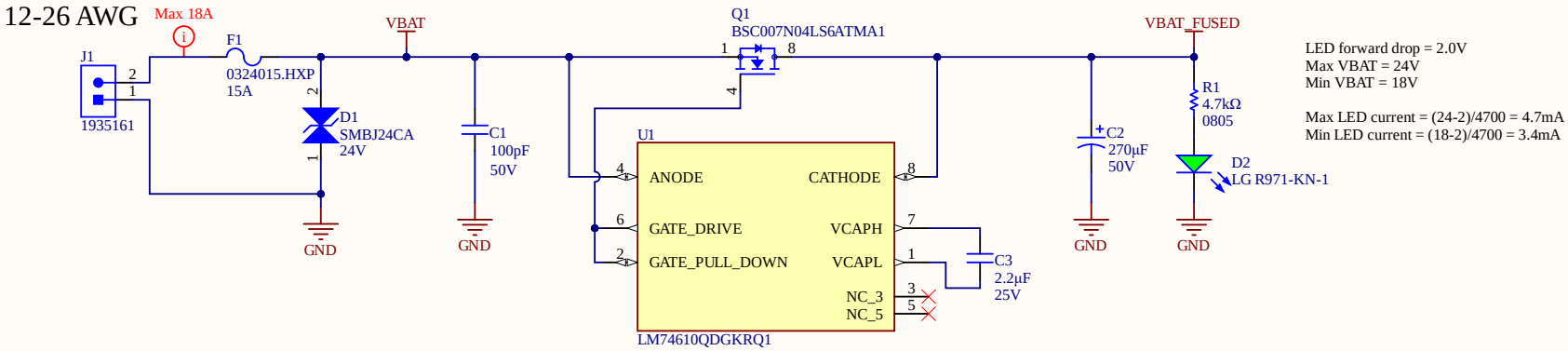
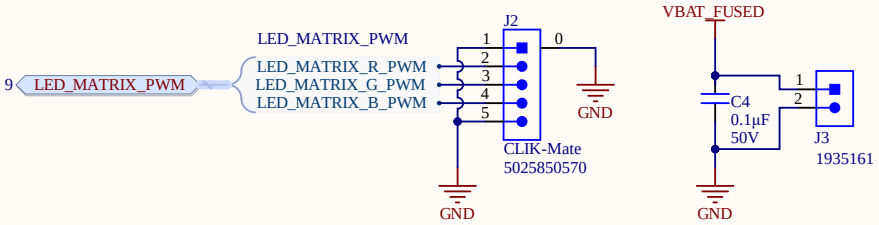
Battery Input (6s1p)

Ideal Diode Controller

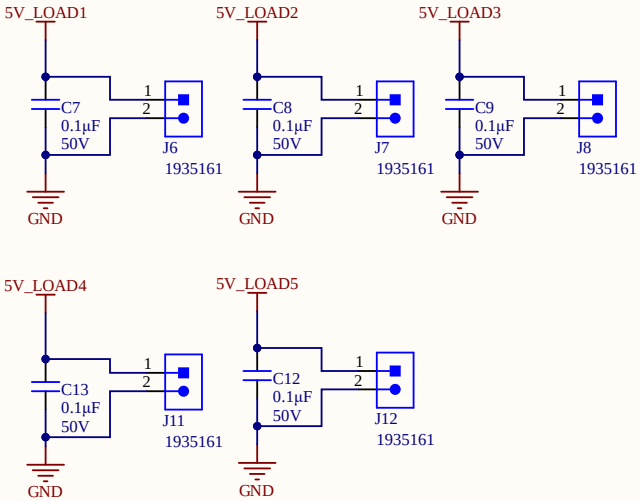


Title Power Distribution Board Rev2 - Power		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-11	Sheet 1 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH1 - POWER.SchDoc		

