Power Distribution System for a CubeSat

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November 14, 2022

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Contents

Objective

To design and implement a fully autonomous power generation, storage and distribution system for a CubeSat

Project Outline

CubeSat (1U):

- Dimensions - 10x10x10 cm^3
- Weight - 2 kg.

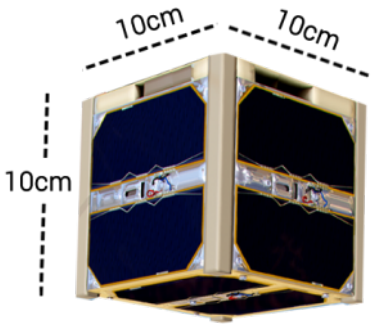

Figure 1: CubeSat 1U (Source: GIS Geography)

Project Outline (Contd.)

Electrical Power System (EPS):

- Harvests energy from the solar panels
- Manages power storage and distribution
- Protects circuits from damage
- Redundant architecture

Literature Review

S. No	Title	Author	Features
1	A Review of Battery Technology in CubeSats and Small Satellites.	Knap, Vaclav & Vestergaard, Lars & Stroe, Daniel-Ioan	Solar cells with Li-ion batteries for storage is preferred.
2	Comparison of Peak Power Tracking Based Electric Power System Architecture for CubeSats.	A. Edpuganti, V. Khadkikar, H. Zeineldin, M. S. E. Moursi and M. Al Hosani	Peak power transfer is preferred over direct power transfer.
3	Review on Charging Techniques of a Li-ion Battery.	E. Ayoub and N. Karami	Charging at 0 - 45°C
4	Centralized, Distributed and Module-Integrated Electric Power System Schemes in CubeSats: Performance Assessment.	B. Hussein, A. M. Massoud and T. Khattab	Distributed EPS scheme is preferred.

System Architecture

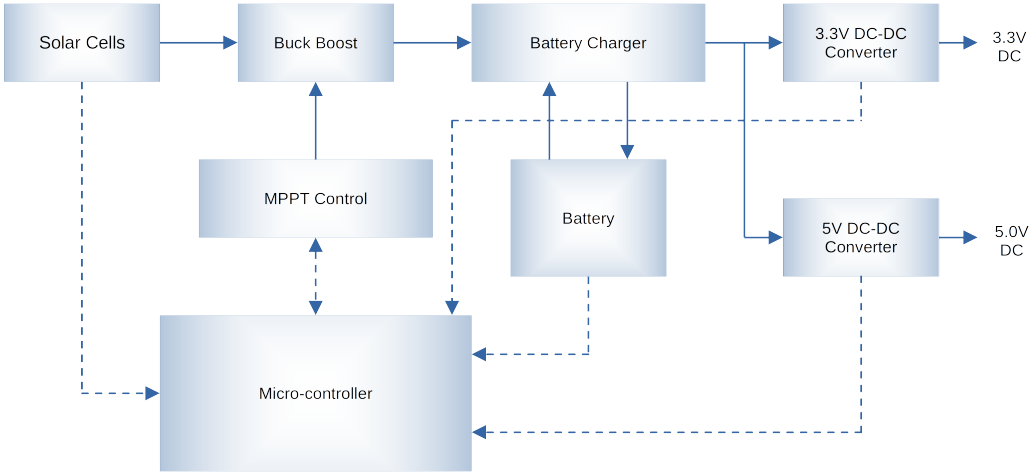

Figure 2: CubeSat EPS Architecture

Methodology

- Identifying the power requirements
- Architecture design and topology selection
- Forming Specifications
- Design and simulation
- Procurement of components
- Fabrication and testing

Requirements

Equipments Requirements:

- SMD Soldering Station
- Oscilloscope
- Power Supply
- Function Generator

Software Requirements:

- MATLAB/Spice
- KiCad
- STM32 CubeIDE

Budget Estimate: Component cost

Sl. No.	Item	Amount (Rs.)
1	STM32 NUCLEO Development Board	3000
2	SMD soldering station	9000
3	Li-ion Cell (x2)	1000
4	Regulated Multi-Output Power Supply	5000
5	Solar Panel	2000
6	Components	8000

Budget Estimate: Fabrication cost

Sl. No.	**Item**	**Amount (Rs.)**
1	PCB Printing	3000
2	SMD soldering	990
3	Inductor Fabrication	1000

Project Timeline

Activity	Oct week 3-4	Nov week 1-2	Nov week 3-4	Dec week 1-2	Dec week 3-4
Literature Review					
Hardware Design					
Report Writing					
Component Procurement					
Fabrication					
Software Development					
Testing					

References I

[1] Knap, Vaclav & Vestergaard, Lars & Stroe, Daniel-Ioan (2020)
A Review of Battery Technology in CubeSats and Small Satellite Solutions
Energies, vol. 13

[2] A. Edpuganti, V. Khadkikar, H. Zeineldin, M. S. E. Moursi and M. Al Hosani (2021)
Comparison of Peak Power Tracking Based Electric Power System Architectures for CubeSats
IEEE Transactions on Industry Applications, vol. 57, no. 3, pp. 2758-2768, May-June 2021

[3] E. Ayoub and N. Karami
Review on the charging techniques of a Li-Ion battery
Third International Conference on Technological Advances in Electrical, Electronics and Computer Engineering (TAEECE), 2015, pp. 50-55

References II

[4] B. Hussein, A. M. Massoud and T. Khattab (2022)
Centralized, Distributed, and Module-Integrated Electric Power System Schemes in CubeSats: Performance Assessment
IEEE Access, vol. 10, pp. 55396-55407