

A

A

B

B

C

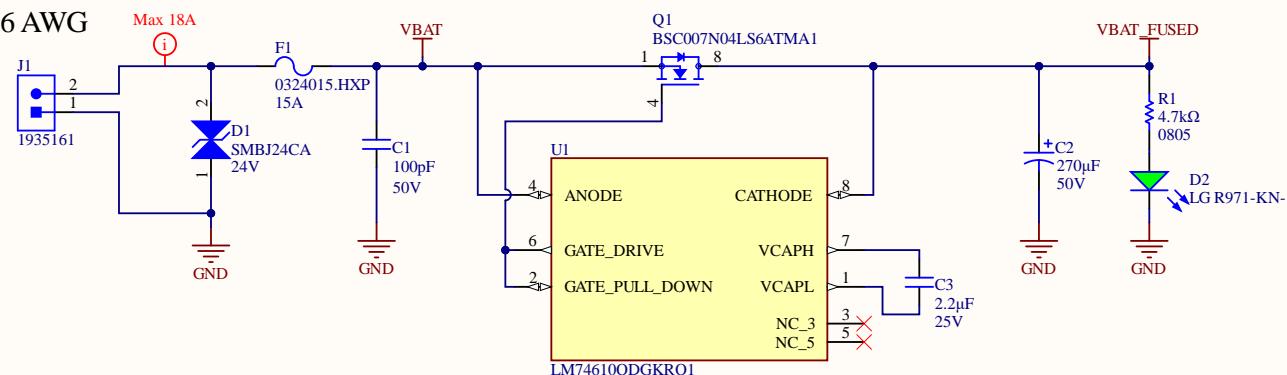
C

D

D

Battery Input (6s1p)

12-26 AWG



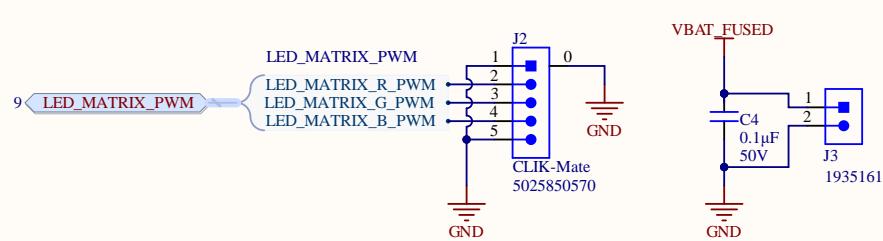
Ideal Diode Controller

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

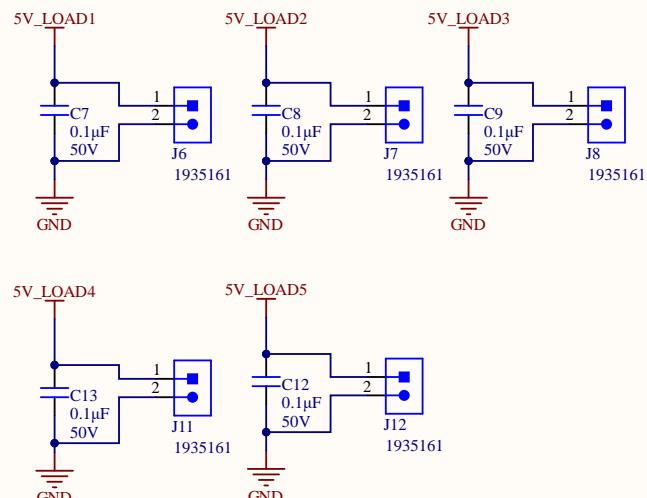
Max LED current = $(24-2)/4700 = 4.7\text{mA}$
Min LED current = $(18-2)/4700 = 3.4\text{mA}$

Title	Power Distribution Board Rev2 - Power	UW Robotics
Size:	Letter	Waterloo Ontario Canada N2L 3G6
Date:	2020-11-12	Sheet 1 of 11
File:	C:\UWRT\MarsRover2021-hardware\Projects\Power	Distribution Board\Rev2\SH1 - POWER.SchDoc

