Avionics

File: Avionics.kicad_sch

Connectors

File: Connectors.kicad_sch

Power

File: Power.kicad_sch

Burn Wires

File: Burn_Wires.kicad_sch

RF

File: RF_and_GPS.kicad_sch

Bus Protection

File: Bus_Protection.kicad_sch

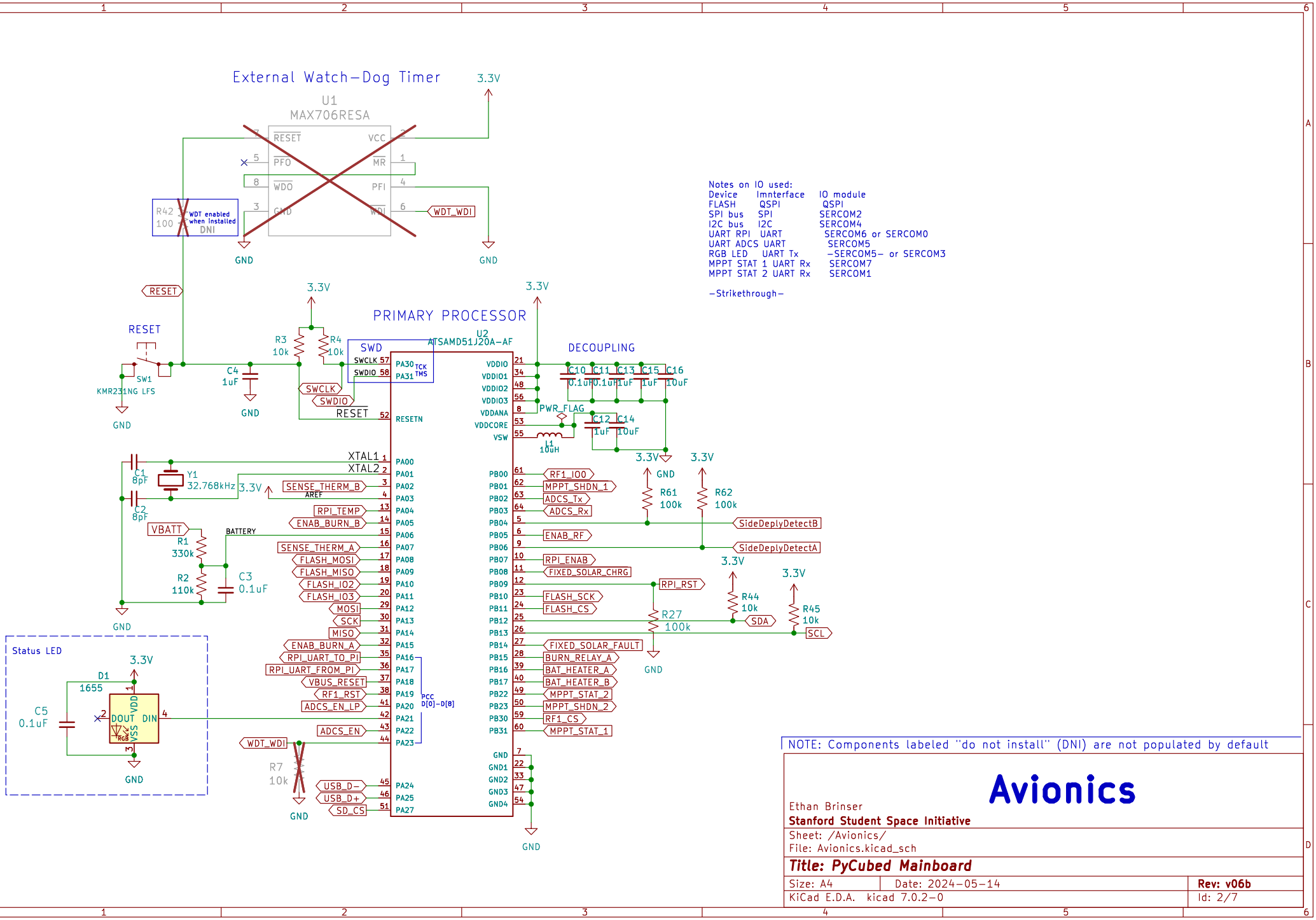
Ethan Brinser
Stanford Student Space Initiative

