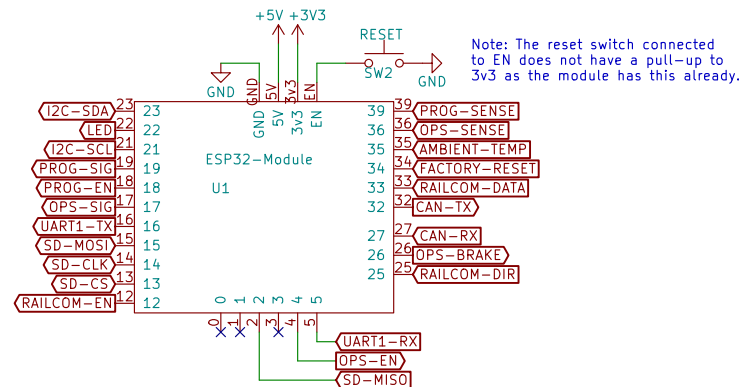
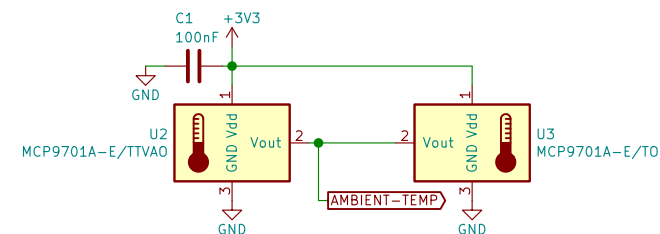


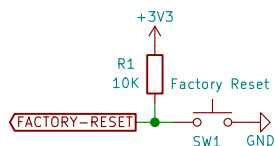
ESP32 Microcontroller (TTGO-T1 or DevKit-C) module.



Ambient temperature sensor

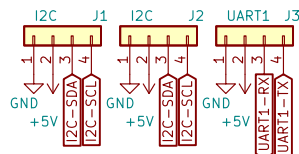


Of the two MCP9701A footprints, only one should be populated. The only difference between the two is SMD vs THT. The THT option may be preferred since it can be elevated off the PCB and be oriented to nearly touch the LMD18200 h-bridge.



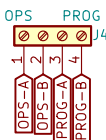
The factory reset jumper can be used to clear all persistent configuration data during startup. It is not recommended to keep this jumper in place during normal operation.

Command Station expansion ports

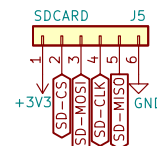


I2C is only used today for OLED/LCD devices. UART1 currently unused but will be in the future.