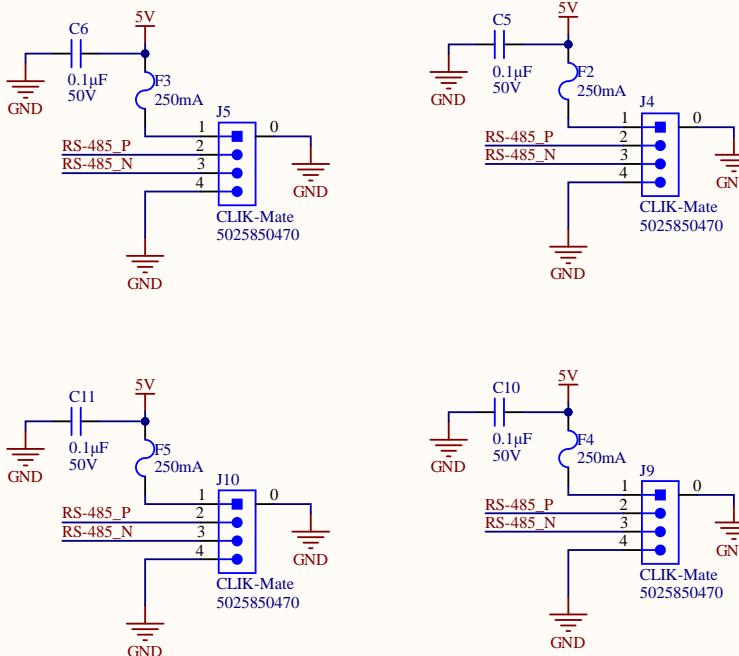
LED Matrix



5V Output



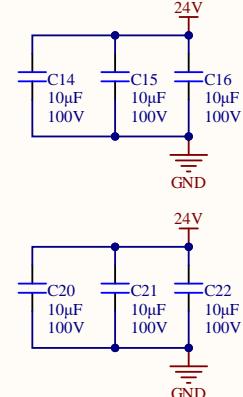
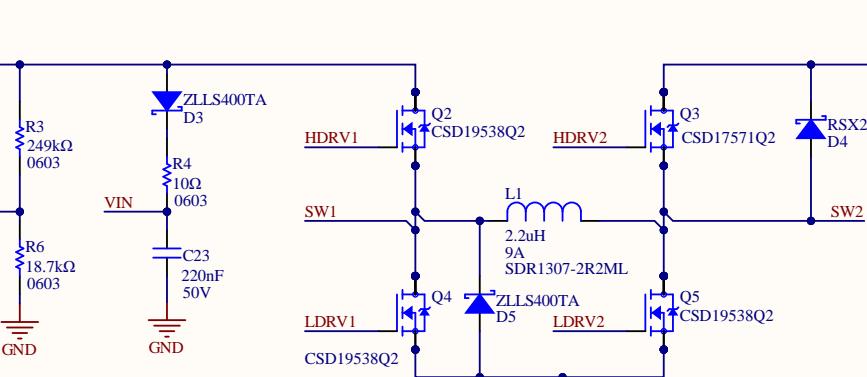
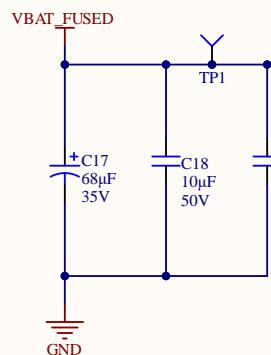
URM04 Ultrasonic Sensors



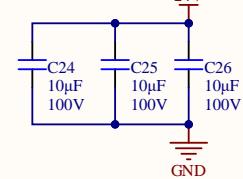
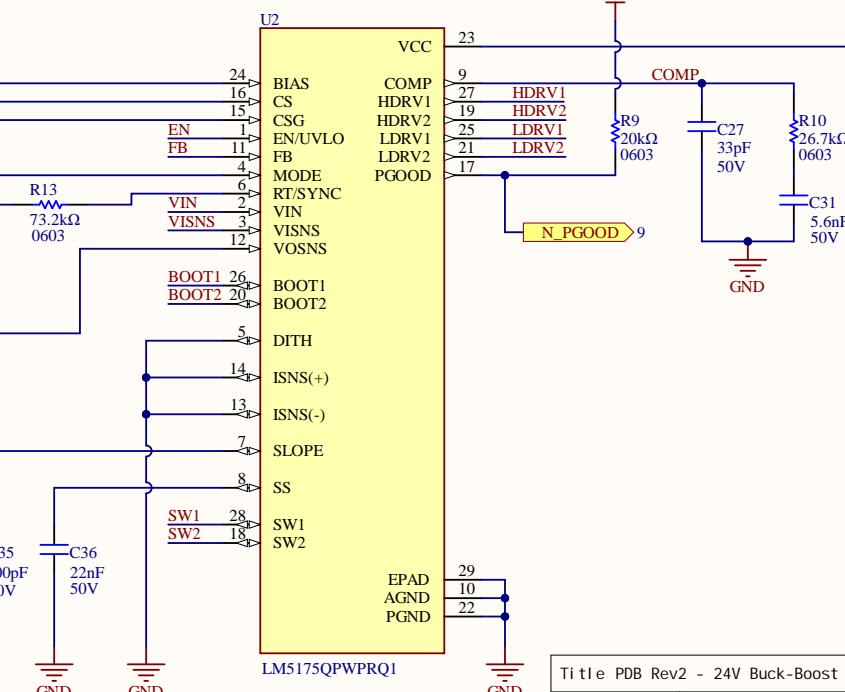
RS-485
12 RS-485 → RS-485_P
RS-485_N ← RS-485_N