PyCubed

Sheet: /
File: mainboard.kicad_sch

Title: PyCubed Mainboard

Size: A4	Date: 2024-05-14	**Rev: v06b**
KiCad E.D.A. kicad 7.0.2-0		Id: 1/7

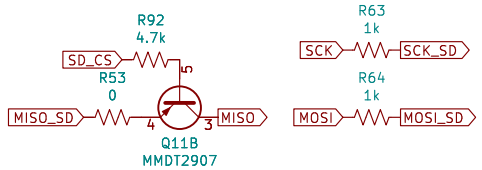


Notes on IO used:

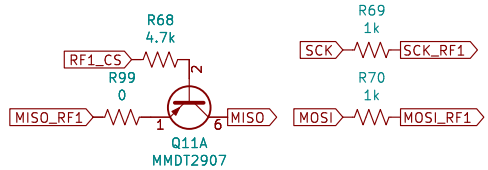
Device	Imnterface	IO module
FLASH	QSPI	QSPI
SPI bus	SPI	SERCOM2
I2C bus	I2C	SERCOM4
UART RPI	UART	SERCOM6 or SERCOM0
UART ADCS	UART	SERCOM5
RGB LED	UART Tx	~~SERCOM5~~ or SERCOM3
MPPT STAT 1	UART Rx	SERCOM7
MPPT STAT 2	UART Rx	SERCOM1

~~Strikethrough~~

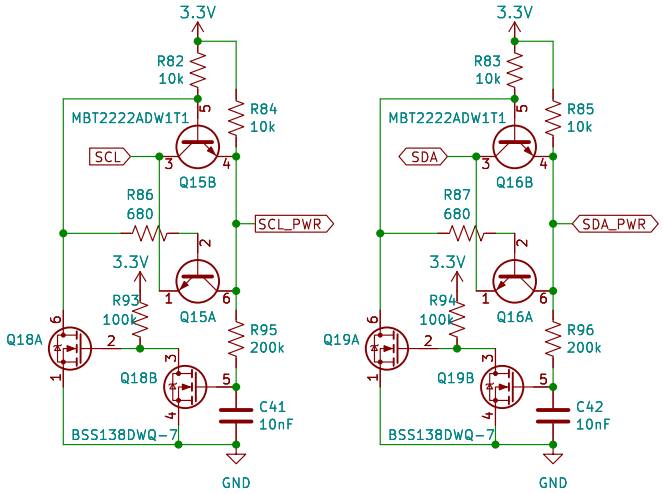
SPI Bus Protection – SD Card and Payloads



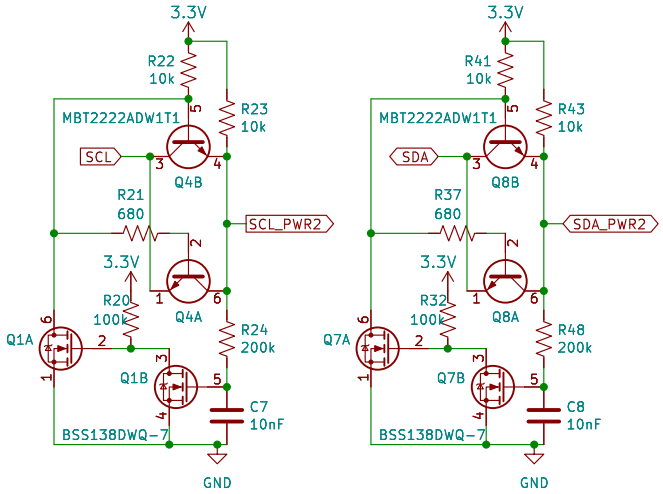
SPI Bus Protection – Radio 1



I2C Bus Protection – Power Monitor



I2C Bus Protection – MPPT Status & USB Charger



NOTE

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

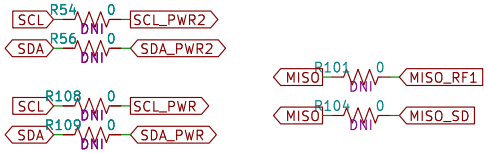
Learn more:
https://doi.org/10.36227/techrxiv.15166620

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.

