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**RadFXSat-2 (Fox-1E)** **Short Functional Test Subset Procedure**

## Version Change Log

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| --- | --- | --- | --- |
| **Revision** | **Date** | **Author** | **Change Log** |
| 1 | March 12, 2018 | B. Fisher, G. Buxton | Create subset of SFT to be done after stacking flight boards before space-frame |

## Satellite Team Responsible Engineers

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**PURPOSE:** The purpose of this document is to detail a subset of the Fox-1E Short Functional Test (SFT) to determine FM stack functionality of the RadFXSat-2 (Fox-1E) CubeSat prior to stack integration.

**WHAT IS TO BE TESTED:** Passing this test confirms the following:

1. IHU is functional and able to perform most functions,
2. MPPT *telemetry* is functional
3. Battery is charged
4. Vanderbilt University experiment is functional
5. MEMS Gyro experiment is responsive

**Required equipment:**

1. AMSAT Fox-1 Umbilical/Battery Tender (UBT), version I or II
2. Electrical power outlet
3. Voltmeter
4. PC running appropriate terminal software

**SHORT FUNCTIONAL TEST:**

| **Step #** | **Description** | **√ or Value** | **Time** | **Date** | **Initial** |
| --- | --- | --- | --- | --- | --- |
|  | Verify the RBF pin ~~i~~nstalled and that a preflight init. has been performed. | **√** | 9:33 | **3/14/2018** | ***Bf*** |
|  | Attach the UBT umbilical USB (mini-B) cable to the CubeSat’s umbilical port. | **√** | 9:33 | 3/14 | ***Bf*** |
|  | Via the UBT, observe the battery voltage is 3.8 V or greater and record the voltage. [**IF** the battery voltage is < 3.8 V, **STOP** **the test** and charge the battery]. | **3.99V** | 9:34 | 3/14 | ***Bf*** |
|  | Attach the UBT’s PC USB cable to the PC. | **√** |  | 3/14 | ***Bf*** |
|  | Verify the UBT’s PWR switch is in the OFF position. | **√** |  | 3/14 | ***Bf*** |
|  | Plug the UBT power supply into a wall socket. | **√** |  | 3/14 | ***Bf*** |
|  | Move the UBT’s PWR switch to the ON position; verify the UBT’s 6Power light is lit and ensure the BATT charge voltage is +5 volts. | **√** | 9:35 | 3/14 | ***Bf*** |
|  | Observe through the –X opening of the CubeSat that the GREEN battery charging LED is lit. | **√** |  | 3/14 | ***Bf*** |
|  | Observe through the +X opening of the CubeSat that the ALERT RED deploy LED is extinguished [**IF** the deploy LED is lit, immediately move the UBT’s PWR switch to the OFF position and **STOP** **the test**]. | **√** |  | 3/14 | ***Bf*** |
|  | Verify the deploy beeper is silent [**IF** the beeper is sounding, immediately move the UBT’s PWR switch to the OFF position and **STOP** **the test**]. | **√** |  | 3/14 | ***Bf*** |
|  | Open a terminal window on the PC and (electronically) connect to the CubeSat’s IHU. | **√** |  | 3/14 | ***Bf*** |
|  | In the terminal window, type **‘v’** to verify the bootloader; then type **‘a’** to begin execution of the flight software and then close the terminal window. | **√** | 9:36 | 3/14 | ***Bf*** |
|  | Open a new terminal window on the PC and (electronically) (re)connect to the CubeSat’s IHU (reboot time is approximately 20 seconds). | **√** |  | 3/14 | ***Bf*** |
|  | After connecting to the IHU terminal, press **ENTER**, then at the command line prompt, type **‘v’** and press **ENTER**; record the CubeSat’s serial number and software version. | **V5.5o S/N 14** |  | 3/14 | ***Bf*** |
|  | In the terminal window, type **‘GET STATUS’** and press **ENTER**; verify the following items in the response (record via check marks): | **√** | 9:37 | 3/14 | ***Bf*** |
