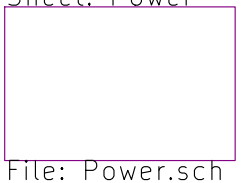
Sheet: Avionics

File: Avionics.sch

Sheet: Connectors

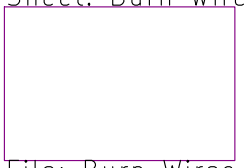
File: Connectors.sch

Sheet: Power



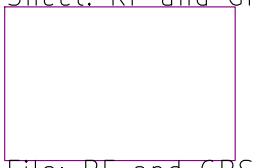
File: Power.sch

Sheet: Burn Wires



File: Burn_Wires.sch

Sheet: RF and GPS



File: RF_and_GPS.sch

Sheet: Bus Protection

File: Bus_Protection.sch

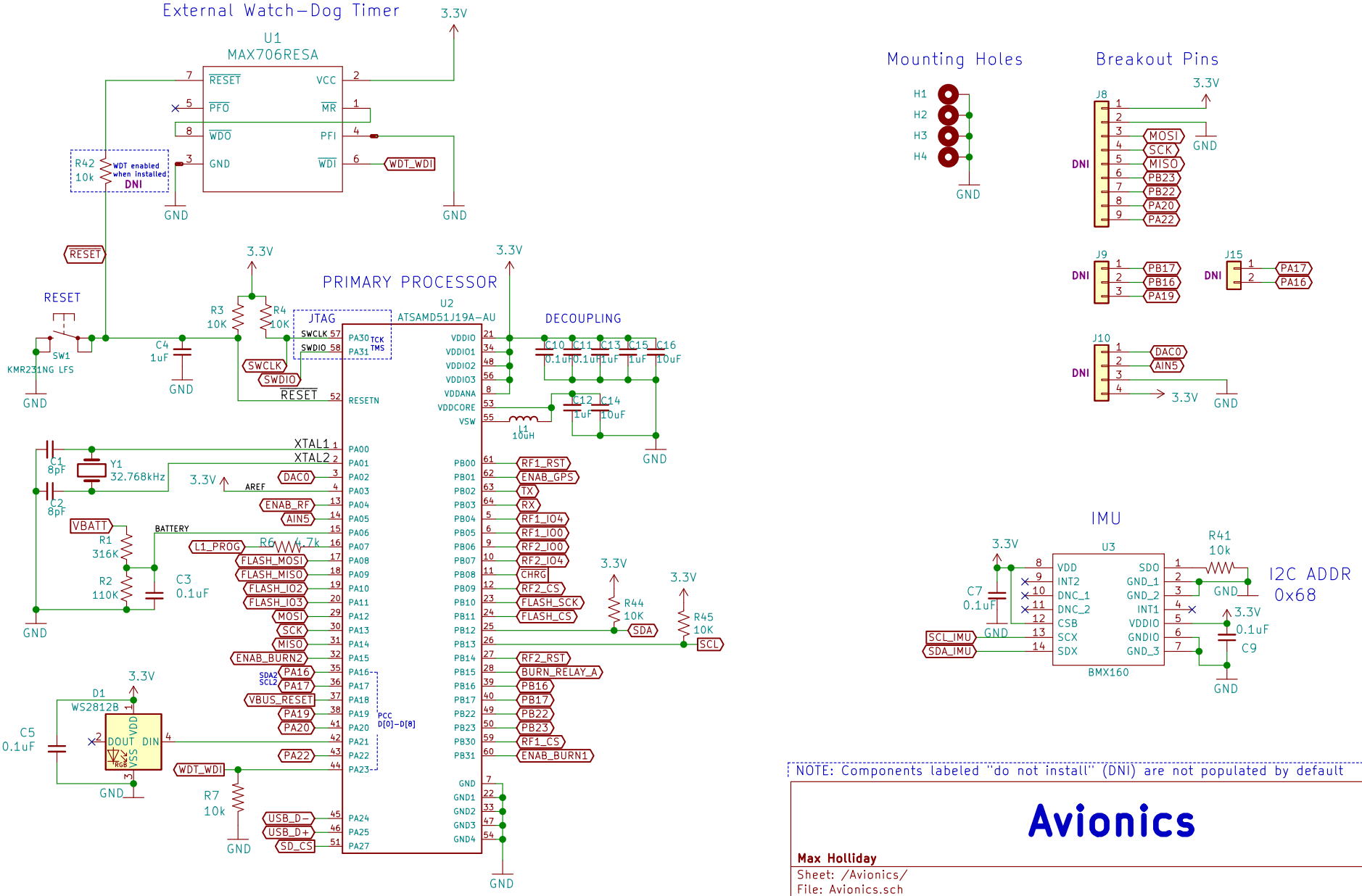
PyCubed