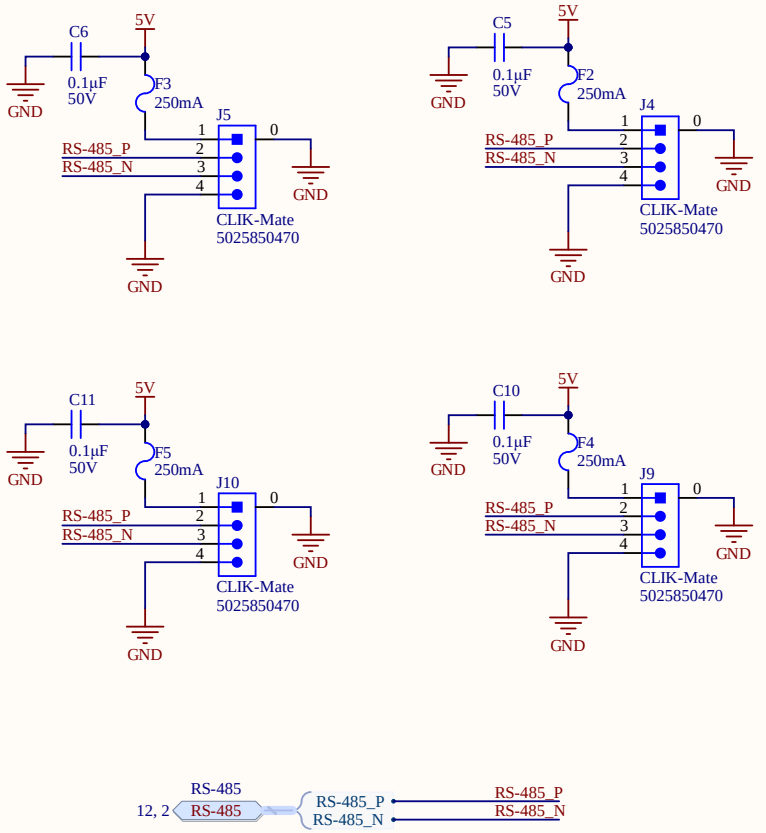
LED Matrix



5V Output



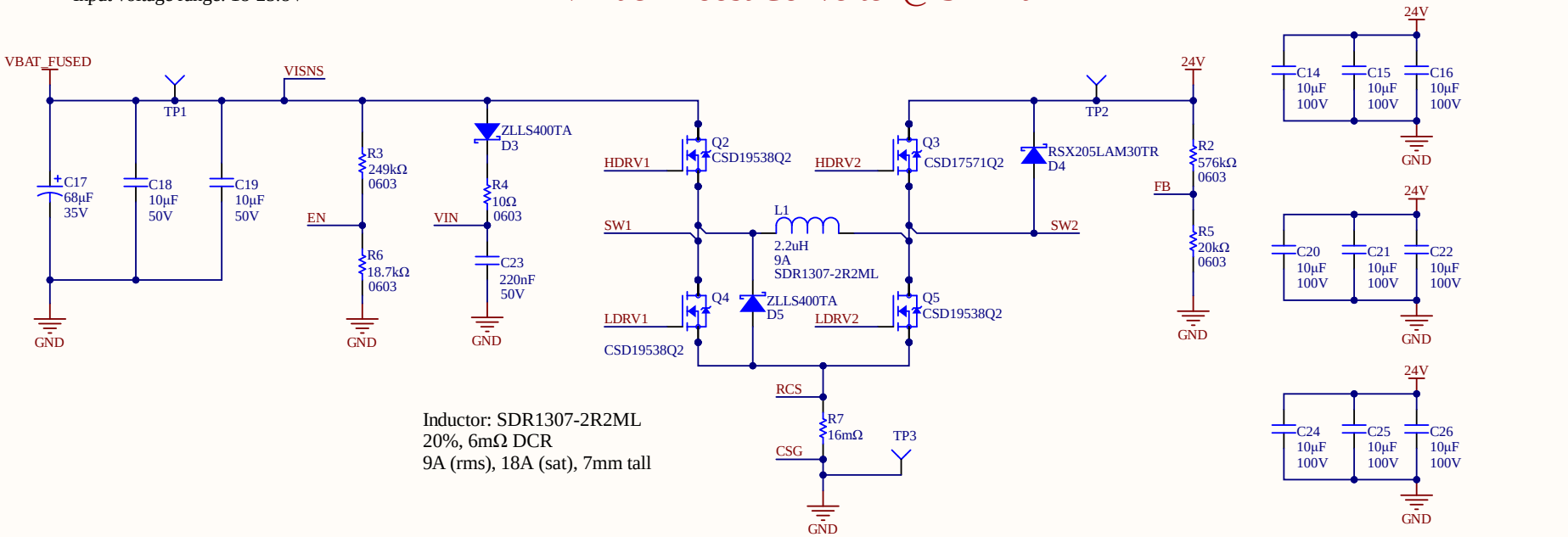
URM04 Ultrasonic Sensors



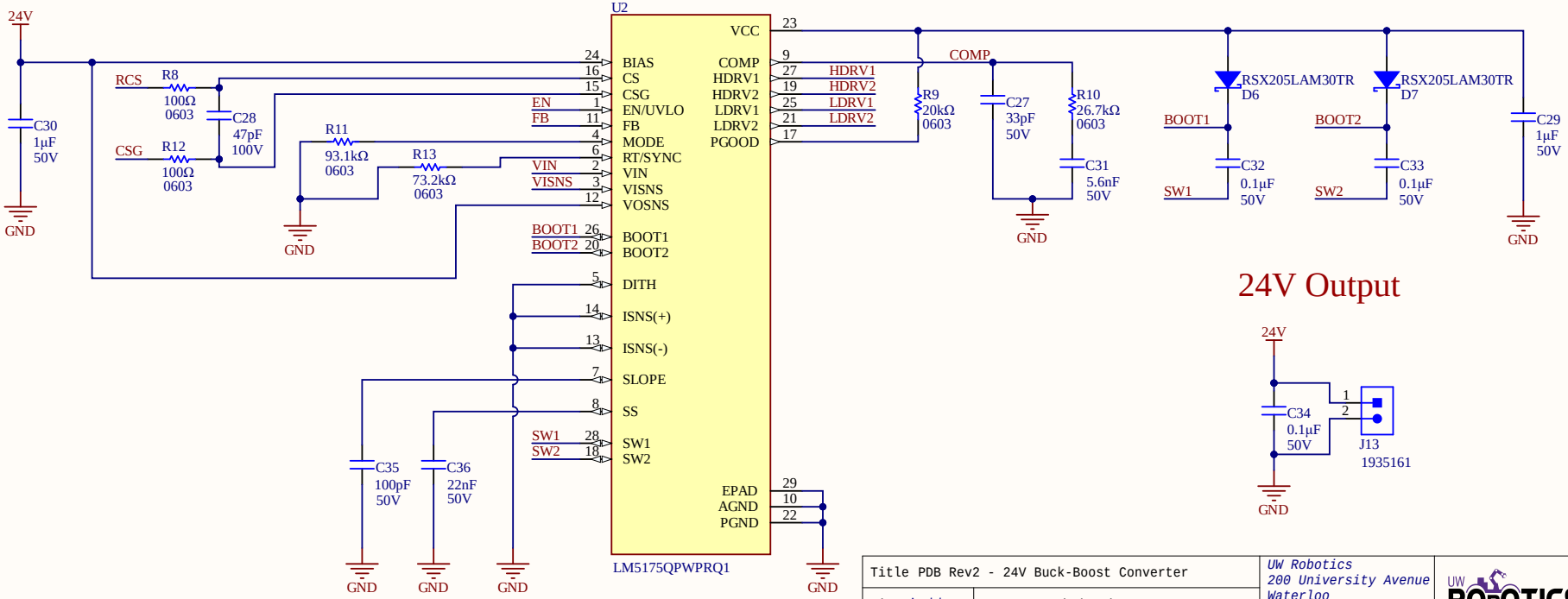
Title Power Distribution Board Rev2 - Connectors		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-11	Sheet 2 of 12		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH2 - CONNECTORS.SchDoc			

