – Item B) + Item D and is a negative number because the profiler is positively buoyant.</i>
2 – Ballast Tank Water Temperature (in °C)	<i>In the McLane lab tank, fresh water is used, so the density depends only on temperature.</i>
3 - Water Density (from table in g/cc)	<i>This is the density, from the table provided with the ballast sheet. If the ballasting is done in seawater, you would measure the pressure, temperature, and salinity of the water and calculate the in situ density using an equation of state.</i>
4 - MMP Volume (in cc)	<i>Volume calculation is: (Item A + Item D) – 1 / or, MMP Air Weight – MMP Water Weight / Water Density. Physically, this is the mass of the water displaced by the profiler divided by fluid density.</i>
5 - MMP Compressibility Constant (in cc/db)	<i>This is experimentally a constant of 0.3.</i>
6 - MMP volume change @ deployment pressure	<i>Compressibility constant multiplied by the pressure at Deployment (Neutral) Depth (Item 5 × Deployment (Neutral) Pressure).</i>
7 - MMP volume @ deployment pressure	<i>This is the calculated volume change at the planned neutral depth. In this calculation, the volume change is subtracted from the reference volume (Item 4 – Item 6).</i>
8 - MMP volume temperature correction constant	<i>This is the constant characterizing the dependence of MMP volume (density) on temperature.</i>
9 - Temperature difference	<i>This calculation is the temperature difference between the reference water and the temperature at the planned neutral depth (Item 2 – Deployment (Neutral) Temperature).</i>
10 - MMP volume change @ deployment temp	<i>This calculation is the temperature constant × temperature difference (Item 8 × Item 9).</i>
11 - MMP volume @ deployment temp & pressure	<i>The temperature (and pressure) of the corrected profiler volume i.e., volume at neutral pressure and temperature (Item 7 – Item 10).</i>
12 - Calculated Air Weight for Neutral MMP @ Deployment Pressure (in g)	<i>The air weight for which the MMP will be neutrally buoyant at the planned neutral depth, neutral volume × neutral density (Item 11 – × Deployment (Neutral) Density).</i>
13 - Weight Difference (in g)	<i>The difference between the required air weight and the actual air weight is the weight of lead that must be attached as ballast for the profiler to be neutrally buoyant at the planned mid-point depth (Item 12 – (Item A + Item D)).</i>
14 - Ballast Weight (in g)	<i>Final calculation is the empirical correction for the remaining uncertainty in the compressibility constant (Item 13 – 128 g). This weight is the quantity of lead to be added as ballast (removed if the quantity is negative). McLane uses an external tare weight, so the value in Item 14, (positive), is the <u>water</u> weight of lead that must be added to the profiler. If the tare weight of lead used to sink the profiler for the water weight measurement were placed inside the pressure housing, Item 14 would be the air weight of lead to add to the lead inside the pressure housing. The lead is added externally.</i>
Note that Items 15 through 19 are used only if ballast weight adjustments are necessary after the initial deployment.	
15 - Average Motor Current Difference from Previous Deployment (in mA)	<i>Average down motor current <u>minus</u> average up motor current. This difference can be used to calculate a ballast adjustment. Retain the sign (+ or –) that results from this calculation for Items 16-19. A positive difference (+) indicates a light MMP (add ballast); a</i>
16 – Effective Motor Current Change for Neutrally Bouyant MMP (in mA)	<i>Item 16 = Item 15 / 2.</i>
17 – Ballast Air Weight Correction based on 4 g/mA Effective Motor Current (in g)	<i>Item 16 × (4 g / mA)</i>
18 – Ballast Water Weight Correction based on density of lead (in g)	<i>Item 17 × (.907)</i>
19 – Corrected Ballast Weight (in g)	<i>Item 14 + Item 18</i>

Determining Air and Water Weights

Air and water weight measurements are provided for the Profiler by McLane. A complete description is also included here to provide an understanding of the process and the accuracy requirements. Contact McLane for a re-ballast if required.



The air weight should be measured on a scale with an accuracy of ± 10 gram (10g) or better.

Accuracy of the water weight measurement may be affected by microscopic bubbles on the exposed surfaces of the MMP. A continuous sheet of bubbles can coat the MMP within a few minutes of immersion. Submerging the Profiler to a depth of two meters or more prevents bubble formation. The presence of bubbles adds a significant amount of buoyancy to the profiler and invalidates the weight measurement.

In addition, the density of the MMP has a distinct temperature dependence. Changes occur in the MMP water weight during temperature equilibration. A plot of these changes over a five hour period is shown in Figure 6-1. In this case the water temperature was approximately 18°C and the initial temperature of the MMP was approximately 25°C. The ultimate change in weight was approximately 40 g (out of a total mass of ~70000 g) or 6 g/°C.

To allow for complete temperature equilibration McLane leaves MMPs suspended at the bottom of our test tank (15m deep) for a minimum of ten hours before recording their water weight.

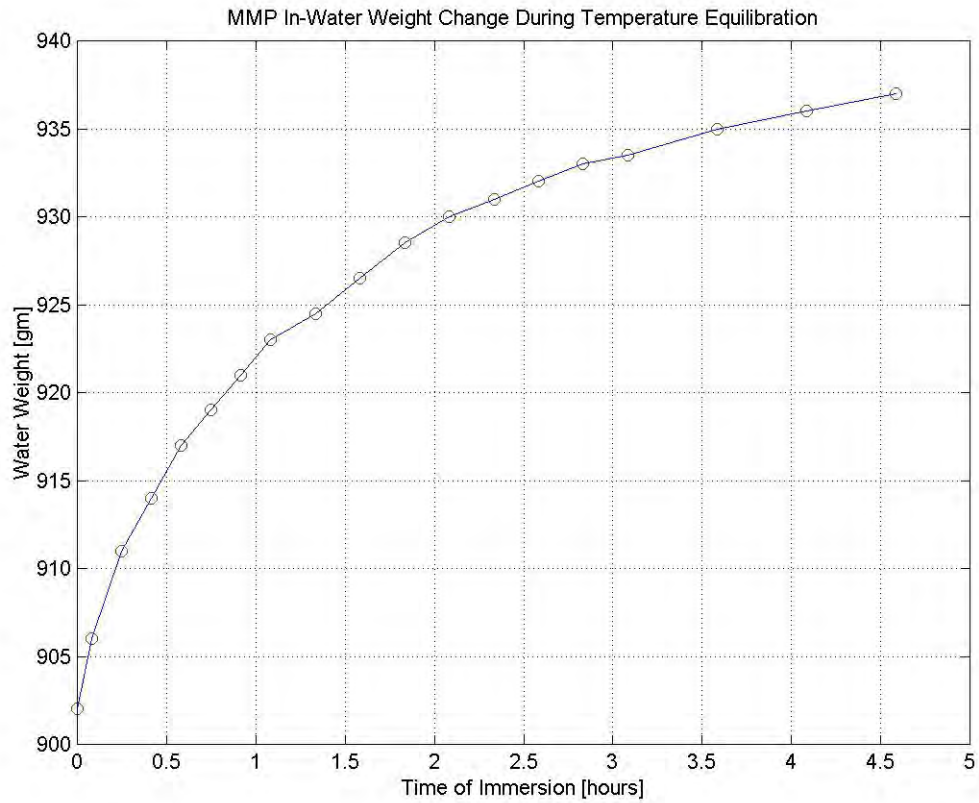


Figure 6-1: Water Weight Changes Over Five Hours

Programming a Deployment

Deployment parameters control profiler travel. Programming requires an understanding of the deployment location condition and other information such as the data density desired. A deployment schedule has profiles, intervals between profiles, and profile stops. Either Patterned or Standard programming mode is available.

Patterned profiling mode

- Deployment is programmed in the Windows-based Deployment Planner software. (included on the Profiler USB or downloaded from <http://www.mclanelabs.com/>). Patterned profiling is a flexible way to create profiles and re-usable patterns.
- Each individual profile can have different shallow and deep pressure stops. Other profile settings include stationary profiles (the Profiler does not travel the mooring line).
- Intervals can be programmed to increase or decrease profiling frequency during the deployment.
- Deployment schedule transfers to the Profiler compact flash card via direct serial communication or by removing the Profiler flash card and using a card reader.

Standard profiling mode

- Deployment is programmed directly in the MMP firmware. This is the ‘legacy’ programming mode developed for early profilers. Standard profiling is useful for very simple and short deployments.
- A single profile goes from bottom to top or top to bottom of the programmed range and intervals between the start of profiles are the same fixed amount of time.
- All profiles have the same shallow and deep limits and the same fixed amount of time between the start of profiles throughout the deployment.

Patterned Profiling Programming (Deployment Planner)

In **Patterned profiling**, the deployment start mode is always ‘Scheduled start’. The user programs a reusable deployment in Windows-based Deployment Planner software. Different shallow and deep pressure stops can be defined for each profile, and time intervals between the start of each profile can increase or decrease profiling frequency over the deployment.

Using Deployment Planner

This section explains using Deployment Planner to program a deployment. This includes the following:

Creating a project: Create or open a project. The project is the deployment schedule.

Creating a pattern and profiles: Add 1 to 100 repeatable profiles (eg, ABCAB) to a pattern(s).

Transferring the deployment schedule: Copy the schedule file from Deployment Planner to the Profiler flashcard.

Pattern

Profiles in Pattern

Visual Preview of Pattern Selected

#	ID	Name	Description	Profile Time	Duration	SLim (Shallow Li...	DLim (Deep Limit)	SBar (Shallow Li...	DBar (Deep Lim...	CheckStopInt	Telemetry Session
0	A	Rise	Ascend to Shallow Limit	08:20:00	12:00:00	0.0	6000.0	600.0	600.0	10	No
1	B	Dive	Descend to Deep Limit	08:20:00	12:00:00	0.0	6000.0	600.0	600.0	10	No
2	C	Statio...	Stationary at depp limit	00:05:00	02:32:03	0.0	6000.0	600.0	600.0	10	No

Figure 6-2: Deployment Planner Patterned Profiling

Creating a Project

Creating a project is required the first time Deployment Planner is used. After the first use, an existing project can be opened or a new project can be created.

1. Open Deployment Planner and click ‘Create a New Project’ (1) or ‘Browse for a Project’ (2) to locate existing files.

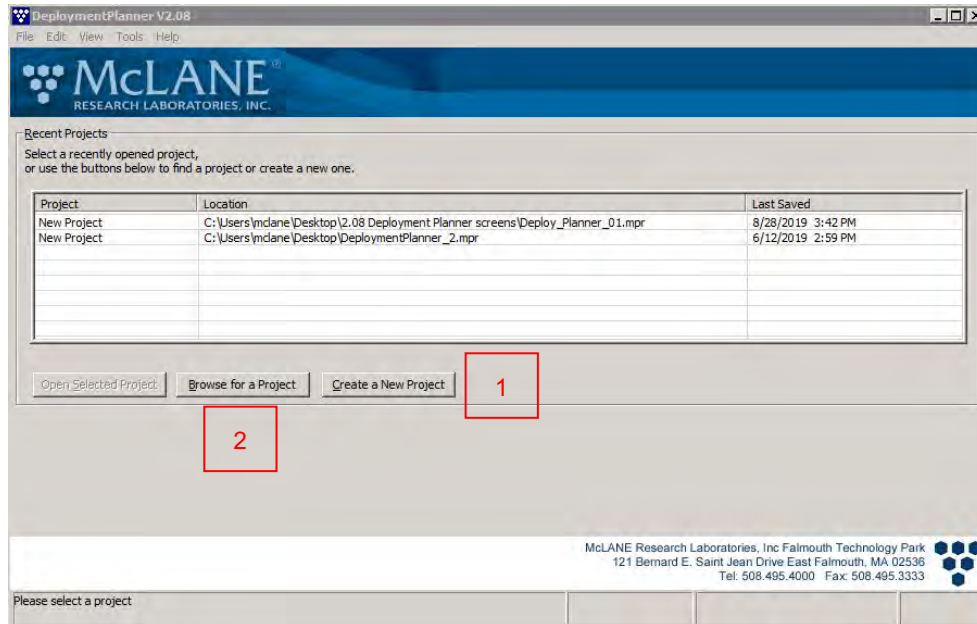


Figure 6-3: Deployment Planner Project Tab

2. Enter a project name and description (3) and define the extreme Shallow and Deep limits (in dBars) for your deployment (4). The deep limit cannot be below 6000.0 dBars. The shallow and deep limits are defaults for each profile added to the pattern. Individual profile limits can be set within the 'Patterns' tab by selecting and changing a profile.
3. Complete the checkboxes under Instrument Configuration (5) with the sensors installed on the MMP. These selections are used only for battery estimates and do not change the actual MMP firmware configuration.
4. Click 'Save Project' (6), and save the new project file to a directory (7).

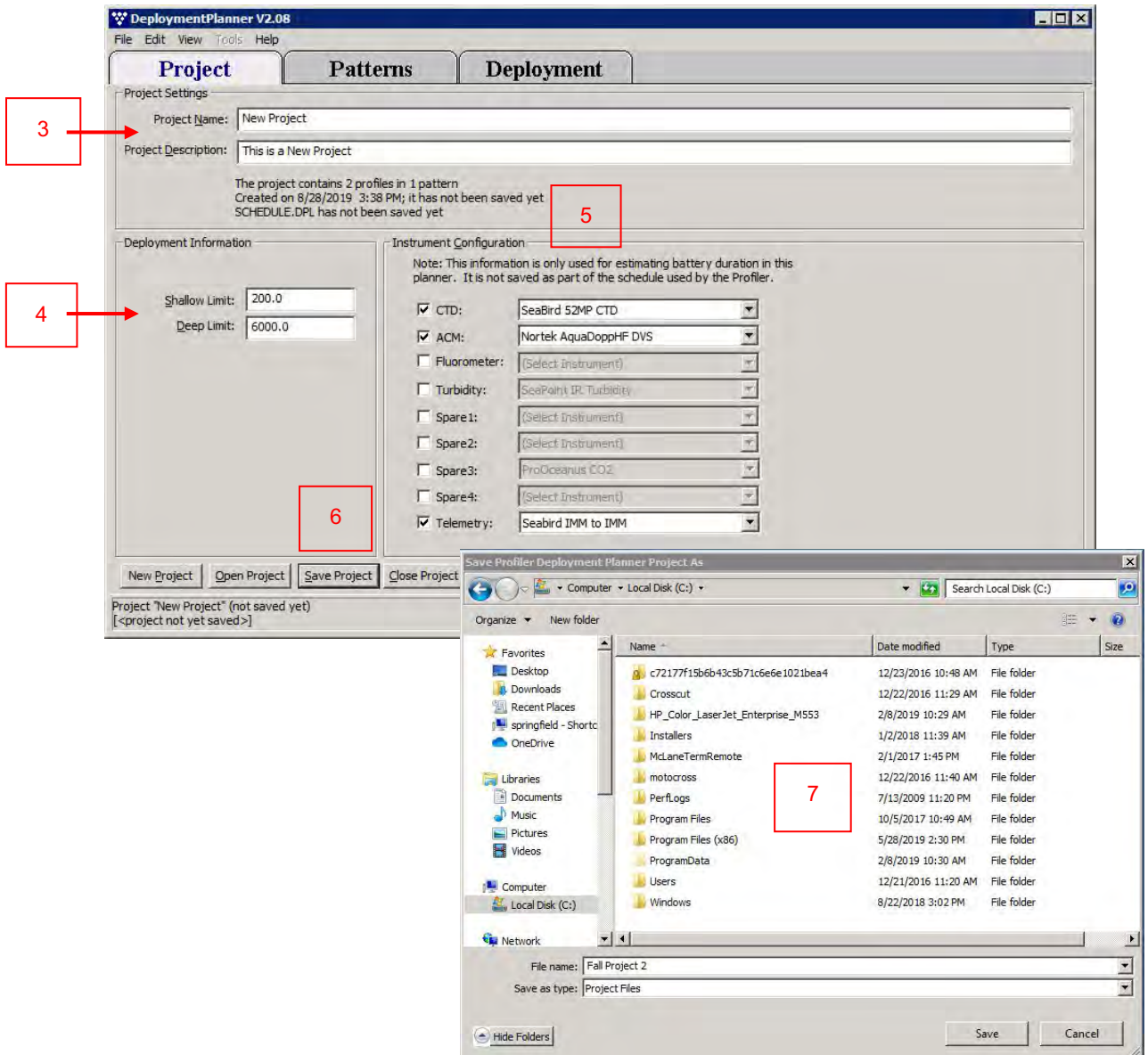


Figure 6-4: Creating a new project

5. Click the Patterns tab (8) to proceed. If a prompt displays that the shallow and deep limits have changed, click to Adjust pressure limits (9) for existing profiles.

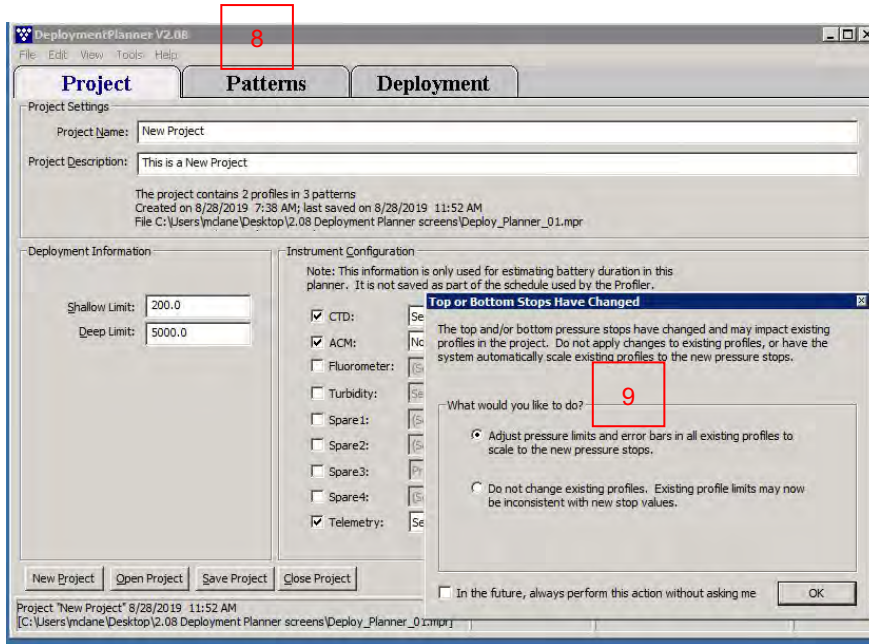


Figure 6-5: Saving a project

Creating Patterns and Profiles

The first new Pattern default is 00. Pattern 00 contains two default profiles. **A** is a rising profile and **B** is a diving profile (1). These profiles are not Dive 0, which is created on the Deployment tab.

The Pattern 00 start date/time (2) (set on the Deployment tab) is when the profiler begins scheduled sampling and affects the rest of the deployment schedule. Patterns have only dates and times (not years) to allow re-use.

Dive Zero date/time sets the year of Pattern 00. This **important Pattern 00/Dive 0 relationship** is explained in more detail later in this section.