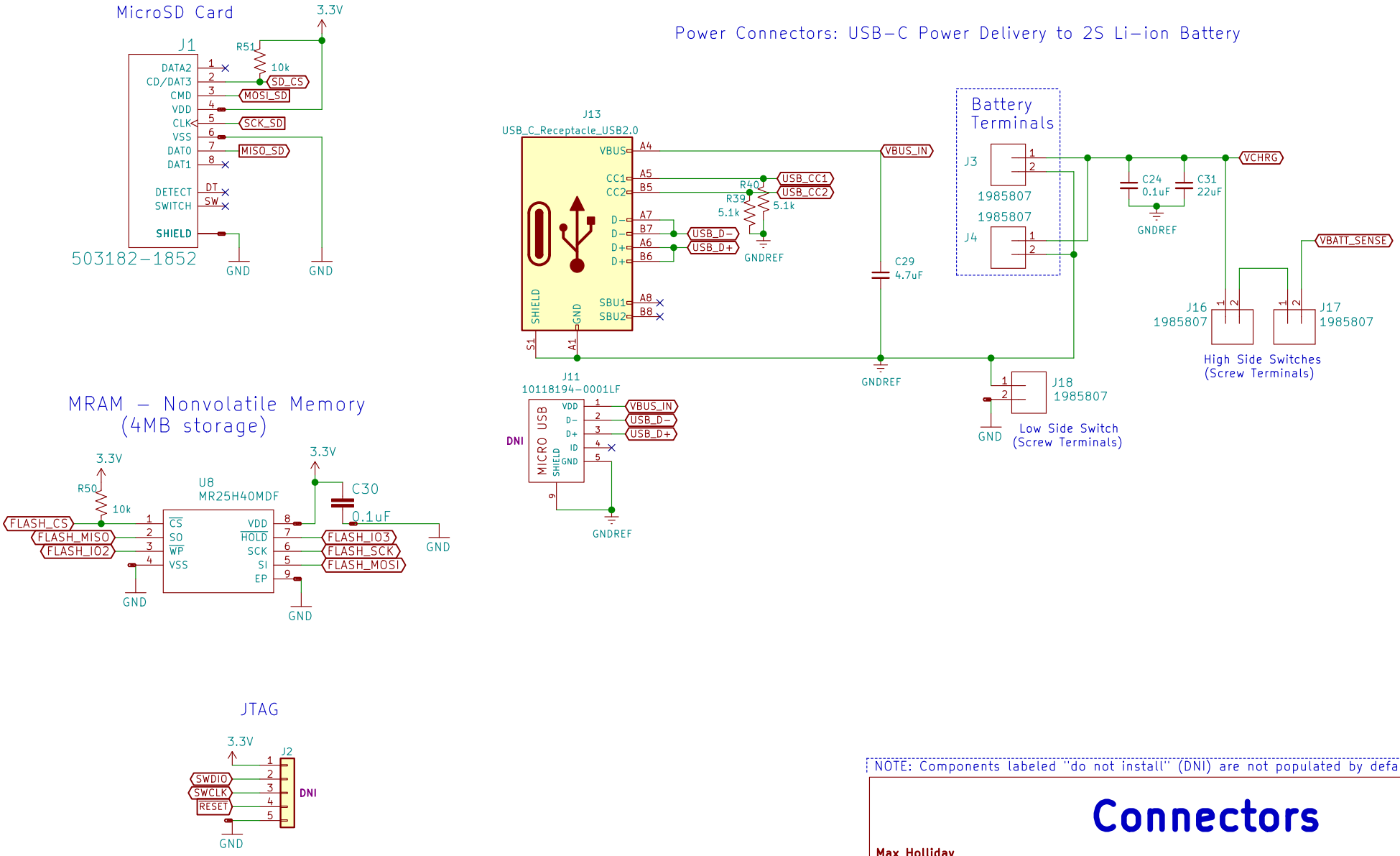
Max Holliday

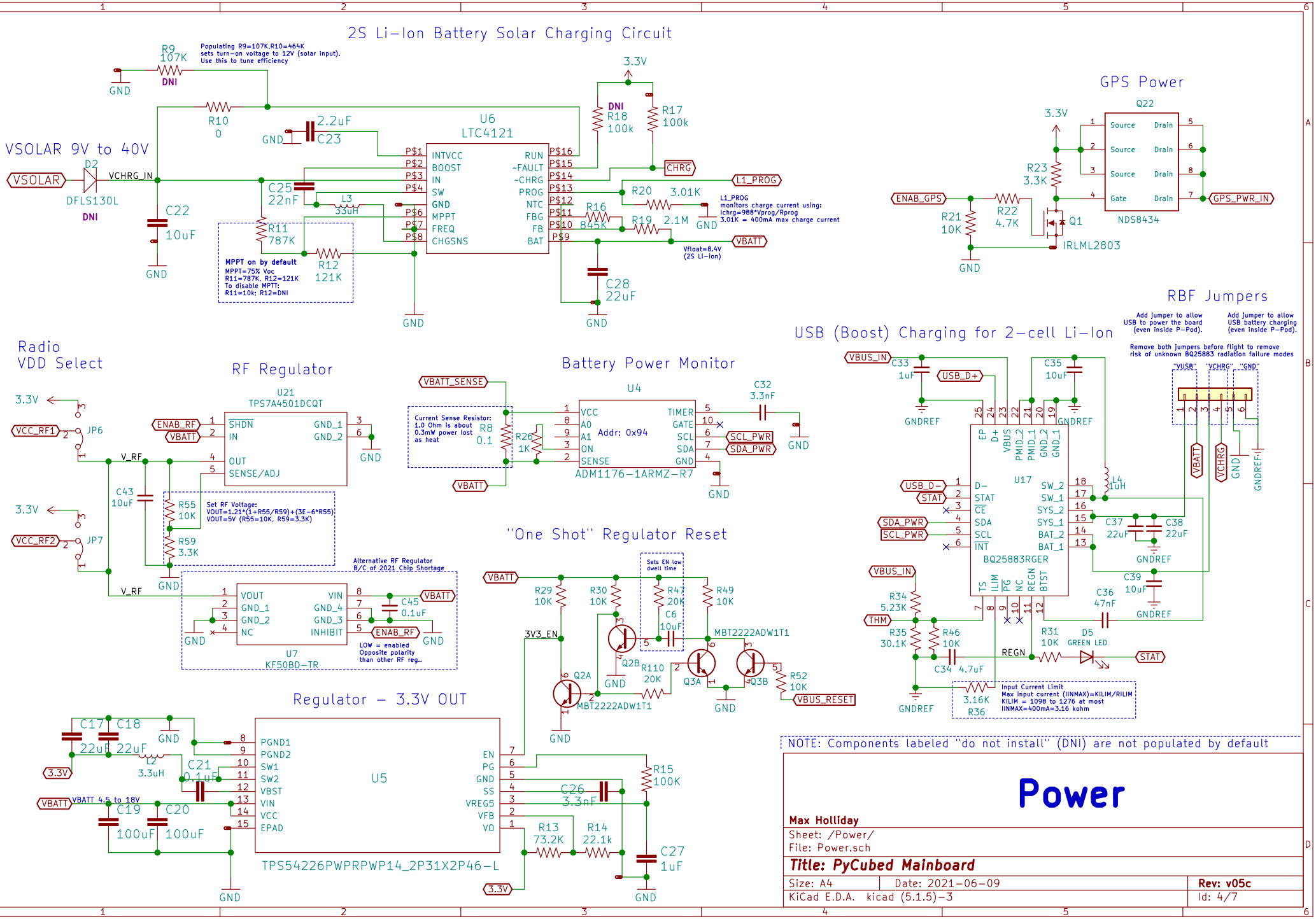
Sheet: /
File: mainboard.sch

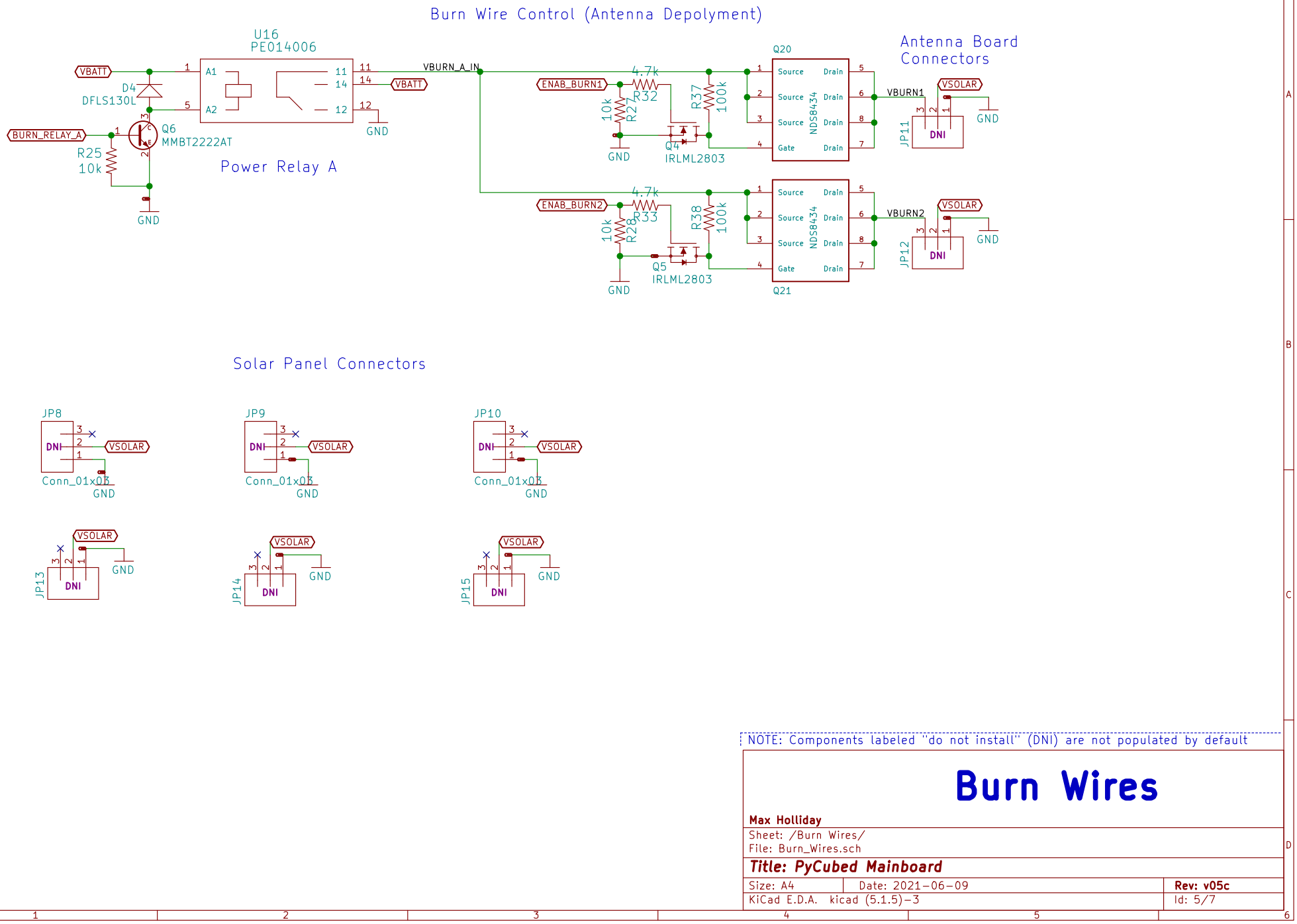
Title: PyCubed Mainboard

Size: A4	Date: 2021-06-09	**Rev: v05c**
KiCad E.D.A. kicad (5.1.5)-3		Id: 1/7

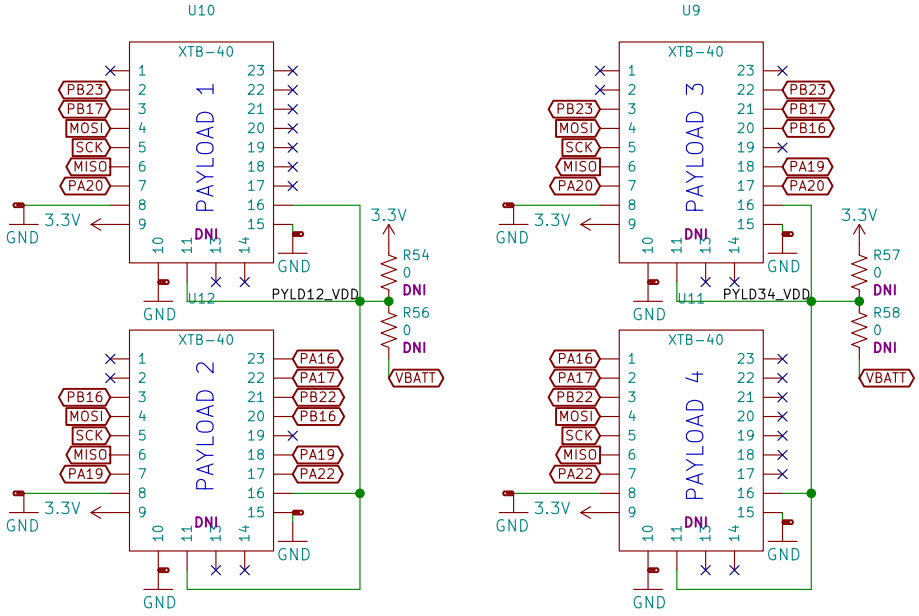

External Watch-Dog Timer
U1
MAX706RESA
RESET
PFO
WDO
GND
VCC
MR
PFI
WDI
WDT_WDI
R42
10k
WDT enabled when installed
