

A

A

B

B

C

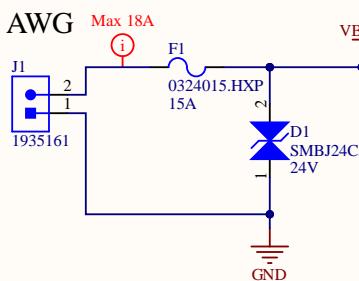
C

D

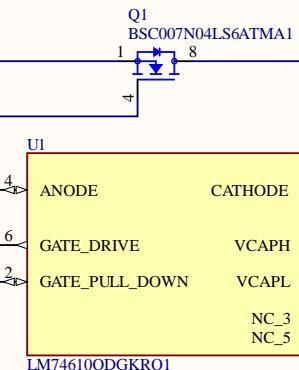
D

Battery Input (6s1p)

12-26 AWG



Ideal Diode Controller



LM74610QDGKRQ1

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

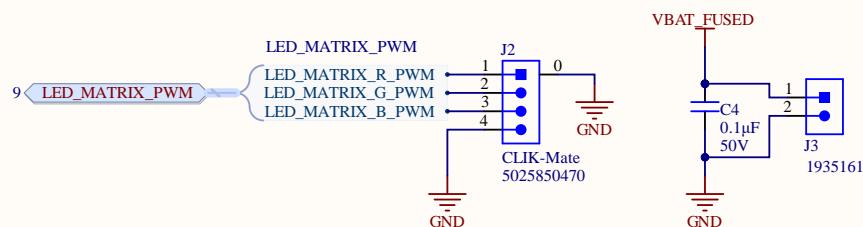
Max LED current = $(24-2)/4700 = 4.7\text{mA}$
Min LED current = $(18-2)/4700 = 3.4\text{mA}$

Title	Power Distribution Board Rev2 - Power	Altium Limited
Size:	Letter	Drawn By: Cindy Li
Date:	2020-11-06	Sheet 1 of 12
File:	C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH1 - POWER.SchDoc	Australia 2086



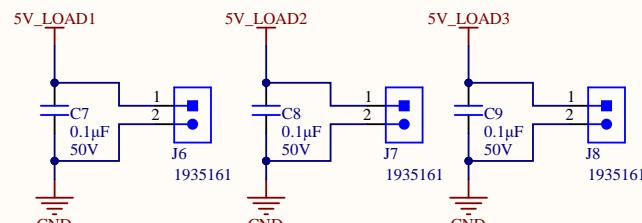
A

LED Matrix

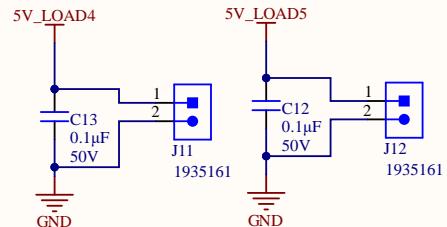


B

5V Output

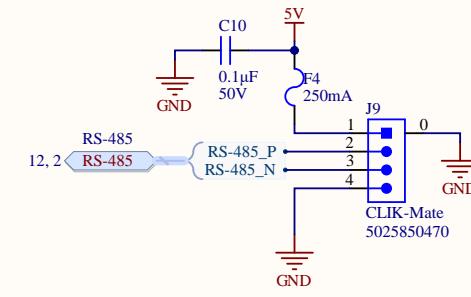
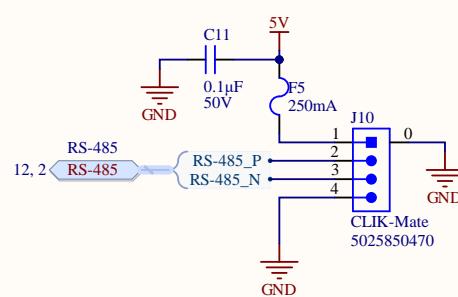
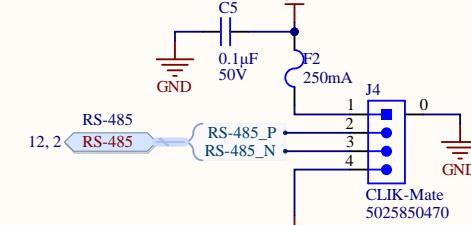
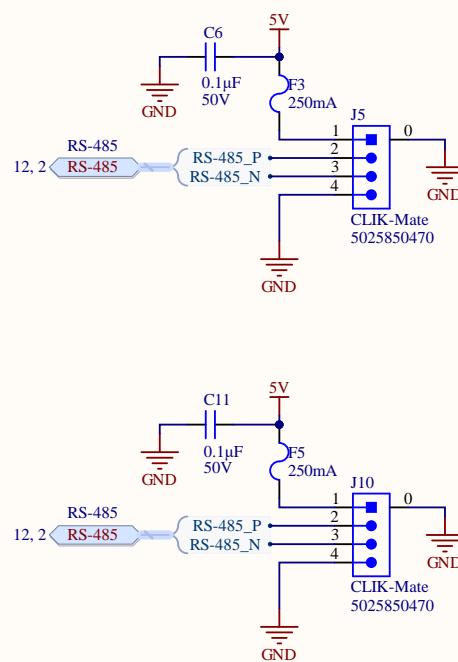


