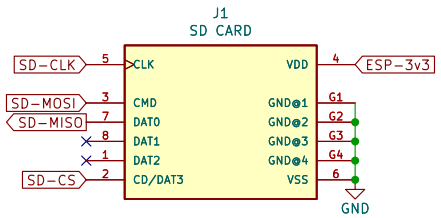
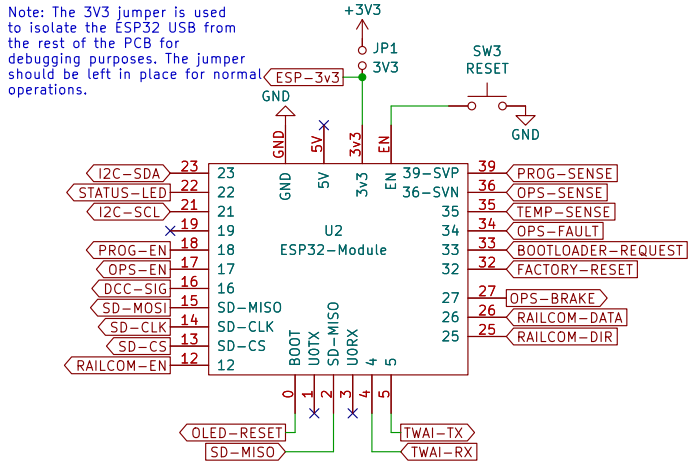
MicroSD Storage

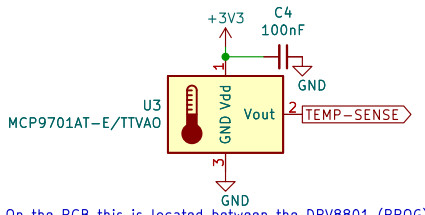


It is highly recommended to use a MicroSD card instead of the built-in flash for persistent configuration data as this will reduce the wear on the flash. The TTGO-T1 board has a built-in MicroSD slot that is wired in parallel to this one.

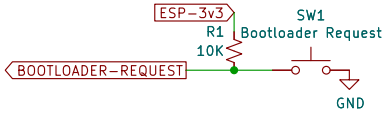
Note: The 3V3 jumper is used to isolate the ESP32 USB from the rest of the PCB for debugging purposes. The jumper should be left in place for normal operations.



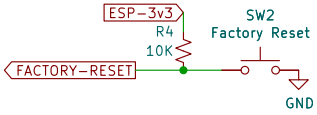
Ambient temperature sensor



On the PCB this is located between the DRV8801 (PROG) and the DRV8873 (OPS). The goal being to alert the user(s) when the PCB temperature is exceeding safe thresholds that are configured by the user.

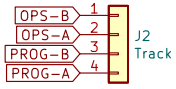


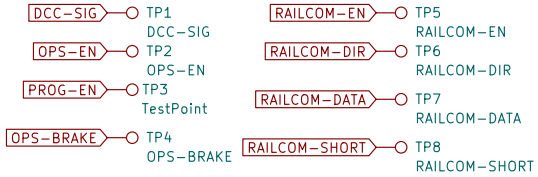
The bootloader button can be pressed on startup to have the node go into the OpenLCB Bootloader.



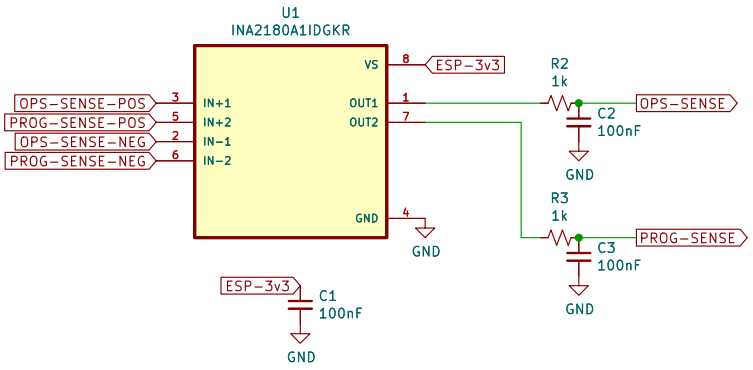
The Factory Reset button be pressed on startup to have the node reset all persistent configuration data.

