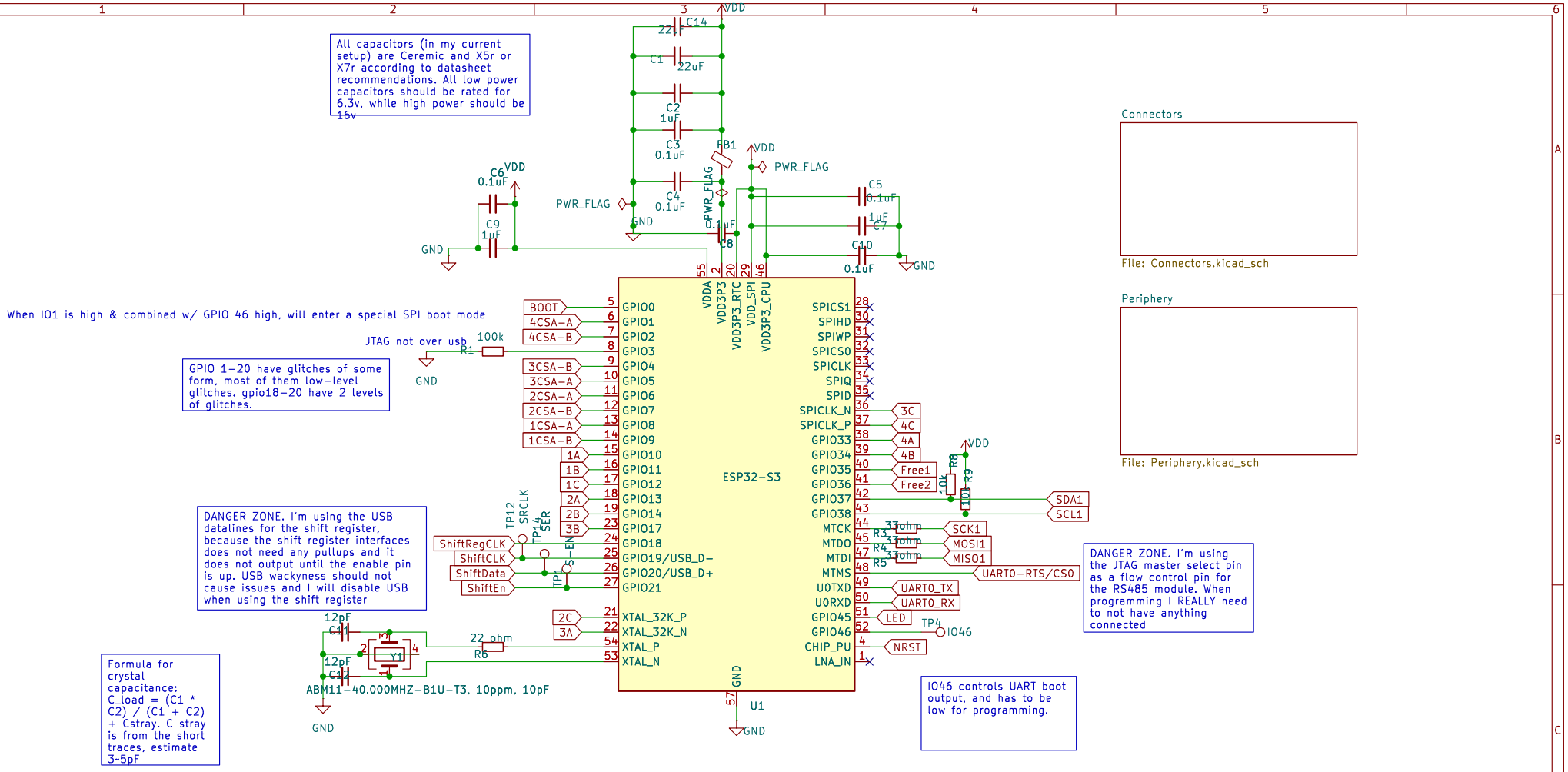

All capacitors (in my current setup) are Ceremic and X5r or X7r according to datasheet recommendations. All low power capacitors should be rated for 6.3v, while high power should be 16v
When IO1 is high & combined w/ GPIO 46 high, will enter a special SPI boot mode
JTAG not over usb
GPIO 1-20 have glitches of some form, most of them low-level glitches. gpio18-20 have 2 levels of glitches.
DANGER ZONE. I'm using the USB datalines for the shift register, because the shift register interfaces does not need any pullups and it does not output until the enable pin is up. USB wackyness should not cause issues and I will disable USB when using the shift register
Formula for crystal capacitance: C_load = (C1 * C2) / (C1 + C2) + Cstray. C stray is from the short traces, estimate 3-5pF
ABM11-40.000MHZ-B1U-T3, 10ppm, 10pF
ESP32-S3
DANGER ZONE. I'm using the JTAG master select pin as a flow control pin for the RS485 module. When programming I REALLY need to not have anything connected
IO46 controls UART boot output, and has to be low for programming.
Connectors
File: Connectors.kicad_sch
Periphery
File: Periphery.kicad_sch
Author: Asher Edwards
Licensed under CERN-OHL-S v2
Sheet: /
File: ESP32-S3 Hub.kicad_sch
Title: CACKLE - Hub
Size: A4
Date: 2024-10-08
Rev: V1
KiCad E.D.A. 8.0.7
Id: 1/3

Motor Drivers

CS pullup helps during device startup and decreases randomness

1A
1B
1C
1CSA–A
1CSA–B
J1
1.27mm 3pin socket
J2
1.27mm 3pin socket
VDD
10k
GND
R2
CS1
SCK1
MISO1
MOSI1
GND
J3
7 pin FPC 0.3mm Panasonic Y3b