Input voltage range: 18-25.8V

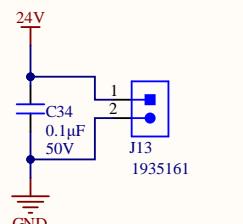
24V Buck-Boost Converter @ 3A Max



Inductor: SDR1307-2R2ML
20%, 6mΩ DCR
9A (rms), 18A (sat), 7mm tall



24V Output



Title PDB Rev2 - 24V Buck-Boost Converter

Size: Letter Drawn By: Cindy Li

Date: 2020-11-12 Sheet 8 of 11

File: C:\UWRT\MarsRover2021-hardware\Projects\Power

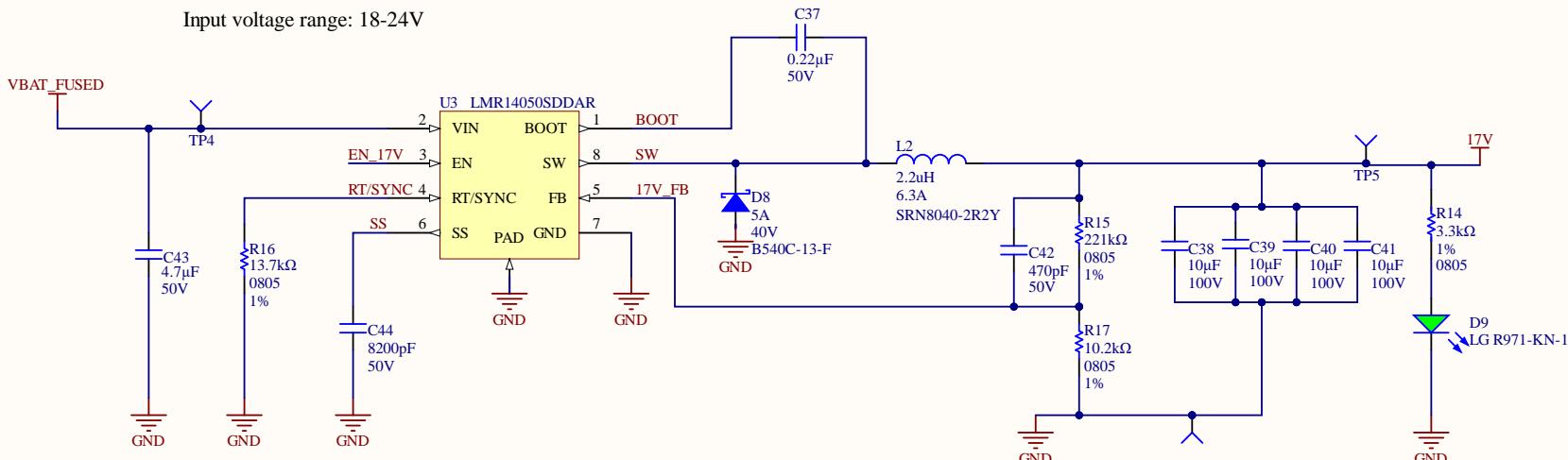
UW Robotics
200 University Avenue
Waterloo
Ontario
Canada N2L 3G6