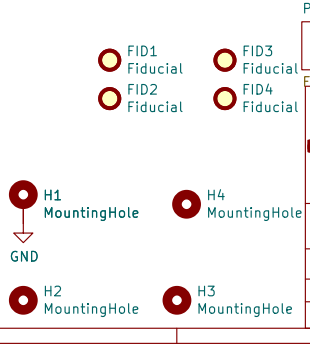
OPS and PROG track connection

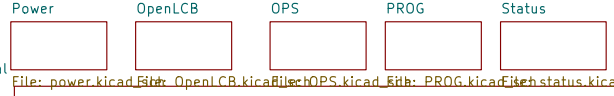




OPS and PROG current sense monitoring





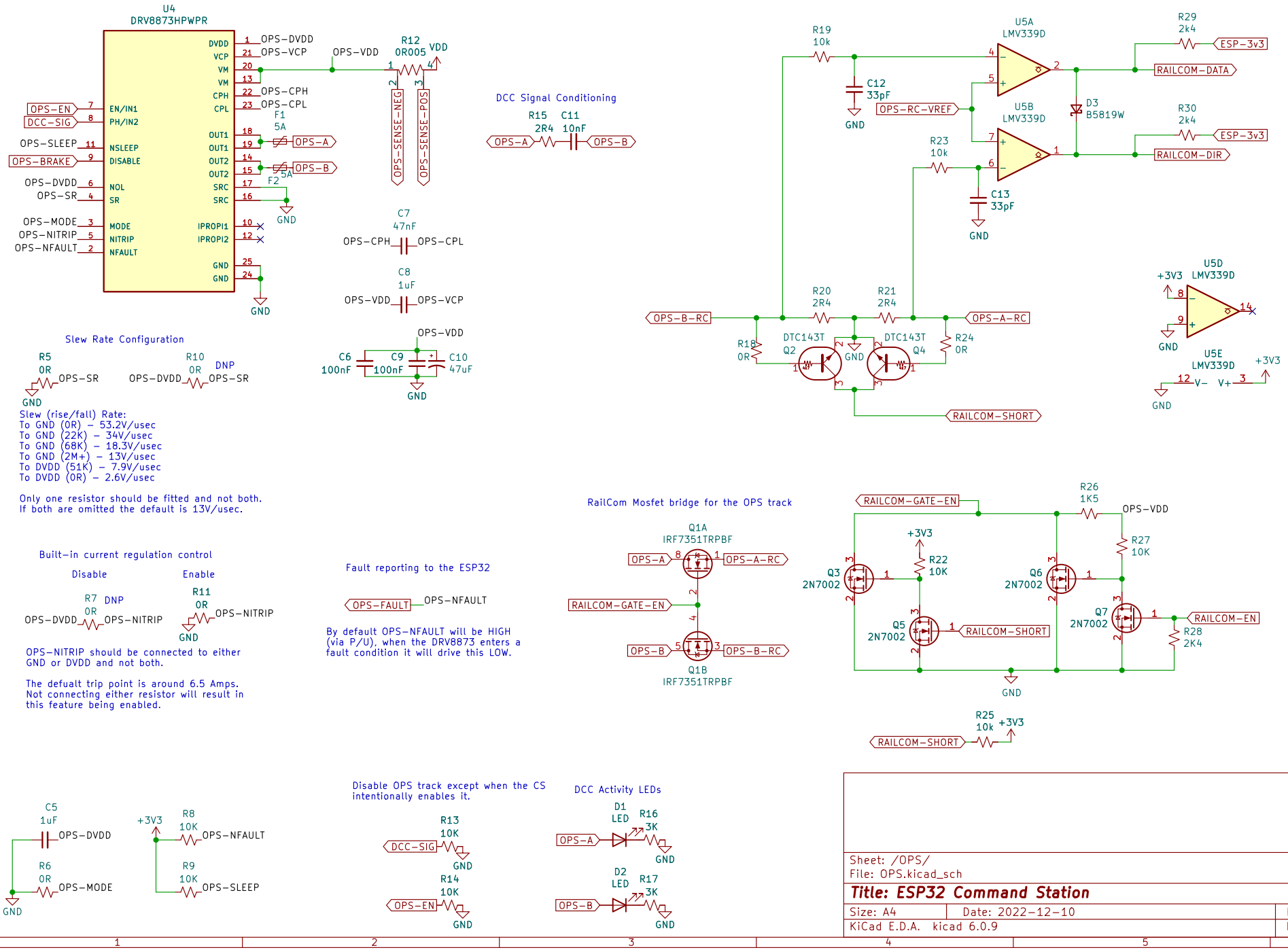


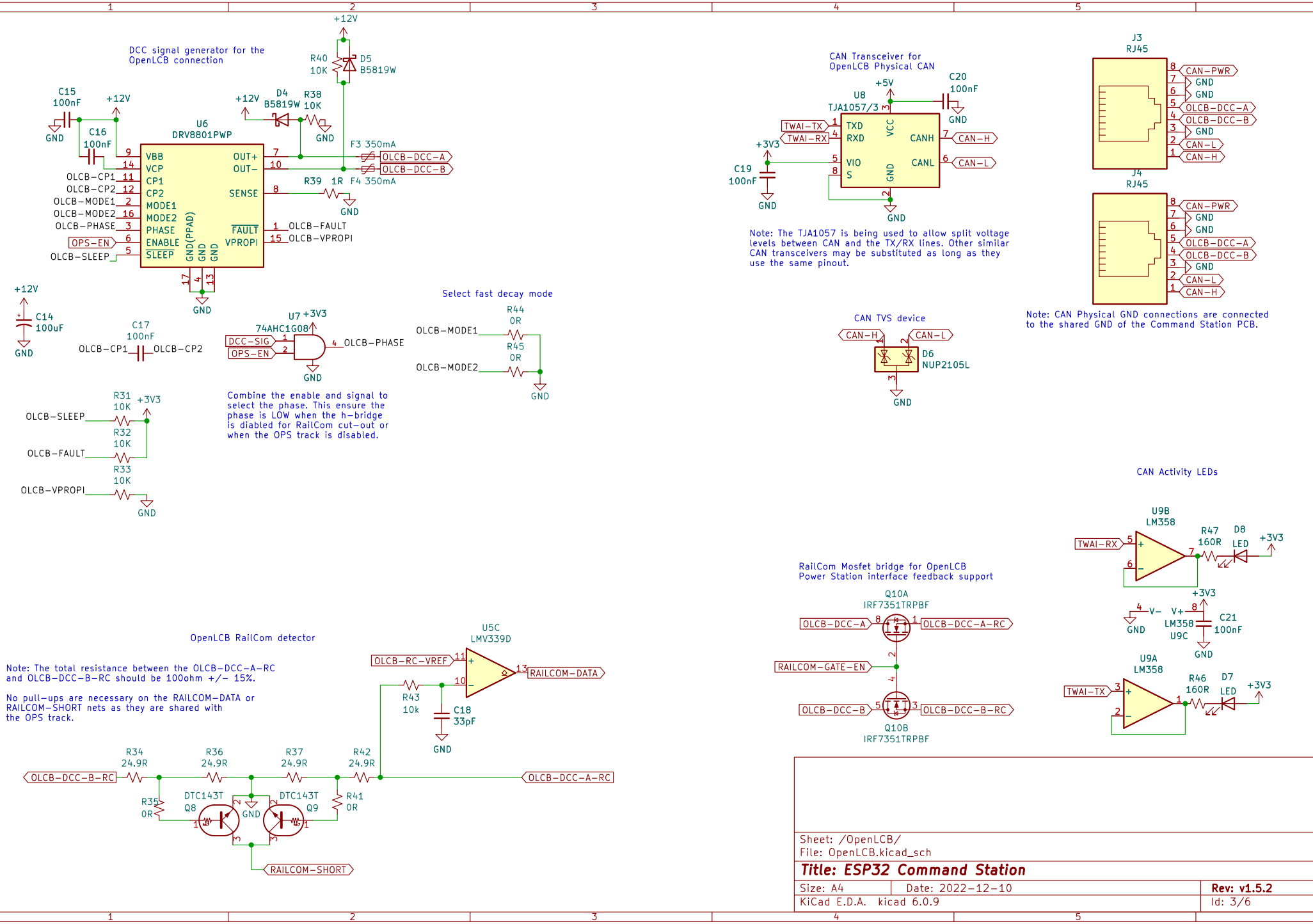
File: power.kicad_sch File: OpenLCB.kicad_sch File: OPS.kicad_sch File: PROG.kicad_sch File: status.kicad_sch