2A
2B
2C
2CSA–A
2CSA–B
J4
1.27mm 3pin socket
J6
1.27mm 3pin socket
VDD
10k
GND
R18
CS2
SCK1
MISO1
MOSI1
GND
J5
7 pin FPC 0.3mm Panasonic Y3b

3A
3B
3C
3CSA–A
3CSA–B
J7
1.27mm 3pin socket
J9
1.27mm 3pin socket
VDD
10k
GND
R19
CS3
SCK1
MISO1
MOSI1
GND
J8
7 pin FPC 0.3mm Panasonic Y3b

4A
4B
4C
4CSA–A
4CSA–B
J10
1.27mm 3pin socket
J12
1.27mm 3pin socket
VDD
10k
GND
R20
CS4
SCK1
MISO1
MOSI1
GND
J11
7 pin FPC 0.3mm Panasonic Y3b

Can't populate due to parts not being available from China. Will have to manually populate

DEBUG pins

CS0
TP20
UART0–RTS/CS0
UART0_RX
TP21
RX
UART0_TX
TP22
TX

I have 3 extra pins I could use instead of filling it with power connections. I could hook them up to USB for prog, and the LED

Communication/Chaining/Stacking Connectors

Reverse Orientation Connector, All pins are the same on both sides

The CS pins can be used as a generic digital output, connected to the shift register. Each half of the board has its own pair of CS pins

Hubs can stack vertically or horizontally, and can hold two sensors per side

Top Side Receptacles

J13
TE 3–2363961–0 receptacle

VDD
GND
CS5
CS6
Free1
RS485+
RS485–
SCK1
MOSI1
MISO1
SCL1
SDA1
MP

J16
TE 3–2363961–0 receptacle

VDD
GND
CS7
CS8
Free2
RS485+
RS485–
SCK1
MOSI1
MISO1
SCL1
SDA1
MP

Bottom Side Plugs

TE 3–2363962–0 Connector
J14

VDD
GND
SDA1
SCL1
RS485+
RS485–
SCL1
SDA1
MP

TE 3–2363962–0 Connector
J17

VDD
GND
SDA1
SCL1
RS485+
RS485–
SCL1
SDA1
MP

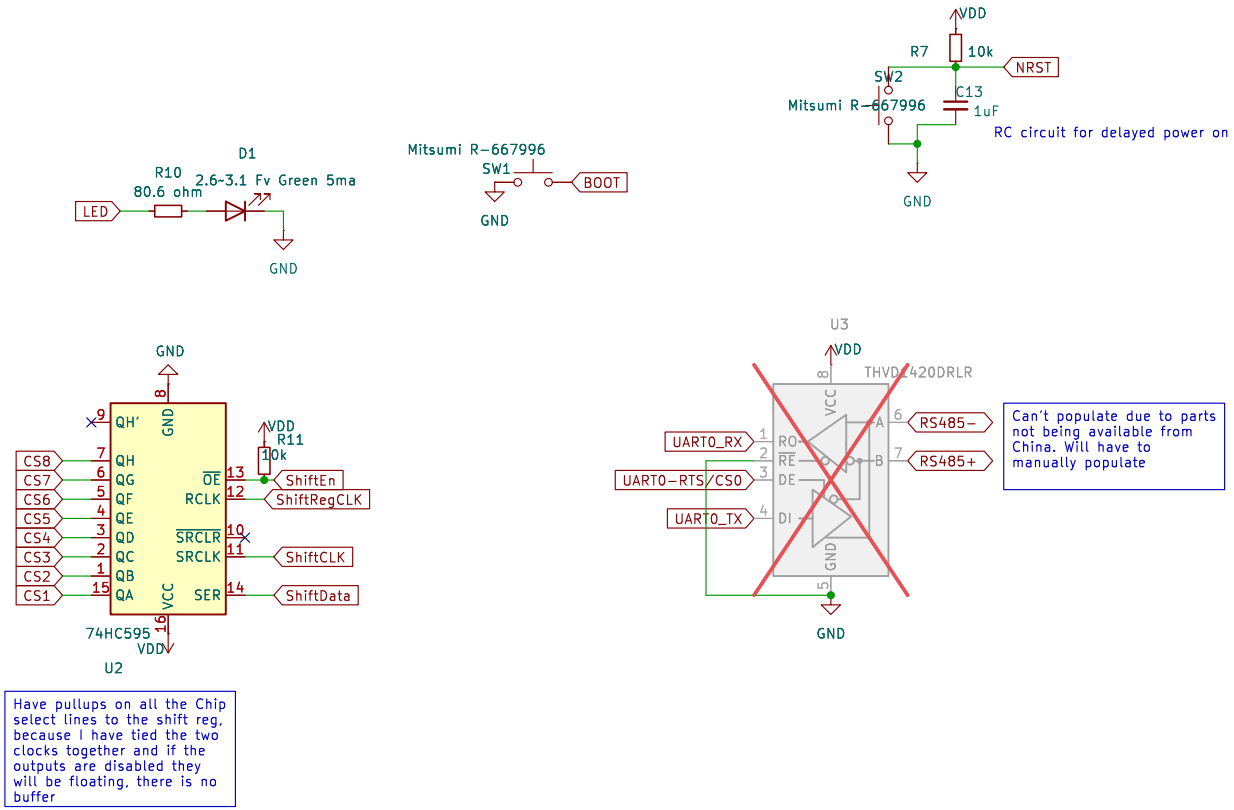
1.27mm 4 pin socket
J21
VDD
RS485+
RS485–
GND
J22
1.27mm 4 pin header