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

Bus Protection – Bypass Jumpers



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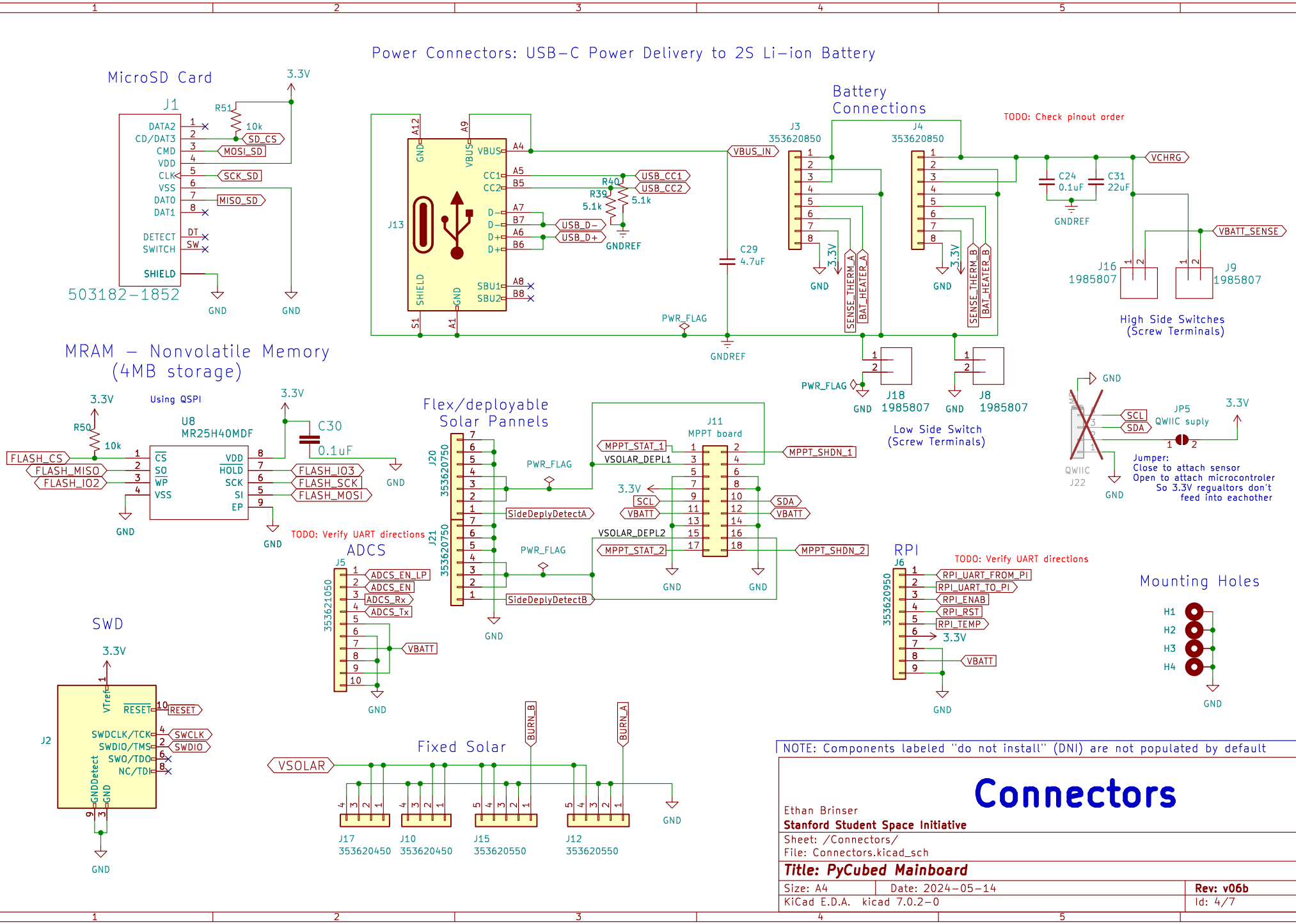
Stanford Student Space Initiative