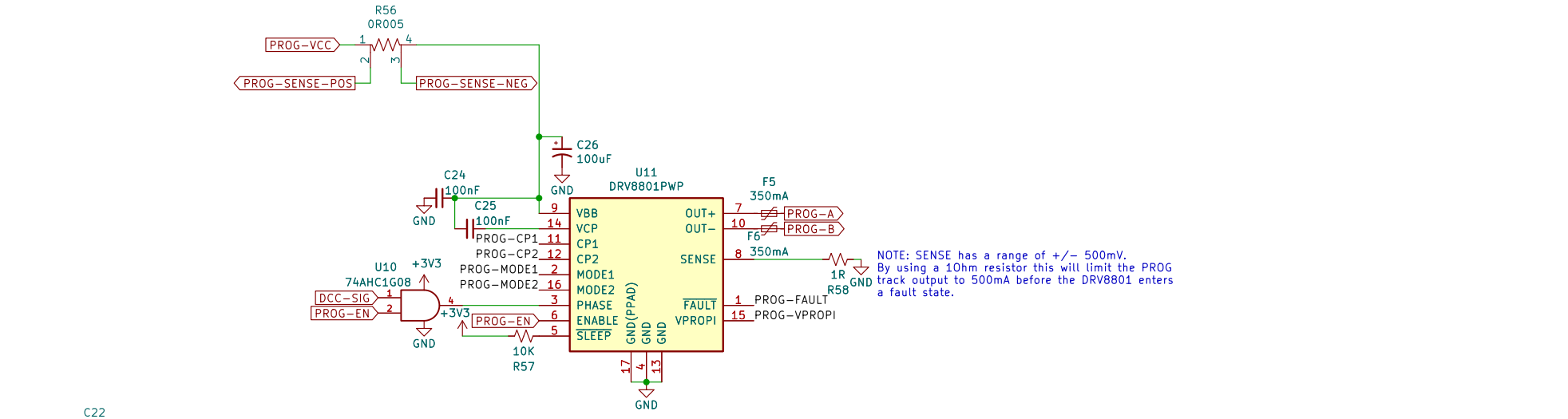
Sheet: /
File: esp32cspcb.kicad_sch

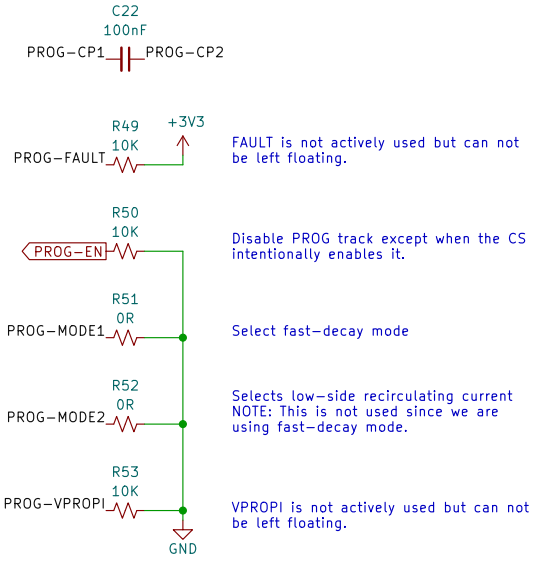
Title: ESP32 Command Station

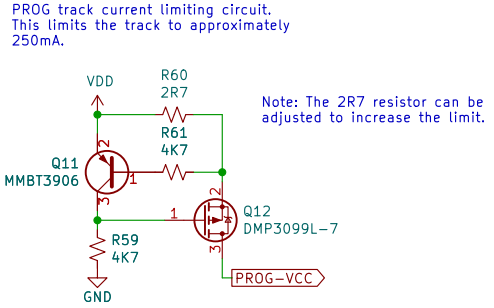
Size: A4	Date: 2022-12-10	**Rev: v1.5.2**
KiCad E.D.A. kicad 6.0.9		Id: 1/6

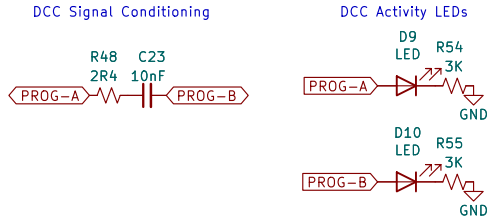

U4
DRV8873HPWPR
OPS-EN
DCC-SIG
OPS-SLEEP
OPS-BRAKE
OPS-DVDD
OPS-SR
OPS-MODE
OPS-NITRIP
OPS-NFAULT
OPS-DVDD
OPS-VCP
OPS-VDD
OPS-CPH
OPS-CPL
OPS-A
OPS-B
F1
F2
5A
R12
0R005
OPS-SENSE-NEG
OPS-SENSE-POS
GND
C7
47nF
C8
1uF
C6
100nF
C9
100nF
C10
47uF
Slew Rate Configuration
R5
0R
R10
0R
DNP
Slew (rise/fall) Rate:
To GND (0R) – 53.2V/usec
To GND (22K) – 34V/usec
To GND (68K) – 18.3V/usec
To GND (2M+) – 13V/usec
To DVDD (51K) – 7.9V/usec
To DVDD (0R) – 2.6V/usec
Only one resistor should be fitted and not both.
If both are omitted the default is 13V/usec.
Built-in current regulation control
Disable
Enable
R7 DNP
0R
R11
0R
OPS-NITRIP should be connected to either
GND or DVDD and not both.