DNI
3.3V
PRIMARY PROCESSOR
U2
ATSAMD51J19A-AU
JTAG
SWCLK
SWDIO
RESETN
DECOUPLING
C10
C11
C13
C15
C16
0.1uF
1uF
10uF
C12
C14
L1
10uH
VDDIO
VDDIO1
VDDIO2
VDDIO3
VDDANA
VDDCORE
VSW
R3
10K
R4
10K
C4
1uF
SW1
KMR231NG LFS
XTAL1
XTAL2
Y1
32.768kHz
C1
8pF
C2
8pF
AREF
DAC0
ENAB_RF
AIN5
VBATT
BATTERY
R1
316K
R2
110K
C3
0.1uF
L1_PROG
R6
4.7k
FLASH_MOSI
FLASH_MISO
FLASH_IO2
FLASH_IO3
MOSI
SCK
MISO
ENAB_BURN2
VBUS_RESET
PA16
PA17
PA18
PA19
PA20
PA21
PA22
PA23
PA24
PA25
PA27
PCC D[0]-D[8]
SDA
SCL
R44
10K
R45
10K
RF1_RST
ENAB_GPS
TX
RX
RF1_IO4
RF1_IO0
RF2_IO0
RF2_IO4
CHRG
RF2_CS
FLASH_SCK
FLASH_CS
RF2_RST
BURN_RELAY_A
PB16
PB17
PB22
PB23
RF1_CS
ENAB_BURN1
D1
WS2812B
DOUT
DIN
VDD
VSS
C5
0.1uF
R7
10k
WDT_WDI
USB_D-
USB_D+
SD_CS
GND
GND1
GND2
GND3
GND4
Mounting Holes
H1
H2
H3
H4
Breakout Pins
J8
J9
J10
J15
DNI
MOSI
SCK
MISO
PB23
PB22
PA20
PA22
PB17
PB16
PA19
PA17
PA16
DAC0
AIN5
IMU
U3
BMX160
VDD
INT2
DNC_1
DNC_2
CSB
SCX
SDX
SDO
GND_1
GND_2
INT1
VDDIO
GNDIO
GND_3
SCL_IMU
SDA_IMU
C7
0.1uF
C9
0.1uF
R41
10k
I2C ADDR
0x68
NOTE: Components labeled "do not install" (DNI) are not populated by default
Avionics
Max Holliday
Sheet: /Avionics/
File: Avionics.sch
Title: PyCubed Mainboard
Size: A4
Date: 2021-06-09
Rev: v05c
KiCad E.D.A. kicad (5.1.5)-3
Id: 2/7


