Avionics

File: Avionics.kicad_sch

Connectors

File: Connectors.kicad_sch

Power

File: Power.kicad_sch

Burn Wires

File: Burn_Wires.kicad_sch

RF and GPS

File: RF_and_GPS.kicad_sch

Bus Protection

File: Bus_Protection.kicad_sch

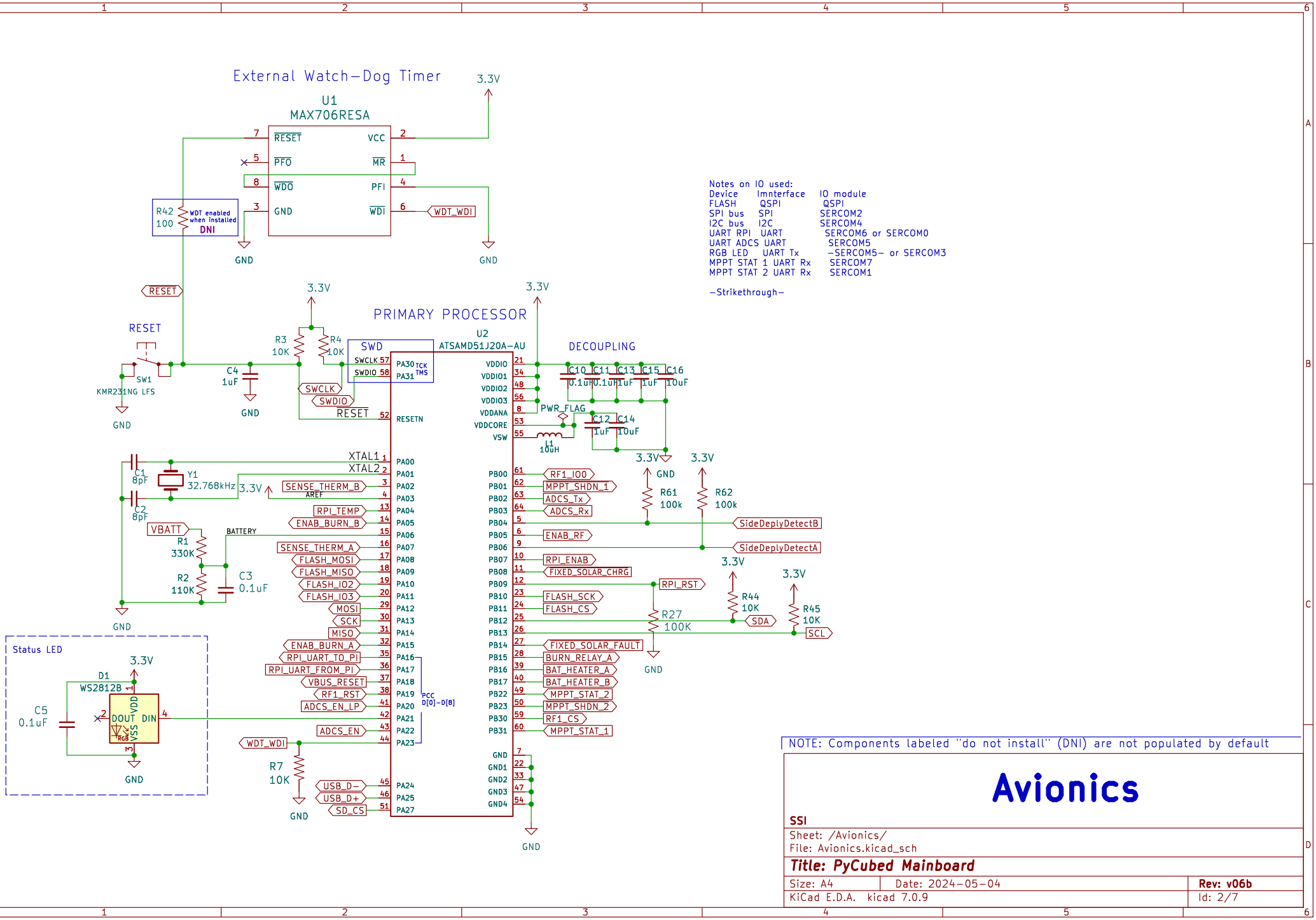
PyCubed

SSI

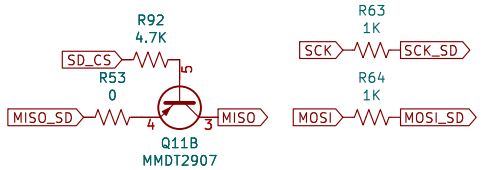
Sheet: /
File: mainboard.kicad_sch

Title: PyCubed Mainboard

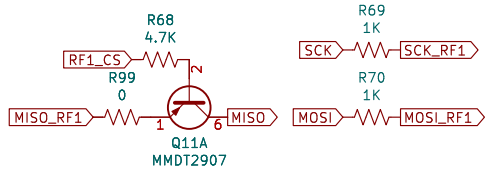
Size: A4	Date: 2024-05-04	**Rev: v06b**
KiCad E.D.A. kicad 7.0.9		Id: 1/7


External Watch-Dog Timer
U1
MAX706RESA
RESET
PFO
WDO
GND
VCC
MR
PFI
WDI
WDT_WDI
R42
100
WDT enabled when installed
DNI
3.3V
GND
PRIMARY PROCESSOR
U2
ATSAMD51J20A-AU
SWD
SWCLK
SWDIO
RESET
R3
10K
R4
10K
C4
1uF
SW1
KMR231NG LFS
DECOUPLING
VDDIO
VDDIO1
VDDIO2
VDDIO3
VDDANA
VDDCORE
VSW
PWR_FLAG
L1
10uH
C10
0.1uF
C11
0.1uF
C13
1uF
C15
1uF
C16
10uF
C12
1uF
C14
10uF
XTAL1
XTAL2
Y1
32.768kHz
C1
8pF
C2
8pF
AREF
C3
0.1uF
VBATT
BATTERY
R1
330K
R2
110K
RESETN
PA00
PA01
PA02
PA03
PA04
PA05
PA06
PA07
PA08
PA09
PA10
PA11
PA12
PA13
PA14
PA15