C



D

URM04 Ultrasonic Sensors



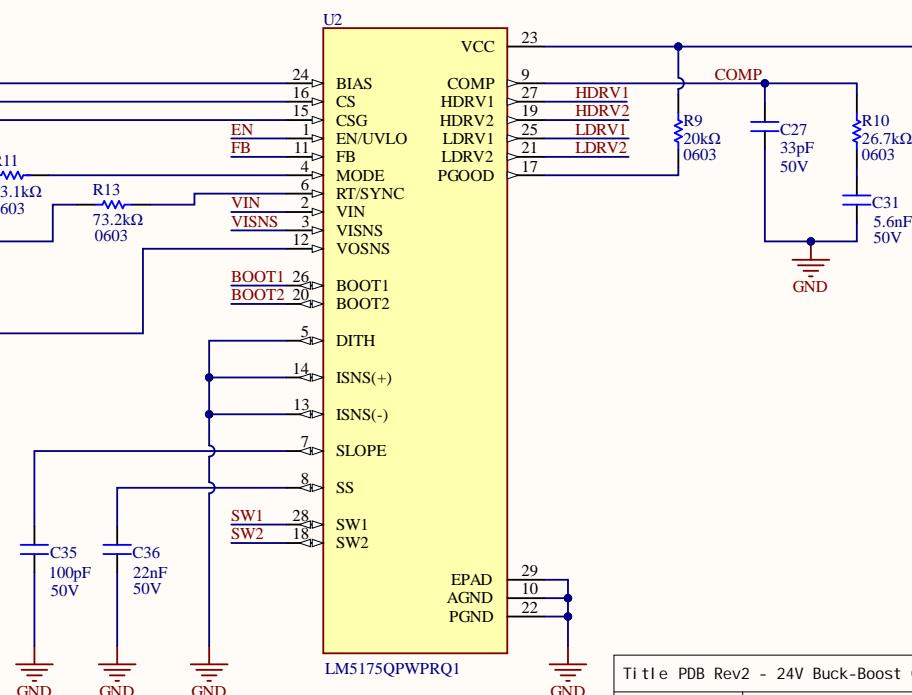
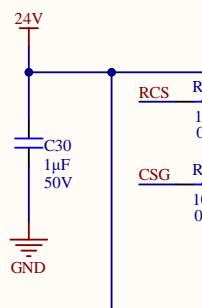
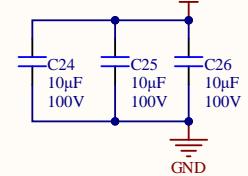
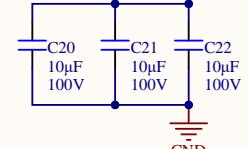
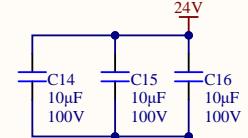
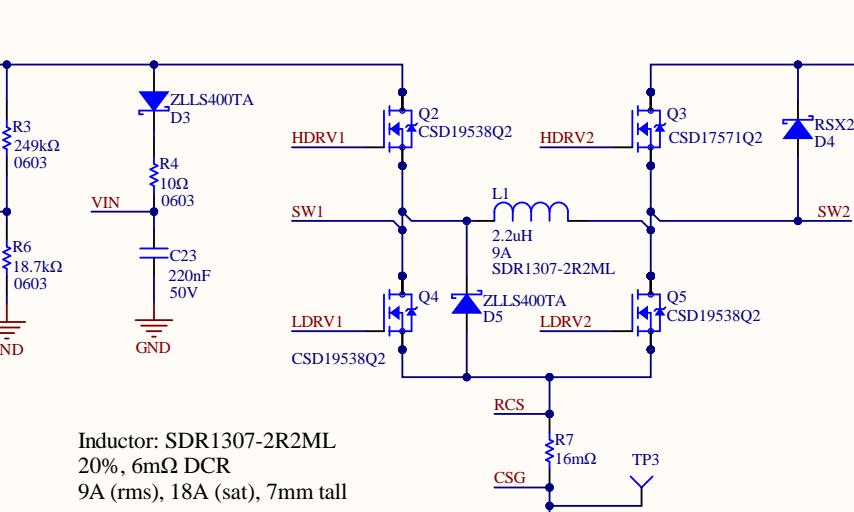
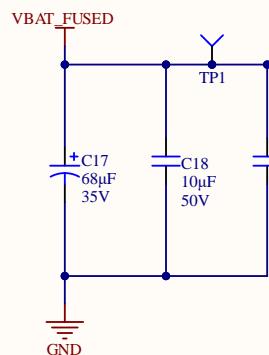
Title	Power Distribution Board Rev2 - Connectors
Size:	Letter
Drawn By:	Cindy Li
Date:	2020-11-06
File:	C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH2 - CONNECTORS.SchDoc

