

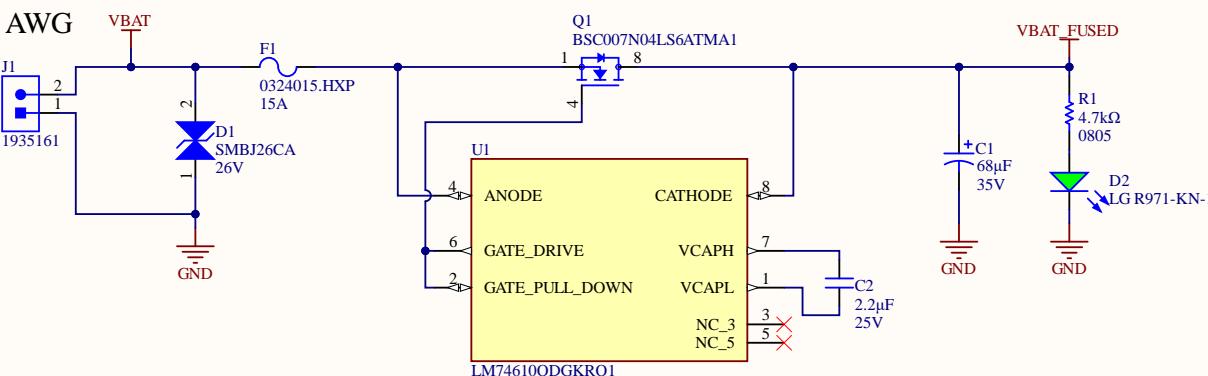
A

A

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 = $(18-2)/4700 = 3.4\text{mA}$

B

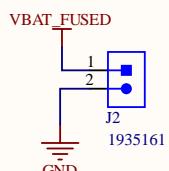
B

Ideal Diode Controller

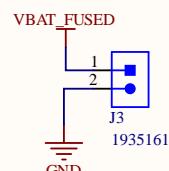
C

C

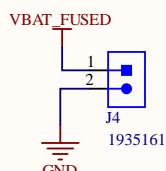
VBat (24V) Outputs



VBat (24V) power to LED Matrix board



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



D

D

Title Power Distribution Board Rev2 - Power

UW Robotics
200 University Avenue
Waterloo
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Size: Letter Drawn By: Cindy Li

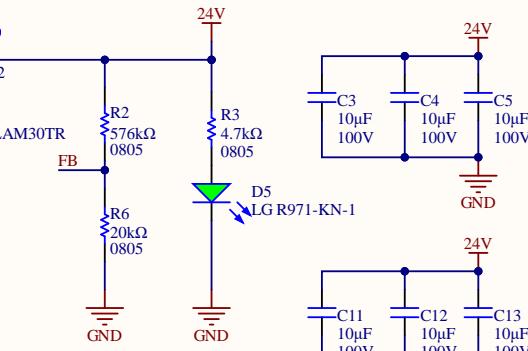
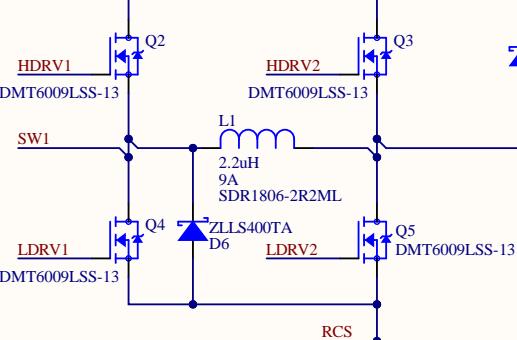
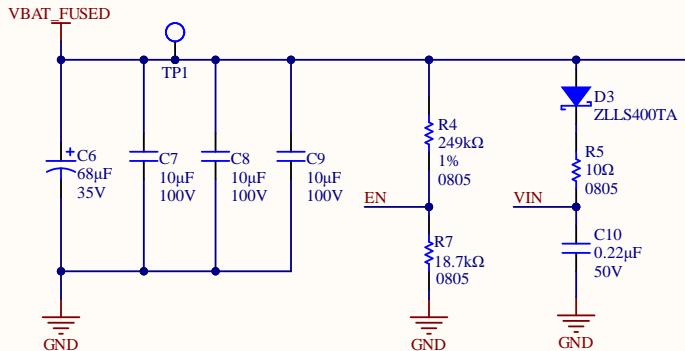
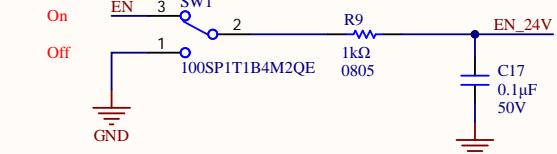
Date: 2020-11-20 Sheet 1 of 10