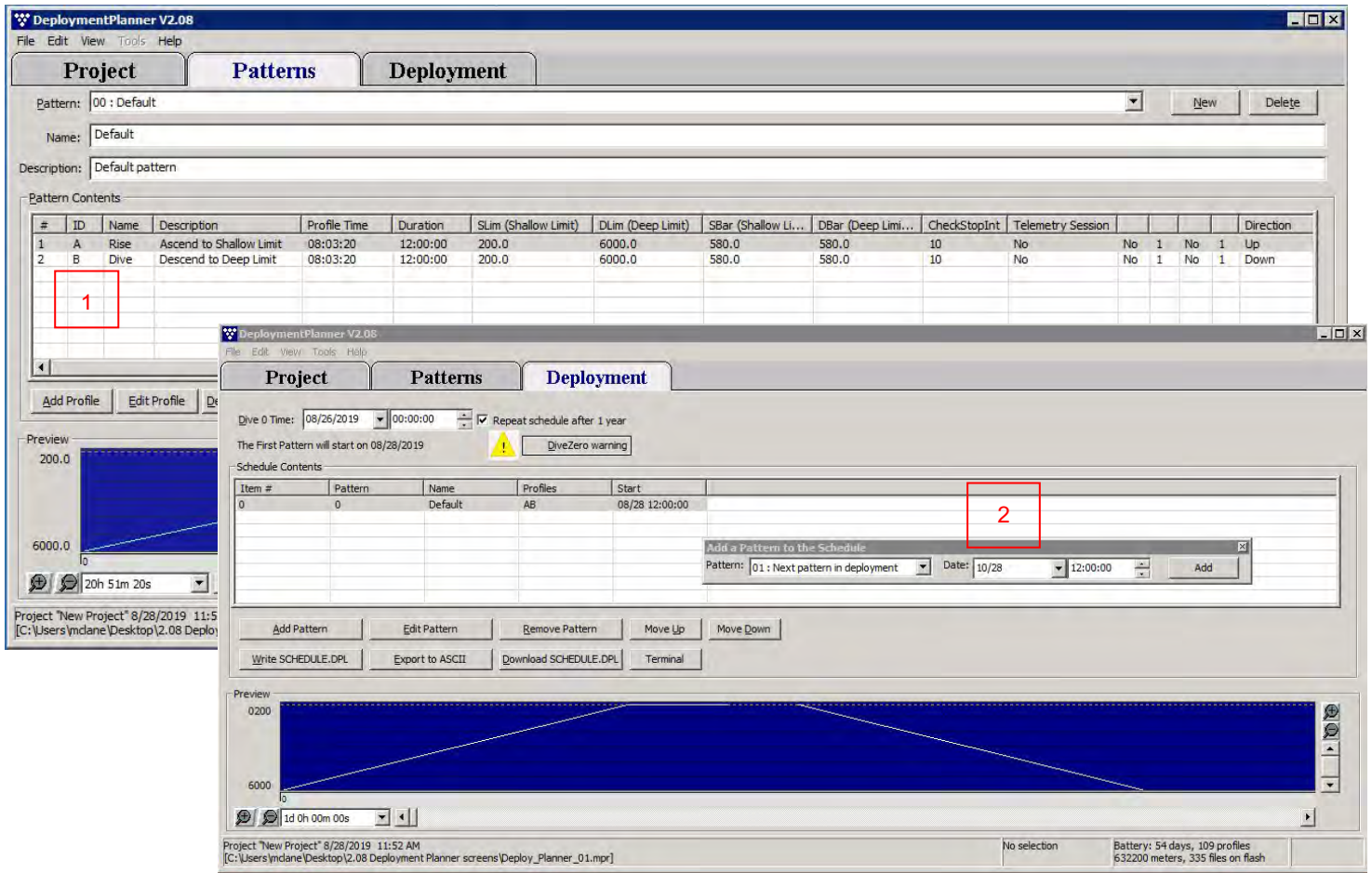


Figure 6-6: Pattern Date/Time Set on Deployment Tab

Adding Profiles to a Pattern

1. Change the default settings for profile A and B (1) by double clicking the Pattern contents line item to display the Profile Editor.

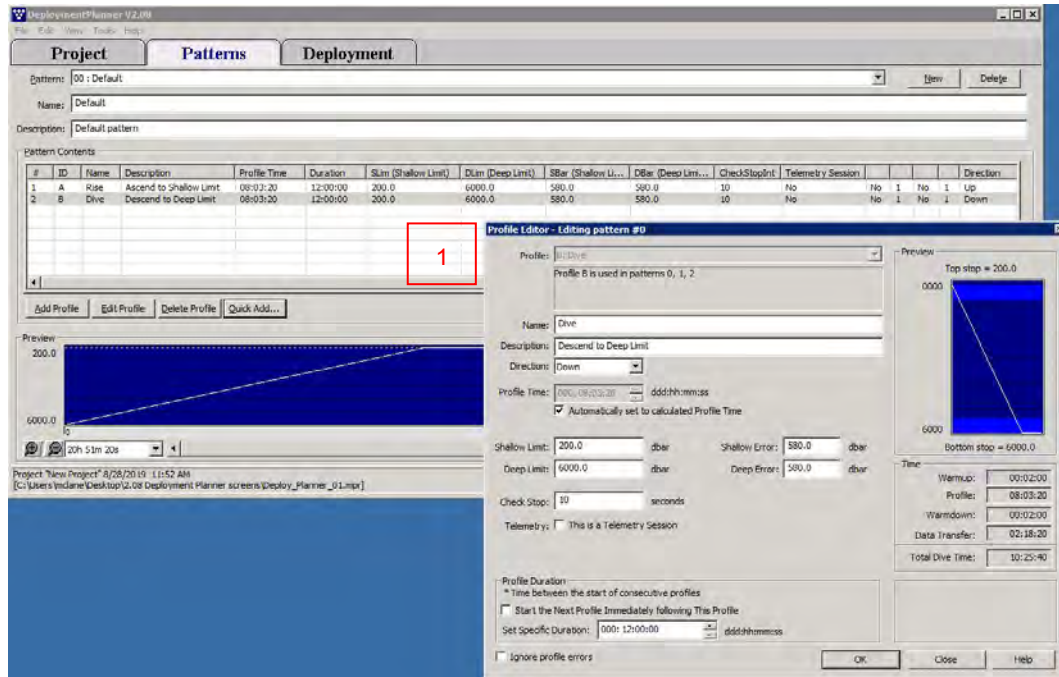


Figure 6-7: Changing a profile

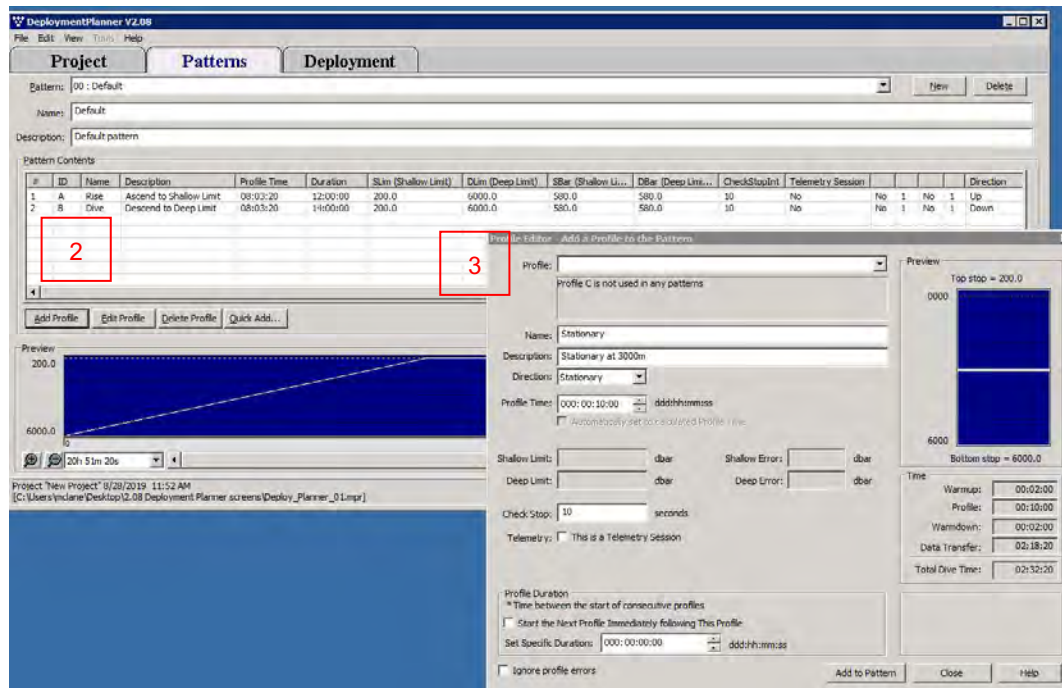


Figure 6-8: Creating a profile

2. Create a new profile by clicking Add profile (2) to display the Profile Editor (3).

Creating New Profiles

1. A new profile gets the next available un-used letter (1). The letter cannot be changed. In edit mode, Name and Description (2) can be changed.

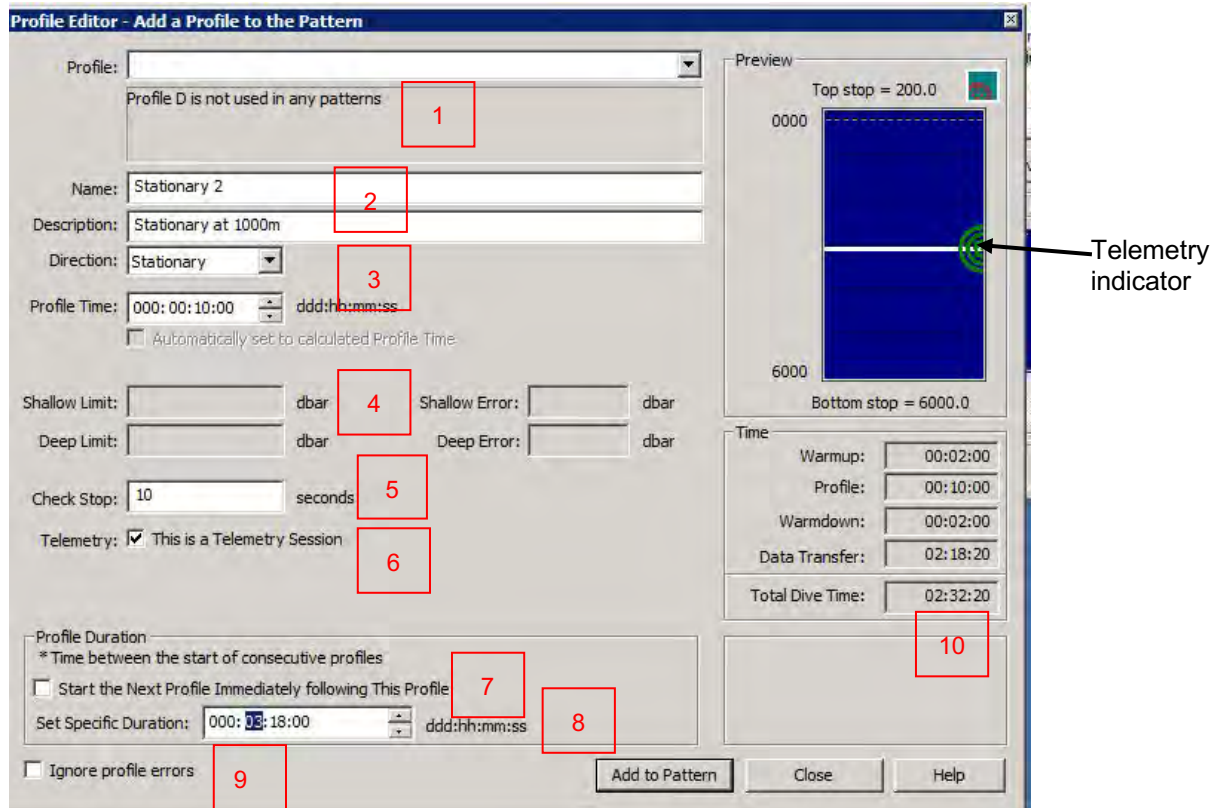


Figure 6-9: Options when creating a profile

2. Change the profile default Direction (Stationary) (3) as necessary. Other settings:
 - Shallow/Deep limits (4) are the MMP travel range on the mooring wire.
 - ‘Check Stop’ (5) sets the time between the MMP’s CTD checks to detect whether shallow/deep limits are met. Profiler motion stops on an upward profile when the ambient pressure is less than the shallow limit. On a downward profile, motion stops when pressure exceeds the deep limit.
 - ‘Telemetry’ (6) creates a profile that transmits data inductively.
 - ‘Start Next Profile Immediately’ (7) sets consecutive (back to back) profiles. ‘Set Specific Duration’ (8) sets a time between the start of the profiles. Leave at zero for an immediate start. Leave ‘Ignore Profile Errors’ (9) unchecked for profile error alerts. Total Dive Time (10), is automatically calculated based on profile settings.
3. Define profile details and click ‘Add to pattern’ to save the new profile.

Using Quick Add

Adding existing profiles to a pattern or changing existing profiles, uses Quick Add or the Profile Editor.

Clicking Quick Add, type profile letters (1) and click Ok. The profiles are added into the pattern by the order in which they are typed (2).

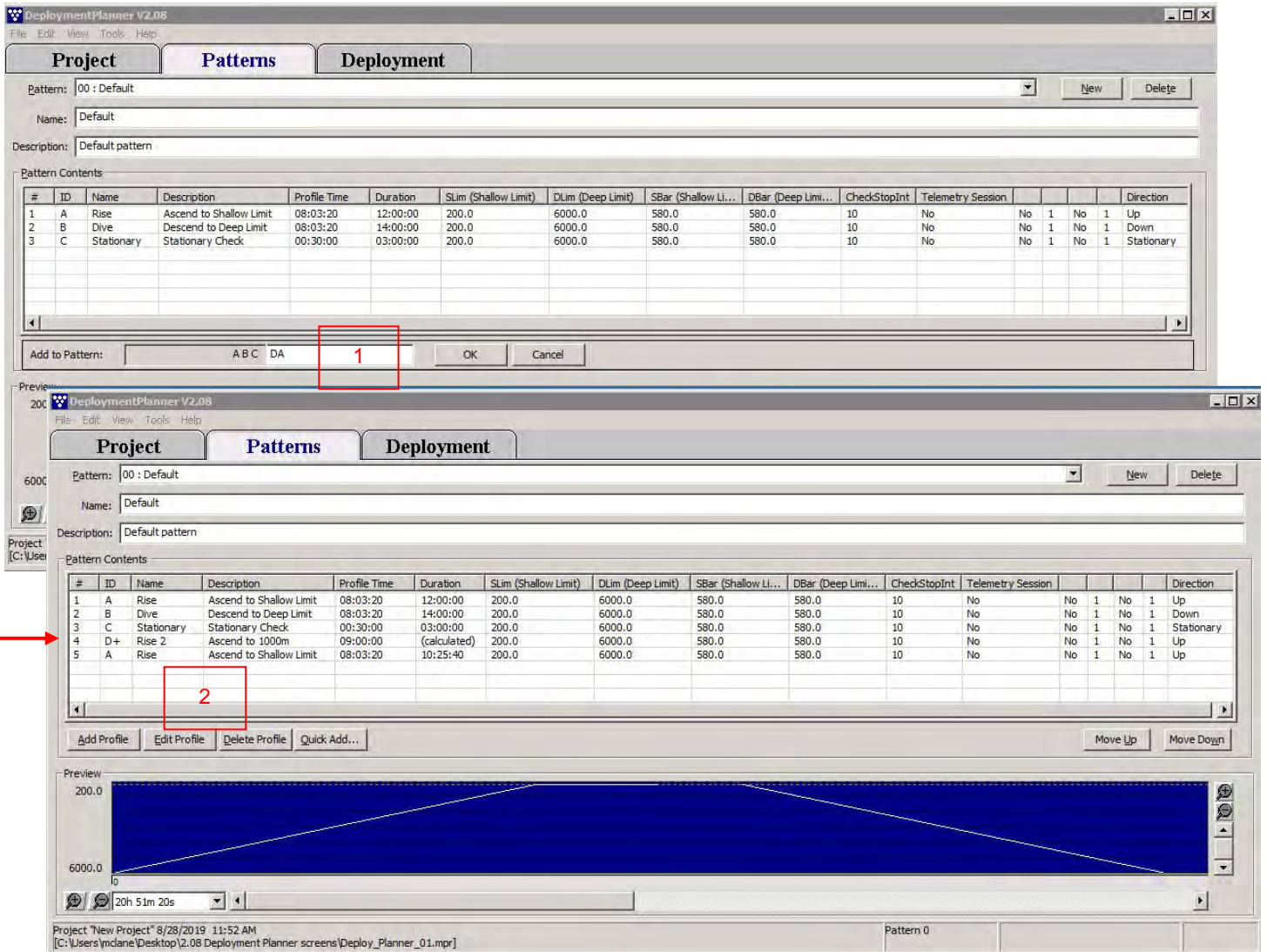


Figure 6-10: Options when creating a profile

- The first Profile in a Pattern is number Profile 1.
- The + symbol next to Profile D indicates a system-calculated setting. This automatic calculation results from 'Start next profile immediately following This Profile'.

Create Additional Patterns

1. Click New (1) to add another pattern to the deployment. A 'Create a New Pattern' (2) pop-up will appear with options for creating a new pattern. A completely new pattern can be created or use the option to copy an existing pattern and change to be a unique pattern.

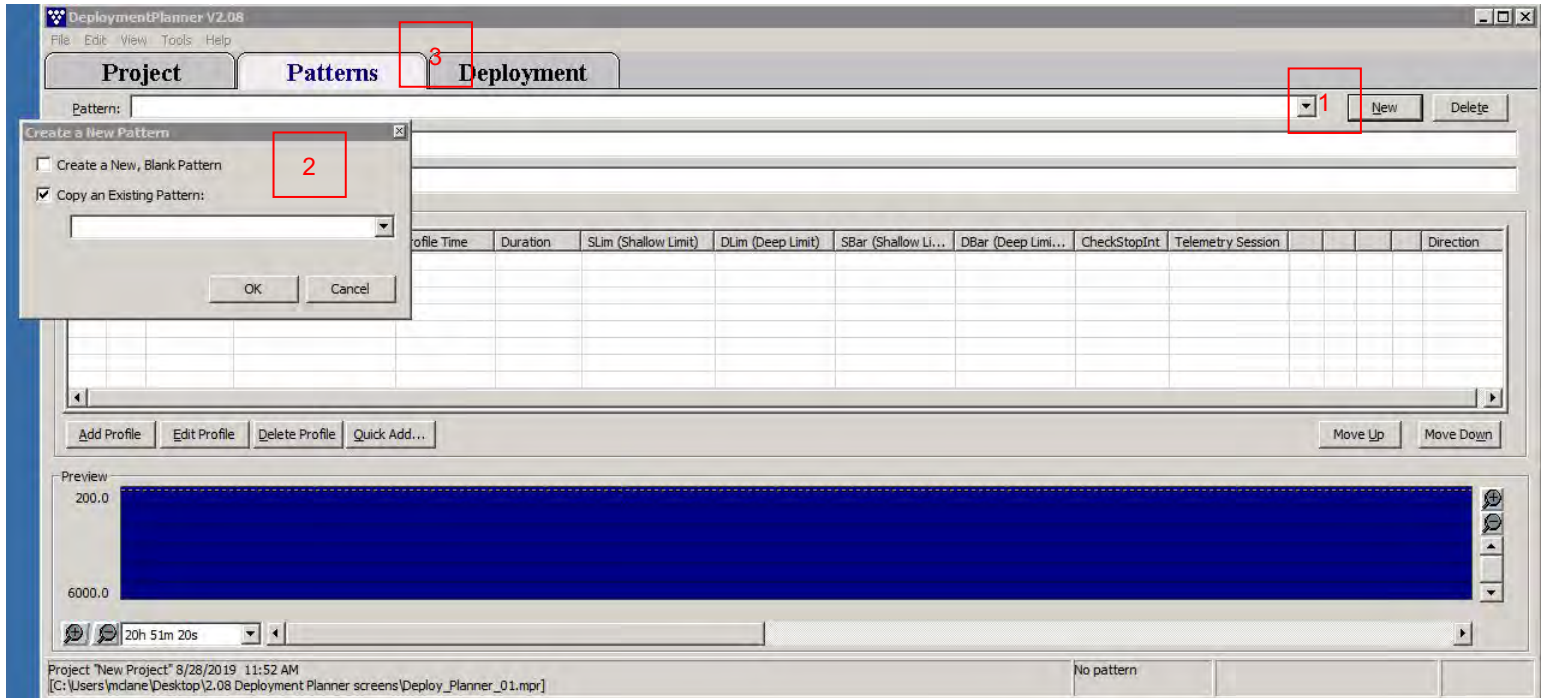


Figure 6-11: Creating another pattern

2. After profiles are added to patterns and the deployment contains the desired patterns, click the Deployment tab (3) to verify patterns and profiles and make changes.

Deployment Tab

When the Deployment tab is first viewed the Schedule Contents window lists only the default Pattern (00). To include additional Patterns, click 'Add Pattern' (1).

