

A

A

B

B

C

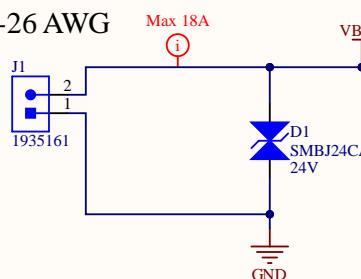
C

D

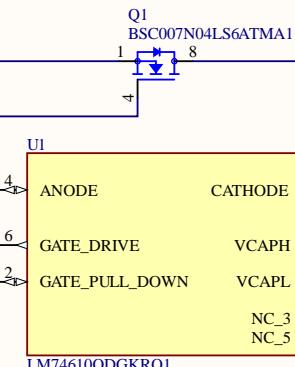
D

Battery Input (6s1p)

12-26 AWG

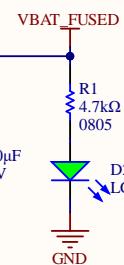


Ideal Diode Controller



LED forward drop = 2.0V
Max VBAT = 24V
Min VBAT = 18V

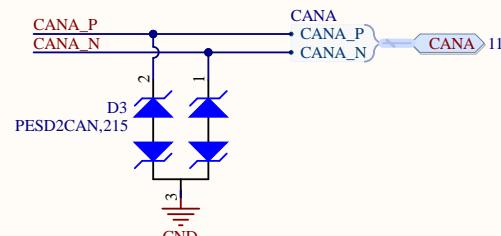
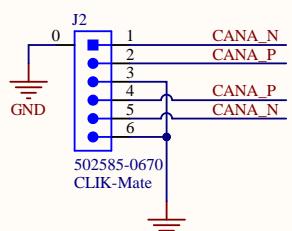
Max LED current = $(24-2)/4700 = 4.7\text{mA}$
Min LED current = $(18-2)/4700 = 3.4\text{mA}$



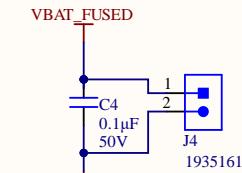
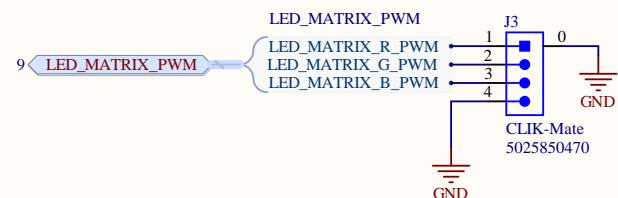
Title	Power Distribution Board Rev2 - Power	Altium Limited
Size:	Letter	Drawn By: Cindy Li
Date:	2020-11-03	Sheet of 12
File:	C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH1 - POWER.SchDoc	Australia 2086



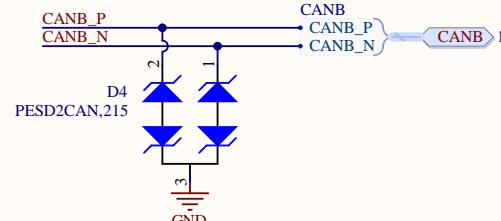
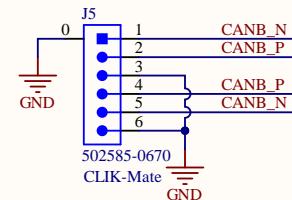
CAN BUS A



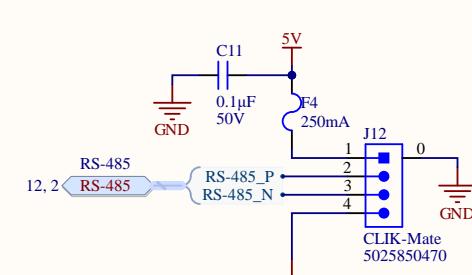
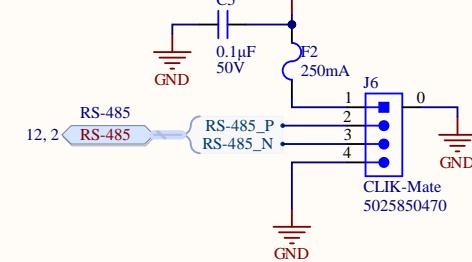
LED Matrix



