

Afridev2 Assembly and Testing Process

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# Introduction

This document contains directions for programming, testing and assembling the Afridev2 units. It shows a sequence of steps that must be done for each unit. The process can be done in batches. For example, the GPS test needs to be done outside, so several units could be readied and the GPS test can be done on them all at the same time.

At the end of the process, the “CW MSP Flasher” folder will contain a .TXT file for each unit. At the conclusion of the assembly process, all instances of these files should be zipped into a file and sent to IPS. These files contain the test results and important calibration data.

# Required Equipment

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The following equipment/software is required for performing these actions per assembly station:

1. A laptop with 2 USB ports (running MS Windows 7, 8 or 10, 32 or 64bit
2. TI MSP-FET Flash Emulation Tool
3. TI MSP-FET432ADPTR
4. Micro USB cable
5. USB Serial Adapter Cable TTL-232R-3V3
6. Afridev2 Harness Cable (made by IPS)
7. Small storage container for holding water

# Advance Preparation

Follow these steps to be ready for assembly of Afridev2 units

|  |  |
| --- | --- |
|  | A laptop with 2 USB ports (running MS Windows 7, 8 or 10, 32 or 64bit   * Unzip “CW MSP Flasher” ZIP file from IPS * Extract CW MSP Flasher ZIP file to get the EXE files for the next steps   Install MSP430 driver:   * Install the file ti\_msp430driver\_setup\_1.0.1.0.exe on your machine   Install MSP Flasher Utility:   * Unzip MSPFlasher-1\_03\_18\_00-windows-installer.zip * Run MSPFlasher-1.3.18-windows-installer.exe * Use default install options. Make sure the tool installs at “C:\ti\MSPFlasher\_1.3.18” directory   Install TeraTerm:   * Install TeraTerm or some other Terminal Emulation program to watch data from the unit * Setup the tool to watch data at 9600/8 bit/ 1 stop bit |
|  | - Insert MSP-FET432ADPTR board into 14 pin slot  - Connect Micro USB cable to the box  - Connect the USB-A jack to your laptop |
|  | TI MSP-FET432ADPTR:  - Move slider switch to “Provide External Power”  - Attach 14-pin connector of Harness cable |
|  | - The other side of the Harness cable is attached to the Afridev2 board during assembly |
|  | Have a small storage container of water nearby filled nearly to the top. This will be used for water testing of the Afridev2 unit. The Afridev2 unit will be immersed in this water during testing. |

# Assembly Process, Part 1

There are a number of steps for the programming and assembly of the Afridev2 unit.

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|  | Insert gaskets into Afridev2 unit lid |
|  | Put foam pad on modem side of the board. The same side of the board as the “charity: water” logo |
|  | Insert board slightly into the housing with the foam size facing the center of the unit. You will need to compress the foam while inserting the board. |
|  | Before running the test, insert the flat connector of the harness cable to the connector. The black ground wire should be on the left. |
|  | Fully insert the board, slowly. Taking care to not scrape the components against the housing on the back side of the board. This Attach the board to the housing with 2 screws. |
|  | Connect the black and yellow wires of the harness to the black and yellow wires of the USB Serial cable. The Orange wire remains unconnected. |

# Programming the board.

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|  | - Connect an assembled housing cover with battery and board to the MSP-FET box (black box with red board)  - Connect the two USB connectors to a lap top with the required software installed |
|  | - Open a Windows Command Prompt window as an administrator (right click on icon and select Administrator)  - CD to the “CW MSP Flasher” folder |
|  | - Enter the write\_it command  *NOTE: When you run this, it cancels and erases the results of all previous tests run on this unit, including calibration data stored* |
|  | This runs the MSP Flasher utility. The output of this operation should look like this screen capture.  *Any failures will stop the operation. If there is a failure, double check:*  *- Are you running it in the correct directory?*  *- Are all the wires correctly attached?*  *- Is the battery connected?* |

# Running the GPS Test

This test may need to be run outside, depending on the building’s construction and orientation of the building in regards to the available GPS satellites.

The 20-pin JTAG connector to the MSP\_FET box can be removed for this test.

The unit is awaiting the reception of GPS satellite data. As data is received, it is displayed on the debug trace.

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| l | Open the TeraTerm application.  The Afridev2 unit should have started running after programming the board.  Hit the reset button on the board (next to battery connector)  The output should look like this |

The time data usually shows first, if the time data is not seen after 30 seconds, this is a sign that the test needs to be run elsewhere.

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|  | This capture shows a successful GPS test.  The test takes a minimum of 60 seconds. It finishes when HDOP (h=3.0 or less), Sattelite Count (s=4 or higher). |
|  | If the test runs for 5 miuntes without a GPS fix, then the unit fails. It will report |

# Running the Water Sensing Test

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|  | Upon completion of the GPS test, the unit records AIR Target data and records it into flash.  There are 6 pads of data numbered 0(?) to 5(?). The numbers that follow are hexadecimal measurements for Air. All of these values should be greater than 0x8000. If the numbers are lower, there is a board defect. |
|  | (optional) if the reset button is hit, this should appear.  If \*\*GPS Test Begin\*\*\* appears, then the GPS test did not pass. |
|  | Hold the unit over an almost full container of water and plunge the unit into the water.  If the container is smaller than the unit you can set the unit down on the container |
|  | When placed in the water, the Tera Term should show measurement data. |
| The second to last column (boxed in red) shows the measured level of water from L1 to L6.  When the unit detects L6 (all pads covered) the test passes. The unit can be removed from the water  The data reports “Manufacturing Test Pass” when GPS and Water Detection is verified. | |
|  | The temperature measured during the water test should be close to the room temperature where the test was run.  This image shows a negative temperature which is a failure. T=-26.2 (boxed in red). |
| If there is a hardware fault with the unit’s Thermistor, a message “\*\*\* Thermistor Failure \*\*\*” is displayed  The thermistor is defective and it needs to be replaced. | |