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

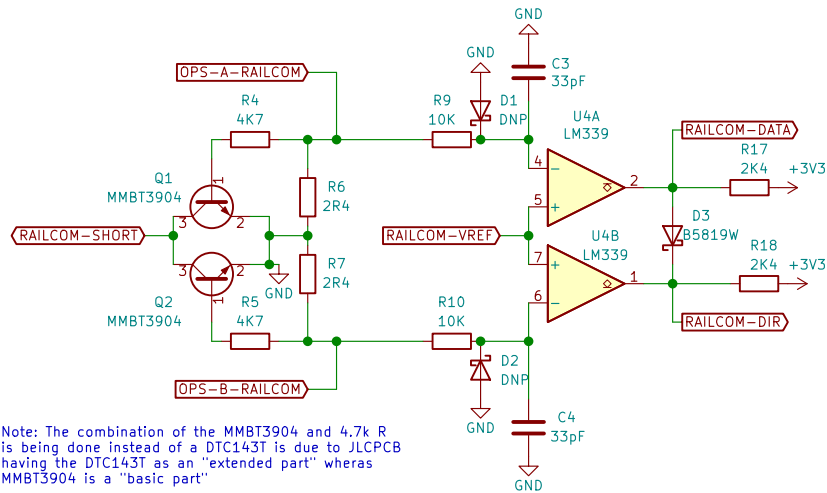
Size: A4 Date: 2020-10-28

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Rev: 1.4

Id: 1/8

OPS Track RailCom detector circuit

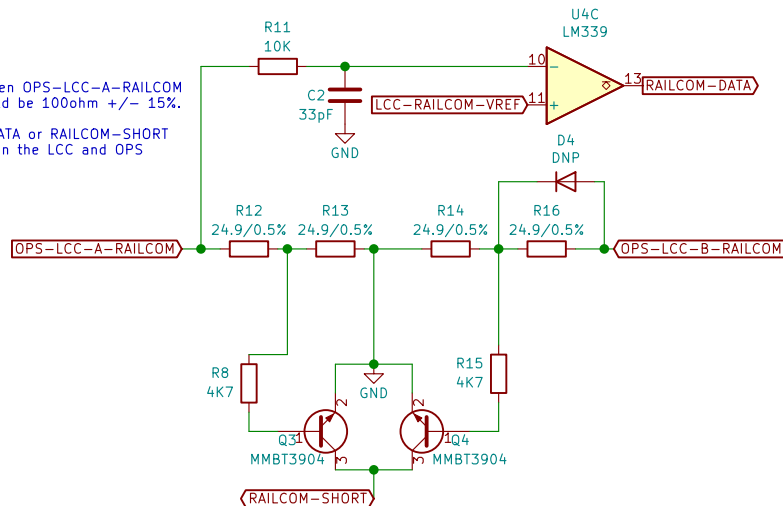


Note: The combination of the MMBT3904 and 4.7k R is being done instead of a DTC143T is due to JLCPCB having the DTC143T as an "extended part" whereas MMBT3904 is a "basic part"

Power Station Feedback Interface via LCC ports

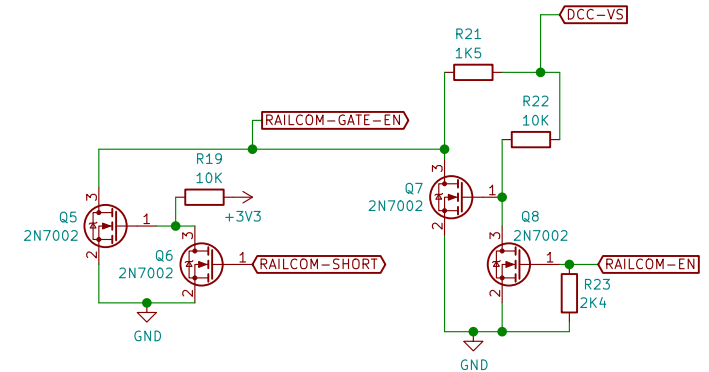
Note: The total resistance between OPS-LCC-A-RAILCOM and OPS-LCC-B-RAILCOM should be 100ohm +/- 15%.

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

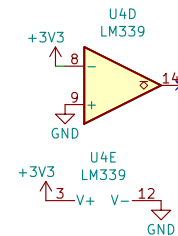


Note: The combination of the MMBT3904 and 4.7k R is being done instead of a DTC143T is due to JLCPCB having the DTC143T as an "extended part" whereas MMBT3904 is a "basic part"

RailCom FET gate enable circuit



Force RailCom short to be HIGH by default.



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

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"

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

Title:

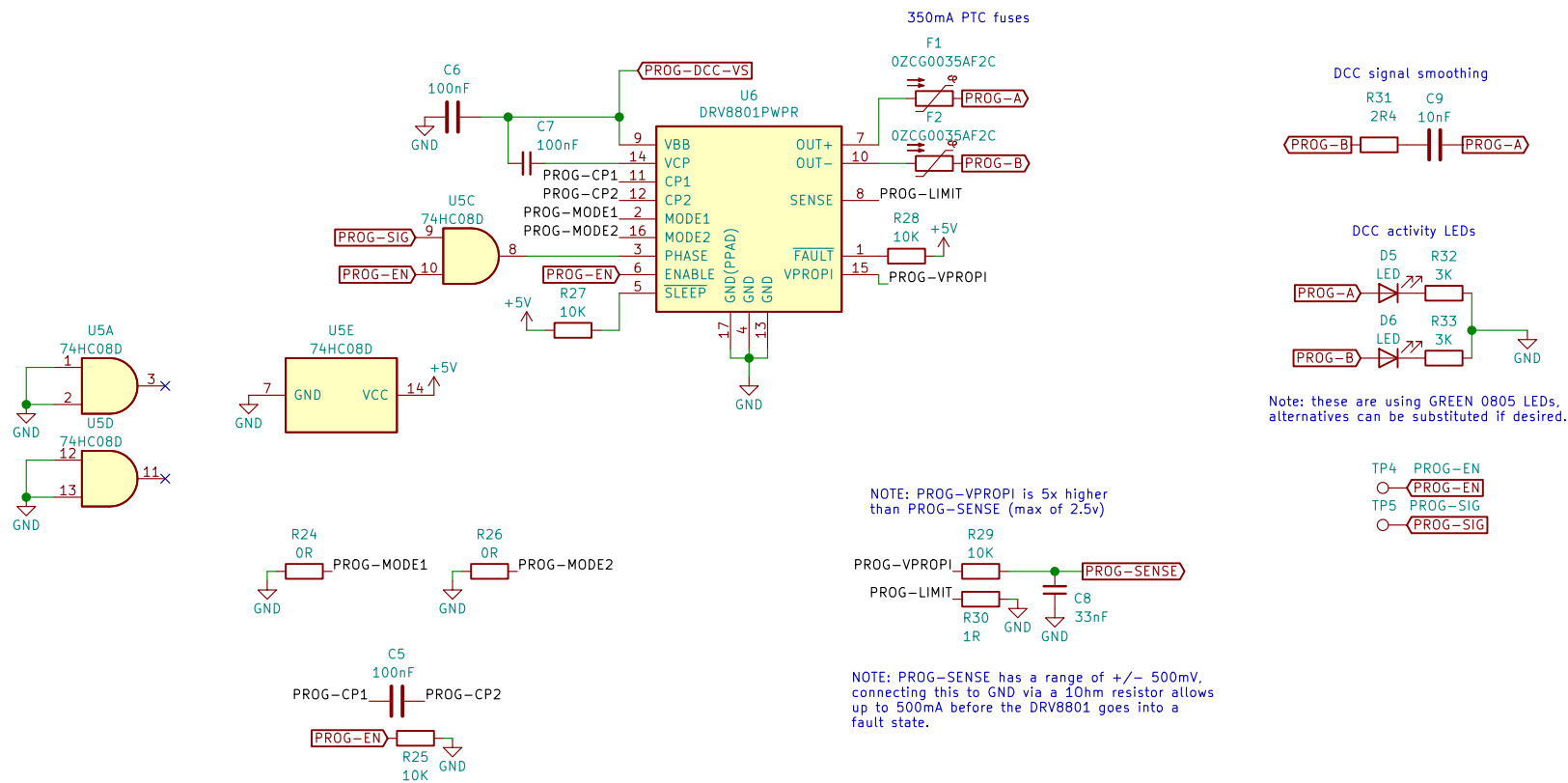
Size: A4 Date: 2020-10-28

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Rev: 1.4

Id: 2/8

DCC signal generator for PROG track



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

Title:

Size: A4
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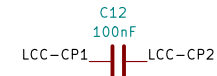
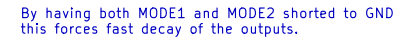
Date: 2020-10-28

Rev: 1.4

Id: 3/8

NOTE: SENSE has a range of +/- 500mV, connecting this to GND via a 10hm resistor allows up to 500mA before the DRV8801 goes into a fault state.