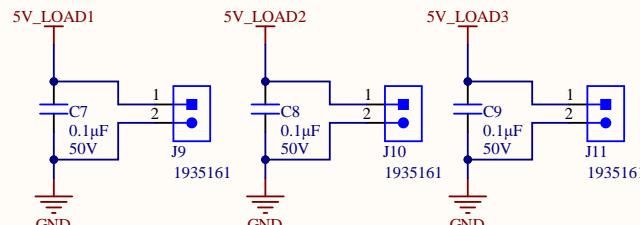
CAN BUS B



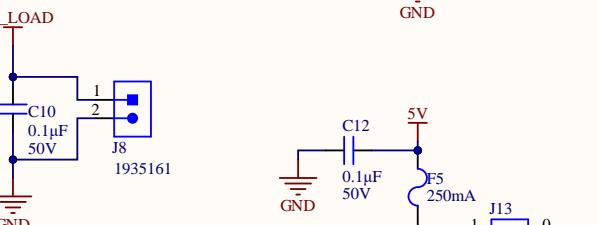
URM04 Ultrasonic Sensors



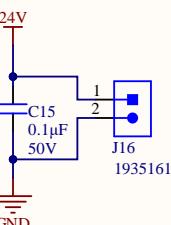
5V Output



17V Output



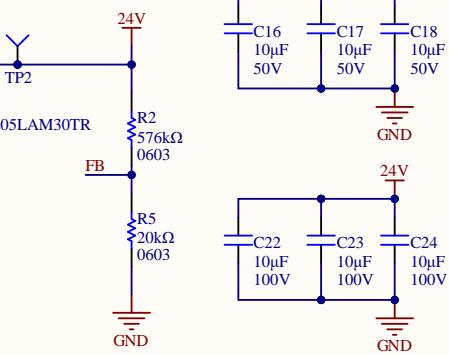
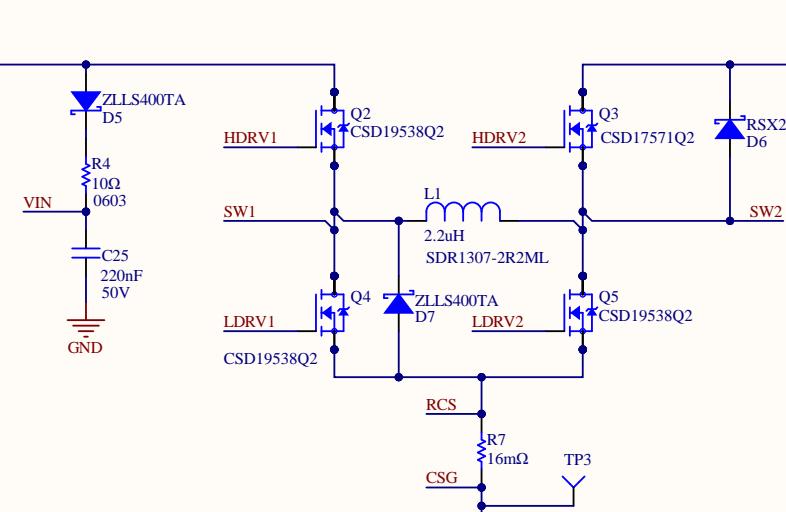
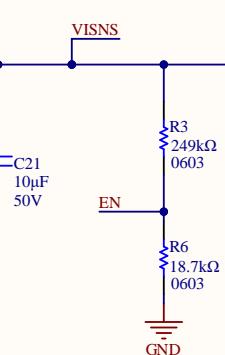
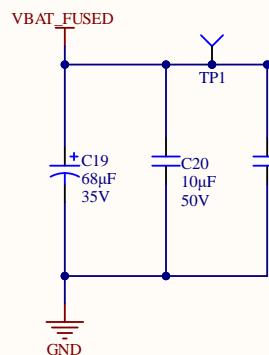
24V Output



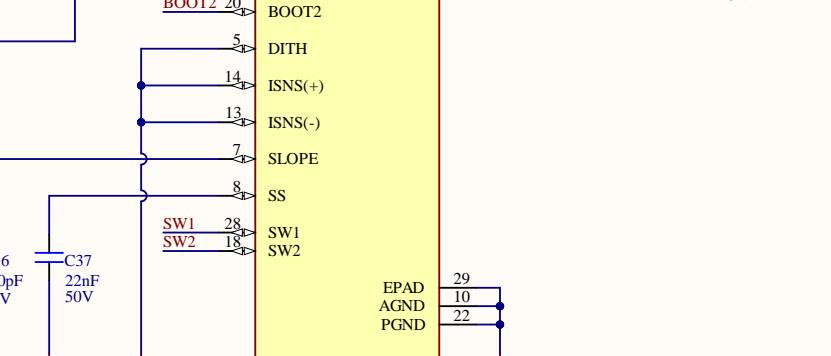
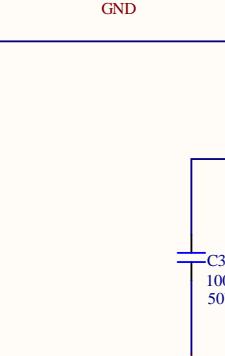
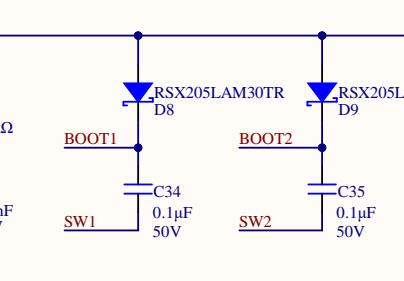
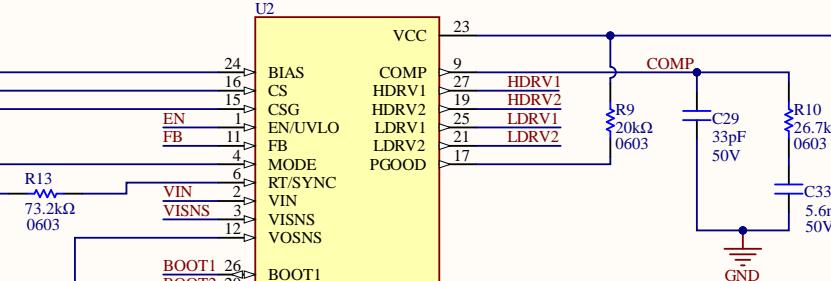
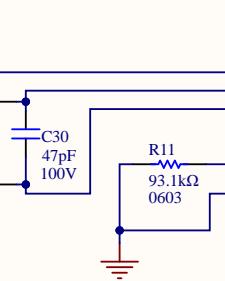
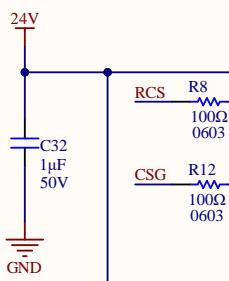
Can use 12-26AWG

