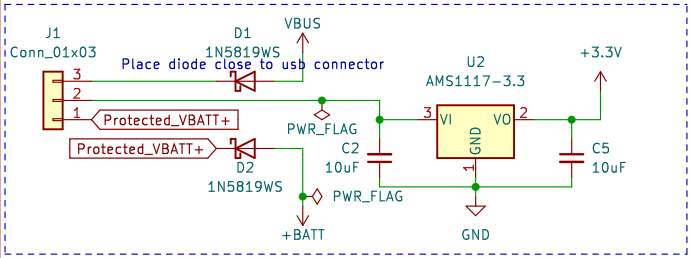
3.3V Net

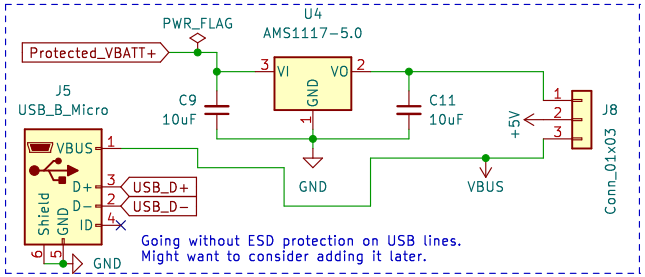
Powered from LDO via USB or Battery based on jumper position



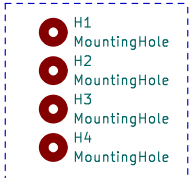
Jumper selects how the 3.3V net is powered. USB or Battery.
Diode to make sure I can't blow up my computer.
Todo: add DNP diode bypass?
Put it on the battery side too because why not.
Consider changing battery diode to P-Channel mosfet for more efficient polarity protecion only.

5V Net

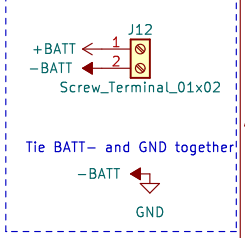
Powered straight from USB or from Battery through LDO based on jumper position



