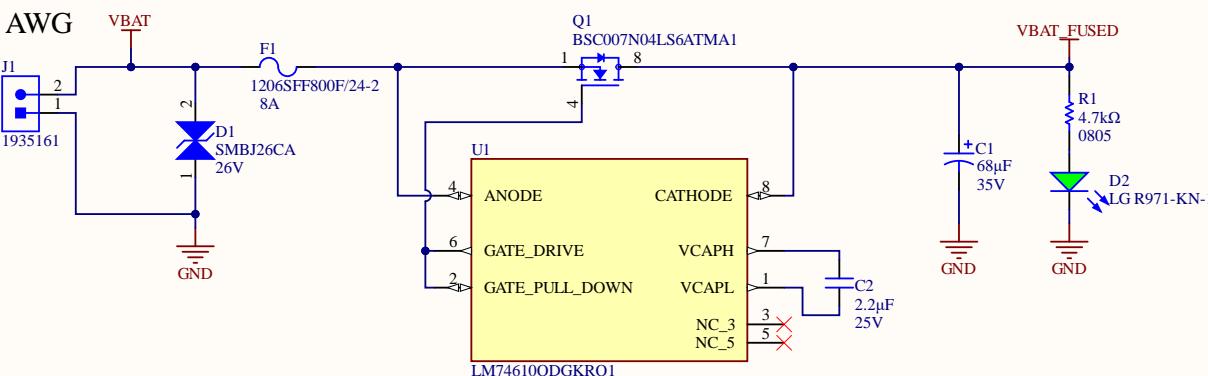


## Battery Input (6s1p)

Input voltage range: 18-25.2V

12-26 AWG

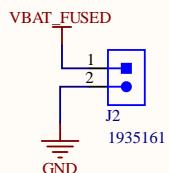


LED forward drop = 2.0V  
Max VBAT = 24V  
Min VBAT = 18V

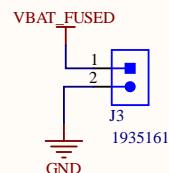
Max LED current =  $(24-2)/4700 = 4.7\text{mA}$   
Min LED current =  $(18-2)/4700 = 3.4\text{mA}$

## Ideal Diode Controller

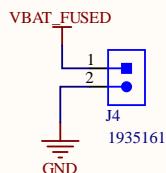
## VBat (24V) Outputs



VBat (24V) power to LED Matrix board



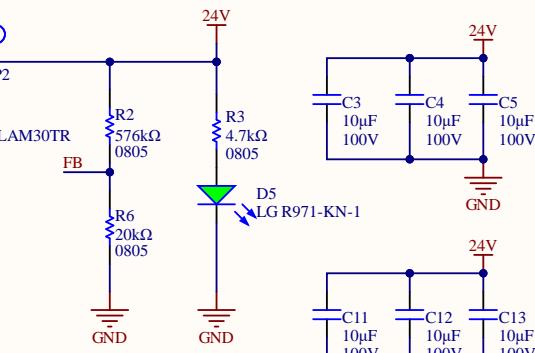
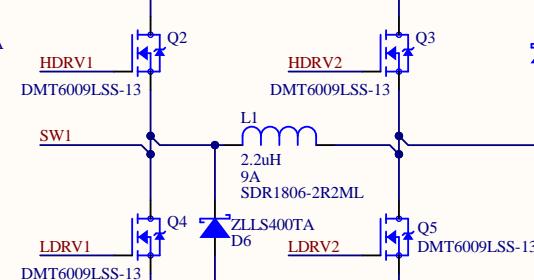
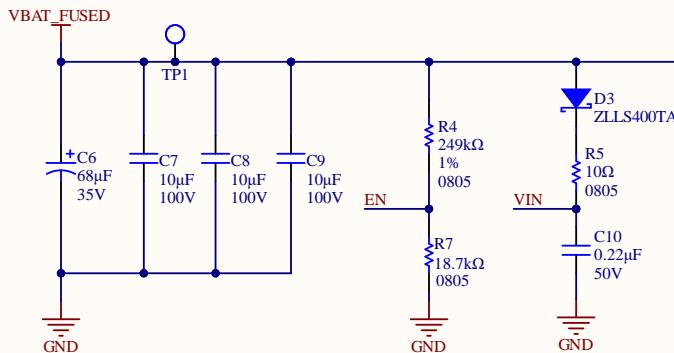
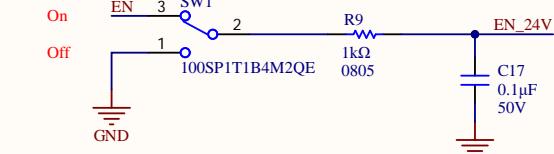
VBat (24V) power to Arm, Science, Gimbal, or Localization boards (to be decided in Rev3)