UW ROBOTICS TEAM

A

A

17V Regulator @ 4A Max

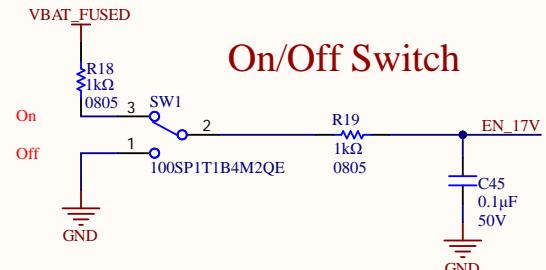


Estimated max current draw: 1.65A

Peak efficiency: 94.8%

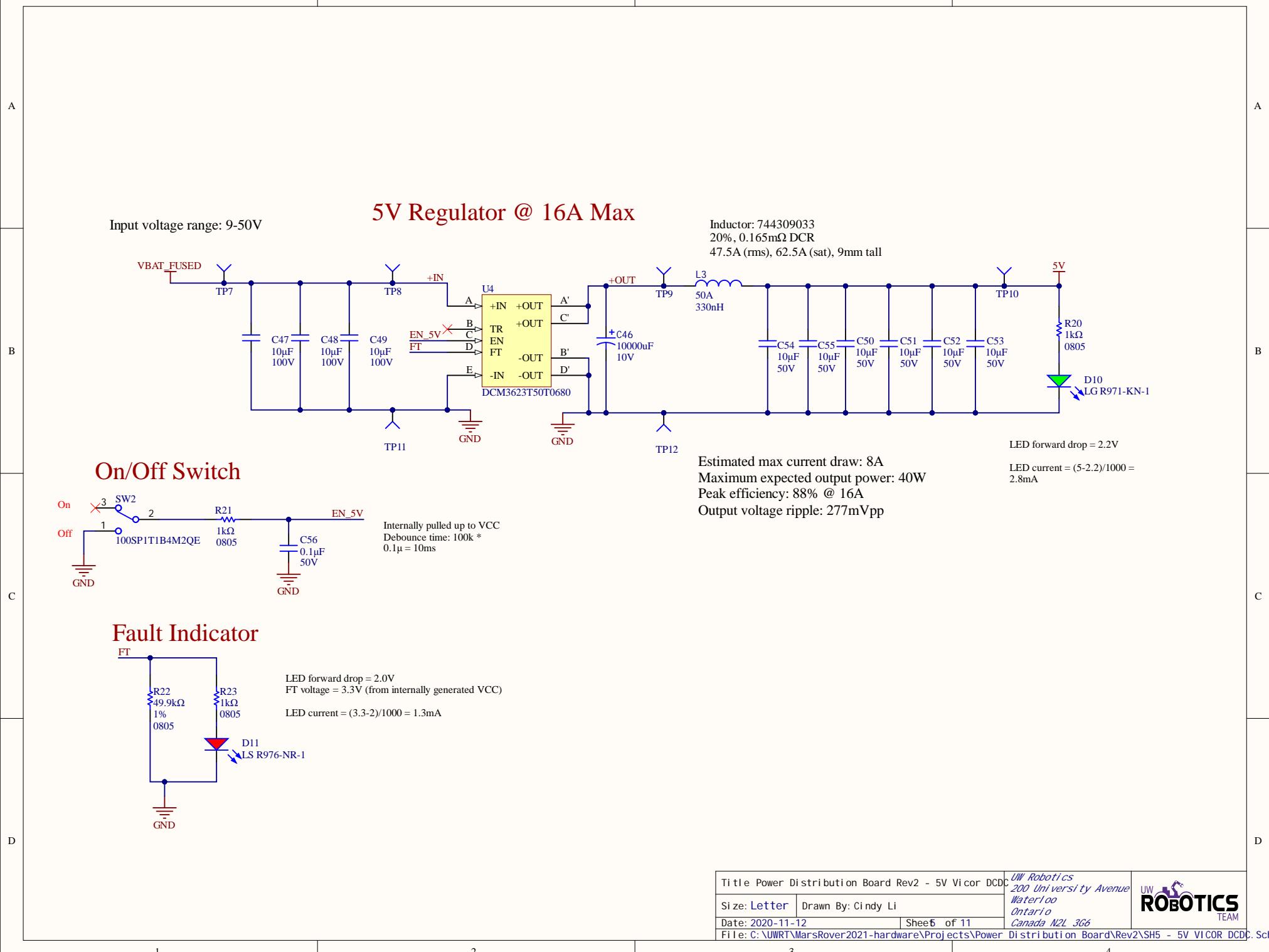
Output voltage ripple: 19.45mVpp

LED forward drop = 2.2V

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

D

D



A

A

B

B

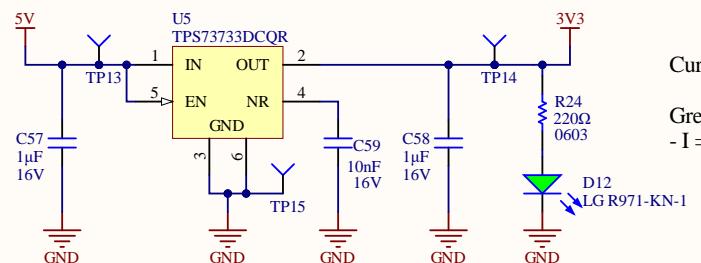
C

C

D

D

5V to 3.3V LDO (Max 1A)