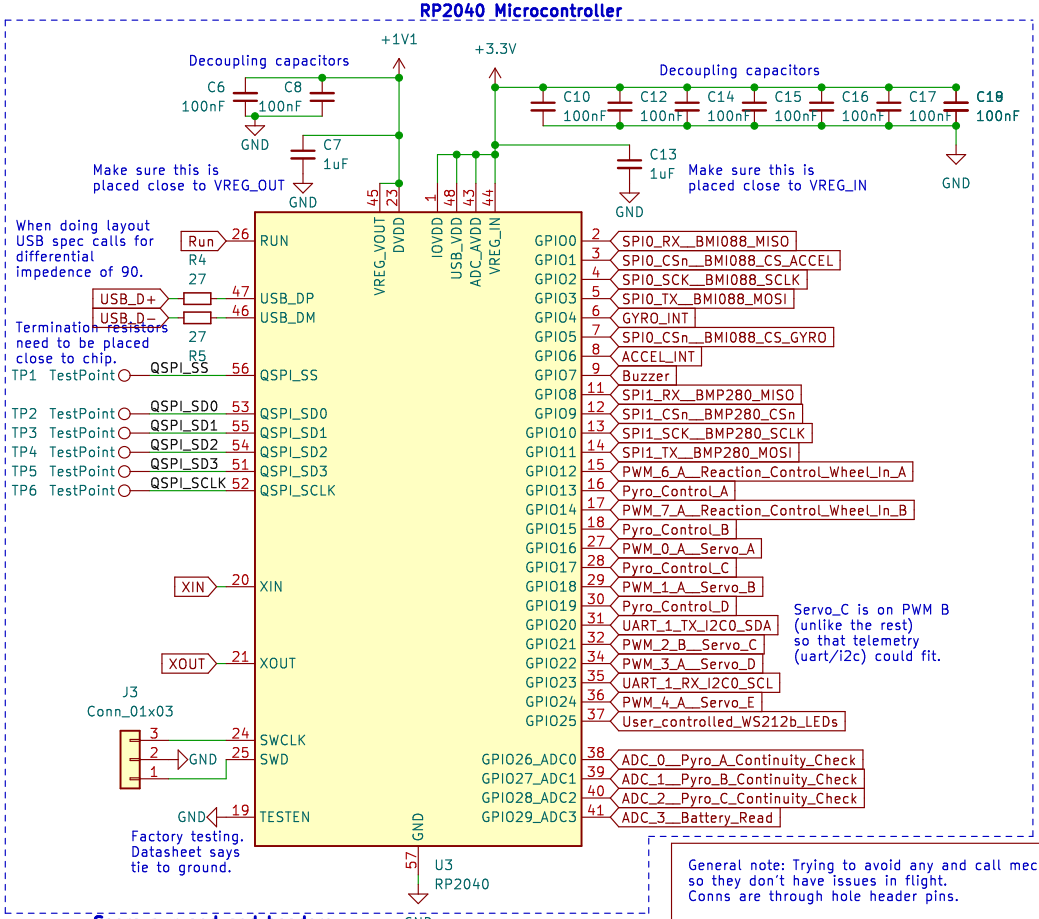
Board mounting holes



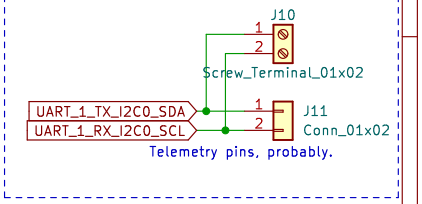
Battery terminal



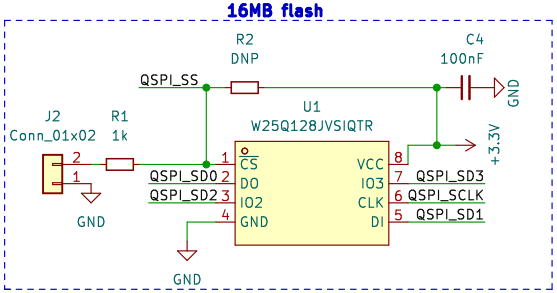
RP2040 Microcontroller



Additional pins broken out, likely for telemetry radio.

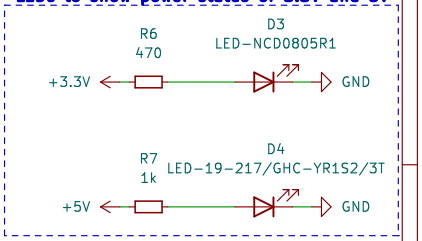


16MB flash

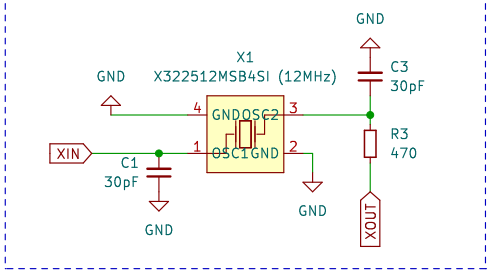


Flash chip recommends pullup resistor on CS but has been found to not be needed. Use 10k if going to populate.
Connect CS to ground via jumper for different boot modes.
Datasheet recommends pullups on data lines but those are even less necessary.