Author: Asher Edwards
Licensed under CERN–OHL–S v2

Sheet: /Connectors/
File: Connectors.kicad_sch

Title: CACKLE – Hub/Connectors

Size: A4	Date: 2024–10–08	Rev: V1
KiCad E.D.A. 8.0.7		Id: 3/3

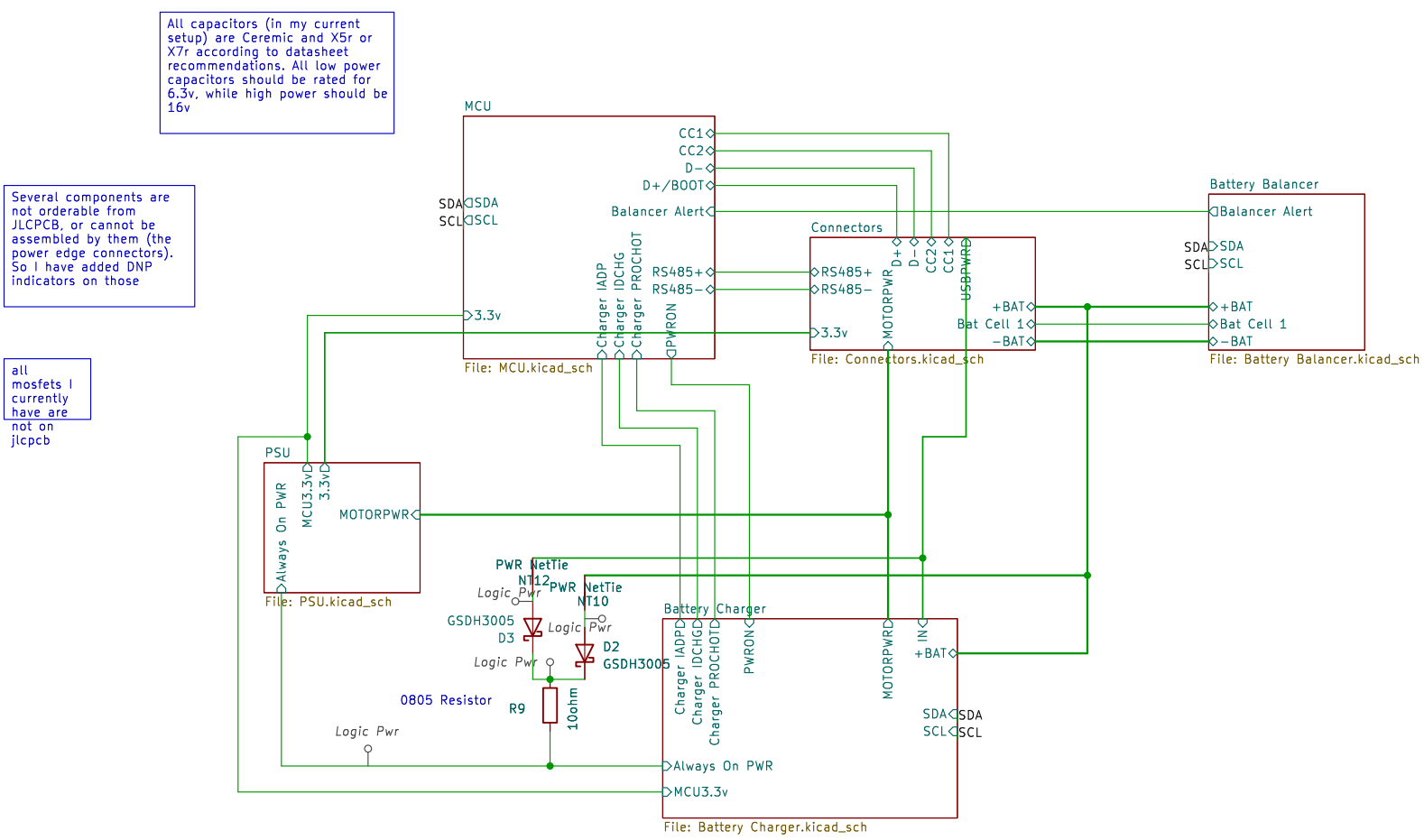


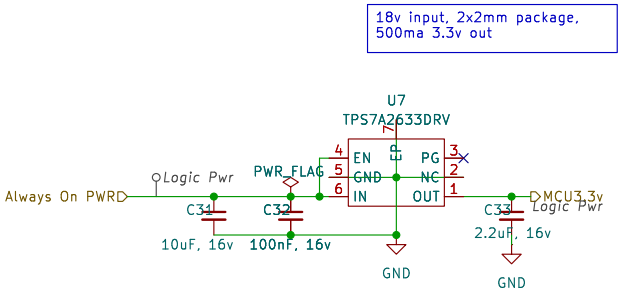
Author: Asher Edwards
Licensed under CERN-OHL-S v2

