

# Appendix E

## Adaptive Sampling Firmware

Adaptive sampling firmware provides the user with command-line control over the PPS. By issuing commands from a provided command set, the user has full control over the system and can execute valve movements, pumping operations, and other system functions.



The Adaptive Sampling option requires a continuous RS-232 connection from the PPS to a computer or other microcontroller.

PPS Adaptive Sampling firmware AWT-2\_05 and higher includes Antifouling and Solenoid Valve commands, and an Adaptive Deployment option. Adaptive deployment automates many of the necessary steps required to perform a deployment from the command-line interface.

- The Antifouling option replaces Sample 24 with an antifouling reservoir bag and sample container.
- The Solenoid Valve option is used to administer a fixative onto the sample filter after the water sample has been taken. See Appendix D for more detailed information.

### Adaptive Deployment

An Adaptive Deployment is a deployment that is pre-programmed to perform the same functions as a standard (time-series) deployment, except that a serial command sent to the controller triggers each sample collection. In standard deployment mode, a date and time trigger sample collection.

Adaptive deployment provides a single command that automates many deployment steps, or users can perform on-demand actions by using commands that function the same as the Manual Operations menu in the standard PPS firmware.

## Command Prompt

In Adaptive Deployment mode, there is no menu as in the standard firmware. A Command Prompt is displayed as shown below.

```
07/20/2016 09:57:10 AWT ML12345-67>
```

The command prompt is formatted with the current date (mm/dd/yyyy format), current time (hh:mm:ss format), firmware family name, and instrument serial number followed by the “>” symbol.

```

CF2-AWT-2.05 R3 L2.3 | ADEV2.05.c compiled Apr 1 2016 at 14:58
WTS-125M S/N ML12345-67 Adaptive Water Transfer System
© 2010-2016 McLane Research Laboratories. All rights reserved.

Seeking home port ...
Seeking home port...
Port 00
Port 01

Home port located. Aligning... Confirmed
McLane Research Laboratories, Inc.
CF2 Adaptive Remote Sampler
Version 3.04 of Mar 13 2015 08:55
Pump type: Maxon 125ml
Bag capacity: 100

Type "Help" or "?" at the prompt, or with a command.
03/16/15 10:54:00 Suspended ... ? ← Command Prompt
Enter ^C now to wake up ... [^C]
03/20/15 09:57:10 AWT ML12345-67>

```

Figure E-1: Adaptive Deployment Mode

## Waking the Instrument from the Command Prompt

Adaptive firmware will automatically enter low-power sleep mode to conserve power after 20 minutes of inactivity. In order to wake the device, enter <CTRL>-C three times with a one second pause between each <CTRL>-C.

Command to Controller	Response from Controller
<CTRL>-C	?
<CTRL>-C	Enter ^C now to wake up ...
<CTRL>-C	03/16/15 11:06:50 AWT ML12345-67> Sampler is now ready to receive commands

## AWT Commands (Adaptive PPS Sampling)

The section that follows lists AWT commands included in firmware AWT-2\_05 and higher. Some parameters are password protected to prevent accidental configuration changes. Where passwords are required, the entry is *mclane*. Commands are listed in alphabetical order.

### Command Help

Command help is displayed by entering “Help” at the command line, or by entering a question mark after a specific command (Figure E-2).

```

07/15/16 10:19:21 AWT ML12345-67>applyfixative ?
-----
APPLYFIXATIVE
-----
Description:
-----
Apply fixative using the provided parameters.
Example: APPLYFIXATIVE 10 100 50 0 1
Syntax:
-----
APPLYFIXATIVE |volume|flow rate|min. flow|time limit|port
  
```

**Type command ? for Help**
  
**Command description**
  
**Command example**
  
**Command syntax**

Figure E-2: Command Help

<b>Command:</b> ANTIFOUL
<b>Syntax:</b> ANTIFOUL   ENABLE or DISABLE
<b>Description:</b> Enables or disables antifoul operations.
<b>Example:</b> 03/20/15 09:57:10 AWT ML12345-67>ANTIFOUL ENABLE 03/20/15 09:57:10 AWT ML12345-67>ANTIFOUL DISABLE

<b>Command:</b> ANTIFOULFLUSH
<b>Syntax:</b> ANTIFOULFLUSH   volume   flow rate   min. flow rate   time limit
<b>Description:</b> Performs an Antifouling Flush using the specified parameters.
<b>Example:</b> 03/20/15 09:57:10 AWT ML12345-67>ANTIFOULFLUSH 20 80 50 0

<b>Command:</b> APPLYFIXATIVE
<b>Syntax:</b> APPLYFIXATIVE   volume   flow rate   min. flow rate   time limit   port
<b>Description:</b> Performs a Fixative Flush using the specified parameters.
<b>Example:</b> 03/20/15 09:57:10 AWT ML12345-67>APPLYFIXATIVE 20 80 50 0 1  Applies 20 ml of fixative to port 1 at 80 ml / min with a min. rate of 50 and an automatically calculated time limit.