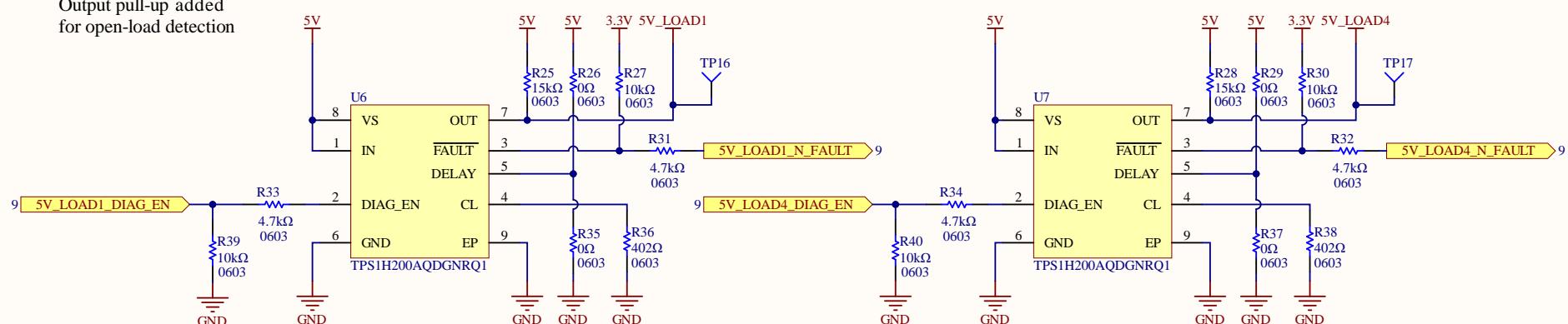
Current Calculations

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

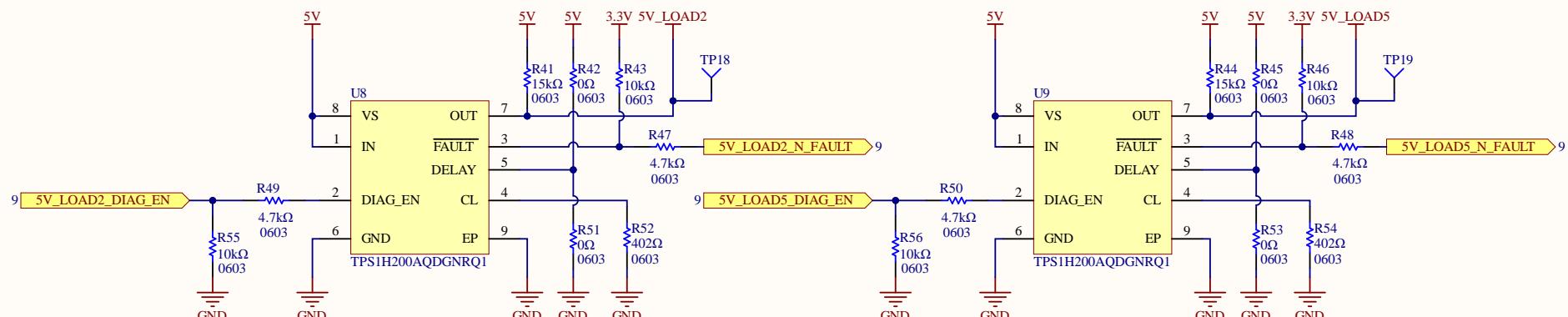
Title Power Distribution Board Rev2 - 3.3V Linear		<i>UW Robotics</i> 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-12	Sheet 6 of 11	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH6 - 3.3V LINEAR REGULATOR.SchDoc		UW ROBOTICS TEAM

5V Loads Smart Switches

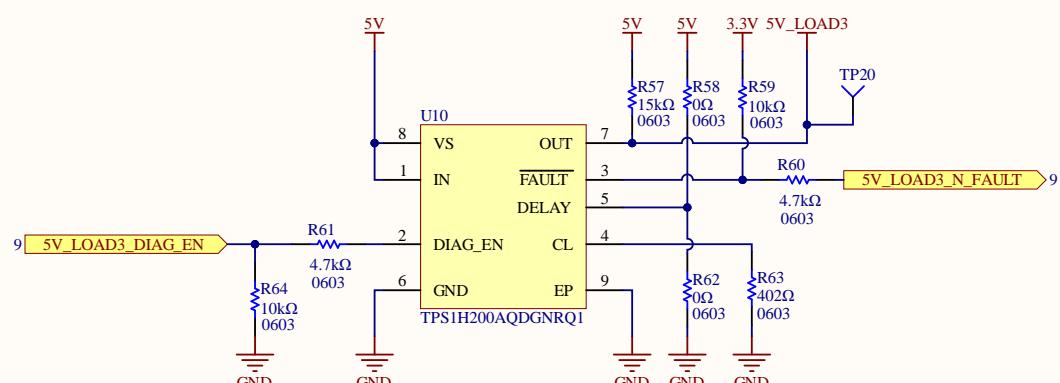
A
Output pull-up added for open-load detection



