Kenny Na

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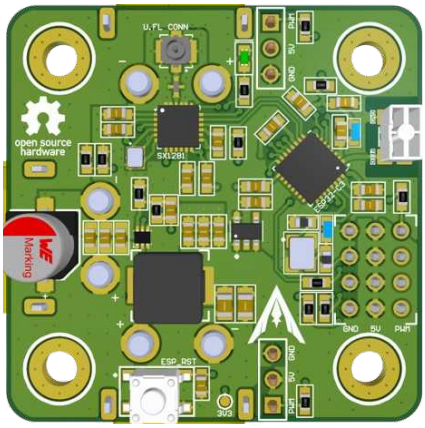
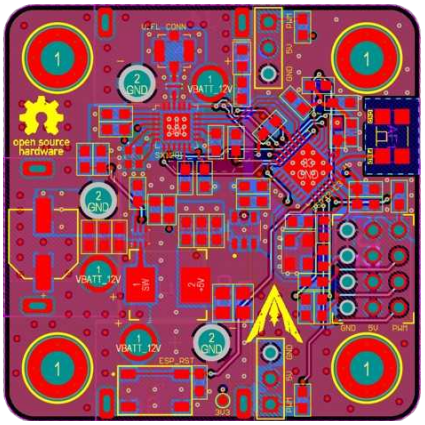
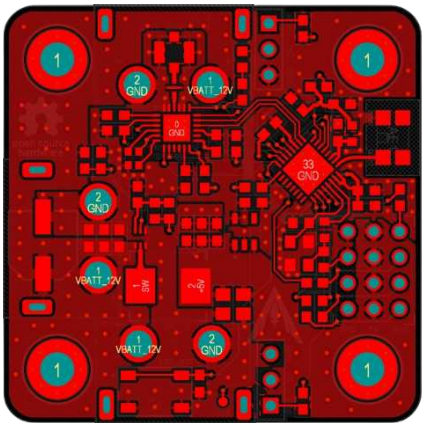
12-5V @ 4A Buck Converter with ExpressLRS Module



Top 3D View



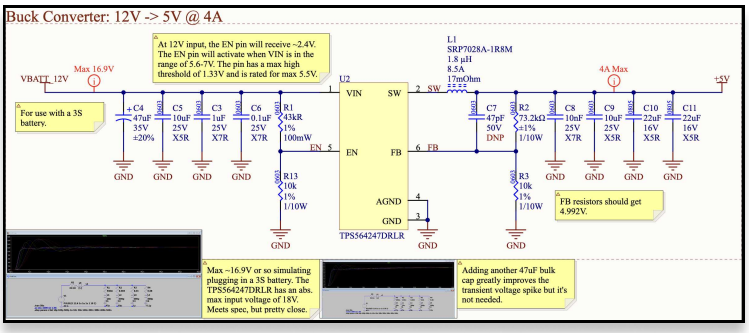
2D View (L1/L3/L4)



Top Layer (SIG/PWR)

Description

- Integrates a 12V to 5V at 4A buck converter with a 5V to 3.3V LDO, ESP32-C3, and SX1281 RF transceiver, supporting two 12V propellers and six 5V PWM servo outputs on a COTS board size of 30.5x30.5mm.
- Features a pi-network matching circuit and impedance-matched routing for the ESP32-C3's power and antenna nets.
- Addresses possible transient voltage spikes from the source impedance of a 3S battery and XT60 connector, as well as resonant frequencies in high-Q capacitors (MLCCs), using LTspice simulations.
- Built to be deployed for a fleet of foam fixed-wing UAVs for flight training at the Waterloo Aerial Robotics Group.



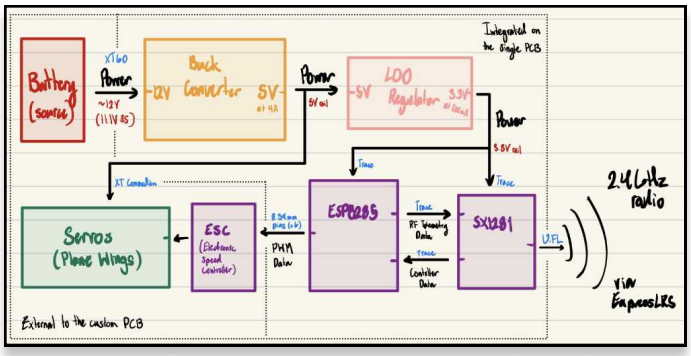
Buck Converter Schematic

Details

- Splits power to two XT60s, capable of up to 30A per motor (transient max)
- Matches existing ExpressLRS target for straightforward firmware flashing
- Originally implemented with an ESP8285, redesigned with ESP32-C3 for stronger PWM signalling, 6+ available GPIO pins for PWM, and better ExpressLRS compatibility

Relevant Skills

- Schematic and layout with Altium Designer
- PDN analysis with Power Analyzer by Keysight
- Frequency domain and time domain-based input filter simulation with LTspice, SimSurfing by Murata
- Impedance-controlled layout/routing for RF signals