<b>Command:</b> BATTERY
<b>Syntax:</b> BATTERY
<b>Description:</b> Displays the battery voltage.
<b>Example:</b> 03/20/15 09:57:10 AWT ML12345-67>battery Battery: 32.1V [Alkaline, 18V minimum]

<b>Command:</b> CLOCK
<b>Syntax:</b> CLOCK mm/dd/yy hh:mm:ss
<b>Description:</b> Sets the date and time.
<b>Example:</b> 03/20/15 10:02:45 AWT ML12345-67>clock 03/20/2015 10:04:06 Clock: 03/20/15 10:04:06

<b>Command:</b> CODES
<b>Syntax:</b> CODES
<b>Description:</b> Displays the pumping termination code table. Pumping codes are displayed in the RESULT command.
<b>Example:</b> 03/20/15 10:04:06 AWT ML12345-67>codes  Termination Codes: # description 0 = Pumping in progress 1 = Volume reached 2 = Time limit reached 3 = Min flow reached 4 = Low battery 5 = Stopped by user 6 = Pump would not start

<b>Command:</b> COPYRIGHT
<b>Syntax:</b> COPYRIGHT
<b>Description:</b> Displays the firmware copyright notice.
<b>Example:</b> 03/20/15 10:04:06 AWT ML12345-67>copyright  _____ CF2-AWT-2.05 R3 L2.3   ADEV2.05.c compiled Apr 1 2016 at 14:58 WTS-125M S/N ML12345-67 Adaptive Water Transfer System © 2010-2016 McLane Research Laboratories. All rights reserved. _____

<b>Command:</b> DATE
<b>Syntax:</b> DATE mm/dd/yy
<b>Description:</b> Sets the date.
<b>Example:</b> 03/20/15 10:46:20 AWT ML12345-67>date 03/20/15 Clock: 03/20/15 10:47:04

<b>Command:</b> EXIT password required
<b>Syntax:</b> EXIT [ <i>password</i> ]
<b>Description:</b> Exits the program to the operating system. Restart the program by typing <i>app</i> at the prompt.
<b>Example:</b> 03/20/15 10:47:04 AWT ML12345-67>exit mclane

<b>Command:</b> FORWARD
<b>Syntax:</b> FORWARD volume   flow rate   min. flow rate   time limit
<b>Description:</b> Starts a forward pump operation. If zero is entered for time limit, time limit will automatically be calculated based on the volume and the minimum allowable flow rate.
<b>Example:</b> 03/20/15 10:41:10 AWT ML12345-67>forward 50 100 50 0
<pre>         --- command ---   ----- result -----         port  vol flo min  tl   vol flowr minfl sec mmdyy hhmmss  batt V  pump cur. code Status 00   50 100 50 2   1.1 69.0 0.0 1 040116 111220   29.8 V  91 mA  0 Status 00   50 100 50 2   2.7 92.0 0.0 2 040116 111221   29.8 V  87 mA  0 Status 00   50 100 50 2   4.3 99.9 0.0 3 040116 111222   29.8 V  80 mA  0 Status 00   50 100 50 2   6.0 100.3 0.0 4 040116 111223   29.8 V  90 mA  0 Status 00   50 100 50 2   7.7 100.3 0.0 5 040116 111224   29.8 V  88 mA  0 Status 00   50 100 50 2   9.4 99.9 0.0 6 040116 111225   29.8 V  89 mA  0 Status 00   50 100 50 2   11.0 99.9 0.0 7 040116 111226   29.8 V  85 mA  0 Status 00   50 100 50 2   12.7 100.3 0.0 8 040116 111227   29.8 V  88 mA  0 </pre>

<b>Command:</b> HELP
<b>Syntax:</b> [ <i>command</i> ] ?
<b>Description:</b> Displays the help text including syntax.
<b>Example:</b> 07/15/16 10:19:21 AWT ML12345-67>applyfixative ?  _____ APPLYFIXATIVE  _____  Description:  _____  Apply fixative using the provided parameters.  Example: APPLYFIXATIVE 10 100 50 0 1  _____ Syntax:  _____  APPLYFIXATIVE  volume flow rate min. flow time limit port

<b>Command:</b> HISTORY
<b>Syntax:</b> HISTORY
<b>Description:</b> Displays the command history list.
<b>Example:</b> 07/15/16 10:19:21 AWT ML12345-67>HISTORY  -1: COPYRIGHT -2: VERSION -3: SERIAL -4: CODES -5: CLOCK 11/11/11 11:11:11 -6: DATE 11/11/11 -7: TIME 11:11:11 -8: TIME -9: BATTERY -10: ID -11: REVERSE 50 100 50 0 -12: PUMPTYPE mclane maxon 125 -13: PUMPTYPE

<b>Command:</b> HOME
<b>Syntax:</b> HOME
<b>Description:</b> Sets the valve to the home position
<b>Example:</b> 07/15/16 10:19:21 AWT ML12345-67>HOME  Seeking port 24... Located. Aligning... Confirmed. Seeking home port... Located. Aligning... Confirmed.  Port: 00

<b>Command:</b> ID
<b>Syntax:</b> ID
<b>Description:</b> Displays identification information.
<b>Example:</b> 07/15/16 10:19:21 AWT ML12345-67>ID  Identity: CF2-ADEV2.05 ML12345-67

<b>Command:</b> MCLANE
<b>Syntax:</b> MCLANE
<b>Description:</b> Displays McLane contact information.