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

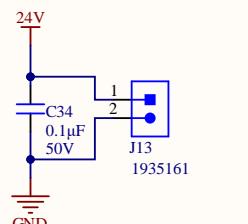


Input voltage range: 18-25.8V

24V Buck-Boost Converter @ 3A Max



24V Output



Title: PDB Rev2 - 24V Buck-Boost Converter

Size: Letter Drawn By: Cindy Li

Date: 2020-11-06 Sheet 8 of 12

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

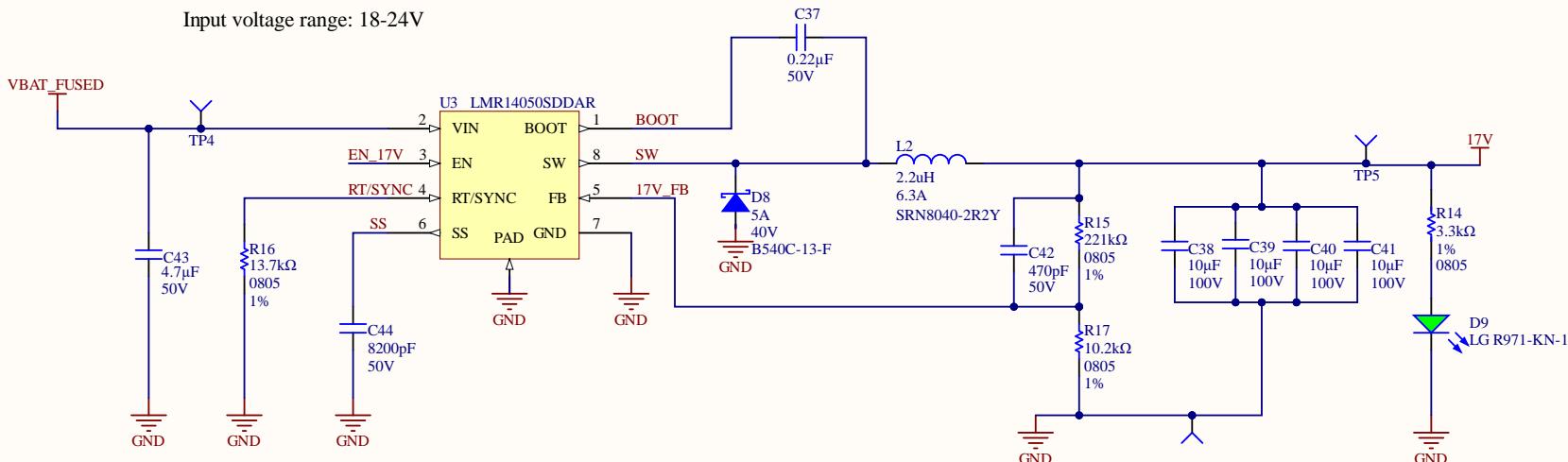
Altium Limited
L3, 12a Rodborough Rd
Frenchs Forest
NSW Australia 2086