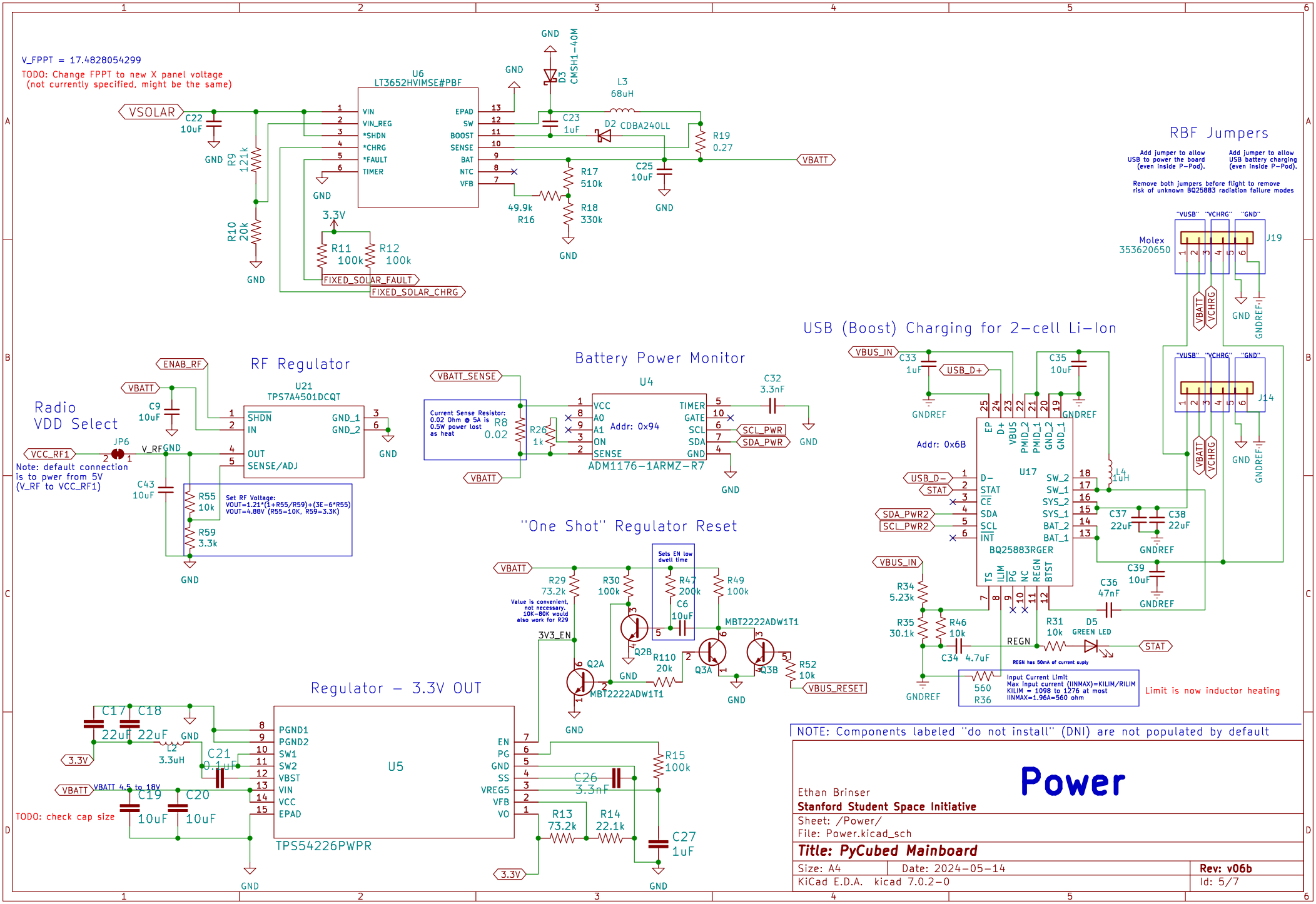
Bus Protection