24V Buck-Boost Converter @ 3A Max

Input voltage range: 18-25.8V



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

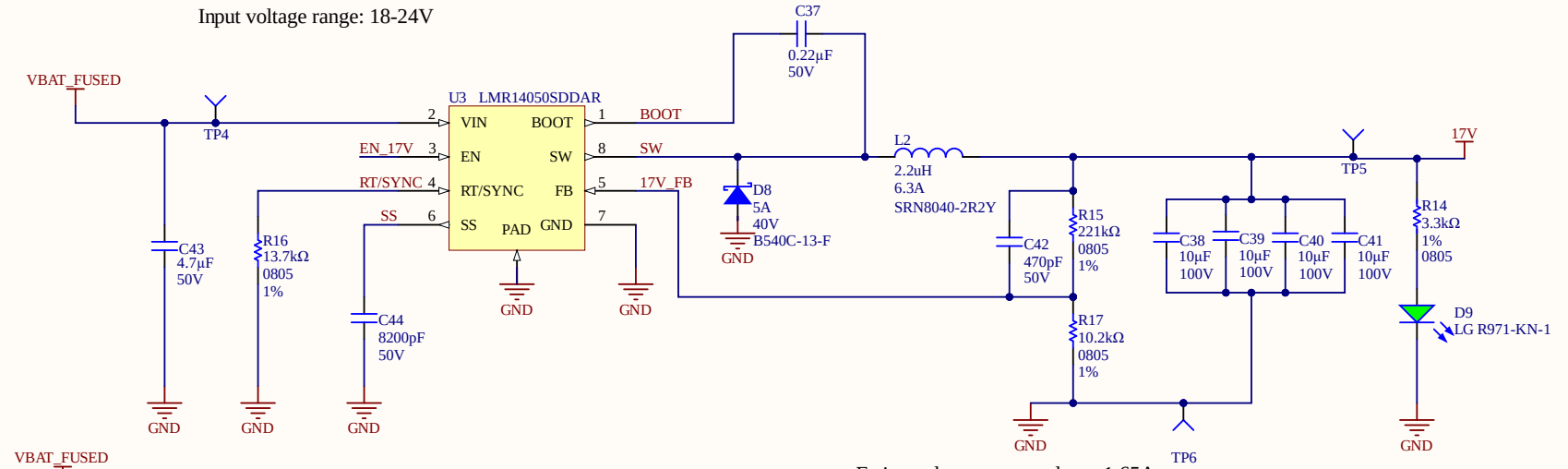


24V Output

Title PDB Rev2 - 24V Buck-Boost Converter		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-11	Sheet 8 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH3 - 24V BUCK-BOOST CONVERTER.SchD		

17V Regulator @ 4A Max

Input voltage range: 18-24V

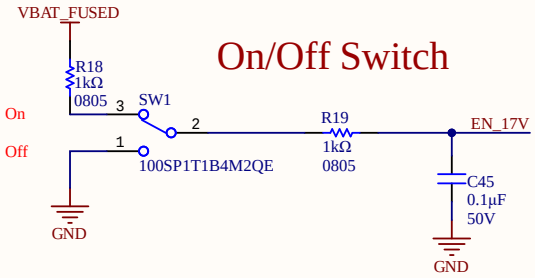


Estimated max current draw: 1.65A
Peak efficiency: 94.8%
Output voltage ripple: 19.45mVpp

LED forward drop = 2.2V

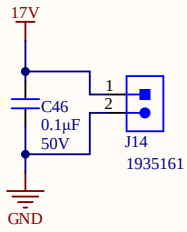
LED current = (17-2.2)/3300 = 4.5mA

On/Off Switch



Internally pulled up
Pull below 1.2V to disable.
Float or connect to VIN to enable.
Debounce time: 100k * 0.1µ = 10ms

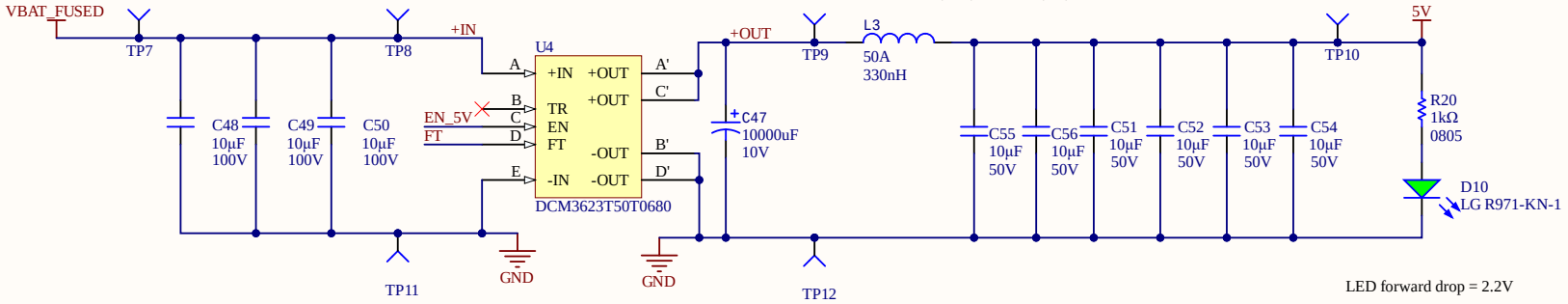
17V Output



Title Power Distribution Board Rev2 - 17V Buck Converter		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-11	Sheet 4 of 12		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH4 - 17V BUCK CONVERTER.SchDoc			

