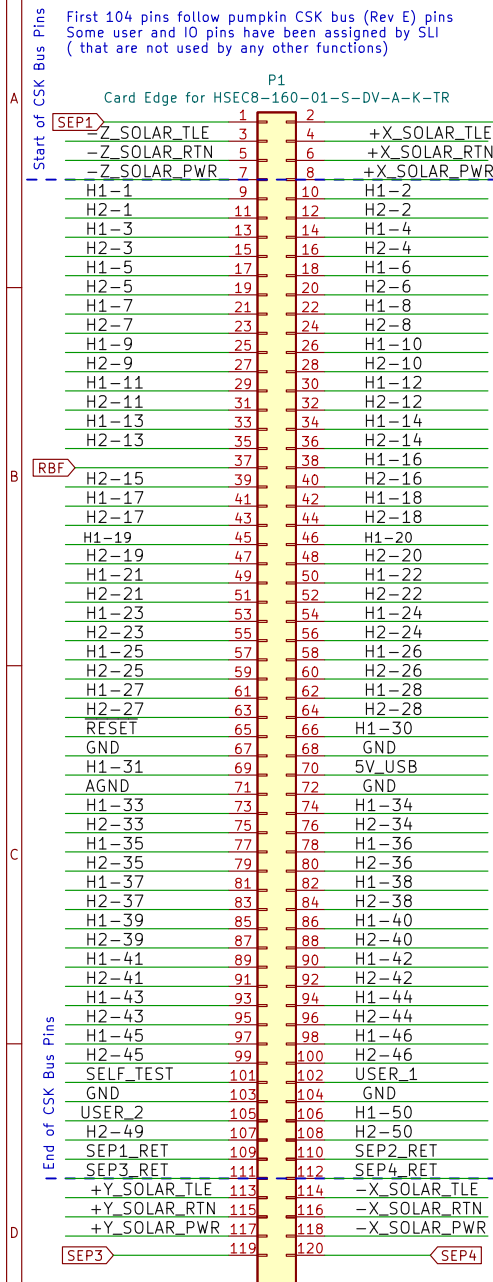
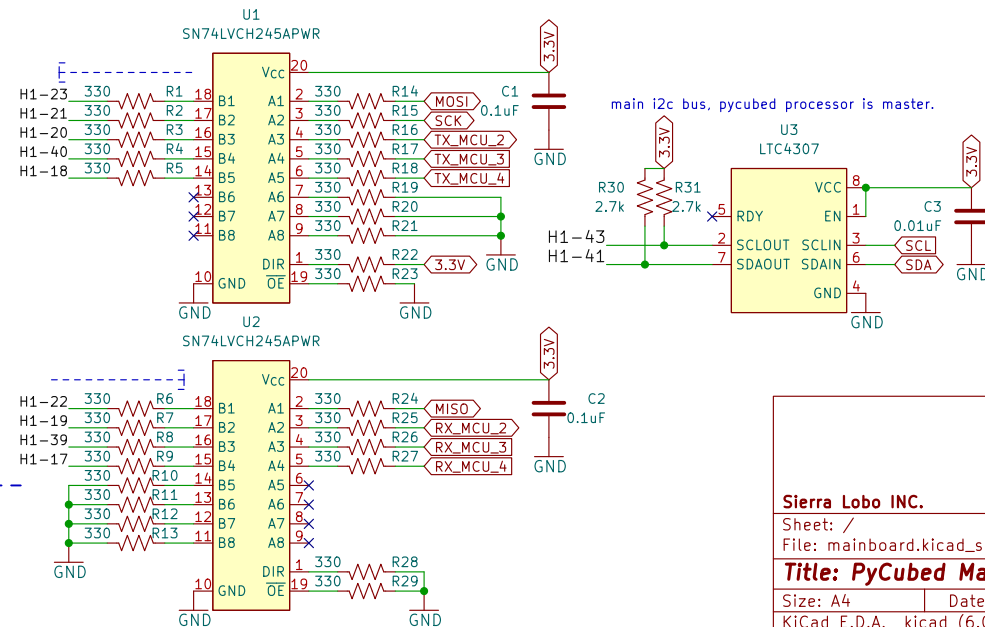
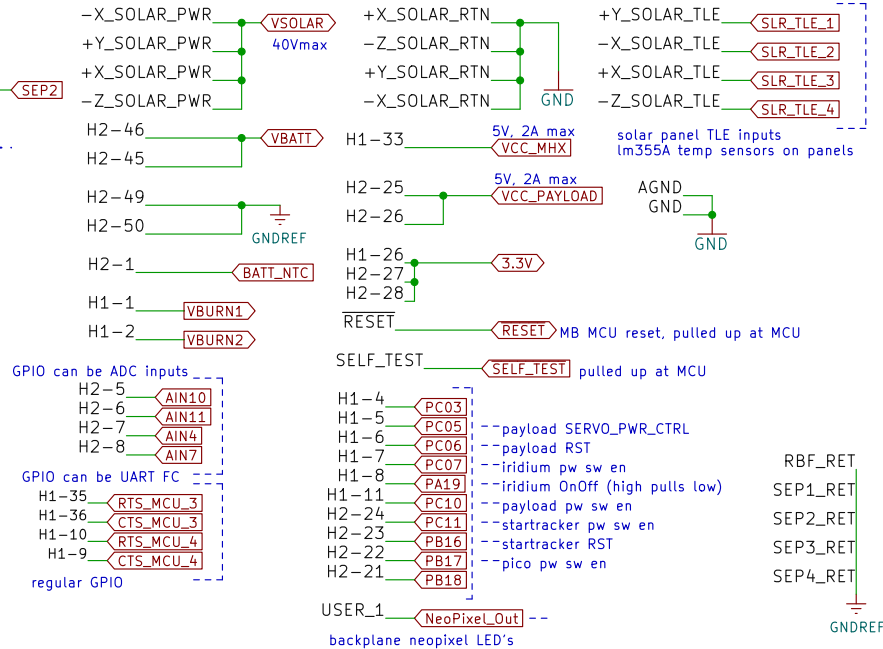


First 104 pins follow pumpkin CSK bus (Rev E) pins
Some user and IO pins have been assigned by SLI
(that are not used by any other functions)



The diagram illustrates the wiring for a Raspberry Pi 4B to a custom PCB. It is organized into several functional sections:

- Power Connections:**
 - V_{Solar}:** Connected to -X_SOLAR_PWR, +Y_SOLAR_PWR, +X_SOLAR_PWR, and -Z_SOLAR_PWR. Labeled 40V_{max}.
 - V_{Batt}:** Connected to H2-46 and H2-45.
 - VCC_MMX:** 5V, 2A max. Connected to H1-33.
 - VCC_PAYLOAD:** 5V, 2A max. Connected to H2-25 and H2-26.
 - 3.3V:** Connected to H1-26, H2-27, and H2-28.
- Ground Connections:**
 - GND:** Connected to -X_SOLAR_RTN, -Z_SOLAR_RTN, +Y_SOLAR_RTN, -X_SOLAR_RTN, AGND, and GND.
 - GNDREF:** Connected to H2-50.
- Sensors:**
 - BATT_NTC:** Connected to H2-1.
 - V_{Burn1} / V_{Burn2}:** Connected to H1-1 and H1-2.
 - SELF_TEST:** Connected to H1-4, labeled "pulled up at MCU".
 - PC03-PC10:** Connected to H1-4 through H1-11.
 - PB16-PB18:** Connected to H2-22 through H2-21.
 - NeoPixel Out:** Connected to USER_1, labeled "backplane neopixel LED's".
- Solar Panel:**
 - SLR_TLE_1-4:** Connected to +Y_SOLAR_TLE, -X_SOLAR_TLE, +X_SOLAR_TLE, and -Z_SOLAR_TLE. Labeled "solar panel TLE inputs".
- Temperature Sensor:**
 - Im3554:** Connected to AGND and GND. Labeled "Im3554 temp sensors on panels".
- Other Connections:**
 - RTS_MCU_3, CTS_MCU_3, RTS_MCU_4, CTS_MCU_4:** Connected to -35, -36, -10, and -19. Labeled "can be UART FC".
 - MB MCU reset:** Connected to RESET, labeled "MB MCU reset, pulled up at MCU".
 - payload SERVO_PWR_CTRL, payload pw sw en, startracker pw sw en, startracker RST, pico pw sw en:** Connected to H1-5 through H2-21.
 - RBF_RET, SEP1_RET, SEP2_RET, SEP3_RET, SEP4_RET:** Connected to H1-8 through H2-21.



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File: Bus_Protection.kicad_sch

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The number of people 405 years of age or older has increased by 1,152,921,504,606,846,976,000 percent. The number of people 410 years of age or older has increased by 2,305,843,009,213,693,952,000 percent. The number of people 415 years of age or older has increased by 4,611,686,018,427,387,904,000 percent. The number of people 420 years of age or older has increased by 9,223,372,036,854,775,808,000 percent. The number of people 425 years of age or older has increased by 18,446,744,073,709,551,616,000 percent. The number of people 430 years of age or older has increased by 36,893,488,147,419,103,232,000 percent. The number of people 435 years of age or older has increased by 73,786,976,294,838,206,464,000 percent. The number of people 440 years of age or older has increased by 147,573,952,589,676,412,928,000 percent. The number of people 445 years of age or older has increased by 295,147,905,179,352,825,856,000 percent. The number of people 450 years of age or older has increased by 590,295,810,358,705,651,712,000 percent. The number of people 455 years of age or older has increased by 1,180,591,620,717,411,303,424,000 percent. The number of people 460 years of age or older has increased by 2,361,183,241,434,822,606,848,000 percent. The number of people 465 years of age or older has increased by 4,722,366,482,869,645,213,696,000 percent. The number of people 470 years of age or older has increased by 9,444,732,965,739,290,427,392,000 percent. The number of people 475 years of age or older has increased by 18,889,465,931,478,580,854,784,000 percent. The number of people 480 years of age or older has increased by 37,778,931,862,957,161,709,568,000 percent. The number of people 485 years of age or older has increased by 75,557,863,725,914,323,419,136,000 percent. The number of people 490 years of age or older has increased by 151,115,727,451,828,646,838,272,000 percent. The number of people 495 years of age or older has increased by 302,231,454,903,657,293,676,544,000 percent. The number of people 500 years of age or older has increased by 604,462,909,807,314,587,353,088,000 percent. The number of people 505 years of age or older has increased by 1,208,925,819,614,629,174,706,176,000 percent. The number of people 510 years of age or older has increased by 2,417,851,639,229,258,349,412,352,000 percent. The number of people 515 years of age or older has increased by 4,835,703,278,458,516,698,824,704,000 percent. The number of people 520 years of age or older has increased by 9,671,406,556,917,033,397,649,408,000 percent. The number of people 525 years of age or older has increased by 19,342,813,113,834,066,795,298,816,000 percent. The number of people 530 years of age or older has increased by 38,685,626,227,668,133,590,597,632,000 percent. The number of people 535 years of age or older has increased by 77,371,252,455,336,267,181,195,264,000 percent. The number of people 540 years of age or older has increased by 154,742,504,910,672,534,362,390,528,000 percent. The number of people 545 years of age or older has increased by 309,485,009,821,345,068,724,781,056,000 percent. The number of people 550 years of age or older has increased by 618,970,019,642,690,137,449,562,112,000 percent. The number of people 555 years of age or older has increased by 1,237,940,039,285,380,274,899,124,224,000 percent. The number of people 560 years of age or older has increased by 2,475,880,078,570,760,549,798,248,448,000 percent. The number of people 565 years of age or older has increased by 4,951,760,157,141,521,099,596,496,896,000 percent. The number of people 570 years of age or older has increased by 9,903,520,314,283,042,199,193,993,792,000 percent. The number of people 575 years of age or older has increased by 19,807,040

File: Burn_Wires.kicad_sch

File: Connectors.kicad_sch

5V_USB → USB_VCC
 X → USB_EN
 USB 2.0 microB → USB_FLG
 USB_D+ → USB_D+
 USB_D- → USB_D-
 GND → LED_GND
 GND → GND
 GNDREF → USB_GND
 CHS → CHS

LED_VCC → 0
 RED_LED → VBUS
 YEL_LED → VCC_PAYLOAD
 ORG_LED → VCC_MXH
 GRN_LED → 3.3V
 SW_VCC → Open Drain
 SW_NO → RESET
 SW_COM → GND

remove for flight
 R32
 VBUS

File: Blank-Card-Default.kicad_sch

File: Blank-Card-Default.kicad_sch

PyCubed

Sierra Lobo INC.

