



Radiation Tolerant DC/DC Buck-Boost Converter

Texas Space Grant Consortium – 2025 NASA Design Challenge

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GaN FETs for Satellites

- GaN FETs are inherently more radiation tolerant since they don't have a gate oxide layer
- GaN FETs are smaller which allows for larger scale integration
- Prime applications include DC/DC converters and On-board computers (OBCs)

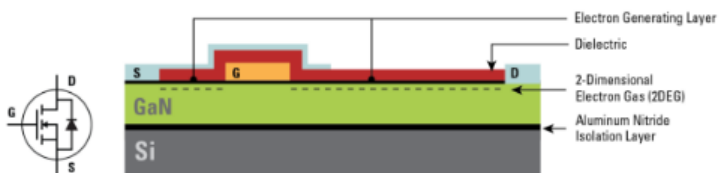


Fig. 1 – GaN FETs Design

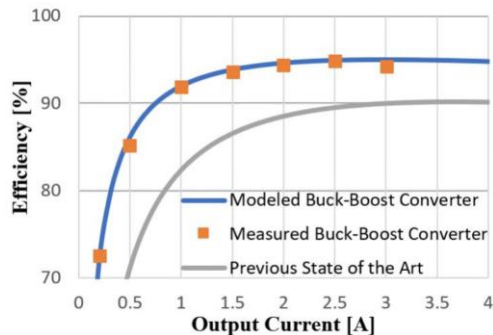


Fig. 2 – GaN Converter vs Si Converter

DC/DC Converters

- DC/DC converters take a supply voltage from the Electrical Power System (EPS) and either step it up or down
- Common voltages for spacecraft electronics are 15V, 12V, 3.3V, and 1.5V
- Four-switch converters have a wider I/O range and are faster
- Two-switch converters are simpler and can be more efficient for very small voltage changes

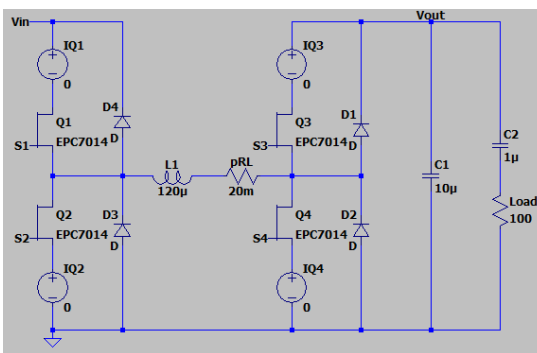


Fig. 3 – Four Switch Buck/Boost Converter

LTSpice Simulations

- LTSpice simulations showed this architecture is particularly fast for stepping down the voltage (<0.5ms settle time), with both Buck and Boost settling times being around 1ms

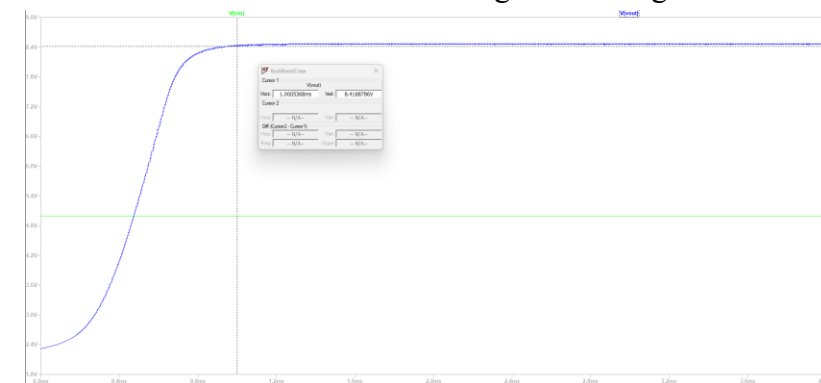


Fig. 4 – Boost Mode 5V to 8.5V

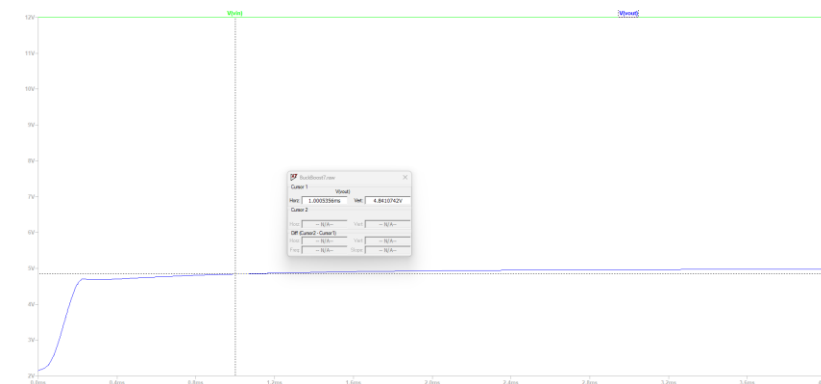


Fig. 5 – Buck Mode 12V to 4.8V