

From Concept to Implementation: CubeSat Power Supply Using GaN FET Technology

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CubeSats demand many systems and subsystems to be integrated together to produce a working nanosatellite. The study of these systems can be in-depth and require meticulous efforts to ensure the systems are properly designed. Throughout ECG 615/L, students explored these efforts and worked together to conclude the concept/design phase of a 1U CubeSat design with potential for the same systems to be integrated into the future planned 3U CubeSat design. The CubeSats utilize the PC/104 design standard with stackable PCBs to provide a completely autonomous optical and navigation flight package with the ability to monitor from multiple ground stations on Earth.

Each student in the course was given a system/subsystem to design. The power supply unit/battery board concept/design is pursuant to the thesis work that has been continually performed under Dr. Sun's direction, exploring the use of GaN FET technology to replace the commonly used silicon devices. While the IC does remain silicon based, special consideration is given to driving the Gallium Nitride (GaN) Field Effect Transistors (FETs), specifically to not exceed the absolute maximum gate voltage of $-4/+6V$. The input branch of the power supply unit/battery board has been designed to receive a wide range solar panel open circuit voltage of upto 80V while the GaN FETs depend on Pulse Width Modulation (PWM) provided by an ISL81806 Buck-style Voltage Converter to produce the intended V_{out} voltages of 12.6V and 5V.

When the CubeSat is in the power production phase of its orbit (directed toward the Sun), the 12.6V V_{out} voltage is utilized to charge the onboard 3-S LiFePo batteries. When the CubeSat is in the power consumption phase (directed away from the Sun) of its orbit, The secondary 5V V_{out} voltage provides redundancy to the downstream Main Processor Unit (MPU) and onboard peripherals in the case of a failure of the 3-S battery pack.