PA16
PA17
PA18
PA19
PA20
PA21
PA22
PA23
PA24
PA25
PA27
PB00
PB01
PB02
PB03
PB04
PB05
PB06
PB07
PB08
PB09
PB10
PB11
PB12
PB13
PB14
PB15
PB16
PB17
PB22
PB23
PB30
PB31
GND
GND1
GND2
GND3
GND4
SENSE_THERM_B
RPI_TEMP
ENAB_BURN_B
SENSE_THERM_A
FLASH_MOSI
FLASH_MISO
FLASH_IO2
FLASH_IO3
MOSI
SCK
MISO
ENAB_BURN_A
RPI_UART_TO_PI
RPI_UART_FROM_PI
VBUS_RESET
RF1_RST
ADCS_EN_LP
ADCS_EN
WDT_WDI
R7
10K
USB_D-
USB_D+
SD_CS
PCC D[0]-D[8]
RF1_IO0
MPPT_SHDN_1
ADCS_Tx
ADCS_Rx
ENAB_RF
RPI_ENAB
FIXED_SOLAR_CHRG
FLASH_SCK
FLASH_CS
FIXED_SOLAR_FAULT
BURN_RELAY_A
BAT_HEATER_A
BAT_HEATER_B
MPPT_STAT_2
MPPT_SHDN_2
RF1_CS
MPPT_STAT_1
R61
100k
R62
100k
SideDeplyDetectB
SideDeplyDetectA
RPI_RST
R27
100K
R44
10K
R45
10K
SDA
SCL
Status LED
D1
WS2812B
C5
0.1uF
DOUT
DIN
VDD
VSS
RGB
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-
NOTE: Components labeled "do not install" (DNI) are not populated by default
Avionics
SSI
Sheet: /Avionics/
File: Avionics.kicad_sch
Title: PyCubed Mainboard
Size: A4
Date: 2024-05-04
Rev: v06b
KiCad E.D.A. kicad 7.0.9
Id: 2/7