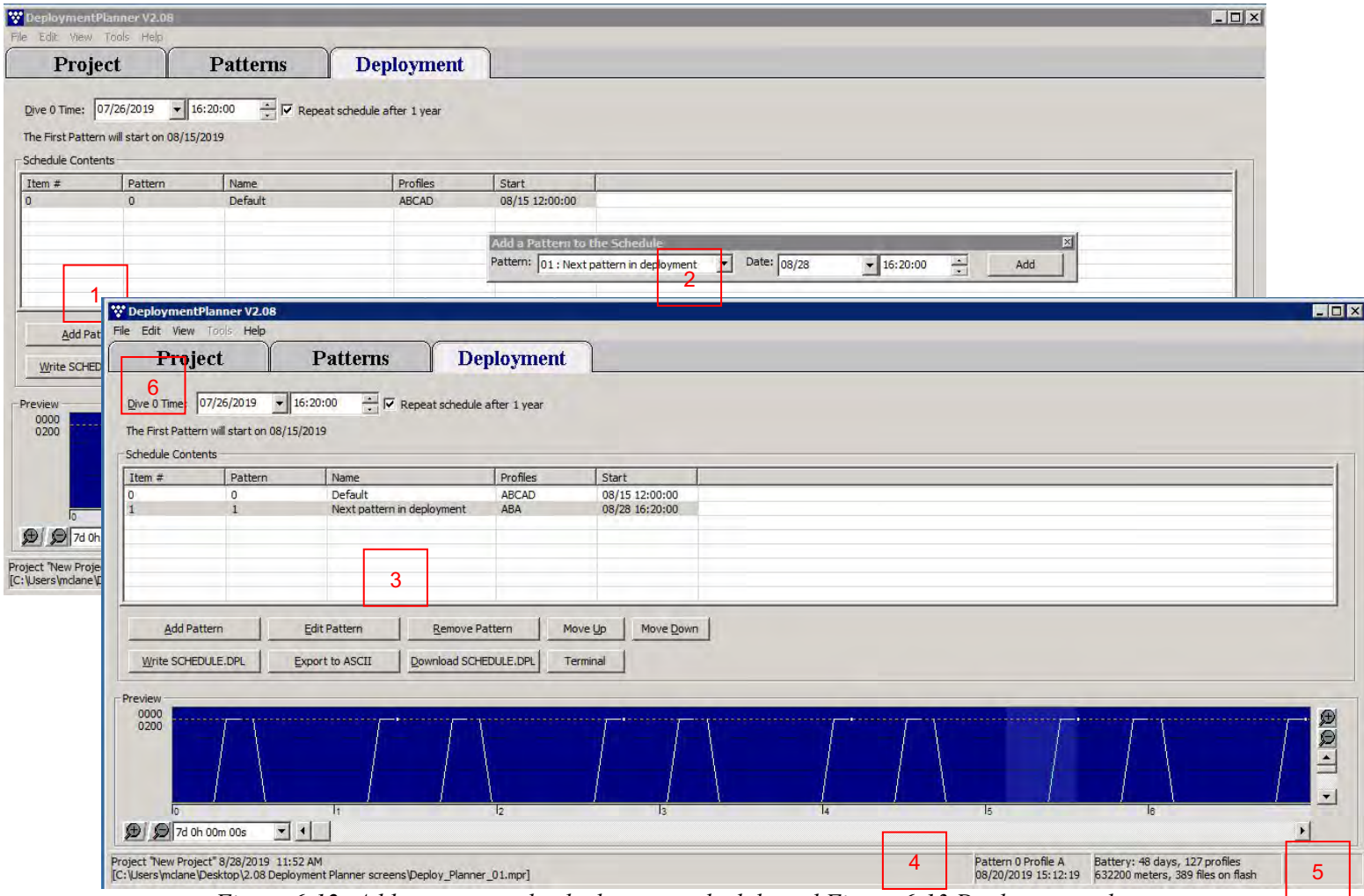


Figure 6-12: Add patterns to the deployment schedule and Figure 6-13 Deployment tab

Including Additional Patterns in the Deployment

1. Double click the Pattern in the Schedule Contents window to set the Pattern start. Patterns can be reordered using the Move Up and Move Down buttons (2).
2. Click Add, Edit or Remove buttons (3) to change patterns. Be sure to set the Pattern start date/time according to your deployment needs.
3. Click in the Preview window and the selected pattern/profile are indicated in the Status window (4). Battery endurance estimate (5) is based on the project Instrument Configuration selections, not on the sensors installed on the profiler.

- Set the deployment Dive 0 date/time (6). You can change this information in the Profiler firmware before the deployment,. See the next page to understand how Dive 0 determines Pattern 00 start year.

Contact mclane@mclanelabs.com with any questions about deployment scheduling.

Understanding How Dive 0 Determines Pattern 00 Start Year

A critical concept to understand is how Deployment Planner calculates the Pattern 00 start year based on the number of days between Pattern 00 and Dive 0. Without this knowledge, you risk programming an unintended long sleep.



If Pattern 00 starts within 30 days before or after Dive Zero, Dive Zero and Pattern 00 occur in the same year. If Pattern 00 starts more than 30 days before or after Dive Zero, Pattern 00 starts on the set date, but in the next year. A long sleep is inserted before Pattern 00.

Always check the Dive Zero warning messages. Deployment Warning messages display if a lengthy delay could affect the start Pattern 0.

Figure 6-16 shows a Dive 0 of 04/09/2019 and a Pattern 00 of 05/08. Pattern 00 is within 30 days after Dive Zero therefore Pattern 00 starts in the same year on 05/08/2019.

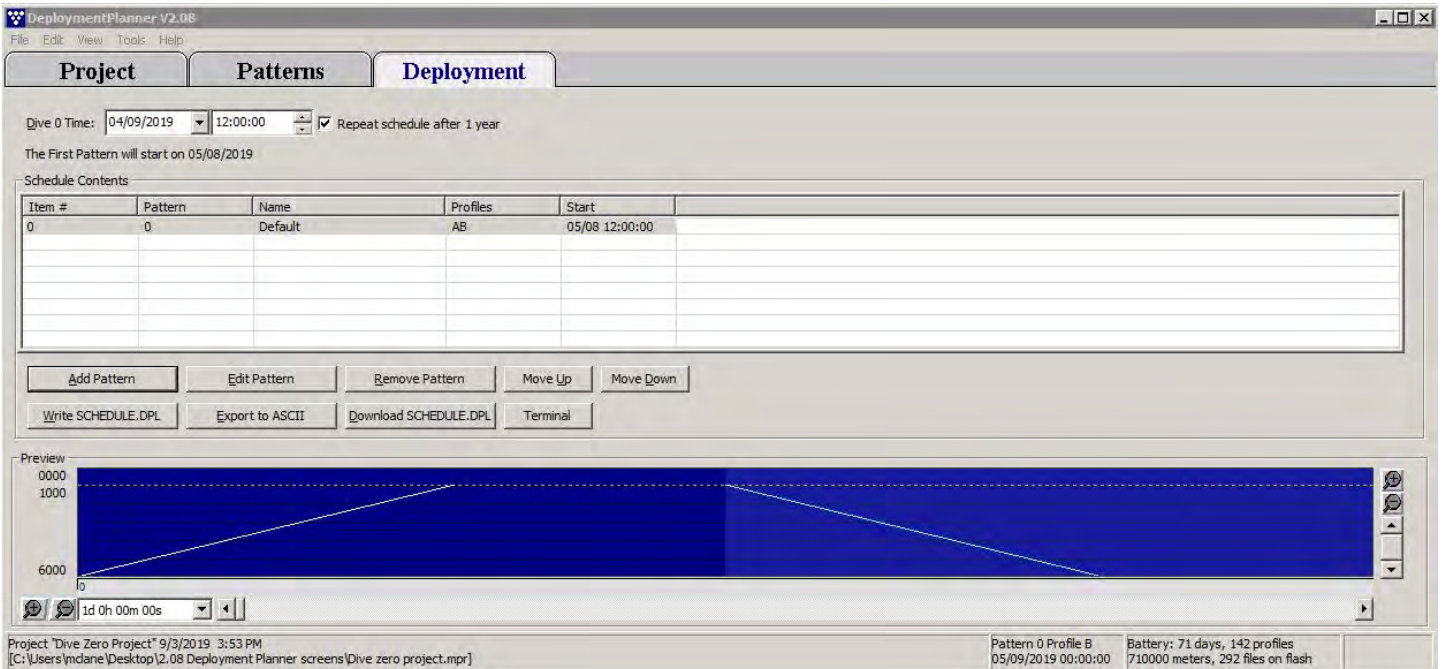


Figure 6-14: Pattern 00 Starts in Same Year as Dive 0

Figure 6-15 shows a Dive 0 Time of 07/07/2019 and a Pattern 0 Start of 07/09. Because Dive 0 is less than a week before Pattern 00, a warning message reminds you there is a risk if the deployment is delayed more than 30 days past Pattern 00, the deployment schedule will not pick up when the next date arrives. Instead, a long sleep will occur and Pattern 00 will begin on 07/09/2020.

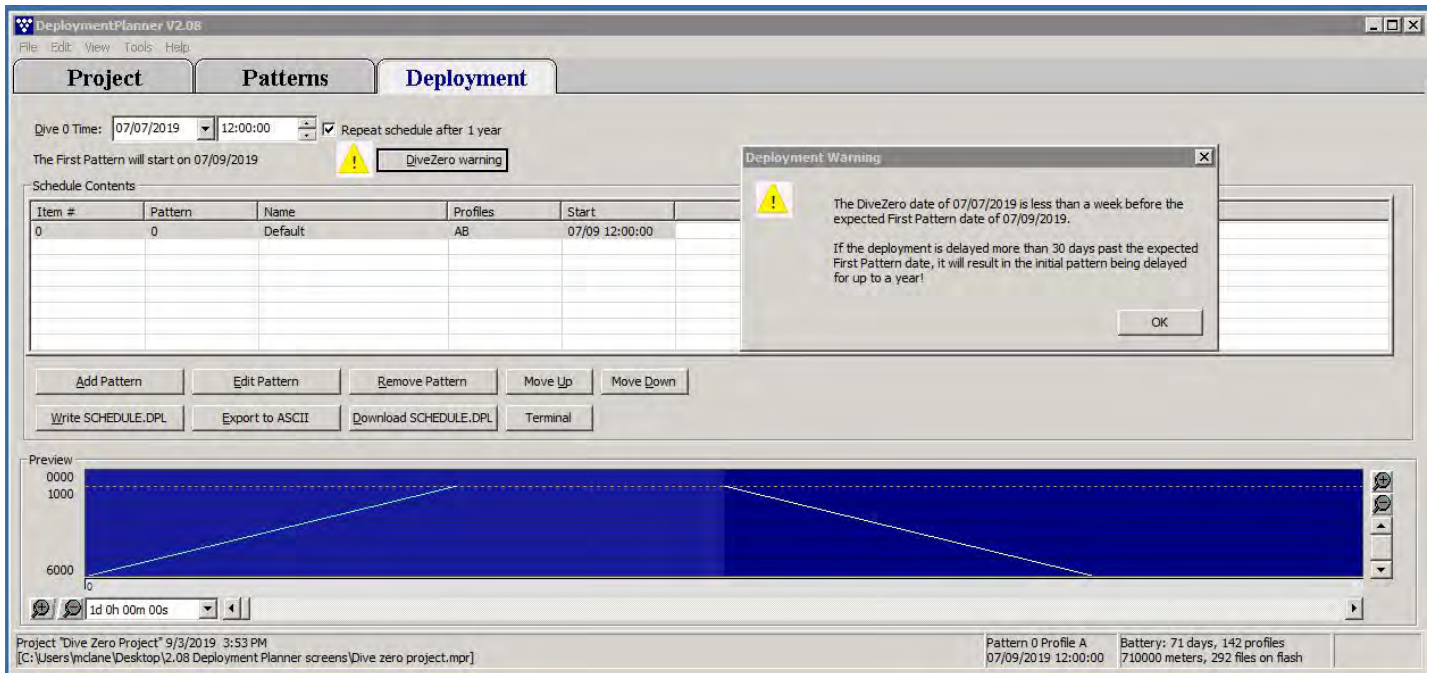


Figure 6-15: Pattern 00 Starts the Year After Dive 0

Figure 6-16 shows the warning when Dive Zero Time is 06/09/2019 and Pattern 0 Start is 05/09. As programmed, this deployment has a long sleep of 11 months after Dive 0, until the deployment begins on 05/09 2020.

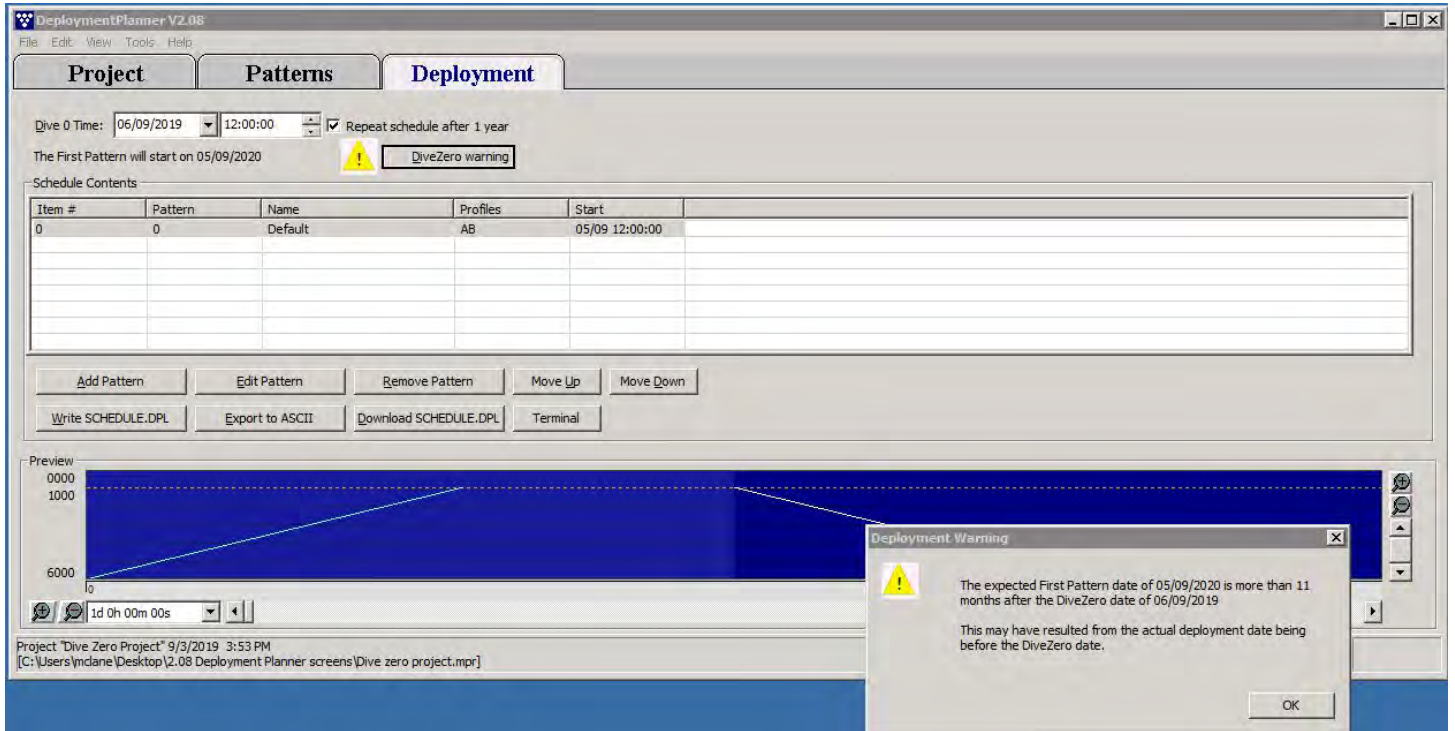


Figure 6-16: Long Deployment Delay

SCHEDULE.DPL must be on the Profiler flashcard to run a Pattern Profiling deployment. Buttons on the Deployment tab allow you to save the deployment schedule in flashcard format, load it onto the Profiler flashcard and then start a Profiler terminal emulation session.

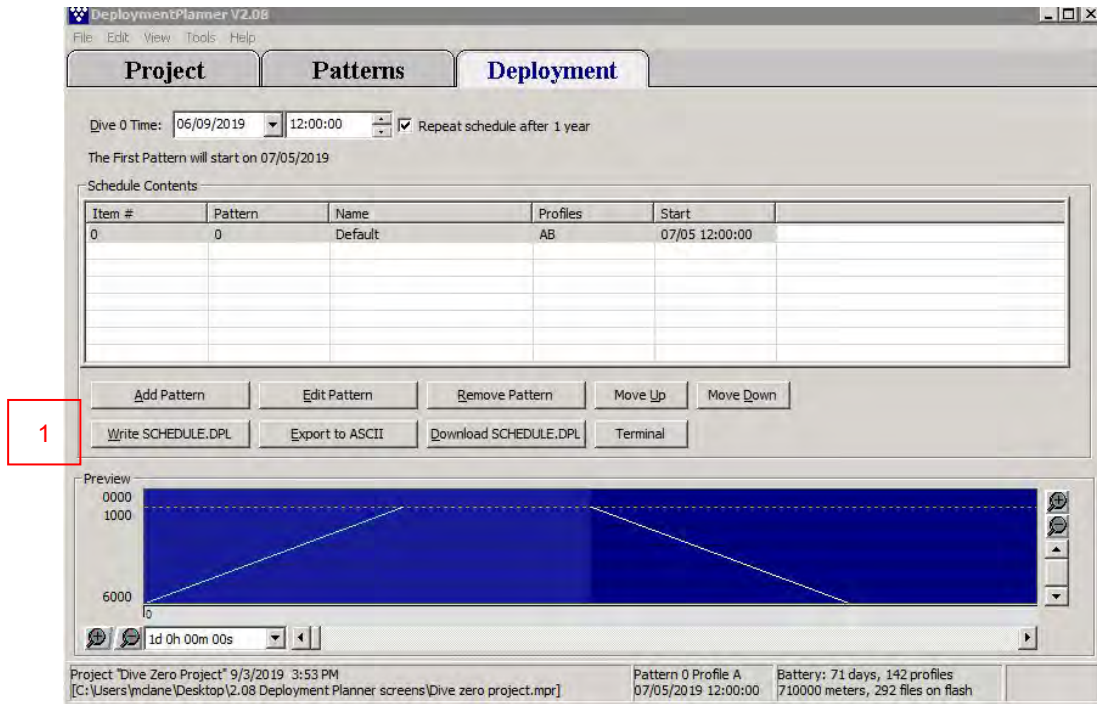


Figure 6-17: Transferring the Deployment Schedule to the Profiler

1. Choose a method to copy the SCHEDULE.DPL to the profiler flashcard.
 - Click ‘Write SCHEDULE.DPL’ (1) to save the deployment schedule in flashcard format, then write the file to the Profiler flash card through the card reader or save on the computer and copy onto the flash card using the card reader. Or, connect the COM cable, click ‘Download SCHEDULE.DPL’ and the file will copy directly to the profiler electronics.

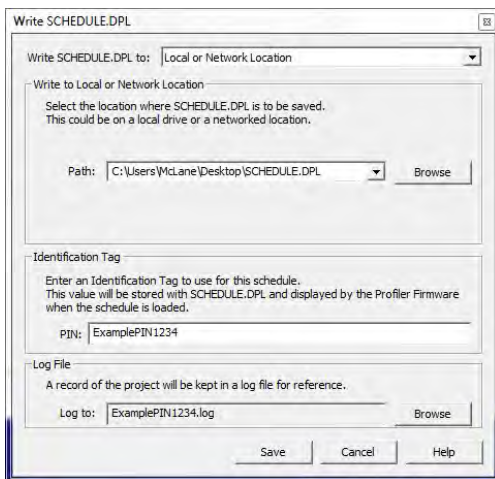


Figure 6-18: Write Schedule.DPL

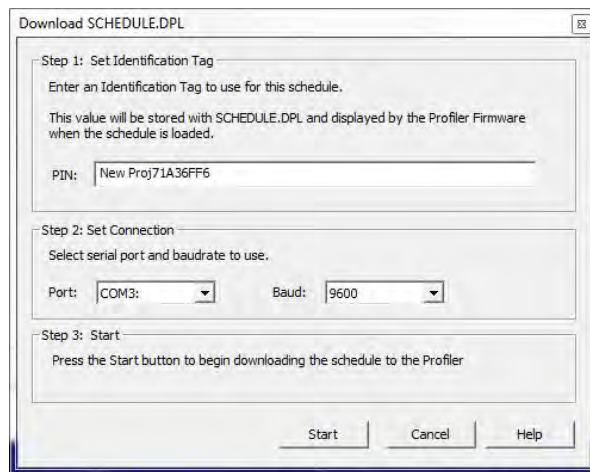


Figure 6-19: Download Schedule.DPL

Status window shows the results and number of COM protocol exchanges, and log file is also generated and saved by default in the project directory.