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A

A

17V Regulator @ 4A Max



Estimated max current draw: 1.65A

Peak efficiency: 94.8%

Output voltage ripple: 19.45mVpp

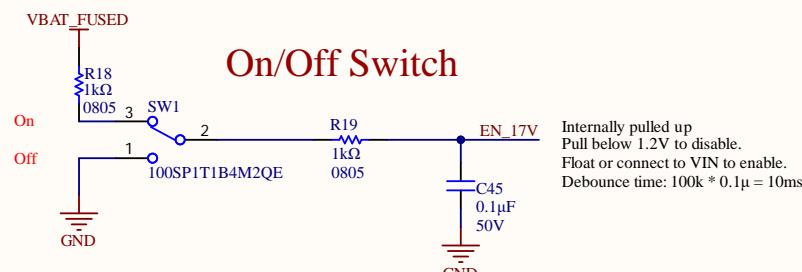
LED forward drop = 2.2V

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

C

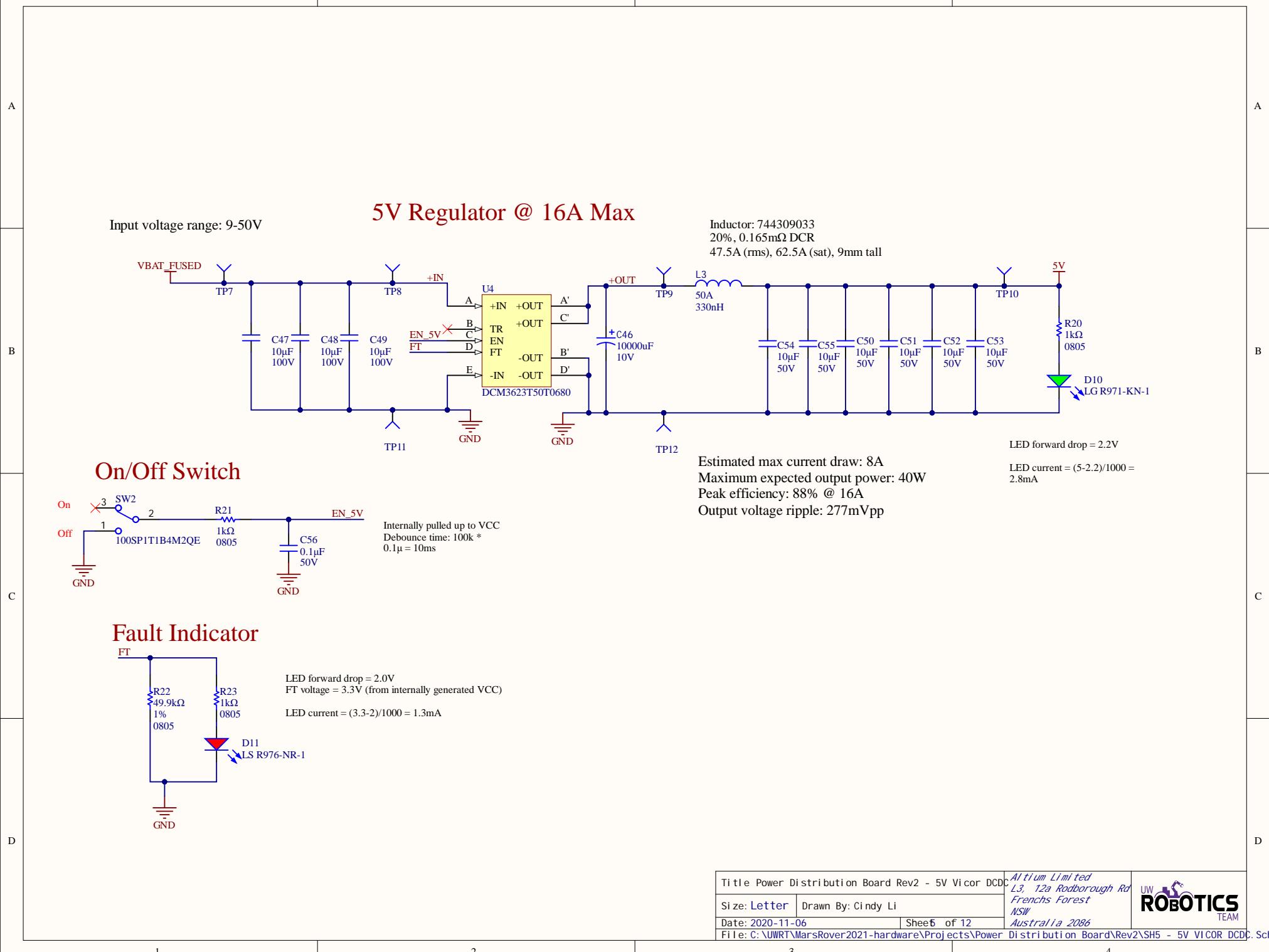
C

On/Off Switch



D

D



A

A

B

B

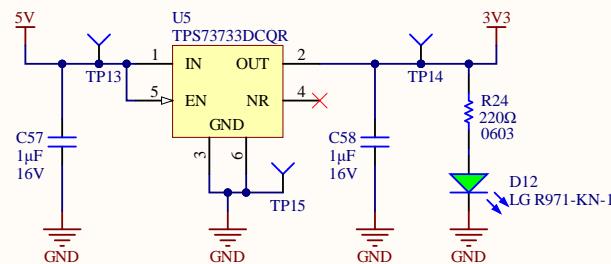
C

C

D

D

5V to 3.3V LDO (Max 1A)