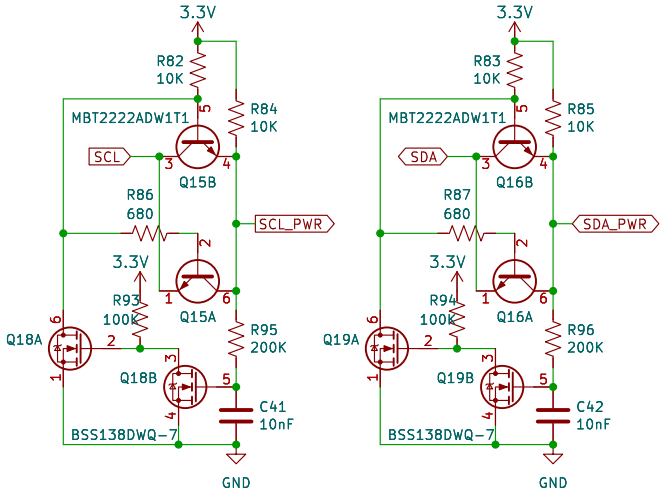
SPI Bus Protection – SD Card and Payloads



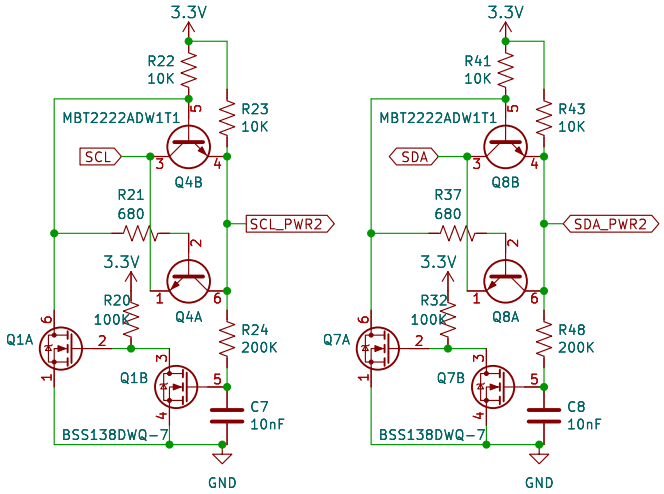
SPI Bus Protection – Radio 1



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.

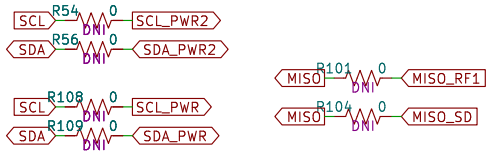
Learn more:
https://doi.org/10.36227/techrxiv.15166620

