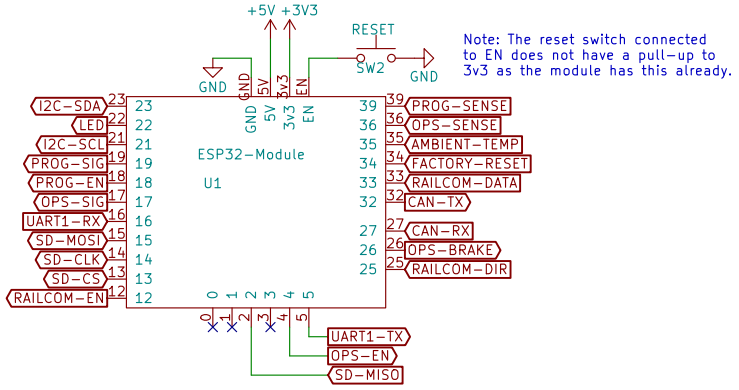
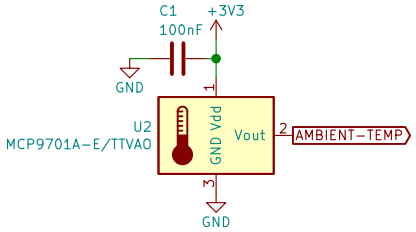
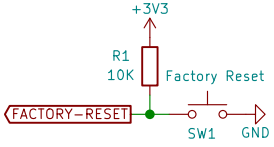
ESP32 Microcontroller (TTGO-T1 or DevKit-C) module.



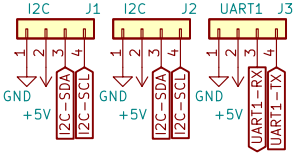
Ambient temperature sensor





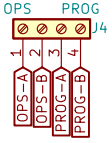
The factory reset jumper can be used to clear all persistent configuration data during startup. It is not recommended to keep this jumper in place during normal operation.

Command Station expansion ports

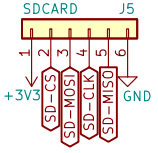


I2C is only used today for OLED/LCD devices. UART1 currently unused but will be in the future.

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.

Sheet: Power
File: pcb-power.sch

Sheet: Status LEDs
File: pcb-status-led.sch

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

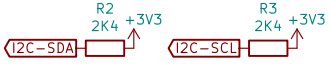
Sheet: Programming Track DCC
File: pcb-prog-dcc.sch

Sheet: LCC DCC Signal
File: pcb-lcc-dcc.sch

Sheet: LCC CAN
File: pcb-lcc-can.sch

Sheet: RailCom Detector
File: pcb-railcom.sch

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



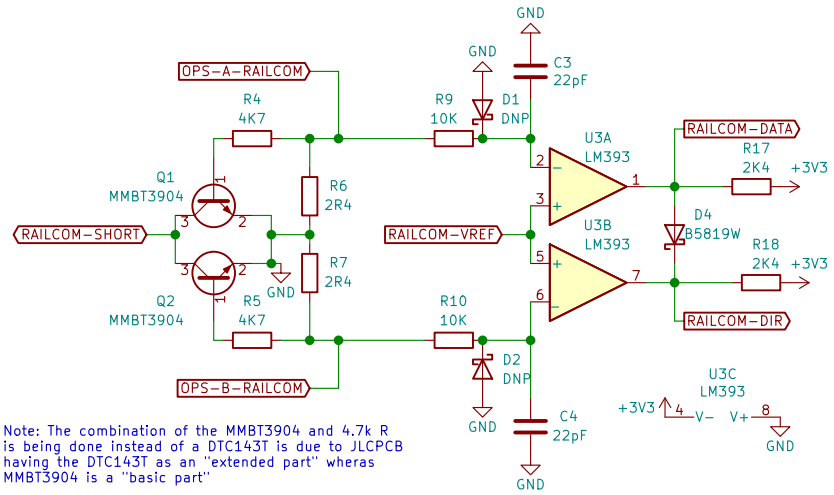
H1 MountingHole
H2 MountingHole
H3 MountingHole
H4 MountingHole