Input voltage range: 18-25.8V

24V Buck-Boost Converter @ 3A Max



TODO:
- add appropriate comments



Title PDB Rev2 - 24V Buck-Boost Converter

Size: Letter | Drawn By: Cindy Li

Date: 2020-11-03 | Sheet 8 of 12

File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH3 - 24V BUCK-BOOST CONVERTER.SchD

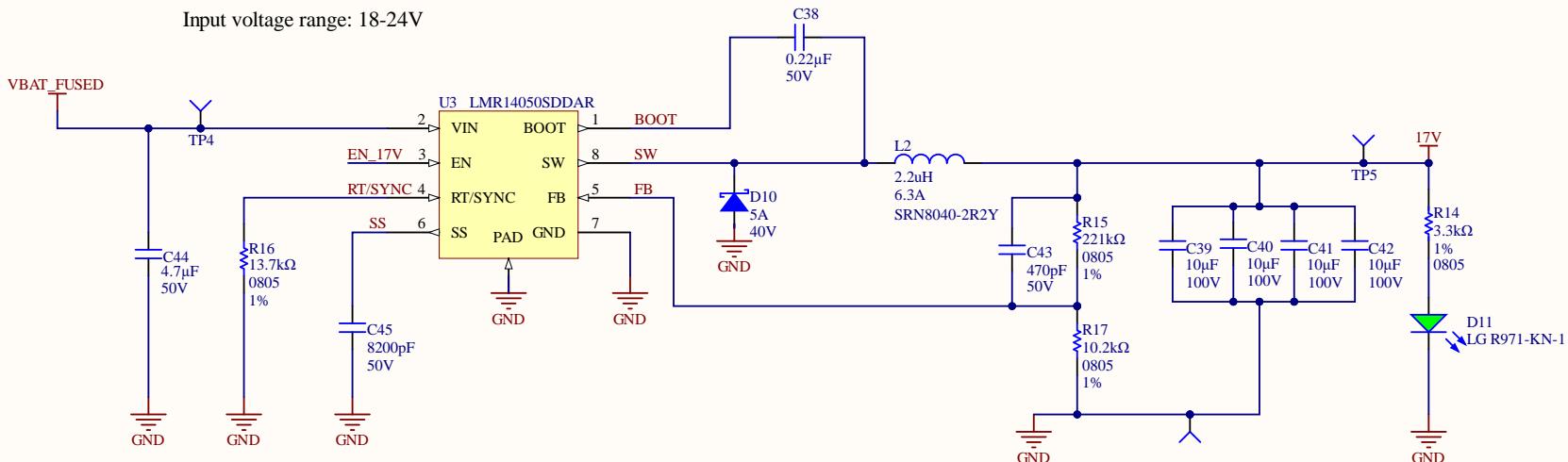
Altium Limited
L3, 12a Rodborough Rd
Frenchs Forest
NSW Australia 2086

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17V Regulator @ 4A Max

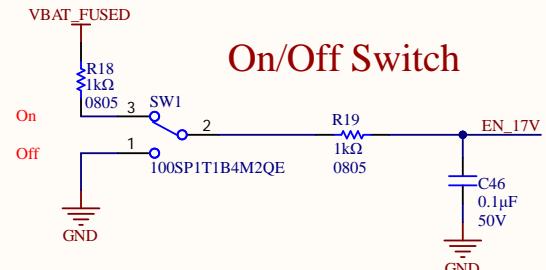


Estimated max current draw: 1.65A

Peak efficiency: 94.8%

Output voltage ripple: 19.45mVpp

LED forward drop = 2.2V

LED current = $(17-2.2)/3300 = 4.5\text{mA}$ 

D

D

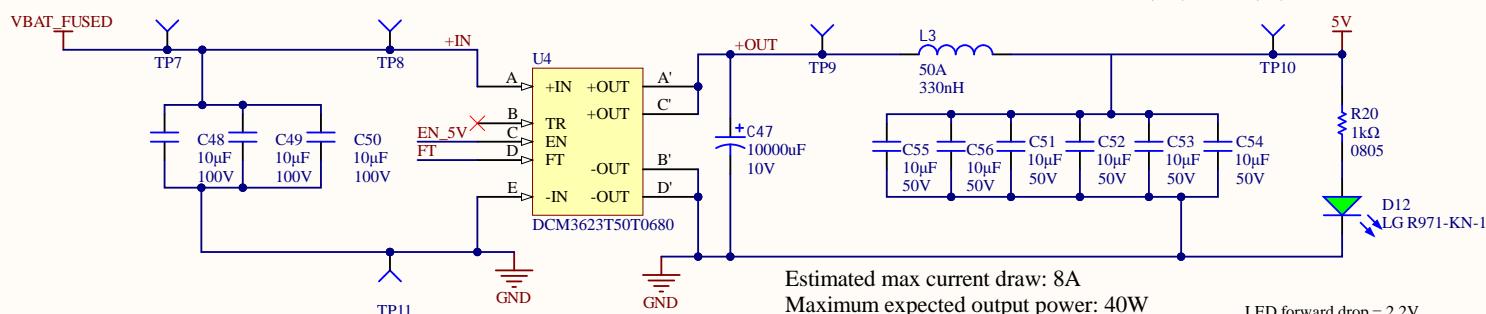
A

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Input voltage range: 9-50V

5V Regulator @ 16A Max

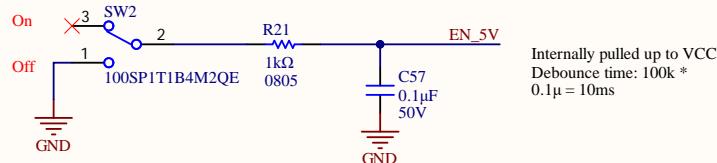
Inductor: 744309033
20%, 0.165mΩ DCR
47.5A (rms), 62.5A (sat), 9mm tall