LEDs to show power status of 3.3V and 5V

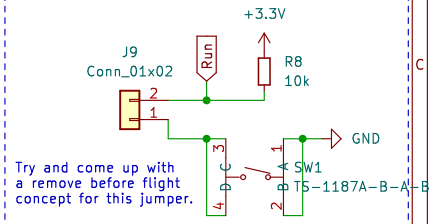


12MHz oscillator 20pF load capacitance

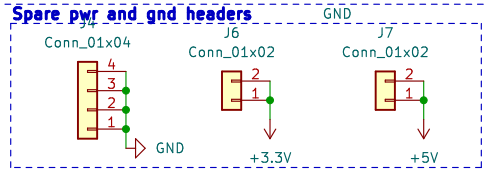


See AN2867 for calculations.
Load capacitance = 20pf.
Guessing 5pF parasitic capacitance like rp2040 hw design doc.
Page 13 - calculate capacitor values
So C_L = 20pF, C_S = 5pF, then C_L1 = C_L2 = 30pF.
Page 16 - calculate resitor value
R_ext = 1/(2*pi*Freq*C_L2) = 442, round to 470

Reset switch



Spare pwr and gnd headers



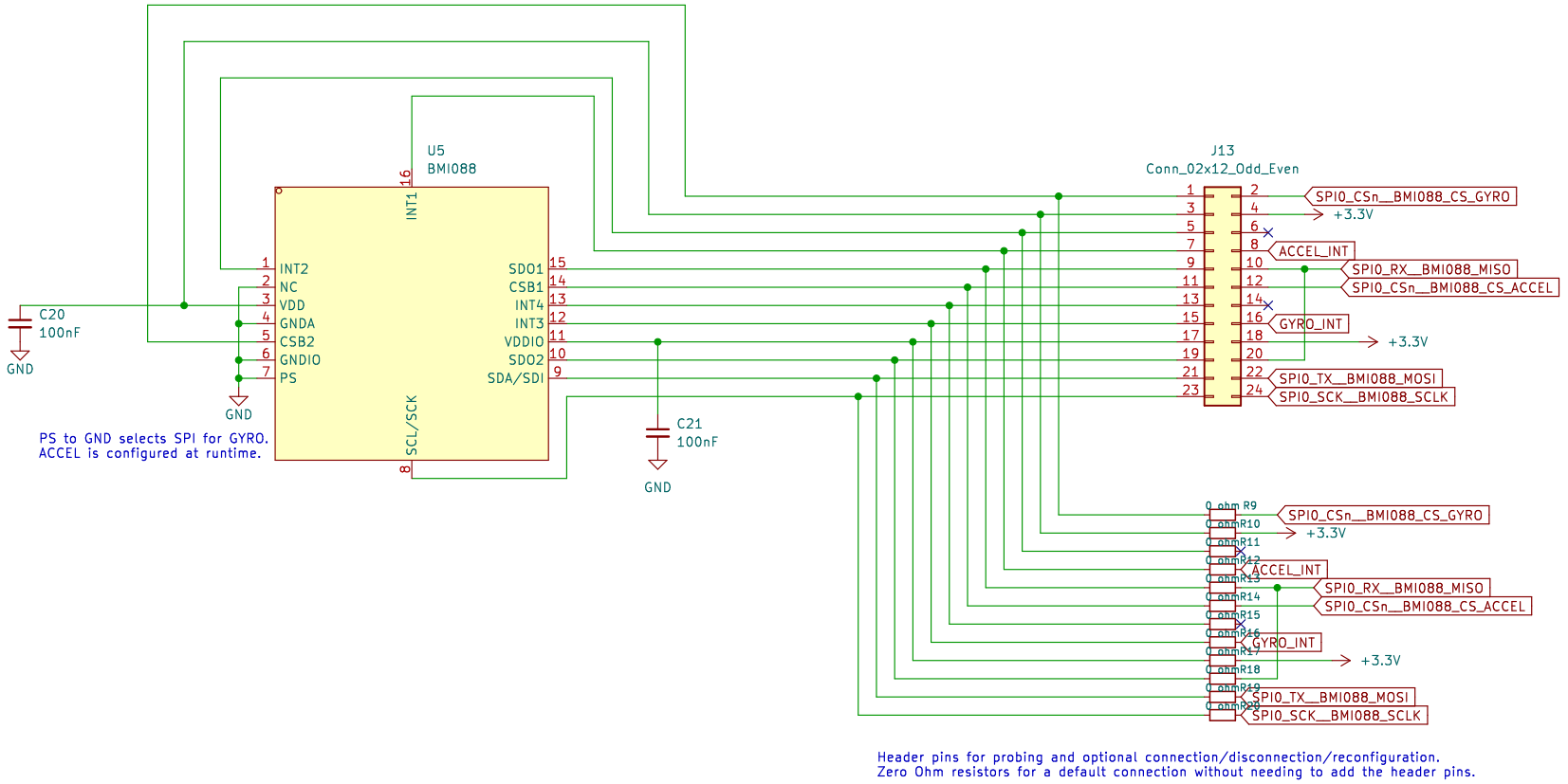
General note: Trying to avoid any and call mechanical buttons/switches/relays so they don't have issues in flight.
Conns are through hole header pins.

