Power Subsystem Specification

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1. SCOPE. This specification is for the design of the power generation, storage, and distribution systems for the CubeSat satellite.

1.1 General. This specification establishes the design, construction, performance, development, and test requirements for the cubic satellite, (herein referred to as the CS).

2. APPLICABLE DOCUMENTS.

The following documents of the exact issue shown shall form part of this specificaion to the extent specified herein. In the event of conflict between the requirements of this specification and any referenced document the order of precedence shall be 1. The contract, 2. This specification, 3. Referenced documents.

2.1 Government Documents. The following government military standard documents are referenced in this specification for the CS:

MIL-STD-810E

MIL-STD-461E - Electromagnetic Compatibility

MIL-STD-704E - Input Power Characteristics

MIL-STD-1275A

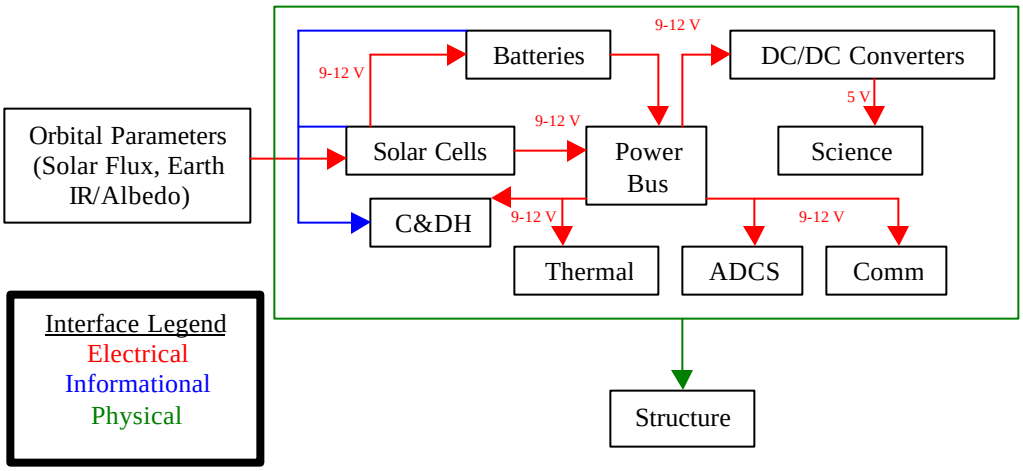
2.2 Industry Documents. The following industrial documents are referenced in this specification for the CS:

The P-POD Payload Planner's Guide, Revision C

3. REQUIREMENTS

3.1 Item definition. The power subsystem is required to generate, store, regulate, and distribute the required power for all phases of the mission of the CS. In order to accomplish these tasks respectively, body mounted solar cells, batteries, DC/DC converters, and buck regulators are to be used. The solar cells shall supply power to the CS and charge the batteries during the direct sunlight portions of the orbit. By contrast, the batteries shall supply power during the eclipse periods of the orbit. All unregulated power shall pass directly to the subsystems, and regulated flow will be accomplished through the DC/DC converters.

3.1.1 Functional Block Diagram. (Figure 1)



3.1.2 Interface Definition.

3.1.2.1 Physical.

- The solar cells shall be body mounted to the exterior of the CS using a TBD epoxy.
- The batteries, regulators, and DC/DC converters shall be contained within thermal containers that shall be mounted to the interior of the CS using TBD fasteners.

3.1.2.2. Electrical. The photovoltaic energy from the sun shall pass directly to the solar cells. The batteries shall be connected to the 9-12 V bus. The power shall be distributed to the command and data handling (C&DH) system, the communications system, the attitude determination and control system (ADCS), and the thermal regulation system using TBD connections at a bus voltage of no less than 9 or greater than 12 Volts DC. The power bus shall also be connected to a 5 Volt DC/DC converter that shall be connected to the science subsystem. Note that:

- The unregulated bus voltage for the solar cells and the batteries shall range from 9 V to 12 V.
- The regulated voltage shall be 5 V (within 1%).
- Total power draw from the batteries shall not exceed 4 Watts.

