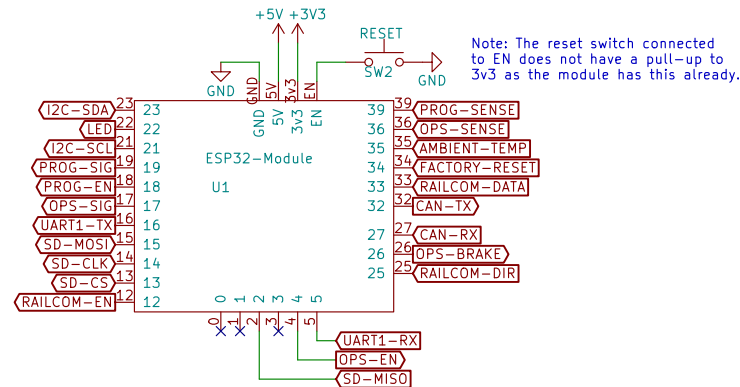
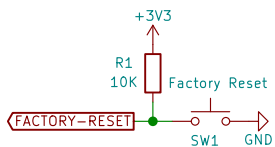
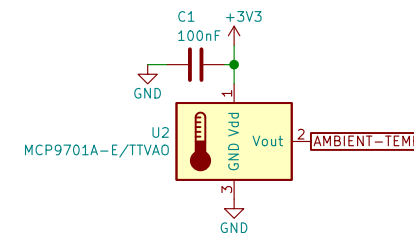


ESP32 Microcontroller (TTGO-T1 or DevKit-C) module.

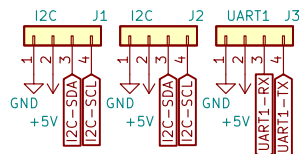


Ambient temperature sensor



The factory reset jumper can be used to clear all persistent configuration data during startup. It is not recommended to keep this jumper in place during normal operation.

Command Station expansion ports

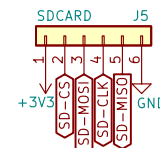


I2C is only used today for OLED/LCD devices. UART1 currently unused but will be in the future.

Track Output connections



SD Module connection



When using a DevKit-C (or compatible) ESP32 module it is recommended to use an SD card SPI module. This is to reduce the wear on the on-board FLASH and to allow updating the CS in the future. For the TTGO-T1 this is not used since it has this on-board.