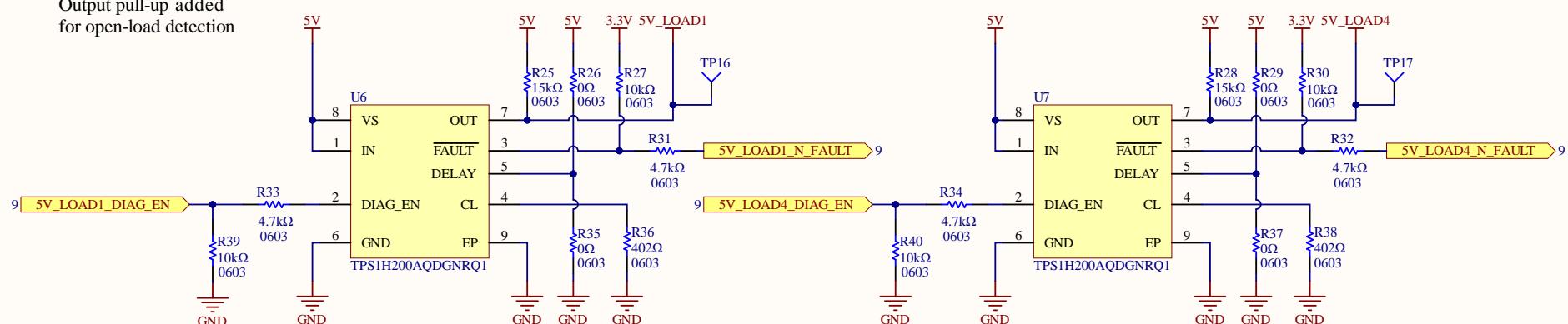
Current Calculations

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

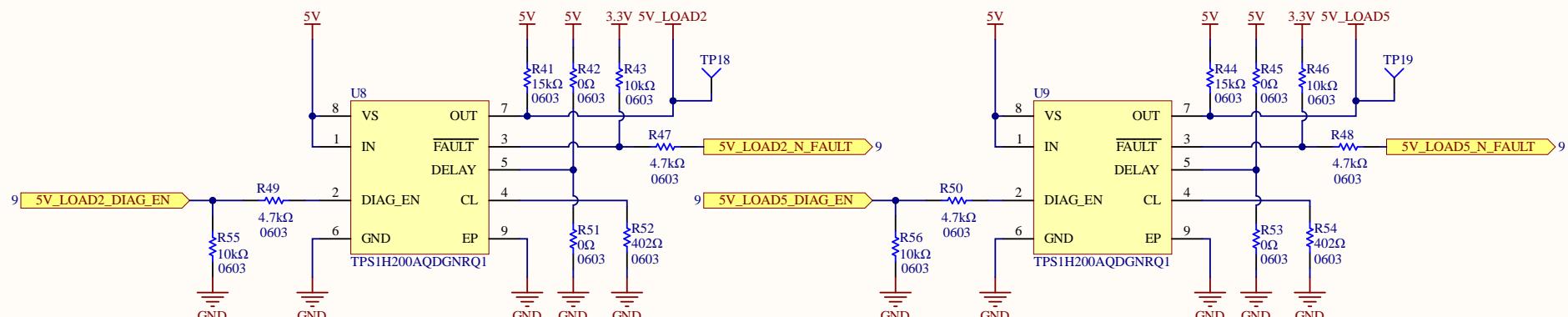
Title Power Distribution Board Rev2 - 3.3V Linear		<i>Altium Limited</i> 23/728 Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-06	Sheet 6 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH6 - 3.3V LINEAR REGULATOR.SchDoc		UW ROBOTICS TEAM

5V Loads Smart Switches

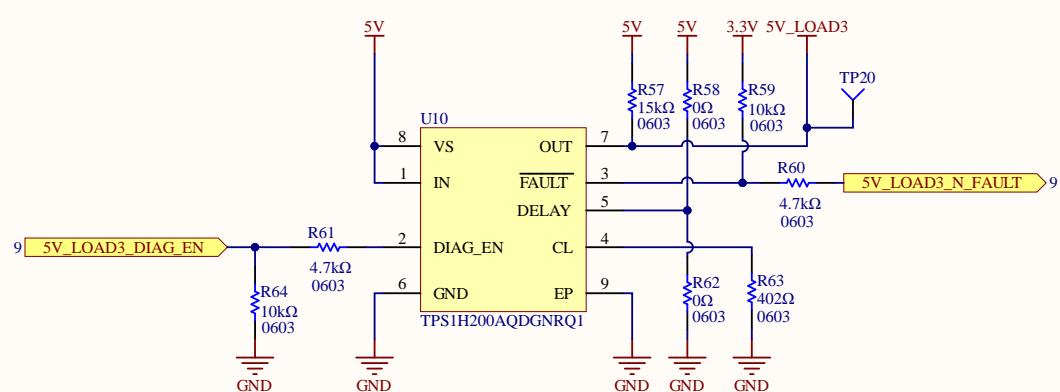
A
Output pull-up added for open-load detection



B



C



D

Smart Switch Current Limited to 5A

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

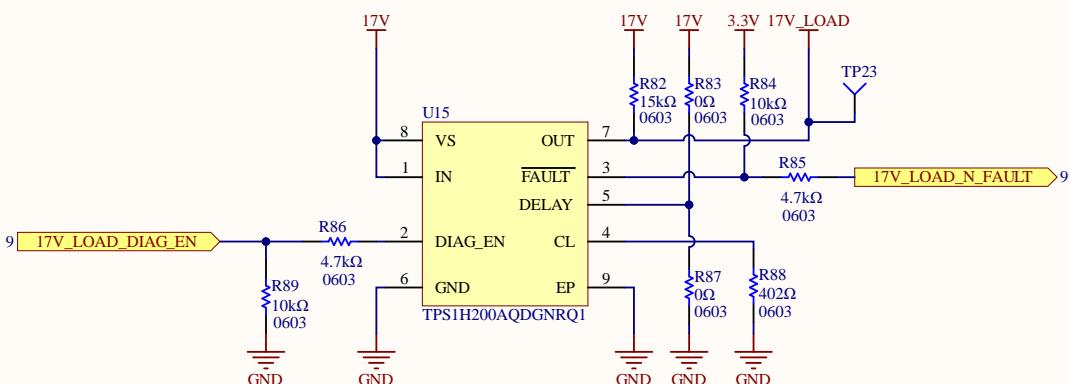
Current Limit Configurations - Refer to DELAY Pin