Sheet: /

File: mainboard.kicad_sch

Title: PyCubed Mainboard

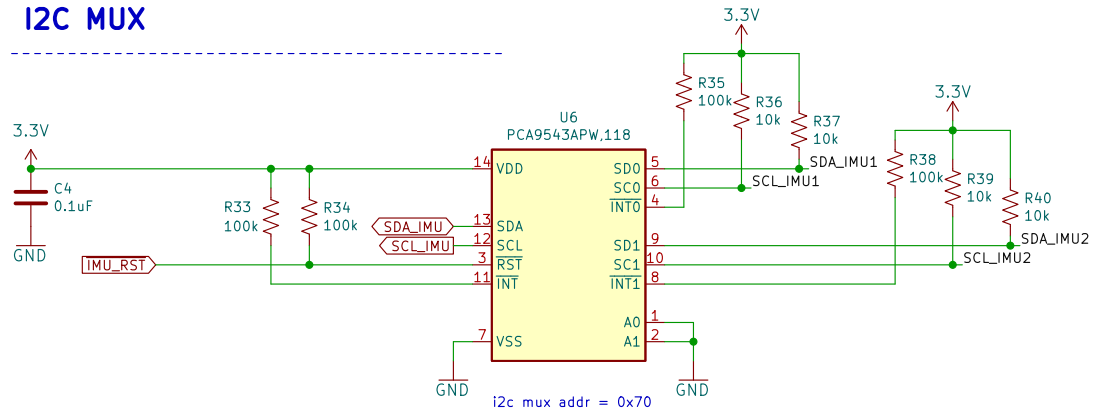
Size: A4	Date: 2021-06-09
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Size: A1	Date: 21/01/2025
KiCad E.D.A.	kicad (6.0.5)

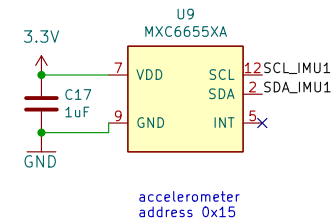
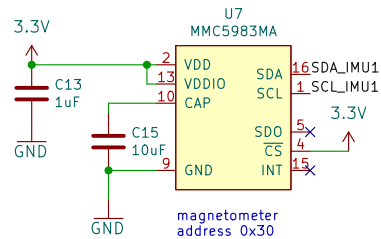
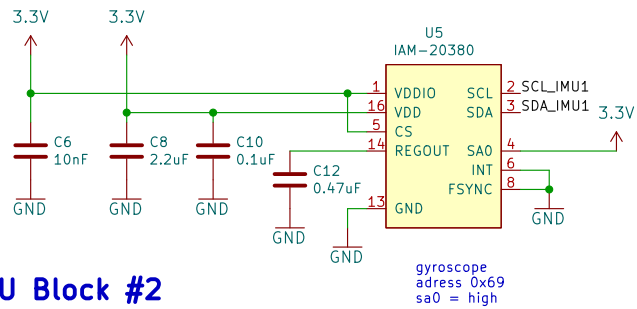
Rev: v05c

Id: 1/14

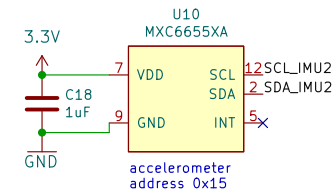
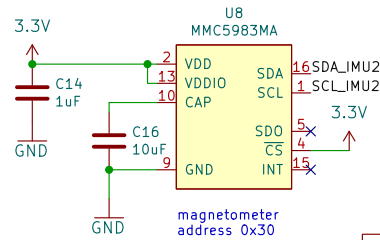
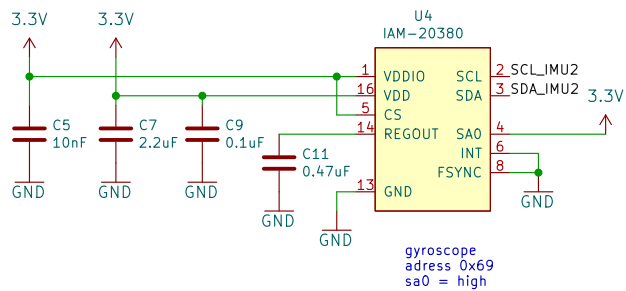
I2C MUX



IMU Block #1



IMU Block #2



Sierra Lobo INC.

Sheet: /Avionics/IMU/
File: IMU.kicad_sch

Title:

Size: A4

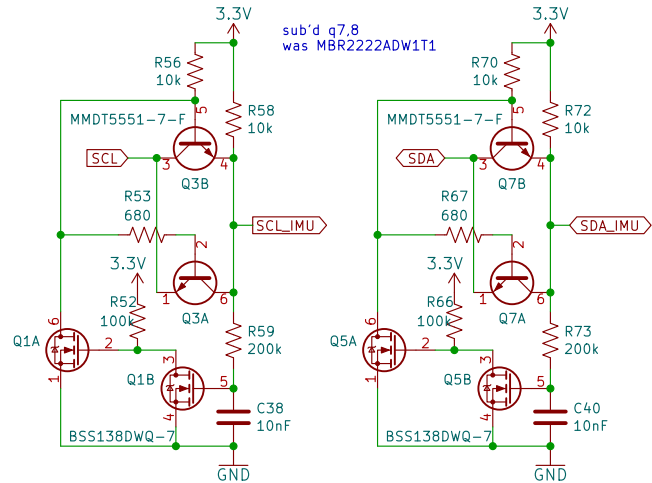
Date:

KiCad E.D.A. kicad (6.0.5)

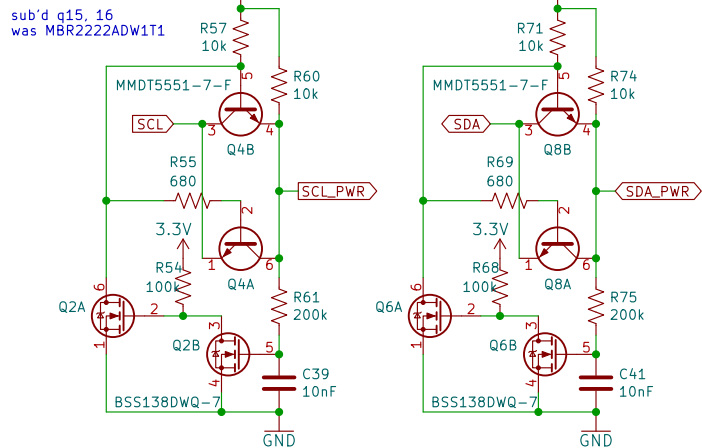
Rev:

Id: 2/14

I2C Bus Protection – IMU



I2C Bus Protection – Power Monitor & USB Charger



NOTE

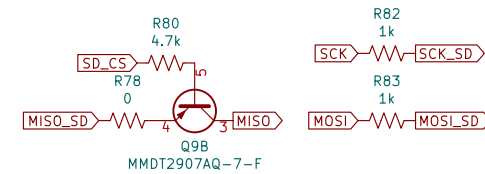
These novel bus protection circuits prevent traditional I2C/SPI failure modes where a single slave failure can disable the entire bus.