Sheet: /
File: pcb.sch

Title: ESP32 Command Station with LCC and RailCom

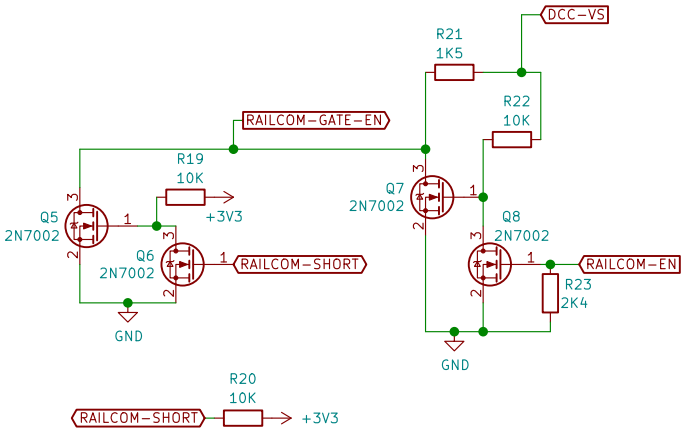
Size: A4	Date: 2020-07-31	**Rev: 1.3**
KiCad E.D.A. kicad 5.1.6		Id: 1/8

OPS Track RailCom detector circuit



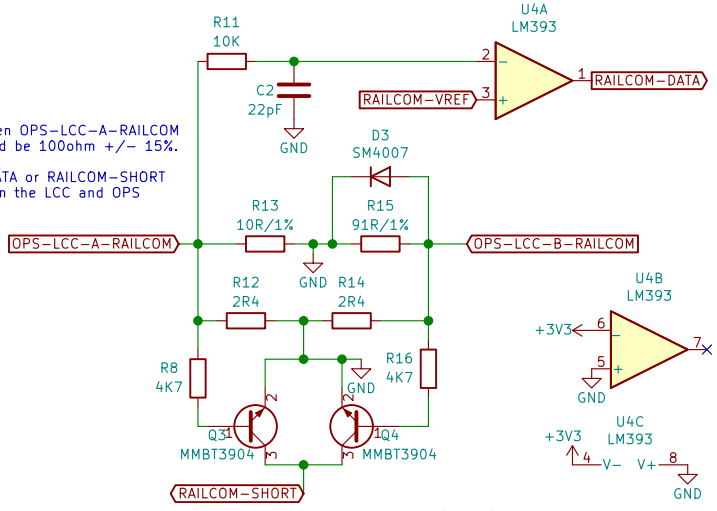
Note: The combination of the MMBT3904 and 4.7k R is being done instead of a DTC143T is due to JLCPCB having the DTC143T as an "extended part" wheras MMBT3904 is a "basic part"

RailCom FET gate enable circuit



Force RailCom short to be HIGH by default.

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" wheras MMBT3904 is a "basic part"

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"

