

Power Distribution System for a CubeSat

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Objective

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

Methodology

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

Power Budget

Sub-system		Voltage (V)	Max. Current (mA)	Power (mW)	Contingency 5%	Margin 20%	Duty Cycle (%)	Energy (Wh)
ADCS	ADCS	3.3	20	66	69.3	83.16	100	0.133725438
	Magnetorquer	3.3	100	330	346.5	415.8	50	0.334313595
OBC	OBC	5	40	200	210	252	100	0.4052286
Rx-Tx	Telemetry	5	300	1500	1575	1890	11	0.334313595
	Beacon	5	20	100	105	126	100	0.2026143
	GPS	3.3	40	132	138.6	166.32	30	0.0802352628
Payload	LoRa	5	20	100	105	126	10	0.02026143
EPS	EPS	-	-	160	168	201.6	100	0.32418288
	Thermal	-	-	250	262.5	315	32	0.16209144
					Tot Power(mW)	3575.88	Tot. Energy	1.997

System Architecture

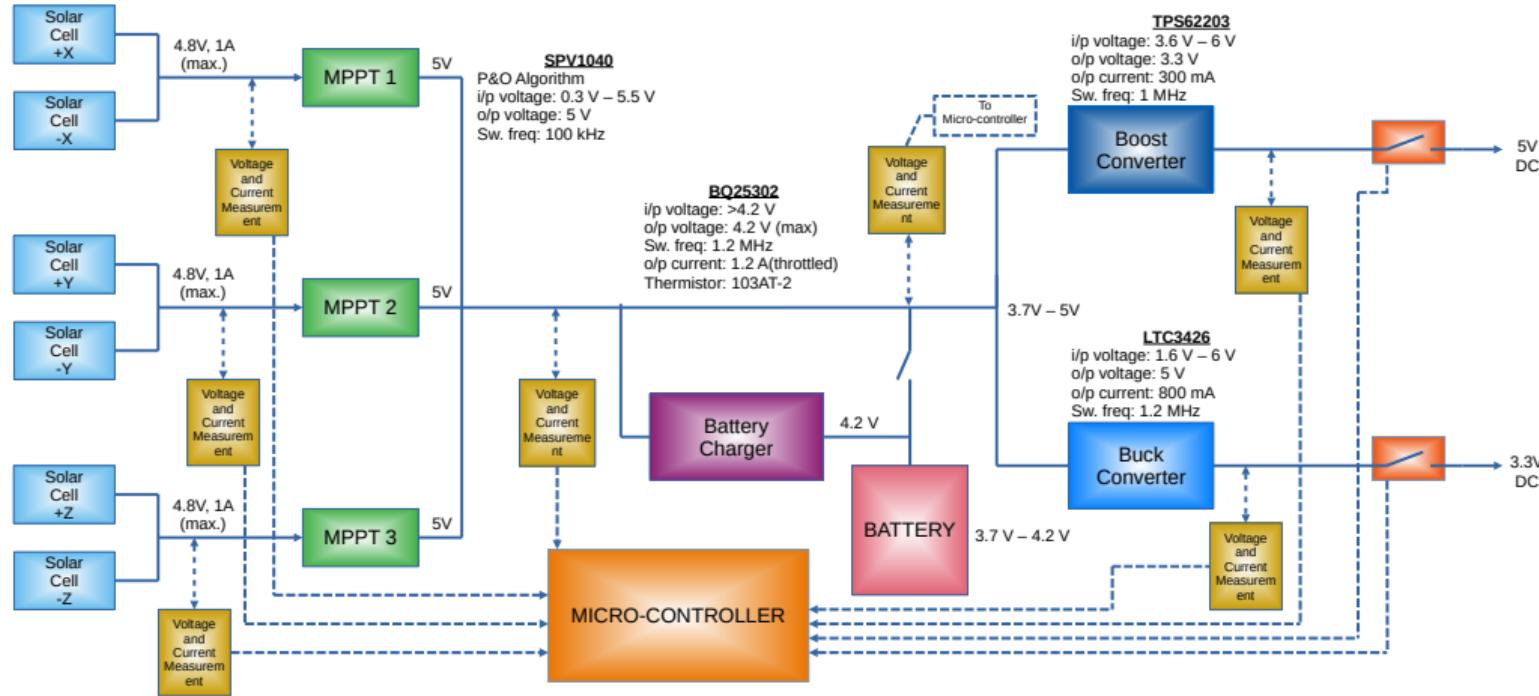


Figure 1: CubeSat EPS Architecture

Hardware Design

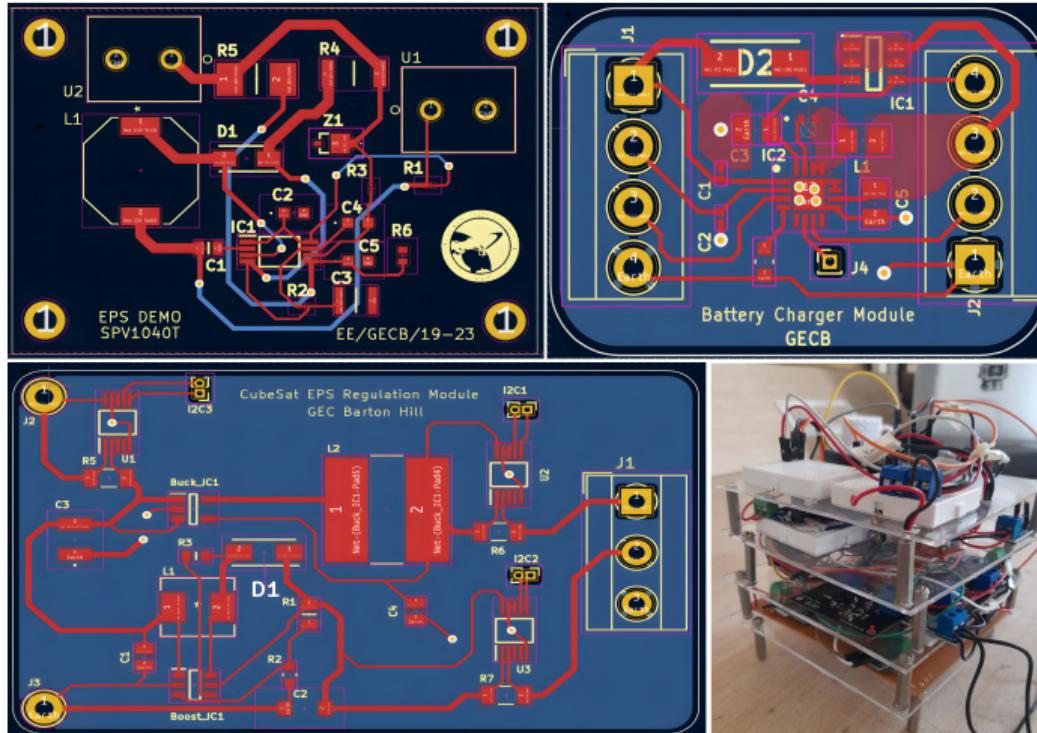


Figure 2: Circuit design of buck and boost converters with monitoring

Fully Integrated EPS

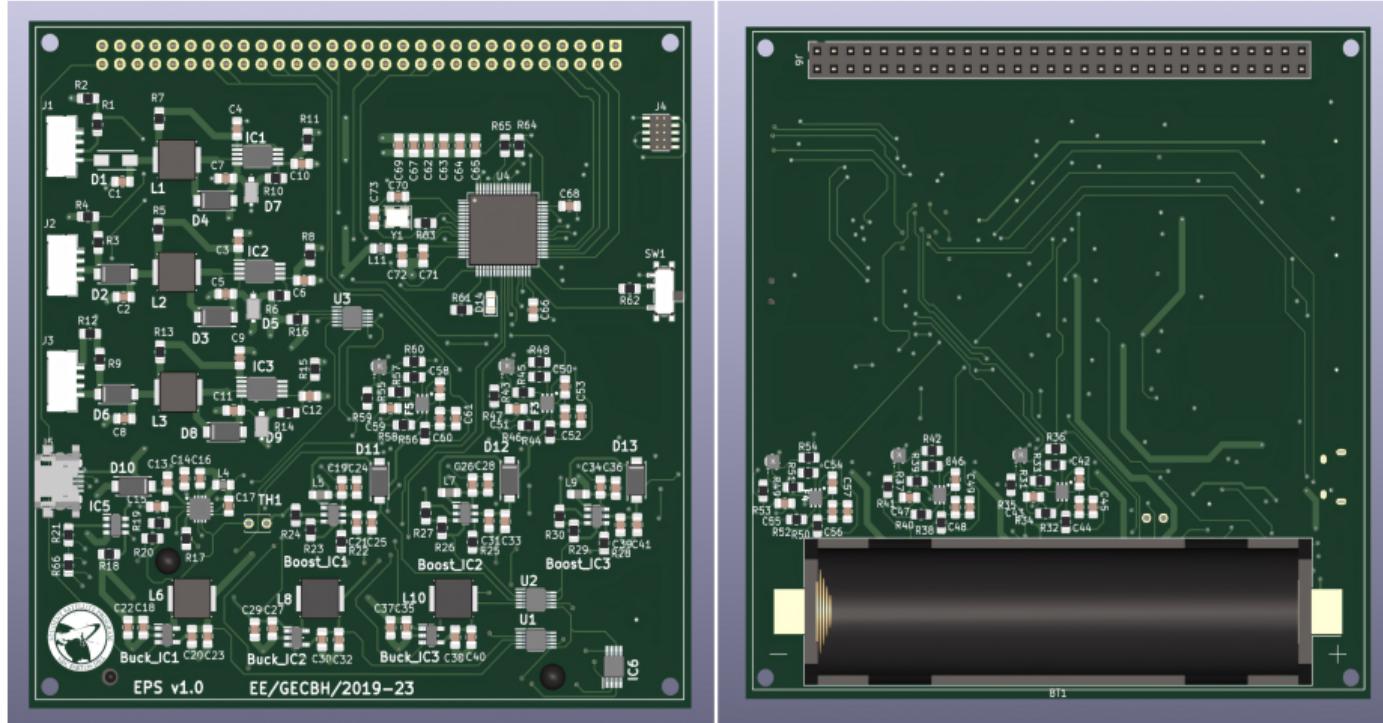


Figure 3: PCB design of EPS (9.5 cm x 9.5 cm)