I2C SDA/SCL pull-up resistors for 3v3 I2C bus



Sheet: Power

File: pcb-power.sch

Sheet: OPS Track DCC

File: pcb-ops-dcc.sch

Sheet: LCC DCC Signal

File: pcb-lcc-dcc.sch

Sheet: RailCom Detector

File: pcb-railcom.sch

Sheet: Status LEDs

File: pcb-status-led.sch

Sheet: Programming Track DCC

File: pcb-prog-dcc.sch

Sheet: LCC CAN

File: pcb-lcc-can.sch

Sheet: /  
File: pcb.sch

**Title: ESP32 Command Station with LCC and RailCom**

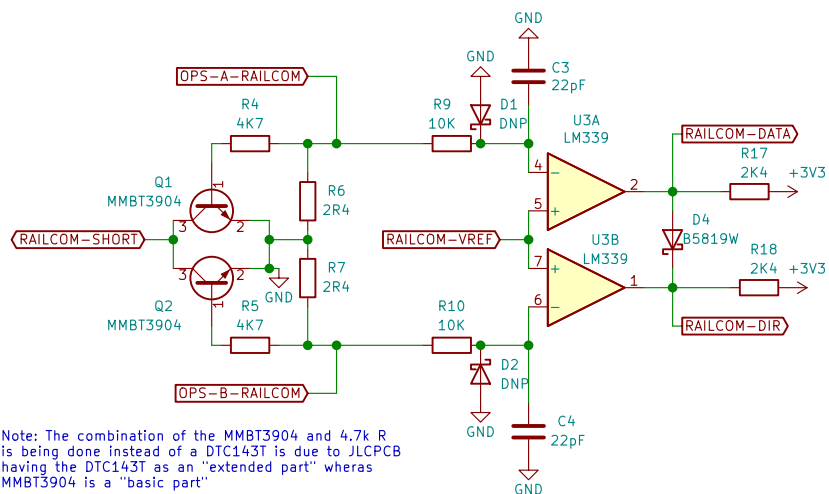
Size: A4 Date: 2020-09-13

KiCad E.D.A. kicad 5.1.6

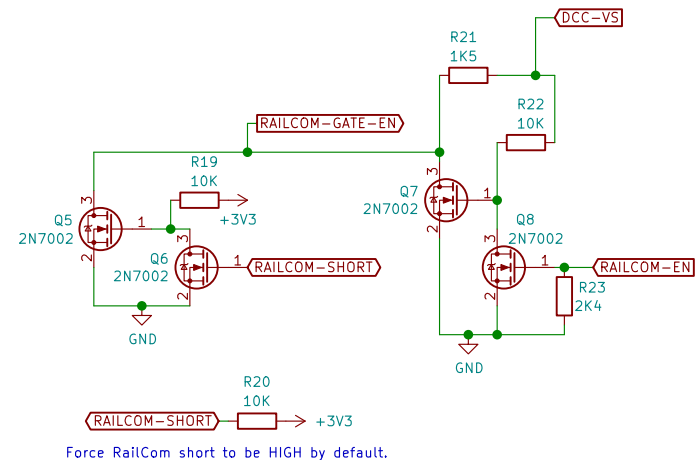
Rev: 1.4

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OPS Track RailCom detector circuit



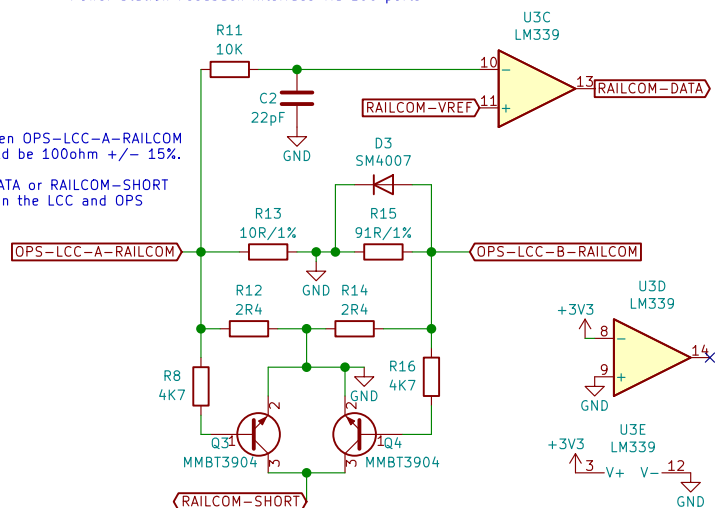
RailCom FET gate enable circuit



Power Station Feedback Interface via LCC ports

Note: The total resistance between OPS-LCC-A-RAILCOM and OPS-LCC-B-RAILCOM should be 100ohm +/- 15%.

No P/U is added to RAILCOM-DATA or RAILCOM-SHORT as these nets are shared between the LCC and OPS detectors.



NOTE: The usage of two LM393 instead of one LM339 is due to JLCPCB having LM339 as an "extended part" and LM393 as a "basic part"

TP1 RAILCOM-EN  
○ RAILCOM-EN  
TP2 RAILCOM-DATA  
○ RAILCOM-DATA  
TP3 RAILCOM-SHORT  
○ RAILCOM-SHORT

Sheet: /RailCom Detector/  
File: pcb-railcom.sch

Title:

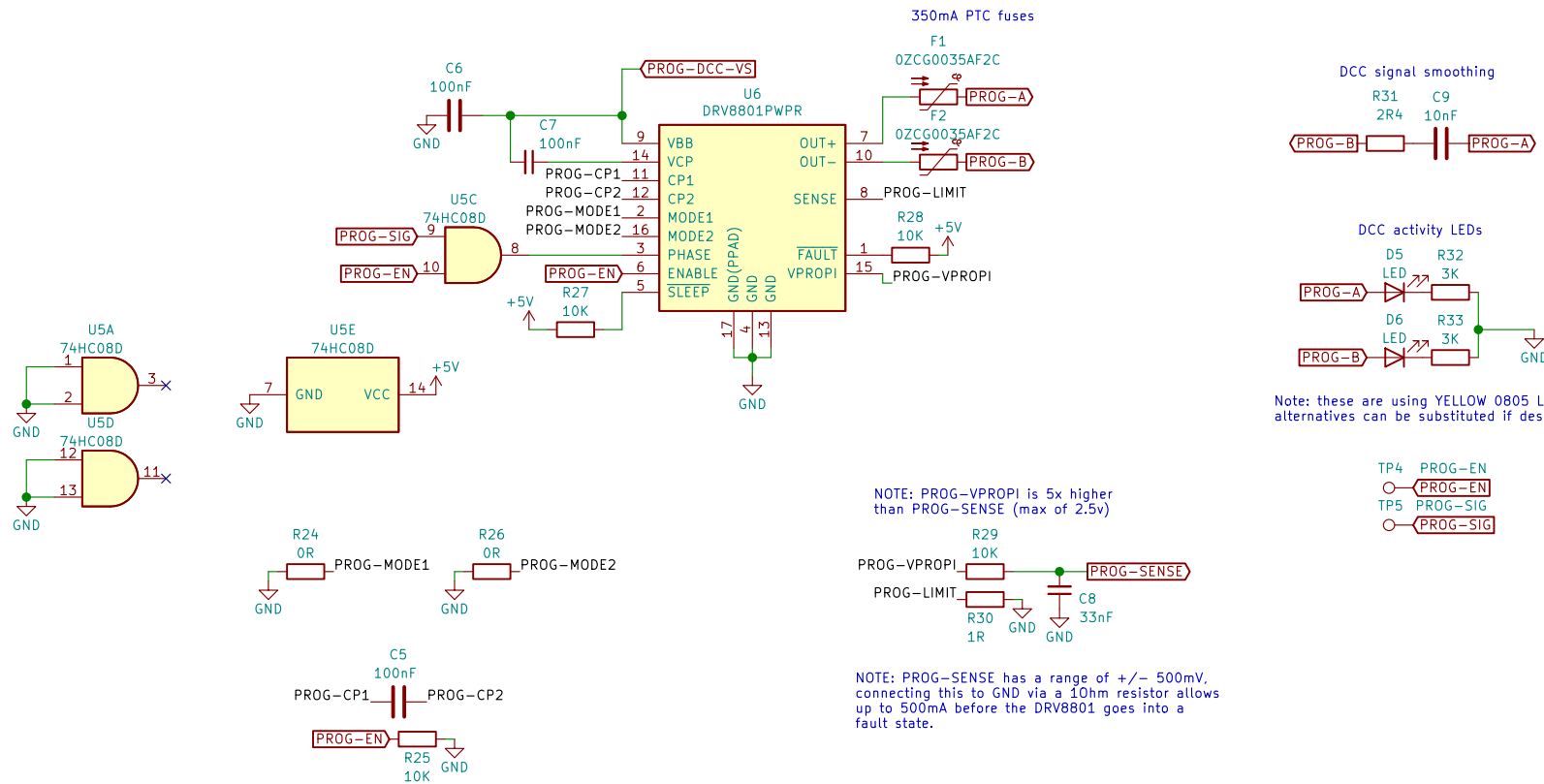
Size: A4 Date: 2020-09-13

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Id: 2/8

# DCC signal generator for PROG track



Sheet: /Programming Track DCC/  
File: pcb-prog-dcc.sch

## Title:

Size: A4 Date: 2020-09-13

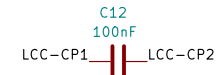
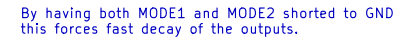
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Rev: 1.4

Id: 3/8

[illegible]

NOTE: SENSE has a range of  $\pm 500\text{mV}$ , connecting this to GND via a  $10\text{ohm}$  resistor allows up to  $500\text{mA}$  before the DRV8801 goes into a fault state.

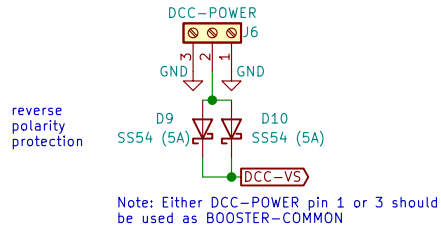


Note: these are using YELLOW 0805 LEDs, alternatives can be substituted if desired.

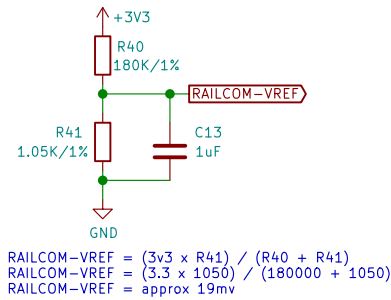
[illegible]

Sheet: /LCC DCC Signal/		D
File: pcb-lcc-dcc.sch		
<b>Title:</b>		
Size: A4	Date: 2020-09-13	
KiCad E.D.A. kicad 5.1.6		Rev: 1.4 Id: 4/8