<b>Command:</b> OFFLOAD
<b>Syntax:</b> OFFLOAD ALL
<b>Description:</b> Offloads deployment data.
Example: 03/20/15 10:41:10 AWT ML12345-67> OFFLOAD ALL

<b>Command:</b> OFFLOADEEP
<b>Syntax:</b> OFFLOADEEP
<b>Description:</b> Offloads EEPROM deployment data
<b>Example:</b> Example: 03/20/15 10:41:10 AWT ML12345-67> OFFLOADEEP
<pre> EVENT SUMMARY ----- Event:          1  Start time:     04/01/16 11:26:34 Volume pumped: 101 ml Elapsed time:   61 sec Lowest battery: 29.8 V Average current: 87.0 mA Highest current: 93.0 mA Port used:      00 Stop time:      04/01/16 11:29:41 Status:         Volume reached  End of EEPROM event backup cache.  Terminate file logging operation now and press any key to continue.  End of EEPROM data. </pre>

<b>Command:</b> PAUSEDEPLOY
<b>Syntax:</b> PAUSEDEPLOY
<b>Description:</b> Pauses an adaptive deployment. This command is built in because certain commands cannot be executed while there is an active deployment. It is not suggested to enter these commands mid-deployment, but this command makes it possible.

<b>Command:</b> PORT
<b>Syntax:</b> PORT [port]
<b>Description:</b> Displays or sets the valve position.
<b>Example:</b> 03/20/15 10:51:20 AWT ML12345-67>port 1

<b>Command:</b> PRINTPARMS
<b>Syntax:</b> PRINTPARAMS
<b>Description:</b> Print the programmed event parameters.
<b>Example:</b> 03/20/15 10:51:20 AWT ML12345-67>PRINTPARAMS  SAMPLE PARAMETERS  04/01/16 11:12:55  Water Flush: Volume [ml] = 100 Flow rate [ml/min] = 100 Min. flow rate [ml/min] = 50 Time limit [minutes] = 3  Sample: Volume [ml] = 101 Flow rate [ml/min] = 101 Min. flow rate [ml/min] = 51 Time limit [minutes] = 3  Fixative Flush: Volume [ml] = 25 Flow rate [ml/min] = 70 Min. flow rate [ml/min] = 50 Time limit [minutes] = 1

<b>Command:</b> PUMPTYPE <i>password required</i>
<b>Syntax:</b> Set pump type: PUMPTYPE   password   Maxon or Pittman   125 or 250 Display pump type: PUMPTYPE
<b>Description:</b> Displays or sets the pump type.
<b>Example:</b> 03/20/15 10:52:39 AWT ML12345-67>pumptype mclane maxon 250 Configuration successfully stored Pump type: Maxon 250ml

<b>Command:</b> QUIT <i>password required</i>
<b>Syntax:</b> QUIT [ <i>password</i> ]
<b>Description:</b> Quits the program.
<b>Example:</b> 03/20/15 10:52:39 AWT ML12345-67>quit mclane

<b>Command:</b> REBOOT
<b>Syntax:</b> REBOOT
<b>Description:</b> Reboots system, after confirming the command.
<b>Example:</b> 03/20/15 10:52:39 AWT ML12345-67>REBOOT  Reboot the system? [N] ?

<b>Command:</b> REBOOTNOW
<b>Syntax:</b> REBOOTNOW
<b>Description:</b> Reboots system immediately.

<b>Command:</b> RESULT
<b>Syntax:</b> RESULT
<b>Description:</b> Report results for last PUMPING operation. Format: Result port   vol flow minf tlim   vol flow minf secs date-time   batt code
<b>Example:</b>

<b>Command:</b> RESUMEDEPLOY
<b>Syntax:</b> RESUMEDEPLOY
<b>Description:</b> Resumes an adaptive deployment.
<b>Example:</b>

<b>Command:</b> REVERSE
<b>Syntax:</b> REVERSE volume flowrate minflow timelimit
<b>Description:</b> Start a reverse pump operation.  If zero is entered for time limit, time limit will automatically be calculated based on the volume and the minimum allowable flow rate.
<b>Example:</b> 03/20/15 10:41:10 AWT ML12345-67>reverse 50 100 50 0  <pre>         --- command ---   ----- result -----         port  vol flo min  tl   vol flowr minfl sec  mmddyy hhmmss  batt V  pump cur. code Status 00   50 100 50 2   1.1 65.2 0.0 1 040116 111148   29.8 V 89 mA 0 Status 00   50 100 50 2   2.6 88.6 0.0 2 040116 111149   29.8 V 99 mA 0 Status 00   50 100 50 2   4.2 97.4 0.0 3 040116 111150   29.8 V 98 mA 0 Status 00   50 100 50 2   5.8 99.5 0.0 4 040116 111151   29.8 V 98 mA 0 Status 00   50 100 50 2   7.5 99.9 0.0 5 040116 111152   29.8 V 97 mA 0 Status 00   50 100 50 2   9.2 99.9 0.0 6 040116 111153   29.8 V 97 mA 0 </pre>