Learn more:
<https://doi.org/10.36227/techrxiv.15166620>

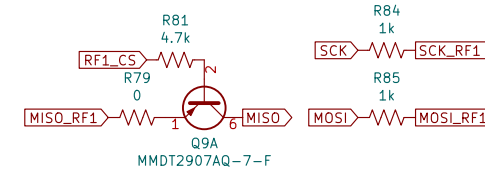
By default, slave clock and/or data lines can be held low and the Master (SAMD51) will still be able to communicate with the remainder of the bus.

They can individually be bypassed by removing the transistor(s) and soldering the 0ohm the jumpers below.

SPI Bus Protection – SD Card and Payloads



SPI Bus Protection – Radio 1



Bus Protection – Bypass Jumpers



NOTE: Components labeled "do not install" (DNI) are not populated by default

Bus Protection

Sierra Lobo INC.

Sheet: /Bus Protection/
File: Bus_Protection.kicad_sch

Title: PyCubed Mainboard

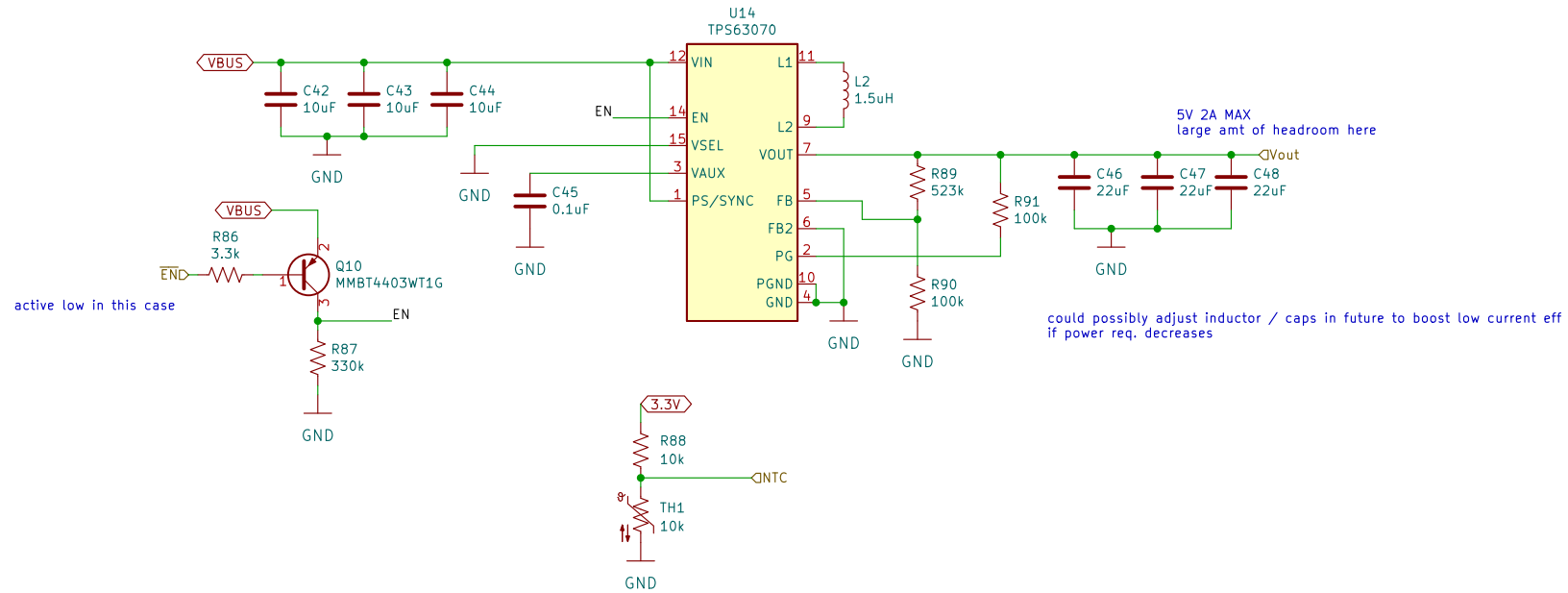
Size: A4 Date: 2021-06-09

KiCad E.D.A. kicad (6.0.5)

Rev: v05c

Id: 4/14

payload / rf regulator
based from TI WebBench Design



Sierra Lobo INC.

Sheet: /Power/5V Payload Regulator/
File: 5V_regulator.kicad_sch

Title:

Size: A4

Date:

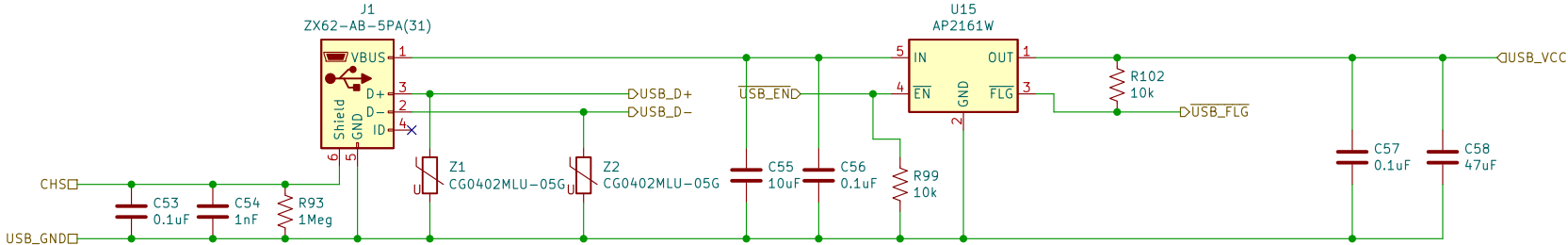
KiCad E.D.A. kicad (6.0.5)

Rev:

Id: 6/14

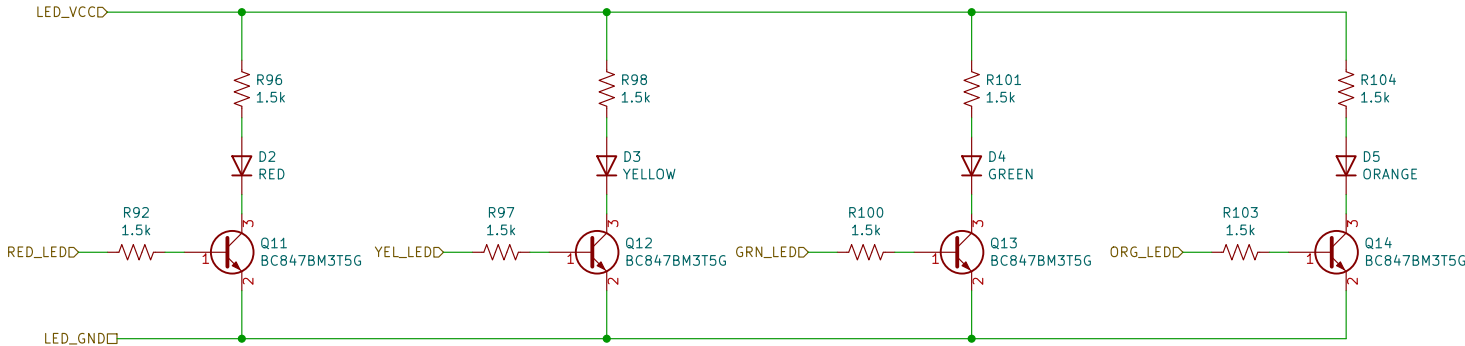
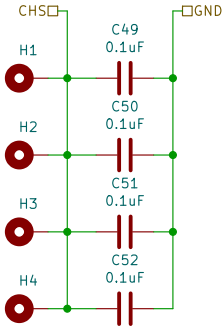
USB protection

U200 limits USB current to 1.5A (1A rec by mfr.)

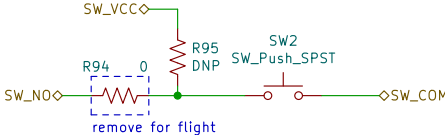


LEDs

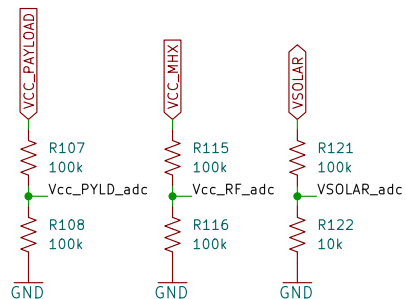
Mounting Holes



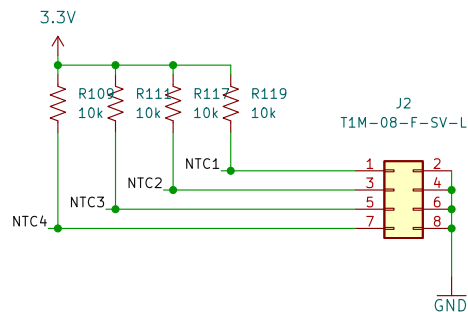
Switch



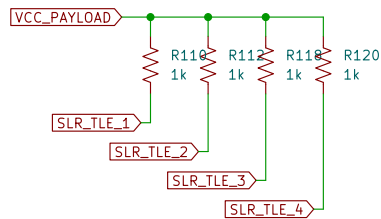
Sierra Lobo INC.		
Sheet: /Backplane Card Interface/ File: Blank-Card-Default.kicad_sch		
Title:		
Size: A4	Date:	Rev:
KiCad E.D.A. kicad (6.0.5)		Id: 7/14



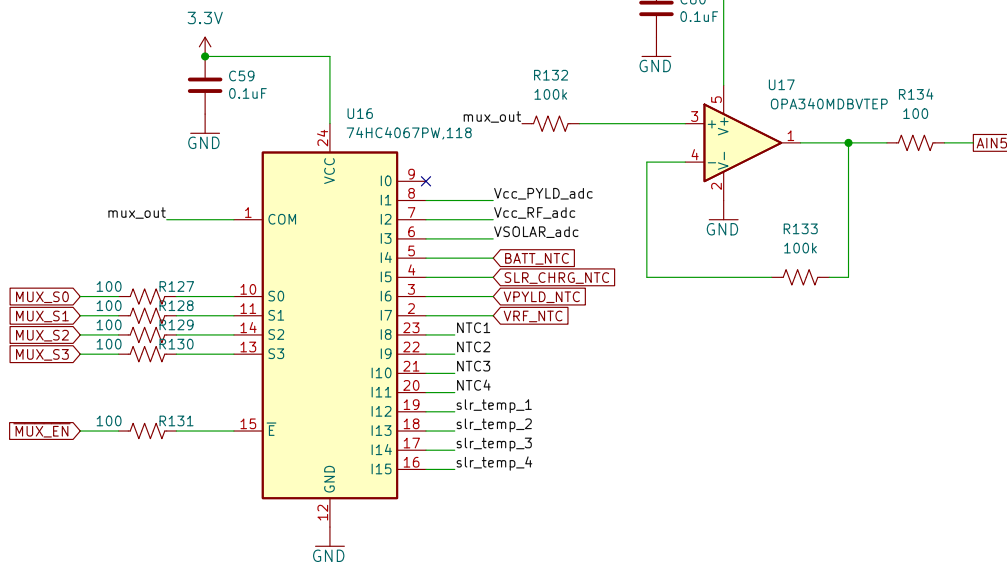
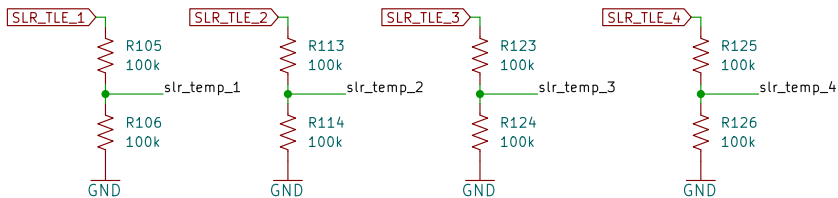
all analog signals have a max of 3.3V.
atdamd51 has a 12b adc



lm355a is rated to 100degC
arbitrarily selecting max temp sensed as 400K - 125C



really should have an op amp here but board space is already constrained



Sierra Lobo INC.

Sheet: /Avionics/ADC Mux/
File: analog_mux.kicad_sch

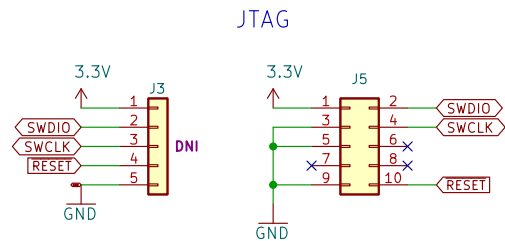
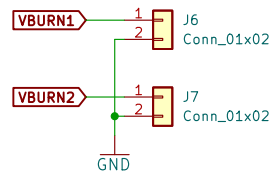
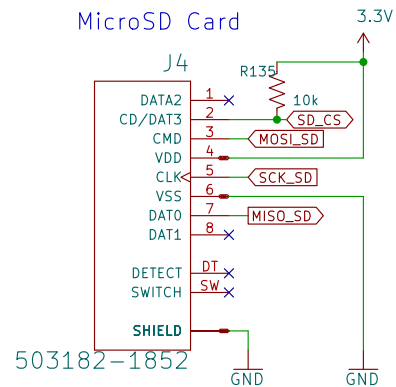
Title:

Size: A4
KiCad E.D.A. kicad (6.0.5)

Date:

Rev:

Id: 8/14



NOTE: Components labeled "do not install" (DNI) are not populated by default

Connectors

Sierra Lobo INC.

