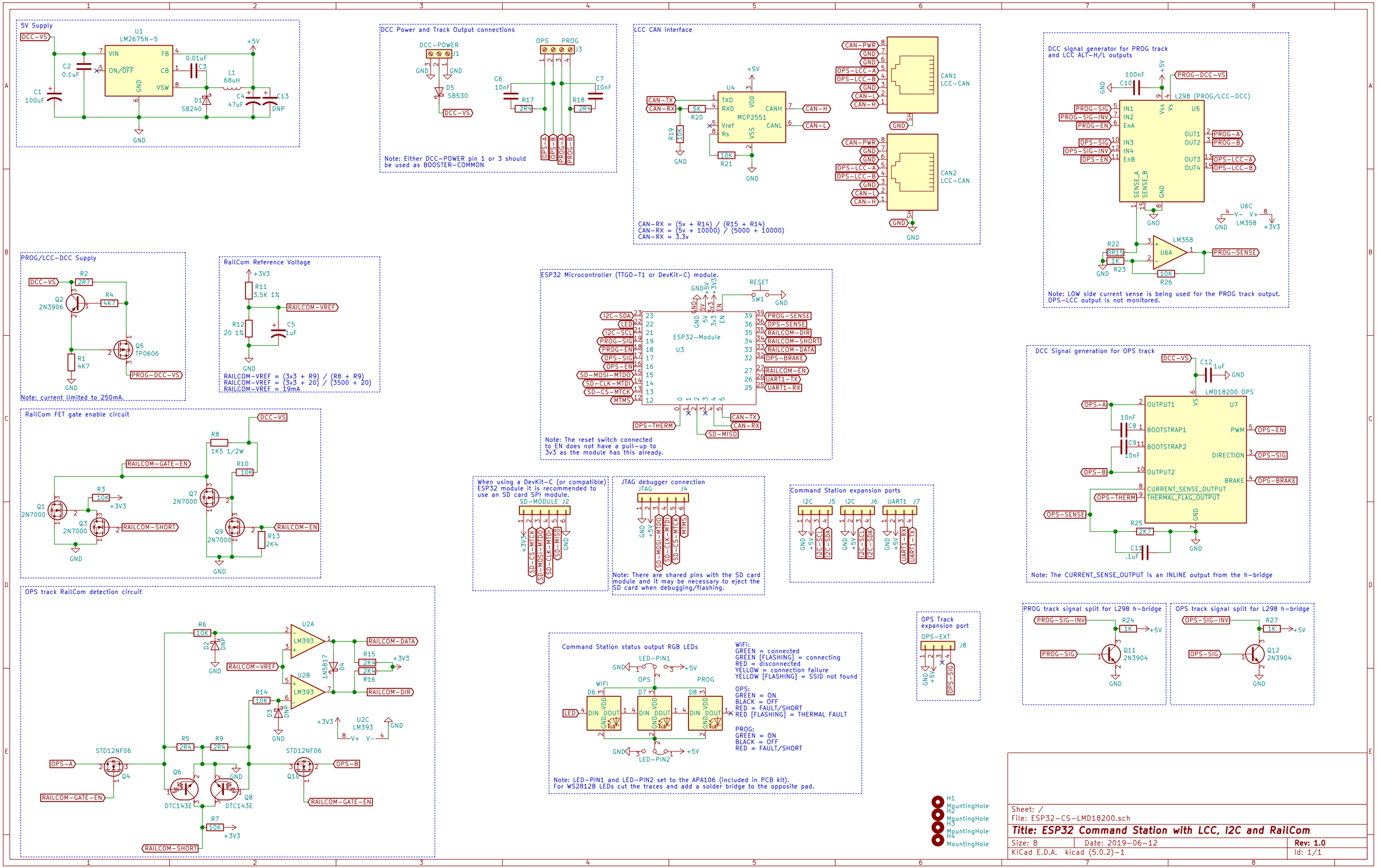
5V Supply
U1
LM2675N-5
DCC-VS
VIN
FB
ON/OFF
CB
GND
VSW
C1
100uF
C2
0.1uF
0.01uF
C3
L1
68uH
+5V
D1
SB240
C4
47uF
C13
DNP
GND
DCC Power and Track Output connections
DCC-POWER
J1
D5
SB530
OPS
PROG
J3
C6
10nF
C7
10nF
R17
2R4
R18
2R4
OPS-A
OPS-B
PROG-A
PROG-B
Note: Either DCC-POWER pin 1 or 3 should be used as BOOSTER-COMMON
LCC CAN interface
U4
MCP2551
TXD
RXD
Vref
Rs
VDD
VSS
CANH
CANL
CAN-TX
CAN-RX
5K
R20
R19
10K
10K
R21
CAN-H
CAN-L
CAN-PWR
OPS-LCC-A
OPS-LCC-B
CAN1
LCC-CAN
CAN2
LCC-CAN
CAN-RX = (5v + R14) / (R15 + R14)
CAN-RX = (5v + 10000) / (5000 + 10000)
CAN-RX = 3.3v
DCC signal generator for PROG track and LCC ALT-H/L outputs
100nF
C10
PROG-DCC-VS
L298 (PROG/LCC-DCC)
U5
IN1
IN2
EnA
IN3
IN4
EnB
Vss
Vs
OUT1
OUT2
OUT3
OUT4
SENSE_A
SENSE_B
PROG-SIG
PROG-SIG-INV
PROG-EN
OPS-SIG
OPS-SIG-INV
OPS-EN
PROG-A
PROG-B
OPS-LCC-A
OPS-LCC-B
U6C
LM358
+3V3
R22
0R15
1K
R23
U6A
LM358
R26
10K
PROG-SENSE
Note: LOW side current sense is being used for the PROG track output.