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



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

Q9A
IRF7351TRPBF

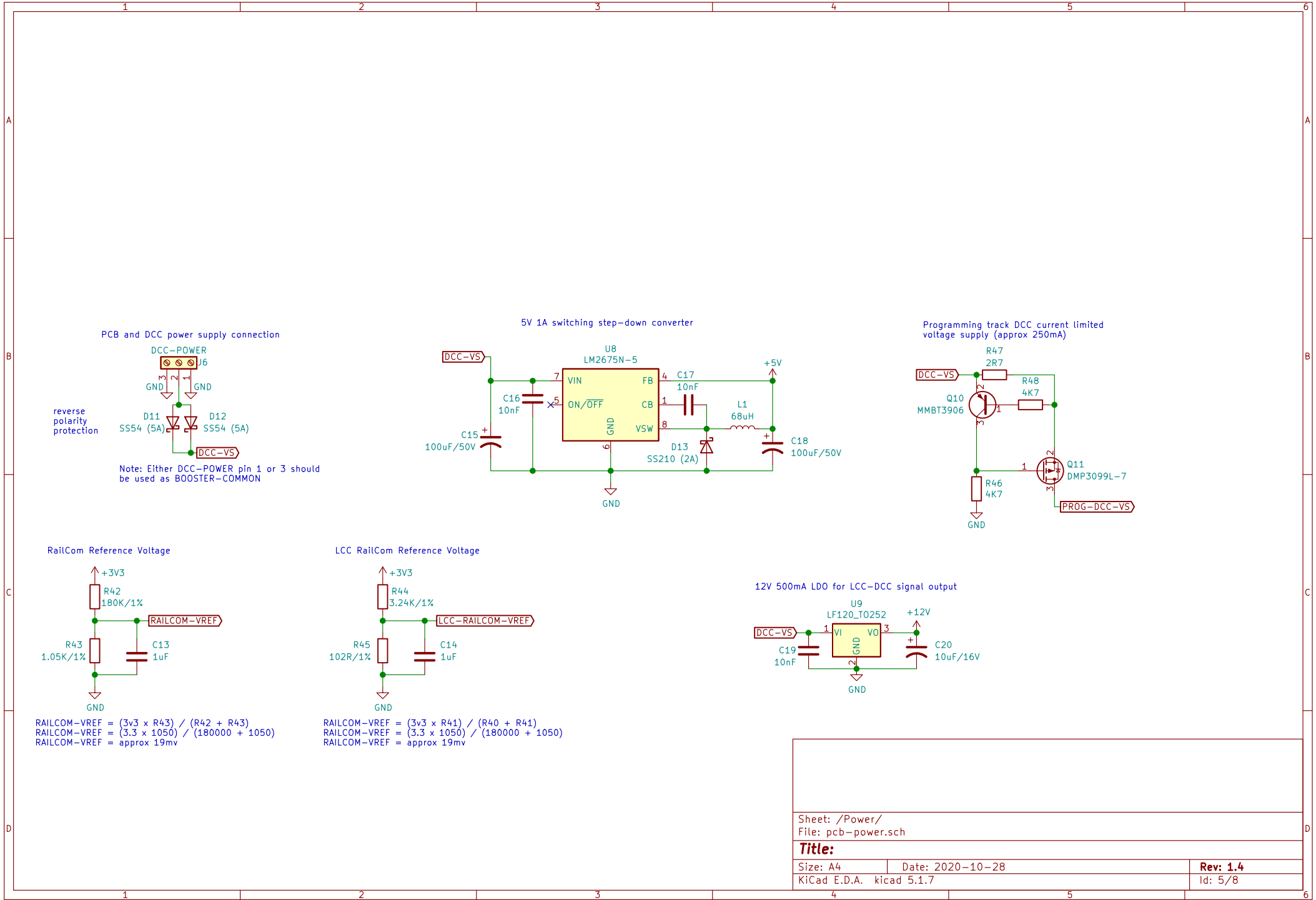
OPS-LCC-A 8 4 1 OPS-LCC-A-RAILCOM

RAILCOM-GATE-EN 2 4

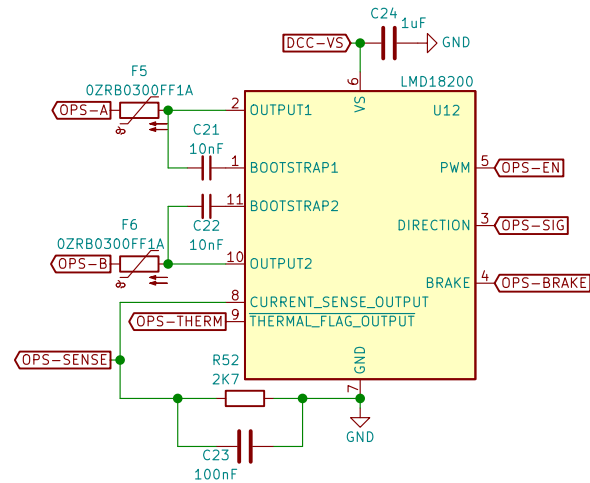
OPS-LCC-B 5 3 OPS-LCC-B-RAILCOM

Q9B
IRF7351TRPBF

Sheet: /LCC DCC Signal/		D
File: pcb-lcc-dcc.sch		
Title:		
Size: A4	Date: 2020-10-28	
KiCad E.D.A. kicad 5.1.7		Rev: 1.4 Id: 4/8



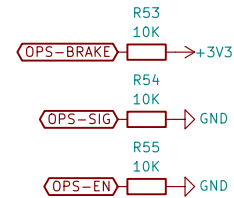
LMD18200 h-bridge (3A continous, 6A peak) for OPS track DCC signal generation.



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

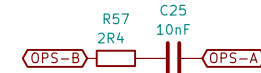
P/U and P/D to force LMD18200 into a known state on startup.



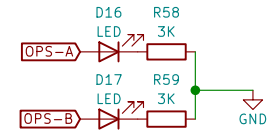
Thermal alert LED (RED), when ON the LMD18200 is detecting a temperature of at least 145C.



DCC Signal smoothing

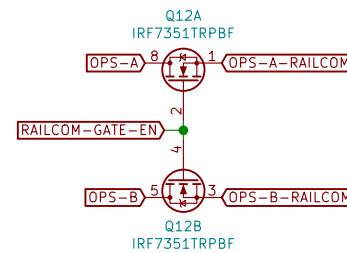


DCC activity LEDs



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

RailCom FET bridge for OPS track



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

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

Title:

Size: A4 Date: 2020-10-28
KiCad E.D.A. kicad 5.1.7

Rev: 1.4
Id: 7/8