5V Regulator @ 16A Max

Input voltage range: 9-50V



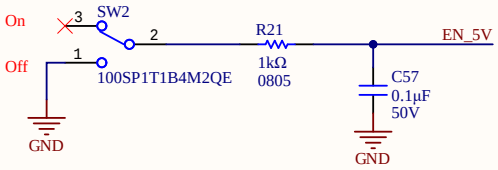
Inductor: 744309033
20%, 0.165mΩ DCR
47.5A (rms), 62.5A (sat), 9mm tall

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

LED forward drop = 2.2V

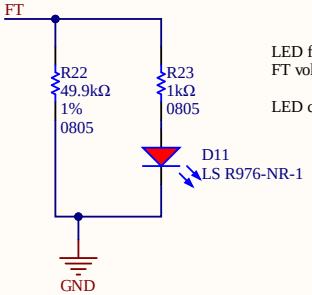
LED current = (5-2.2)/1000 = 2.8mA

On/Off Switch



Internally pulled up to VCC
Debounce time: 100k * 0.1µ = 10ms

Fault Indicator

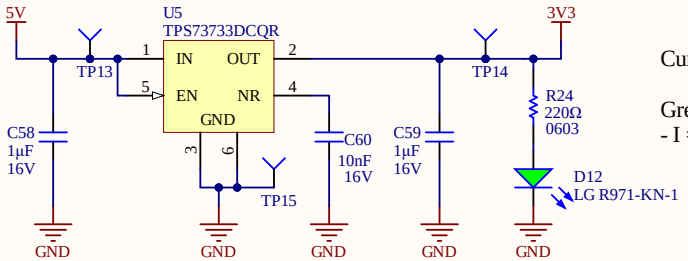


LED forward drop = 2.0V
FT voltage = 3.3V (from internally generated VCC)

LED current = (3.3-2)/1000 = 1.3mA

Title: Power Distribution Board Rev2 - 5V Vicor DCDC		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-11	Sheet 5 of 12		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH5 - 5V VICOR DCDC.SchDoc			

5V to 3.3V LDO (Max 1A)



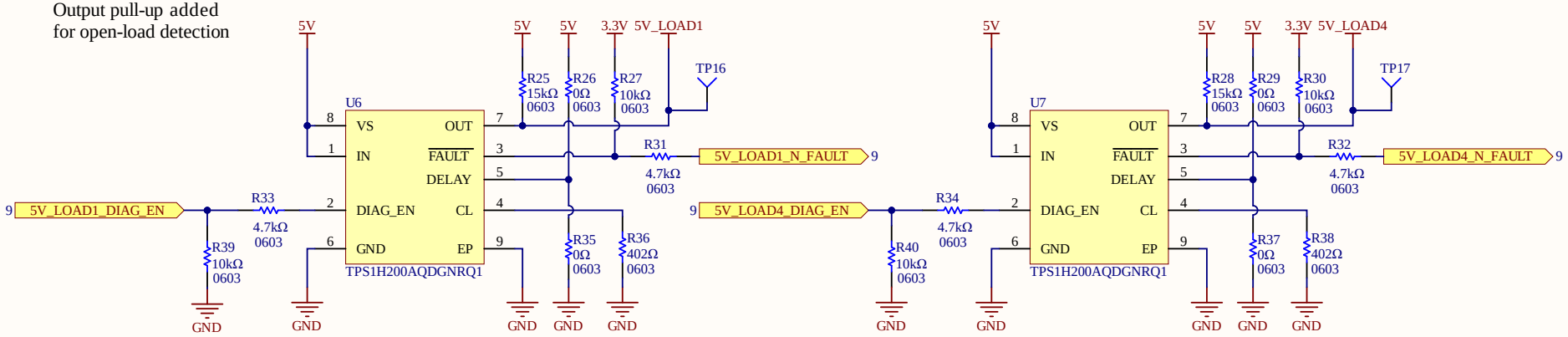
Current Calculations

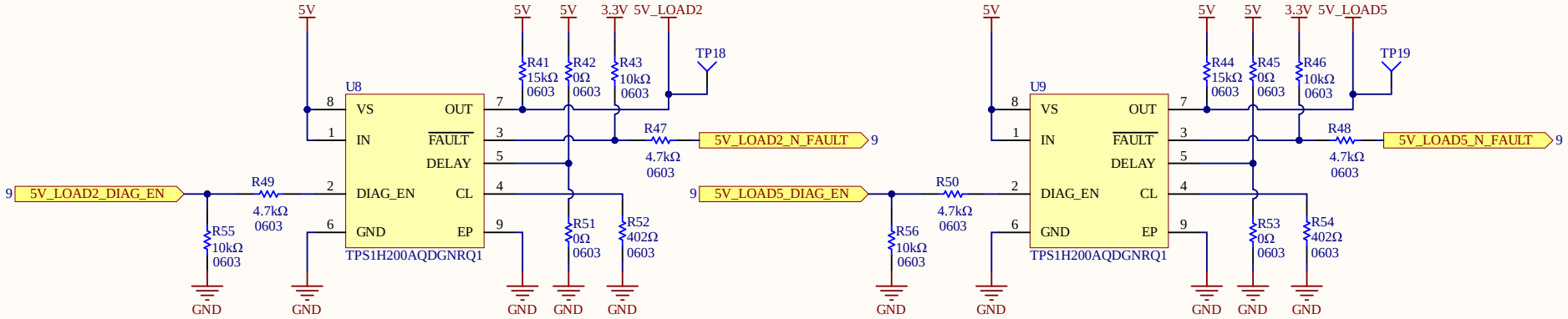
Green LED voltage drop: 2.2V
- I = (3.3-2.2V)/220 = 5mA