Input voltage range: 18-25.2V

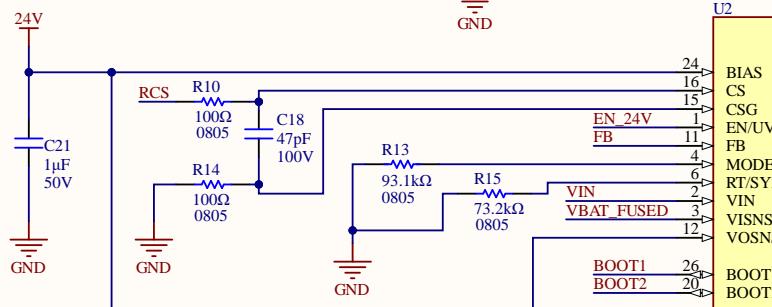
**24V Buck-Boost Converter @ 3A Max**

LED forward drop = 2.0V

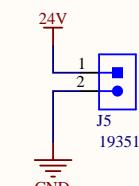
LED current =  $(24-2)/4700 = 4.7\text{mA}$ **On/Off Switch**

Pull below 0.4V to disable.  
For  $0.7\text{V} < \text{EN\_24V} < 1.23\text{V}$ , the controller operates in standby mode (VCC regulator enabled but PWM controller is not switching).  
For  $\text{EN\_24V} > 1.23\text{V}$ , the PWM function is enabled.  
Debounce time:  $100\text{k} * 0.1\mu\text{s} = 10\text{ms}$