<b>Command:</b> SAMPLE
<b>Syntax:</b> SAMPLE
<b>Description:</b> Sample next position in an adaptive deployment using the predefined parameters programmed with the set command. The system must be in an active deployment.
<b>Example:</b> See Figure E-3 in this Appendix

<b>Command:</b> SAMPLERESULT
<b>Syntax:</b> SAMPLERESULT
<b>Description:</b> Displays results of last sample.
<b>Example:</b> 03/20/15 10:41:10 AWT ML12345-67>SAMPLERESULT  1 Start: 04/01/16 11:26:34 29.8 Vbat 25.2 °C PORT = 00 Intake Flush PORT 00 100 ml 61 sec LB 29.8 V Average I 83.0 mA Highest I 89.0 mA Volume reached Sample PORT 01 101 ml 61 sec LB 29.8 V Average I 87.0 mA Highest I 93.0 mA Volume reached Fixative Flush PORT 01 25 ml 22 sec LB 29.8 V Average I 57.0 mA Highest I 64.0 mA Volume reached  End: 04/01/16 11:29:42 29.8 Vbat 26.0 °C PORT = 00

<b>Command:</b> SERIAL
<b>Syntax:</b> SERIAL
<b>Description:</b> Displays the sampler serial number.
<b>Example:</b> Serial: ML12345-67

<b>Command:</b> SET
<b>Syntax:</b> SET   procedure name   Procedure parameters (see examples)
<b>Description:</b> Sets event parameters for an adaptive deployment.
<b>Example:</b> Auto calculate time limits by entering zero for time limit value. Example: SET WATER 100 200 50 0  To turn flush off just enter: SET WATER 0  PRE-SAMPLE FLUSH PARAMETERS: SET   WATER   VOLUME   FLOW RATE   MINIMUM FLOW RATE   TIME LIMIT (Minutes) Example: SET WATER 100 200 50 0  SAMPLE PARAMETERS: SET   SAMPLE   VOLUME   FLOW RATE   MINIMUM FLOW RATE   TIME LIMIT (Minutes) Example: SET SAMPLE 500 200 50 0  FIXATIVE PARAMETERS (if solenoid valve is installed and enabled): SET   FIXATIVE   VOLUME   FLOW RATE   MINIMUM FLOW RATE   TIME LIMIT (Minutes) Example: SET FIXATIVE 30 75 50 0  ANTIFOULING FLUSH PARAMETERS (If antifouling is installed and enabled): SET   ANTIFOUL   VOLUME   FLOW RATE   MINIMUM FLOW RATE   TIME LIMIT (Minutes) Example: 03/20/15 10:41:10 AWT ML12345-67> SET ANTIFOUL 30 75 50 0

<b>Command:</b> SLEEP
<b>Syntax:</b> SLEEP
<b>Description:</b> Invokes low-power sleep.

<b>Command:</b> STARTDEPLOY
<b>Syntax:</b> STARTDEPLOY
<b>Description:</b> Starts an adaptive deployment.  Allows user to perform samples using parameters defined with the SET command. The system automatically selects the next port in the deployment and will stop when there are no available ports left to sample.
<b>Example:</b> See Figure E-8 in this Appendix.

<b>Command:</b> STOPDEPLOY
<b>Syntax:</b> STOPDEPLOY
<b>Description:</b> Stops an adaptive deployment.

<b>Command:</b> SV
<b>Syntax:</b> SV   ENABLE or DISABLE SV   ON or OFF SV   FIXATIVE or OCEAN
<b>Description:</b> The SV command has arguments that will enable or disable the solenoid valve, and switch the solenoid valve position. ON is the alternate fluid source (typically a fixative) and off is the resting position, which is plumbed to the primary fluid source (the environment) you can use either the ON/OFF arguments or the OCEAN/FIXATIVE arguments to switch the valve position.
<b>Example:</b> 03/20/15 10:41:10 AWT ML12345-67>SV ENABLE - Configures system with a solenoid valve. 03/20/15 10:41:10 AWT ML12345-67>SV DISABLE - Configures system without a solenoid valve. 03/20/15 10:41:10 AWT ML12345-67>SV ON - Energizes solenoid valve, switches to alternate fluid position. 03/20/15 10:41:10 AWT ML12345-67>SV FIXATIVE Energizes solenoid valve, switches to alternate fluid position.. 03/20/15 10:41:10 AWT ML12345-67>SV OFF - De-energizes solenoid valve, moves to resting position (default fluid position). 03/20/15 10:41:10 AWT ML12345-67>SV OCEAN - De-energizes solenoid valve, moves to resting position (default fluid position).