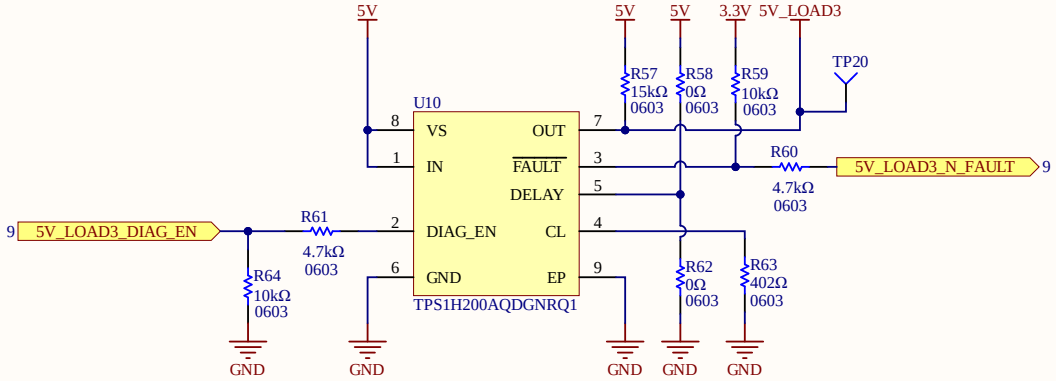
Title: Power Distribution Board Rev2 - 3.3V Linear Regulator			UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-11	Sheet 6 of 12		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH6 - 3.3V LINEAR REGULATOR.SchDoc			

5V Loads Smart Switches

Output pull-up added
for open-load detection







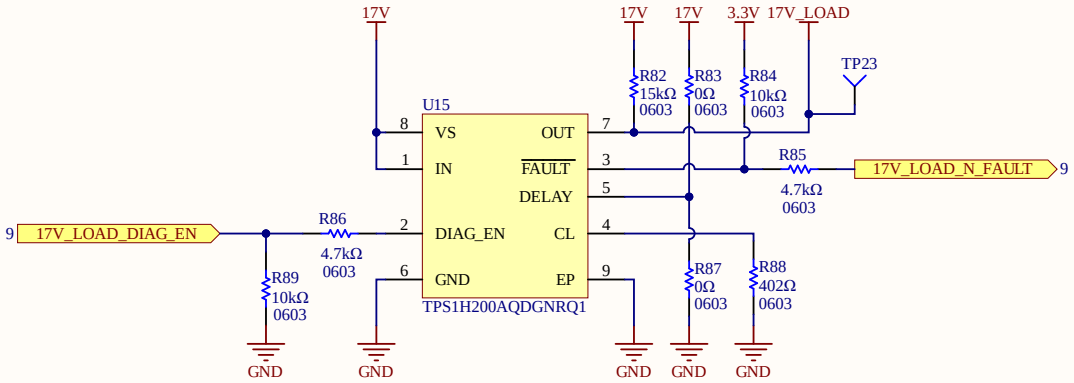
Smart Switch Current Limited to 5A

- I_out = 5A, V_CL(th) = 0.8V, K_CL = 2500 (values from datasheet)
- R_CL = V_CL(th) * K_CL / I_out = 0.8 * 2500 / 5 = 400Ω → use R_CL = 402Ω

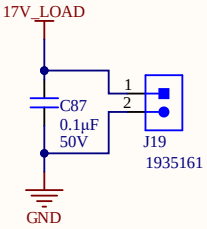
Current Limit Configurations - Refer to DELAY Pin
- Holding mode: depopulate pull-up and populate pull-down with a 0Ω resistor
- Latch-off mode: depopulate pull-up and populate pull-down with a capacit o r (calculated based on required delay time)
- Auto-retry mode: populate pull-up with a pull-up resistor and depopulate pull-down

Title Power Distribution Board Rev2 - Load Monitoring 1		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-11	Sheet 7 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH7 - LOAD MONITORING 1.SchDoc		