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



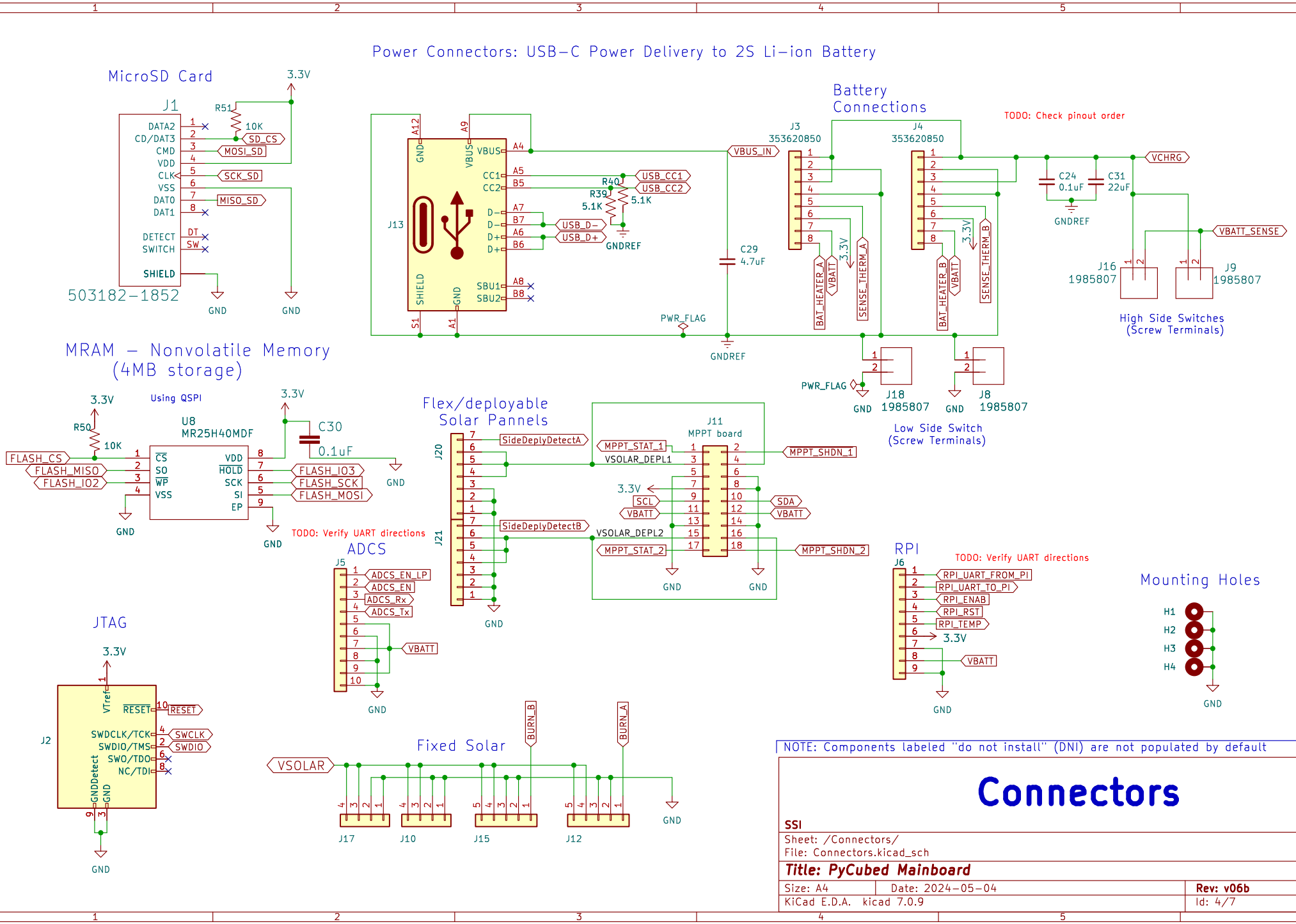
Bus Protection

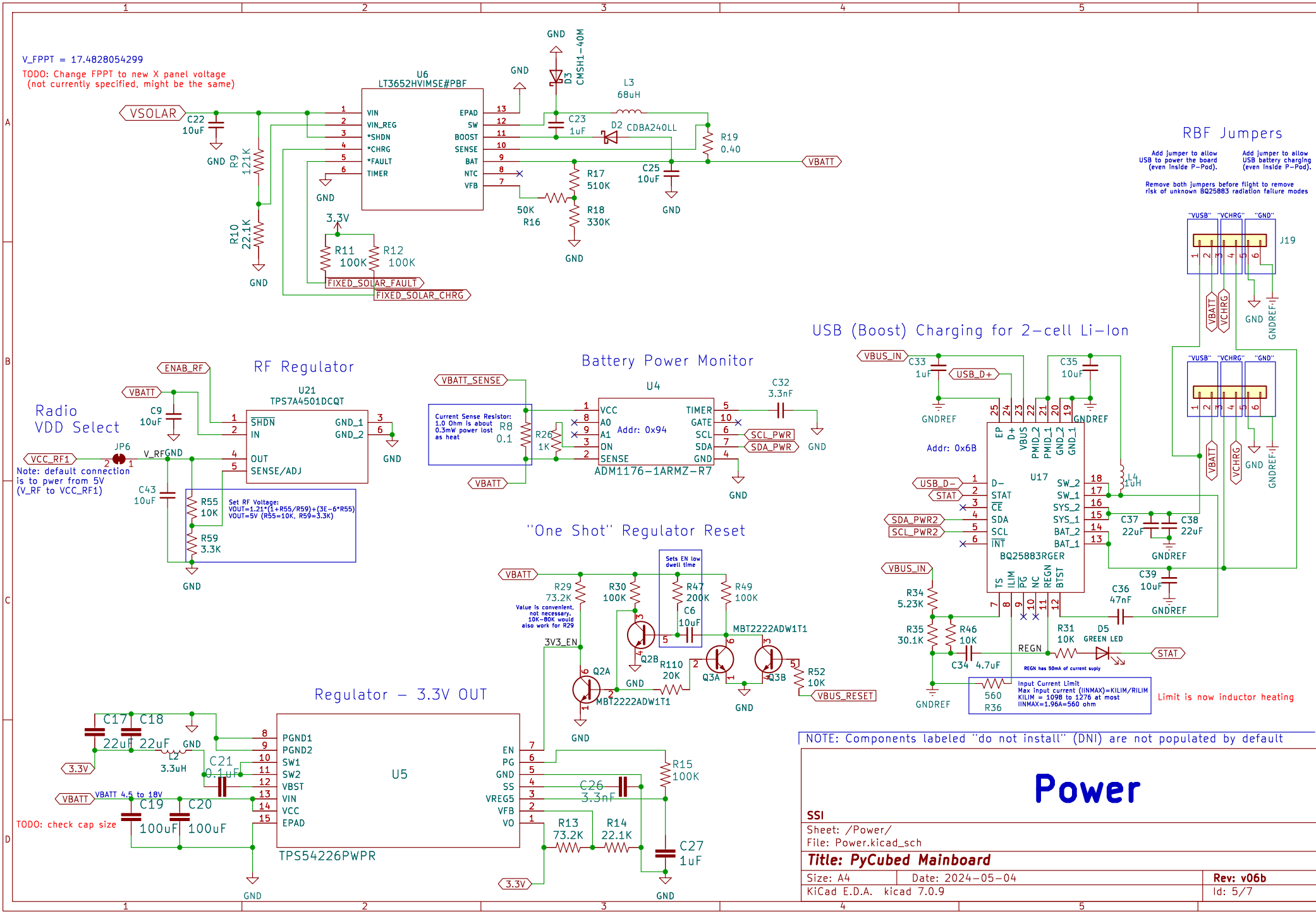
SSI

Sheet: /Bus Protection/
File: Bus_Protection.kicad_sch

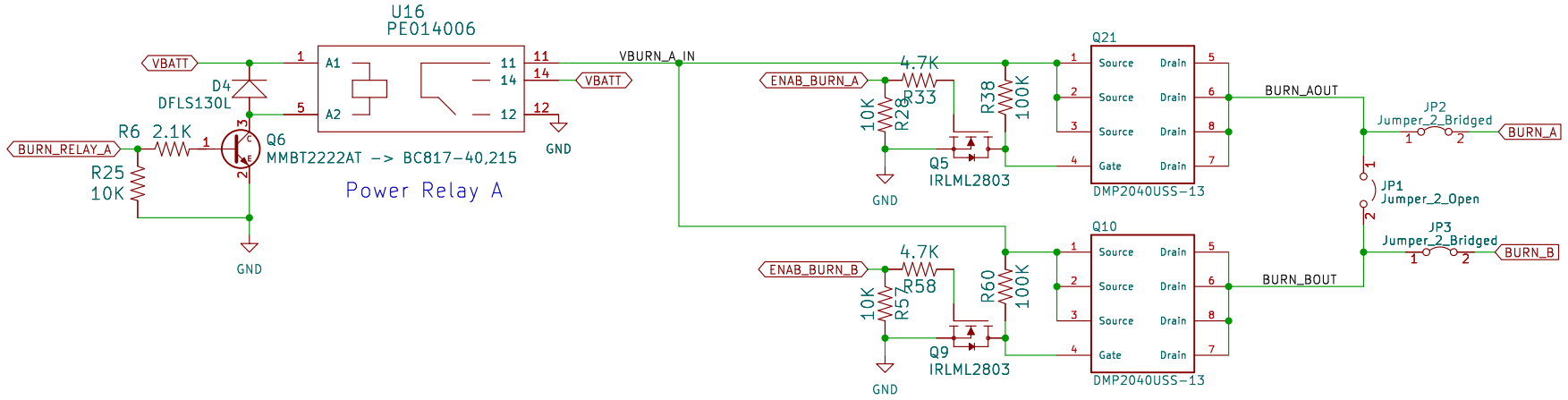
Title: PyCubed Mainboard

Size: A4	Date: 2024-05-04	**Rev: v06b**
KiCad E.D.A. kicad 7.0.9		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
VBUS_IN
C29
4.7uF
PWR_FLAG
Battery Connections
J3
353620850
J4
353620850
TODO: Check pinout order
BAT_HEATER_A
VBATT
SENSE_THERM_A
BAT_HEATER_B
SENSE_THERM_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
FLASH_CS
FLASH_MISO
FLASH_IO2
FLASH_IO3
FLASH_SCK
FLASH_MOSI
C30
0.1uF
TODO: Verify UART directions
Flex/deployable
Solar Pannels
J20
J21
SideDeplyDetectA
SideDeplyDetectB
J11
MPPT board
MPPT_STAT_1
VSOLAR_DEPL1
VSOLAR_DEPL2
MPPT_STAT_2
MPPT_SHDN_1
MPPT_SHDN_2
SCL
SDA
ADCS
J5
ADCS_EN_LP
ADCS_EN
ADCS_Rx
ADCS_Tx
RPI
J6
TODO: Verify UART directions
RPI_UART_FROM_PI
RPI_UART_TO_PI
RPI_ENAB
RPI_RST
RPI_TEMP
Mounting Holes
H1
H2
H3
H4
JTAG
J2
VTref
RESET
SWDCLK/TCK
SWDIO/TMS
SWO/TDO
NC/TDI
GNDDetect
SWCLK
SWDIO