<b>Command:</b> TIME
<b>Syntax:</b> TIME hh:mm:ss
<b>Description:</b> Sets the time.
<b>Example:</b> 03/20/15 10:41:10 AWT ML12345-67>TIME 11:11:11 Clock: 04/01/16 11:11:11

<b>Command:</b> VERSION
<b>Syntax:</b> VERSION
<b>Description:</b> Displays version information
<b>Example:</b> 03/20/15 10:41:10 AWT ML12345-67>VERSION  Version:  McLane Research Laboratories, Inc. CF2 Adaptive Water Transfer System Version 2.05 of Apr 1 2016 14:58 Pump type: Maxon 125ml

<b>Command:</b> VOLUME
<b>Syntax:</b> VOLUME   ANTIFOUL or FIXATIVE
<b>Description:</b> Sets the available fixative or antifouling fluid volume.
<b>Example:</b> 03/20/15 10:41:10 AWT ML12345-67>VOLUME FIXATIVE 100 03/20/15 10:41:10 AWT ML12345-67>VOLUME ANTIFOULING 100



## Using Automated Adaptive Commands

To perform an adaptive deployment, use the SET, STARTDEPLOY and SAMPLE commands. Use the OFFLOAD DATA command to offload the deployment data.

### SET Command

With the SET command, the user can predefine water flush, sample parameters, fixative flush, and antifouling flush parameters.

```
03/13/15 10:43:48 AWT ML12345-67>set water 100 100 50 0
Water Flush:
Volume          [ml]          = 100
Flow rate       [ml/min]      = 100
Min. flow rate  [ml/min]      = 50
Time limit      [minutes]     = 3
```

*Figure E-2 SET Command*

### Deploy Commands

The commands STARTDEPLOY and ENDEPLOY start and stop the automated deployment. After the sample event parameters have been predefined, entering STARTDEPLOY starts the deployment. The system clears stored data from the previous deployment, then goes to sleep until the user enters the SAMPLE command to wake the system.

```
03/13/15 10:54:03 AWT ML12345-67>startdeploy
Erasing previous deployment data .....
Deployment started.

04/01/16 11:12:58 Suspended ...
04/01/16 11:20:01 Suspended ...

SAMPLE

04/01/16 11:26:34 Event 1 starting
```

*Figure E-2 STARTDEPLOY Command*

### Sample Command

When the SAMPLE command is entered the system automatically selects the next available port, executes the predefined sample parameters, and records event data. The system locates the next port, confirms alignment and remains in suspend mode until the next sample is automatically triggered (Figure E-3).

The SET command can be run during the deployment to change the sample volume, flow rates and time limits, for the remaining samples.

```

12/10/15 16:14:58 AWT ML12935-01>sample ← Collect Sample
12/10/15 16:15:01 Event 1 starting

FLUSHING INTAKE PORT

-----
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl  sec  mmddyy hhhmss  batt V  pump cur. code
Status 00 | 50 125 100  1 | 0.6 36.4 0.0  1 121015 161503 | 22.5 V  105 mA  0
Status 00 | 50 125 100  1 | 2.0 81.1 0.0  2 121015 161504 | 22.5 V  129 mA  0
. . . ← Shortened to save space
Status 00 | 50 125 100  1 | 47.1 125.0 125.0 24 121015 161526 | 22.5 V  151 mA  0
Status 00 | 50 125 100  1 | 49.2 125.0 125.0 25 121015 161527 | 22.5 V  140 mA  0

Volume reached

Total volume pumped      = 50 ml
Elapsed time of event    = 26 sec
Lowest battery detected  = 22.5 V
Average pump current     = 142 mA
Highest pump current     = 151 mA

Seeking port 01...
Located.
Aligning...
Confirmed.

PUMPING SAMPLE

-----
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl  sec  mmddyy hhhmss  batt V  pump cur. code
Status 01 | 255 125 50  6 | 0.6 36.4 0.0  1 121015 161540 | 22.5 V  108 mA  0
Status 01 | 255 125 50  6 | 2.0 81.5 0.0  2 121015 161541 | 22.5 V  133 mA  0
. . . ← Shortened to save space
Status 01 | 255 125 50  6 | 251.4 125.0 124.6 122 121015 161741 | 22.5 V  150 mA  0
Status 01 | 255 125 50  6 | 253.5 125.0 124.6 123 121015 161742 | 22.5 V  147 mA  0

Volume reached

Total volume pumped      = 255 ml
Elapsed time of event    = 124 sec
Lowest battery detected  = 22.5 V
Average pump current     = 149 mA
Highest pump current     = 153 mA

Seeking port 02...
Located.
Aligning...
Confirmed.

12/10/15 16:18:48 AWT ML12935-01>set sample 200 75 50 0 ← Set Sample Parameters
Sample:
Volume          [ml]      = 200
Flow rate       [ml/min]  = 75
Min. flow rate  [ml/min]  = 50
Time limit      [minutes] = 5
12/10/15 16:19:01 AWT ML12935-01>sample
12/10/15 16:19:04 Event 2 starting ← Collect Sample

FLUSHING INTAKE PORT

-----
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl  sec  mmddyy hhhmss  batt V  pump cur. code
Status 00 | 100 75 50  3 | 0.6 36.8 0.0  1 121015 161906 | 22.5 V  75 mA  0
Status 00 | 100 75 50  3 | 1.6 57.3 0.0  2 121015 161907 | 22.5 V  84 mA  0
← Shortened to save space

```

Figure E-3 SAMPLE and SET Commands

## Ending the Deployment

The deployment automatically ends when all available ports have been sampled.

Alternatively, the user can end the deployment at any point using the STOPDEPLOY command.