B



C



D

Smart Switch Current Limited to 5A

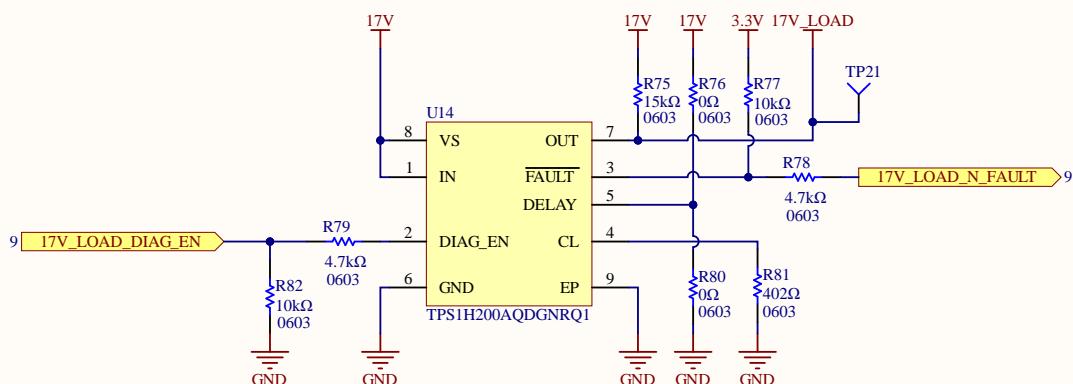
- $I_{out} = 5A$, $V_{CL(th)} = 0.8V$, $K_{CL} = 2500$ (values from datasheet)
- $R_{CL} = V_{CL(th)} * K_{CL} / I_{out} = 0.8 * 2500 / 5 = 400\Omega \rightarrow$ use $R_{CL} = 402\Omega$

Current Limit Configurations - Refer to DELAY Pin

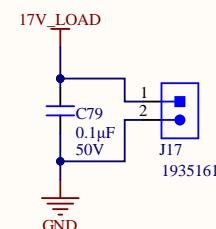
- Holding mode: depopulate pull-up and populate pull-down with a 0Ω resistor
- Latch-off mode: depopulate pull-up and populate pull-down with a capacitor or (calculated based on required delay time)
- Auto-retry mode: populate pull-up with a pull-up resistor and depopulate pull-down

A

17V Load Smart Switch

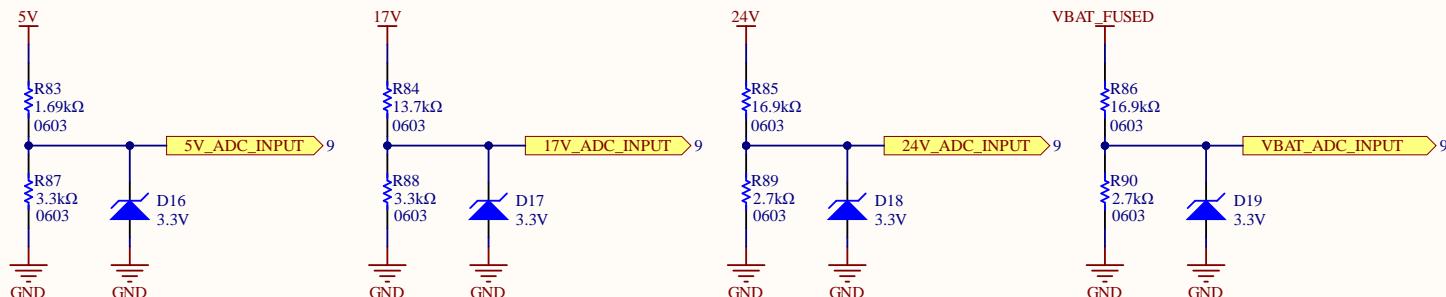


17V Output



B

Power Rail Voltage Monitoring



Divides 5V to 3.3V

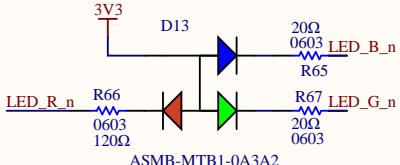
Divides 17V to 3.3V

Divides 24V to 3.3V

Divides 24V to 3.3V

D

Status LED

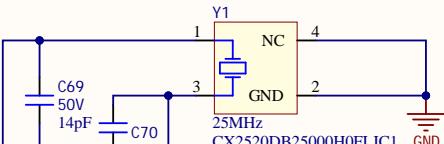


Current Calculations

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: $I = (3.3 - 3.1V)/20 = 10mA$