Inductor: SDR1806-2R2ML  
20%, 6.8mΩ DCR  
9A (rms), 22A (sat), 6.9mm tall

**24V Output**

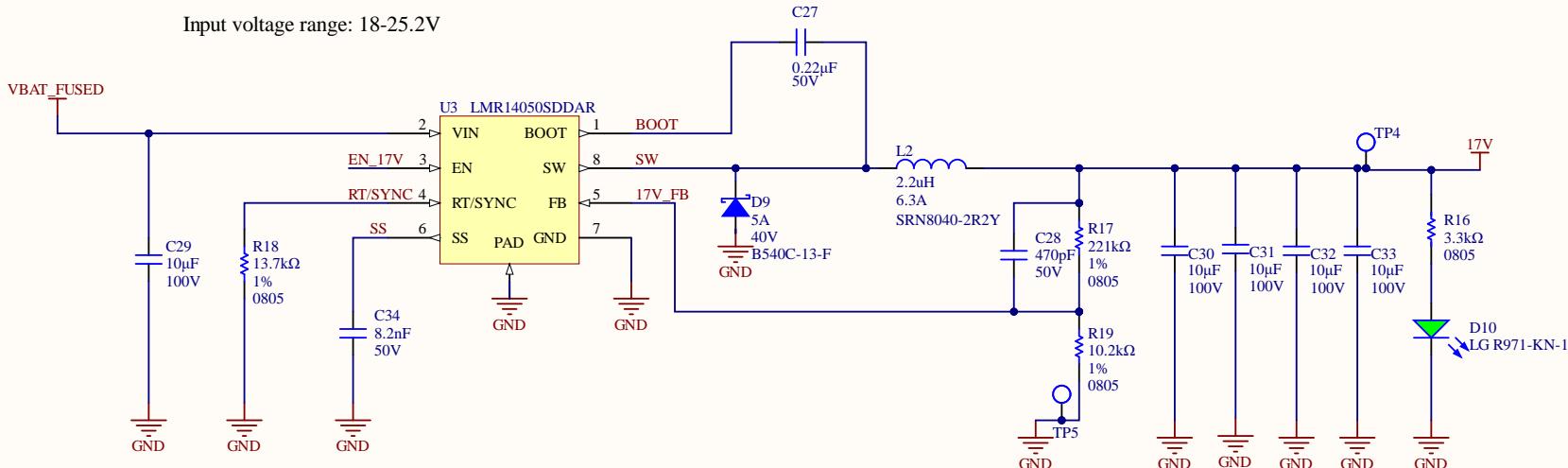
24V power to ethernet switch



A

A

## 17V Regulator @ 4A Max



Estimated max current draw: 1.65A

Peak efficiency: 94.8%

Output voltage ripple: 19.45mVpp

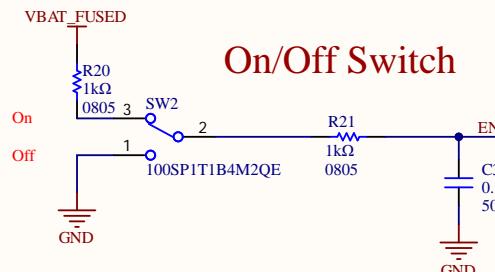
LED forward drop = 2.2V

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

C

C

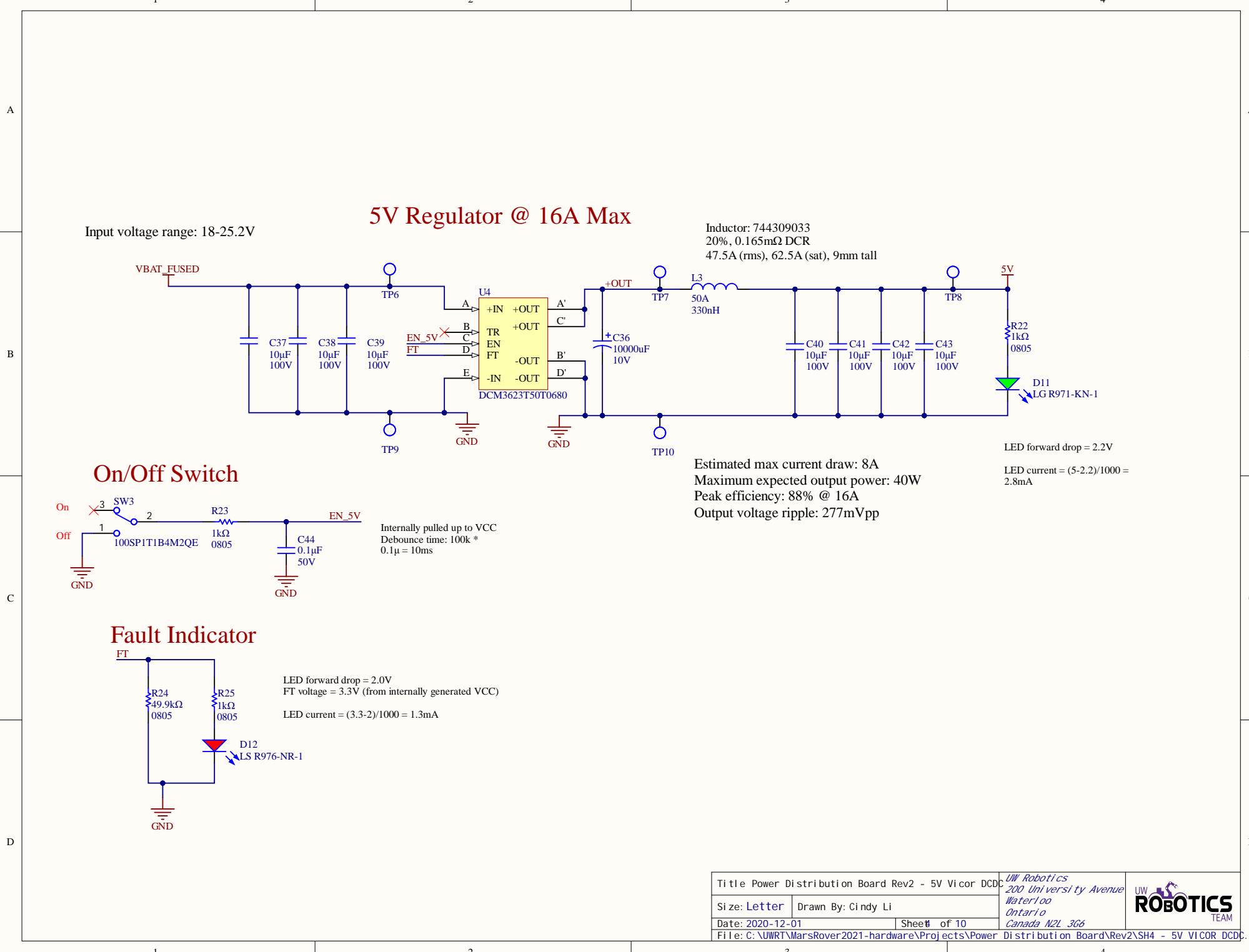
## On/Off Switch



Internally pulled up  
Pull below 1.2V to disable.  
Float or connect to VIN to enable.  
Debounce time:  $100\text{k} \times 0.1\mu\text{s} = 10\text{ms}$

