Electrical Power System

A1 Regulatory Compliance

The EPS shall comply with NASA CubeSat launch initiative regulations

Rationale: compliance is required for launch.

A1.1 pre-Launch/Launch Power States

The satellite will be completely powered off during launch, or launch with completely discharged batteries.

Rationale: No power must flow to electronics during launch to prevent EMI from interfering with the Launch vehicle. We need power immediately after launch to deploy and de-tumble so we would prefer to launch with charged batteries.

A1.1.1 Deployment Switch

The EPS shall include at least one deployment switch on rail 1 (+x, –y) or rail 3 (-x, +y) compressing the deployment switch shall turn off all power in the satellite

Rationale: The deployment switch allows the satellite to remain powered off during launch per requirement 1.1.1.

A1.1.1 Remove Before Flight (RBF) pin

The EPS shall include a Remove Before Flight (RBF) pin which shall completely power off the satellite when the pin is in and be accessible from an access port to be removed after integration into the P-Pod.

Rationale: The RPF will allow us to remain powered off while outside of the P-pod on the ground.

A2 Operational Lifetime

The EPS shall remain operational for 3 months

Rational: spacecraft lifetime

A2.1 Battery Cycle Life

The batteries shall be rated for 1500 cycles.

Rationale: The batteries will be charged to full each orbit making one cycle per orbit. 3 months of operation is 1500 orbits.

A2.1.1 Individual Battery Voltage limit

No individual Li-Fe PO4 cell in the battery pack shall go outside the range of 3.6V to 2V.

Rationale: Operating outside the batteries voltage range reduces the cycle life of the battery.

A2.1.2 Battery temperature limits

The batteries should not be charged while below 0 C

Rationale: Charging the batteries below 0 c reduces the cycle life of the batteries.

A3 Bus Voltage limits

The battery pack shall not go outside the range of 5.2V to 7.2 Volts.

Rationale: 5.2 is the minimum voltage for our 5V LDO/Buck converters to operate, and 7.2V is the max voltage on two cells in series.

A4 Battery full state identification.

The batteries shall have a clearly measurable full state, defined through the charge method.

Rationale: A full battery gives permission for the PPT to fire for the remainder of the orbit.

A5 Store power for eclipse.

The EPS shall manage power usage such that when entering eclipse the batteries have enough charge to last through eclipse with an additional margin of safety. (calculate an exact percent needed when entering eclipse?)

Rationale: If the satellite enters low power state in eclipse, the reaction wheels will decelerate and the satellite will tumble.

A5.1 Battery State of Charge (SOC) measurement

The batteries shall be able to measure the State of Charge (SOC) using coulomb counting.

Rationale: Li-Fe PO4 batteries have a very flat Voltage VS SOC curve, so in order to meet requirement A5 current into and out of the battery must be monitored.

A6 Solar panel efficiency

The EPS shall be able to control the voltage on the solar panels.

Rationale: If the voltage on the solar panels is able to drift too far from the maximum power point (MPP) voltage, then the solar panels will experience significantly reduced efficiency. By setting the voltage to either a constant voltage close to the average MPP, or implementing a maximum power point tracking (MPPT) algorithm, we can maintain an efficiency high enough to satisfy power requirements.

A7 Peak current

The EPS shall be able to deliver a maximum of \_\_\_A to the satellite.

Rationale: