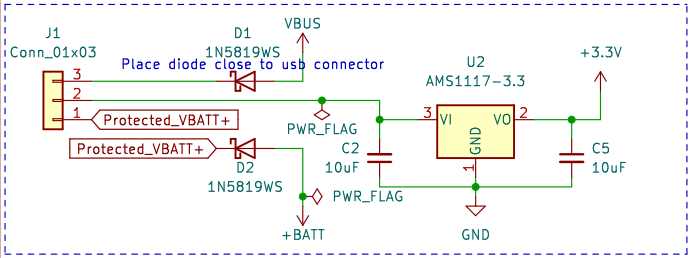
3.3V Net

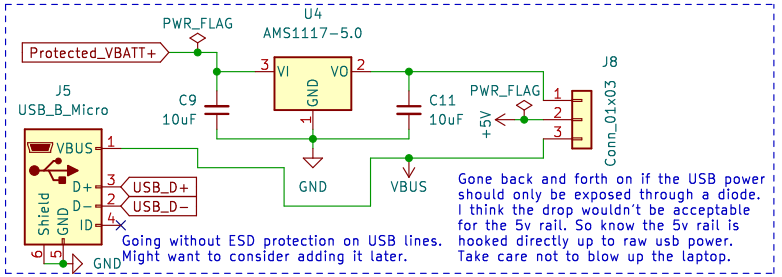
Powered from LDO via USB or Battery based on jumper position



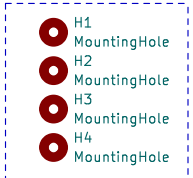
Jumper selects how the 3.3V net is powered. USB or Battery.
Diode to make sure I can't blow up my computer.
Todo: add DNP diode bypass?
Put it on the battery side too because why not.
Consider changing battery diode to P-Channel mosfet for more efficient polarity protecion only.

5V Net

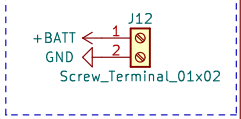
Powered straight from USB or from Battery through LDO based on jumper position



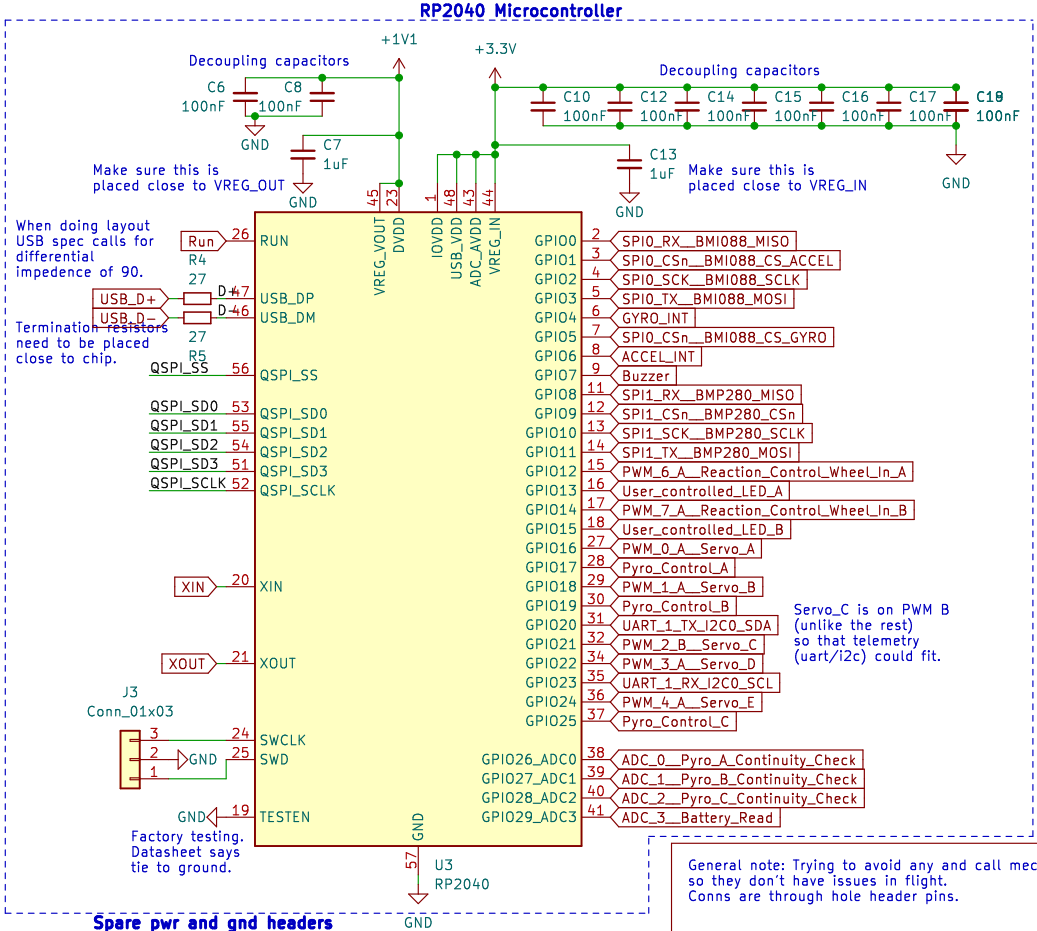
Board mounting holes



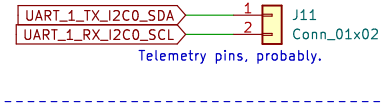
Battery terminal



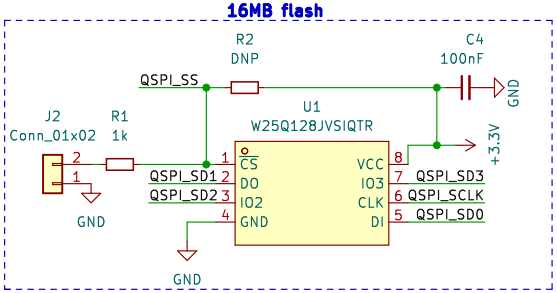
RP2040 Microcontroller



Additional pins broken out, likely for telemetry radio.

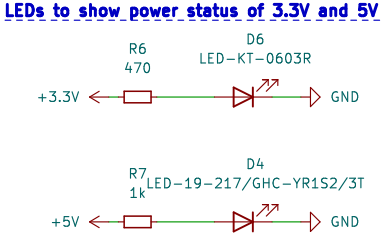


16MB flash

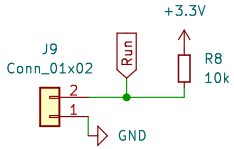


Flash chip recommends pullup resistor on CS but has been found to not be needed. Use 10k if going to populate.
Connect CS to ground via jumper for different boot modes.
Datasheet recommends pullups on data lines but those are even less necessary.

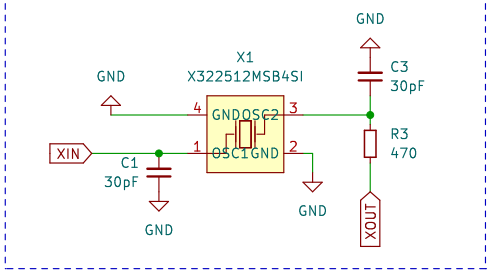
LEDs to show power status of 3.3V and 5V



Reset switch

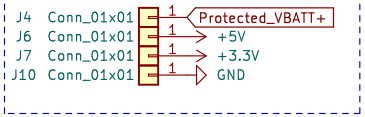


12MHz oscillator 20pF load capacitance



See AN2867 for calculations.
Load capacitance = 20pf.
Guessing 5pF parasitic capacitance like rp2040 hw design doc.
Page 13 - calculate capacitor values
So C_L = 20pF, C_S = 5pF, then C_L1 = C_L2 = 30pF.
Page 16 - calculate resitor value
R_ext = 1/(2*pi*Freq*C_L2) = 442, round to 470

Spare pwr and gnd headers



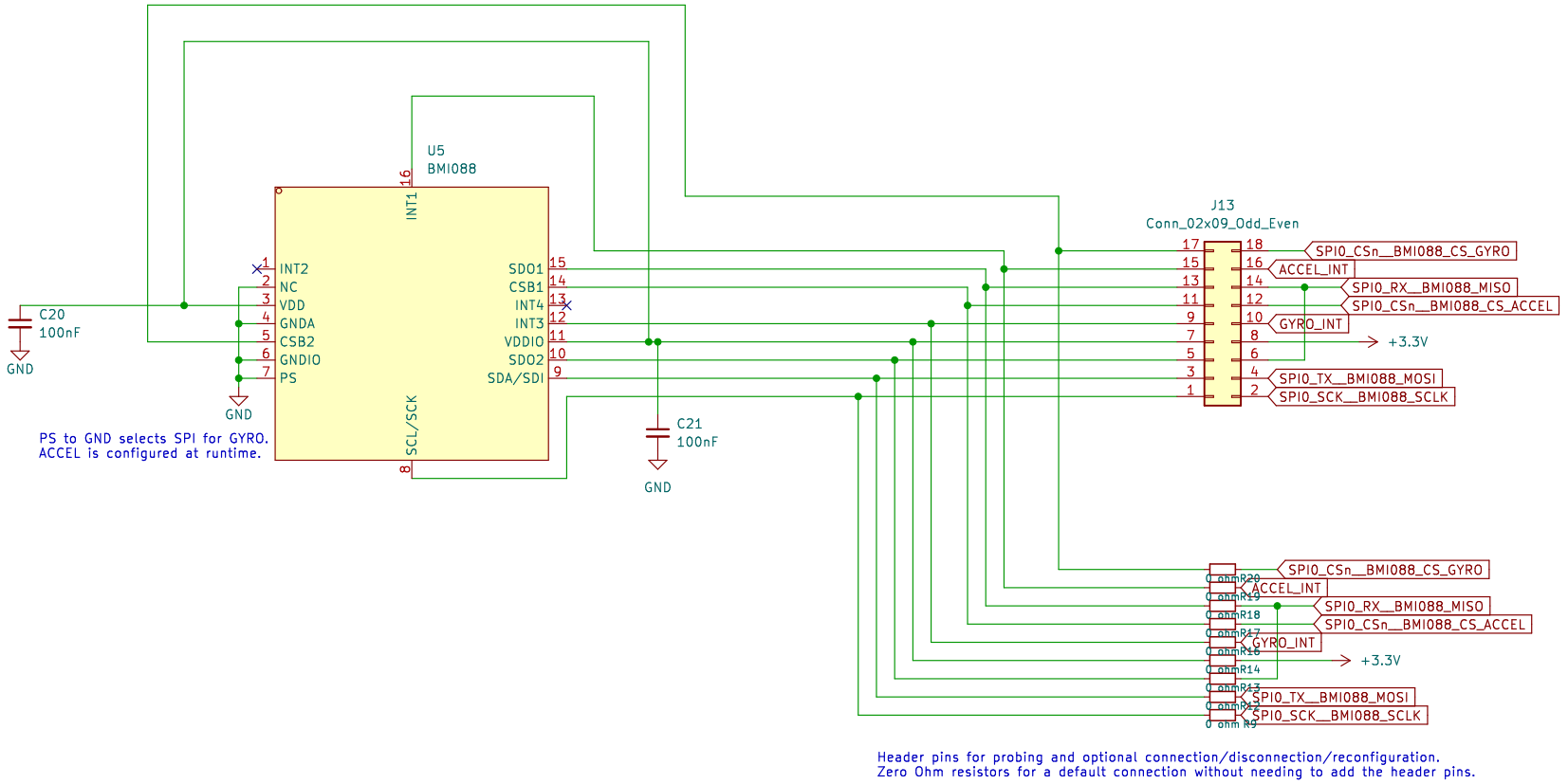
General note: Trying to avoid any and call mechanical buttons/switches/relays so they don't have issues in flight.
Conns are through hole header pins.

Sheet: /
File: rp2040_v0.kicad_sch

Title: rp2040 Flight Computer

Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 1/8

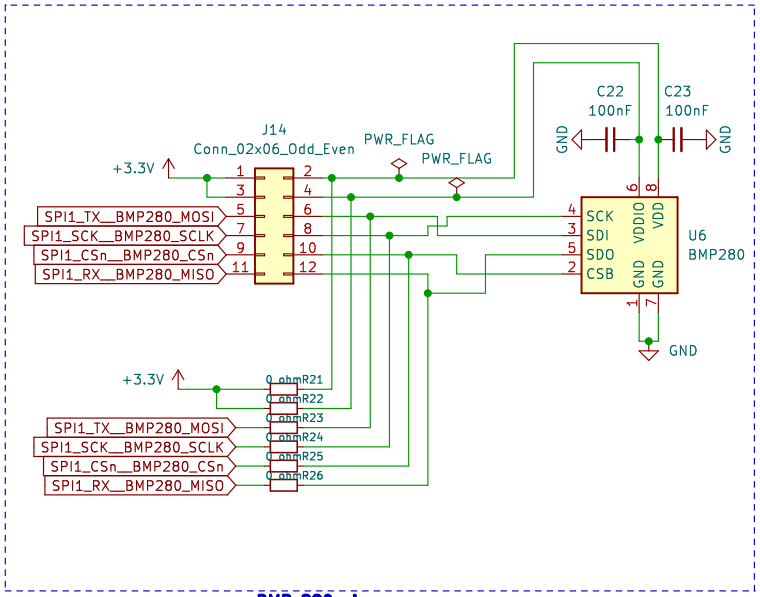
BMI088
IMU for Accelerometer (+-24g) and Gyroscope



Sheet: /IMU/
File: IMU.kicad_sch

Title: IMU – Accelerometer and Gyrocope

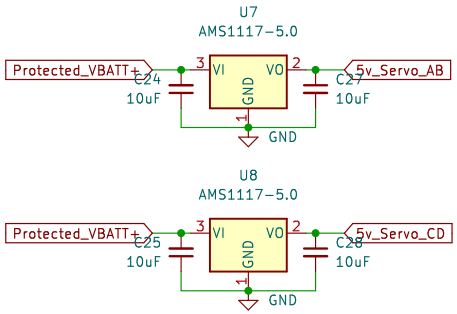
Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 2/8



BMP 280 air pressure sensor
Interestingly, no interrupt pin.

Sheet: /Barometer/		
File: Barometer.kicad_sch		
Title: Barometer		
Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 3/8

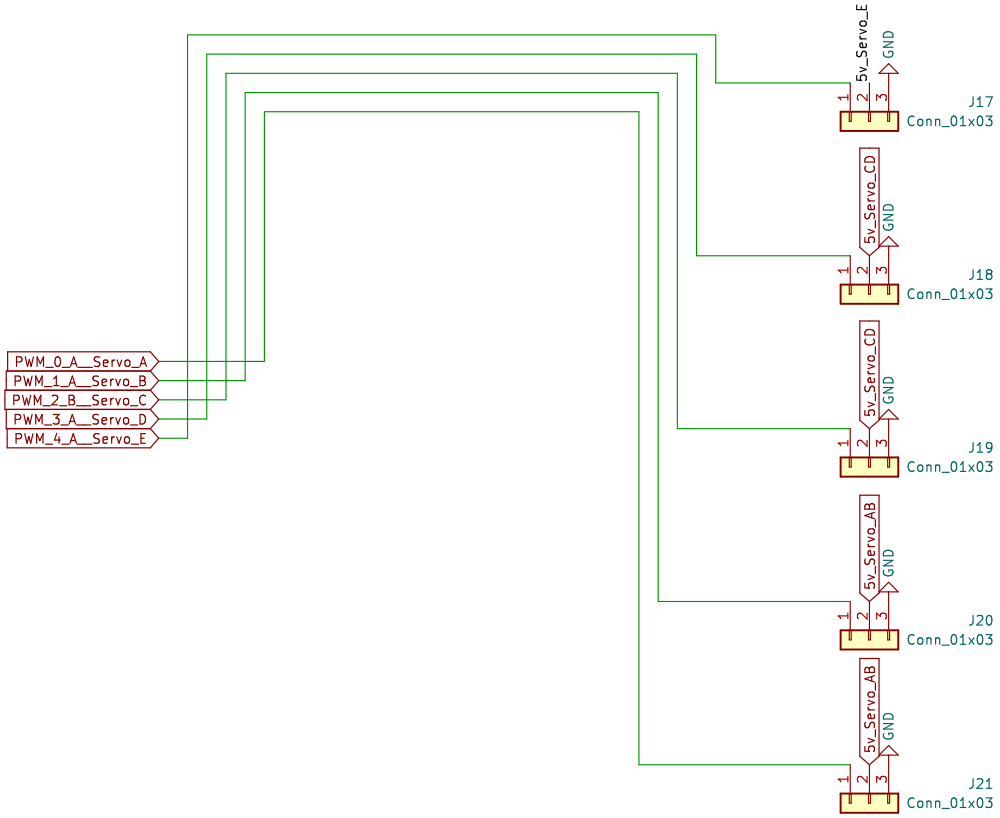
Servo Power Delivery



+5V ← 5v_Servo_E

Use normal 5V rail.
Double check what else is coming off the LDO and make sure it can handle it.
As of 01/29/23 it's LEDs and potentially a motor driver.

Datasheet does not say anything about servo power.
Internet has a lot of different info.
Consencous seems to bee servos stall at 650-800mA but usually operate in the 300mA or below range.
Go with two servos per 1A LDO.
Chances of using more than 3 servos is probably slim. Just put them on separate rails.
There's no way this can bite me in the butt right? RIGHT!?



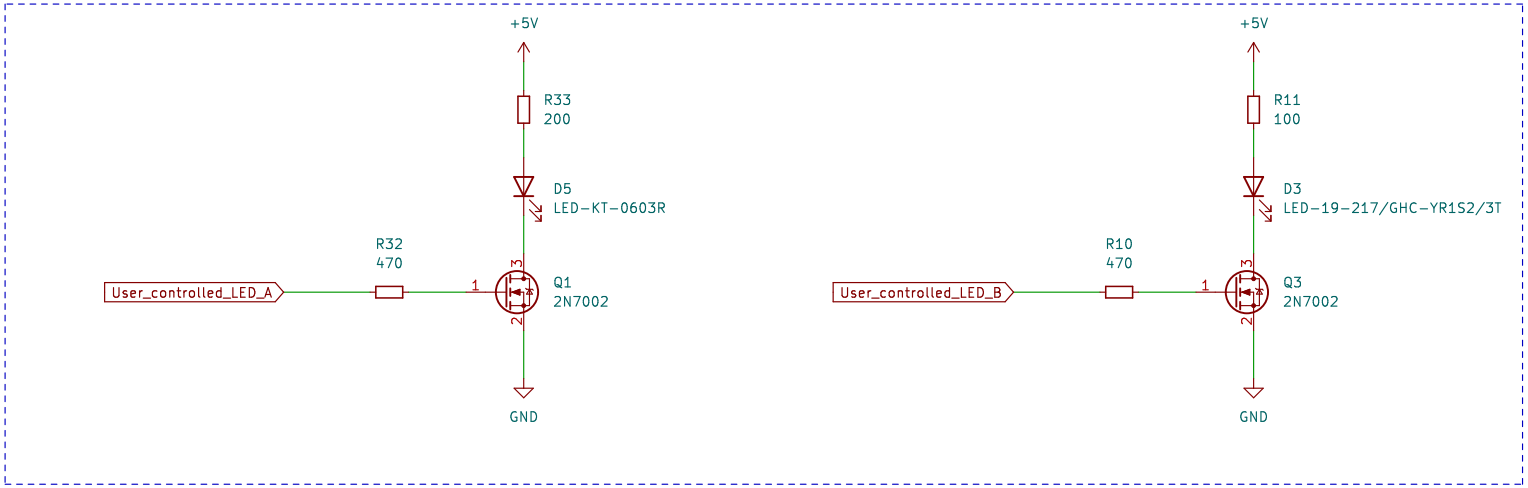
Servo connections and potential level shifter

Sheet: /Servos/
File: Servos.kicad_sch

Title: Servo Motor Circuitry

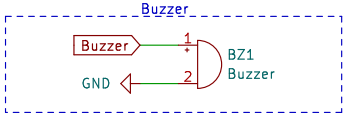
Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 4/8

User Controlled LEDs



WS2812B takes very specific timing.
Implement this using PIO.

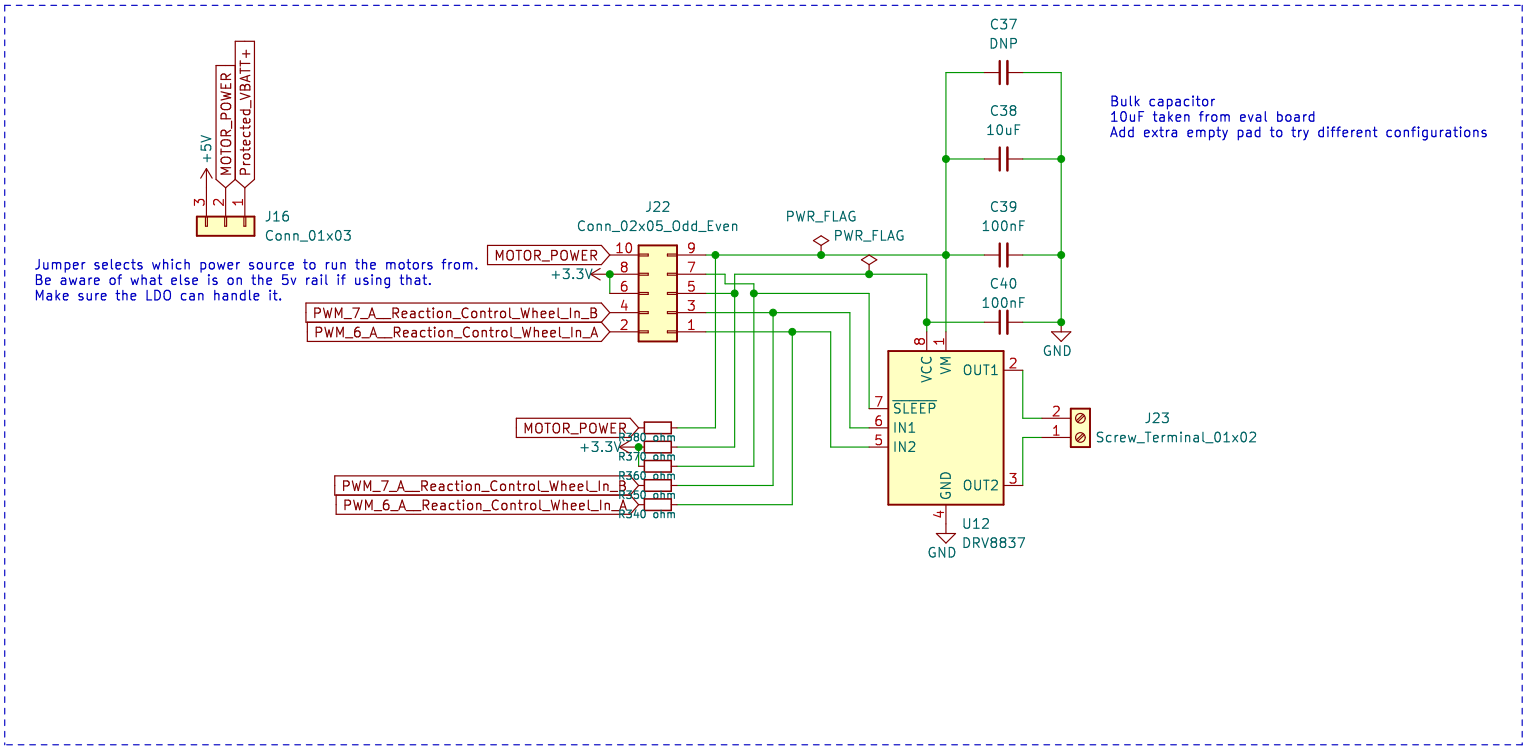
Buzzer



Buzzer takes a direct pwm signal from MCU.
No amplification necessary.

Sheet: /LEDs_and_buzzer/		
File: LEDs_and_buzzer.kicad_sch		
Title: User Controlled LEDs and Buzzer		
Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 5/8

Reaction wheel motor driver



Sheet: /reaction_control_wheel/		
File: reaction_control_wheel.kicad_sch		
Title: Reaction Control Wheel		
Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 6/8

Pyro power source with resistor

Actually want raw VBATT instead of protected because don't want the diode voltage drop, and polarity doesn't matter in this case.

+BATT

J15 Conn_01x02

Added a saftey feature! The Pyro channel can never be fired unless it is armed! Arm the channels by placing a jumper on the pins, connecting the circuit.

R39 3(DNP)

Current limiting resistor that can handle a lot of power is needed.
Calculations for resistor:
Nichrome should be 28awg or 30awg and be roughly 1-1.5 ohms.
Ematch is also roughly an ohm.
Expecting 12v (11.1v nominal) lipo, or 8v (7.2v nominal) if using a 2s lipo.
Desire 3ish amps. I=V/R, I=12/4, I=3ish with 4ohms total resistance
Or 1 Ohm for ematch/nichrome, and 3 Ohms for the resistor.
Calculating power requirements:
P=V*I, P=12*3, P=36W, a hefty resistor.
These are very loose hand wavy numbers (+-50%).
They fall on the side of NOT meeting requirements but I think it will be fine.
That's what testing is for!
2.2 Ohms is available as well. That might be the better option.

R46 2.2
R48 2.2
R47 2.2
R49 2.2

I've been told, and believe, that the Pyros fire for much less than a second and thus you can get away with small wattage (1W-5W) through hole resistors that don't meet the theoretical requirements.
This would make things much cheaper.
Leave some parallel and series configurations options open for experimentation.

Armed_Batt+_with_big_pyro_resistor

Pyro Channel A

Armed_Batt+_with_big_pyro_resistor

J25 Screw_Terminal_01x02

Pyro charge goes in here

R41 390k

R42 91k

GND

ADC_0__Pyro_A_Continuity_Check

Inrush current protection resistor
R45 470

Pyro_Control_A

Q2 AO3400A

Pulldown resistor to ensure no accidental firing of the pyro channel.

R44 10k

GND

GND

The Impedence of the rp2040 adc pins are not given.
Hopefully it's high enough to not cause issues...
Should give roughly a 1/5th of the battery reading if there is continuity.
Back of envelope worst case scenario amperage: V=12, R=400k, I=12/400k= .0275mA or 27.5uA.
And 27.5uA should be well below whats required to set off any pyros.
And 3.3v*5 is much greater than the battery could be, so the adc should always be in range.

Pyro Channel B

Armed_Batt+_with_big_pyro_resistor

J27 Screw_Terminal_01x02

Pyro charge goes in here

ADC_1__Pyro_B_Continuity_Check

R52 390k

R53 91k

GND

R58 470

Pyro_Control_B

R56 10k

GND

Q4 AO3400A

GND

Same circuit as Pyro Channel A.

Pyro Channel C

Armed_Batt+_with_big_pyro_resistor

J28 Screw_Terminal_01x02

Pyro charge goes in here

ADC_2__Pyro_C_Continuity_Check

R54 390k

R55 91k

GND

R59 470

Pyro_Control_C

R57 10k

GND

Q5 AO3400A

GND

Same circuit as Pyro Channel A.

Battery voltage reading circuit

+BATT

ADC_3__Battery_Read

390k R43

R40 91k

GND

Read the raw battery voltage through the ADC.

General notes - Make these traces big!

Sheet: /Pyro_Channels/
File: pyro_channels.kicad_sch

Title: Pyros!

Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 7/8

V0.0 – Initial schematic!
V0.1 – After porting to PCB realized it was way too big. Start stripping out components. Start pcb layout.
V0.2 – CRITICAL MISTAKE SPOTTED! Flash Chip was wired wrong. Fixed. Continue PCB layout
v0.3 – Didn't realize the IMU should be in the center of the board. (Lots of) reworking.

Sheet: /version_notes/
File: version_notes.kicad_sch

Title: Version notes!

Size: A4	Date: 2023-01-31	**Rev: v0.3**
KiCad E.D.A. kicad (6.0.10)		Id: 8/8