

# Solar Array Charging Test Report

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## 1. Introduction

This test was performed to characterize how the Solar Array (SA) will charge the system in sunlight.

## 2. Test Setup

This testing was performed outdoors on July 19, 2014 through July 22, 2014. All FU3 and all FU4 data, except for FU4's -Y side, were taken in the lot on the East side of the EPS building. The data for the -Y side for FU4 was taken near the main entrance of the EPS building on July 19, 2014. All FU3 data was taken between 1756 UTC (11:56 local) and 1820 UTC (12:20 local) on July 22, 2014. FU4 data was taken between 2122 UTC (15:22 local) and 2129 UTC (15:29 local) on July 19, 2014 and also between 1706 UTC (11:06 local) and 1725 UTC (11:25 local) on July 20, 2014.

Figure 1 shows the test setup used. The each flight unit was mounted to the white SPACEBUOY rotational test jig, using an aluminum adapter plate and 1.5U CubeSat mount. All sides of the CubeSat mount were covered with alumiLOY and Kapton tape, to reduce contamination during transportation and setup. During the actual test, the alumiLOY cover was removed from the side that was being tested. After testing for that side was completed the side was re-covered with alumiLOY and the flight unit was transported back to the clean bench and gently wiped down with ethanol and ChemWipes.

As shown in Figure 1, the mounting hardware on the adapter plate was used to align the appropriate side of the flight unit towards the sun. This alignment will be referred to as normal or 0°. Data was taken at a total of four different angles, from 0° to 60°. For each angle the flight unit was rotated around the axis indicated in the figure, and the protractor built into the rotational test jig was used to measure the offset from 0°.

Commands and telemetry were sent to and from the flight unit through a USB GSE cable connected to a laptop running InControl. At each of the four test angles values were recorded using the FIREBIRD II Test Outline.

At each test angle, the current solar irradiance was measured using the AMPROBE Solar-100 Solar Power Meter.



Figure 1: Test Setup and Sun Alignment

### 3. Results

Table 1 shows the values recorded for FU3 during the test.

Table 1: FU3 SA Charging Test Data

Solar Array	Angle	SA Voltage [V]	SA Current [A]	SA Power [W]	Battery Voltage [V]	Battery Current [A]	Battery Power [W]	Solar Irradiance [W/M^2]	Time [UTC]
Y+	0	8.39	0.286	2.400	7.92	0.262	2.078	1356	1756
	20	8.33	0.275	2.290	7.98	0.247	1.970	1361	1758
	40	8.35	0.236	1.969	7.88	0.212	1.674	1361	1759
	60	8.35	0.184	1.536	7.94	0.162	1.289	1369	1801
X+	0	8.16	0.027	0.218	7.82	-0.004	-0.030	1372	1806
	20	8.16	0.015	0.121	7.82	-0.013	-0.098	1375	1808
	40	8.08	0.012	0.097	7.90	-0.014	-0.112	1382	1810
	60	8.13	0.004	0.035	7.84	-0.021	-0.165	1382	1811
Y-	0	8.25	0.250	2.063	7.88	0.209	1.646	1382	1816
	20	8.30	0.237	1.963	7.94	0.195	1.550	1380	1818
	40	8.23	0.217	1.785	7.84	0.176	1.381	1393	1819
	60	8.29	0.146	1.207	7.94	0.111	0.880	1391	1820

Figure 2 shows FU3's SA power vs the angle.