|  | SAFE MODE | **√** |  | 3/14 | ***Bf*** |
|  | Vbatt/2 reading is at least 2680 **(represents ~3.8 V)** | **3040** |  | 3/14 | ***Bf*** |
|  | On-orbit flag is FALSE | **√** |  | 3/14 | ***Bf*** |
|  | [Startup CRC faulty] message is NOT present | **√** |  | 3/14 | ***Bf*** |
|  | [Main code CRC faulty] message is NOT present | **√** |  | 3/14 | ***Bf*** |
|  | In the terminal window, type **‘GET REALTIME TELEMETRY**’ and press **ENTER**; verify and record the following values in the response (the expected ranges are shown in parenthesis; **bold** values are the desired results): | **√** | 9:38 | 3/14 | ***Bf*** |
|  | FoxID is 5 | **√** |  | 3/14 | ***Bf*** |
|  | Uptime value matches the approximate number of seconds since the system was booted in step #12 | **√** |  | 3/14 | ***Bf*** |
|  | Exp4Temp is 1800-2400 (1990 is about 23C) | 1814 |  | 3/14 | ***Bf*** |
|  | expfail0 = (**0**-1) | **√** |  | 3/14 | ***Bf*** |
|  | I2CfailureBatt = (**0**-1) | **√** |  | 3/14 | ***Bf*** |
|  | I2CfailurePSU1 = (**0**-1) | **√** |  | 3/14 | ***Bf*** |
|  | I2CfailurePSU2 = (**0**-1) | **√** |  | 3/14 | ***Bf*** |
|  | Num Telem Resets is 0-5 | **√** |  | 3/14 | ***Bf*** |
|  | RxAntDeploy is 0 | 1 |  | 3/14 | ***Bf*** |
|  | TxAntDeploy is 0 | 1 | 9:40 | 3/14 | ***Bf*** |
|  | Battery Card Battery A Voltage is 2000-3000 (2150=1.3V) | 2222 |  | 3/14 | ***Bf*** |
|  | Battery Card Battery B Voltage is 2900-3500 (3225=2.6V) | 3371 |  | 3/14 | ***Bf*** |
|  | Battery Card Battery C Voltage is 3000-3500 (3200=3.9V) | 3310 |  | 3/14 | ***Bf*** |
|  | Battery Card Battery A Temperature is 2000-2600 (2345 = 22.7 degrees) | 2246 |  | 3/14 | ***Bf*** |
|  | Battery Card Battery B Temperature is 2000-2600 | 2275 |  | 3/14 | ***Bf*** |
|  | Battery Card Battery C Temperature is 2000-2600 | 2243 |  | 3/14 | ***Bf*** |
|  | Battery Card Temperature is 2000-2600 | 2145 |  | 3/14 | ***Bf*** |
|  | Battery Card Battery Current is 1500-2000 | 1772 |  | 3/14 | ***Bf*** |
|  | PSU Card +X Voltage is 10-2500 | 1 | 9:43 | 3/14 | ***Bf*** |
|  | PSU Card -X Voltage is 10-2500 | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card +Y Voltage is 10-2500 | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card -Y Voltage is 10-2500 | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card +Z Voltage is 10-2500 | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card -Z Voltage is 10-2500 | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card +X Temperature is <25 (If no light on cell) | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card -X Temperature is <25 “ | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card +Y Temperature is <25 “ | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card -Y Temperature is <25 “ | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card +Z Temperature is <25 “ | 1 |  | 3/14 | ***Bf*** |
|  | PSU Card -Z Temperature is <25 “ | 1 | 9:43 | 3/14 | ***Bf*** |
|  | PSU Card Temp is 2100-2700 (2400=23.7) | 2224 |  | 3/14 | ***Bf*** |
|  | **N/A** | -- |  | 3/14 | ***Bf*** |
|  | PSU Card Calculated Spin is 0 | **√** |  | 3/14 | ***Bf*** |
|  | PSU Card PSU Current is 0000-0040 | 0088\* |  | 3/14 | ***Bf*** |
|  | RF Cards LT Temp is 900-1200 (1039=27.4C) | 958 |  | 3/14 | ***Bf*** |
|  | RF Cards Transmit Antenna is 0\* | 1 |  | 3/14 | ***Bf*** |
|  | RF Cards PA Current is 0000-500 (408=54ma) | 221 |  | 3/14 | ***Bf*** |
|  | Power—3V 3650-3750 | 3748 |  | 3/14 | ***Bf*** |
|  | 3V Prot 3650-3750 | 3741 |  | 3/14 | ***Bf*** |
|  | 2.5V: 3050-3150 | 3050 |  | 3/14 | ***Bf*** |