MicroSD Card
J1
503182-1852
DATA2
CD/DAT3
CMD
VDD
CLK
VSS
DAT0
DAT1
DETECT
SWITCH
SHIELD
DT
SW
R51
10k
SD_CS
MOSI_SD
SCK_SD
MISO_SD
3.3V
GND
Power Connectors: USB-C Power Delivery to 2S Li-ion Battery
J13
USB_C_Receptacle_USB2.0
VBUS
CC1
CC2
D-
D+
SBU1
SBU2
SHIELD
GND
S1
A1
R40
R39
5.1k
USB_CC1
USB_CC2
USB_D-
USB_D+
GNDREF
VBUS_IN
C29
4.7uF
Battery Terminals
J3
J4
1985807
C24
0.1uF
C31
22uF
VCHRG
VBATT_SENSE
J16
J17
High Side Switches
(Screw Terminals)
J18
Low Side Switch
(Screw Terminals)
J11
10118194-0001LF
MICRO USB
VDD
D-
D+
ID
DNI
MRAM - Nonvolatile Memory
(4MB storage)
U8
MR25H40MDF
R50
C30
0.1uF
FLASH_CS
FLASH_MISO
FLASH_IO2
FLASH_IO3
FLASH_SCK
FLASH_MOSI
JTAG
J2
SWDIO
SWCLK
RESET
NOTE: Components labeled "do not install" (DNI) are not populated by default
Connectors
Max Holliday
Sheet: /Connectors/
File: Connectors.sch
Title: PyCubed Mainboard
Size: A4
Date: 2021-06-09
Rev: v05c
KiCad E.D.A. kicad (5.1.5)-3
Id: 3/7