**Figure 2: FU3 SA Power VS Angle**

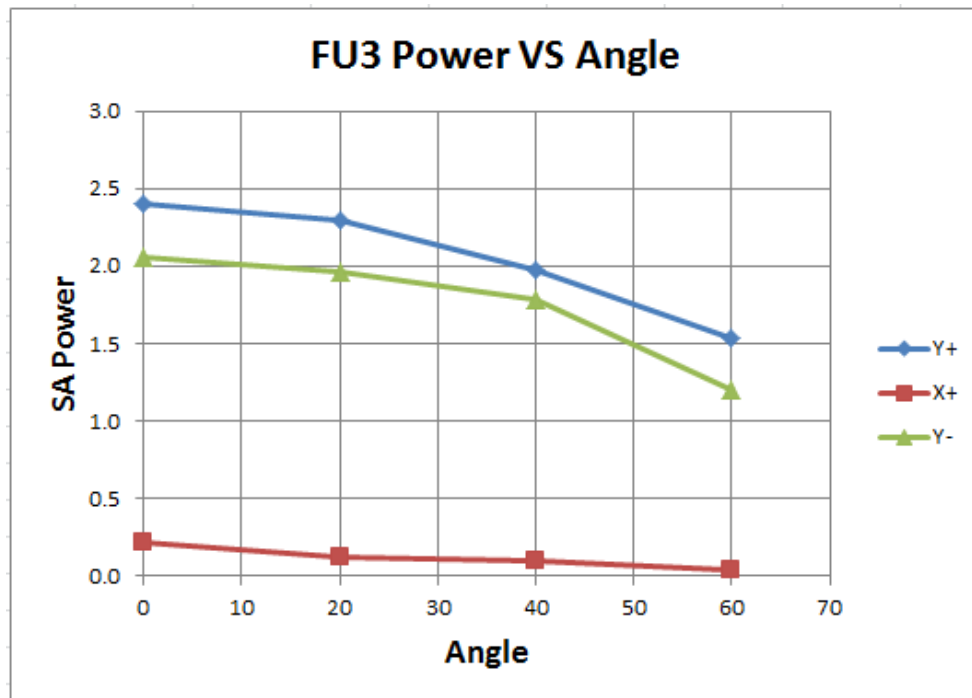


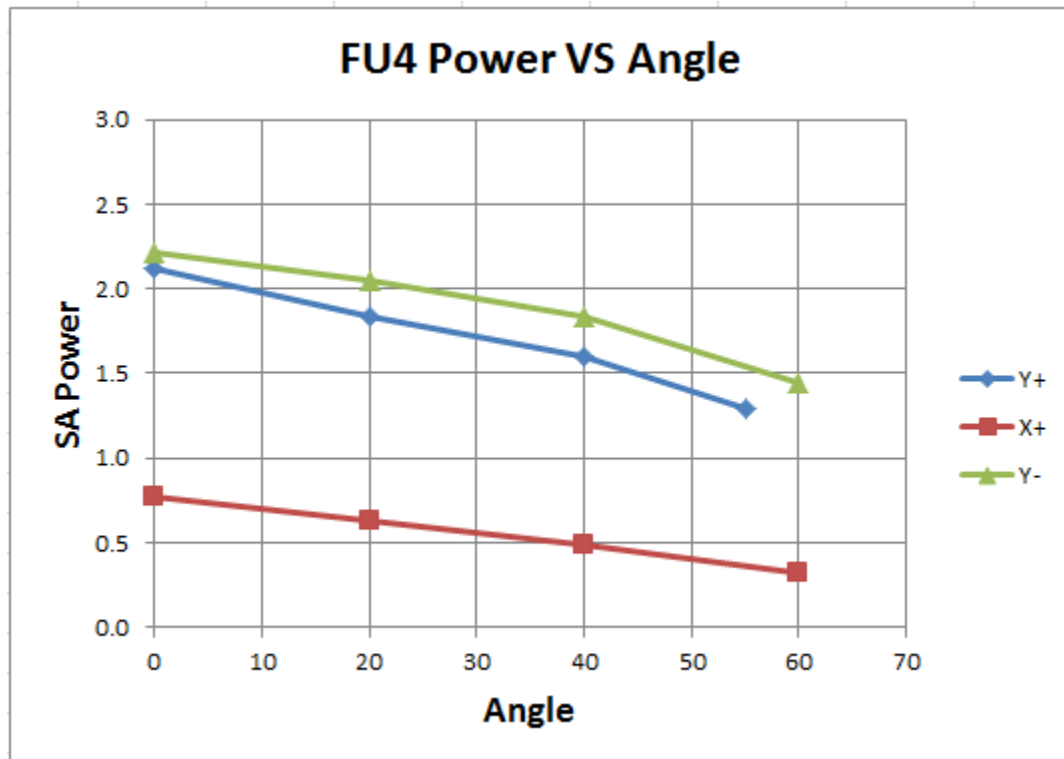
Table 2 shows the values recorded for FU4 during the test.

**Table 2: FU4 SA Charging Test Data**

Solar Array	Angle	SA Voltage [V]	SA Current [A]	SA Power [W]	Battery Voltage [V]	Battery Current [A]	Battery Power [W]	Solar Irradiance [W/M^2]	Time [UTC]
Y+	0	8.33	0.255	2.125	7.95	0.203	1.615	1350	1706
	20	8.22	0.223	1.833	7.96	0.200	1.589	1342	1708
	40	8.22	0.194	1.597	7.88	0.168	1.326	1357	1709
	55	8.22	0.157	1.291	7.88	0.134	1.052	1351	1711
X+	0	8.20	0.094	0.771	7.99	0.066	0.524	1322	1720
	20	8.19	0.077	0.633	7.90	0.050	0.395	1340	1722
	40	8.16	0.060	0.487	7.87	0.034	0.270	1348	1724
	60	8.19	0.040	0.328	7.92	0.013	0.106	1339	1725
Y-	0	8.45	0.262	2.211	8.07	0.208	1.681	1402	2122
	20	8.34	0.246	2.052	8.00	0.200	1.597	1404	2124
	40	8.30	0.222	1.839	7.94	0.175	1.391	1409	2125
	60	8.38	0.172	1.441	8.05	0.130	1.047	1530	2129

Figure 3 shows FU4's SA Power VS angle.

Figure 3: FU4 SA Power VS angle



#### 4. Conclusions

This test showed that the Y+ and Y- sides of both flight units provide adequate power. What is troubling is that the X+ sides of both Flight Units provide little power compared to the others. While it was originally thought during the tests that this was caused by the batteries being full, this turned out not to be the case because the Y- side on FU3 was providing adequate power and the Y- side was tested after the X+ side.

Other hypothesizes is that it may be an issue with the actual solar cell or an issue with connectivity. Further testing would need to be done to find the issue with the SAs on the X+ sides of the flight units.