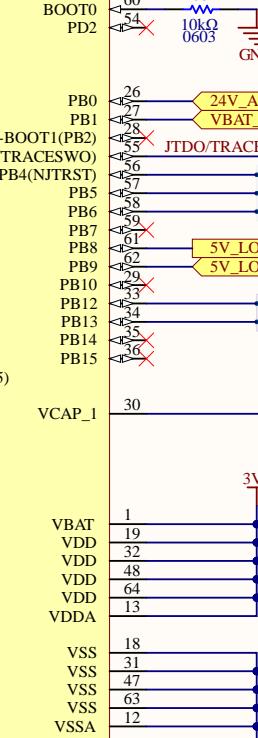
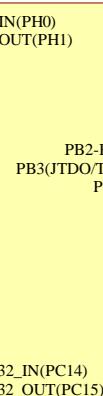
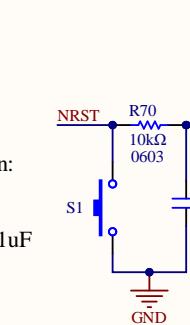
STM32F446RET6



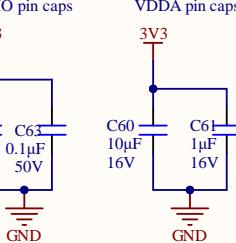
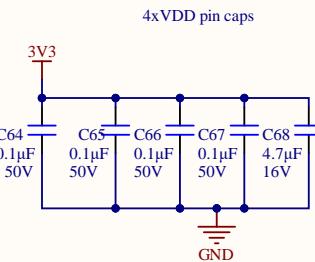
Debounce Calculation:

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

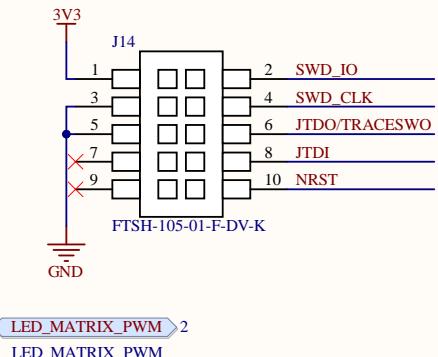
$$C = 10ms / 10k\Omega = 1\mu F$$



Decoupling Caps

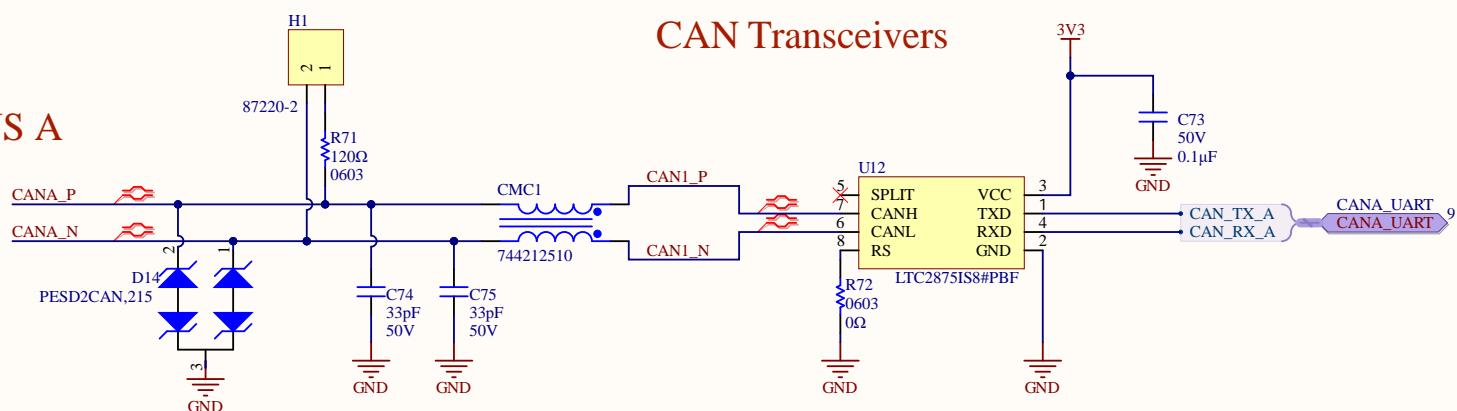
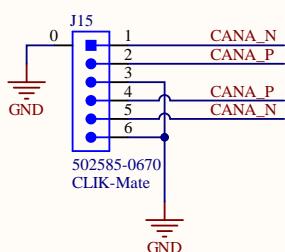