File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH1 - POWER.SchDoc

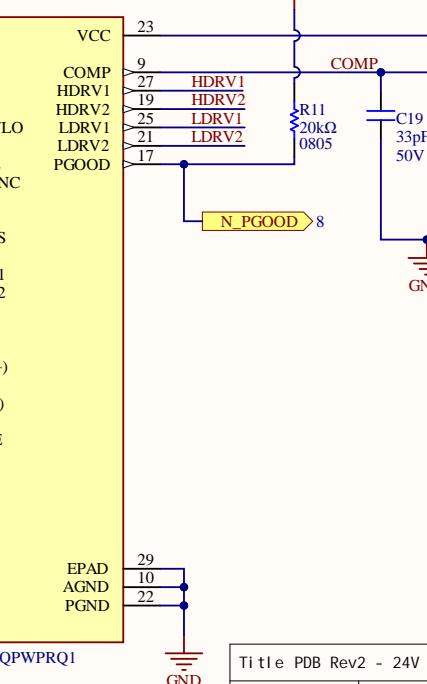
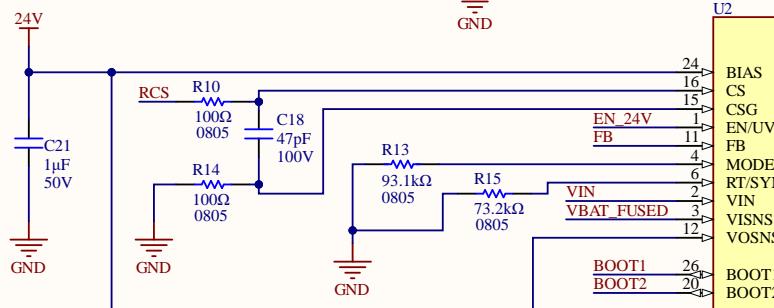
Input voltage range: 18-25.2V

24V Buck-Boost Converter @ 3A Max

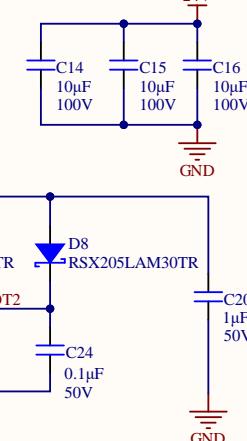
LED forward drop = 2.0V

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

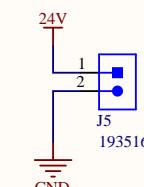
Pull below 0.4V to disable.
For $0.7\text{V} < \text{EN_24V} < 1.23\text{V}$, the controller operates in standby mode (VCC regulator enabled but PWM controller is not switching).
For $\text{EN_24V} > 1.23\text{V}$, the PWM function is enabled.
Debounce time: $100\text{k} * 0.1\mu\text{s} = 10\text{ms}$