|  | 2.5V Prot: 3050-3150 (Expected intermittent)\*\*\* | 2 | 9:47 | 3/14 | ***Bf*** |
|  | SnsrPwr: 3650 -3750 | 3722 |  | 3/14 | ***Bf*** |
|  | VbattUnreg: 1600-1800 | 1730 |  | 3/14 | ***Bf*** |
|  | **N/A** | -- |  | 3/14 | ***Bf*** |
|  | RF Cards Receive RSSI is 400-1400 | 742 |  | 3/14 | ***Bf*** |
|  | IHU MCU Temp is 650-850 | 673 |  | 3/14 | ***Bf*** |
|  | IHU X Spin (MEMS) = (2000-2200) (Record value) | 2089 |  | 3/14 | ***Bf*** |
|  | IHU Y Spin (MEMS) = (2000-2200) “ | 2139 |  | 3/14 | ***Bf*** |
|  | IHU Z Spin (MEMS) = (2000-2200) “ | 2107 |  | 3/14 | ***Bf*** |
|  | In the terminal window, type **‘GET HIGH TELEMETRY’** and press **ENTER**; verify the following values in the response: | **√** |  | 3/14 | ***Bf*** |
|  | AutoSafeModeActive=**0** | **√** | 9:50 | 3/14 | ***Bf*** |
|  | AutoSafingAllowed=**1** | **√** |  | 3/14 | ***Bf*** |
|  | Type the command ‘**TRANSPONDER MODE**” | **√** | 9:53 | 3/14 | ***Bf*** |
|  | Wait 10 seconds; in the terminal window, type **‘GET MODE’** and press **ENTER**; verify the response is “Satellite is in transponder mode”. | **√** | 9:53 | 3/14 | ***Bf*** |
|  | Wait 30 seconds; in the terminal window, type **‘GET REALTIME TELEMETRY”** and press **ENTER**; verify the response contains “expfail0=0” **[VU EXP. Is talking, but we want to confirm that all boards are working]** | **√** |  | 3/14 | ***Bf*** |
|  | Enter an umbilical command **EXP SET 2.** | **√** | 9:55 | 3/14 | ***Bf*** |
|  | Wait 2 minutes and enter command **GET SCIENCE TELEMETRY.** | **√** | 9:57 | 3/14 | ***Bf*** |
|  | In the resulting output confirm:   * “Good CRC Return” * “Board 2 is Active” (at the bottom) * Under “Experiment 2” the state row should say “Active”   If a different board is active, repeat from step 21. If board 2 is active, but a different experiment state is active, wait 2 minutes and repeat this step. | **√** |  | 3/14 | ***Bf*** |
|  | Under “VUC Raw Data” count over 10 2-digit hex numbers from the top left. To pass, there must be at least one non-0 number after the 10th.  **[This confirms that we are getting data from board 2, not just from the VUC]** | **√** |  | 3/14 | ***Bf*** |
|  | Repeat from step 21 through 24 using **exp set 3** and looking for board 3 and experiment 3. \*\*\* | **√** | 15:03 | 3/14 | ***Bf*** |
|  | Repeat from step 21 through 24 using **exp set 4** and looking for board 3 and experiment 4. | **√** | 15:06 | 3/14 | ***Bf*** |
|  | in the terminal window, type **‘SAFE MODE’** and press **ENTER**. | **√** | 15:10 | 3/14 | ***Bf*** |
|  | Wait 10 seconds; in the terminal window, type **“GET MODE”** and press **ENTER**; verify the response is “Satellite is in Safe Mode” | **√** | 15:10 | 3/14 | ***Bf*** |
|  | *Wait 1 minute*. Move the UBT’s PWR switch to the OFF position and verify the UBT’s RED power light is not lit. | **√** | 15:10 | 3/14 | ***Bf*** |
|  | Disconnect the UBT from the wall outlet and disconnect the PC cable connection. | **√** | 15:10 | 3/14 | ***Bf*** |
|  | Disconnect the umbilical USB (mini-B) cable from the CubeSat’s umbilical port. | **√** | 15:10 | 3/14 | ***Bf*** |

### Exception Log:

\* This is a stack without solar panels or frame. Antennas are expected to read ‘deployed’

\*\* Value range has been updated

\*\*\* Anomalous behavior. When running step 22 with ‘exp set 3’ the umbilical terminal stopped working. Debug proceded until afternoon. We decided the behavior can be worked around and had nothing to do with the experiment. We restarted the experiment test around 15:03.

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