Fixed Solar
VSOLAR
BURN_B
BURN_A
J17
J10
J15
J12
NOTE: Components labeled "do not install" (DNI) are not populated by default
Connectors
SSI
Sheet: /Connectors/
File: Connectors.kicad_sch
Title: PyCubed Mainboard
Size: A4
Date: 2024-05-04
Rev: v06b
KiCad E.D.A. kicad 7.0.9
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
22.1K
VIN
VIN_REG
*SHDN
*CHRG
*FAULT
TIMER
EPAD
SW
BOOST
SENSE
BAT
NTC
VFB
D3
CMSH1-40M
L3
68uH
C23
1uF
D2
CDBA240LL
R19
0.40
VBATT
C25
10uF
R17
510K
50K
R16
R18
330K
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
"VUSB"
"VCHRG"
"GND"
J19
VBATT
VCHRG
GNDREF
RF Regulator
Radio
VDD Select
ENAB_RF
VBATT
C9
10uF
U21
TPS7A4501DCQT
SHDN
IN
OUT
SENSE/ADJ
GND_1
GND_2
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=5V (R55=10K, R59=3.3K)
Battery Power Monitor
VBATT_SENSE
Current Sense Resistor:
1.0 Ohm is about
0.3mW power lost
as heat
R8
0.1
R26
1K
U4
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+
GNDREF
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
USB_D-
STAT
SDA_PWR2
SCL_PWR2
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
R36
560
Input Current Limit