Sheet: /
File: rp2040_v0.kicad_sch

Title: rp2040 Flight Computer

Size: A4	Date: 2023-01-28	Rev: v0
KiCad E.D.A. kicad (6.0.10)		Id: 1/7

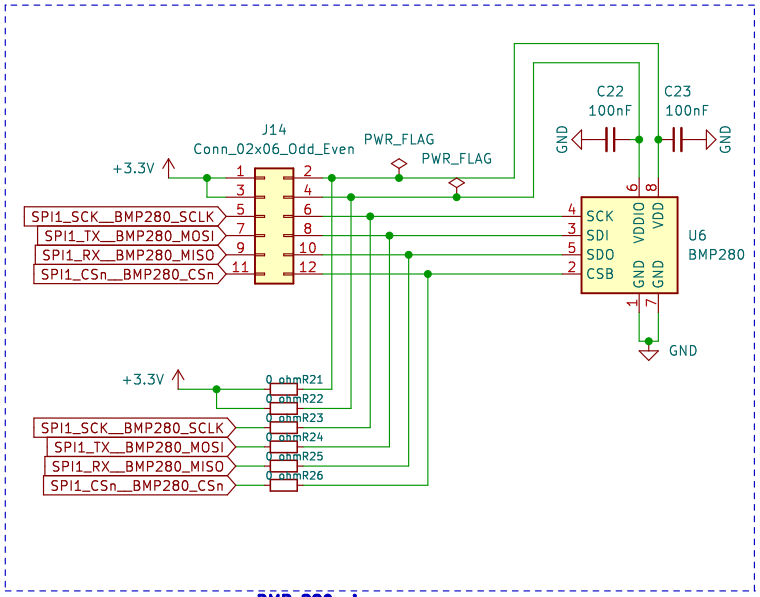
BMI088
IMU for Accelerometer (+-24g) and Gyroscope



Sheet: /IMU/
File: untitled.kicad_sch

Title: IMU – Accelerometer and Gyrocope

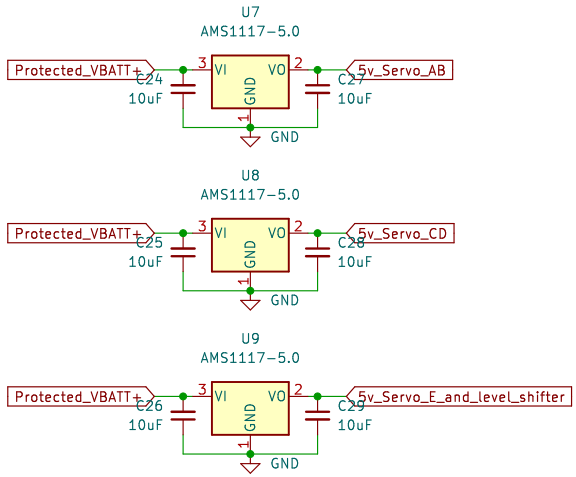
Size: A4	Date: 2023-01-28	**Rev: v0**
KiCad E.D.A. kicad (6.0.10)		Id: 2/7