The defualt trip point is around 6.5 Amps.
Not connecting either resistor will result in
this feature being enabled.
Fault reporting to the ESP32
OPS-FAULT
By default OPS-NFAULT will be HIGH
(via P/U), when the DRV8873 enters a
fault condition it will drive this LOW.
DCC Signal Conditioning
R15
2R4
C11
10nF
U5A
LMV339D
U5B
LMV339D
R19
10k
C12
33pF
OPS-RC-VREF
D3
B5819W
R23
10k
C13
33pF
R29
2k4
R30
2k4
ESP-3v3
RAILCOM-DATA
RAILCOM-DIR
U5D
LMV339D
U5E
LMV339D
+3V3
V-
V+
OPS-B-RC
OPS-A-RC
R20
2R4
R21
2R4
R18
0R
R24
0R
DTC143T
Q2
DTC143T
Q4
RAILCOM-SHORT
RailCom Mosfet bridge for the OPS track
Q1A
IRF7351TRPBF
Q1B
IRF7351TRPBF
RAILCOM-GATE-EN
R26
1K5
R27
10K
R22
10K
Q3
2N7002
Q6
2N7002
Q5
2N7002
Q7
2N7002
R28
2K4
RAILCOM-EN
R25
10k
C5
1uF
R6
0R
R8
10K
R9
10K
Disable OPS track except when the CS
intentionally enables it.
R13
10K
R14
10K
DCC Activity LEDs
D1
LED
R16
3K
D2
LED
R17
3K
Sheet: /OPS/
File: OPS.kicad_sch
Title: ESP32 Command Station
Size: A4
Date: 2022-12-10
Rev: v1.5.2
KiCad E.D.A. kicad 6.0.9
Id: 2/6