Sheet: /Connectors/

File: Connectors.kicad_sch

Title: PyCubed Mainboard

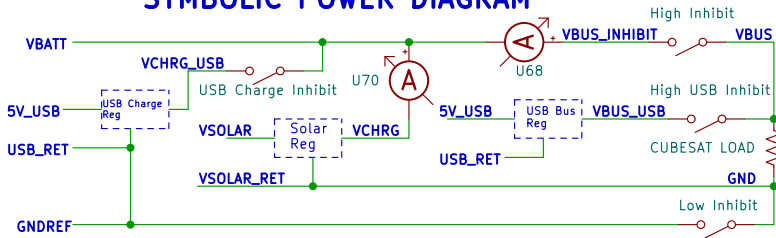
Size: A4 Date: 2021-06-09

KiCad E.D.A. kicad (6.0.5)

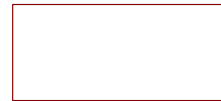
Rev: v05c

Id: 9/14

SYMBOLIC POWER DIAGRAM

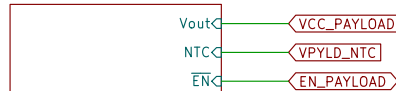


Inhibits



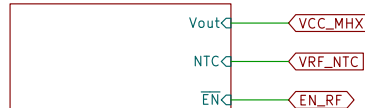
File: inhibits.kicad_sch

5V Payload Regulator



File: 5V_regulator.kicad_sch

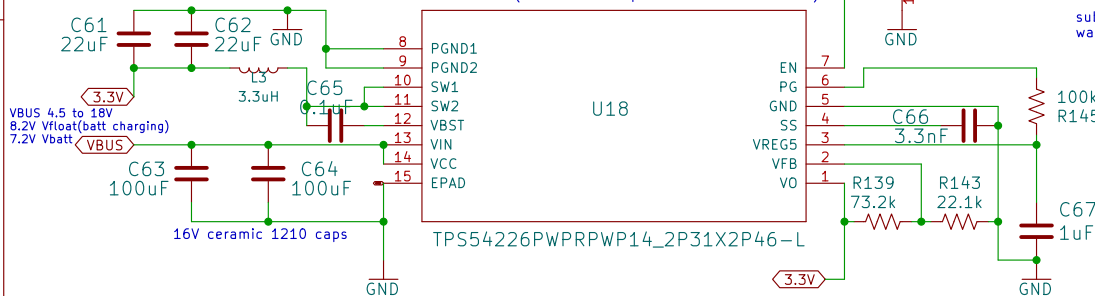
5V RF Regulator



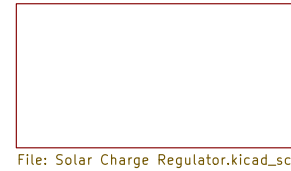
File: 5V_regulator.kicad_sch

Regulator - 3.3V OUT

-1.5A OCP (See datasheet p8 for more information.)

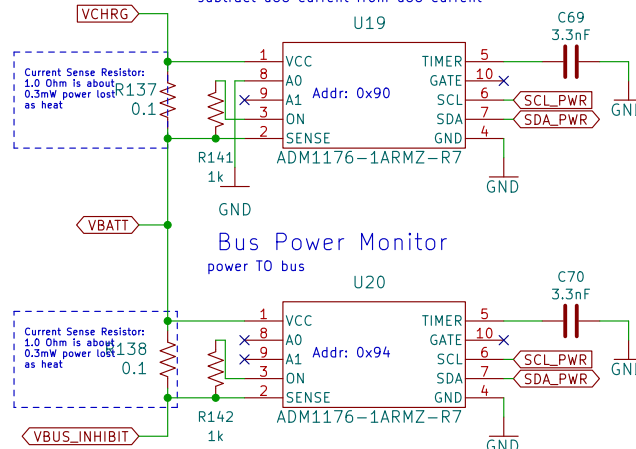


Solar Charge Regulator



Battery Charge Monitor

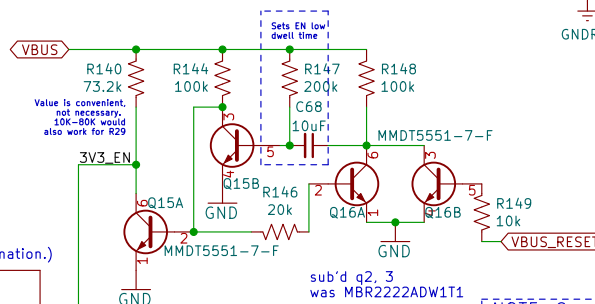
power TO battery node
to get battery charging current,
subtract u68 current from u68 current



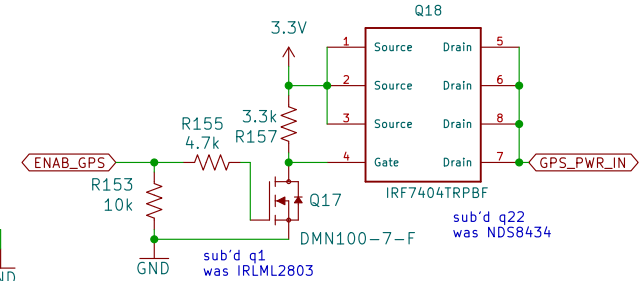
Bus Power Monitor

power TO bus

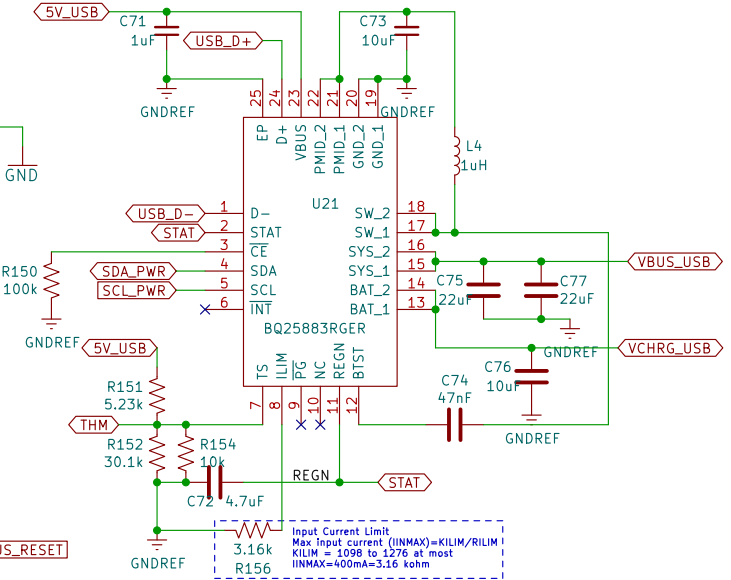
"One Shot" Regulator Reset



GPS Power Switch



USB (Boost) Charging for 2-cell Li-Ion



[NOTE: Components labeled "do not install" (DNI) are not populated by default]

Power

Sierra Lobo INC.