- 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

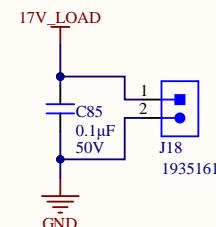
Title Power Distribution Board Rev2 - Load Monitor		Altium Limited 123, 12a Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-06	Sheet of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH7 - LOAD MONITOR.Dwg		Page 1. SchDoc

A

17V Load Smart Switch

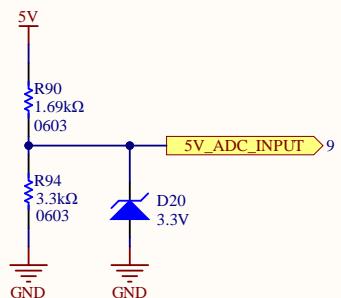


17V Output

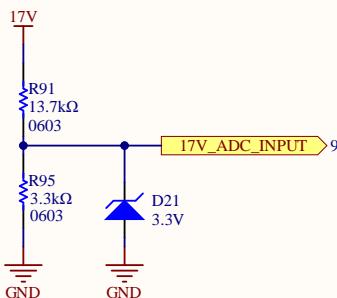


B

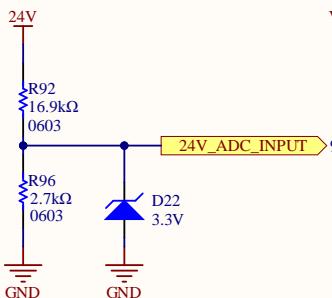
Power Rail Voltage Monitoring



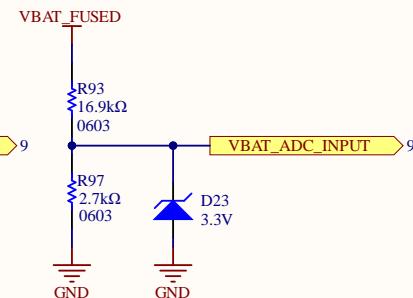
Divides 5V to 3.3V



Divides 17V to 3.3V



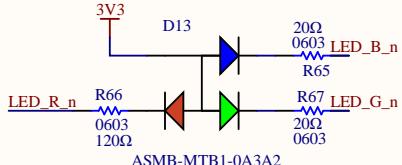
Divides 24V to 3.3V



Divides 24V to 3.3V

D

Status LED

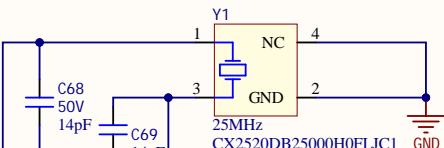


Current Calculations

RGB LED voltage drops:

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

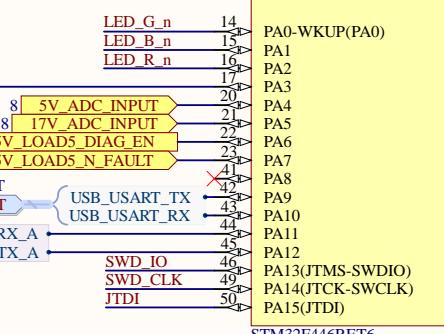
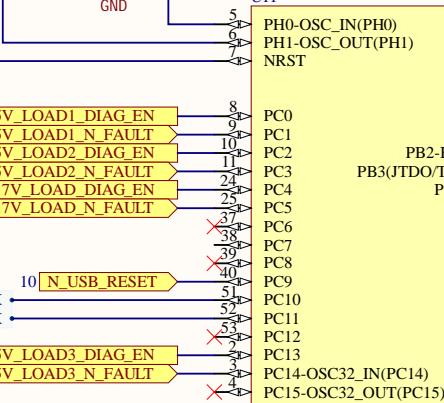
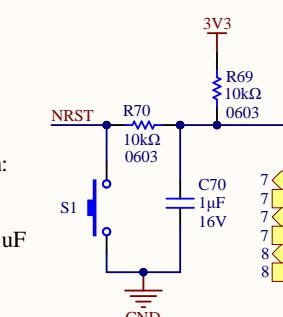
STM32F446RET6