Estimated max current draw: 8A
Maximum expected output power: 40W
Peak efficiency: 88% @ 16A
Output voltage ripple: 277mVpp

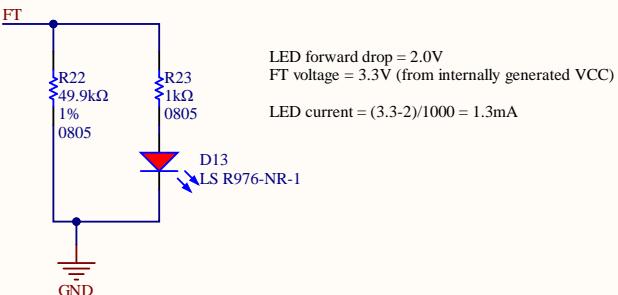
LED forward drop = 2.2V
LED current = $(5-2.2)/1000 = 2.8\text{mA}$

On/Off Switch



Internally pulled up to VCC
Debounce time: $100\text{k} \times 0.1\mu\text{s} = 10\text{ms}$

Fault Indicator



LED forward drop = 2.0V
FT voltage = 3.3V (from internally generated VCC)
LED current = $(3.3-2)/1000 = 1.3\text{mA}$

Title Power Distribution Board Rev2 - 5V Vicor DDC		Altium Limited L3, 12a Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-03	Sheet 6 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH5 - 5V VICOR DDC.SchDoc		



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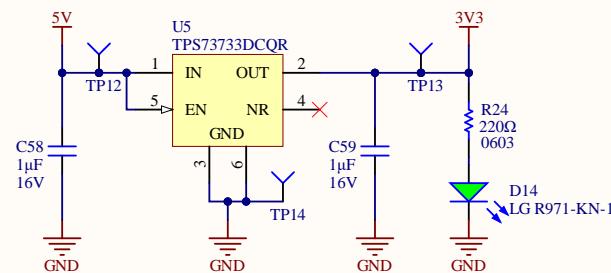
C