Sheet: /Power/
File: Power.kicad_sch

Title: PyCubed Mainboard

Size: A4

Date: 2021-06-09

KiCad E.D.A. kicad (6.0.5)

Rev: v05c

Id: 10/14

OUTPUT:
8.4Vfloat, 1.4A, 12W
adjust feedback divider for lower/higher float voltage.
Vfloat must be $\geq V_{in}+1$ due to buck topology

```
| Input:
| 2x3U Pumpkin Cells in parallel (7 series cells)
| Vdc = 17.5V
| cell BOL Vpp = 2.405V
| BOL Vpp = 16.835V
| RIN1/RIN2 = (16.825/2.7)-1 = 5.23
| RIN1 = 267k
| VINMIN actual = XXX
```

$r_{sense} = 0.1/(ichg_{max})$

C82 1uF
 SBRT5A50SA-13 D8
 1S5400T1G D7
 L5 22uH
 R163 0.068
 C83 10uF
 C84 10uF
 C85 100uF
 R165 634k
 R166 412k
 R164 412k
 VCHRG
 GND

$IDIODE(MAX) > ICHG(MAX) \cdot (VIN(MAX) - 0.7 \cdot v_{float}) / VIN(MAX) \text{ (A)}$
 $> 1.5 \cdot (34 - 0.7 \cdot 8.4) / 32$
 $> 1.42 \text{ A (20\% derate)}$

$RFB1 = (VBAT(FLT) \cdot 2.5 \cdot 10^5) / 3.3$
 $= 8.4 \cdot 2.5 \cdot 10^5 / 3.3 = 636.36k$

$RFB2 = (RFB1 \cdot (2.5 \cdot 10^5)) / (RFB1 - (2.5 \cdot 10^5))$
 $= 636360 \cdot 2.5 \cdot 10^5 / (636360 - (2.5 \cdot 10^5))$
 $= 411.77k$

Rev:
Id: 11/14



Sierra Lobo INC.

Sheet: /Burn Wires/
File: Burn_Wires.kicad_sch

Title: PyCubed Mainboard

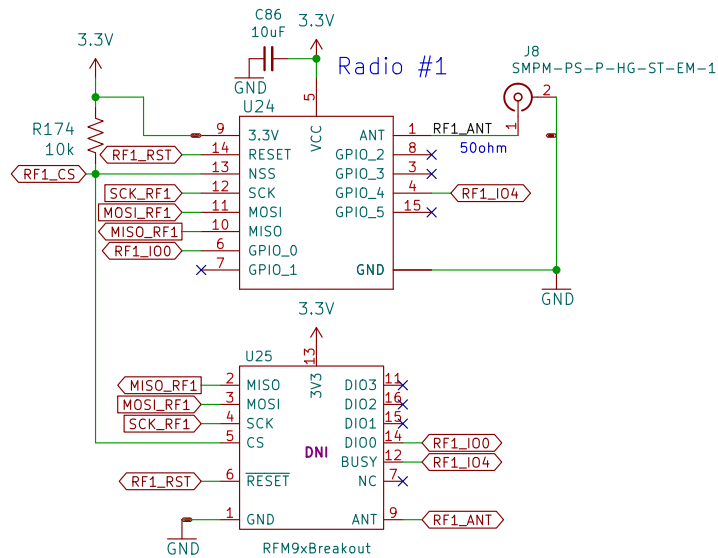
Size: A4	Date: 2021-06-09
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Size: A4	Date: 20
KiCad E.D.A.	kicad (6.0.5)

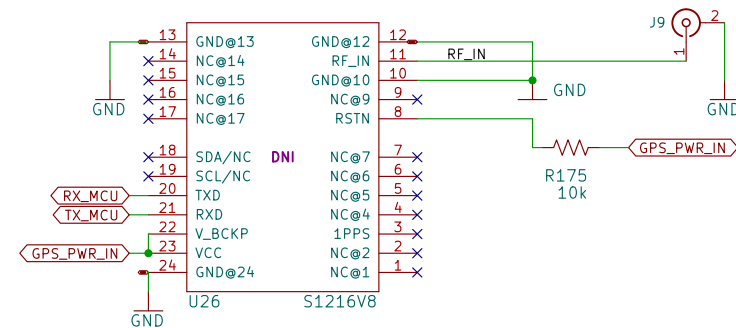
Rev: v05c

Id: 12/14

Modular Radios (HopeRF format)



GPS Module



NOTE: Components labeled "do not install" (DNI) are not populated by default

Radio, GPS, Payloads

Sierra Lobo INC.