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

**24V Output**

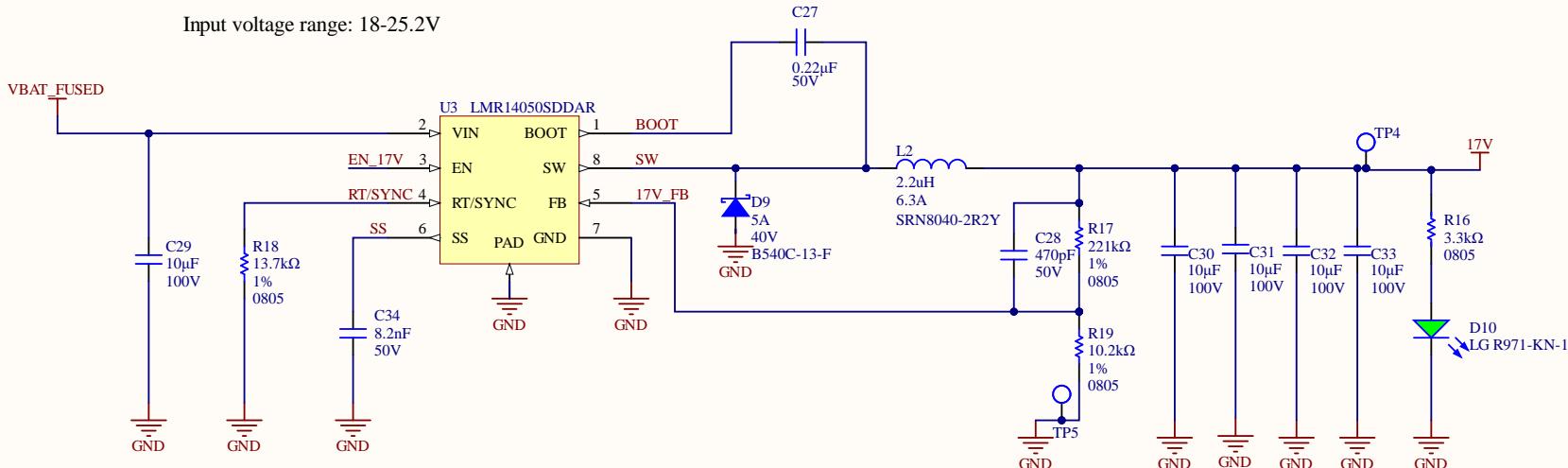
24V power to ethernet switch



A

A

17V Regulator @ 4A Max



Estimated max current draw: 1.65A

Peak efficiency: 94.8%

Output voltage ripple: 19.45mVpp

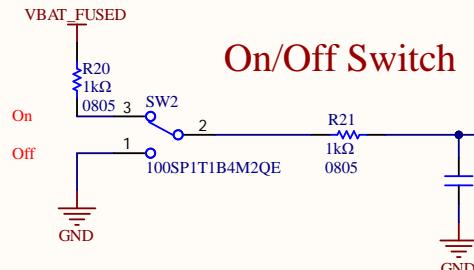
LED forward drop = 2.2V

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

C

C

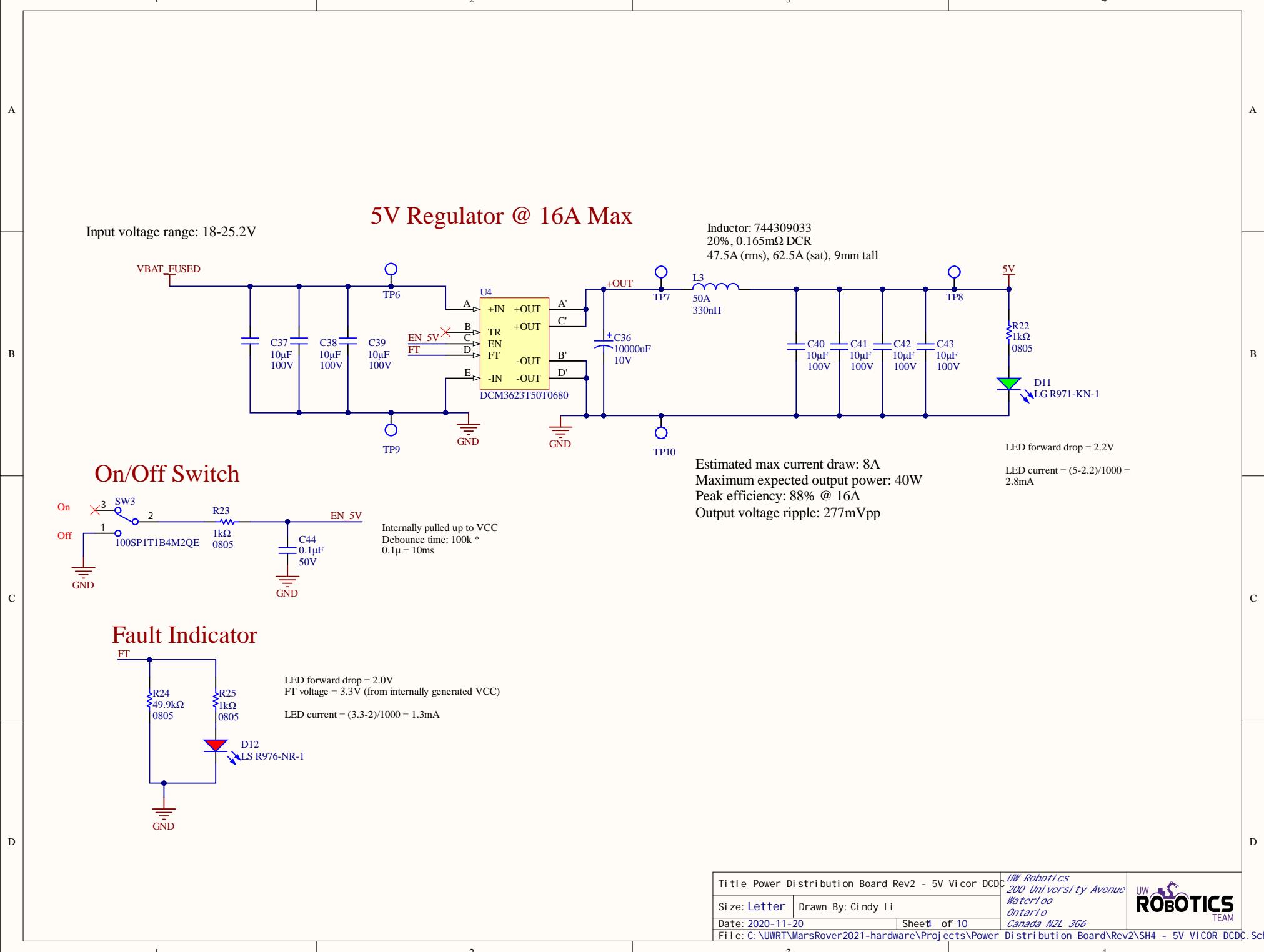
On/Off Switch