Once STOPDEPLOY is entered, the automated deployment cannot be restarted.

```
. . . .
Status 01 | 101 101 51 3 | 97.0 100.8 100.8 58 040116 112845 | 29.8 V 90 mA 0
Status 01 | 101 101 51 3 | 98.7 101.2 100.8 59 040116 112846 | 29.8 V 88 mA 0
Status 01 | 101 101 51 3 | 100.4 100.8 100.8 60 040116 112847 | 29.8 V 84 mA 0

Volume reached

Total volume pumped = 101 ml
Elapsed time of event = 61 sec
Lowest battery detected = 29.8 V
Average pump current = 87 mA
Highest pump current = 93 mA

Seeking port 24...
Located.

Aligning...
Confirmed.

Seeking home port...
Located.

Aligning...
Confirmed.

Sample completed. Normal shutdown now in effect.
04/01/16 16:18:10 Suspended ...
```

*Figure E-4 Deployment Ends After Last Sample*

Seeking port 01... Located. Aligning... Confirmed.

. . .

PUMPING SAMPLE

port	vol	flo	min	tl	vol	flowr	minfl	sec	mmddy	hhmmss	batt V	pump cur.	code
Status 01	101	101	51	3	1.2	69.8	0.0	1	040116	112748	29.8 V	90 mA	0
Status 01	101	101	51	3	2.7	92.8	0.0	2	040116	112749	29.8 V	88 mA	0
Status 01	101	101	51	3	4.4	100.3	0.0	3	040116	112750	29.8 V	88 mA	0
Status 01	101	101	51	3	6.1	101.2	0.0	4	040116	112751	29.8 V	88 mA	0
. . .													
Status 01	101	101	51	3	97.0	100.8	100.8	58	040116	112845	29.8 V	90 mA	0
Status 01	101	101	51	3	98.7	101.2	100.8	59	040116	112846	29.8 V	88 mA	0
Status 01	101	101	51	3	100.4	100.8	100.8	60	040116	112847	29.8 V	84 mA	0

Volume reached

Total volume pumped = 101 ml  
Elapsed time of event = 61 sec  
Lowest battery detected = 29.8 V  
Average pump current = 87 mA  
Highest pump current = 93 mA

04/01/16 11:26:34 AWT ML12345-67> STOPDEPLOY

Deployment ended.

Figure E-5 End Deployment Using STOPDEPLOY

## Offload Command

The OFFLOAD command is used any time during the deployment to offload data. This command is available if you use adaptive deployment rather than Manual Operations commands such as PUMP FORWARD.

```

12/10/15 16:27:27 AWT ML12935-01>offload

Software version:  AWT-2.05.c
Compiled:          Dec 10 2015 16:04:04
Electronics S/N:  ML12345-01

Data start:       12/10/15 16:14:53
Data stop:        12/10/15 16:23:53

-----
HEADER
-----
...
...
...

-----
SAMPLE PARAMETERS
-----
      Flush      Flush      Sample      Flow      Min      Sample      Pump
      Vol        Time Lim.  Vol        Rate      Flow     Time Lim.  Data Increment
Event 1      50          1          255       125       50         6          60          Set at
12/10/15 16:14:32
Event 2     100         3          200       75        50         5          60          Set at
12/10/15 16:19:01

-----
DEPLOYMENT DATA
-----

 1 Start: 12/10/15 16:15:01  22.6 Vbat  23.7 øC  PORT = 00
   Intake Flush PORT 00  50 ml      26 sec   LB 22.5 V Average I  142.0 mA Highest I  151.0 mA
   Volume reached
   Sample PORT 01  255 ml      124 sec  LB 22.5 V Average I  149.0 mA Highest I  153.0 mA
   Volume reached
   End: 12/10/15 16:18:10  22.6 Vbat  23.7 øC  PORT = 01

 2 Start: 12/10/15 16:19:04  22.6 Vbat  23.8 øC  PORT = 00
   Intake Flush PORT 00  100 ml     81 sec   LB 22.5 V Average I  88.0 mA Highest I   95.0 mA
   Volume reached
   Sample PORT 02  200 ml     162 sec  LB 22.5 V Average I  87.0 mA Highest I   95.0 mA
   Volume reached
   End: 12/10/15 16:23:53  22.6 Vbat  24.0 øC  PORT = 02

-----
PUMPING DATA
-----
Pump data period = 1 minute
[event#] [ml/min] [ml] [Vbat] [Av. Cur] [High Cur]
 1 125 122 22.5 147.0 152.0
 1 125 247 22.5 149.0 153.0
 2 75 74 22.5 87.0 94.0
 2 75 149 22.5 88.0 95.0

```

Figure E-6: OFFLOAD Command

## Using Manual Commands

To perform adaptive sampling with manual commands for each step, use the PORT, FORWARD, and REVERSE commands. Using manual commands do not have a data offload. These commands are equal to using the Manual Operations menu in the standard firmware.