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5V to 3.3V LDO



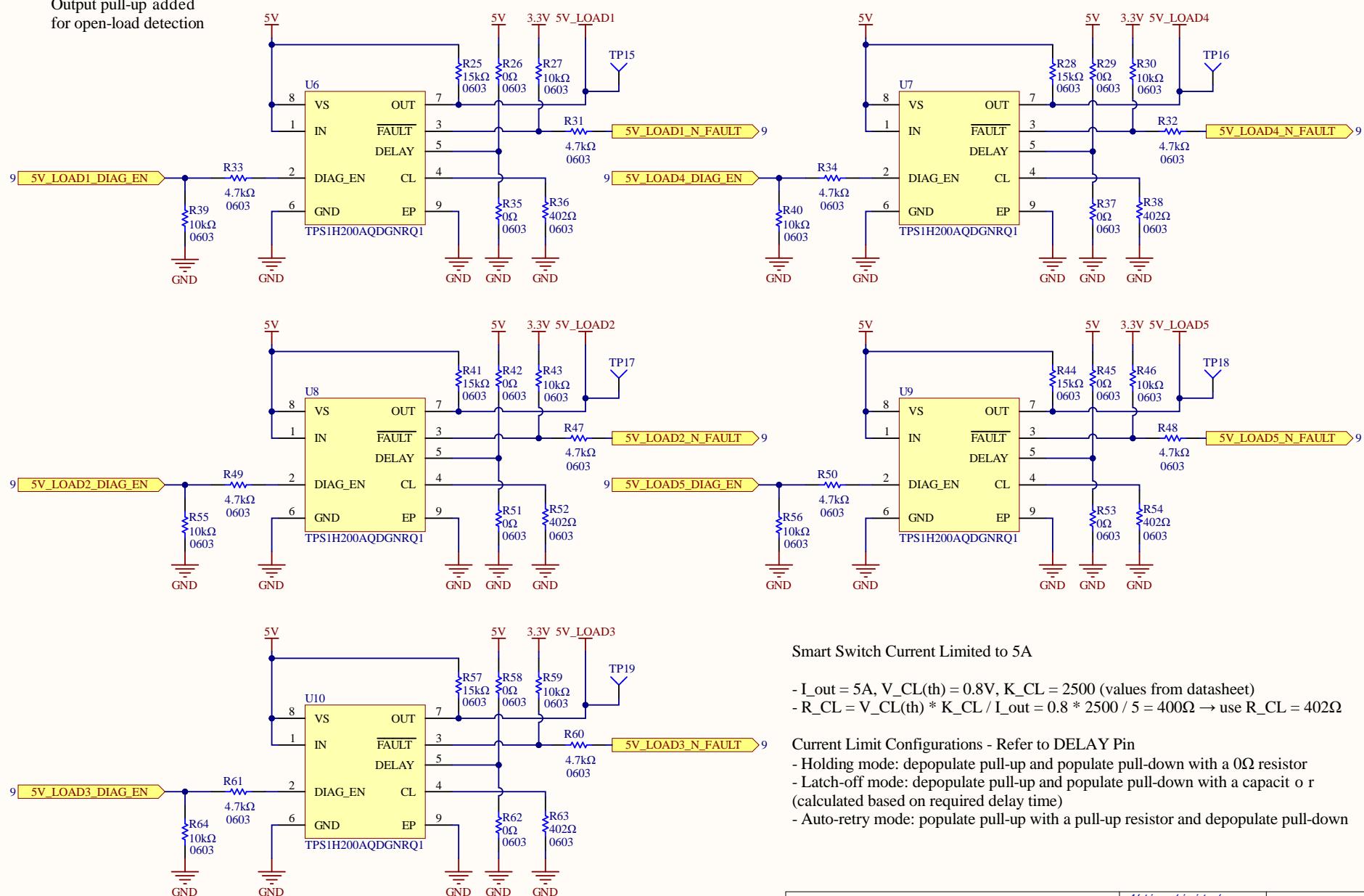
Current Calculations

Green LED voltage drop: 2.2V
 $- I = (3.3 - 2.2V) / 220 = 5mA$

Title Power Distribution Board Rev2 - 3.3V Linear		<i>Mitium Limited</i> 23/728 Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-03	Sheet 6 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH6 - 3.3V LINEAR REGULATOR.SchDoc		UW ROBOTICS TEAM

5V Loads Smart Switches

Output pull-up added
for open-load detection



Smart Switch Current Limited to 5A

- $I_{out} = 5A$, $V_{CL(th)} = 0.8V$, $K_{CL} = 2500$ (values from datasheet)
- $R_{CL} \equiv V_{CL(th)} / K_{CL} / I_{out} = 0.8 * 2500 / 5 = 400\Omega \rightarrow \text{use } R_{CL} = 402\Omega$

Current Limit Configurations - Refer to DELAY Pin

- Holding mode: depopulate pull-up and populate pull-down with a 0Ω resistor
 - Latch-off mode: depopulate pull-up and populate pull-down with a capacitor or (calculated based on required delay time)
 - Auto-retry mode: populate pull-up with a pull-up resistor and depopulate pull-down

Title Power Distribution Board Rev2 - Load Monitor
 Size: Letter Drawn By: Cindy Li
 Date: 2020-11-03 Sheet 1 of 12
 File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH7 - LOAD MONITOR.DWG 1. SchDoc

*Altium Limited
 13, 12a Roxborough Rd
 Frenchs Forest
 NSW
 Australia 2086*

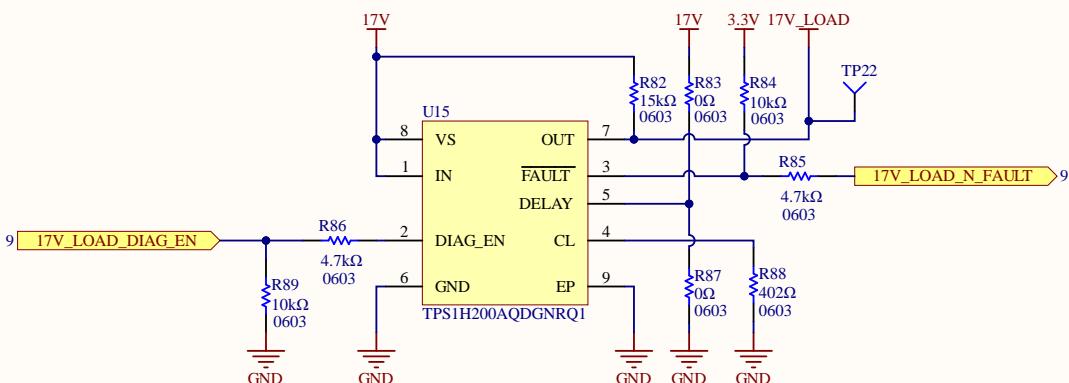
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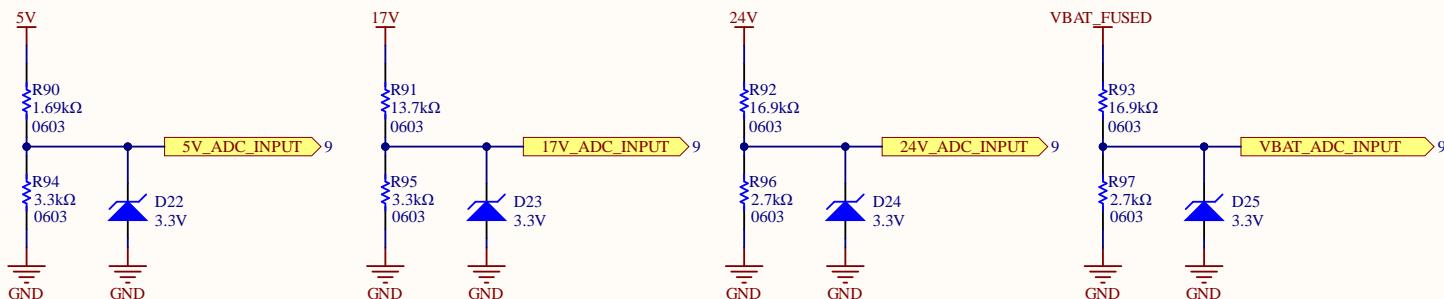
17V Load Smart Switch