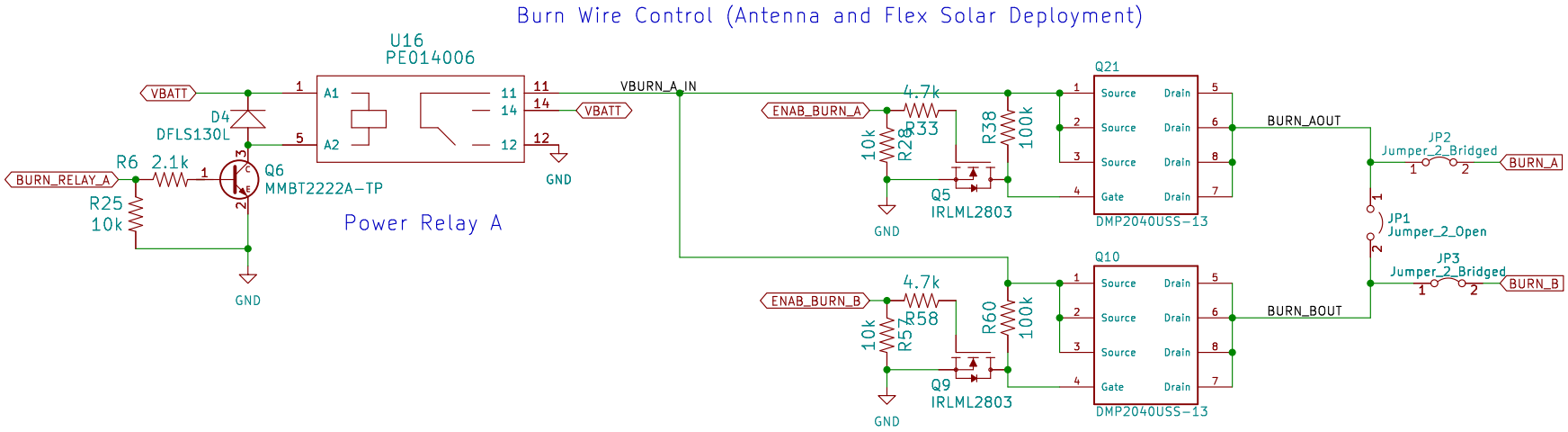
Sheet: /Bus Protection/
File: Bus_Protection.kicad_sch