Figure E-7 shows manually commanding the move to Port 1. Manually commanding forward pumping is also shown.

```
12/10/15 15:09:39 AWT ML12935-01>port 1 ← Port 1
Seeking port 01...
Located.
Aligning...
Confirmed.
Port: 01
12/10/15 15:01:10 AWT ML12935-01>forward 100 250 100 0 ← Forward
| --- command --- | ----- result ----- |
port  vol flo min  t1    vol flowr minfl  sec  mmddyy hhmss  batt V  pump cur. code
Status 00 | 100 250 100  2 |  1.0  72.8  0.0  1 121015 150150 | 22.5 V  108 mA  0
Status 00 | 100 250 100  2 |  3.5 160.6  0.0  2 121015 150151 | 22.5 V  132 mA  0
Status 00 | 100 250 100  2 |  6.7 207.4  0.0  3 121015 150152 | 22.5 V  139 mA  0
Status 00 | 100 250 100  2 | 10.3 227.5  0.0  4 121015 150153 | 22.5 V  144 mA  0
```

Figure E-7: Manually Commanding Pumping

## Configuring the Solenoid Valve and Antifouling Options

If the Solenoid Valve or Antifouling options are installed, these options must be enabled in the firmware, and the volume of available fixative or antifouling solution must be defined. Fixative and Antifouling Flush parameters can be predefined and automatically executed in an Adaptive Deployment, or executed manually using the FIXATIVEFLUSH and ANTIFOULFLUSH commands. The following examples explain how to configure a system with the Solenoid Valve and Antifouling option, and how to predefine Fixative and Antifouling Parameters.

### Solenoid Valve Option

1. Type SV ENABLE to enable the solenoid valve option.

```
07/15/16 10:03:20 PPS ML12345-67>sv enable  
Solenoid valve ENABLED
```

*Figure E-8: Enabling the Solenoid Fixative Option*

2. Define the available fixative volume.

```
07/15/16 10:03:25 AWT ML12345-67>volume fixative 1000  
Available fixative: 1000.0 ml
```

*Figure E-9: Defining the Available Fixative*

3. Type SET FIXATIVE to define the Fixative Flush parameters.

```
07/15/16 10:04:08 AWT ML12345-67>set fixative 20 100 50 0  
Fixative Flush:  
Volume [ml] = 20  
Flow rate [ml/min] = 100  
Min. flow rate [ml/min] = 50  
Time limit [minutes] = 1
```

*Figure E-10: Setting the Fixative Parameters*

## Antifouling Flush Option

1. Type ANTIFOUL ENABLE to enable the Antifouling Option.

```
07/15/16 10:03:32 AWT ML12345-67>antifoul enable
```

```
Antifouling ENABLED
```

*Figure E-11: Enabling the Antifouling Option*

2. Define the available antifouling solution volume.

```
07/15/16 10:03:39 AWT ML12345-67>volume antifoul 1000
```

```
Available antifouling solution: 1000.0 ml
```

*Figure E-12: Defining the Available Antifouling Solution*

3. Type SET ANTIFOUL to define the Antifouling Flush parameters.

```
07/15/16 10:04:17 AWT ML12345-67>set antifoul 20 100 50 0
```

```
Antifouling Flush:  
Volume           [ml]           = 20  
Flow rate        [ml/min]        = 100  
Min. flow rate   [ml/min]        = 50  
Time limit       [minutes]       = 1  
Fixative Flush:  
Volume           [ml]           = 25  
Flow rate        [ml/min]        = 70  
Min. flow rate   [ml/min]        = 50  
Time limit       [minutes]       = 1
```

*Figure E-13: Setting the Antifouling Parameters*



## Adaptive Deployment with Solenoid Fixative and Antifouling

Figure E-15 and E-16 show a deployment with Solenoid Fixative Valve and Antifouling options enabled.

```

07/15/16 10:04:23 AWT ML12345-67>startdeploy
Erasing previous deployment data .....
Deployment started.
07/15/16 10:04:31 Suspended ...  [^C]
07/15/16 10:05:01 AWT ML12345-67>sample
Seeking home port...  Located. Aligning...  Confirmed.
07/15/16 10:05:23 Event 1 starting

```

---

```

FLUSHING INTAKE PORT

```

---

--- command ---		----- result -----											
port	vol	flo	min	tl	vol	flowr	minfl	sec	mmddy	hhmmss	batt V	pump cur.	code
Status 00	20	100	50	1	0.4	22.2	0.0	1	010136	000225	23.9 V	25 mA	0
Status 00	20	100	50	1	1.1	41.8	0.0	2	010136	000226	23.9 V	32 mA	0
. . .													
Status 00	20	100	50	1	18.0	97.8	93.7	14	010136	000238	23.8 V	86 mA	0
Status 00	20	100	50	1	19.6	98.3	93.7	15	010136	000239	24.2 V	83 mA	0

```

Volume reached
Total volume pumped      = 20 ml
Elapsed time of event    = 16 sec
Lowest battery detected  = 23.5 V
Average pump current     = 499 mA
Highest pump current     = 868 mA

```

```

Seeking port 01...  Located. Aligning...  Confirmed.