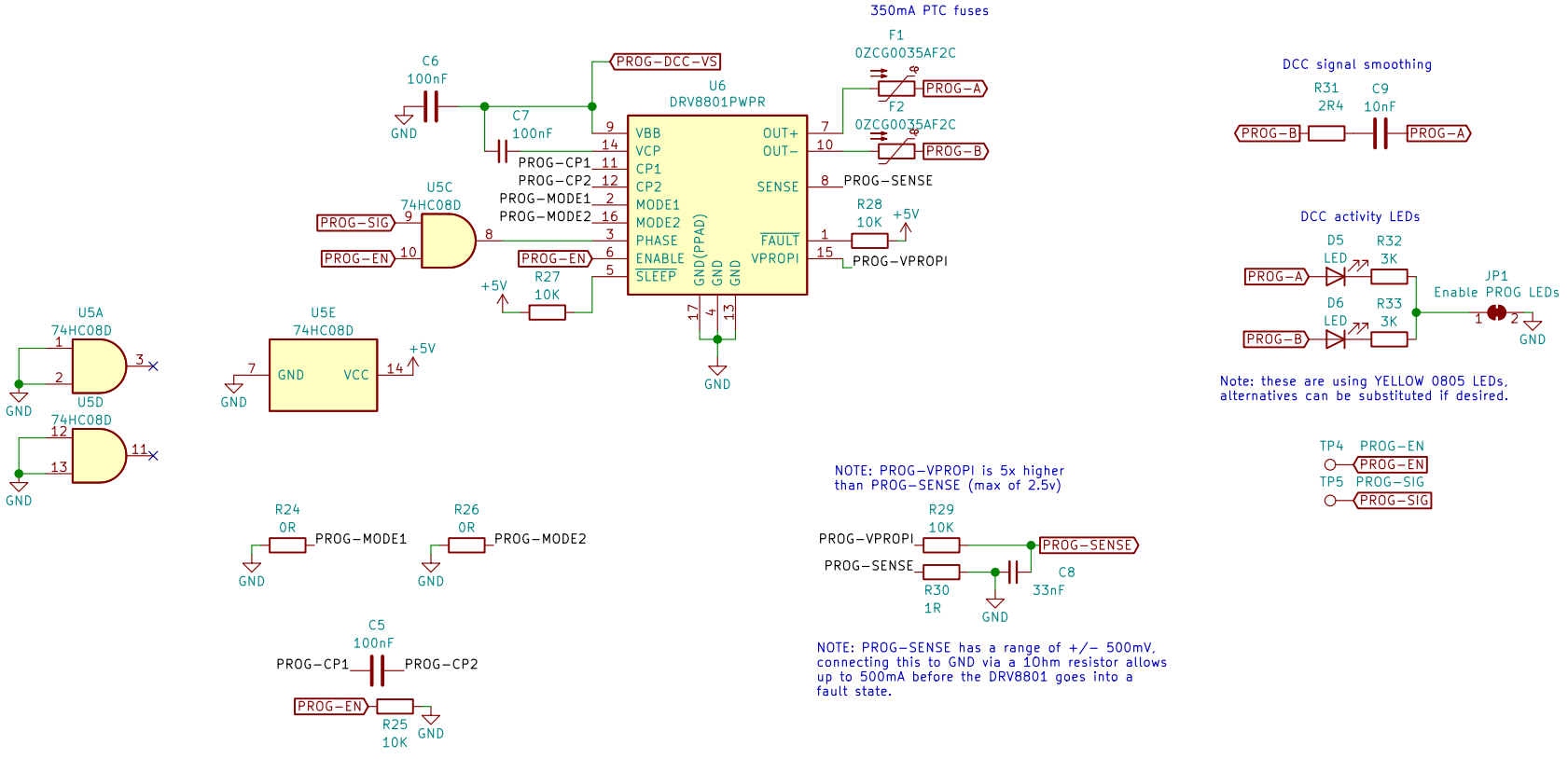
TP1 RAILCOM-EN
TP2 RAILCOM-DATA
TP3 RAILCOM-SHORT

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

Title:

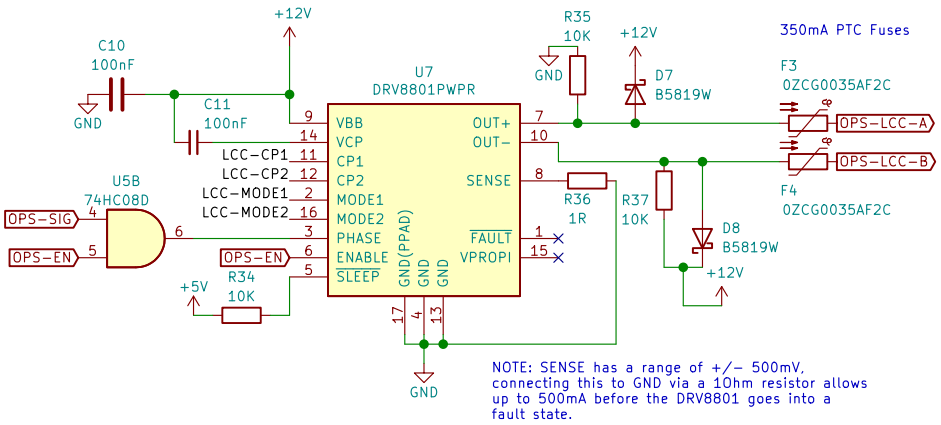
Size: A4	Date: 2020-07-31	**Rev:**
KiCad E.D.A. kicad 5.1.6		Id: 2/8

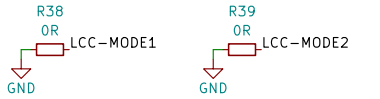
DCC signal generator for PROG track



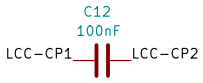
Sheet: /Programming Track DCC/		
File: pcb-prog-dcc.sch		
Title:		
Size: A4	Date: 2020-07-31	**Rev:**
KiCad E.D.A. kicad 5.1.6		Id: 3/8

LCC DCC Signal based on the OPS track signal

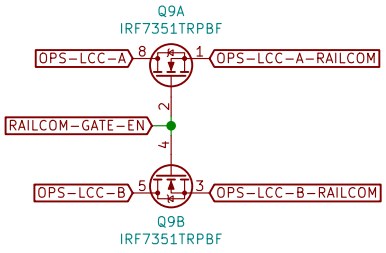




By having both MODE1 and MODE2 shorted to GND this forces fast decay of the outputs.

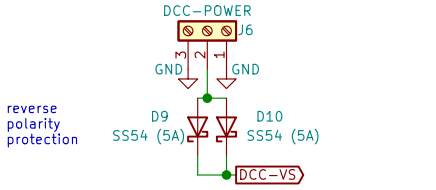


RailCom FET Bridge for LCC Booster Feedback



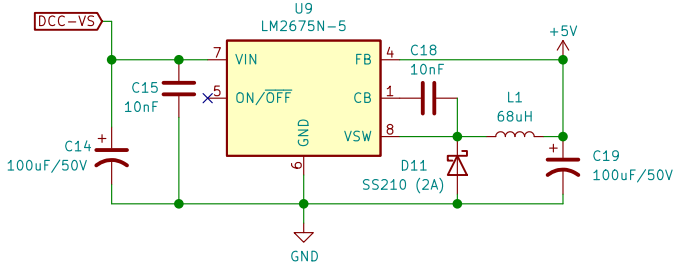
Sheet: /LCC DCC Signal/		
File: pcb−lcc−dcc.sch		
Title:		
Size: A4	Date: 2020−07−31	**Rev:**
KiCad E.D.A. kicad 5.1.6		Id: 4/8

PCB and DCC power supply connection

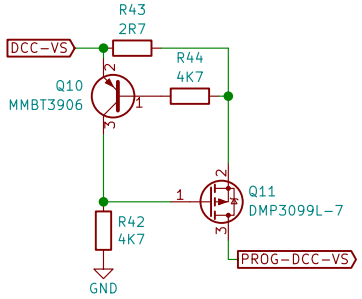


Note: Either DCC-POWER pin 1 or 3 should be used as BOOSTER-COMMON

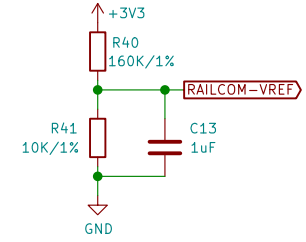
5V 1A switching step-down converter



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

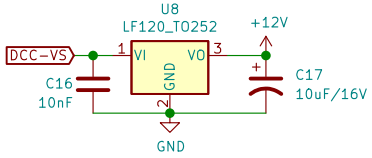


RailCom Reference Voltage



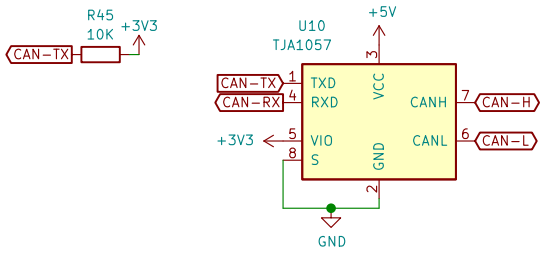
RAILCOM-VREF = (3v3 x R38) / (R37 + R38)
RAILCOM-VREF = (3.3 x 10000) / (160000 + 10000)
RAILCOM-VREF = approx 19mv

12V 500mA LDO for LCC-DCC signal output

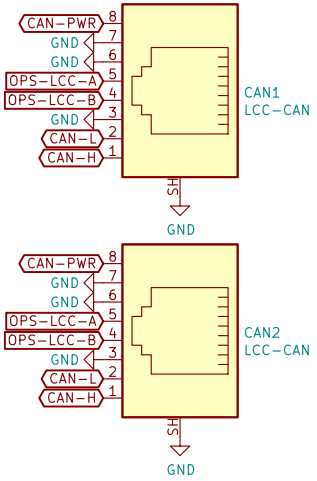


Sheet: /Power/		
File: pcb-power.sch		
Title:		
Size: A4	Date: 2020-07-31	**Rev:**
KiCad E.D.A. kicad 5.1.6		Id: 5/8

