Randall FC

Model Rocket Flight Computer for 74mm Airframes

Overview

Randall is the third installation in the Peregrine Developments line of flight computers, and is not intended for public sale, however design files/specifications may be made public if sufficient interest arises. Randall is intended to command up to two 9g servo motors and two 4 amp pyro channels for the safe and successful flight of a thrust vectoring-enabled model rocket.

Framework

Randall utilizes the Arduino framework, written to extend C++ for use in microcontrollers, and the Cortex M7-based Teensy 4.1 microcontroller. Programming is accomplished through the Teensy's onboard microUSB connector, and per-flight configurable parameters are loaded from onboard microSD into onboard EEPROM. Inflight, Randall uses the Teensy 4.1's capability to support onboard flash memory, soldered to the underside of the microcontroller board in the form of the W25Q128JVSIQ TR, a fast QSPI flash chip from Winbond. A RAM expander chip is also soldered to the Teensy underside, but is not yet utilized. Teensy 4.1 was chosen over previously released 3.6 and 4.0 revisions due to its comparable speed with the 4.0, and extended I/O capabilities similar to the 3.6.

Power Supply

Randall can operate on any battery with >6V and sufficient current throughput to maintain such during pyro events, although off-the-shelf 7.4v LiPo batteries have shown to be optimal. 2 amps of regulated 5V power is made available for the Teensy and servos through an AP63205 buck converter from Diodes Inc. Combined power draw from Teensy and servos **must not** exceed 2 amps, or brownout during flight is risked. State storage in EEPROM is utilized in order to maximize chance of recovery if brownout occurs, but precaution is the best safety.

Onboard Sensors

Randall gathers data from a number of onboard sensors in flight for datalogging and thrust vector control applications. Sensor data regarding orientation and acceleration is provided by a Bosch Sensortec BMI088, and barometric pressure, humidity, and temperature are provided by a BME280 of the same family. Bosch Sensortec-family components were chosen due to their high rated accuracy, and simplicity of application, requiring only decoupling capacitors and I2C pullups to operate. Additional lines are connected to BMI088 for data ready interrupts, and may be used by software if desired.

Pyro Channels

Randall has two pyro channels onboard for the purpose of igniting motors, firing parachute ejection charges, or any other desired event that requires high current for short periods of time (>1 second). Total draw of both pyro channels must not exceed 4 amps, and a current limiting resistor ensures this condition should never be met. Pyro channel MOSFETs are both also sourced from Diodes Inc, in the form of the SSM3K127TU,LF. Rated amperage for MOSFETs is 2 amps continuous, 4 amps pulsed, and large copper pours are available for thermal dissipation during and after pyro channel use.

Additional I/O

Furthermore, Randall has four additional I/O connectors available for use. Three JST-XH connectors are used for quick addition of such peripherals as an external data downloader/configurator, and switches for arming of vehicle and detecting contact with ground. An additional 2x4 pin socket is available with power, ground, and four GPIO pins, for any future additions desired.

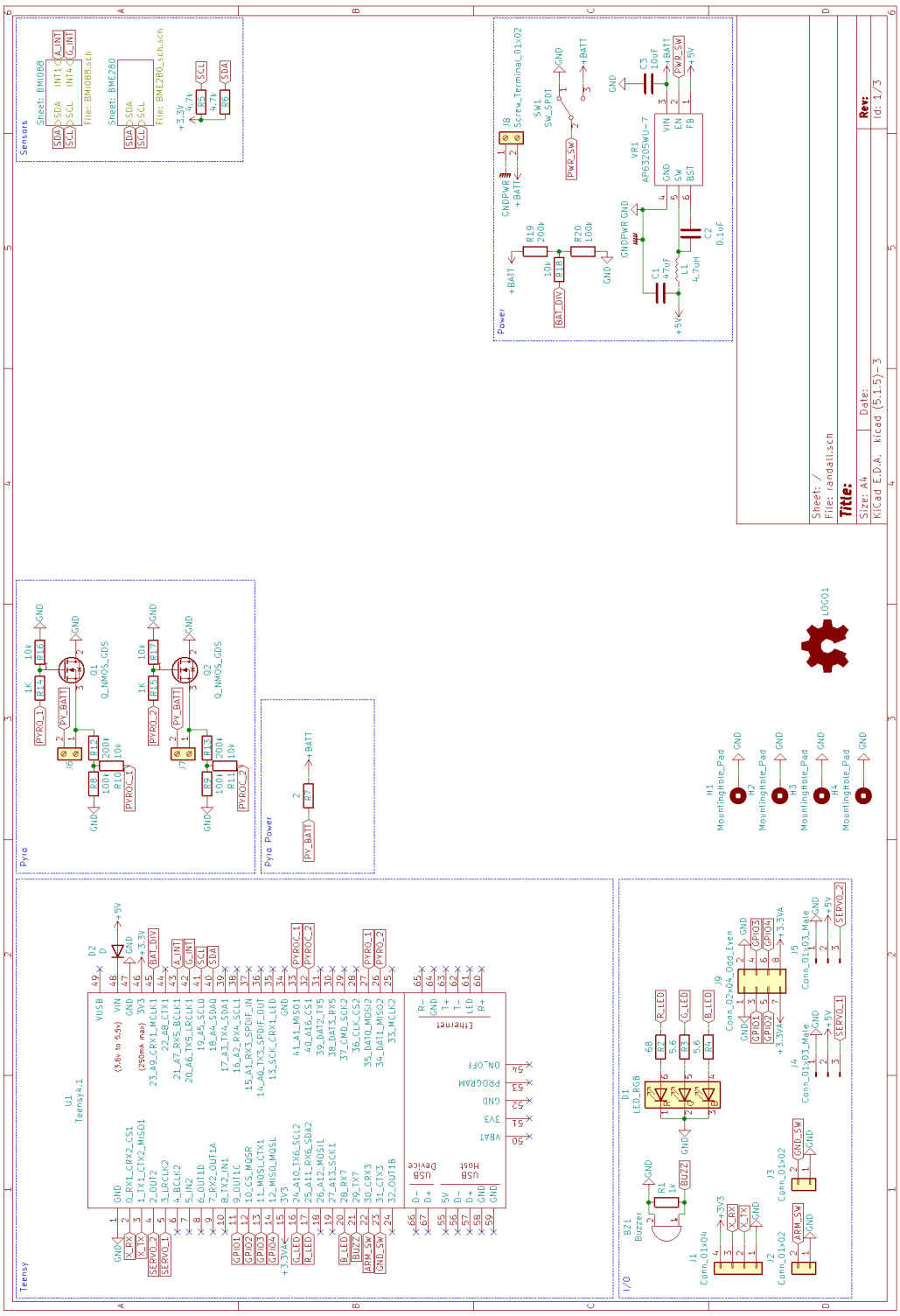
Revisions

Rev1 of Randall initially came with no JST-XH breakouts, and no interrupts for BMI088

Rev2 has added breakouts, GPIO pin socket, and BMI088 interrupts, and fixed some component footprints that were found to be slightly undersized

Reference Pictures on Next Page

Schematic (best viewed zoomed in)



PCB Layout