The screenshot displays the DeploymentPlanner V2.08 interface. The main window is divided into three tabs: Project, Patterns, and Deployment. The Deployment tab is active, showing a schedule for item 0 starting on 12/19/2019 at 12:00:00. A status window titled "Downloading SCHEDULE.DPL" is open, showing the progress of downloading the schedule to the profiler. The status window displays the following transactions:

```

COM2: Data P 13 = [0 0 0 0 0 ...]
COM2: Packet=13 (110 ms)
COM2: Sent Packet=13 Size=128 NCG=03H CRC=cbefH
COM2: Packet=13 ACKed
R: P 14
COM2: Packet=14 Size=128
COM2: Data P 14 = [0 0 0 0 0 ...]
COM2: Packet=14 (110 ms)
COM2: Sent Packet=14 Size=128 NCG=03H CRC=0FH
COM2: Packet=14 ACKed
R: P 15
COM2: Packet=15 Size=128
COM2: Data P 15 = [0 0 0 0 0 ...]
COM2: Packet=15 (109 ms)
COM2: Sent Packet=15 Size=128 NCG=03H CRC=d589H
COM2: Packet=15 ACKed
COM2: File Close returns 0
COM2: EOT sent
COM2: EOT was ACKed
COM2: Success!
Schedule download Succeeded: 100% (13 ACK, 0 NAK)
15 packets sent, 0 packets NAKed
Waiting 60 seconds for [Selection] from CP2
12/19/2019 10:52:36 SYSTEM Closing SCHEDULE.NEW.
12/19/2019 10:52:36 SYSTEM Received SCHEDULE.NEW.
12/19/2019 10:52:36 SYSTEM Checking SCHEDULE.OLD existence.
12/19/2019 10:52:36 SYSTEM Renaming SCHEDULE.001 to SCHEDULE.002.
12/19/2019 10:52:37 SYSTEM Renaming SCHEDULE.OLD to SCHEDULE.001.
12/19/2019 10:52:37 SYSTEM Checking SCHEDULE.DPL existence.
12/19/2019 10:52:37 SYSTEM Renaming SCHEDULE.DPL to SCHEDULE.OLD.
12/19/2019 10:52:37 SYSTEM Loading SCHEDULE.DPL.
12/19/2019 10:52:37 SYSTEM Scheduled dive zero time is 12/19/2019 00:00:00.
12/19/2019 10:52:38 SYSTEM Filling in schedule years ... done.
12/19/2019 10:52:38 SYSTEM Loaded SCHEDULE.DPL.
12/19/2019 10:52:38 SYSTEM Generating SCHEDULE.TXT ... done.
12/19/2019 10:52:40 SYSTEM Generating 000000000000.DAT from SCHEDULE.DPL ...
12/19/2019 10:52:40 SYSTEM Copying SCHEDULE.DPL to 000000000000.DAT.
SCHEDULE.DPL
    
```

Below the status window, a waveform preview is visible, showing a series of pulses. The status bar at the bottom indicates the project name, date, and time, along with system information like battery level and file count.

Figure 6-20: Schedule Download and Status Window

1. Connect the COM cable to the PC and the Profiler firmware.
2. On the Deployment tab, click the Terminal button (1) to start a terminal emulation session from within Deployment Planner and access the Profiler firmware.

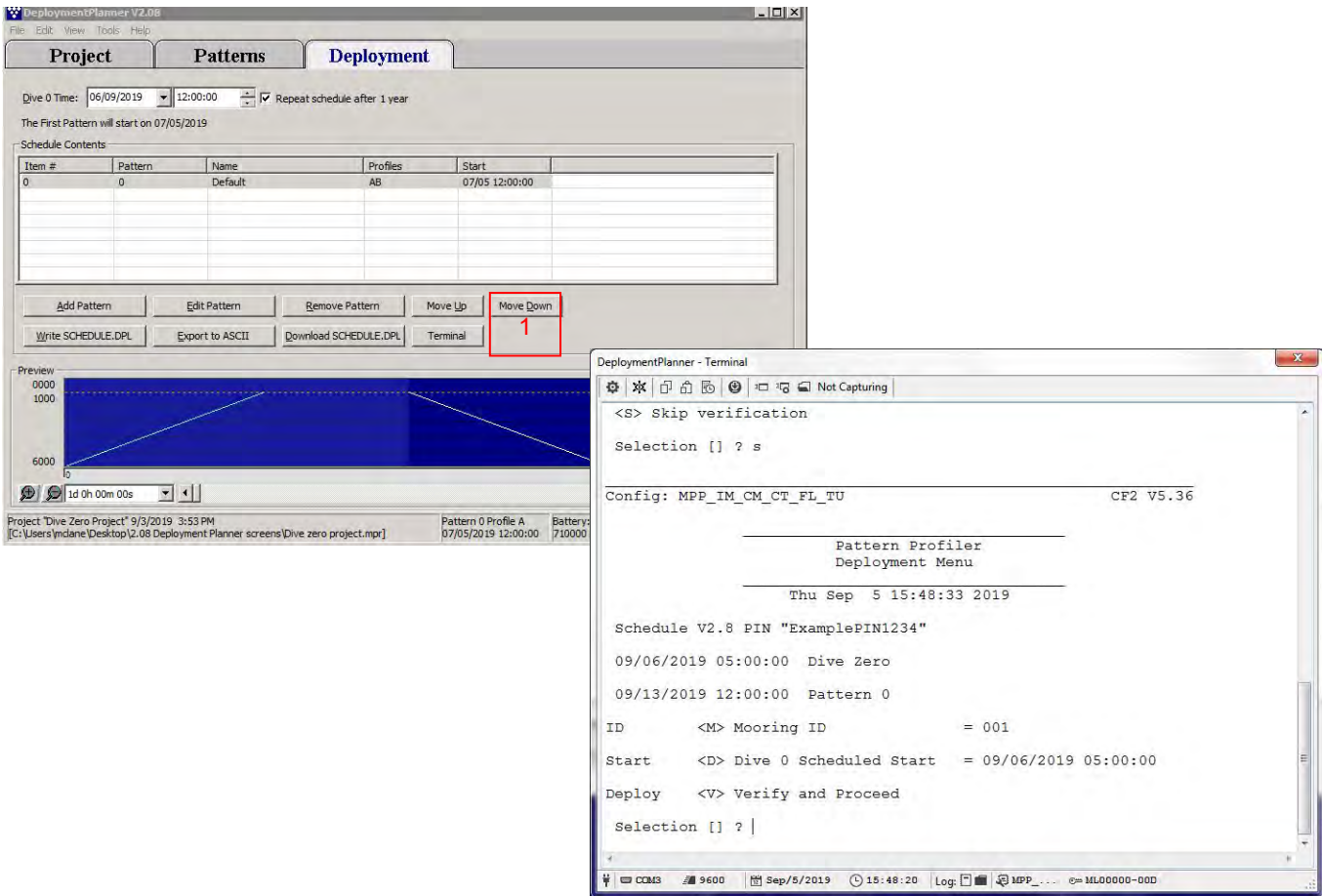


Figure 6-21: Start Terminal Emulation

Dive 0 and Mooring ID can be changed using the Profiler firmware once SCHEDULE.DPL is loaded.

Starting the Deployment

These steps are completed in the Profiler firmware with the communication cable connected. Leave the communications cable in place until the firmware prompts you to remove the cable and put the bulkhead plug in place.

Regardless of programming mode, archive a copy of the data files stored on the flash card before deploying the MMP. Once the Profiler is set into deployment mode, the flash card is reformatted, erasing stored data files.

1. In the Profiler firmware, select option <6> to start the deployment program. A series of clock and sensor verification screens display next.
2. Typing *N* indicates the clock setting does not need to be changed and displays the Sensor Verification Menu next.

```
Config: MPP_IM_CM_CT_FL_TU                               CF2 V5.35

      McLane Research Laboratories, USA
      Pattern Profiler
      S/N: ML14754-01D

      -----
      Pattern Profiler
      Main Menu

      -----
      Wed May 29 14:08:06 2019

<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 [] ? 6

05/29/2019 14:12:11  SYSTEM Filling in schedule years ... done.

Clock reads 05/29/2019 14:12:11. Change it [N] ?

05/29/2019 14:12:12  SYSTEM Setting watchdog clock ... done.
05/29/2019 14:12:13  SYSTEM Reading D:ODOMETER.DAT ... done.
05/29/2019 14:12:13  SYSTEM History: 25.46 motor hours, 99 meters.
05/29/2019 14:12:13  SYSTEM Primary battery measures 12.5V.
05/29/2019 14:12:14  SYSTEM Backup battery measures 3.0V.
```

Figure 6-22: Starting a Deployment - Patterned Profiling

3. Select the Sensor Verification method. The screens for verification will differ depending on installed sensors.

Sensor Verification Methods

- **Automated:** Automated verification (shown in Figure 6-23)
- **Manual:** Manual verification
- **Skip:** Skipping verification

```

Config: MPP_IM_CM_CT_FL_TU                                     CF2 V5.35
-----
                Pattern Profiler
            Verification of Sensor Settings
-----
                Wed May 29 14:12:14 2019
-----
<A> Automated (standard settings only)
<M> Manual   (operator controlled)
<S> Skip verification

Selection [ ] ? a

05/29/2019 14:12:17  SYSTEM Automated verification of sensor settings.

05/29/2019 14:12:17  SYSTEM Verifying CTD ...
05/29/2019 14:12:17  SBE/52MP 9.6 kBaud communication channel opened.
05/29/2019 14:12:17  SBE/52MP Powered on.
05/29/2019 14:12:18  SBE/52MP Sending command [qs].
05/29/2019 14:12:19  SBE/52MP Sending command [].
05/29/2019 14:12:19  SBE/52MP Sending command [].
05/29/2019 14:12:19  SBE/52MP Sending command [].
05/29/2019 14:12:20  SBE/52MP Sending command [pctutoff= -9.9].
05/29/2019 14:12:20  SBE/52MP Sending command [outputctdo=N].
05/29/2019 14:12:21  SBE/52MP Sending command [outputctdoraw=N].
05/29/2019 14:12:21  SBE/52MP Sending command [outputdensity=N].
05/29/2019 14:12:21  SBE/52MP Sending command [outputpressure=N].
05/29/2019 14:12:22  SBE/52MP Sending command [outputpts=N].
05/29/2019 14:12:22  SBE/52MP Sending command [outputtrt=N].
05/29/2019 14:12:23  SBE/52MP Sending command [outputpsn=N].
05/29/2019 14:12:23  SBE/52MP 9.6 kBaud communication channel closed.
05/29/2019 14:12:27  SBE/52MP Identified as V2.5, S/N 200.
05/29/2019 14:12:27  SBE/52MP Checking parameters ...

05/29/2019 14:12:42  SBE/52MP Pressure = +0.140 dbar.

05/29/2019 14:12:47  SYSTEM CTD settings verified.

05/29/2019 14:12:47  SYSTEM Verifying ACM ...
05/29/2019 14:12:48  FSI/ACM+ 19.2 kBaud communication channel opened.
05/29/2019 14:12:48  FSI/ACM+ Powered on.
05/29/2019 14:12:50  FSI/ACM+ Identified as V3.20, S/N 1354.
05/29/2019 14:12:50  FSI/ACM+ Sending command [ECHO=ON].
. . .
05/29/2019 14:13:03  SYSTEM ACM settings verified.
05/29/2019 14:13:03  SYSTEM Sensor suite initialized and ready.

Proceed with the deployment [Y] ?

```

← Display shortened to save space

Figure 6-23: Deployment Sensor Verification

4. Typing *Y* proceeds to the Deployment Menu next.

```
Proceed with the deployment [Y] ?

-----
Config: MPP_IM_CM_CT_FL_TU                               CF2 V5.35
-----

                Pattern Profiler
                Deployment Menu
-----

                Wed May 29 14:13:10 2019

Schedule V2.6 PIN "New ProjC5F58DE"

05/29/2019 14:55:00  Dive Zero
05/29/2019 15:30:01  Pattern 0

ID      <M> Mooring ID          = 001
Start   <D> Dive 0 Scheduled Start = 05/29/2019 14:55:00
Deploy  <V> Verify and Proceed

Selection [] ? v
```

Figure 6-24: Deployment Menu Patterned Profiling

5. Use the information that follows to add a mooring ID if needed.

Mooring ID <M>

Option <M> ‘Mooring ID’ is a user defined three digit mooring identifier (001 to 999) that differentiates deployment data when multiple profilers are deployed. Mooring ID is stored in the Unattended Reset, Autonomous Operation URAO, and also embedded in the metadata that precedes files transferred via the inductive modem (if the inductive communications option is installed).

Dive 0 Scheduled Start <D>

Dive 0 that was defined in Deployment Planner can be changed here. Be sure you understand how the number of days between Dive 0 and Pattern 0 affects the Pattern 0 start year to avoid an unplanned long sleep. See “Understanding How Dive 0 Determines Pattern 00 Start Year” previously explained in this chapter.

Committing to the Deployment

<V> Verify and Proceed

Proceed when deployment programming is complete. The firmware conducts profiling range and consistency checks and estimates battery expiration. Range violations and parameter inconsistencies trigger user prompts for changes.

1. Typing *V* prompts to accept and store SCHEDULE.DPL in non-volatile EEPROM.
2. System status displays followed by a prompt to overwrite the flash card with the new deployment schedule. A 'No' response returns to the Deployment Menu for further changes. A 'Yes' response stores the schedule.

```
Accept and store schedule selections [Y] ?
05/29/2019 14:13:15  SYSTEM Updating SCHEDULE.DPL ... done.
05/29/2019 14:13:16  SYSTEM Storing deployment parameters ... done.
!!!!!!!!!! WARNING: If you have not already done so,
                    Remove the CTD flow path caps NOW.

                    Failure to remove the caps prevents proper CTD operation
                    during the deployment & may cause permanent sensor damage..

Have you removed the CTD caps [Y] ?
05/29/2019 14:13:17  SYSTEM Status.

Real-time clock      Watchdog clock    Battery  Motor
05/29/2019 14:13:18, 05/29/2019 14:13:18,  12.5V,  0mA

!!!!!!!!!! CAUTION: Deployment will ERASE ALL DATA stored on flash card.

Proceed [N] ? y
```

Figure 6-25: SCHEDULE.DPL Updated and Stored

```

05/29/2019 14:13:20 SYSTEM Initializing autonomous operation.
05/29/2019 14:13:21 SYSTEM Setting motor to Free Wheel during launch ... done.

!!!!!!! NOTICE: DO NOT REMOVE communication cable until instructed.

05/29/2019 14:13:22 SBE/IMM 9.6 kBaud communication channel opened.
05/29/2019 14:13:22 SBE/IMM Powered on.
05/29/2019 14:13:23 SBE/IMM Sending command [\r\n]. .
05/29/2019 14:13:23 SBE/IMM Sending command [SETDEBUGLEVEL=2]. .
05/29/2019 14:13:24 SBE/IMM Sending command [SETTERMFROMHOST=255]. .
05/29/2019 14:13:24 SBE/IMM Sending command []. .
05/29/2019 14:13:24 SBE/IMM Sending command []. .
05/29/2019 14:13:24 SBE/IMM Sending command [GETCD]. . . . .
.
05/29/2019 14:13:28 SBE/IMM Sending command [FORCECAPTURELINE]. .
05/29/2019 14:13:29 SBE/IMM Sending command [SENDWAKEUPTONE]. . .
05/29/2019 14:13:33 SBE/IMM Sending command [#G0:@@MMP/ML14754-01/001/01]. .
05/29/2019 14:13:34 SBE/IMM Sending command [RELEASELINE]. .
05/29/2019 14:13:35 SBE/IMM Sending command [PWROFF]. .

05/29/2019 14:13:36 SYSTEM Initializing data pointers and status flags ... done.
05/29/2019 14:13:36 SYSTEM Initializing flash card.
05/29/2019 14:13:36 SYSTEM Deleting all previous data files. Please wait ...
05/29/2019 14:13:37 SYSTEM Renaming D:ERRORLOG.001 to D:ERRORLOG.002.
05/29/2019 14:13:37 SYSTEM Copying C:ERRORLOG.TXT to D:ERRORLOG.001.
ERRORLOG.TXT

1 file(s) cop
05/29/2019 14:13:38 SYSTEM Copying C:AUTOEXEC.BAT to D:.
AUTOEXEC.BAT

1 file(s) co
05/29/2019 14:13:38 SYSTEM Copying C:SCHEDULE.DPL to D:.
SCHEDULE.DPL

1 file(s) copied

05/29/2019 14:13:38 SYSTEM Copying C:SCHEDULE.TXT to D:.
SCHEDULE.TXT

1 file(s) copied

05/29/2019 14:13:39 SYSTEM Format C: /v:Profiler535 /q /p ...

05/29/2019 14:13:55 SYSTEM Copying D:AUTOEXEC.BAT to C:.
AUTOEXEC.BAT

1 file(s) cop
05/29/2019 14:13:56 SYSTEM Copying D:SCHEDULE.DPL to C:.
SCHEDULE.DPL

1 file(s) copied

05/29/2019 14:13:56 SYSTEM Copying D:SCHEDULE.TXT to C:.
SCHEDULE.TXT

1 file(s) cop
05/29/2019 14:13:56 SYSTEM Copying D:PROFILER.PXE to C:.
PROFILER.PXE

1 file(s) cop

```

From
Deployment
Planner

Figure 6-26: Sample Deployment – Patterned Profiling (1 of 2)

```
05/29/2019 14:14:01 SYSTEM Initializing disk pointers.
05/29/2019 14:14:02 SYSTEM Creating DEPLOY.DAT ... done.
05/29/2019 14:14:02 SYSTEM Creating PROFILES.DAT ... done.
05/29/2019 14:14:03 SYSTEM Creating IRQ_XCPT.LOG ... done.
05/29/2019 14:14:03 SYSTEM Creating LASTSENT.DAT ... done.
05/29/2019 14:14:04 SYSTEM Generating directory listing ...
05/29/2019 14:14:04 SYSTEM 11 files are listed in C:FILELIST.TXT.
05/29/2019 14:14:04 SYSTEM Generating S0000000.DAT from SCHEDULE.DPL ...
05/29/2019 14:14:05 SYSTEM Copying SCHEDULE.DPL to S0000000.DAT.
SCHEDULE.DPL

1 file(s) copied
05/29/2019 14:14:06 SYSTEM Flash card initialization complete.
05/29/2019 14:14:07 SYSTEM Saving emergency schedule ..... done.

05/29/2019 14:14:08 SYSTEM Current time is 05/29/2019 14:14:07.
05/29/2019 14:14:09 SYSTEM Sensor warmup at 05/29/2019 14:55:00.
05/29/2019 14:14:09 SYSTEM Initial dive at 05/29/2019 14:57:00.

!!!!!!! NOTICE: System is ready to deploy.

Remove communication cable NOW.
Install communications port dummy plug.
Attach faired bottom cap to vehicle.

05/29/2019 14:14:10 SYSTEM Waiting until 05/29/2019 14:55:00. ...
```

System sleeping.
Deploy MMP in the water.



Figure 6-27: Sample Deployment –Patterned Profiling (2 of 2)

Once the firmware enters Sleep (Suspend) mode, the firmware waits for the programmed Dive 0 time. During this time, the MMP can be deployed in the water.

Other Deployment Planner Features

The section that follows explains other useful Deployment Planner features.

Checking for Software Updates

If selected, a 'Check for Updates' feature on the File menu prompts you to upgrade to the current Deployment Planner version and installs the upgrade if you click OK. The current software version is also under the Profiler software menus on the McLane website (www.mclanelabs.com).