CAN Transceiver for LCC Physical CAN



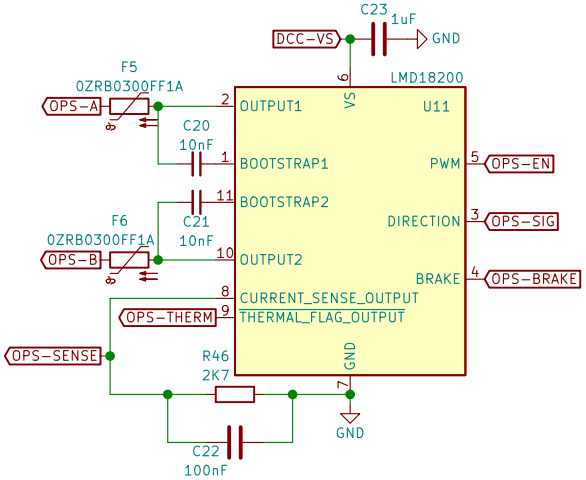
Note: The TJA1057 is being used to allow split voltage levels between the MCU and the CAN bus.



NOTE: Can Physical GND connections are connected to the shared GND of the PCB.

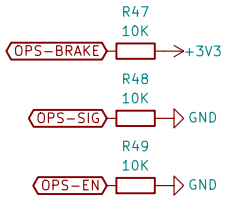
Sheet: /LCC CAN/		
File: pcb-lcc-can.sch		
Title:		
Size: A4	Date: 2020-07-31	**Rev:**
KiCad E.D.A. kicad 5.1.6		Id: 6/8

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)

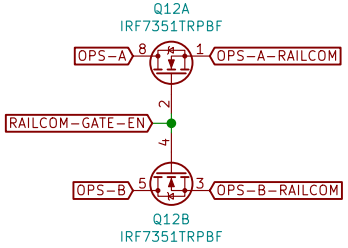
P/U and P/D to force LMD18200 into a known state on startup.



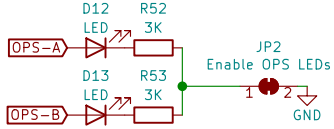
Thermal alert LED (RED), when ON the LMD18200 is detecting a temperature of at least 145C.

DCC Signal smoothing

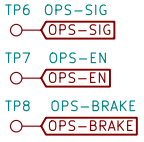
RailCom FET bridge for OPS track



DCC activity LEDs



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

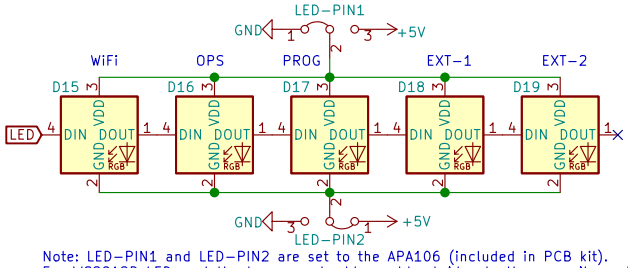


Sheet: /OPS Track DCC/
File: pcb-ops-dcc.sch

Title:

Size: A4	Date: 2020-07-31	**Rev:**
KiCad E.D.A. kicad 5.1.6		Id: 7/8

Command Station status output RGB LEDs



Note: LED-PIN1 and LED-PIN2 are set to the APA106 (included in PCB kit).
For WS2812B LEDs cut the traces and add a solder bridge to the opposite pads.

LED color indications:

WiFi:
GREEN [ON] = connected
GREEN [FLASHING] = connecting
RED = disconnected
BLUE = SoftAP available

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

EXT-1 and EXT-2 LEDs are currently unused
and can safely be left unpopulated.

Sheet: /Status LEDs/		
File: pcb-status-led.sch		
Title:		
Size: A4	Date: 2020-07-31	**Rev:**
KiCad E.D.A. kicad 5.1.6		Id: 8/8