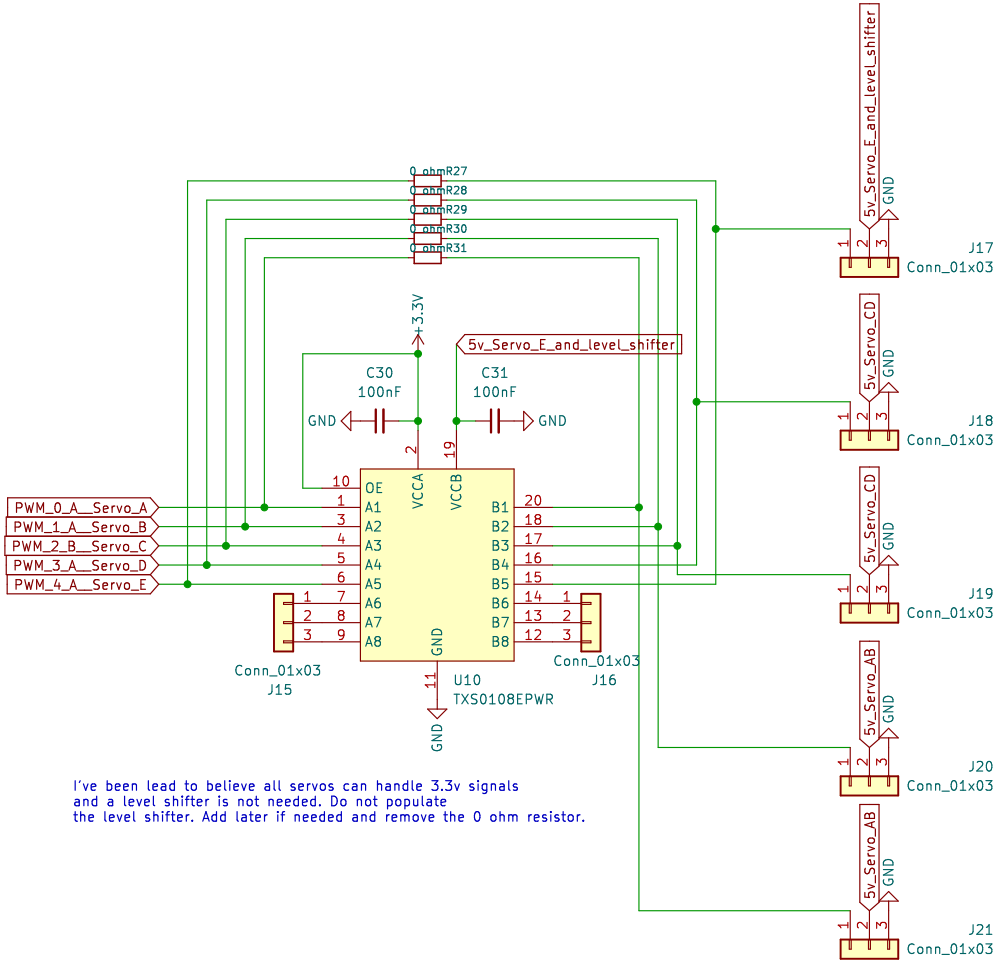
BMP 280 air pressure sensor
Interestingly, no interrupt pin.

Sheet: /Barometer/		
File: Barometer.kicad_sch		
Title: Barometer		
Size: A4	Date: 2023-01-28	**Rev: v0**
KiCad E.D.A. kicad (6.0.10)		Id: 3/7

Servo Power Delivery



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!?



I've been lead to believe all servos can handle 3.3v signals
and a level shifter is not needed. Do not populate
the level shifter. Add later if needed and remove the 0 ohm resistor.