OPS-LCC output is not monitored.
PROG/LCC-DCC Supply
R2
2R7
Q2
2N3906
R4
4K7
Q5
TP0606
R1
4K7
PROG-DCC-VS
Note: current limited to 250mA.
RailCom Reference Voltage
+3V3
R11
3.5K 1%
RAILCOM-VREF
R12
20 1%
C5
1uF
RAILCOM-VREF = (3v3 + R9) / (R8 + R9)
RAILCOM-VREF = (3v3 + 20) / (3500 + 20)
RAILCOM-VREF = 19mA
ESP32 Microcontroller (TTGO-T1 or DevKit-C) module.
RESET
SW1
ESP32-Module
U3
I2C-SDA
LED
I2C-SCL
PROG-SIG
PROG-EN
OPS-SIG
OPS-EN
SD-MOSI-MTDO
SD-CLK-MTDI
SD-CS-MTCK
MTMS
OPS-THERM
PROG-SENSE
OPS-SENSE
RAILCOM-DIR
RAILCOM-SHORT
RAILCOM-DATA
OPS-BRAKE
RAILCOM-EN
UART1-TX
UART1-RX
CAN-TX
CAN-RX
SD-MISO
Note: The reset switch connected to EN does not have a pull-up to 3v3 as the module has this already.
DCC Signal generation for OPS track
DCC-VS
C12
1uF
LMD18200 OPS
U7
OUTPUT1
BOOTSTRAP1
BOOTSTRAP2
OUTPUT2
CURRENT_SENSE_OUTPUT
THERMAL_FLAG_OUTPUT
VS
PWM
DIRECTION
BRAKE
GND
OPS-A
OPS-B
10nF
C8
C9
10nF
OPS-EN
OPS-SIG
OPS-BRAKE
OPS-THERM
OPS-SENSE
R25
2K7
C11
.1uF
Note: The CURRENT_SENSE_OUTPUT is an INLINE output from the h-bridge
RailCom FET gate enable circuit
DCC-VS
R8
1K5 1/2W
R10
10K
RAILCOM-GATE-EN
R3
10K
+3V3
Q1
2N7000
Q3
2N7000
RAILCOM-SHORT
Q7
2N7000
Q9
2N7000
RAILCOM-EN
R13
2K4
When using a DevKit-C (or compatible) ESP32 module it is recommended to use an SD card SPI module.
SD-MODULE J2
+3V3
SD-CS-MTCK
SD-MOSI-MTDO
SD-CLK-MTDI
SD-MISO
GND
JTAG debugger connection
JTAG
J4
+5V
SD-MOSI-MTDO
SD-CLK-MTDI
SD-CS-MTCK
MTMS
Note: There are shared pins with the SD card module and it may be necessary to eject the SD card when debugging/flashing.
Command Station expansion ports
I2C
J5
J6
UART1
J7
I2C-SCL
I2C-SDA
UART1-RX
UART1-TX
OPS track RailCom detection circuit
R6
10K
D2
DNP
U2A
LM393
U2B
LM393
RAILCOM-VREF
RAILCOM-DATA
RAILCOM-DIR
R15
2K4
R16
2K4
+3V3
1N5817
D4
R14
10K
D3
DNP
U2C
LM393
R5
2R4
R9
2R4
STD12NF06
Q4
Q10
OPS-A
OPS-B
RAILCOM-GATE-EN
Q6
DTC143E
Q8
DTC143E
R7
10K
RAILCOM-SHORT
Command Station status output RGB LEDs
LED-PIN1
LED-PIN2
WIFI
OPS
PROG
D6
D7
D8
LED
DIN
DOUT
VDD
GND
RGB
WIFI:
GREEN = connected
GREEN [FLASHING] = connecting
RED = disconnected
YELLOW = connection failure
YELLOW [FLASHING] = SSID not found
OPS:
GREEN = ON
BLACK = OFF
RED = FAULT/SHORT
RED [FLASHING] = THERMAL FAULT
PROG:
GREEN = ON
BLACK = OFF
RED = FAULT/SHORT
Note: LED-PIN1 and LED-PIN2 set to the APA106 (included in PCB kit).
For WS2812B LEDs cut the traces and add a solder bridge to the opposite pad.
OPS Track expansion port
OPS-EXT
J8
OPS-SIG
PROG track signal split for L298 h-bridge
PROG-SIG-INV
R24
1K
PROG-SIG
Q11
2N3904
OPS track signal split for L298 h-bridge
OPS-SIG-INV
R27
1K
OPS-SIG
Q12
2N3904
H1
MountingHole
H2
MountingHole
H3
MountingHole
H4
MountingHole
Sheet: /
File: ESP32-CS-LMD18200.sch
Title: ESP32 Command Station with LCC, I2C and RailCom
Size: B
Date: 2019-06-12
Rev: 1.0
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