System Diagram

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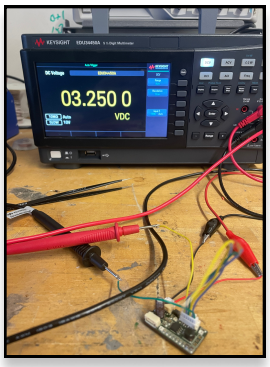
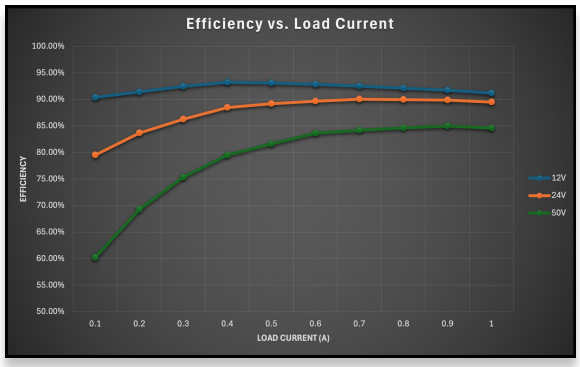
Bring-up & Validation

- SMT soldering for various custom PCBs with paste/stencil, reflow oven, hotplate
- Reworking with iron, hot air station, etc.
- Continuity testing with DMM probing
- Load and efficiency testing with e-load
- Measuring input transient response with oscilloscope / power supply

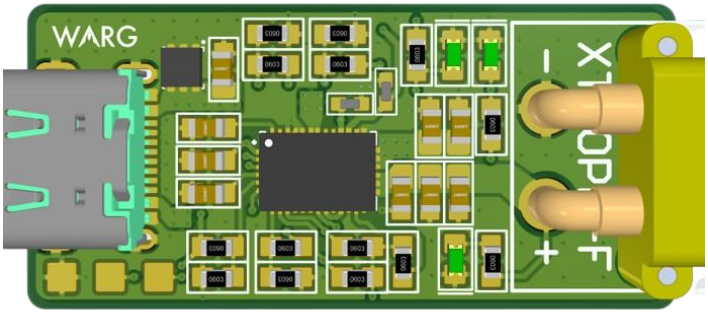


'Single Servo Driver'

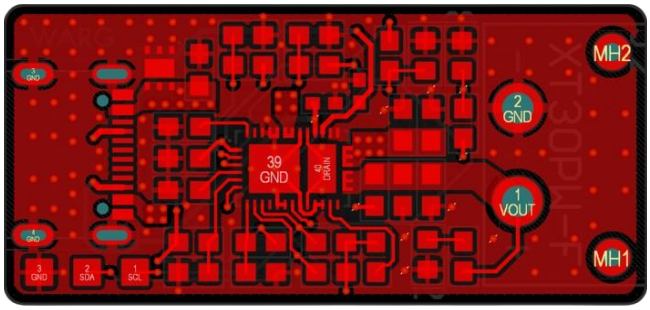


Efficiency Validation

USB-C PD Sink



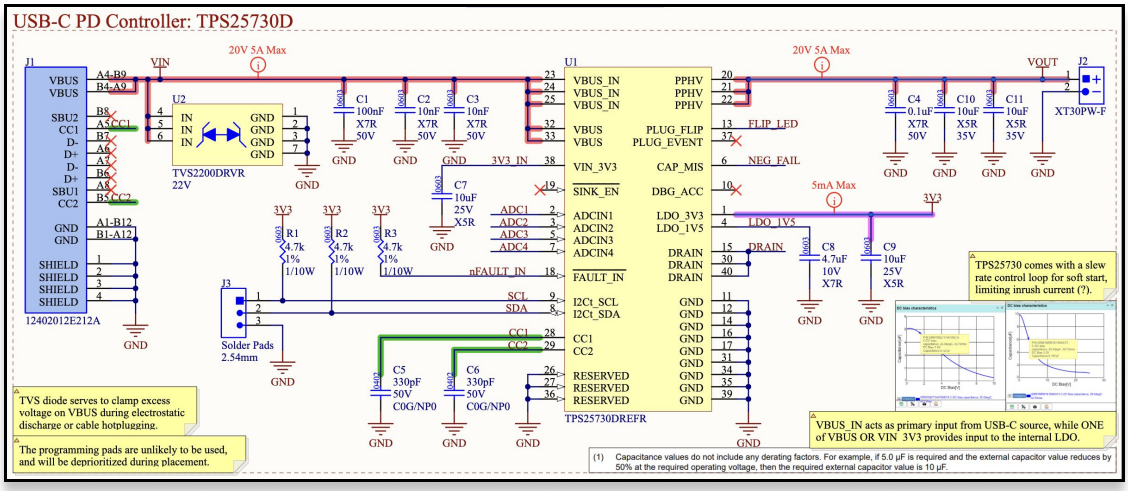
Top 3D View



Top Layer

Description

- USB-C to XT30 adapter to deliver up to 100W (20V 5A) to a drone during stationary debugging and testing.
- PD arbitration handled by the TPS25730, power configuration with resistor dividers on the PMIC's ADC pins.
- Auto-run; excludes the use of a microcontroller or dedicated buck/boost converters to save on BOM cost.



TPS25730 Schematic