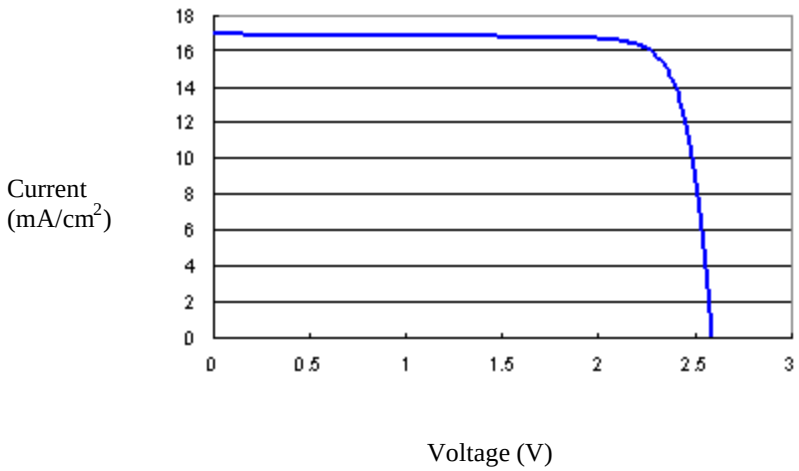
3.1.2.3. Informational. The C&DH subsystem shall be connected using TBD cables to TBD sensors for voltage and current characteristics for all subsystems that require power generation and regulation. The solar cells and batteries shall have TBD sensors connected to the C&DH system using TBD connections to monitor and regulate, if necessary, the generating, charging, and flow characteristics of the power subsystem on the CS.

3.2 Characteristics.

3.2.1 Performance Characteristics. The power subsystem of the CS shall supply at least 1.5 Watts of usable power (this number assumes 75% of four sides and the top of the satellite, solar cell efficiency of 25%, 80% DC/DC efficiency, at least 90% battery efficiency, 10% margin for error, and a solar intensity of 1353 W/m^2).

- The solar cells shall be triple-junction $GaInP_2$/GaAs/Ge photovoltaics with a minimum average efficiency of at least 25%. The characteristic current-voltage graph is shown in figure 2 below.

Figure 2. Typical IV Characteristic



- The DC/DC converters shall have an efficiency of no less than 80%.

3.2.2 Physical characteristics.

- The solar cells shall be TBD cm wide and TBD cm long, leaving five cells per string and TBD cells on each side and the top. The mass of the cells shall be 0.84 kg/m^2, giving a total mass of the solar cells of 37.8 gm maximum (assuming 75% of 5 sides). The cells shall be 175 μm thick.
- The DC/DC converters shall be of TBD size and TBD mass.
- The switching frequencies shall be 250-500 kHz.

3.2.3 Reliability.

- P_s = 0.9xxxx (TBD)
- MTBF = TBD
- The characteristics of the power subsystem of the CS shall not be affected during its mission due to fatigue since the mission length does not allow for an extended duration of use.

3.2.4 Maintainability. No maintenance shall be required.

3.2.5 Environments.

3.2.5.1 Natural Environments. The following power subsystem components shall meet the requirements of this specification during and after exposure to any combination of any of the following natural environments. The item may be packaged to precluded exposure to any environments that would control the design.

- Operating Temperatures: The ranges shall be as follows for the components listed below:
    1. Solar cells: -80ºC to 100ºC
    2. Batteries: 0ºC to 45ºC during charge, -20ºC to 60ºC during discharge
    3. DC/DC converters: -40 to 80ºC
- Survival Temperatures: The ranges shall be as follows for the components listed below:
    4. Solar cells: -80ºC to 100ºC
    5. Batteries: -40ºC to 65ºC
    6. DC/DC converters: -55ºC to 125ºC
- Magnetic fields. All components of the power subsystem shall not be adversely affected by the magnetic fields in orbit.
- Radiation: All components of the power subsystem shall not be adversely affected by external radiation.

3.2.5.2 Induced Environments. The power subsystem components shall meet the requirements of this specification during and after exposure to any logical combination of the following environments:

- Shock. TBD (Systems Spec.)
- Vibration. TBD (Systems)
- Load factors and acceleration. TBD (Systems)
- Space Environment including Radiation, Atomic Oxygen. TBD (Systems)