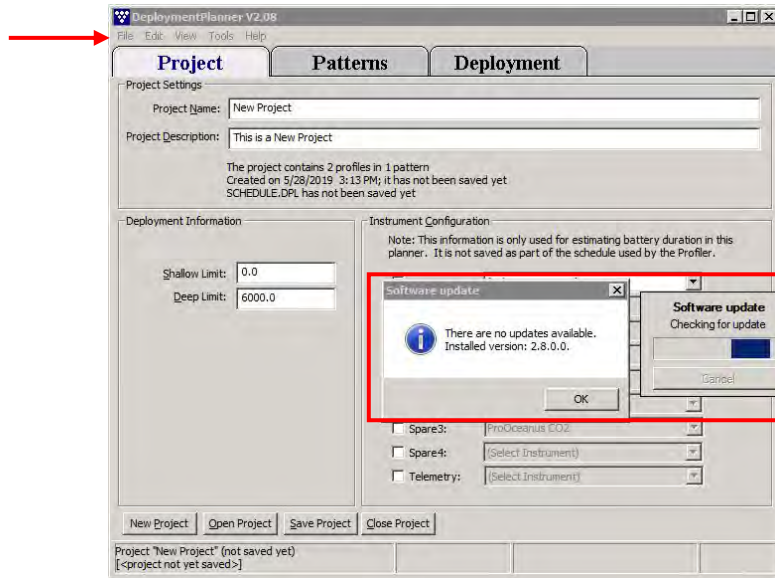


Figure 6-28: Check for Deployment Planner Updates

Changing User Preferences

Some User Preferences can be changed from the Initial screen. Available options that reset defaults including changing the battery endurance calculation.

Clearing the Recent Projects list removes the projects that are listed on the initial Deployment Planner screen.

Clicking 'Battery Calculations' displays the dialog box to change the default current draw (in mAh) for each sensor selected on the Project Tab. This affects the battery estimate only.

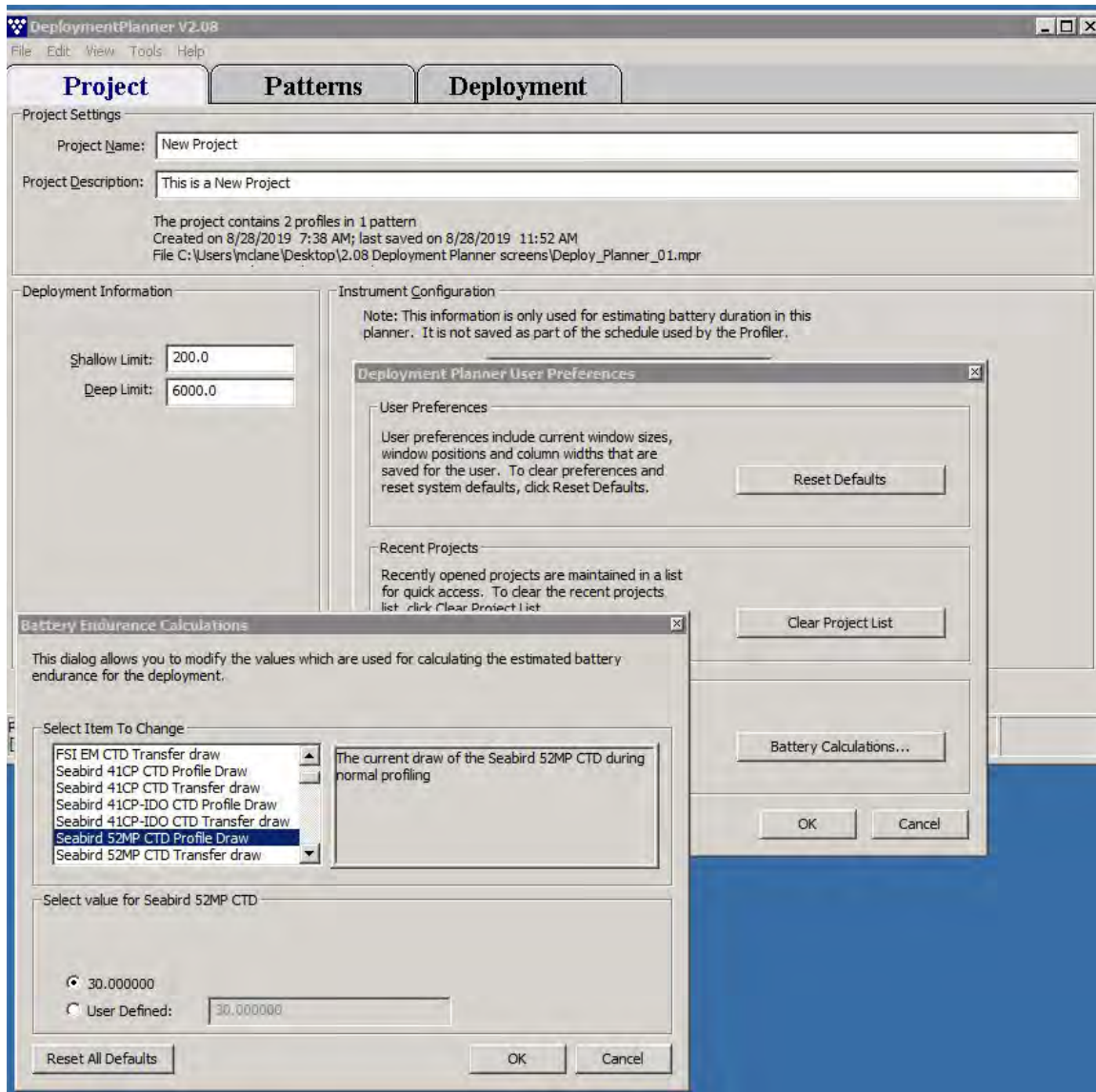


Figure 6-29: User Preferences

Standard Profiling Deployment Programming

In **Standard profiling**, the user programs a deployment schedule directly in the MMP firmware with profiles, the same fixed times (intervals) between profile starts, and profile stops. Patterned Profiling users can skip this section and proceed to page 6-52 “Final Deployment Operations”.

Profile Types

Single profiles and/or paired profiles: A single profile goes from bottom to top or top to bottom of the programmed range. Each profile has the same shallow and deep limits and the same common top and bottom stop points. Paired profiles are scheduled in up and down pairs. If no profiles are skipped or missed, odd numbered profiles go from the bottom to the top of the programmed range. Even numbered profiles go from top to bottom of the programmed range.

Regular profile intervals or bursts: Intervals are the fixed times between profiles. Burst intervals have regular intervals between bursts and shorter intervals between profiles within a burst. Single profiles, paired profiles, and burst intervals are illustrated in Figure 6-30.

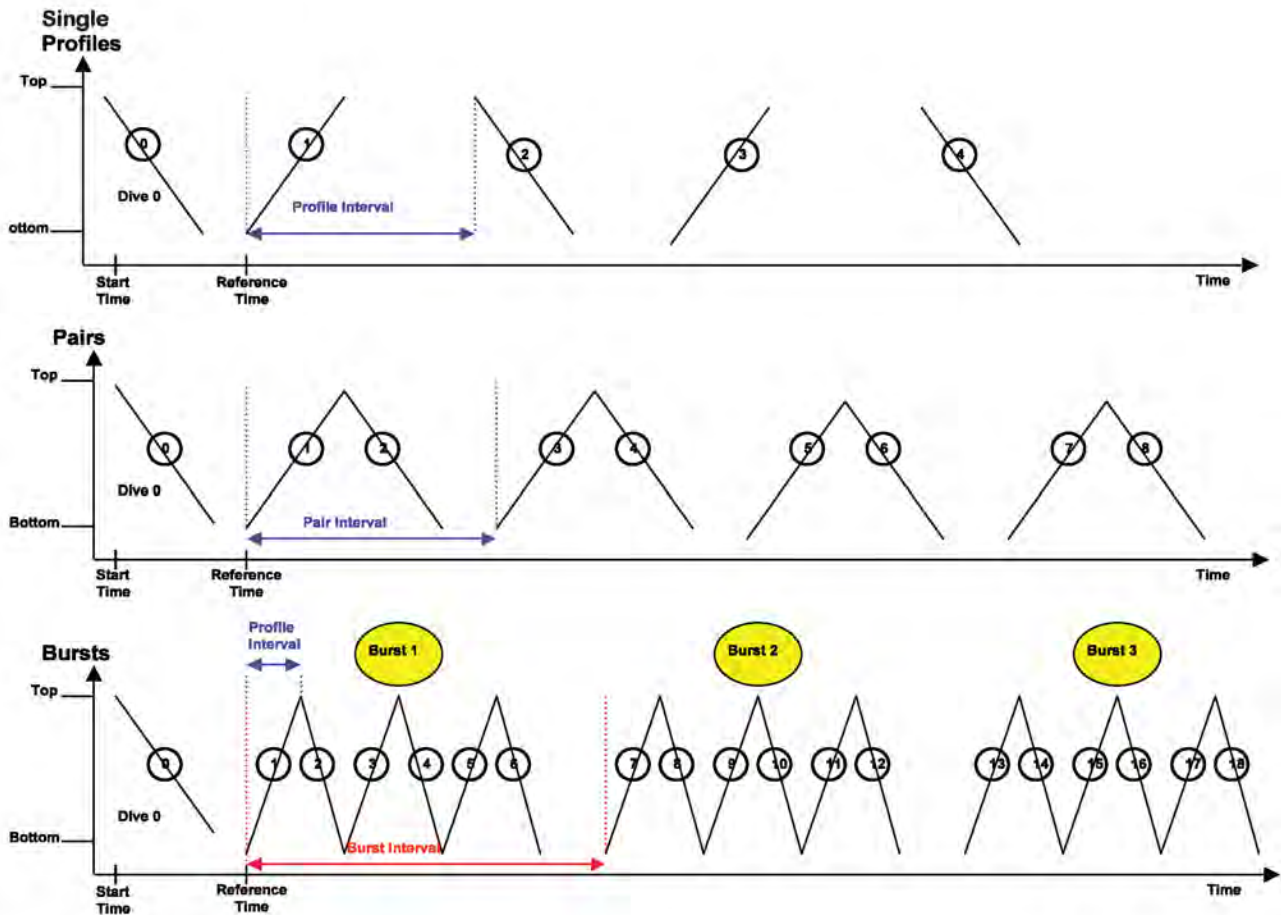


Figure 6-30: Single Profiles, Paired Profiles, Bursts: Standard Profiling

Creating the deployment schedule

The steps are completed in the Profiler firmware with the communication cable connected. Leave the communications cable in place until the firmware prompts you to remove the cable and put the bulkhead plug in place.

1. Select option <6> to start or confirm deployment schedule programming.
2. Typing *N* indicates the clock setting does not need to be changed and displays the Sensor Verification Menu next.

```
Config: MMP_IM_CM_CT_MP_PA_SC                               CF2 V5.31
                                     McLane Research Laboratories, USA
                                     Standard Profiler
                                     S/N: ML12345-01D
-----
                                     Standard Profiler
                                     Main Menu
-----
                                     Fri Jul 20 14:54:29 2018

<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 [] ? 6

Clock reads 07/20/2018 14:54:41. Change it [N] ?

07/20/2018 14:54:42  SYSTEM Setting watchdog clock ... done.
07/20/2018 14:54:43  SYSTEM Reading D:ODOMETER.DAT ... done.
07/20/2018 14:54:43  SYSTEM History: 187.67 motor hours, 92098 meters.
07/20/2018 14:54:43  SYSTEM Primary battery measures 11.9V.
07/20/2018 14:54:43  SYSTEM Backup battery measures 3.0V.
```

Figure 6-31: Starting a Standard Deployment

3. Select the Sensor Verification method (Figure 6-30 shows automatic verification):
 - Automated:** Automated verification
 - Manual:** Manual verification
 - Skip:** Skipping verification
4. Following sensor verification, type *Y* to proceed with the deployment.

```

Config: MMP_IM_CM_CT_MP_PA_SC                               CF2 V5.31

-----
                Standard Profiler
            Verification of Sensor Settings
-----
                Fri Jul 20 14:54:44 2018
<A> Automated (standard settings only)
<M> Manual      (operator controlled)
<S> Skip verification

Selection [ ] ? a

07/20/2018 14:54:54  SYSTEM Automated verification of sensor settings.
07/20/2018 14:54:54  SYSTEM Verifying CTD ...
07/20/2018 14:54:55  SBE/52MP 9.6 kBaud communication channel opened.
07/20/2018 14:54:55  SBE/52MP Powered on.
07/20/2018 14:54:55  SBE/52MP Sending command [qs].
07/20/2018 14:54:56  SBE/52MP Sending command [].
07/20/2018 14:54:56  SBE/52MP Sending command []. .
07/20/2018 14:54:56  SBE/52MP Sending command []. .
07/20/2018 14:54:57  SBE/52MP Sending command [pcutoff= -9.9]. .
07/20/2018 14:54:57  SBE/52MP Sending command [outputctdo=N]. .
07/20/2018 14:54:57  SBE/52MP Sending command [outputctdoraw=N]. .
07/20/2018 14:54:58  SBE/52MP Sending command [outputdensity=N]. .
07/20/2018 14:54:58  SBE/52MP Sending command [outputpressure=N]. .
07/20/2018 14:54:59  SBE/52MP Sending command [outputpts=N]. .
07/20/2018 14:54:59  SBE/52MP Sending command [outputtrt=N]. .
07/20/2018 14:55:00  SBE/52MP Sending command [outputsn=N]. .
07/20/2018 14:55:00  SBE/52MP 9.6 kBaud communication channel closed.
07/20/2018 14:55:04  SBE/52MP Identified as V2.5, S/N 184.
07/20/2018 14:55:04  SBE/52MP Checking parameters ...

07/20/2018 14:55:19  SBE/52MP Pressure = +0.050 dbar.

07/20/2018 14:55:24  SYSTEM CTD settings verified.
. . . ← Display shortened to save space
07/20/2018 14:56:36  OST/5kMP Settings verified.
07/20/2018 14:56:36  SYSTEM Sensor suite initialized and ready.

Proceed with the deployment [Y] y

```

Figure 6-32: Sensor Verification

5. Use the detailed descriptions that follow to program the deployment schedule (profiles, intervals, and profile stops) or skip to “Committing to the Deployment” section if the deployment schedule is already programmed.

```

Config: MMP_IM_CM_CT_MP_PA_SC                               CF2 V5.31

-----
                Standard Profiler
                Deployment Menu
-----

                Fri Jul 20 14:56:38 2018

Start:
<Z> Countdown delay           12:00:00 [HH:MM:SS]
<M> Mooring ID                001

Schedule:

<I> profile start Interval    000 12:00:00 [DDD HH:MM:SS]
<R> Reference date/time       05/08/2018 00:00:00
<P> Paired profiles           disabled
<N> profiles per burst        disabled
<B> Burst interval            disabled

Stops:

<S> Shallow pressure          1.5 dbar
<D> Deep pressure              11.5 dbar
<H> sHallow error              1.0 dbar
<E> dEep error                 1.0 dbar
<T> profile Time limit        00:03:00 [HH:MM:SS]
<K> stop check interval       30 seconds

Installed Sensors & Options:

Nortek AquaDopp2 DVS ----- AQUADOP2 Active & queued
Seabird 52MP CTD ----- SBE/52MP Active & queued
OceanServer5000 MotionPack ---- OST/5kMP Active & queued
Biospherical PAR ----- BII/PAR 2200 @ 1X, 5 samp/avg
Wetlabs ECO BBFL2 ----- WL/BBFL2
Seabird Inductive Modem ----- SBE/IMM @ 1200 Baud

Endurance Estimates:
11 mAh / profile
14118 total profiles / 240 Ah
Battery expiration on 10/11/1901

Deploy:

<V> Verify and Proceed      <^c> Cancel deployment

Selection [] ? v

```

Figure 6-33: Deployment Programming Standard Profiling

Start Parameters

Option <Z> defines the start of Profile 0 (Dive 0) which begins the deployment (1). The first dive can have a countdown delay or scheduled start.

Countdown delay: A countdown delay of hours, minutes, and seconds can be set between 00:00:00 and 24:00:00. Profile 0 begins when the countdown reaches zero.

Scheduled start: A scheduled start is an absolute date and time. Profile 0 begins when the Real Time Clock (RTC) reaches the specified time. The scheduled start time must be at least 10 minutes in the future when 'V' Verify and Proceed is selected.

```
Start:
<Z> Countdown delay      12:00:00 [HH:MM:SS] 1
<M> Mooring ID           001 2
Selection [] ? z

(S)cheduled start or (C)ountdown delay [] ? c

Enter deployment delay

Hours    ( 0-24) [ 0] ? 0
Minutes  ( 0-59) [ 0] ? 6
Seconds  ( 0-59) [ 0] ? 0
```

Figure 6-34: Start Parameters

Mooring ID <M>

Option <M> 'Mooring ID' (2) is a user defined three digit mooring identifier (001 to 999) that differentiates deployment data when multiple profilers are deployed. Mooring ID is stored in the Unattended Reset, Autonomous Operation URAO and also embedded in the metadata that precedes files transferred via the inductive modem (if the inductive communications option is installed).

Profile Schedules and Intervals

The profile schedule, intervals, bursts, stops, pressure rate, pressure limits and ramming action are all user defined settings that affect the deployment schedule.

Profile interval is the time between profiles (or profile pairs). If the interval is less than the time required to complete a profile (or profile pairs), the next profile (or pair) will be skipped to prevent asynchronous profiling. Asynchronous profiling is continuous and provides the most dense MMP sampling possible. During continuous profiling there is no delay between profiles (each profile starts as soon as data from the previous profile is saved). Other settings that affect the deployment schedule include reference date/time and ramming action.

Profile Start Interval/Pair Start Interval <I>

Option <I> 'Profile start interval' (3) is the time between profiles (or pairs). Continuous profiling is set by entering 0 for the Profile Start Interval. The Profile Start Interval must be greater than the Profile Time Limit (one of the Stops conditions).

```
Schedule:
<I> profile start Interval 000 00:30:00 [DDD HH:MM:SS] 3
<R> Reference date/time 11/29/12 15:10:33 4
<P> Paired profiles disabled 5
<N> profiles per burst disabled 6
<B> Burst interval disabled 7
```

Figure 6-35: Schedule and Stops Settings

Reference Date/Time <R>

Option <R> 'Reference date/time' (4) keeps the deployment schedule in sync. If an unexpectedly long profile time occurs, the reference time algorithm synchronizes the profile start time with the programmed deployment schedule. If the actual profile time is less than or exceeds the Profile Start Interval, the reference time algorithm adjusts the profile start times as needed. Reference time is also used during recovery from a Watchdog reboot.

Figure 6-34 shows profiles starting at 0000 hrs, 0600 hrs, 1200 hrs, 1800 hrs, and so on. The initial reference time is set to the intended start time of Profile 1. The actual time required for Profile 1 is less than the start interval for the deployment, so the reference time calculation yields 0600 hrs as the expected start time for Profile 2. In Profile 2, the actual time required exceeds the start interval, so the reference time calculation yields 1800 hrs and the profile scheduled at 1200hrs is skipped. In this example, Profile 3 would begin at 1800 hrs.

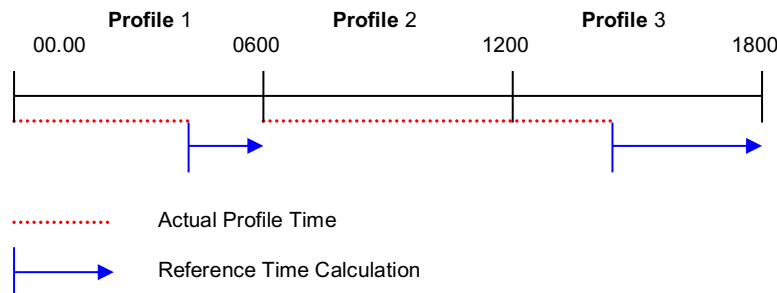


Figure 6-36: Reference Date/Time Example

Paired Profiles <P>

When Paired Profiles are enabled (5), the deployment is scheduled in up-down pairs. The down profile starts as soon as the up profile data storage is completed. The start interval is the time between the start of motion for sequential up profiles.

Profiles Per Burst/ Pairs Per Burst <N>

If Burst Profiling is disabled (set to 1), the profiling schedule is determined by the profile start interval. A number greater than 1 enables Profiles per Burst (6) (the firmware also displays a default Burst Interval which should be changed based on specific deployment needs). Profile 0 is not part of the number of Profiles per Burst.

Burst Interval

The burst interval (7) is the time between bursts of profiles or pairs. Sampling with profile bursts or profile pairs strikes a balance between the need for relatively high frequency profiling given the need for long time series and the finite battery endurance. When Profiles per Burst is enabled (set to a number greater than 1), the firmware displays a default Burst Interval. Change this default to the desired Burst Interval. Range is 0 seconds to 366 days in 1 second increments. The MMP continues a burst until it has completed all of the profiles or pairs in the burst. If this requires longer than the burst interval, the next burst (or bursts) will be skipped. Range is 1 – 1000 profiles or pairs of profiles.

Stops Parameters

Zero pressure rate is based on the pressure rate (dP/dt), calculated using CTD pressure measurements. When zero pressure rate is detected, the Profiler's action depends on the depth, current profiling direction, and shallow or deep error programmed. With an MMP nominal profiling speed of 25cm/s, wave mooring motions that modulate steady MMP progress can falsely detect a zero pressure rate.

CTD pressure rates are averaged specified amount of time. Zero pressure is detected when the average drops below a specified pressure rate threshold. Settings that impact the zero pressure rate detection are explained below. The Advanced Interface menu (Figure 6-38) contains these settings.

Pressure Rate Threshold: (8) The threshold (dbar/sec) the CTD pressure rate, averaged over the Pressure Rate Time Limit, must stay above. A zero pressure rate is detected when the pressure rate average is below this threshold. Default is 0.045 dbar/s ~ (4.5 cm/s).

Pressure Rate Time Limit: (9) Amount of time the CTD pressure rates are collected before the average pressure rate is calculated. Default is 120 seconds.

Backtrack Iterations: (10) Number of times the Profiler moves upwards on the mooring wire to clear an obstruction and prevent a zero pressure rate detection. The obstacle detection does not have to be at or near the same depth. The profile continues if the mooring wire clears. If the wire does not clear, the zero pressure rate triggers after the Pressure Rate Time Limit. Each profile restart is logged in the engineering data file. Default tries is 3. Disable backtracking by extending Deep and Shallow errors to cover the full extent of the profiling range

```
Config: MMP_CM_CT_FL_TU                                     CF2 V5.31
-----
                Standard Profiler
                Advanced Interface
-----
                Fri Jul 13 11:05:26 2018
<0> full Speed                0.250 dbar/sec
<1> pressure Rate threshold    0.045 dbar/sec
<2> pressure rate Time limit   60 seconds
<3> Sensor warmup             120 seconds
<4> Sensor warmdown           120 seconds
<7> Configure active sensors   A-C-----
<8> Configure offload queue    A-C-----
<A> Annunciate comm traffic    NO
<B> Backtrack iterations       3
<D> Display verbose messages  NO
                ← Display shortened to save space
```

Figure 6-37: Advanced Interface Default Settings

CTD pressure measurements are time tagged and stored in the engineering data file. The pressure measurements and time tags are kept in rolling, indexed buffers so that the mooring motion filtering requirement of the calculation can be verified. Failed pressure acquisitions are flagged and not used in the calculation.

The next zero pressure rate detection after the programmed number of backtrack iterations terminates the profile. Following profile termination, the sensor data acquisition continues for the warm down period before sensor logging is stopped and sensor data is transferred to the Profiler flash card.

Shallow and Deep Pressure Limits

Shallow and deep pressure are ambient pressure levels (dbars) the MMP travels between. Physical locations on the mooring wire are referenced in meters.

Stops:		
<S> Shallow pressure	1.5 dbar	11
<D> Deep pressure	11.5 dbar	12
<H> sHallow error	1.0 dbar	
<E> dEep error	1.0 dbar	
<T> profile Time limit	00:02:00 [HH:MM:SS]	
<K> stop check interval	10 seconds	

Figure 6-38: Shallow and Deep Pressure Limits

Option <S> ‘Shallow pressure’ (11) is the intended “top” of the profiling range. The MMP stops profiling on an upward profile when the ambient CTD pressure becomes less than the shallow pressure limit. The shallow pressure limit is ignored during downward profiles. The shallow pressure setting range is deep pressure to 0.0 dbar.

Option <D> ‘Deep pressure’ (12) is the intended “bottom” of the profiling range. The firmware stops profiling on a downward profile when the ambient CTD pressure becomes greater than the deep pressure limit. The deep pressure limit is ignored during upward profiles. The deep pressure setting Range is shallow pressure to 6000.0 dbar

Figure 6-37 shows an example of Deep and Shallow pressure limits on the mooring.

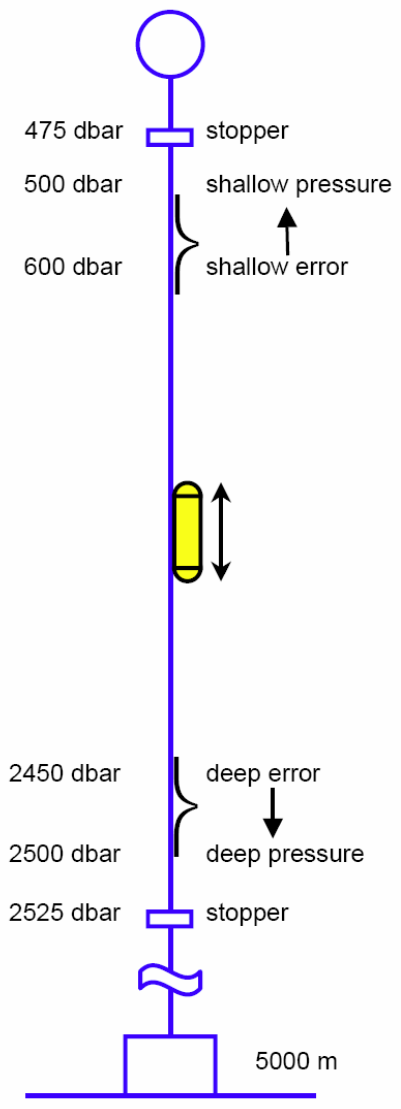


Figure 6-39: Example of Shallow and Deep Pressure Limits

Shallow Error <H>

Option <H> ‘Shallow error’ defines a pressure below (deeper than) the shallow pressure stop. If a zero pressure rate is detected while inside the shallow error window on an upward profile, the MMP stops profiling. The mid-water obstacle ramming behavior is not triggered. The shallow error is ignored on downward profiles.

The shallow error allows the operator to compensate for mooring dynamics and uncertainty in the actual depth of the shallow bumper. As the mooring leans over in a current or if the anchor is deeper than expected the shallow bumper may be pulled below the shallow pressure stop. In these cases the obstacle ramming behavior would be undesirable. The shallow error is chosen based on calculations of the dynamic mooring behavior and knowledge of the possible depth error. Inside that window a zero pressure rate is interpreted as the shallow bumper and the ramming behavior is not triggered. The profile terminates as if the shallow pressure stop had been detected.

The mid-water obstacle ramming behavior can be disabled during upward profiles by setting the shallow error below (deeper than) the deep pressure. Range is 0.0 dbar to 6000.0 dbar.

Deep Error <E>

Option <E> ‘Deep error’ defines a pressure above (more shallow than) the deep pressure stop. If the firmware detects a zero pressure rate while inside the deep error window on a downward profile, the MMP stops profiling. The mid-water obstacle ramming behavior is not triggered. The deep error is ignored on upward profiles. The deep error allows the operator to compensate for mooring dynamics and uncertainty in the actual depth of the bottom. If the mooring dynamics are less than anticipated or if the bottom is shallower than expected, the deep bumper may rise above the deep pressure stop. In these cases the obstacle ramming behavior would be undesirable. The deep error is chosen based on calculations of the dynamic mooring behavior and knowledge of the possible depth error. Inside that window a zero pressure rate is interpreted as the deep bumper, and the ramming behavior is not triggered. The profile terminates as if the deep pressure stop had been detected. Range is 0.0 dbar to 6000.0 dbar.

Profile Time Limit <T>

Option <T> 'Profile time limit' is the maximum time allowed for MMP motion. The firmware displays a default Profile Time Limit after the shallow and deep pressure stops are entered (this should be changed for the specific deployment). When the firmware cannot detect a pressure or pressure rate based stop (and the battery voltage and motor current are within their prescribed limits), the profile terminates based on elapsed travel time.

If the time limit expires while the MMP is profiling, the firmware halts MMP motion. The sensor data acquisition continues before the firmware stops logging and transfers the sensor data to the flash card. The time limit applies only to the period of profiler motion during a single profile. It does not include the sensor logging intervals that occur before and after profile motion or the time required to move data from the sensors to the flash card.

Changes to shallow or deep pressure settings trigger the firmware to calculate the time that will be required to cover that distance: $profile\ time\ limit = 1.25 \times (deep\ pressure - shallow\ pressure) / nominal\ profiling\ speed$.

The additional time (25%) is added to account for slower profiling near the battery life limit. The operator can accept or manually change the suggested time limit. Note that any subsequent changes to the shallow or deep pressures will automatically update the profile time limit, overwriting the manual change.

The profile time limit has an absolute maximum value of 8 hours. The memory capacity and the data rate of the CTD and the ACM limit internal logging to approximately 8.5 hours.

The time limit is dynamically incremented during a profile whenever the mid-water obstacle ramming behavior is triggered. The increment includes the duration of the two additional velocity ramps, the zero pressure rate interval, and the stop check interval. The time limit is reset to 8 hours whenever an increment raises the time limit above the absolute maximum.

In general, the profile time limit will not be reached. Setting the time limit to 8 hours maximizes the amount of time to reach the stop on each profile and each profile will likely terminate on pressure or pressure rate. However, if there are problems acquiring pressure measurements, this approach will also result in the maximum amount of time pushing against the physical stop and wasting battery energy. Range is 10 seconds to 8 hours in 1 second increments.

Stop Check Interval <K>

Option <K> ‘Stop check interval’ sets the period at which the profiler checks to determine if the MMP has reached a stop condition (shallow or deep pressure). Stop check interval is also the rate at which the Profiler records data for non-self-logging sensors (see Chapter 1 of this User Manual for more information about sensors). The Engineering file (E-File) that is produced for each profile will contain data points at the stop check interval.

During a profile, the firmware periodically sends a data request to the CTD while the CTD is logging internally. The CTD responds with the most recent scan of data which is parsed to extract the pressure used in the stop check interval algorithm.

The checks include examination of the ambient pressure, the pressure rate, the elapsed time, battery voltage and motor current. Sensors that are not self logging are also polled during stop checks. The electronics enters a low energy state between checks. Allowed range: 2 seconds to 60 seconds in 1 second increments.

Infrequent checks (30 to 60 second intervals) save a small amount of power and are appropriate for relatively long profiles (>500m) or in situations where E-File data density can be less. The longer the stop check interval the more likely the MMP is to overshoot the pressure stop and push against the physical stop until the next stop check is executed. More frequent stop checks (5 to 15 second intervals), use more power but also reduce the likelihood that the MMP will push against the physical stop on the mooring line. Frequent checks are appropriate for relatively short profiles (< 500m) or in situations where high E-File data density is desired.

The stop check “algorithm” is:

- Firmware always checks:
 - Motor current below 1500 mA
 - Elapsed time less than profile time limit
 - Battery voltage above 7.5 V
- Firmware checks after velocity ramp:
 - Pressure
 - Pressure rate

Enabled Sensors and Options

These deployment settings display for the active sensors. For more detailed information see the Profiler Integrated Sensors and Communications Interface User Manual.

Endurance Parameters

Endurance estimates show the number of programmed profiles and an estimated battery expiration. The estimate adjusts each time a deployment parameter is changed. The single profile battery drain is also listed for information purposes.

Single Profile Current

An estimate in mAh of the battery drain for a single profile.

Total Profiles/(Ah)

Estimated total profiles per battery pack. The standard L24-1000 battery is 240Ah. Change this default, if necessary in the ‘Nominal Endurance’ option on the System Configuration menu. The extended Profiler battery is an additional 120Ah battery which provides 50% more battery capacity and is 12.7cm longer than the standard MMP battery.

Estimated Battery Expiration

An estimate of battery expiration based on battery energy (the default is 240Ah), the single profile drain, and the total number of profiles. The estimate is updated each time a deployment parameter is changed.

Committing to the Deployment

<V> Verify and Proceed

Proceed when deployment programming is complete. The firmware conducts profiling range and consistency checks and estimates battery expiration. Range violations and parameter inconsistencies trigger user prompts for changes.

Regardless of programming mode, archive a copy of the data files stored on the flash card before deploying the MMP. Once the Profiler is set into deployment mode, the flash card is reformatted, erasing stored data files.

1. Typing *V* prompts the system to perform consistency checks.
2. If the consistency checks pass, a prompt displays to accept and store the selections in non-volatile EEPROM. A 'No' response returns to the Deployment Menu for further changes. A 'Yes' response stores the parameters.

```
Selection [] ? v

07/20/2018 14:56:50  SYSTEM Checking entries ... done.
07/20/2018 14:56:50  SYSTEM All entries are within allowed ranges.
07/20/2018 14:56:50  SYSTEM Checking profile schedule ... done.
07/20/2018 14:56:50  SYSTEM Calculated minimum profile duration is 00:05:36.
07/20/2018 14:56:51  SYSTEM Profile schedule selections are consistent.
07/20/2018 14:56:51  SYSTEM Checking burst schedule ... done.
07/20/2018 14:56:51  SYSTEM Burst mode disabled.

Accept and store schedule selections [Y] ?

07/20/2018 14:56:53  SYSTEM Storing deployment parameters ... done.

!!!!!!! WARNING: If you have not already done so,
                    Remove the CTD flow path caps NOW.
                    Failure to remove the caps prevents proper CTD operation
                    during the deployment & may cause permanent sensor damage..

Have you removed the CTD caps [Y] ?
```

Figure 6-40: System Consistency Checks

Consistency Checks

Parameter Range Check

The parameter range checks verify that each of the deployment parameters is within its allowed range. If a range violation is detected, the operator is prompted to change the parameter and then returns to the deployment menu.

Schedule Check

When all of the deployment parameters are within the specified ranges, the firmware performs a profile consistency check on the proposed schedule. The consistency checks begin with the calculation of the minimum profile duration (MPD) where:

$$\text{MPD} = \left\{ \left[\frac{\text{DPL} - \text{SPL}}{\text{NPS}} + \text{SLBP} + \text{SLAP} \right] \left(1 + \frac{\text{DGR}}{\text{DTR}} \right) \right\} \times 1.10$$

(Note: In the original image, blue arrows point from the labels below to the corresponding variables in the equation above.)

Profile travel time (NPS) Sensor logging (SLBP, SLAP) Data transfer time (DGR, DTR) Time buffer (1.10)

DPL	=	Deep Pressure Limit	[dbar]
SPL	=	Shallow Pressure Limit	[dbar]
NPS	=	Nominal Profiling Speed	[dbar/sec]
SLBP	=	Sensor Logging Before Profiling	[sec]
SLAP	=	Sensor Logging After Profiling	[sec]
DGR	=	Data Generation Rate	[byte/sec]
DTR	=	Data Transfer Rate	[byte/sec]



If continuous profiling is selected, the profile consistency check is not performed.

The MPD is compared to the profile start interval. If the programmed start interval is shorter than the MPD the operator will be prompted to change the selections. The operator may choose to disregard the warning and proceed, thus accepting the risk of skipped profiles (or bursts) during the deployment.



If burst mode is disabled (profiles/pairs per burst set to 1) or if continuous bursts are selected (burst interval set to 00 00:00:00), no burst consistency check is performed.

When burst mode is enabled and the burst interval is not zero, the firmware compares the minimum burst duration with the burst interval which is one of:

- $\text{MPD} \times \text{profiles per burst}$ if continuous profiling is enabled
- $\text{start interval} \times \text{profiles per burst}$ if $\text{MPD} < \text{a non-zero start interval}$
- $[\text{MPD} / \text{start interval}] \times \text{profiles per burst}$ if $\text{MPD} \geq \text{a non-zero start interval}$

An inconsistent (but operator approved) start interval can also be detected. If the programmed burst interval is shorter than the calculated time to conduct the burst the user is prompted to change the selections.



Consistency checks are based on the calculated travel time for a profile, not on the profile time limit set by the operator.

3. The Diagnostics routine is run and the initial dive time displays on the screen.
4. The final prompt is 'Proceed with the deployment (Yes/No) [N]?'.
5. Diagnostics runs and the Dive 0 time displays.
6. The final prompt proceeds with the deployment. Typing *Y* starts the deployment which initiates copying of puts the firmware in Sleep/Suspend mode until Dive 0.

```
07/20/2018 14:56:55  SYSTEM Status.  
Real-time clock      Watchdog clock      Battery  Motor  
  
07/20/2018 14:56:56, 07/20/2018 14:56:56,  11.9V,  0mA  
  
!!!!!!! CAUTION: Deployment will ERASE ALL DATA stored on flash card.  
  
Proceed [N] ? y
```

Figure 6-41: Proceed with Deployment


```

07/20/2018 14:56:59 SYSTEM Initializing autonomous operation.
07/20/2018 14:56:59 SYSTEM Setting motor to Free Wheel during launch ... done.
!!!!!!! NOTICE: DO NOT REMOVE communication cable until instructed.
07/20/2018 14:57:00 SBE/IMM 9.6 kBaud communication channel opened.
07/20/2018 14:57:00 SBE/IMM Powered on.
07/20/2018 14:57:01 SBE/IMM Sending command [\r\n]. .
07/20/2018 14:57:02 SBE/IMM Sending command [SETDEBUGLEVEL=2]. .
07/20/2018 14:57:02 SBE/IMM Sending command [SETTERMFROMHOST=255]. .
07/20/2018 14:57:03 SBE/IMM Sending command []. .
07/20/2018 14:57:03 SBE/IMM Sending command []. .
07/20/2018 14:57:03 SBE/IMM Sending command [GETCD].....
07/20/2018 14:57:07 SBE/IMM Sending command [FORCECAPTURELINE]. .
07/20/2018 14:57:07 SBE/IMM Sending command [SENDWAKEUPTONE]. ...
07/20/2018 14:57:12 SBE/IMM Sending command [#GO:@@MMP/ML14300-01/001/01]. .
07/20/2018 14:57:13 SBE/IMM Sending command [RELEASELINE]. .
07/20/2018 14:57:13 SBE/IMM Sending command [PWROFF]. .

    1 file(s) c
07/20/2018 14:57:35 SYSTEM Copying D:SCHEDULE.DPL to C:.
SCHEDULE.DPL

    1 file(s)
07/20/2018 14:57:35 SYSTEM Copying D:SCHEDULE.TXT to C:.
SCHEDULE.TXT

    1 file(s)
07/20/2018 14:57:36 SYSTEM Copying D:AQUADOPP.CFG to C:.
AQUADOPP.CFG

    1 file(s)
07/20/2018 14:57:36 SYSTEM Copying D:PROFILER.PXE to C:.
PROFILER.PXE

    1 file(s)
07/20/2018 14:57:41 SYSTEM Initializing disk pointers.
07/20/2018 14:57:42 SYSTEM Creating DEPLOY.DAT ... done.
07/20/2018 14:57:42 SYSTEM Creating PROFILES.DAT ... done.
07/20/2018 14:57:42 SYSTEM Creating IRQ_XCPT.LOG ... done.
07/20/2018 14:57:43 SYSTEM Creating LASTSENT.DAT ... done.
07/20/2018 14:57:43 SYSTEM Generating directory listing ...
07/20/2018 14:57:44 SYSTEM 12 files are listed in C:FILELIST.TXT.
07/20/2018 14:57:44 SYSTEM Flash card initialization complete.
07/20/2018 14:57:46 SYSTEM Current time is 07/20/2018 14:57:44.
07/20/2018 14:57:46 SYSTEM Sensor warmup at 07/21/2018 02:55:44.
07/20/2018 14:57:47 SYSTEM Initial dive at 07/21/2018 02:57:44.

!!!!!!! NOTICE: System is ready to deploy.
                    Remove communication cable NOW.
                    Install communications port dummy plug.
                    Attach faired bottom cap to vehicle.

07/20/2018 14:57:47 SYSTEM Waiting until 07/21/2018 02:55:44. ... [^C]

```

System sleeping.
Deploy MMP in the water.



Figure 6-42: Sample Deployment – Standard Profiling

Final Deployment Operations

Final deployment operations are to close the end cap, attach the MMP to the mooring wire, and deploy the mooring. Check the sensor-specific chapters in the Profiler Integrated Sensors and Communications Interface User Guide for sensor-specific mounting components such as hinged support brackets that must be removed to attach the mooring wire.

Closing and Sealing the Controller Housing

Always inspect o-rings for signs of wear and the presence of any foreign material (which can cause leaks). See Chapter 2, “System Description”, for critical details about placement of the end cap and o-rings before sealing the end cap to the controller housing.