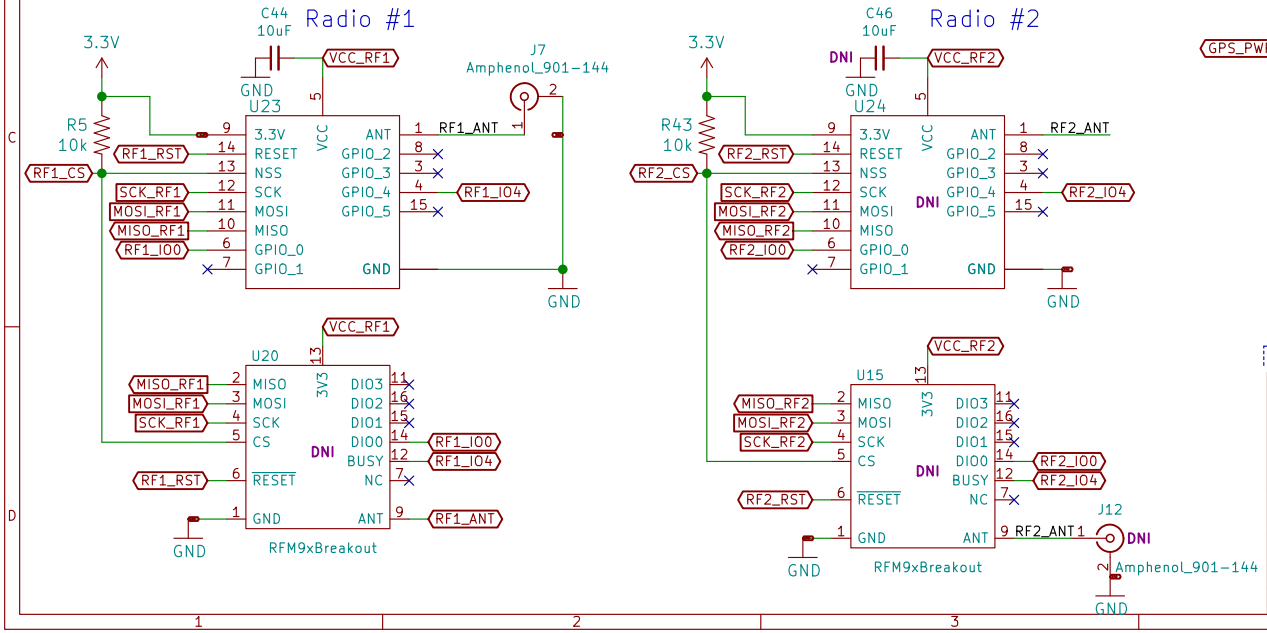

2S Li-Ion Battery Solar Charging Circuit
VSOLAR 9V to 40V
U6
LTC4121
INTVCC
BOOST
IN
SW
GND
MPPT
FREQ
CHGSNS
RUN
~FAULT
~CHRG
PROG
NTC
FBG
FB
BAT
MPPT on by default
MPPT=75% Voc
R11=787K, R12=121K
To disable MPTT:
R11=10k; R12=DNI
L1_PROG
monitors charge current using:
Ichrg=988*Vprog/Rprog
3.01K = 400mA max charge current
Vfloat=8.4V
(2S Li-ion)
GPS Power
Q22
NDS8434
IRLML2803
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
USB (Boost) Charging for 2-cell Li-Ion
BQ25883RGER
Radio
VDD Select
RF Regulator
U21
TPS7A4501DCQT
Set RF Voltage:
VOUT=1.21*(1+R55/R59)+(3E-6*R55)
VOUT=5V (R55=10K, R59=3.3K)
Alternative RF Regulator
B/C of 2021 Chip Shortage
U7
KF50BD-TR
LOW = enabled
Opposite polarity
than other RF reg..
Battery Power Monitor
U4
ADM1176-1ARMZ-R7
Addr: 0x94
Current Sense Resistor:
1.0 Ohm is about
0.3mW power lost
as heat
"One Shot" Regulator Reset
Sets EN low
dwell time
MBT2222ADW1T1
Regulator - 3.3V OUT
U5
TPS54226PWPRPWP14_2P31X2P46-L
VBATT 4.5 to 18V
Input Current Limit
Max input current (IINMAX)=KILIM/RILIM
KILIM = 1098 to 1276 at most
IINMAX=400mA=3.16 kohm
NOTE: Components labeled "do not install" (DNI) are not populated by default
Power
Max Holliday
Sheet: /Power/
File: Power.sch
Title: PyCubed Mainboard
Size: A4
Date: 2021-06-09
Rev: v05c
KiCad E.D.A. kicad (5.1.5)-3
Id: 4/7

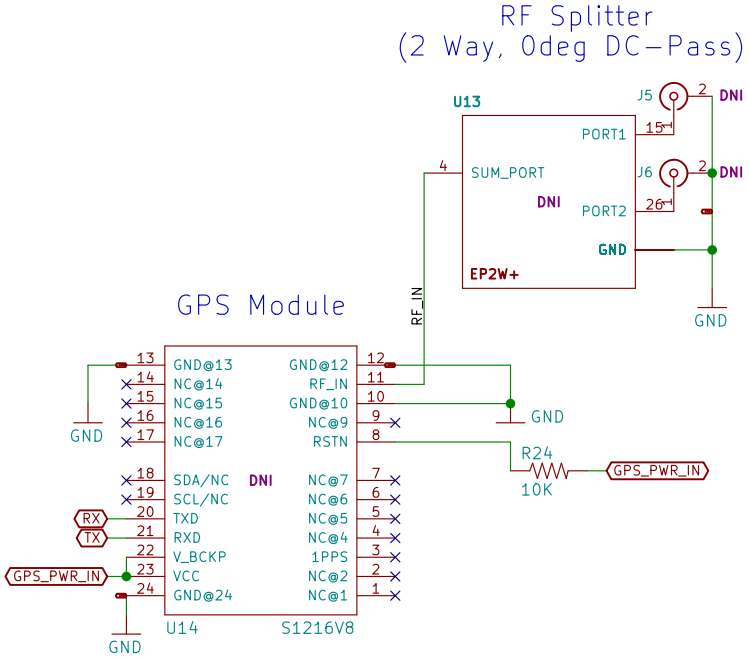

Burn Wire Control (Antenna Depolyment)
U16
PE014006
VBATT
D4
DFLS130L
BURN_RELAY_A
Q6
MMBT2222AT
R25
10k
GND
Power Relay A
VBURN_A_IN
Antenna Board
Connectors
Q20
ENAB_BURN1
4.7k
R32
10k
R27
R37
100k
Q4
IRLML2803
NDS8434
VBURN1
VSOLAR
JP11
DNI
ENAB_BURN2
R33
R28
R38
Q5
IRLML2803
Q21
VBURN2
JP12
Solar Panel Connectors
JP8
JP9
JP10
Conn_01x03
JP13
JP14
JP15
NOTE: Components labeled "do not install" (DNI) are not populated by default
Burn Wires
Max Holliday
Sheet: /Burn Wires/
File: Burn_Wires.sch
Title: PyCubed Mainboard
Size: A4
Date: 2021-06-09
Rev: v05c
KiCad E.D.A. kicad (5.1.5)-3
Id: 5/7

Modular Payloads



Modular Radios (HopeRF format)