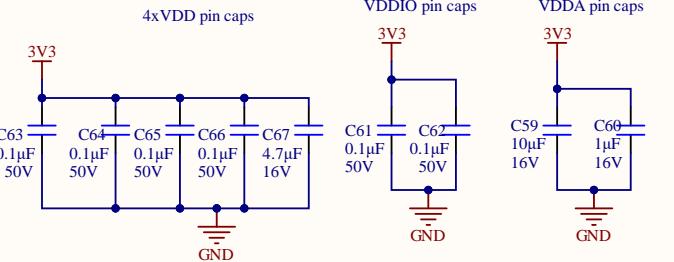
Debounce Calculation:

$$T = RC \rightarrow C = T/R$$

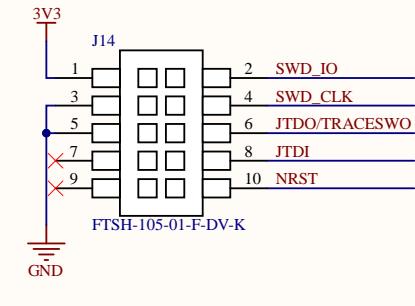
$$C = 10ms / 10k\Omega = 1\mu F$$



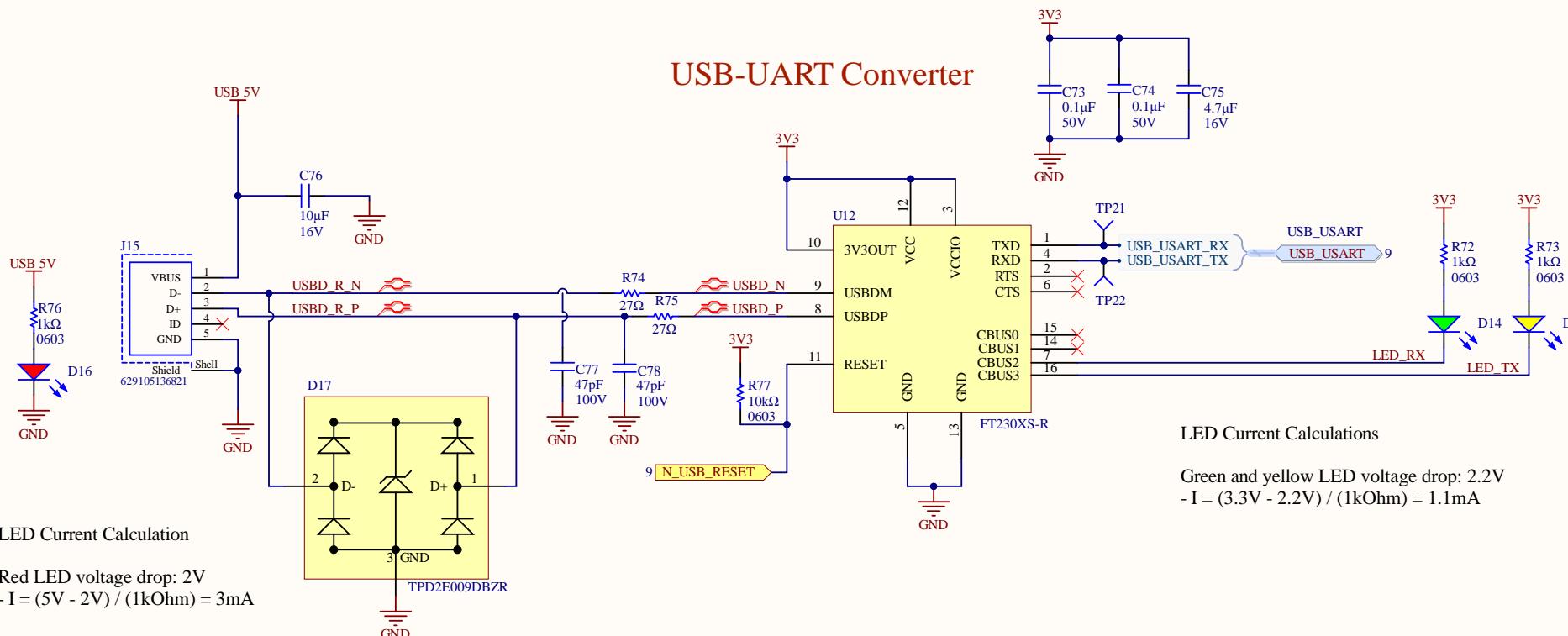
Decoupling Caps



Debug/Programming

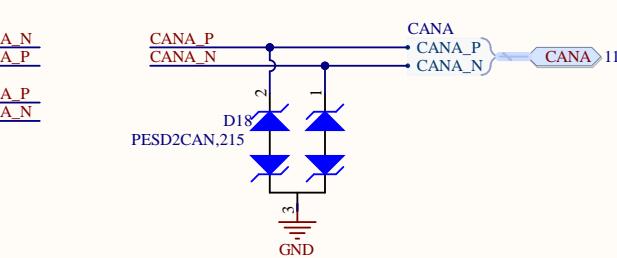


USB-UART Converter

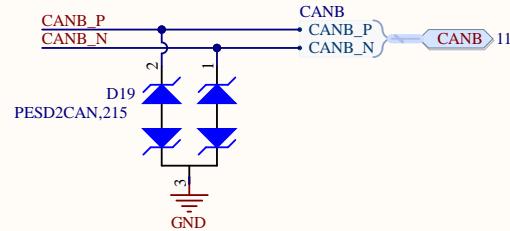


Title Power Distribution Board Rev2 - USB		Altium Limited
Size: Letter	Drawn By: Cindy Li	L3, 12a Rodborough Rd Frenchs Forest NSW Australia 2086