D

D



A

A

B

B

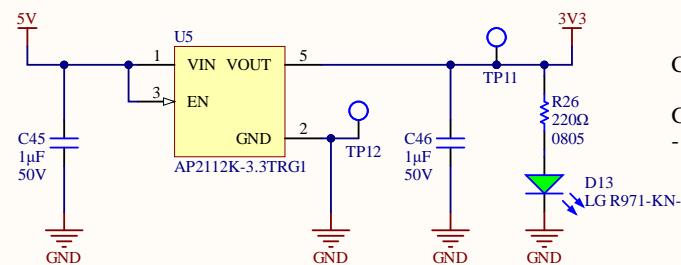
C

C

D

D

### 3.3V LDO @ 600mA Max



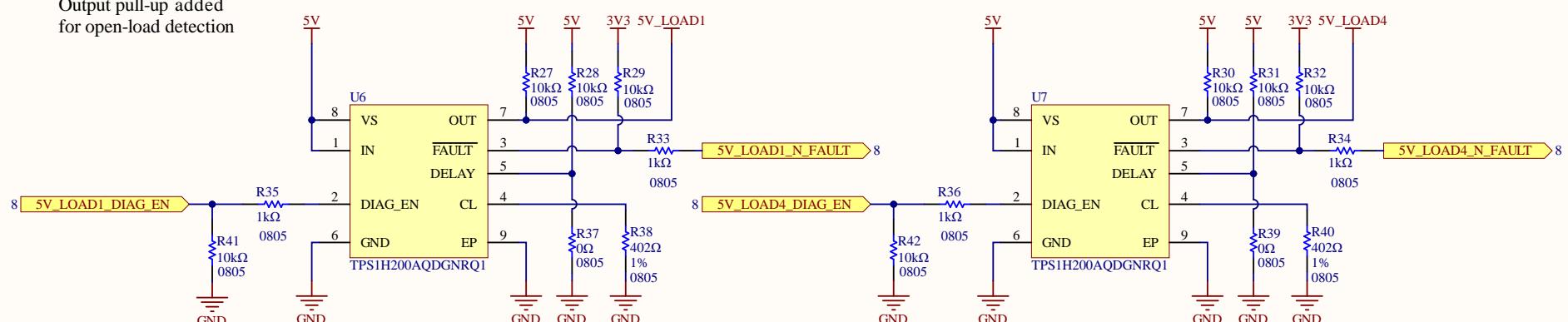
#### Current Calculations

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

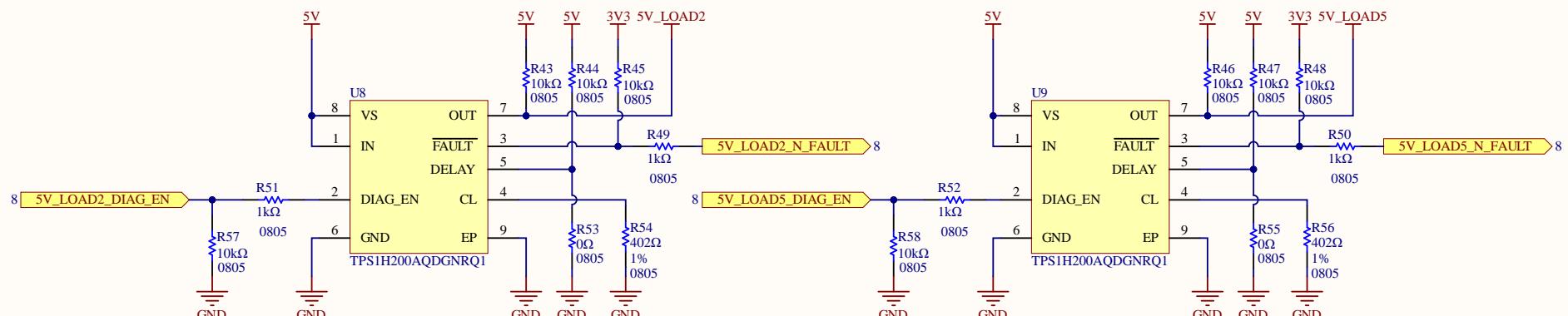
Title Power Distribution Board Rev2 - 3.3V Linear		<i>UW Robotics</i> 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-12-01	Sheet 6 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH5 - 3.3V LINEAR REGULATOR.SchDoc		<b>UW ROBOTICS TEAM</b>