Sheet: /Periphery/
File: Periphery.kicad_sch

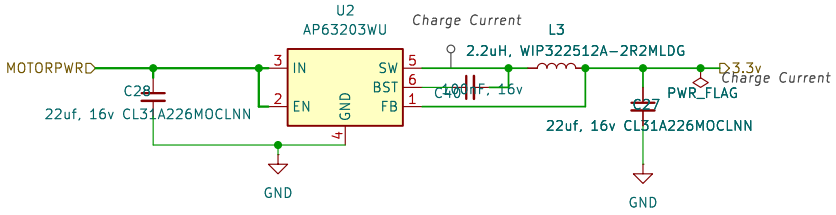
Title: CACKLE – Hub/Periphery

Size: A4	Date: 2024-10-08	**Rev: V1**
KiCad E.D.A. 8.0.7		Id: 3/3


All capacitors (in my current setup) are Ceremic and X5r or X7r according to datasheet recommendations. All low power capacitors should be rated for 6.3v, while high power should be 16v
Several components are not orderable from JLCPCB, or cannot be assembled by them (the power edge connectors). So I have added DNP indicators on those
all mosfets I currently have are not on jlcpcb
MCU
CC1
CC2
D−
D+/BOOT
Balancer Alert
SDA
SCL
3.3v
Charger IADP
Charger IDCHG
Charger PROCHOT
PWRON
RS485+
RS485−
File: MCU.kicad_sch
Connectors
D+
D−
CC2
CC1
USBPWRD
MOTORPWR
+BAT
Bat Cell 1
−BAT
File: Connectors.kicad_sch
Battery Balancer
Balancer Alert
SDA
SCL
+BAT
Bat Cell 1
−BAT
File: Battery Balancer.kicad_sch
PSU
Always On PWR
MCU3.3v
3.3vD
MOTORPWR
File: PSU.kicad_sch
PWR NetTie
NT12
PWR NetTie
NT10
Logic Pwr
GSDH3005
D3
D2
GSDH3005
0805 Resistor
R9
10ohm
Battery Charger
IN
Always On PWR
MCU3.3v
File: Battery Charger.kicad_sch
I might want to find a better diode for blocking current, but 0.01ma leakage doesn't seem bad
Licensed under CERN−OHL−S
Author: Asher Edwards
Sheet: /
File: 2s 40A PSU and charger.kicad_sch
Title: CACKLE 2s 40A PSU & Charger
Size: A4
Date: 2024−12−23
Rev: V1
KiCad E.D.A. 8.0.7
Id: 1/6