Attaching the Dummy Plug and Connecting the Battery

When you are ready to attach the profiler to the mooring wire first complete these steps:

1. Disconnect the communications cable and attach the dummy plug.
2. Secure the bottom end cap of the controller housing.

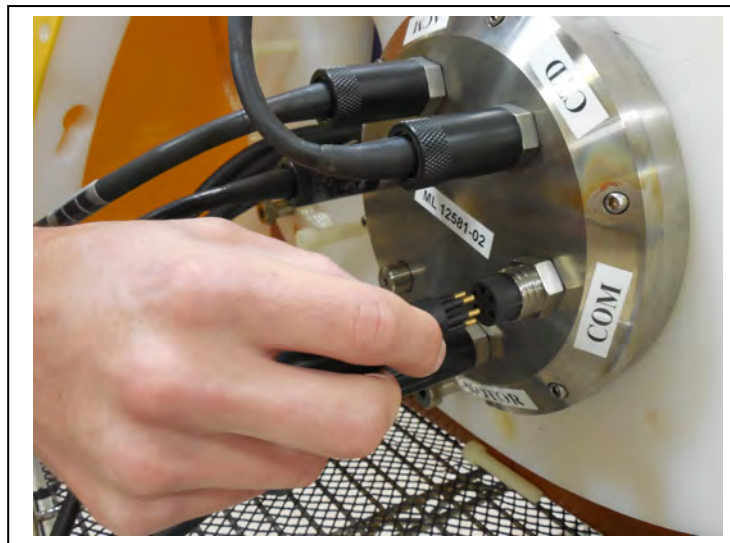


Figure 6-43: Connecting the COM Cable Dummy Plug

Attaching the Profiler to the Mooring Wire

An example of attaching to a simple mooring is provided next for reference.

1. Remove the cable retainers to attach the MMP to the mooring cable.



Figure 6-44: Removing the Cable Retainers

2. Lay the cable in place along the front plate of the MMP, ensuring the cable is oriented so that the top of the profiler is towards the subsurface float and the bottom of the profiler is towards the block.
3. Secure the MMP to the cable with the cable retainers. Tighten all eight of the socket head nylon cap screws firmly.
4. Pass the cable under the hinged bracket on which the ACM sting is mounted and secure the bracket. Make sure the drive wheel properly engages the cable.
5. Using the crane and appropriate tag lines, lift the MMP using the loop of rope that extends out of the bottom faired end cap.

Mooring Example

A simple mooring has a subsurface float, a single, continuous length of jacketed cable, an acoustic release, and an anchor. Padded stoppers are mounted on the mooring, typically placed 5 meters to 50 meters outside the range defined by the pressure stops to keep the profiler in the desired depth range on the mooring. These stoppers are made by McLane specifically for use with the profiler.

Actual stopper placement depends on the anticipated dynamics of the mooring and the placement of other mooring components. More complex moorings may have additional instruments above and/or below the physical stops.



The Profiler requires 500 lbs (227 kg) of tension be maintained on the wire at all times in order to move up and down.

A simple mooring example is shown next for reference. This example assumes deployment from a ship with a rear A-frame, a crane, and a selection of winches, blocks, and capstans.

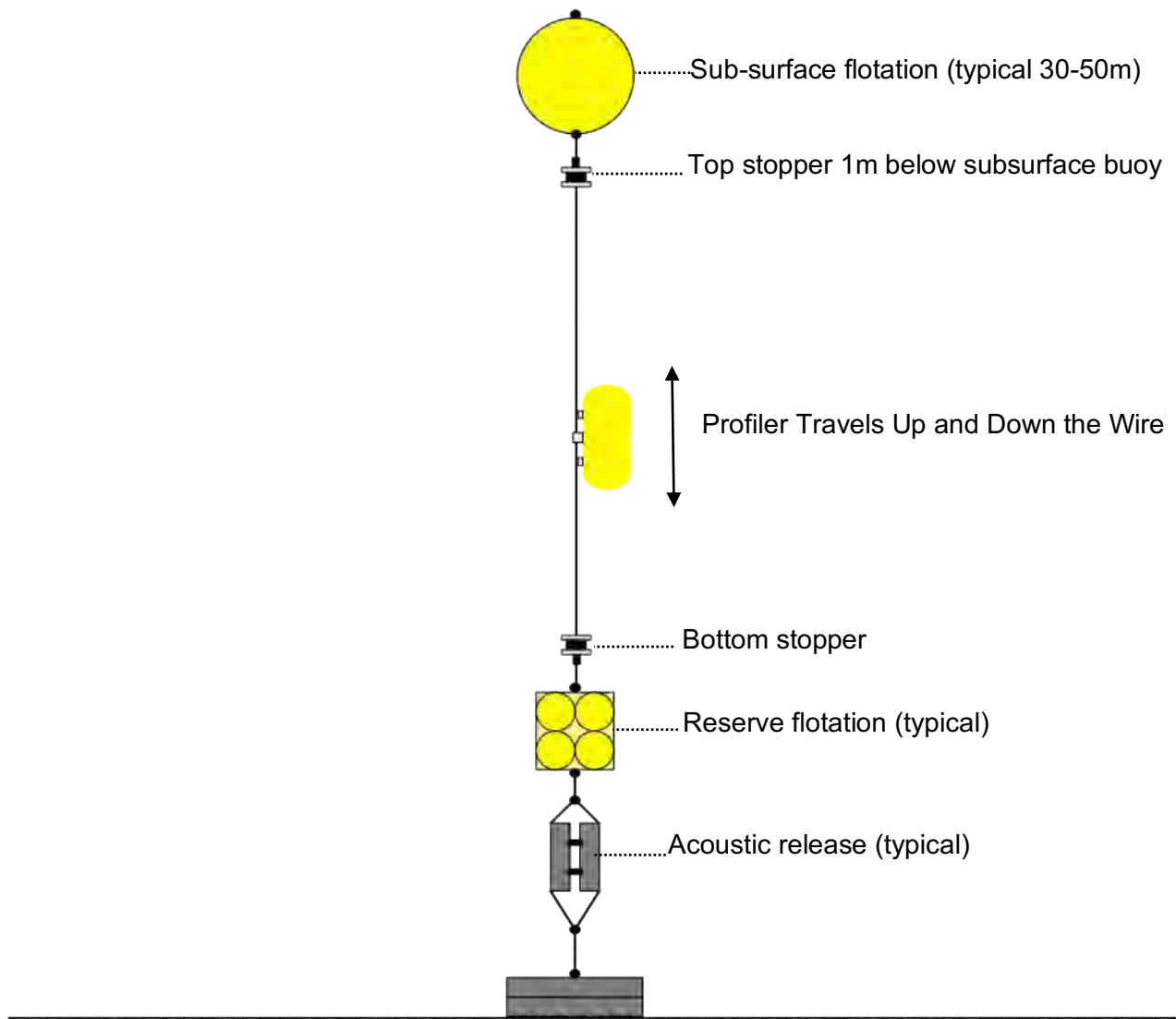


Figure 6-45: Simple Mooring

Notes

Chapter 7

Deployment Recovery and System Maintenance

Deployment Termination

A deployment typically ends when the MMP battery drains or the last profile in the deployment schedule is completed. The deployment may also be manually terminated after MMP recovery.

Battery Drain

The lithium battery voltage output is nominally 10.8 V until ~90% of the available energy is gone. The MMP uses a threshold of 7.5 V to detect battery exhaustion and terminate the deployment. The following describes the battery drain and calculation:

- With ~90% of the available energy gone, the voltage drops rapidly to ~7.8 V and stays at that level while most of the remaining available energy is used.
- Near complete exhaustion (with 99 +% of the available energy gone), the voltage falls rapidly to zero.



A code with the reason for the deployment termination can be offloaded with deployment data. See Appendix B of this User Manual for a complete list of deployment termination codes and definitions.

Recovery Procedure

A sample MMP recovery procedure is provided next for reference. Mooring detail is not included because moorings will differ greatly based on design. Be aware the MMP is not buoyant in air. Even with strong coupling, the drive wheel will only sustain a few pounds.

1. When the upper MMP bumper is reached, pull that section of cable onto the ship's deck and remove the bumper.
2. Continue to wind cable onto the winch. The MMP will be on the tether somewhere between the bumpers. The exact MMP location depends on the profiling schedule, ballasting accuracy, and whether the tension in the cable after release can sustain some degree of coupling with the drive wheel. Flotation modules below the lower bumper may have a strong effect on coupling.

3. Continue to wind the mooring cable onto the winch. In the absence of severe fouling or entanglement, the MMP must eventually fetch up against the bottom bumper. The bumper will sustain the full flooded weight of the MMP and can be used to lift the profiler clear of the water. If you recover the bottom of the mooring first, the top bumper can be used to lift the MMP.

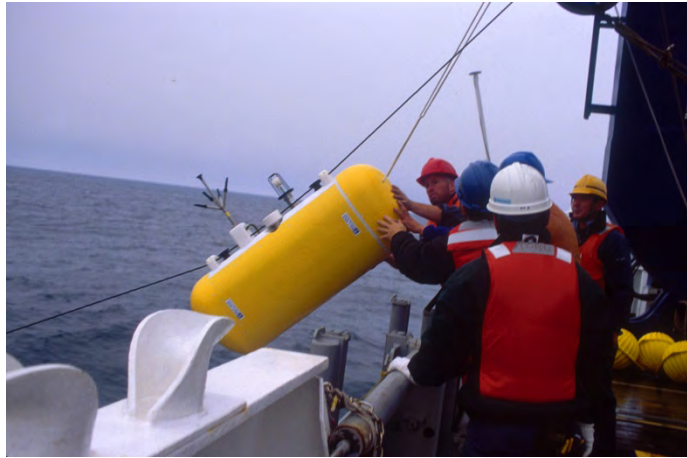


Figure 7-1: Recovering an MMP

4. Once the MMP has been lifted clear, pull it onto the deck and release it from the tether. The drive motor may be running while you work, and can safely be ignored until you can connect the COM cable to the system and terminate the deployment.
5. Move the MMP to a stable location and immediately **rinse with fresh water**. Thoroughly rinse the end cap of the controller housing since you will be opening that first, to review and recover the deployment data.
6. Move the MMP to a dry location before connecting to a computer to check data or use the data offload function.



Do not expose the electronics or flash card to salt water. Move the Profiler to a stable, dry area before opening the pressure housing. If the electronics get wet with salt water, immediately disconnect power, immerse in fresh water (do not immerse the lithium battery) and dry.

Offloading Deployment Data

Use 'Offload Deployment Data' to see selected flash card deployment files and check profiling performance. Offloading the entire deployment is impractical due to the data files sizes.

1. Turn on the computer, start McLaneTerm (with capture 'On') and remove the dummy plug from the MMP bulkhead. Use the COM cable to connect the MMP and the computer.
2. Press [CTRL]-[C] three times to wake the system from Sleep (Suspend) mode, or terminate the deployment if needed. If you terminate the deployment, you are prompted to save or discard the portion of the data for the deployment in process.
3. From the Main Menu select <7> 'Offload Files from FLASH', and select the type of deployment file(s) to offload.
 - <D>: 'Deployment' selects only the specified file type, or all deployment data files. Use this option only for a very short deployment time (such as days). It is not practical to download the entire deployment to a capture file.
 - <S>: 'Single profile' selects only the specified file type, or all files from a specific profile. Note that some sensor files are not available for offloading. The screen displays messages if offload is not possible.
 - <G>: 'Group of profiles' selects all files within a user-specified range or selects only a specified file type.
 - <L>: 'Logging files' selects deployment log files. Within the Offload Logging Files menu option are specific download options.

```
Config: MPP_IM_CM_CT_FL_TU                                CF2 V5.35
-----
                          Pattern Profiler
                          Offload Files From FLASH
-----
                          Fri May 31 14:36:30 2019
Offload from:
<D> Deployment
<S> Single profile
<G> Group of profiles
<L> Logging files
<M> Main Menu
```

Figure 7-2: Select Offload Option

4. If offloading Logging files, select <L> and then select which log file to offload.
 - <1> **Profiles.dat**: Number of the last profile of the deployment.
 - <2> **Deploy.dat**: Conditions under which deployment data was collected.
 - <3> **IRQ/XCPT Log**: Time tagged log of interrupt requests and exceptions. The first entry is the creation time of the file. Subsequent entries include regular watchdog IRQ requests at one minute after each hour.
 - <4> **Profile Termination Log**: Data from the last 10 profiles, including the profile exit condition, stored in rolling file buffers.
 - <5> **Last sent**: Last inductive file transmitted (Inductive option).
 - <6> **Deployment Termination Condition**: Deployment termination code.
 - <7> **C:ERRORLOG.TXT**: Displays the error log file which lists all system errors that may have occurred during the deployment.

```
Selection [] ? 7
-----
Config: MPP_IM_CM_CT_FL_TU                               CF2 V5.35
-----
                        Pattern Profiler
                        Offload Logging Files Menu
-----
                        Fri May 31 14:36:32 2019
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
<7> C:ERRORLOG.TXT
<M> previous Menu
Selection [] ? 1
```

Figure 7-3: Option <L> Offload Logging Files Menu

Unpacking Deployment Data

After using 'Offload Deployment Data' to check data files on the flash card, use the Profile Data Unpacker to copy the binary data files to the computer and unpack the files to readable format. This process is often completed back in the lab.

Removing the Flash Card

To remove the flash card from the electronics housing complete the following steps. This procedure assumes that the steps in the previous section "Offloading Deployment Data" have been completed.

1. Turn on the computer, start McLaneTerm (with capture 'On') and remove the dummy plug from the MMP bulkhead. Use the COM cable to connect the MMP and the computer.
2. Put the system in Sleep (Suspend) mode.
3. Open the pressure relief valve on the pressure housing to equalize the internal and external pressure.



Chapter 4, 'Getting Started' in this User Manual has details about powering up the Profiler that include the controller housing, and the pressure relief valve.

4. Disconnect the cables from the electronics housing.
5. Unscrew the six socket-head stainless steel cap screws that secure the end cap, pry open the pressure housing, and slide out the electronics assembly.

6. Disconnect the battery.
7. Slide the compact flash card out of its socket and remove it.

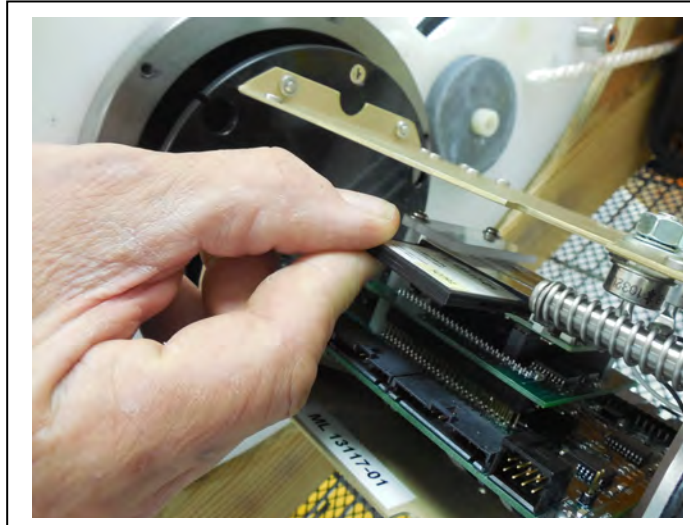


Figure 7-4: Flash Card Removal

8. Insert the compact flash card into the compact flash card reader on a computer.
9. Copy the flash card contents to the computer hard drive (this procedure does not remove the data from the flash card).
10. See the section that follows to use the Profiler Data Unpacker. This tool unpacks the binary data files to readable text files.

Using the Profile Data Unpacker

The Profile Data Unpacker unpacks the binary data files. Unpacked files include self-logging sensor data, engineering files (includes data from non-self logging sensors), auxiliary files, and informational files created by the Unpacker. Data for sensors other than the self-logging sensors log data in the Engineering file.

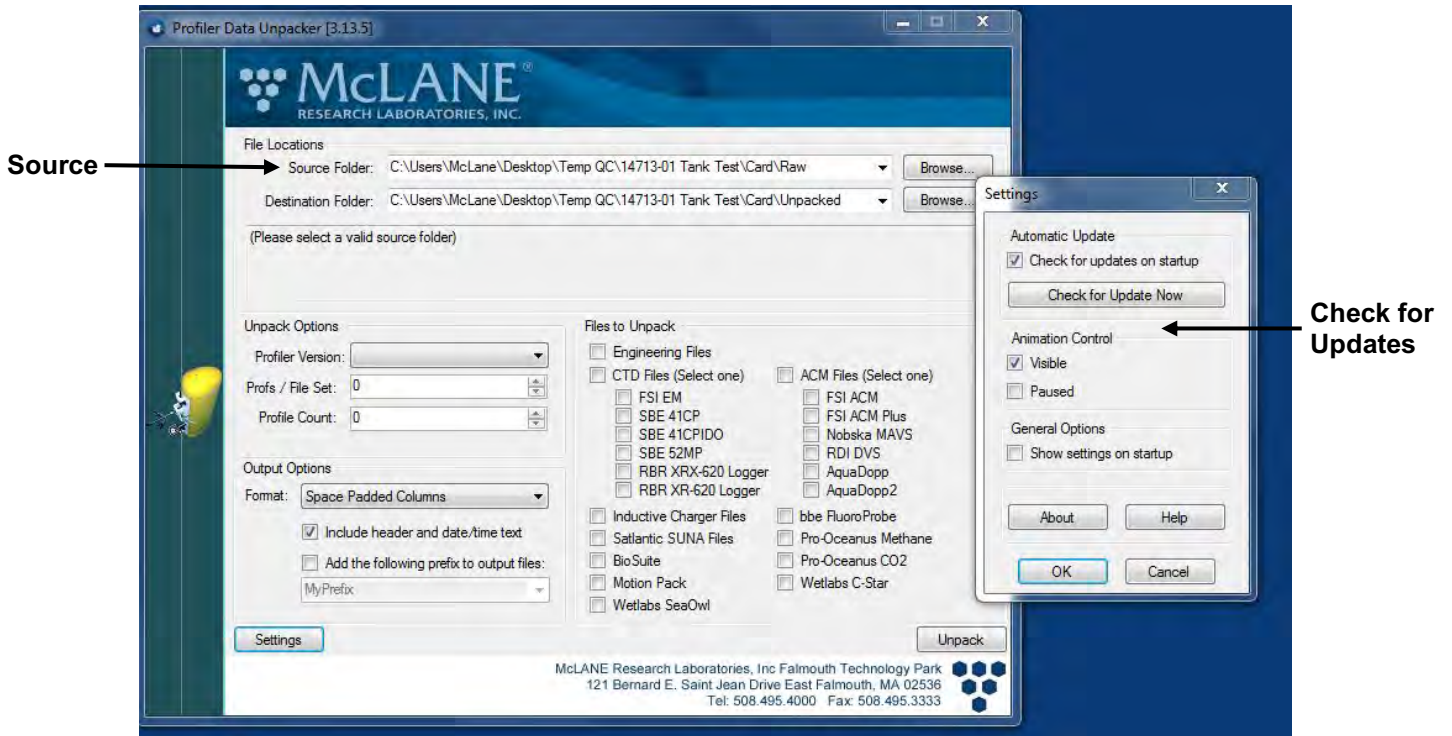


Figure 7-5: Profiler Data Unpacker

1. Unpacker.Exe is included on the USB drive that ships with the MMP. Copy Unpacker.exe to a computer directory or download the most current Unpacker.zip file from www.mclanelabs.com.
2. Start Unpacker.Exe.
3. Select the Source Folder that contains the binary files. The Contents window displays the firmware version that created the file and the number of profiles recorded.
4. Select a Destination folder for the unpacked data, either in the default folder that displays or in a new folder. If the destination directory does not exist, the Unpacker prompts to create the directory.
5. The firmware automatically fills in the appropriate check box in 'Files to Unpack' based on the sensor data that exists in the Source folder.

6. Additional selections display in 'Files to Unpack' if Inductive files are present.
7. The 'Add prefix to output files' checkbox optionally attaches a user-defined prefix to the unpacked data files to identify unpacked files from multiple deployments.
8. Files can be unpacked as Comma Separated Value (CSV) or Space Padded Value (SPV) formats. CSV format is the default.

Unpacking progress displays in the status bar. Errors are reported in the Unpacker Activity Log (see Figure 7-6). Details of the unpacking process are saved in UNPACKER.LOG in the destination directory.