```

---

```

PUMPING SAMPLE

```

---

--- command ---		----- result -----											
port	vol	flo	min	tl	vol	flowr	minfl	sec	mmddy	hhmmss	batt V	pump cur.	code
Status 01	20	100	50	1	0.0	0.0	0.0	1	010136	000252	23.9 V	21 mA	0
Status 01	20	100	50	1	17.8	98.7	98.3	12	010136	000308	23.7 V	81 mA	0
Status 01	20	100	50	1	19.5	98.3	98.3	13	010136	000309	24.0 V	84 mA	0

```

Volume reached
Total volume pumped      = 20 ml
Elapsed time of event    = 14 sec
Lowest battery detected  = 23.7 V
Average pump current     = 0 mA
Highest pump current     = 859 mA

```

Figure E-14: Adaptive Deployment, Solenoid Fixative and Antifouling Enabled (Screen 1 of 2)

Solenoid valve FIXATIVE

APPLYING FIXATIVE

```
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl sec mddy hhmss  batt V  pump cur. code
Status 01 | 20 100 50  1 | 0.0  0.0  0.0  1 010136 000313 | 24.0 V  11 mA  0
Status 01 | 20 100 50  1 | 17.9 98.7 96.2 13 010136 000327 | 23.8 V  85 mA  0
Status 01 | 20 100 50  1 | 19.6 98.3 96.2 14 010136 000328 | 23.9 V  79 mA  0
```

Volume reached

Total volume pumped = 20 ml  
Elapsed time of event = 15 sec  
Lowest battery detected = 23.5 V  
Average pump current = 0 mA  
Highest pump current = 852 mA

Solenoid valve OCEAN

Seeking port 24... Located. Aligning... Confirmed.

ANTI FOULING FLUSH

```
| --- command --- | ----- result ----- |
port  vol flo min  tl    vol flowr minfl sec mddy hhmss  batt V  pump cur. code
Status 24 | 20 100 50  1 | 0.0  1.7  0.0  1 010136 000350 | 23.7 V  660 mA  0
Status 24 | 20 100 50  1 | 17.9 98.7 98.7 12 010136 000406 | 23.5 V  81 mA  0
Status 24 | 20 100 50  1 | 19.5 98.7 98.7 13 010136 000407 | 23.5 V  81 mA  0
```

Volume reached

Total volume pumped = 20 ml  
Elapsed time of event = 14 sec  
Lowest battery detected = 22.7 V  
Average pump current = 0 mA  
Highest pump current = 819 mA

Seeking home port... Located. Aligning... Confirmed.  
Sample completed. Normal shutdown now in effect.

Figure E-15: Adaptive Deployment, Solenoid Fixative and Antifouling Enabled (Screen 2 of 2)

## Using On-Demand Fixative and Antifouling Commands

Figure E-17 and E-18 shows the commands that allow the user to perform fixative and antifouling on-demand.

```

07/15/16 10:19:24 PPS ML12345-67>applyfixative 10 75 50 0 1

Solenoid valve FIXATIVE

Seeking port 01... Located. Aligning...   Confirmed.

-----
APPLYING FIXATIVE
-----

      | --- command --- | ----- result ----- |
port  vol flo min  tl |  vol flowr minfl sec  mmddyy hhmms  batt V  pump cur. code
Status 01 | 10 75 0 1 | 0.4 25.1 0.0 1 010136 002019 | 23.9 V  19 mA  0
Status 01 | 10 75 0 1 | 1.1 38.0 0.0 2 010136 002020 | 23.8 V  24 mA  0
. . .

Status 01 | 10 75 0 1 | 8.2 69.4 0.0 9 010136 002027 | 23.8 V  39 mA  0
Status 01 | 10 75 0 1 | 9.4 70.7 0.0 10 010136 002028 | 23.9 V  41 mA  0

Volume reached
Total volume pumped      = 10 ml
Elapsed time of event    = 11 sec
Lowest battery detected  = 23.8 V
Average pump current     = 329 mA
Highest pump current     = 415 mA

Solenoid valve OCEAN

Seeking port 24... Located. Aligning...   Confirmed.
Seeking home port... Located. Aligning...  Confirmed.

Port: 00

```

Figure E-16: Applying Fixative

```
07/15/16 10:15:44 PPS ML12345-67>antifoulflush 10 75 50 0
```

```
Seeking port 24... Located. Aligning... Confirmed.
```

```
ANTIFOULING FLUSH
```

port	vol	flo	min	tl	vol	flowr	minfl	sec	mmddy	hhmmss	batt V	pump cur.	code
Status 24	10	75	50	1	0.4	22.6	0.0	1	010136	001611	23.9 V	18 mA	0
Status 24	10	75	50	1	1.0	35.5	0.0	2	010136	001612	23.8 V	26 mA	0
Status 24	10	75	50	1	1.7	44.7	0.0	3	010136	001613	23.9 V	31 mA	0
. . .													
Status 24	10	75	50	1	8.0	69.4	0.0	9	010136	001619	23.8 V	45 mA	0
Status 24	10	75	50	1	9.1	71.1	0.0	10	010136	001620	23.7 V	43 mA	0

```
Volume reached  
Total volume pumped = 10 ml  
Elapsed time of event = 11 sec  
Lowest battery detected = 23.7 V  
Average pump current = 358 mA  
Highest pump current = 438 mA
```

```
Seeking home port... Located. Aligning... Confirmed.
```

Figure E-17: Applying Antifouling