# Programming the Production Firmware

|  |  |
| --- | --- |
|  | - Connect an assembled housing cover and board to the MSP-FET box (black box with red board)  - Connect the two USB connectors to a lap top with the required software installed |
|  | Connect the battery to the board. When the battery is connected, within a second the LEDs will blink.  It is normal to see 3 flashes of the Red LED followed by 3 flashes of the Green LED. This Indicates that the battery was previously removed.  (See Section 10.1 for more details on LED flashing) |
|  | - Open a Windows Command Prompt window as an administrator (right click on icon and select Administrator)  - CD to the “CW MSP Flasher” folder |
|  | - Enter the “laststep” command with the last 6 digits of the IMEI number as an argument |
|  | This runs the MSP Flasher utility. The output of this operation should look like this screen capture.  *Any failures will stop the operation. If there is a failure, double check:*  *- Are you running it in the correct directory?*  *- Are all the wires correctly attached?*  *- Is the battery connected?* |

# Provisioning the Modem

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|  | Once the production software is loaded and running,  It is normal to see 3 flashes of the Green LED. This is the Boot Loader successfully Exiting. (See Section 10.1 for more details on LED flashing)  Next, a special command is sent to the Modem to support the Provisioning process.  The board has a red and a green LED that will flash while the modem is being provisioned.  While the Modem is being setup by the network, the two LED’s will alternately flash every 2 seconds. |
| When the flashing stops and is solid green, then the unit passes its Modem provisioning step.  This solid green LED stays on only 5 minutes.  If the LED stays red, then the provisioning failed. |
|  | Record the IMEI number of every unit that passes this test in a list. |

Upon completion of this verification, the unit has fully passed Factory Testing. You can remove the 8 pin harness cable from the board (leave the battery connected). Place a mark on the board indicating “QA” Pass. The unit is ready to be sealed shut and boxed for shipping.

After all the units are assembled and tested up to step 9, a list of the passing IMEI numbers is sent to the Body Trace to finish the activation of the modems.

# Supplemental Information

## LED Flashing

The Afridev2 board has 2 indicator LED’s that are used by the Firmware to show important status information.

### List of Boot Loader Status Indications (each flash is 200 mSec long with a 200 mSec gap)

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| --- | --- | --- |
| LED Sequence | Error Name | Description |
| 3 Green Flashes | Success | The Bootloader completed successfully |
| 2 Red Flashes | NMIIFG | The processor reports in the IFG1 register that it reset with a Non-Maskable Interrupt |
| 3 Red Flashes | OFIFG | The processor reports in the IFG1 register that it reset with a an Oscillator Failure. |
| 4 Red Flashes | WDTIFG | The processor reports in the IFG1 register that it reset with a Watchdog Timeout |
| 5 Red Flashes | CRC Fail | The firmware image that was broadcasted to the unit does not have a correct CRC. It is not used |
| 6 Red Flashes | App Record Fail | The application code records an App Record in flash when the unit successfully operates successfully after a boot. The boot loader counts how many times the unit boots without application success, if this exceeds 64 times, then this signal is given and the unit enters SOS mode.. |
| 7 Red Flashes | Bad IVT | Corrupted Interrupt Vector Table, very bad. Enter SOS mode |

### Boot Loader Indications

When the board is reset or powered up for the first time, the Boot Loader is run first. Every time the board is reset, the TI processor records the reason why the processor reset in the IFG1 register. If there are any notable errors in the Boot Code, then the Red LED is flashed 2 to 7 times to indicate a specific status condition.

When the battery is disconnected and re-connected it will typically report an “Oscillator Failure” shown by 3 Red LED flashes. This is normal.

When the Boot Loader completes, it will indicate success by flashing the Green LED 3 times.

### Critical Failure Indications

When the Boot Loader completes, if an unrecoverable or chronic error such as CRC Fail, App Record Fail, or Bad IV occurs, then the board enters SOS mode. The Boot Loader determined that there is not any viable Application to jump to. Every 12 hours it will enable the Modem and send an SOS message and try to receive a firmware update

This is indicated by lighting both LEDs without blinking. The LEDs stay on until an SOS update is sent via the Modem to the server (if it can)

## Running a Post Activation Modem Test

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|  | When the unit powers up in step 9 it will attempt to send an Final Assembly message (Opcode = 0x00) to the server. |
| Replace the IMEI number with the number of the unit under test:  <http://prov.bodytrace.com/www.cqt.io/raw.html?imei=861508039423348>  Such as shown here:  http://prov.bodytrace.com/www.cqt.io/raw.html?imei=861508039416912 | Open a Web Browser and cut and paste the following URL.  Replace the IMEI number with the number of the unit under test. |
|  | Enter “[sensors@charitywater.org](mailto:sensors@charitywater.org)” for E-mail, and  “823akrJTIO28gh29854n3” for the Password |
|  | If the login attempt returns an error “Invalid username or password”, then it is a sign that either:   1. The modem was not yet provisioned 2. The wrong IMEI number or login credentials were entered |
|  | If a blank page is seen, then the FA message was not yet processed by the Body Trace server, or the Modem was not yet Provisioned. |
|  | If the page opens with a “FinalAssembly” message, it shows that the modem transmitted data.  If the message is not seen after 10 minutes of a battery connection, then unplug the battery and plug back in after 15 seconds. |
|  | If the page opens with yellow shaded data, there was a Modem Transmission failure. Check the antenna and modem connections. The Modem signal may be weak in your area. |