Date: 2020-11-06	Sheet 10 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH10 - USB.SchDoc		UW ROBOTICS TEAM

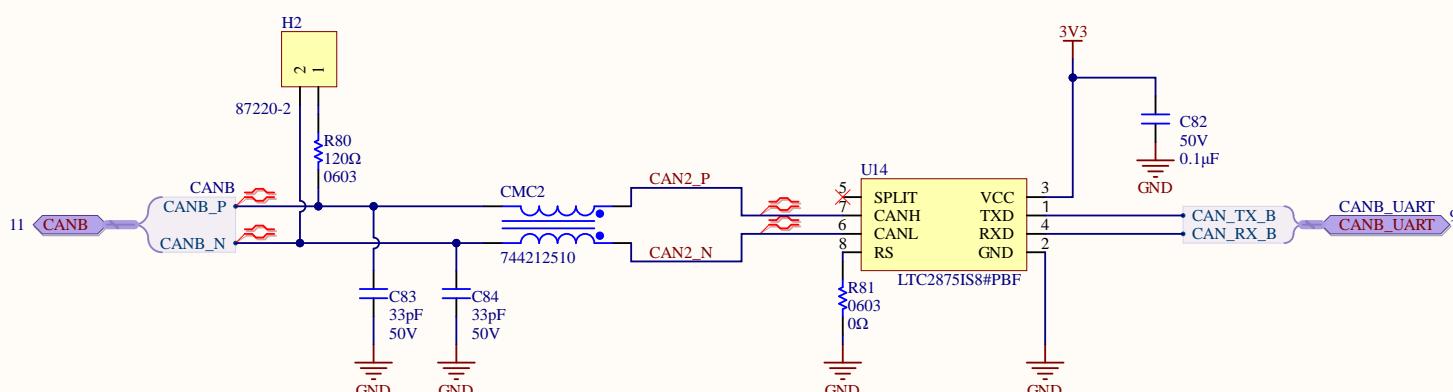
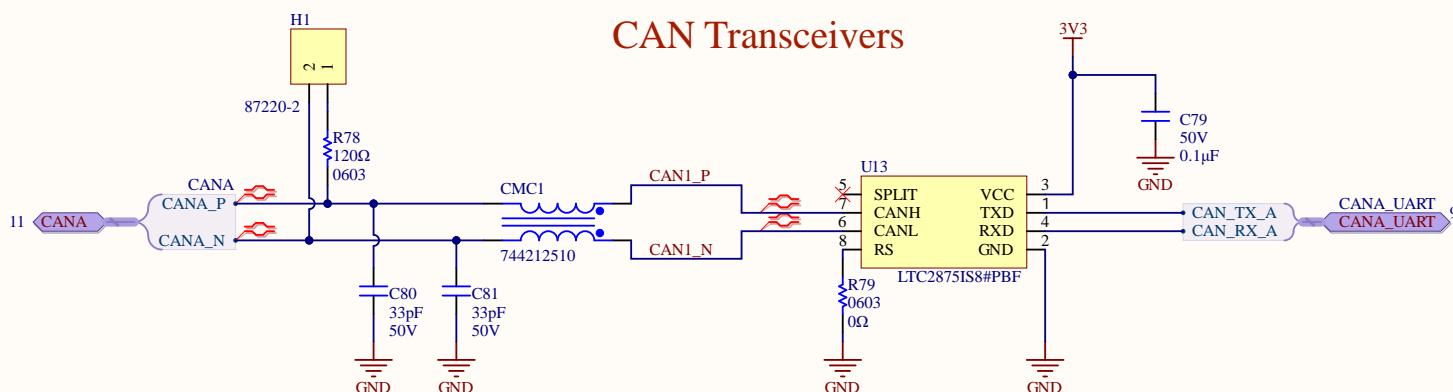
CAN BUS A



CAN BUS B



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: 2020-11-06	Sheet 1 of 12	
File: C:\UWR\火星探测器\硬件\项目\电源分布板\Rev2\SH11 - CAN.SchDoc		UW ROBOTICS TEAM

A

A

B

B

C

C

D

D

RS-485 Transceiver

Voltage divider on RS-485_RX line divides 5V to 3.3V
 MAX485 logic high input voltage is 2V