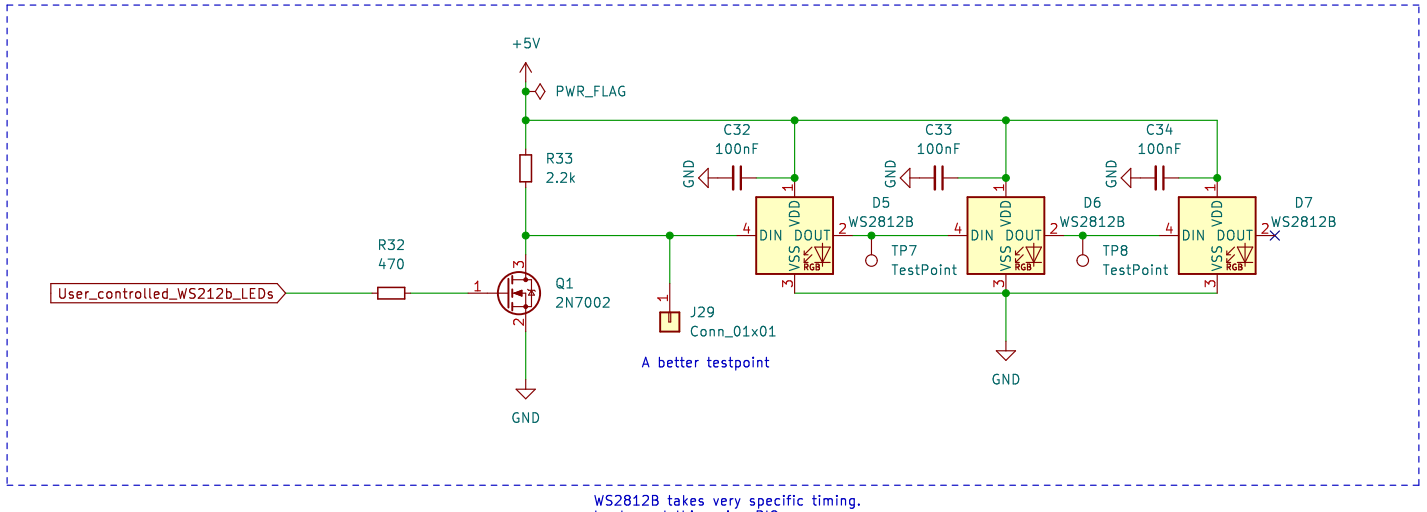
Servo connections and potential level shifter

Sheet: /Servos/
File: Servos.kicad_sch

Title: Servo Motor Circuitry

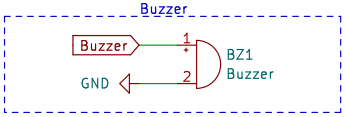
Size: A4	Date: 2023-01-28	**Rev: v0**
KiCad E.D.A. kicad (6.0.10)		Id: 4/7

User Controlled LEDs



WS2812B takes very specific timing.
Implement this using PIO.