Onboard MCU 3.3v Supply, 100mA



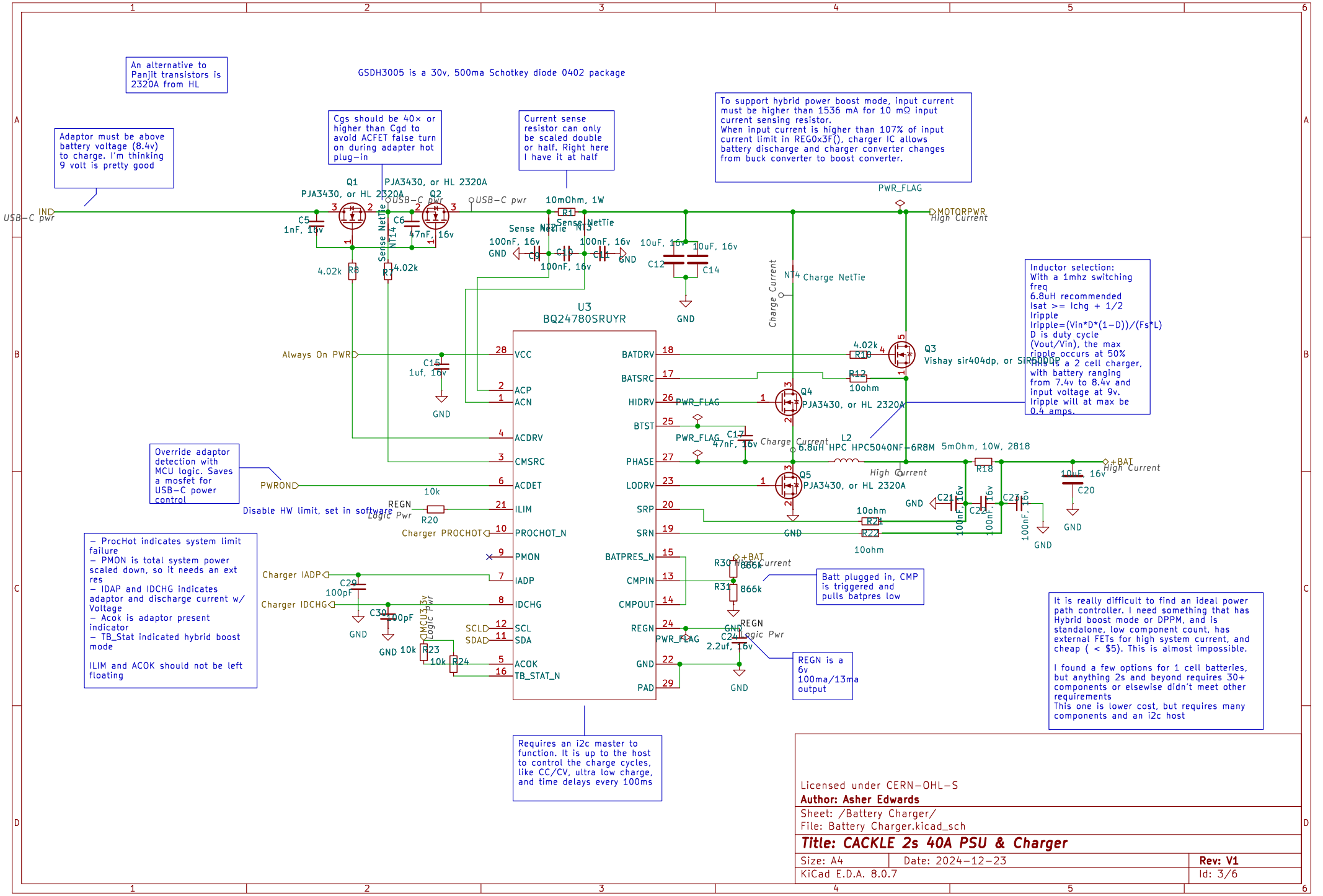
Main 3.3v Supply, 2A

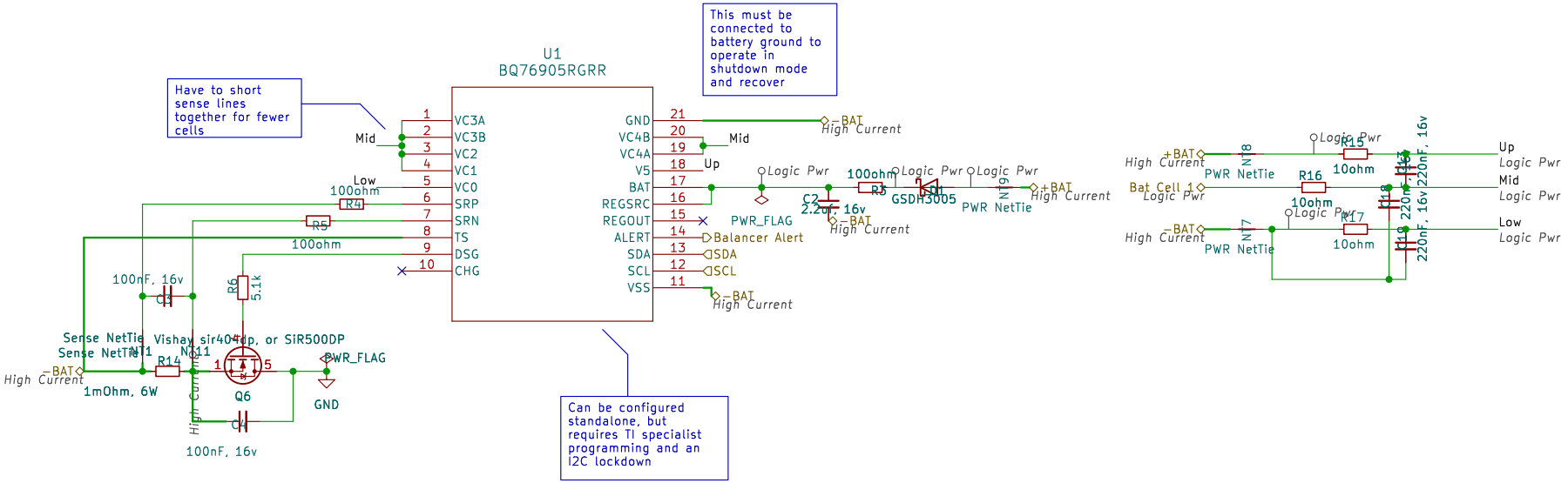
Author: Asher Edwards

Sheet: /PSU/
File: PSU.kicad_sch

Title: CACKLE 2s 40A PSU & Charger

Size: A4	Date: 2024-12-23	**Rev: V1**
KiCad E.D.A. 8.0.7		Id: 2/6


An alternative to Panjit transistors is 2320A from HL
GSDH3005 is a 30v, 500ma Schotkey diode 0402 package
Adaptor must be above battery voltage (8.4v) to charge. I'm thinking 9 volt is pretty good
Cgs should be 40× or higher than Cgd to avoid ACFET false turn on during adapter hot plug-in
Current sense resistor can only be scaled double or half. Right here I have it at half
To support hybrid power boost mode, input current must be higher than 1536 mA for 10 mΩ input current sensing resistor.
When input current is higher than 107% of input current limit in REG0x3F(), charger IC allows battery discharge and charger converter changes from buck converter to boost converter.
Inductor selection:
With a 1mhz switching freq
6.8uH recommended
Isat >= Ichg + 1/2 Iripple
Iripple=(Vin*D*(1-D))/(Fs*L)
D is duty cycle (Vout/Vin), the max ripple occurs at 50%
This is a 2 cell charger, with battery ranging from 7.4v to 8.4v and input voltage at 9v.
Iripple will at max be 0.4 amps.
Override adaptor detection with MCU logic. Saves a mosfet for USB-C power control
Disable HW limit, set in software
- ProcHot indicates system limit failure
- PMON is total system power scaled down, so it needs an ext res
- IDAP and IDCHG indicates adaptor and discharge current w/ Voltage
- Acok is adaptor present indicator
- TB_Stat indicated hybrid boost mode
ILIM and ACOK should not be left floating
Batt plugged in, CMP is triggered and pulls batpres low
REGN is a 6v 100ma/13ma output
Requires an i2c master to function. It is up to the host to control the charge cycles, like CC/CV, ultra low charge, and time delays every 100ms
It is really difficult to find an ideal power path controller. I need something that has Hybrid boost mode or DPPM, and is standalone, low component count, has external FETs for high system current, and cheap (< $5). This is almost impossible.
I found a few options for 1 cell batteries, but anything 2s and beyond requires 30+ components or elsewhere didn't meet other requirements
This one is lower cost, but requires many components and an i2c host
U3
BQ24780SRUYR
Q1
PJA3430, or HL 2320A
Q2
PJA3430, or HL 2320A
Q3
Vishay sir404dp, or SIR5800DP
Q4
PJA3430, or HL 2320A
Q5
PJA3430, or HL 2320A
L2
6.8uH HPC HPC5040NF-6R8M 5mOhm, 10W, 2818
IN
USB-C pwr
USB-C Pwr
USB-C pwr
10mOhm, 1W
R1
Sense NetTie
NT13
Sense NetTie
NT14
Sense NetTie
NT15
Charge NetTie
NT4
Charge Current
PWR_FLAG
MOTORPWR
High Current
+BAT
High Current
Always On PWR
PWRON
REGN
Logic Pwr
Charger PROCHOT
Charger IADP
Charger IDCHG
SCL
SDA
MCU 3.3v
Logic Pwr
GND
C5
1nF, 16v
C6
47nF, 16v
C9
100nF, 16v
C10
100nF, 16v
C11
100nF, 16v
C12
10uF, 16v
C14
10uF, 16v
C15
1uf, 16v
C17
47nF, 16v
C20
10uF, 16v
C21
100nF, 16v
C22
100nF, 16v
C23
100nF, 16v
C24
2.2uf, 16v
C29
100pF
C30
100pF
R7
4.02k
R8
4.02k
R10
4.02k
R12
10ohm
R18
R20
10k
R21
10ohm
R22
10ohm
R23
10k
R24
10k
R30
866k
R31
866k
VCC
ACP
ACN
ACDRV
CMSRC
ACDET
ILIM
PROCHOT_N
PMON
IADP
IDCHG
SCL
SDA
ACOK
TB_STAT_N
BATDRV
BATSRC
HIDRV
BTST
PHASE
LODRV
SRP
SRN
BATPRES_N
CMPIN
CMPOUT
REGN
GND
PAD
Licensed under CERN-OHL-S
Author: Asher Edwards
Sheet: /Battery Charger/
File: Battery Charger.kicad_sch
Title: CACKLE 2s 40A PSU & Charger
Size: A4
Date: 2024-12-23
Rev: V1
KiCad E.D.A. 8.0.7
Id: 3/6