Debug/Programming



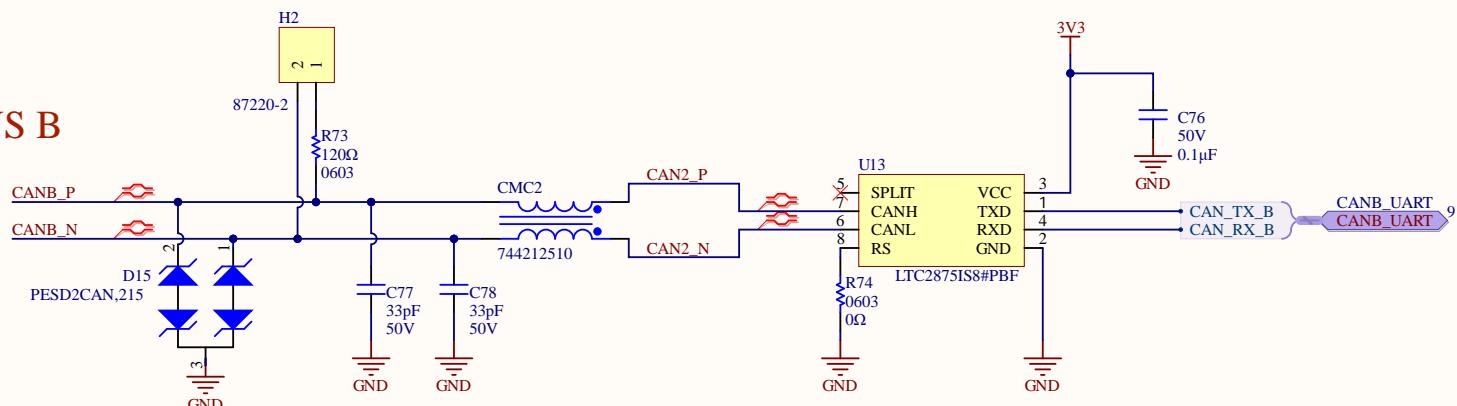
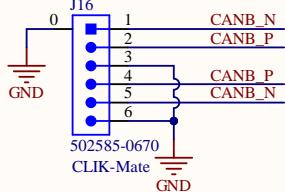
A

A

CAN BUS A

B

B

CAN BUS B

C

C

D

D

A

A

B

B

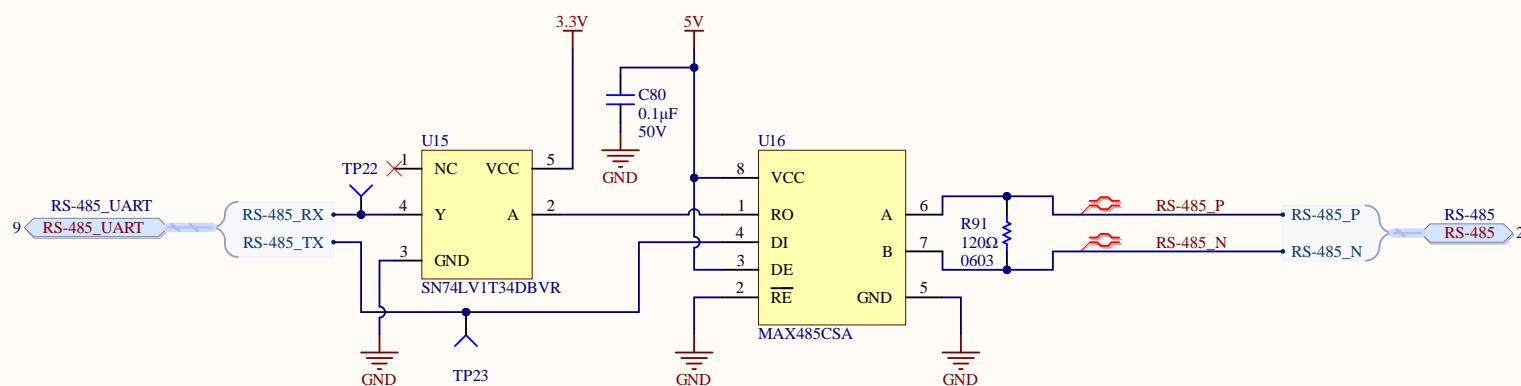
C

C

D

D

RS-485 Transceiver



Title Power Distribution Board Rev2 - RS-485		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
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R64 R62 R63' R61 R60 I10 P57 P58 P59 TP20 P55 P56 P51 P52 P53 P54 P49 D50 P47 P48 U8 U9 P41 P42 P43 P44 P45 P46 TP18 TP19 R39 P40 D35 R36 R37 R38 R33 P34 P31 R32 U6 U7 P25 P26 P27 P28 S29 R30 TP16 TP17