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

D

D



A

A

B

B

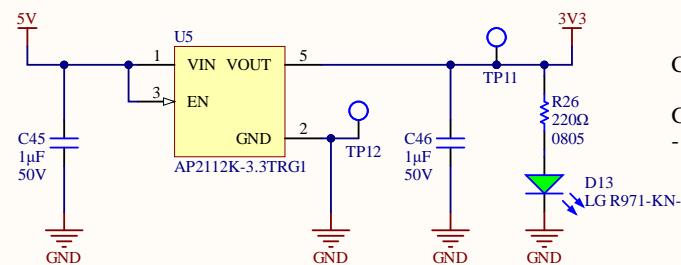
C

C

D

D

3.3V LDO @ 600mA Max



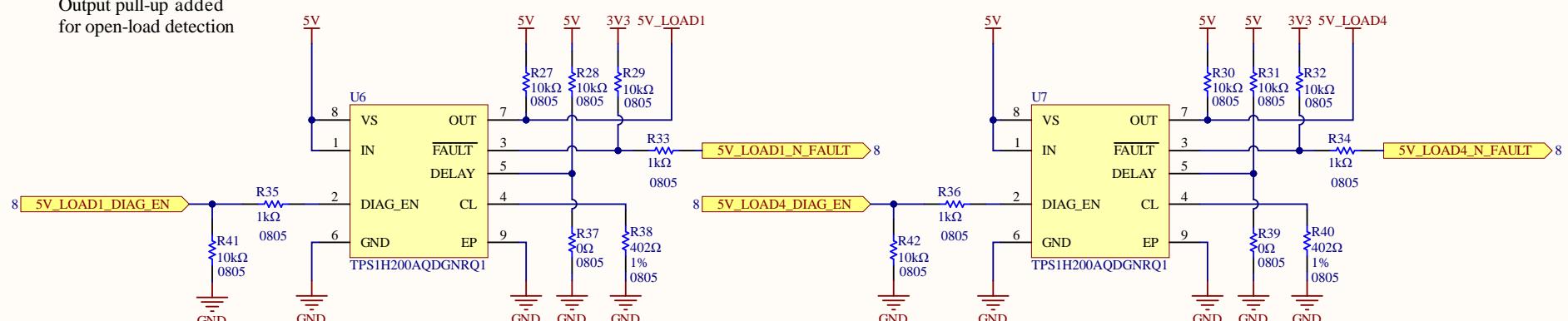
Current Calculations

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

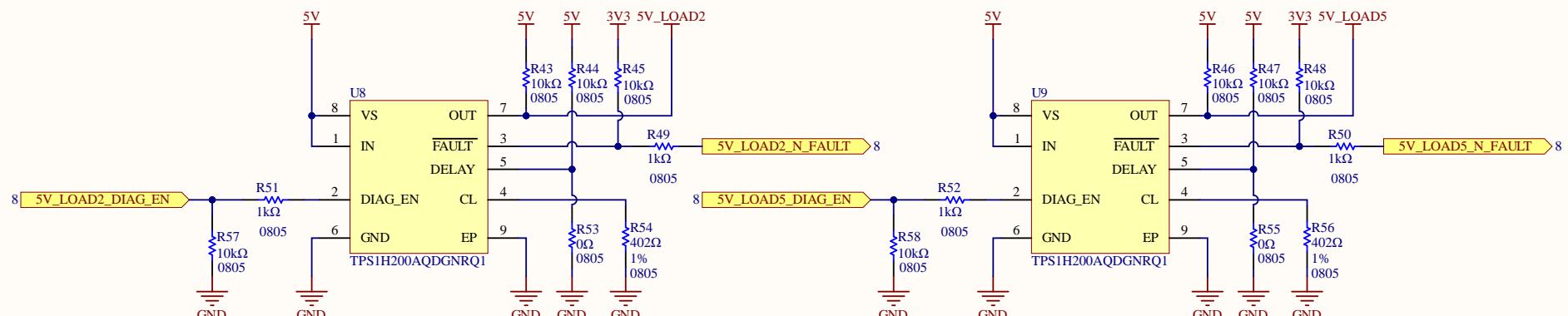
Title Power Distribution Board Rev2 - 3.3V Linear		<i>UW Robotics</i> 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-20	Sheet 6 