Author: Asher Edwards

Sheet: /Battery Balancer/
File: Battery Balancer.kicad_sch

Title: CACKLE 2s 40A PSU & Charger

Size: A4	Date: 2024-12-23	**Rev: V1**
KiCad E.D.A. 8.0.7		Id: 4/6

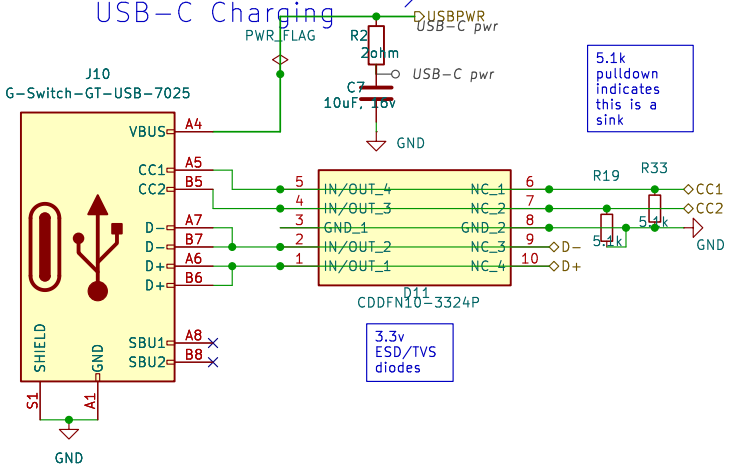
Inputs | Outputs

USB-C Charging

In-rush current limiter and smoother. Need a big resistor size like a 1206.

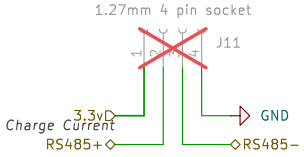
Possible USB-C connectors: G-Switch 7025 (shorter), G-switch 7010asv

5.1k pulldown indicates this is a sink

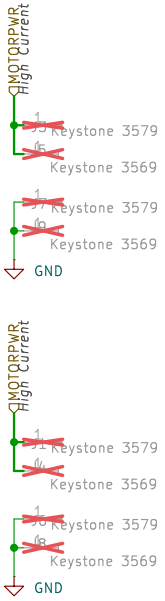


3.3v ESD/TVS diodes

Hubs Connector

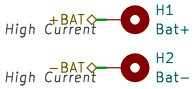


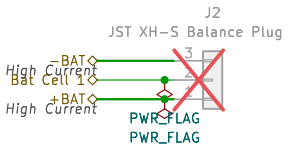
Driver Power



Not populated due to custom handling required, and the parts aren't available from China.