Max Input current (IINMAX)=KILIM/RILIM
KILIM = 1098 to 1276 at most
IINMAX=1.96A=560 ohm
Limit is now inductor heating
"One Shot" Regulator Reset
Sets EN low dwell time
R29
73.2K
R30
100K
R47
200K
C6
10uF
R49
100K
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
C17
22uF
C18
22uF
L2
3.3uH
C21
0.1uF
VBATT 4.5 to 18V
C19
100uF
C20
100uF
TODO: check cap size
U5
TPS54226PWPR
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
SSI
Sheet: /Power/
File: Power.kicad_sch
Title: PyCubed Mainboard
Size: A4
Date: 2024-05-04
Rev: v06b
KiCad E.D.A. kicad 7.0.9
Id: 5/7

Burn Wire Control (Antenna Depolyment)



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

Burn Wires

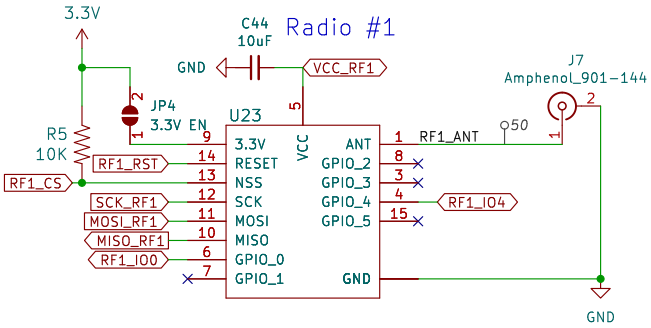
SSI

Sheet: /Burn Wires/
File: Burn_Wires.kicad_sch

Title: PyCubed Mainboard

Size: A4	Date: 2024-05-04	**Rev: v06b**
KiCad E.D.A. kicad 7.0.9		Id: 6/7

Modular Radio (HopeRF format)



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

Radio, GPS, Payloads

SSI

Sheet: /RF and GPS/
File: RF_and_GPS.kicad_sch

Title: PyCubed Mainboard

Size: A4	Date: 2024-05-04	**Rev: v06b**
KiCad E.D.A. kicad 7.0.9		Id: 7/7