B

B

Power Rail Voltage Monitoring



Divides 5V to 3.3V

Divides 17V to 3.3V

Divides 24V to 3.3V

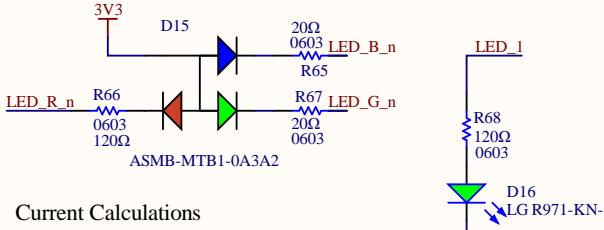
Divides 24V to 3.3V

D

D

Title Power Distribution Board Rev2 - Load Monitor		Altium Limited 102-128 Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-03	Sheet 8 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH8 - LOAD MONITOR.Dwg	NG 2. SchDoc	UW ROBOTICS TEAM

Status/Debug LEDs



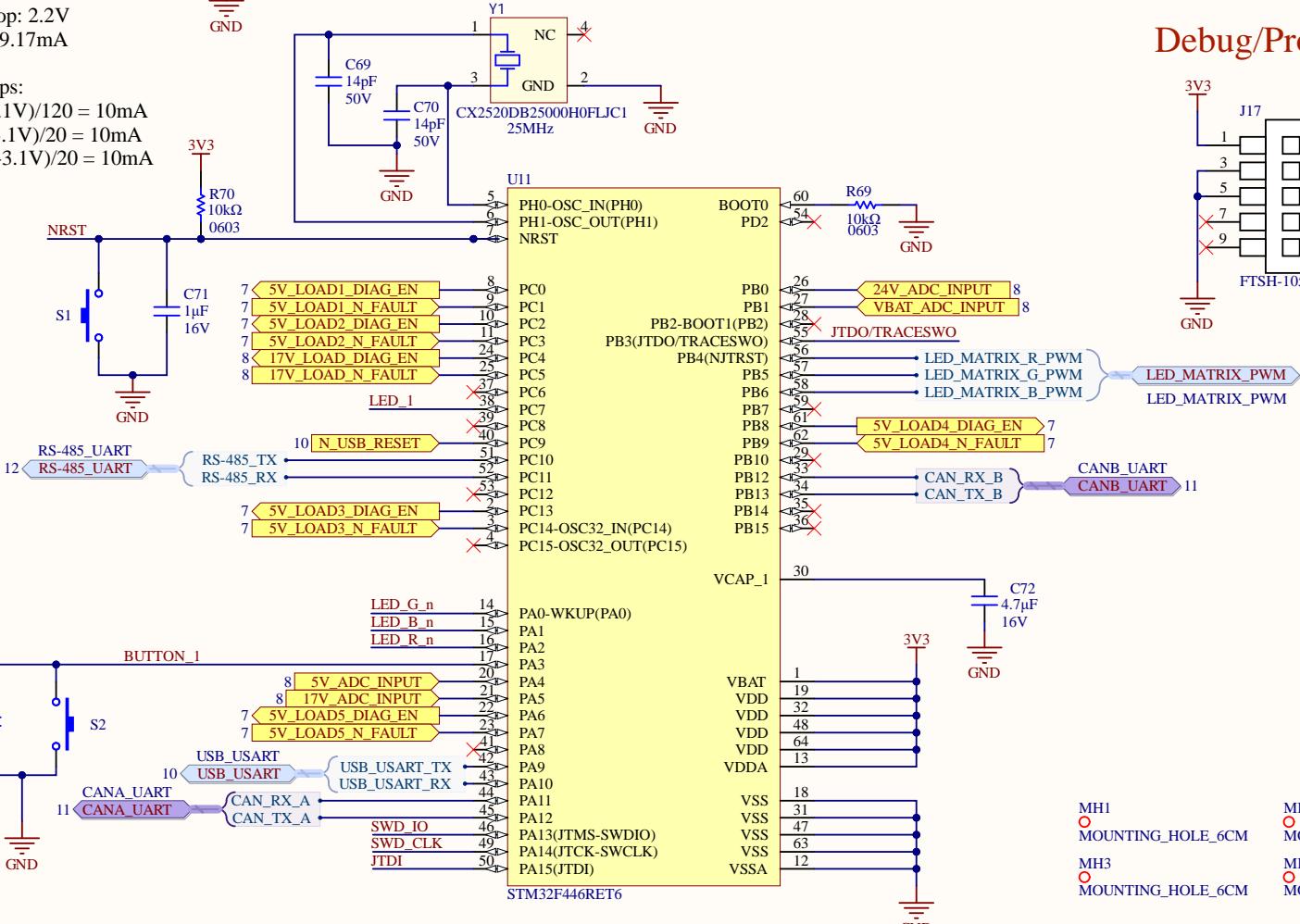
Current Calculations

Green LED voltage drop: 2.2V
 $- I = (3.3-2.2V)/120 = 9.17\text{mA}$

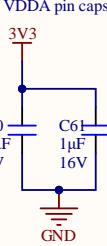
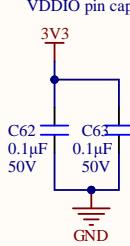
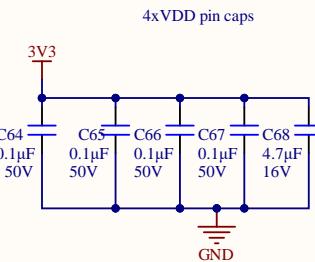
RGB LED voltage drops:

- Red: 2.1V: $I = (3.3-2.1V)/120 = 10\text{mA}$
- Blue: 3.1V: $I = (3.3-3.1V)/20 = 10\text{mA}$
- Green: 3.1V: $I = (3.3-3.1V)/20 = 10\text{mA}$

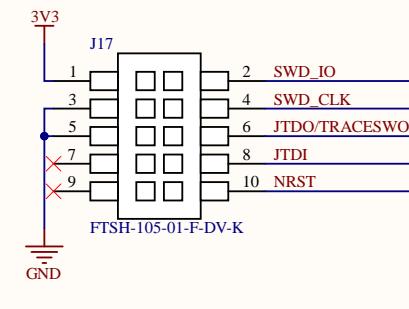
STM32F446RET6

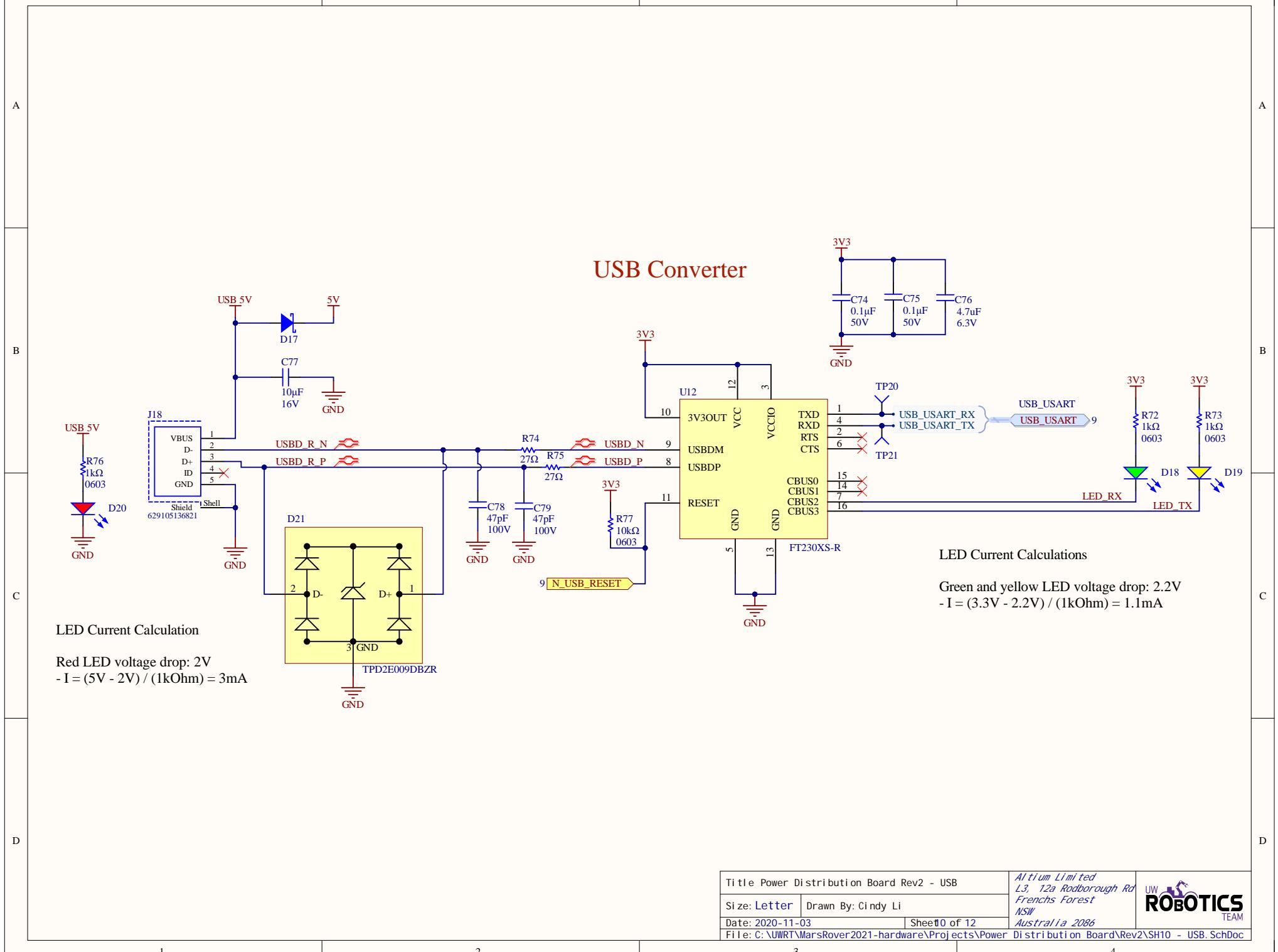


Decoupling Caps



Debug/Programming





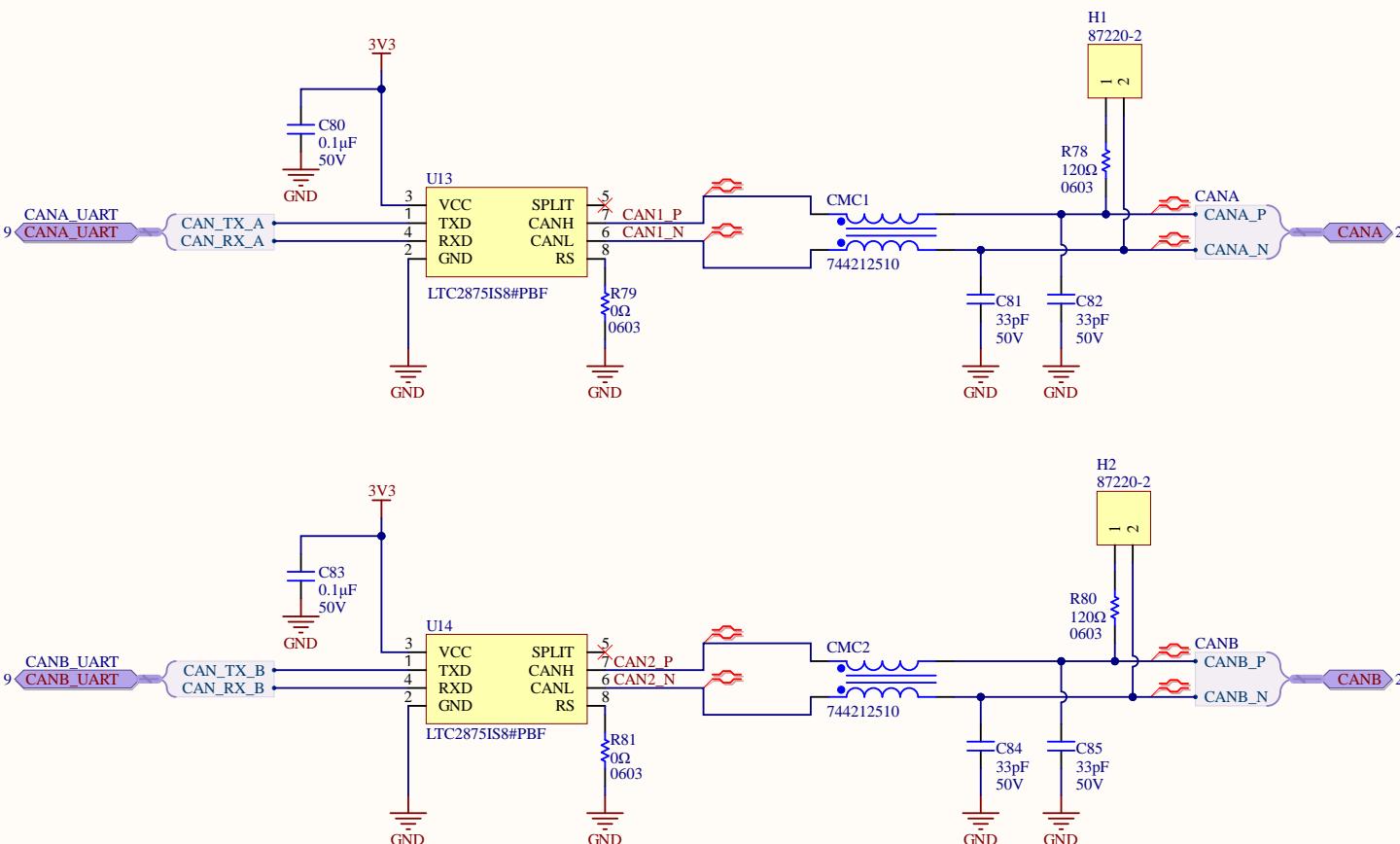
Title Power Distribution Board Rev2 - USB		Altium Limited L3, 12a Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-03	Sheet 10 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH10 - USB.SchDoc		



A

A

CAN Transceivers