DCC signal generator for the OpenLCB connection
U6
DRV8801PWP
VBB
VCP
CP1
CP2
MODE1
MODE2
PHASE
ENABLE
SLEEP
GND(PPAD)
OUT+
OUT−
SENSE
FAULT
VPROPI
OLCB-CP1
OLCB-CP2
OLCB-MODE1
OLCB-MODE2
OLCB-PHASE
OPS-EN
OLCB-SLEEP
OLCB-FAULT
OLCB-VPROPI
F3 350mA
F4 350mA
OLCB-DCC-A
OLCB-DCC-B
R40 10K
D5 B5819W
D4 B5819W
R38 10K
R39 1R
C15 100nF
C16 100nF
C14 100uF
C17 100nF
+12V
GND
U7 74AHC1G08
DCC-SIG
OPS-EN
Select fast decay mode
R44 0R
R45 0R
Combine the enable and signal to select the phase. This ensure the phase is LOW when the h-bridge is diabled for RailCom cut-out or when the OPS track is disabled.
R31 10K
R32 10K
R33 10K
+3V3
CAN Transceiver for OpenLCB Physical CAN
U8
TJA1057/3
TXD
RXD
VIO
S
VCC
CANH
CANL
TWAI-TX
TWAI-RX
CAN-H
CAN-L
C20 100nF
C19 100nF
+5V
Note: The TJA1057 is being used to allow split voltage levels between CAN and the TX/RX lines. Other similar CAN transceivers may be substituted as long as they use the same pinout.
CAN TVS device
D6 NUP2105L
J3 RJ45
J4 RJ45
CAN-PWR
Note: CAN Physical GND connections are connected to the shared GND of the Command Station PCB.
OpenLCB RailCom detector
U5C LMV339D
OLCB-RC-VREF
RAILCOM-DATA
R43 10k
C18 33pF
Note: The total resistance between the OLCB-DCC-A-RC and OLCB-DCC-B-RC should be 100ohm +/- 15%.
No pull-ups are necessary on the RAILCOM-DATA or RAILCOM-SHORT nets as they are shared with the OPS track.
R34 24.9R
R36 24.9R
R37 24.9R
R42 24.9R
R35 0R
R41 0R
DTC143T
Q8
Q9
OLCB-DCC-A-RC
OLCB-DCC-B-RC
RAILCOM-SHORT
RailCom Mosfet bridge for OpenLCB Power Station interface feedback support
Q10A IRF7351TRPBF
Q10B IRF7351TRPBF
RAILCOM-GATE-EN
CAN Activity LEDs
U9B LM358
U9A LM358
U9C LM358
R47 160R
R46 160R
D8 LED
D7 LED
C21 100nF
V-
V+
Sheet: /OpenLCB/
File: OpenLCB.kicad_sch
Title: ESP32 Command Station
Size: A4
Date: 2022-12-10
Rev: v1.5.2
KiCad E.D.A. kicad 6.0.9
Id: 3/6