Battery Plugs



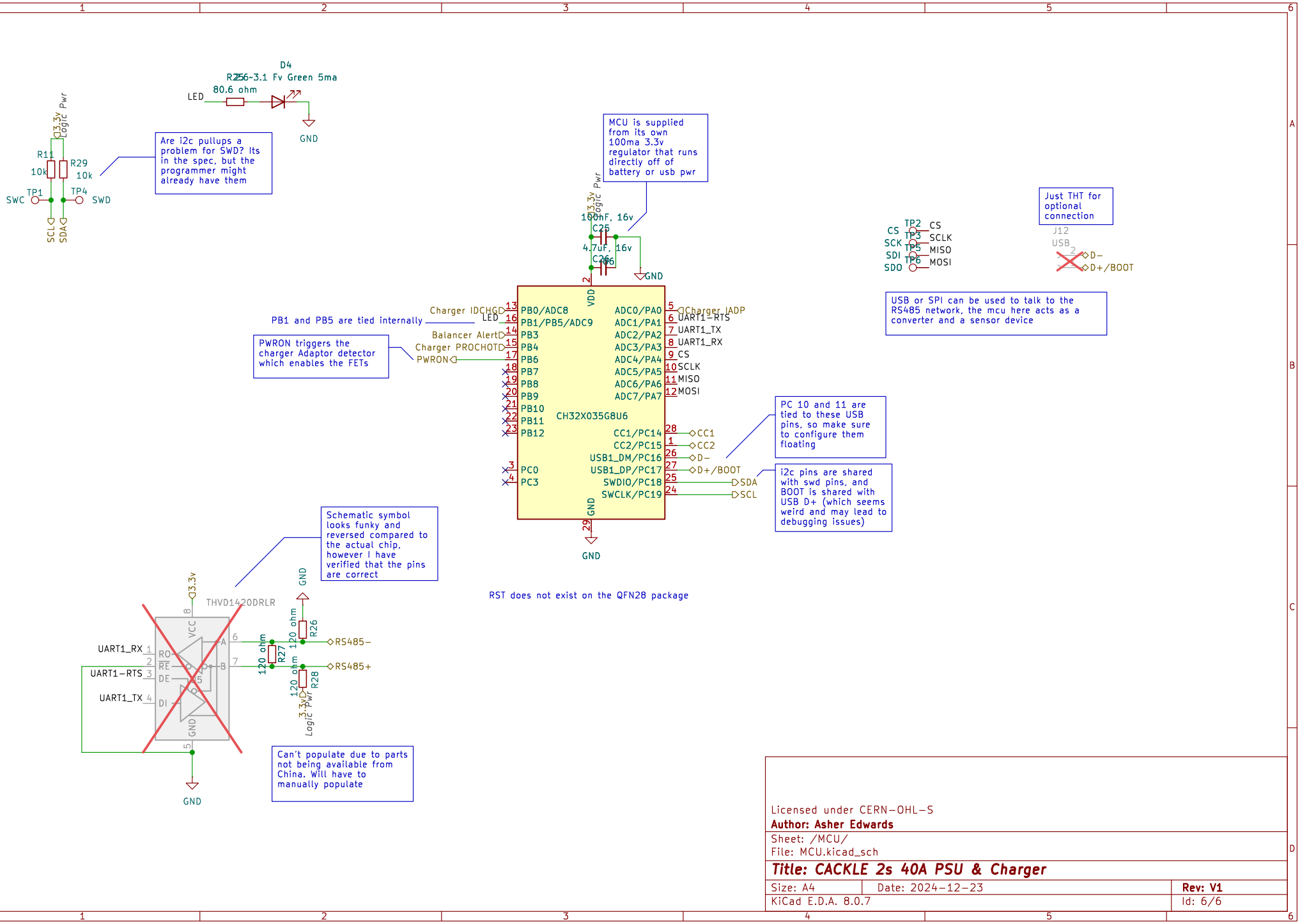


Author: Asher Edwards

Sheet: /Connectors/
File: Connectors.kicad_sch

Title: CACKLE 2s 40A PSU & Charger

Size: A4	Date: 2024-12-23	**Rev: V1**
KiCad E.D.A. 8.0.7		Id: 5/6

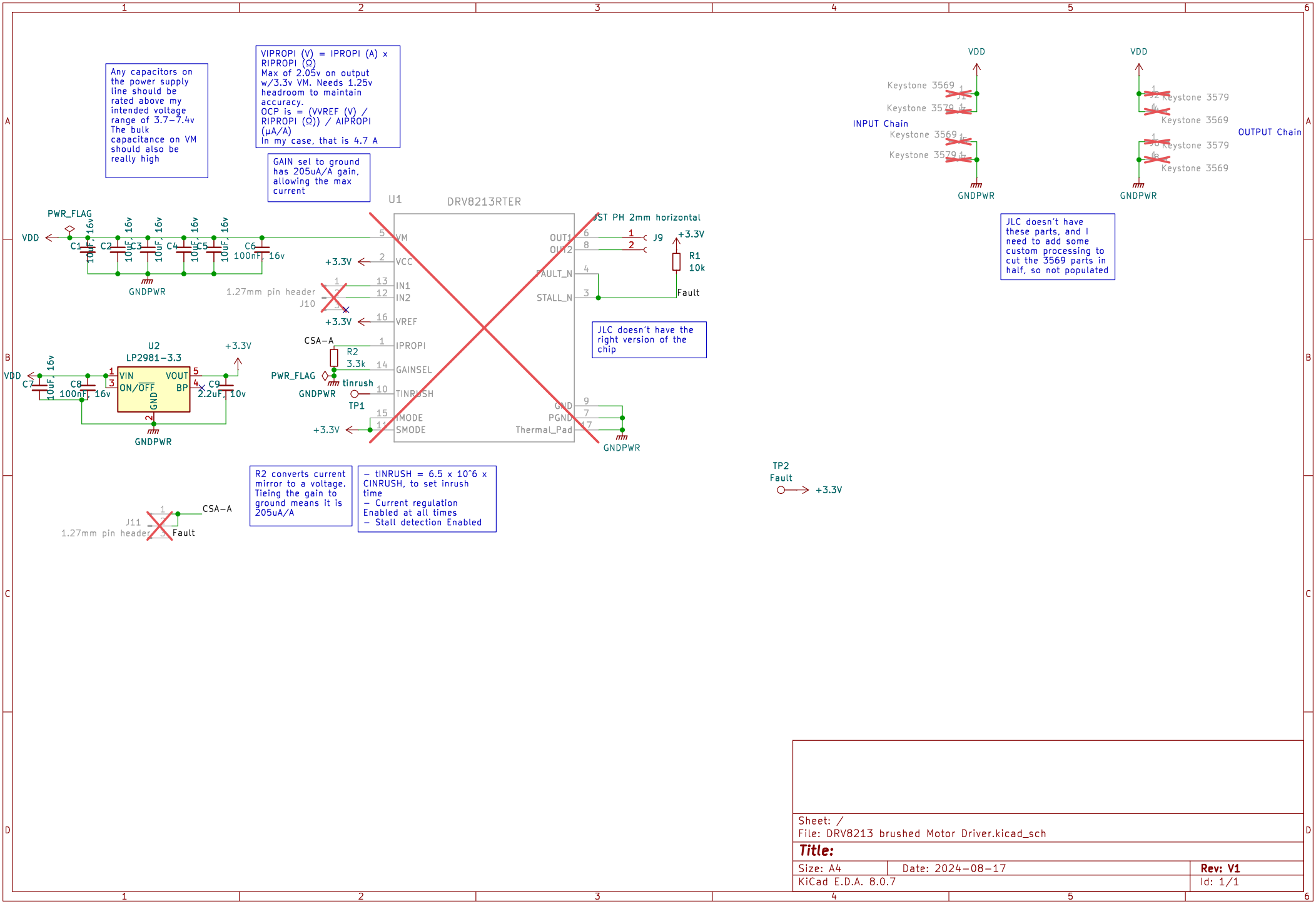


Author: Asher Edwards

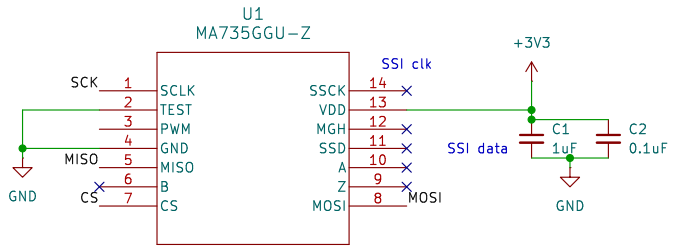
Sheet: /MCU/
File: MCU.kicad_sch

Title: CACKLE 2s 40A PSU & Charger

Size: A4	Date: 2024-12-23	**Rev: V1**
KiCad E.D.A. 8.0.7		Id: 6/6



Sheet: /		
File: DRV8213 brushed Motor Driver.kicad_sch		
Title:		
Size: A4	Date: 2024-08-17	**Rev: V1**
KiCad E.D.A. 8.0.7		Id: 1/1



Internal pulldowns on all SPI lines

Ideally each signal line is next to a ground line. However, this is an extremely space limited part so the most natural wiring from the chip out takes priority. CS kinda acts like ground when it is selected

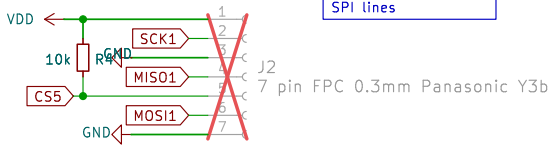