Title: PyCubed Mainboard

Size: A4	Date: 2024-05-14	**Rev: v06b**
KiCad E.D.A. kicad 7.0.2-0		Id: 3/7


Power Connectors: USB-C Power Delivery to 2S Li-ion Battery
MicroSD Card
J1
503182-1852
DATA2
CD/DAT3
CMD
VDD
CLK
VSS
DAT0
DAT1
DETECT SWITCH
SHIELD
R51
10k
SD_CS
MOSI_SD
SCK_SD
MISO_SD
DT
SW
3.3V
GND
J13
VBUS
CC1
CC2
D-
D+
SBU1
SBU2
SHIELD
R40
R39
5.1k
USB_CC1
USB_CC2
USB_D-
USB_D+
GNDREF
C29
4.7uF
VBUS_IN
PWR_FLAG
Battery Connections
J3
353620850
J4
353620850
TODO: Check pinout order
SENSE_THERM_A
BAT_HEATER_A
SENSE_THERM_B
BAT_HEATER_B
C24
0.1uF
C31
22uF
VCHRG
VBATT_SENSE
J16
1985807
J9
1985807
High Side Switches
(Screw Terminals)
J18
1985807
J8
1985807
Low Side Switch
(Screw Terminals)
MRAM - Nonvolatile Memory
(4MB storage)
Using QSPI
U8
MR25H40MDF
R50
10k
C30
0.1uF
FLASH_CS
FLASH_MISO
FLASH_IO2
FLASH_IO3
FLASH_SCK
FLASH_MOSI
CS
SO
WP
VSS
VDD
HOLD
SCK
SI
EP
TODO: Verify UART directions
Flex/deployable
Solar Pannels
J20
353620750
J21
353620750
PWR_FLAG
SideDeplyDetectA
SideDeplyDetectB
J11
MPPT board
MPPT_STAT_1
VSOLAR_DEPL1
VSOLAR_DEPL2
MPPT_STAT_2
MPPT_SHDN_1
MPPT_SHDN_2
SCL
SDA
VBATT
ADCS
J5
353621050
ADCS_EN_LP
ADCS_EN
ADCS_Rx
ADCS_Tx
RPI
J6
353620950
TODO: Verify UART directions
RPI_UART_FROM_PI
RPI_UART_TO_PI
RPI_ENAB
RPI_RST
RPI_TEMP
QWIIC
J22
JP5
QWIIC suply
Jumper:
Close to attach sensor
Open to attach microcontroler
So 3.3V regualtors don't
feed into eachother
Mounting Holes
H1
H2
H3
H4
SWD
J2
VTref
RESET
SWDCLK/TCK
SWDIO/TMS
SWO/TDO
NC/TDI
GNDDetect
SWCLK
SWDIO
Fixed Solar
VSOLAR
BURN_B
BURN_A
J17
353620450
J10
353620450
J15
353620550
J12
353620550
NOTE: Components labeled "do not install" (DNI) are not populated by default
Connectors
Ethan Brinser
Stanford Student Space Initiative
Sheet: /Connectors/
File: Connectors.kicad_sch
Title: PyCubed Mainboard
Size: A4
Date: 2024-05-14
Rev: v06b
KiCad E.D.A. kicad 7.0.2-0
Id: 4/7