The Unpacker skips missing data files and continues processing. A summary at the end of the UnpackLog.TXT and UnapckErrors.TXT files notes the total number of missing files.

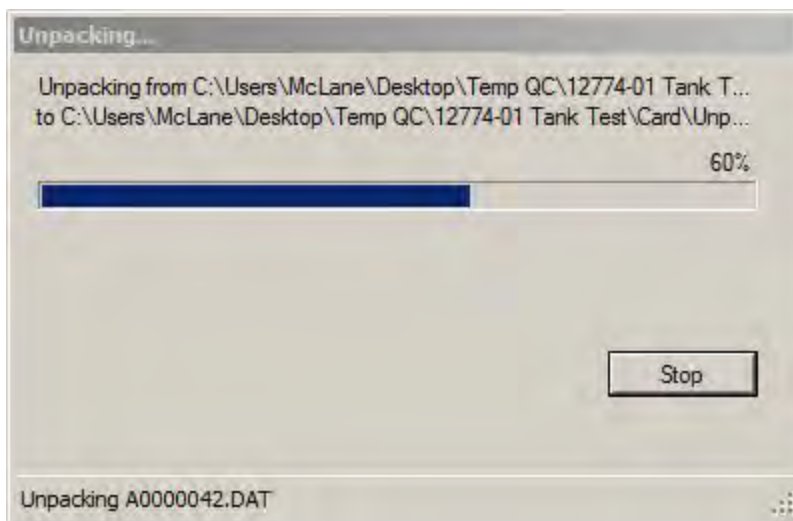


Figure 7-6: Data Unpacking Status

The Source Files, Unpacked Files, Error Log, and Activity Log can be viewed by clicking the appropriate link.

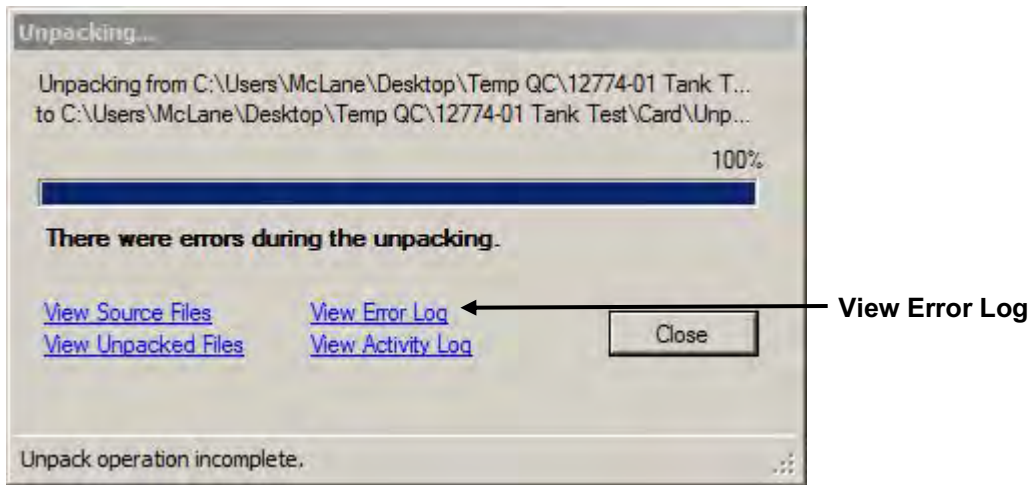


Figure 7-7: Data Unpacking Complete

Converted DEPLOY.DAT information is written to a DEPLOY.TXT file and saved in the destination directory. Archive DEPLOY.DAT as a record of the conditions under which the data was collected.

Unpacked Files

Unpacked files are assigned names with the file type (for example, Engineering files are ENNNNNNN.DAT, CTD files are CNNNNNNN.DAT, ACM files are ANNNNNNNN.DAT, and so on, identifying the files for example, engineering (E) and the profile number padded including leading zeros (0000000, 0000001).

Data can be unpacked in Comma Separated Value (CSV) or Space Padded Values (SPV) which is a fixed format output. The default is CSV.

In addition to UNPACKER.LOG, and the unpacked sensor and Engineering files, other auxiliary text files are saved in the destination directory with DEPLOY.TXT. A complete list of unpacked files and file contents is listed in Appendix C of this User Manual for reference.

Profile Exit Conditions Defined

The unpacked Engineering data for each profile includes the 'Profile exit' condition. This describes how each profile ends.

A complete list of profile exit conditions is provided in Appendix B of this User Manual for reference.

```
Profile 5

Sensors were turned on at 06/14/2019 13:10:02

Vehicle began profiling at 06/14/2019 13:12:01

      Date      [mA]      [V]      [dbar]      Ch1      NTU      Therm
06/14/2019 13:12:02      0      12.0      0.000      1193      4130      541
06/14/2019 13:12:06      46      12.0      0.000      1198      4130      540
06/14/2019 13:12:10      42      11.9      0.000      1202      4130      540
06/14/2019 13:12:14      45      12.0      0.000      1201      4130      540

...
06/14/2019 13:21:55      43      12.0      0.270      1205      4130      536
06/14/2019 13:22:00      44      12.0      0.250      1207      4130      536
06/14/2019 13:22:05      44      12.0      0.390      1204      4130      536

Ramp exit:    SMOOTH RUNNING
Profile exit: TIMER EXPIRED ← Profile Exit Condition
Vehicle motion stopped at 06/14/2019 13:22:07
Sensor logging stopped at 06/14/2019 13:24:10
```

Figure 7-8: Unpacked Engineering File – Profile Exit Condition

Data Processing after Unpacking

Processing and interpreting unpacked Profiler data (for example, mapping velocity measurements and synchronizing sensor data streams) is the next step. **This step is user and sensor specific and processes will vary.**

System Maintenance

Several maintenance procedures are recommended for the MMP. Before deployment, after recovery, and before and after storage, inspect the following:

- O-rings
- Bulkhead and cable connectors
- Nylon and stainless steel hardware
- Glass spheres

Once the compact flash card has been recovered and the end cap has been re-installed, rinse or immerse the MMP in fresh water more thoroughly. If possible, immerse the MMP in fresh water. Warm water with soap or mild detergent added will remove salt and other substances. Common soaps and detergents will not damage the MMP. Do not use solvents.



Thoroughly rinsing the MMP with fresh water immediately after recovery is a critical maintenance procedure to extend system life and prevent future problems. Salt crystals can form on o-rings or o-ring sealing surfaces as seawater evaporates, leaving grit that could cause future leaks.

O-Rings

Before and after every deployment, inspect the face and radial o-rings on both ends of the controller housing. This critical check can prevent housing flooding. Look for small cracks and feel for bumps, grit, or hair. O-rings must stay in position as the end cap is inserted into the cylinder. The Toolkit includes spare o-rings and Chapter 2, “System Description” has the part numbers.

After you inspect the o-rings, apply a thin, even coating of lubricant. McLane recommends Parker O-Lube, a barium-based grease made by Parker Seals, for use with pressure housing o-rings. O-Lube is environmentally safe and can be cleaned up with soap or mild detergent.

Bulkhead and Cable Connectors

All of the connectors are threaded into their end caps and sealed with o-rings. These are long-term seals and do not require regular inspection as long as the connectors and end caps are thoroughly rinsed/soaked in fresh water after recovery. The pins and bodies of the bulkhead connectors and the sockets and cowls of the cable connectors must be regularly inspected, cleaned, and greased to prevent leaks.

Connectors that are regularly connected and disconnected, such as those on the end cap of the controller housing, require regular maintenance. This is particularly true of the communications cable, bulkhead connector, and dummy plug. Apply a thin coating of grease to all contact surfaces, including pins, sockets, cowls, and bodies. McLane recommends Dow-Corning 55, an o-ring lubricant, for this purpose. Silicon-based products such as Dow-Corning 4 or Dow-Corning 5 are also suitable. All of these lubricants are environmentally safe and can be cleaned up with soap or mild detergent.

Connector Alignment

Cables and connectors are labeled to indicate the correct match. Confirm that the cables are matched with the corresponding connectors.



Figure 7-9: Connector Labels



Do not force together cables and connectors until they are properly matched and aligned. Forcing a connection with the wrong cables or misaligned cables could damage the sockets, electronics, or peripheral components.

Nylon and Stainless Steel Hardware

Nylon hardware is used in the MMP because it is light, strong, and does not corrode. Tighten the controller housing end cap screws evenly and carefully.



Do not force the nylon bolts. Nylon absorbs water and swells slightly when immersed, therefore, the screws and bolts will be tighter when the MMP is recovered. The swollen screws and bolts will respond to a slow, steady turn and should not be forced.

Do not over tighten the nylon hardware. The threads are easily stripped and the screw and bolt head can twist off the shaft when excessive torque is applied. The flat head bolts that secure the MMP skin can pull right through the skin if they are over-tightened.

Rinse hardware with fresh water after recovery.

The MMP Toolkit contains spare screws and bolts. Contact McLane if additional spares are needed.

The socket head cap screws securing the controller and motor housing end caps are 316 stainless steel. They are more robust than the nylon hardware, but they should still not be over-tightened. A thin coating of non-metal, anti-seize, thread compound should be applied to the screws before they are threaded into the titanium pressure housing.

McLane recommends Lub-O-Seal's NM-91 non-metal anti-seize thread compound for the MMP controller and motor housings. Replacement socket cap screws used with the titanium housings should be 316 stainless steel. The end cap should slide smoothly into the pressure housing. Visually check that wires are not caught between the end cap and the housing.

Glass Spheres

After each deployment, visually inspect the glass spheres to check for signs of fatigue caused by repeated pressure cycling. Inspect the inside for: (1) excessive glass dust, (2) large shards of glass, (3) spawls on the equator, (4) water.



If signs of glass fatigue are present the sphere should be replaced at McLane. The installation of *new* glass spheres requires re-ballasting. A re-glass, re-ballast service is available at McLane.

Battery Maintenance

Lithium Battery Pack

The MMP is powered by a high-capacity lithium battery pack. The standard battery pack is 24 double-D cells assembled in two layers inside the pack. Electrically, the pack is arranged in eight parallel stacks of three cells in series. The nominal delivered voltage is 10.8 V. The nominal energy capacity of the battery is 240 Ahr.

The optional half battery has 12 double-D cells assembled in one layer inside the pack. The nominal energy capacity is 120 Ah.



The lithium in the battery pack qualifies as Class 9 hazardous goods. U.S. and international regulations require shipping the main lithium battery via an approved hazardous goods shipper.

Sensor Maintenance

Sensors should be fully calibrated at a properly equipped facility before and after deployments. The calibration results allow investigators to account for sensor drift during data post-processing. Calibration can be performed by the sensor manufacturer. If you can provide an environment of known characteristics for the sensor, you can also perform this test to provide a quick verification of function and accuracy.

Packing and Storage

Keep the MMP assembled for shipping or storage. The shipping crate is a fitted, reusable, international freight container for shipping and storing the MMP. Requirements for international transport by ground, ocean, or air freight carriers are in compliance. If storing the MMP for more than one month, properly archive any data stored on the flash card. Disconnect the main lithium battery pack from the controller housing. Check the o-rings, reassemble the housing, and perform any necessary maintenance procedures, including a fresh water rinse.

Storage facility temperatures between 0°C and 40°C are recommended. Temperatures above this range should not cause damage, however, temperatures below 0°C could cause damage if water is still present in crevices or seals.

Packing the FSI ACM Sting in the Crate

If the Profiler has a Falmouth Scientific Inc. (FSI) ACM, the ACM sting fits in the crate next to the top section of the MMP. Remove the sting from the mount and slide a short length of the oil filled cable out from the interior of the MMP and surround the sting with ample padding to prevent movement. Ensure that the fingers are protected on all sides and are clear of the crate cover. Handle the oil filled tube with care. Do not pinch or pull the oil filled tube during packing.



Figure 7-10: Fitting the MMP in the Crate

Stabilizing the Motor in the Crate

To prevent the MMP motor from moving and becoming damaged during shipment, the crate contains additional inside supports. If shipping the MMP in a crate without this added motor stabilization, use foam or other padding to support the motor in a manner similar to Figure 7-11. Alternately, use a large zip tie to support the motor as shown in the figure below.



Figure 7-11: Stabilizing the Motor in the Crate

Storing the Battery

If the main battery is not fully discharged, cover the connector with insulating tape and store the battery within the 0°C and 40°C temperature range. Refer to the battery safety sheet provided on your profiler USB drive for proper storage and handling guidelines. If the main battery is fully discharged it should be disposed in accordance with safety and environmental regulations.

Appendix A

Profile Exit Conditions

The Profile Exit Conditions describe how each profile ends. Some exit condition thresholds are set in the firmware Advanced Interface menu. There is also a code that indicates a user-programmed deployment termination was reached.

The Profile Exit condition is listed in the ENG file. Additionally, the file TIMETAGS.TXT (included with the Profiler data offload), lists a numerical code that corresponds to the profile exit condition. The codes and exit conditions are listed below.

Profile Exit Conditions		
Code	Condition	Definition
0	SMOOTH RUNNING	Profile ended as programmed.
1	MISSION COMPLETE Note - This code refers to deployment completion and is not a profile exit condition.	If an end time is programmed for the deployment, this code indicates the time is successfully reached.
2	OPERATOR [CTRL]-[C]	Operator exit.
3	LOGGER COM FAILURE	Microcontroller error.
4	CTD COMM FAILURE	CTD Communications Error
5	ACM COMM FAILURE	ACM Communications Error
6	TIMER EXPIRED	Time limit expired.
7	MIN BATTERY	Low battery voltage reached.
8	This code is not used.	This code is not used.

Profile Exit Conditions		
Code	Condition	Definition
9	MAX MOTOR CURRENT	High Motor current was detected for the number of Backtrack iterations specified.
10	This code is not used.	This code is not used.
11	This code is not used.	This code is not used.
12	This code is not used.	This code is not used.
13	TOP PRESSURE	Programmed top (shallow) pressure was reached.
14	BOTTOM PRESSURE	Programmed bottom (deep) pressure was reached.
15	PRESSURE RATE ZERO	Pressure rate lower than programmed threshold was detected for the number of Backtrack iterations specified.
16	STOP NULL	Profile ended for an unknown reason.
17	FLASH CARD FULL	Disk capacity was reached.
18	FILE SYSTEM FULL	(For TT8 micro-controllers only) File capacity of 4095 was reached.

Profile Exit Conditions		
Code	Condition	Definition
19	TOO MANY OPEN FILES	File system firmware not functioning properly.
20	AANDERAA COM FAILURE	AANDERAA Optode Communications Error
21	STATIONARY EXPIRED	For Patterned Profiling mode, indicates that a stationary profile completed successfully.
22	DOCK PROXIMITY	For Adaptive and Patterned Profiling modes, indicates that docking with a charging station completed successfully.

2019 January

Notes

Appendix B Unpacked Files

The Profile Data Unpacker unpacks binary deployment data files to readable format. The list that follows provides information about files that the Profile Data Unpacker creates. For more information about the Profile Data Unpacker see Chapter 7 ‘Unpacking Deployment Data’ in this User Manual.

File	Contains
Axxxxxxx.DAT	ACM sensor files
Cxxxxxxx.DAT	CTD sensor files
Nxxxxxxx.DAT	SUNA nitrate sensor files
Bxxxxxxx.DAT	Biosuite sensor files
Mxxxxxxx.DAT	Motion Pack sensor files
Sxxxxxxx.DAT	Deployment Planner Schedule files (for Patterned Profiling)
Exxxxxxx.DAT	Engineering files contain date, mA, V and dbar data. Each sensor occupies a consistent order in the data file. For example, Fluorometer data first, followed by Turbidity data next, followed by Optode data.
Oxxxxxxx.DAT	CO ₂ sensor files
Hxxxxxxx.DAT	Methane sensor files
Fxxxxxxx.DAT	Fluoroprobe sensor files
Txxxxxxx.DAT	Wet Labs C-Star transmissometer files
Wxxxxxxx.DAT	Sea Owl oil-in-water files
Profiles.DAT	Unpacks to Profiles.TXT. Contains profile count (the number of the last profile of the deployment).
LastSent.DAT	Unpacks to Last Sent.TXT
IRQ_XCPT.DAT	Unpacks to IRQ_XCPT.LOG

File	Contains
Deploy.TXT	For the standard Profiler, this file contains deployment configuration, for the scheduled Profiler, this file also contains the deployment schedule.
UnpackErrors.TXT	Summarizes the total files that were unpacked and missing.
UnpackLog.TXT.	Provides a list of unpacked files and indicates file unpacking results. If a file does not unpack it will be missing from the list. A message at the bottom of the screen indicates total number of unpacked and missing files and whether or not errors existed (see Figure C-1).
TimeTags.TXT	Each line contains profile number, sensor power on date and time, motion start date and time, sensor turn off date and time, and profiler termination code defining how each profile ended.
SNSRTIME.TXT	Logs sensor power up and power down times.

2019 December

```
UnpackLog.txt - Notepad
File Edit Format View Help
Unpacker Version 3.05 R1
Source Folder = C:\Users\Cleo\Archives\12201-01 deployment
Destination Folder = C:\Users\Cleo\Archives\12201-01 deployment\unpacked
Unpacking Profiler = Firmware version 4.09 to 4.12
Unpacking options:
Unpacking Smart EFile for Profiler v4.09+Files (expecting 263 files containing 263 profiles)
Note - only detected 8 Smart EFile for Profiler v4.09+ files -- fewer than expected!
Unpacking SEABIRD 52MP CTDFiles (expecting 263 files containing 263 profiles)
Note - only detected 13 SEABIRD 52MP CTD files -- fewer than expected!
Unpacking FSI 2D ACMFiles (expecting 263 files containing 263 profiles)
Note - only detected 9 FSI 2D ACM files -- fewer than expected!
No inductive charger in configuration - skipping files
No satlantic SUNA in configuration - skipping any SUNA files
No Biosuite in configuration - skipping any Biosuite files
No Motion Pack in configuration - skipping any Motion Pack files
Output file is comma-separated

Unpack started at 7/1/2013 9:42:30 AM

Unpacking DEPLOY.DAT
Unpacking E0000000.DAT
Unpacking E0000000_1.DAT
Unpacking E0000001.DAT
Unpacking E0000001_1.DAT
Unpacking E0000002.DAT
Unpacking E0000002_1.DAT
Unpacking E0000261.DAT
Unpacking E0000262.DAT
Unpacking C0000000.DAT
Unpacking C0000000_1.DAT
Unpacking C0000000_2.DAT
Unpacking C0000001.DAT
Unpacking C0000001_1.DAT
Unpacking C0000001_2.DAT
Unpacking C0000002.DAT
Unpacking C0000002_1.DAT
Unpacking C0000002_2.DAT
Unpacking C0000261.DAT
Unpacking C0000261_1.DAT
Unpacking C0000262.DAT
Unpacking C0000262_1.DAT
Unpacking A0000000.DAT
Unpacking A0000001.DAT
Unpacking A0000002.DAT
Unpacking A0000261.DAT
Unpacking A0000261_1.DAT
Unpacking A0000261_2.DAT
Unpacking A0000262.DAT
Unpacking A0000262_1.DAT
Unpacking A0000262_2.DAT

Unpack completed at 7/1/2013 9:42:35 AM
There were 31 files unpacked
There were 759 files missing
There were no errors during unpacking ← Unpacking results
```

Figure B-1: UnpackLog.TXT

Notes

Appendix C

Configuration String Codes

The Configuration String that displays at the top of Profiler menus indicates the current instrument configuration. The codes and corresponding meanings are listed below.

Profiler Configuration String	
Code	Configuration Enabled
MPP	Patterned Profiling Mode
MMP	Standard Profiling Mode
CM	ACM
CO	CO ₂
CT	CTD
FL	Fluorometer
IM	Inductive Telemetry
ME	CH ₄
MP	Motion Pack
NI	Nitrate
OP	Optode
PA	PAR
SC	Scatter
TR	Transmissometer
TU	Turbidity

2018 July

Figure C-1 shows a profiler configured for Patterned profiling with an ACM and a CTD enabled.

Configuration String



```
-----  
Config: MPP_CM_CT                               CF2 V5.29  
  
          McLane Research Laboratories, USA  
          Pattern Profiler  
          S/N: ML12345-01D  
  
-----  
          Pattern Profiler  
          Main Menu  
  
-----  
          Thu Jan 18 11:53:42 2018  
  
<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 C-1: Configuration String