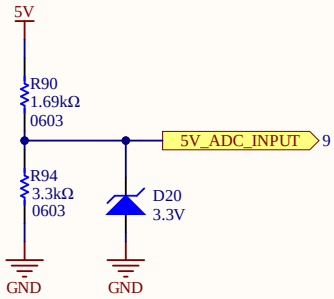
17V Load Smart Switch



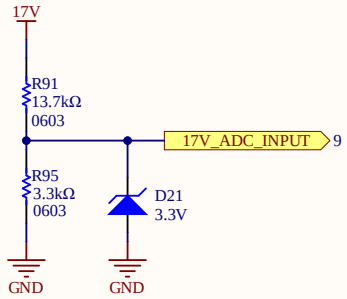
17V Output



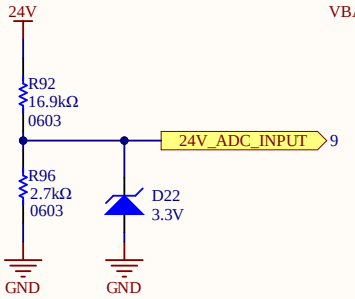
Power Rail Voltage Monitoring



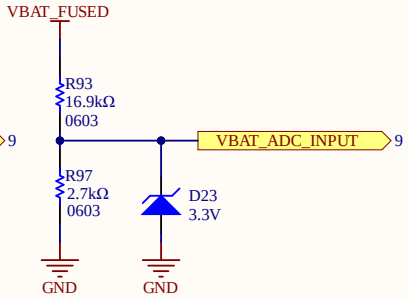
Divides 5V to 3.3V



Divides 17V to 3.3V



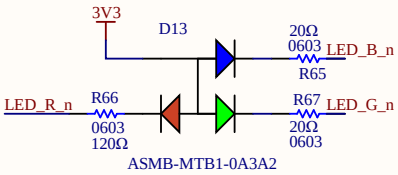
Divides 24V to 3.3V



Divides 24V to 3.3V

Title: Power Distribution Board Rev2 - Load Monitoring 2			UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-11	Sheet 8 of 12		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH8 - LOAD MONITORING 2.SchDoc			

Status LED



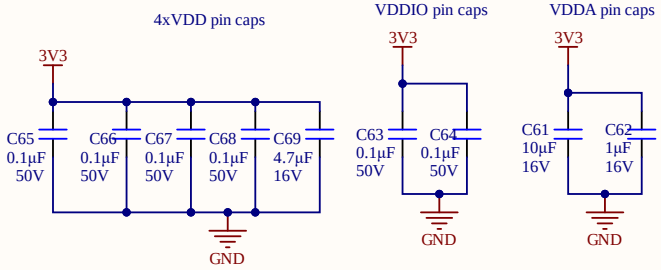
Current Calculations

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

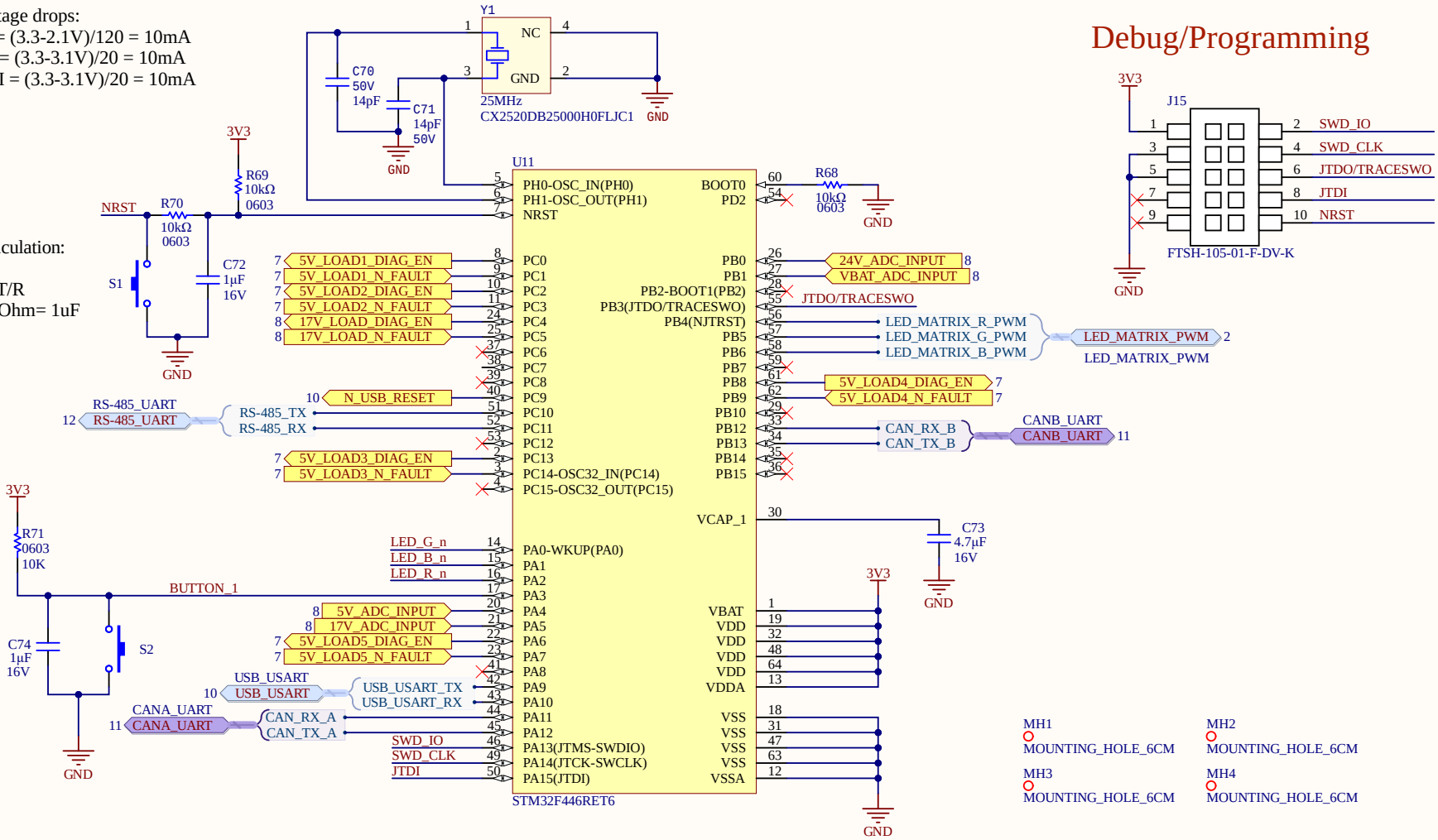
Debounce Calculation:

T=RC -> C= T/R
C= 10ms/10kOhm= 1uF

Decoupling Caps

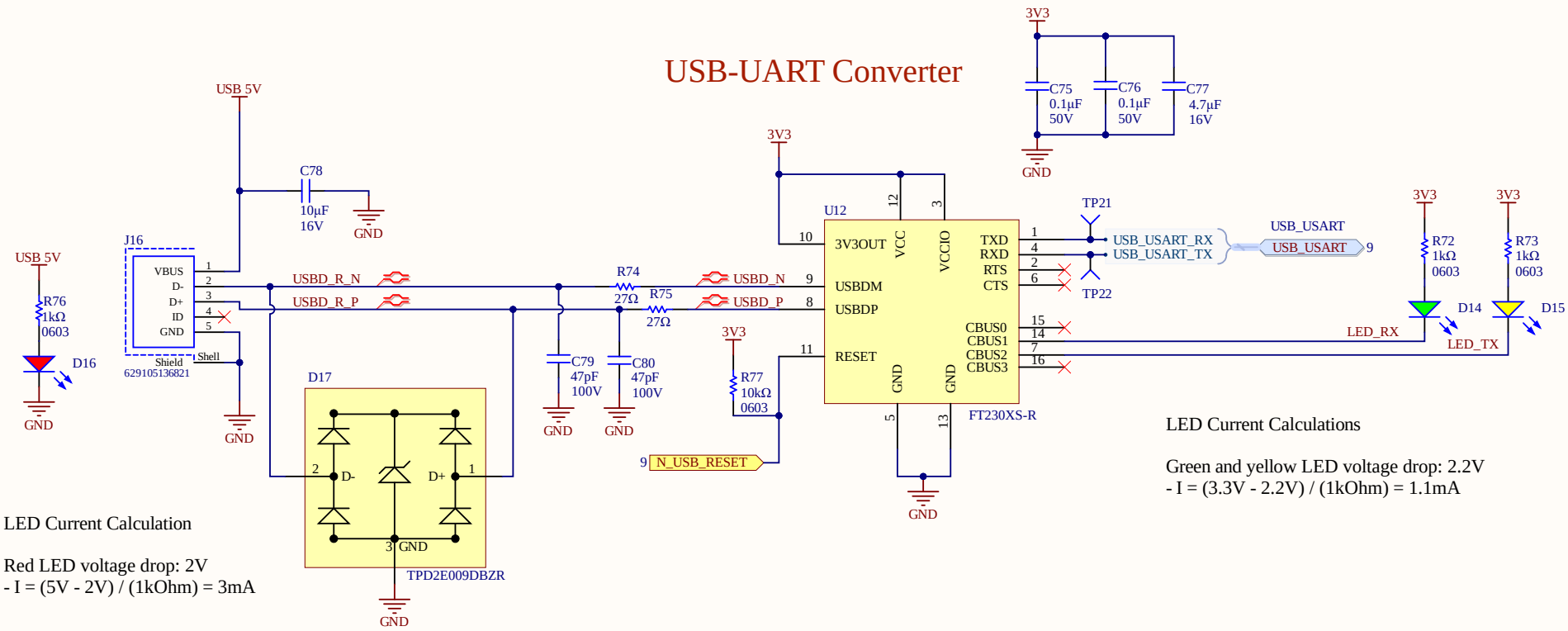


STM32F446RET6



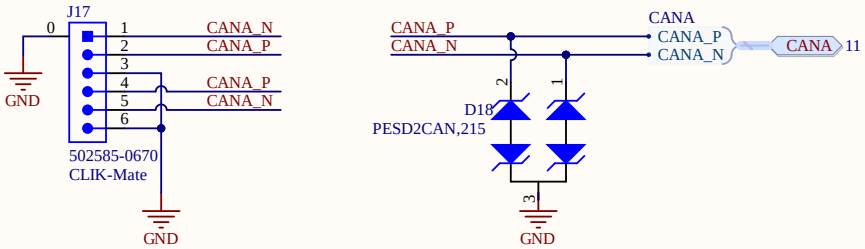
Debug/Programming

Title Power Distribution Board Rev2 - MCU		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-11	Sheet 9 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH9 - MICROCONTROLLER.SchDoc		

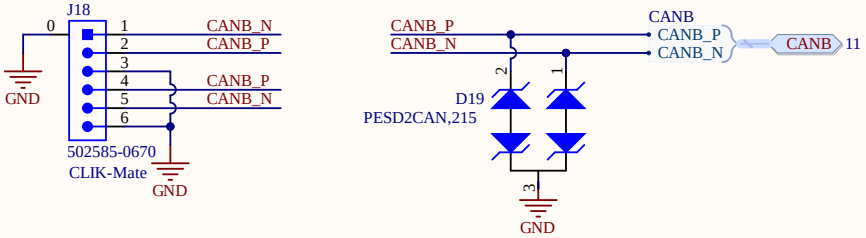


Title Power Distribution Board Rev2 - USB		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-11	Sheet 10 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH10 - USB.SchDoc		