Title Power Distribution Board Rev2 - CAN Transceivers		Altium Limited 13/12a Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-03	Sheet 1 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH11 - CAN.SchDoc		



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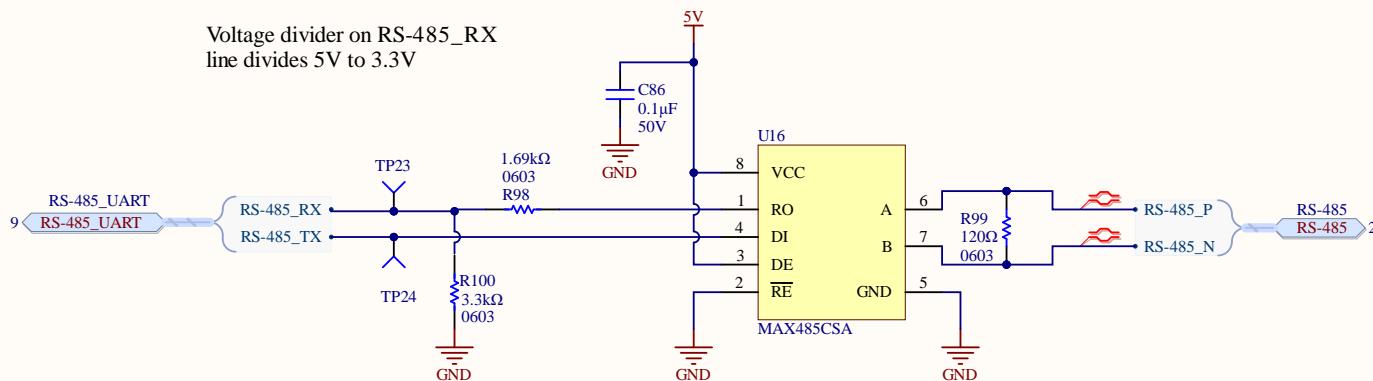
C

C

D

D

RS-485 Transceiver



Title Power Distribution Board Rev2 - RS-485		Altium Limited L3, 12a Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-03	Sheet 12 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH12 - RS-485.SchDoc		