## 5V Loads Smart Switches

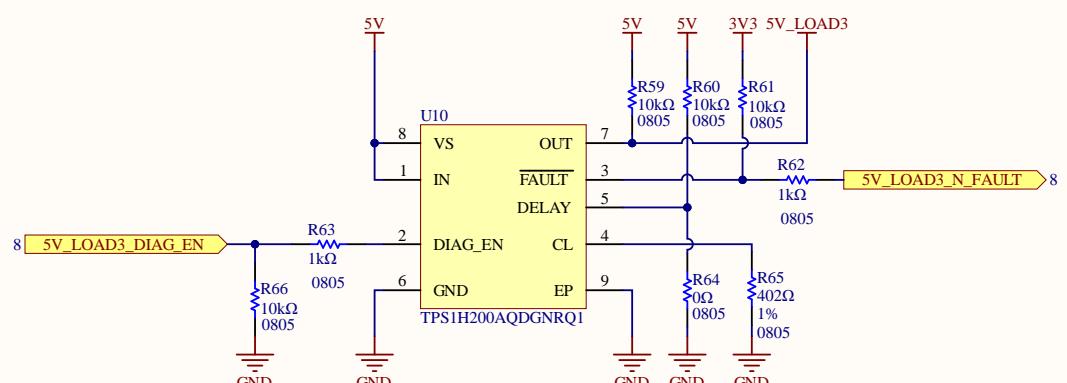
A  
Output pull-up added for open-load detection



B



C



D

### Smart Switch Current Limited to 5A

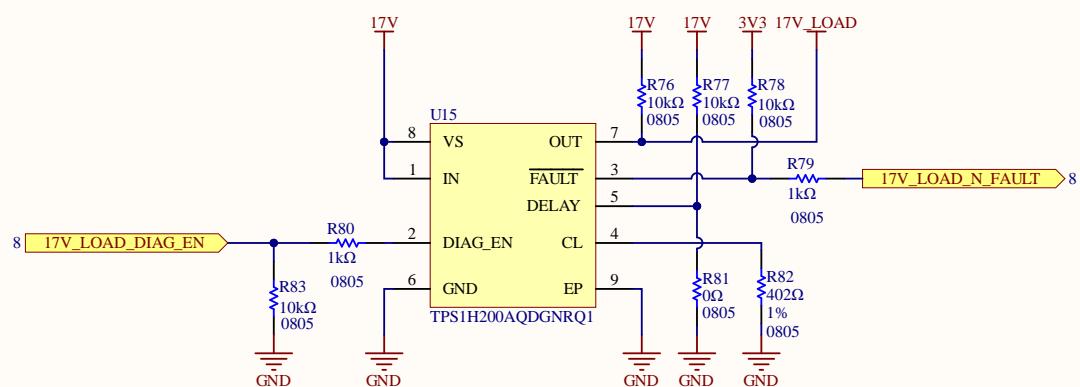
- $I_{out} = 5A$ ,  $V_{CL(th)} = 0.8V$ ,  $K_{CL} = 2500$  (values from datasheet)
- $R_{CL} = V_{CL(th)} * K_{CL} / I_{out} = 0.8 * 2500 / 5 = 400\Omega \rightarrow$  use  $R_{CL} = 402\Omega$

### Current Limit Configurations - Refer to DELAY Pin

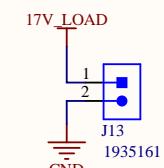
- Holding mode: depopulate pull-up and populate pull-down with a  $0\Omega$  resistor
- Latch-off mode: depopulate pull-up and populate pull-down with a capacitor or (calculated based on required delay time)
- Auto-retry mode: populate pull-up with a pull-up resistor and depopulate pull-down