V_FPPT = 17.4828054299
TODO: Change FPPT to new X panel voltage
(not currently specified, might be the same)
U6
LT3652HVIMSE#PBF
VSOLAR
C22
10uF
R9
121k
R10
20k
VIN
VIN_REG
*SHDN
*CHRG
*FAULT
TIMER
EPAD
SW
BOOST
SENSE
BAT
NTC
VFB
D3
CMSH1-40M
L3
68uH
D2 CDBA240LL
C23
1uF
R19
0.27
VBATT
C25
10uF
R17
510k
R18
330k
49.9k
R16
3.3V
R11
100k
R12
100k
FIXED_SOLAR_FAULT
FIXED_SOLAR_CHRG
GND
RBF Jumpers
Add jumper to allow USB to power the board (even inside P-Pod).
Add jumper to allow USB battery charging (even inside P-Pod).
Remove both jumpers before flight to remove risk of unknown BQ25883 radiation failure modes
Molex
353620650
J19
"VUSB"
"VCHRG"
"GND"
VBATT
VCHRG
GNDREF
RF Regulator
U21
TPS7A4501DCQT
ENAB_RF
VBATT
C9
10uF
SHDN
IN
OUT
SENSE/ADJ
GND_1
GND_2
Radio
VDD Select
VCC_RF1
JP6
V_RF
Note: default connection is to pwer from 5V (V_RF to VCC_RF1)
C43
10uF
R55
10k
R59
3.3k
Set RF Voltage:
VOUT=1.21*(1+R55/R59)+(3E-6*R55)
VOUT=4.88V (R55=10K, R59=3.3K)
Battery Power Monitor
U4
VBATT_SENSE
Current Sense Resistor:
0.02 Ohm @ 5A is 0.5W power lost as heat
R8
0.02
R26
1k
VCC
A0
A1
ON
SENSE
Addr: 0x94
ADM1176-1ARMZ-R7
TIMER
GATE
SCL
SDA
GND
C32
3.3nF
SCL_PWR
SDA_PWR
USB (Boost) Charging for 2-cell Li-Ion
VBUS_IN
C33
1uF
USB_D+
C35
10uF
Addr: 0x6B
U17
BQ25883RGER
EP
D+
VBUS
PMID_2
PMID_1
GND_2
GND_1
D-
STAT
CE
SDA
SCL
INT
SW_2
SW_1
SYS_2
SYS_1
BAT_2
BAT_1
TS
ILIM
PG
NC
REGN
BTST
L4
1uH
C37
22uF
C38
22uF
C39
10uF
C36
47nF
R34
5.23k
R35
30.1k
R46
10k
C34
4.7uF
R31
10k
D5
GREEN LED
REGN
STAT
REGN has 50mA of current suply
Input Current Limit
Max Input current (IINMAX)=KILIM/RILIM
KILIM = 1098 to 1276 at most
IINMAX=1.96A=560 ohm
560
R36
Limit is now inductor heating
J14
"One Shot" Regulator Reset
Sets EN low dwell time
R29
73.2k
R30
100k
R47
200k
R49
100k
C6
10uF
Value is convenient, not necessary. 10K-80K would also work for R29
3V3_EN
Q2B
Q2A
MBT2222ADW1T1
R110
20k
Q3A
Q3B
R52
10k
VBUS_RESET
Regulator - 3.3V OUT
U5
TPS54226PWPR
C17
22uF
C18
22uF
L2
3.3uH
C21
0.1uF
C19
10uF
C20
10uF
VBATT 4.5 to 18V
TODO: check cap size
PGND1
PGND2
SW1
SW2
VBST
VIN
VCC
EPAD
EN
PG
SS
VREG5
VFB
VO
C26
3.3nF
R15
100k
R13
73.2k
R14
22.1k
C27
1uF
NOTE: Components labeled "do not install" (DNI) are not populated by default
Power
Ethan Brinser
Stanford Student Space Initiative
Sheet: /Power/
File: Power.kicad_sch
Title: PyCubed Mainboard
Size: A4
Date: 2024-05-14
Rev: v06b
KiCad E.D.A. kicad 7.0.2-0
Id: 5/7



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

Burn Wires

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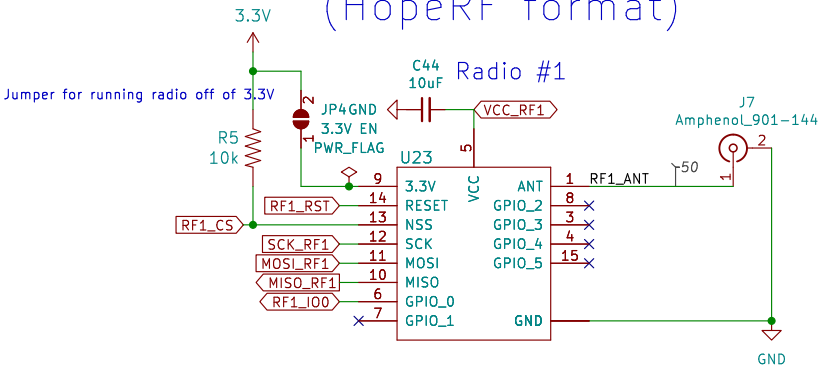
Stanford Student Space Initiative

Sheet: /Burn Wires/
File: Burn_Wires.kicad_sch

Title: PyCubed Mainboard

Size: A4	Date: 2024-05-14	**Rev: v06b**
KiCad E.D.A. kicad 7.0.2-0		Id: 6/7

Modular Radio (HopeRF format)



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

Radio, GPS, Payloads

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Stanford Student Space Initiative

Sheet: /RF/
File: RF_and_GPS.kicad_sch

Title: PyCubed Mainboard

Size: A4	Date: 2024-05-14	**Rev: v06b**
KiCad E.D.A. kicad 7.0.2-0		Id: 7/7