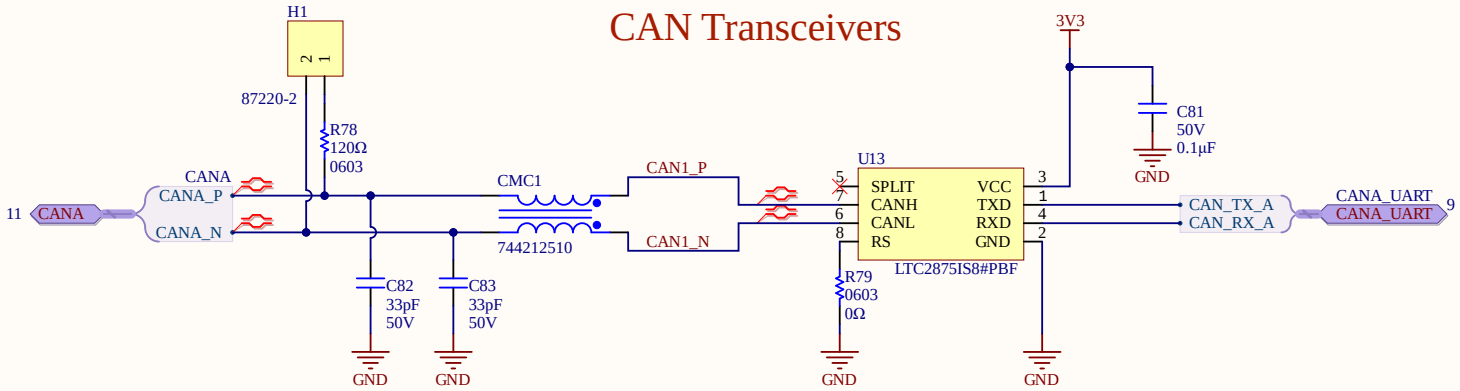
CAN BUS A

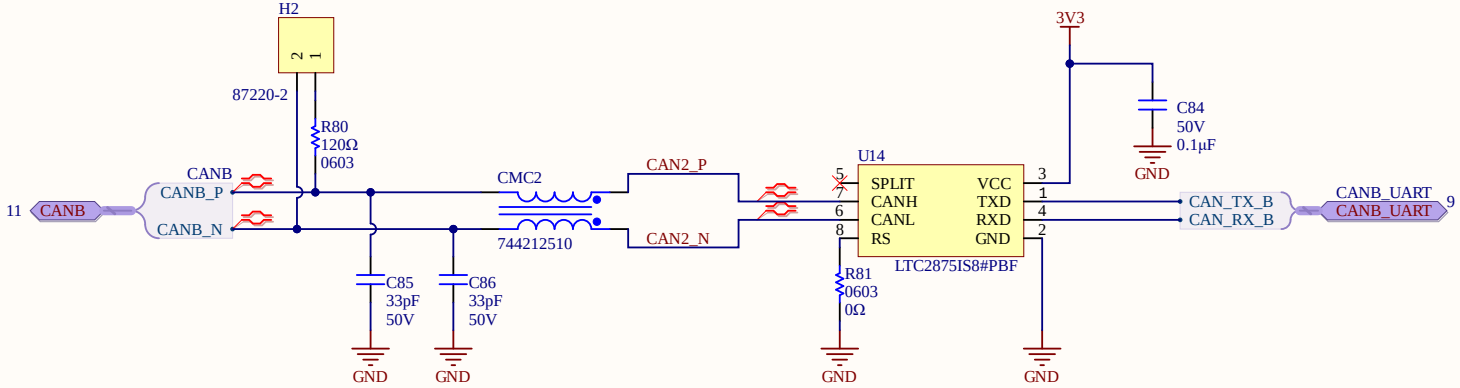


CAN BUS B



CAN Transceivers





Title Power Distribution Board Rev2 - CAN Transceivers			
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-11	Sheet 11 of 12		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH11 - CAN.SchDoc			

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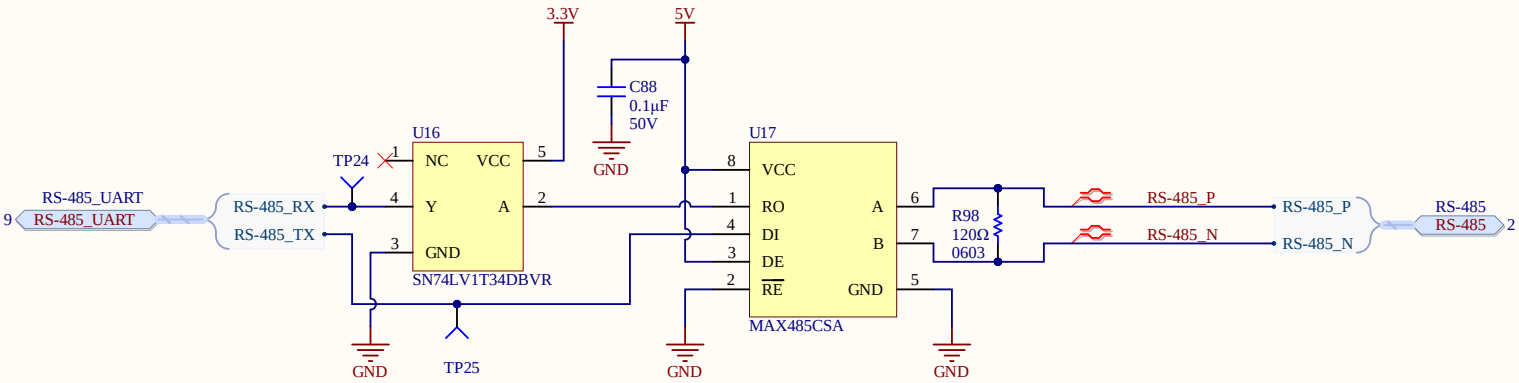
Waterloo
Ontario
Canada N2L 3G6

RS-485 Transceiver



Title Power Distribution Board Rev2 - RS-485			UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-11	Sheet 12 of 12		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH12 - RS-485.SchDoc