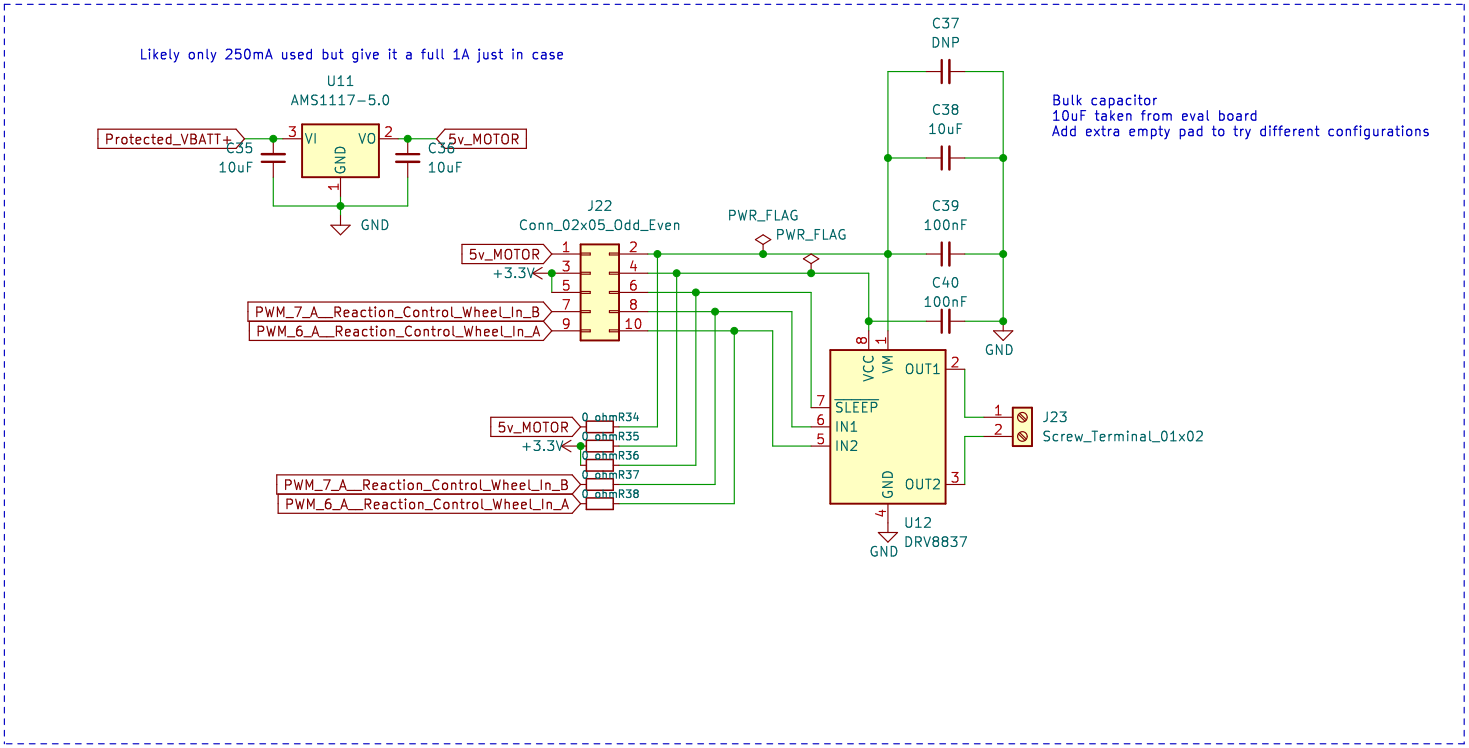
Buzzer



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: 2023-01-28	**Rev: v0**
KiCad E.D.A. kicad (6.0.10)		Id: 5/7

Reaction wheel motor driver



Sheet: /reaction_control_wheel/		
File: reaction_control_wheel.kicad_sch		
Title: Reaction Control Wheel		
Size: A4	Date: 2023-01-28	**Rev: v0**
KiCad E.D.A. kicad (6.0.10)		Id: 6/7

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

R39 3

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 DNP
R48 DNP
R47 DNP
R49 DNP

I've been told, and beilieve, 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.

J24
Screw_Terminal_01x02
Added a saftey feature!
The Pyro channel can never be fired unless it is armed!
Arm the channels by placing a wire in the screw terminal, connecting the circuit.
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

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 D

J26
Screw_Terminal_01x02
Pyro charge goes in here

Armed_Batt+_with_big_pyro_resistor
R51 470
Q3 AO3400A
Pyro_Control_D
R50 10k
GND

Pyro Channel D does not get continuity check because the ADC needs to be used to check the battery (at all times) instead.

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
Q4 AO3400A
Pyro_Control_B
R56 10k
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
Q5 AO3400A
Pyro_Control_C
R57 10k
GND

Same circuit as Pyro Channel A.

Battery voltage reading circuit

+BATT
390k R43
ADC_3__Battery_Read
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: 2023-01-28	**Rev: v0**
KiCad E.D.A. kicad (6.0.10)		Id: 7/7