A

## 17V Load Smart Switch

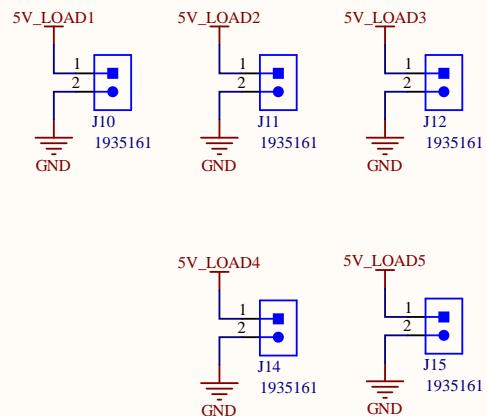


## 17V Output



17V power to Nvidia Jetson board

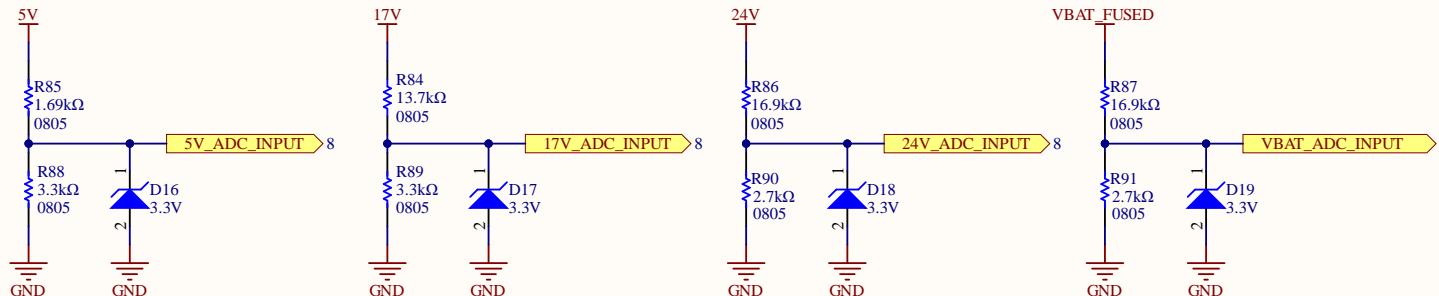
## 5V Outputs



5V power to Arm, Science, Gimbal, and Localization boards (plus one spare)

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

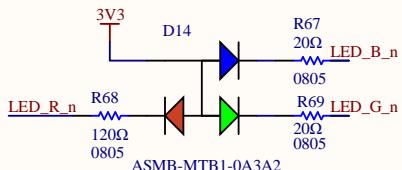
1

2

3

4

## Status LED

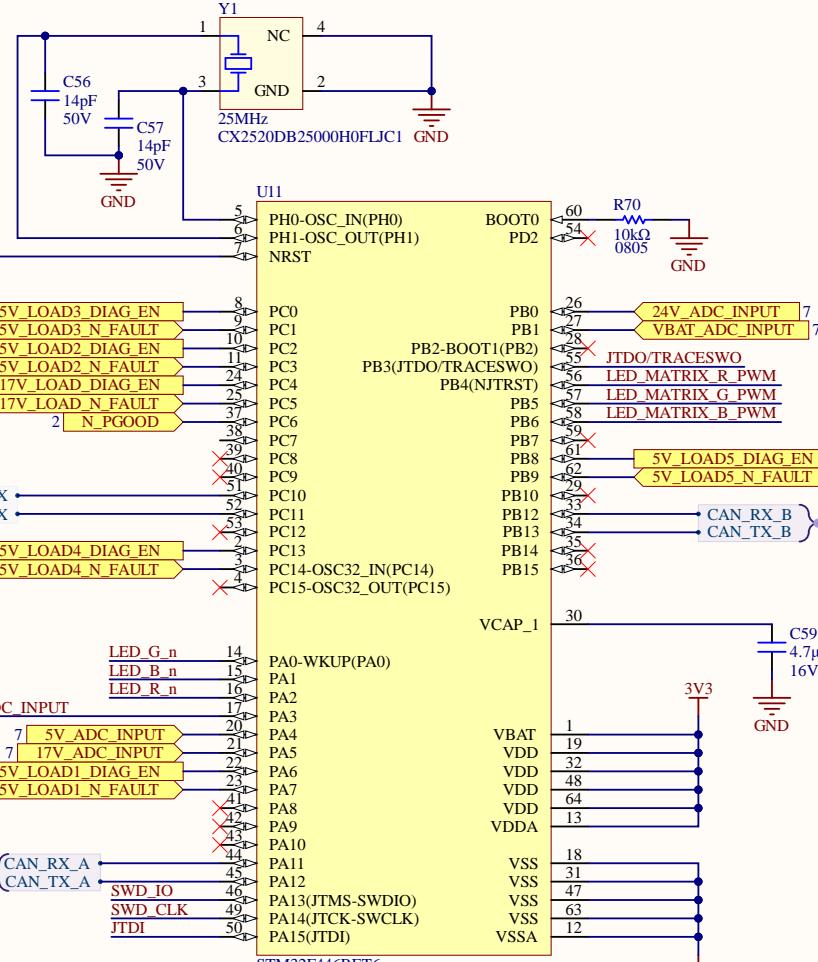


## Current Calculations

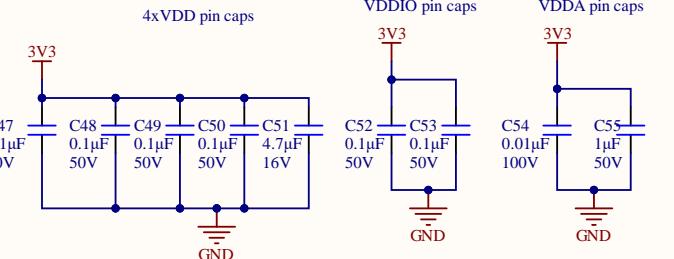
### RGB LED voltage drops:

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

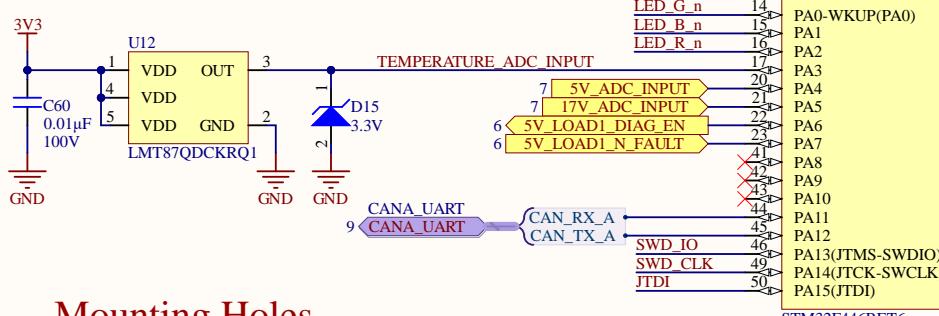
## STM32F446RET6



## Decoupling Caps



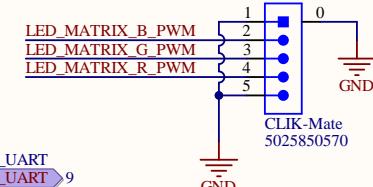
## Temperature Sensor



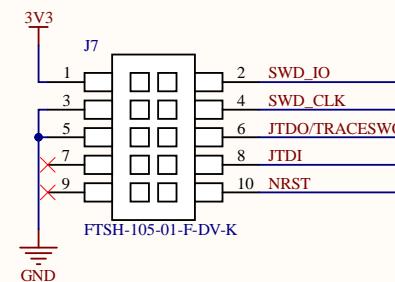
## Mounting Holes

MH1	MH2
MOUNTING_HOLE_5/32	MOUNTING_HOLE_5/32
MH3	MH4
MOUNTING_HOLE_5/32	MOUNTING_HOLE_5/32

## LED Matrix



## Debug/Programming



A

A

B

B

C

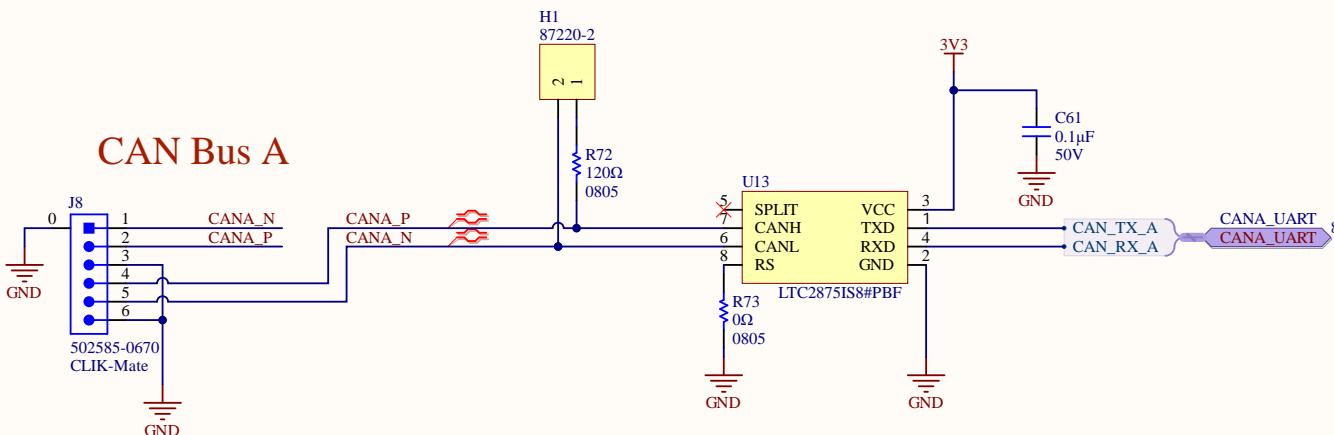
C

D

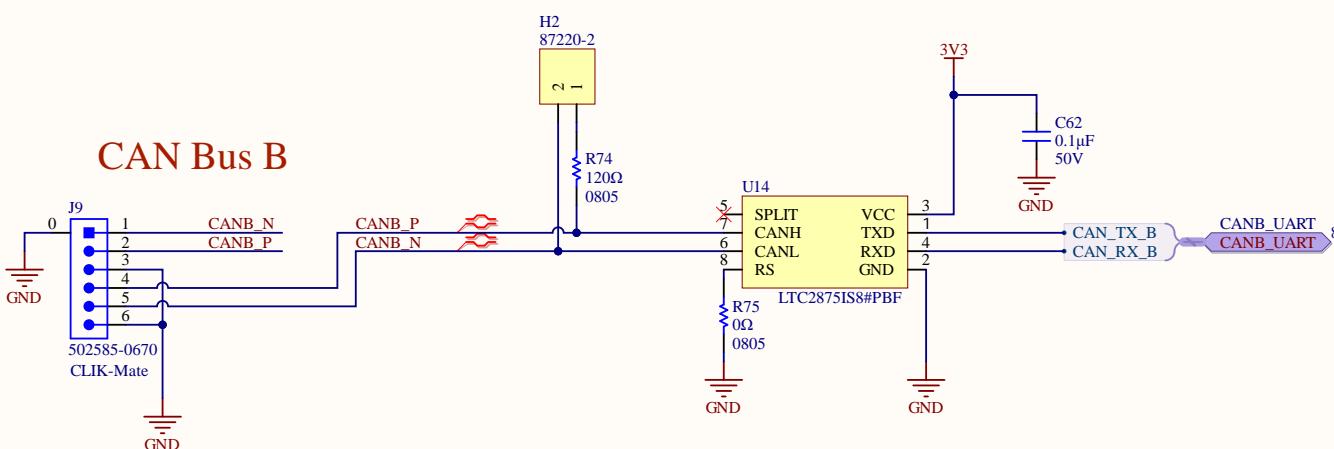
D