Supports SPI mode 0 or 3, automatically

Sheet: /
File: MA735 encoder board.kicad_sch

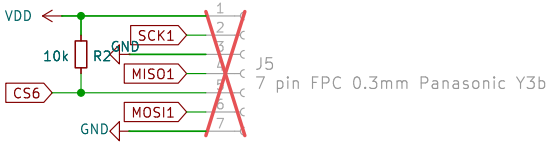
Title:

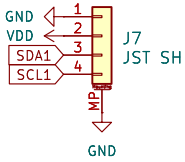
Size: A4	Date:	**Rev:**
KiCad E.D.A. 8.0.7		Id: 1/1

CS pullup helps during device startup and decreases randomness on the SPI lines

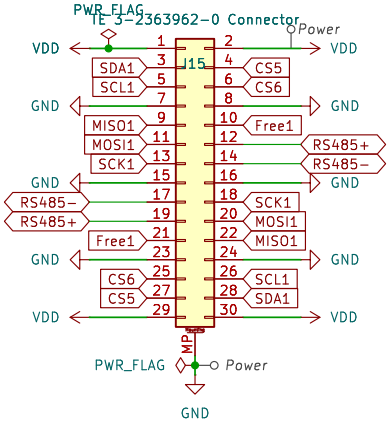


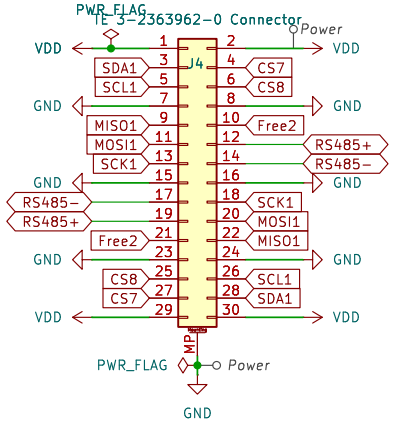
Can't populate due to parts not being available from China. Will have to manually populate

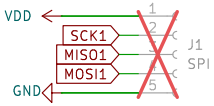




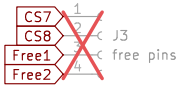
Bottom Side Plugs







The CS pins can be used as a generic output, but they are only expected to be digital outputs (some hubs use a shift register on these). Free1 can be anything



Author: Asher Edwards

Sheet: /

File: 2 connector Sensor Board.kicad_sch

Title: Two connector sensor board

Size: A4	Date: 2024-12-27	**Rev: V1**
KiCad E.D.A. 8.0.7		Id: 1/1