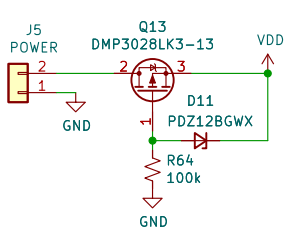


Sheet: /PROG/
File: PROG.kicad_sch

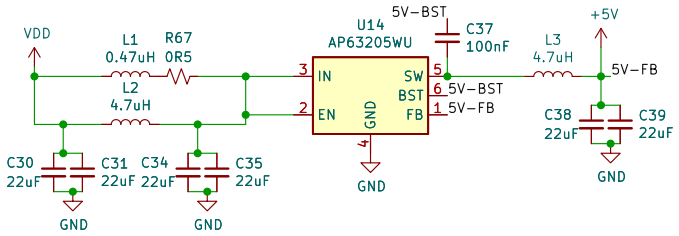
Title: ESP32 Command Station

Size: A4	Date: 2022-12-10	**Rev: v1.5.2**
KiCad E.D.A. kicad 6.0.9		Id: 4/6

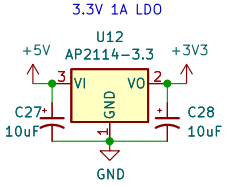
Incoming power with
Reverse Current protection



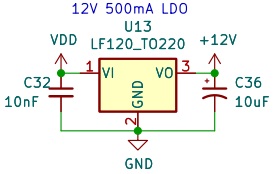
5V 2A buck converter



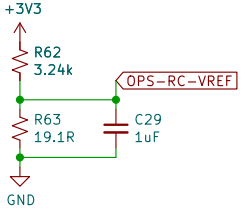
3.3V 1A LDO



12V 500mA LDO

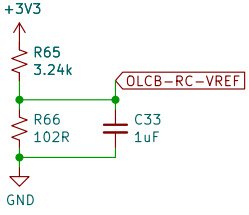


OPS track RailCom
reference voltage



OPS-RC-VREF = (3.3v x R) / (R + R)
OPS-RC-VREF = (3.3 x 19.1) / (3240 + 19.1)
OPS-RC-VREF = 19mV

OpenLCB connection RailCom
reference voltage



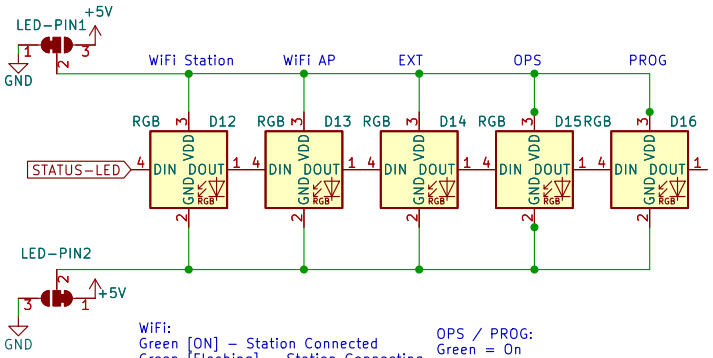
OLCB-RC-VREF = (3.3v x R) / (R + R)
OLCB-RC-VREF = (3.3v x 102) / (3240 + 102)
OLCB-RC-VREF = 101mV

Sheet: /Power/
File: power.kicad_sch

Title: ESP32 Command Station

Size: A4	Date: 2022-12-10	**Rev: v1.5.2**
KiCad E.D.A. kicad 6.0.9		Id: 5/6

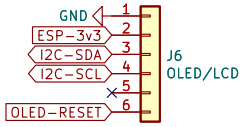
Status LEDs



WiFi:
Green [ON] – Station Connected
Green [Flashing] – Station Connecting
Blue [ON] – SoftAP Active
Blue [Flashing] – SoftAP Starting
Red – Disconnected

OPS / PROG:
Green = On
Off/Black = Off
Yellow = Usage warning (75% of limit)
Red = Fault/Short

Status Display connection



The Status Display connection is for adding an OLED or LCD display to the Command Station. The display shows real-time statistics and status information about the Command Station.

Note: OLED-RESET will be pulsed LOW for approximately 50ms during startup to allow a connected OLED display to reset.

I2C pull-up resistors

Sheet: /Status/		
File: status.kicad_sch		
Title: ESP32 Command Station		
Size: A4	Date: 2022-12-10	**Rev: v1.5.2**
KiCad E.D.A. kicad 6.0.9		Id: 6/6