## CAN Transceivers

**CAN Bus A**



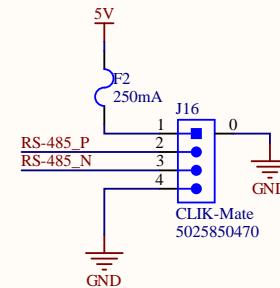
**CAN Bus B**



# URM04 Ultrasonic Sensors

A

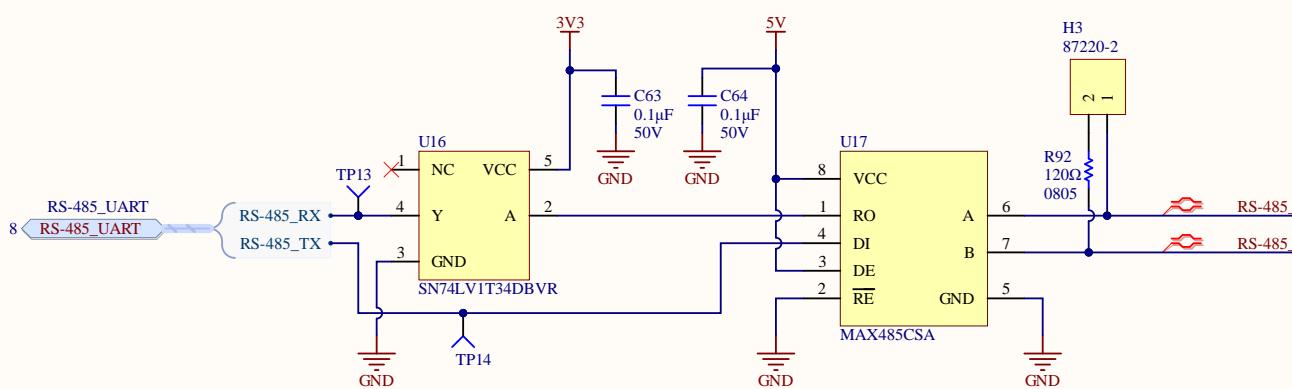
A



B

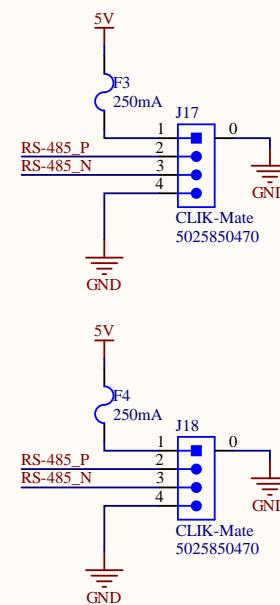
B

## RS-485 Transceiver



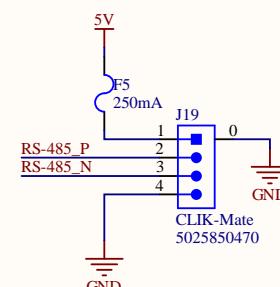
C

C



D

D



Title: Power Distribution Board Rev2 - RS-485	UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	<b>UW ROBOTICS</b> TEAM
Size: Letter	Drawn By: Cindy Li	
Date: 2020-12-01	Sheet 10 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH10 - RS-485.SchDoc		