Results

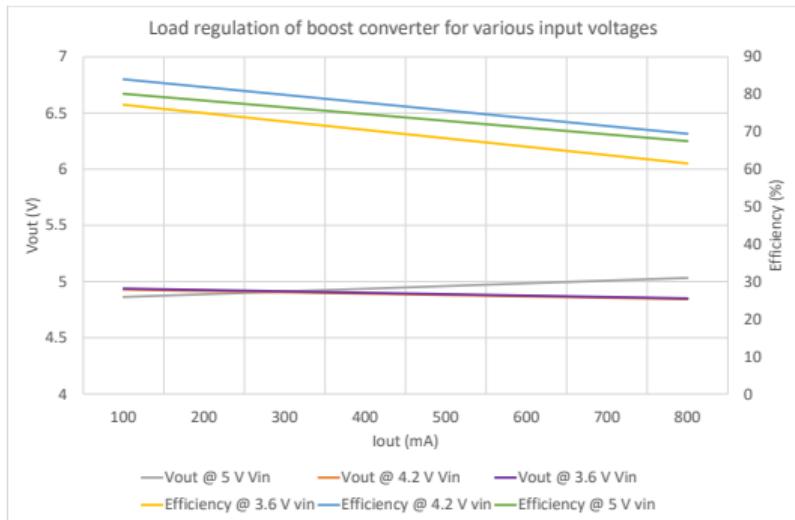


Figure 4: Load regulation of boost converter

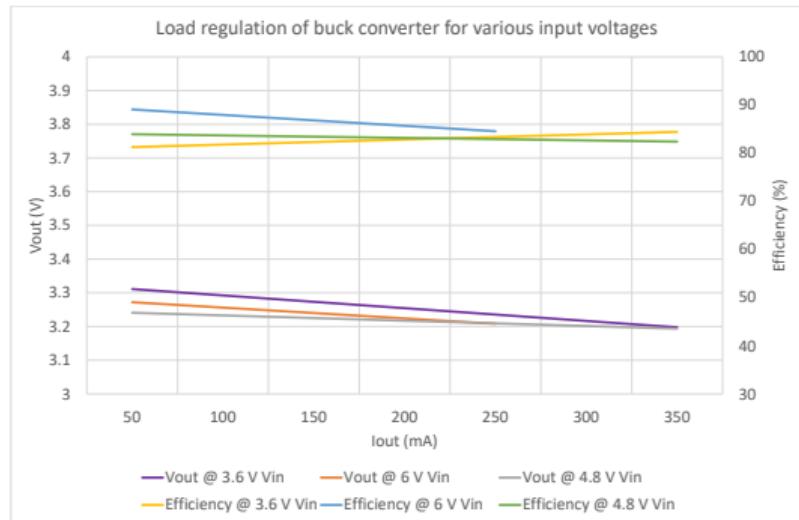


Figure 5: Load regulation of buck converter

Results

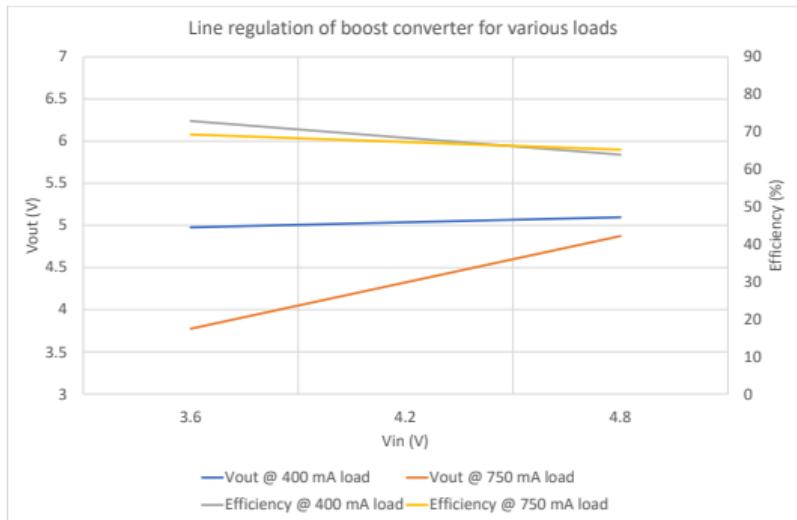


Figure 6: Line regulation of boost converter

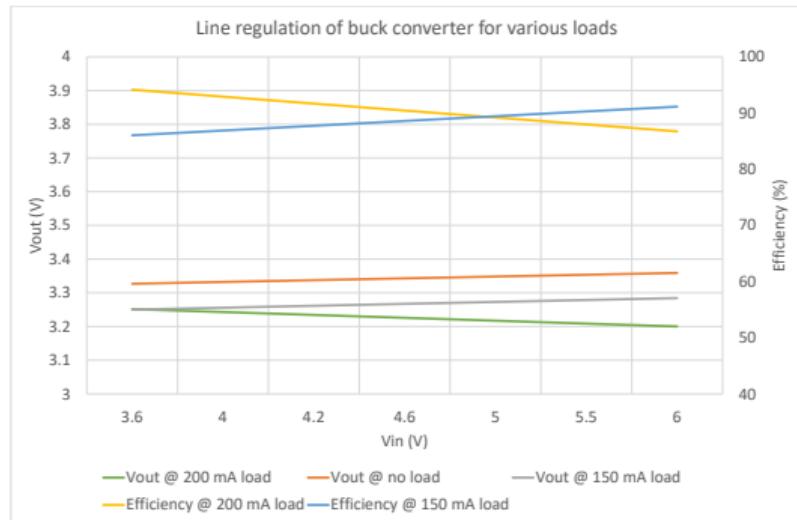


Figure 7: Line regulation of buck converter

Results

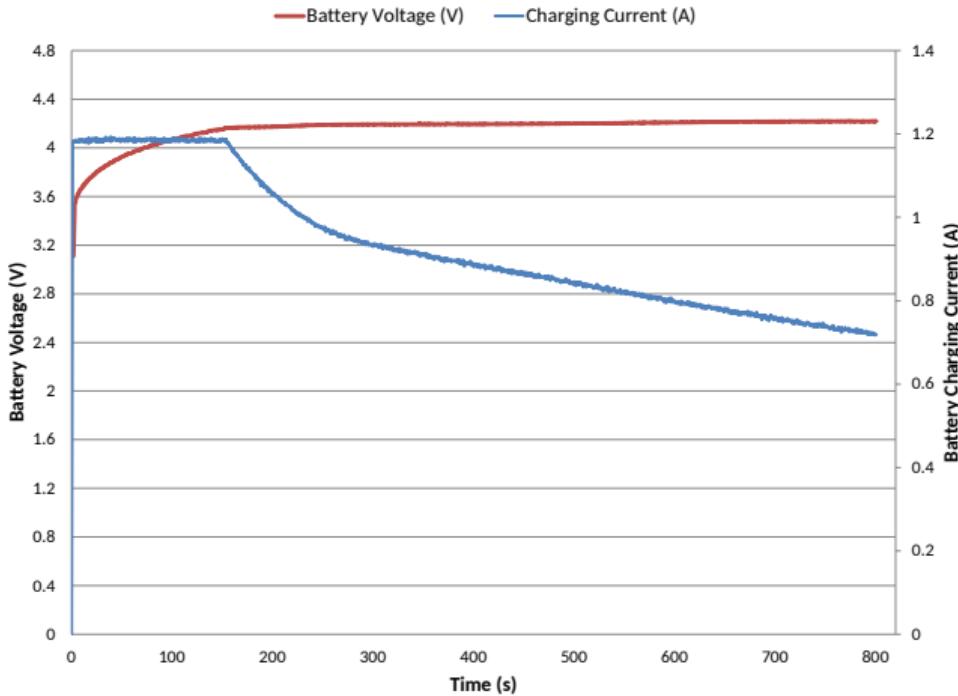


Figure 8: CC CV battery charging

Conclusion

- Conclusion
 - Initial power budget was established to determine the power requirements.
 - System architecture was designed, considering the functional requirements and scalability.
 - PCB design, fabrication and soldering processes was completed and Preliminary testing of all modules were conducted to identify any potential issues or design flaws.
 - Power converters were tested to ensure stable power delivery.
 - Fully integrated EPS was designed in KiCad, incorporating improved designs, protection, and monitoring circuits.
- Future Scope
 - Update power budget
 - Improvements in design
 - Battery heater, Remove Before Flight pin, Watchdog timer
 - Circuit Redundancy
 - FreeRTOS in STM32 microcontroller

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Thank You