Sheet: /RF and GPS/

File: RF_and_GPS.kicad_sch

Title: PyCubed Mainboard

Size: A4 Date: 2021-06-09

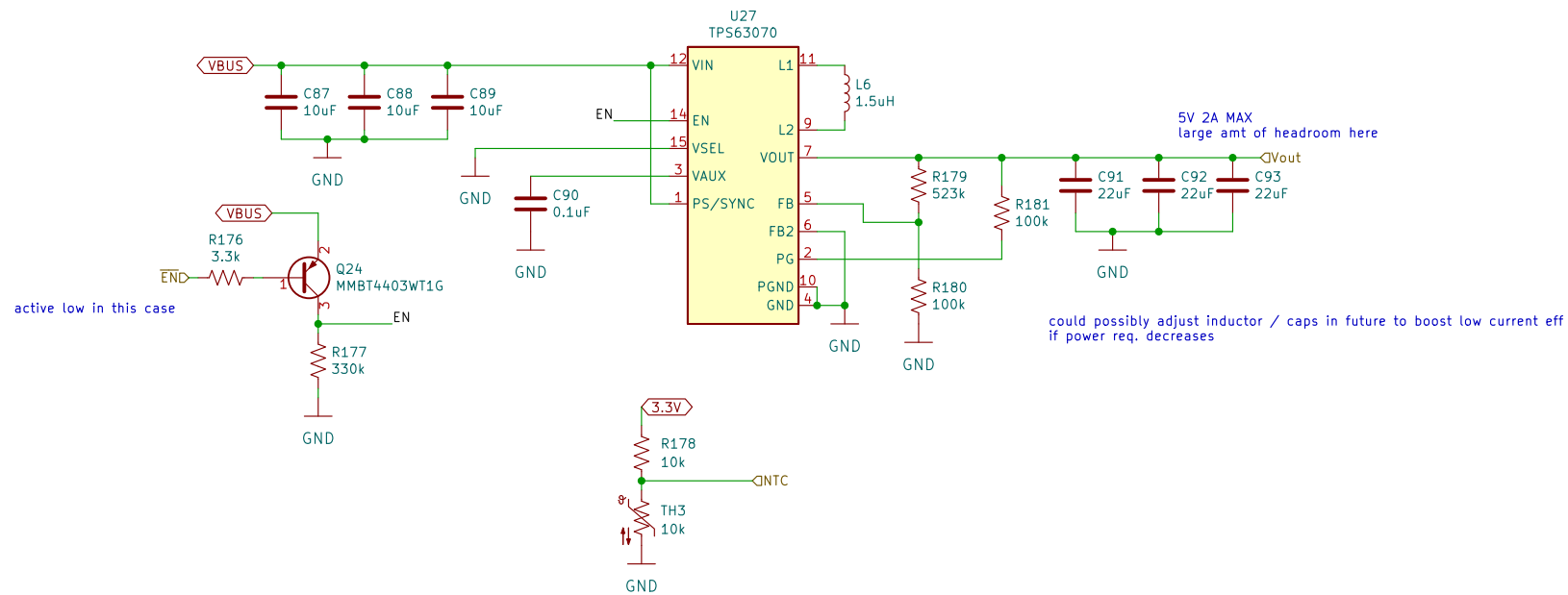
KiCad E.D.A. kicad (6.0.5)

Rev: v05c

Id: 13/14

1 2 3 4 5 6

payload / rf regulator
based from TI WebBench Design



Sierra Lobo INC.

Sheet: /Power/5V RF Regulator/
File: 5V_regulator.kicad_sch

Title:

Size: A4

Date:

KiCad E.D.A. kicad (6.0.5)

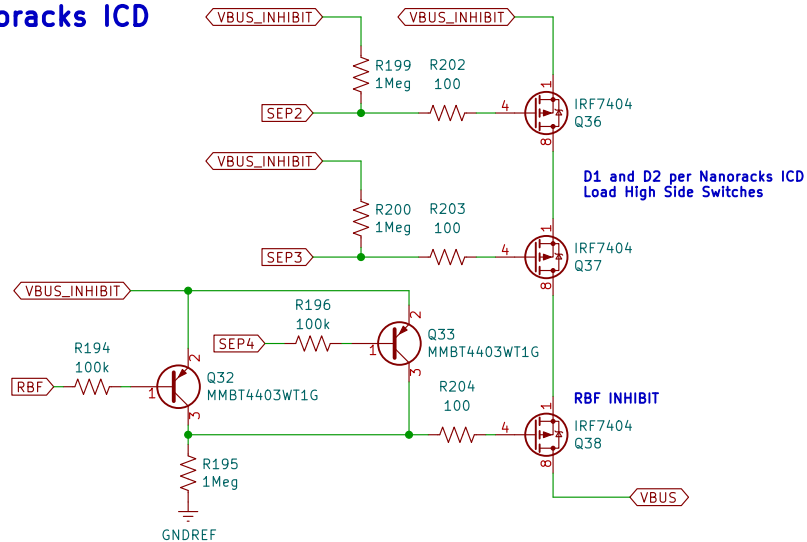
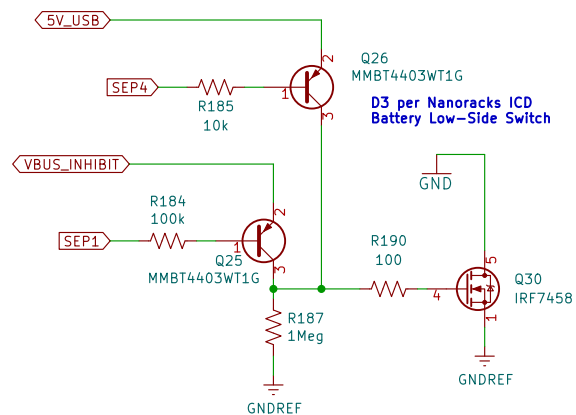
Rev:

Id: 15/14

1 2 3 4 5 6

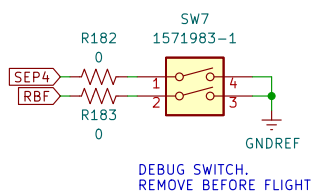
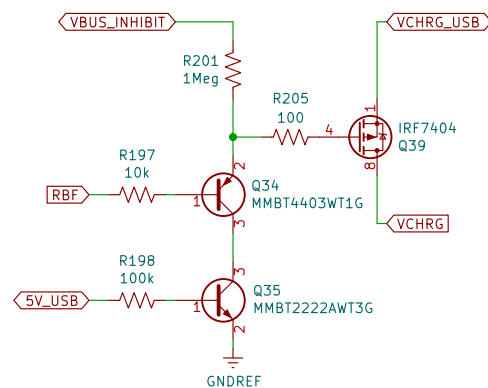
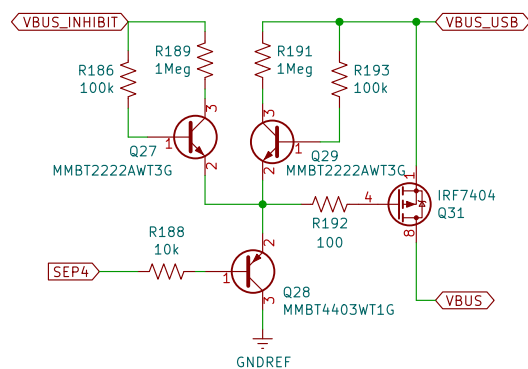
Electrical Inhibits and RBF per Nanoracks ICD

See inhibit_states.xlsx under /design



USB Charge / Debug Inhibits

See inhibit_states.xlsx under /design



Sierra Lobo INC.

Sheet: /Power/Inhibits/
File: inhibits.kicad_sch

Title:

Size: A4

Date:

KiCad E.D.A. kicad (6.0.5)

Rev:

Id: 15/14