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

Radio, GPS, Payloads

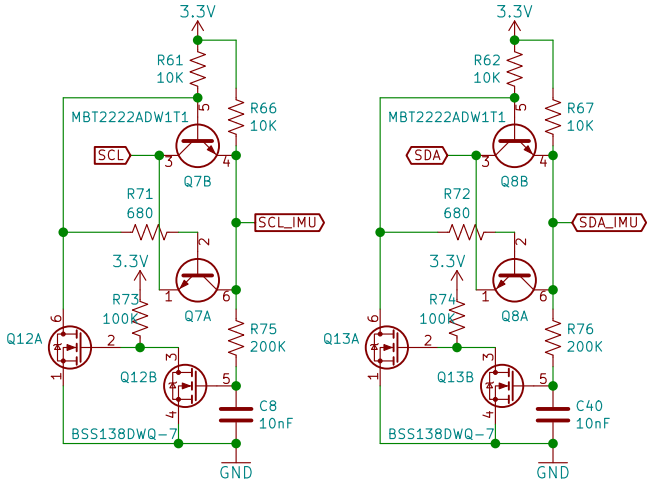
Max Holliday

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

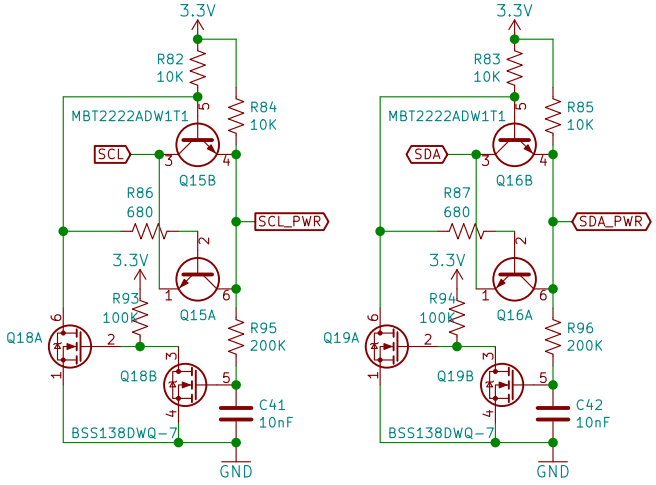
Title: PyCubed Mainboard

Size: A4	Date: 2021-06-09	**Rev: v05c**
KiCad E.D.A. kicad (5.1.5)-3		Id: 6/7

I2C Bus Protection – IMU



I2C Bus Protection – Power Monitor & USB Charger



NOTE

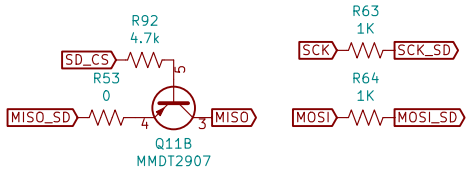
These novel bus protection circuits prevent traditional I2C/SPI failure modes where a single slave failure can disable the entire bus.

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

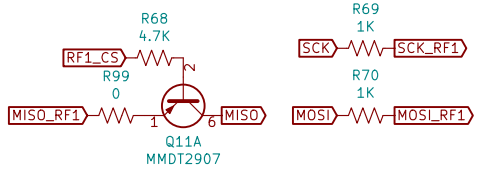
By default, slave clock and/or data lines can be held low and the Master (SAMD51) will still be able to communicate with the remainder of the bus.

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

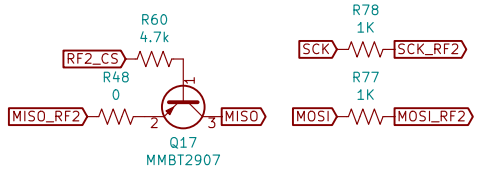
SPI Bus Protection – SD Card and Payloads



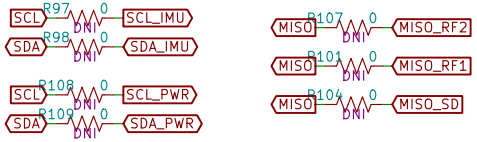
SPI Bus Protection – Radio 1



SPI Bus Protection – Radio 2



Bus Protection – Bypass Jumpers



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

Bus Protection

Max Holliday

Sheet: /Bus Protection/
File: Bus_Protection.sch

Title: PyCubed Mainboard

Size: A4	Date: 2021-06-09	**Rev: v05c**
KiCad E.D.A. kicad (5.1.5)-3		Id: 7/7