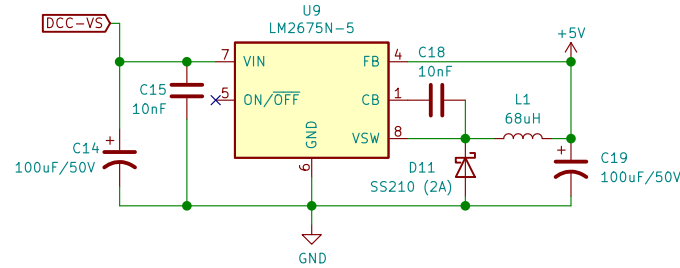
PCB and DCC power supply connection



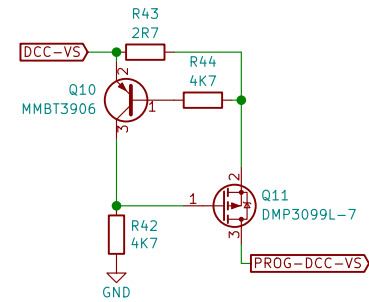
RailCom Reference Voltage



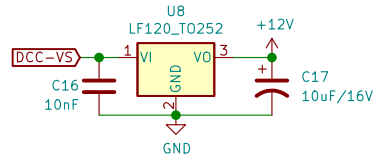
5V 1A switching step-down converter



Programming track DCC current limited voltage supply (approx 250mA)



12V 500mA LDO for LCC-DCC signal output



Sheet: /Power/  
File: pcb-power.sch

**Title:**

Size: A4 Date: 2020-09-13

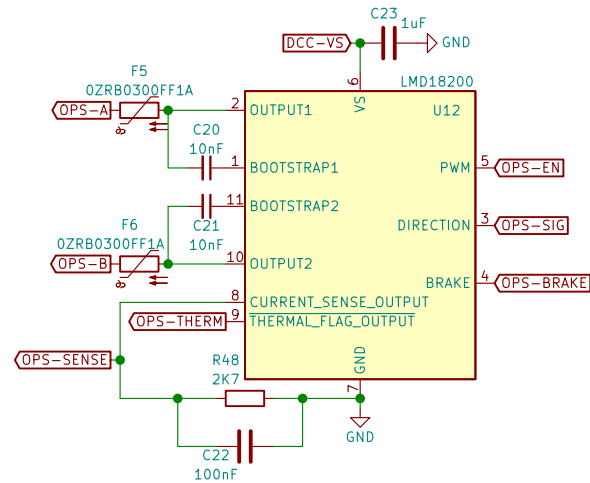
KiCad E.D.A. kicad 5.1.6

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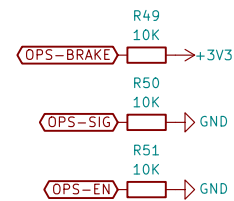
LMD18200 h-bridge (3A continous, 6A peak) for OPS track DCC signal generation.



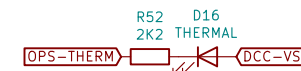
Note: The CURRENT\_SENSE\_OUTPUT is an INLINE output from the h-bridge. The PWM and DIR have a PULL-DOWN and BRAKE has a PULL-UP to force the LMD18200 into a known state on startup (IE: OFF)

- H5 Heatsink Mount 1
- H6 Heatsink Mount 2

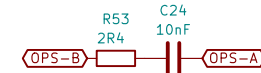
P/U and P/D to force LMD18200 into a known state on startup.



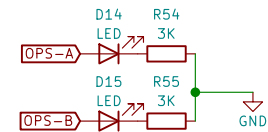
Thermal alert LED (RED), when ON the LMD18200 is detecting a temperature of at least 145C.



DCC Signal smoothing

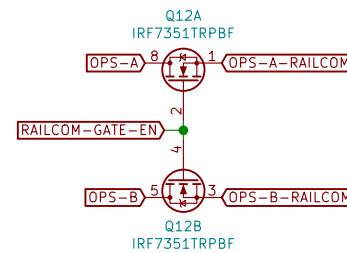


DCC activity LEDs



Note: these are using YELLOW 0805 LEDs, alternatives can be substituted if desired.

RailCom FET bridge for OPS track



- TP6 OPS-SIG
- TP7 OPS-EN
- TP8 OPS-BRAKE

Sheet: /OPS Track DCC/  
File: pcb-ops-dcc.sch

**Title:**

Size: A4 Date: 2020-09-13

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**Rev: 1.4**

Id: 7/8

LED color indications:

OPS and PROG:  
GREEN = ON  
BLACK = OFF  
RED = FAULT/SHORT

Id: 8/8