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH5 - 3.3V LINEAR REGULATOR.SchDoc		UW ROBOTICS TEAM

5V Loads Smart Switches

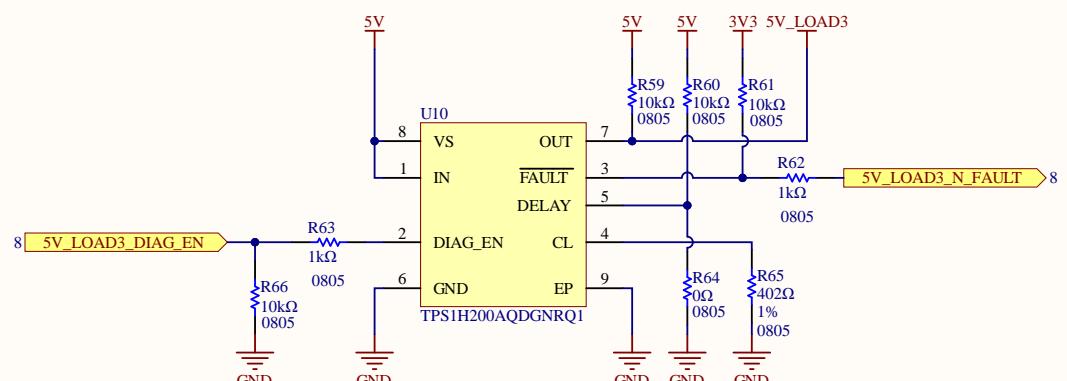
A
Output pull-up added for open-load detection



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 $R_{CL} = 402\Omega$

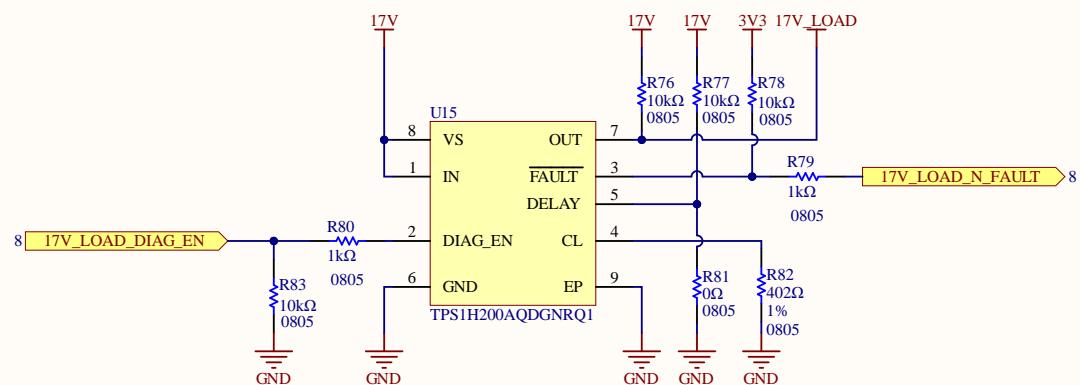
Current Limit Configurations - Refer to DELAY Pin

- 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

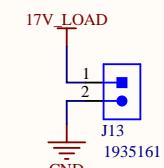
A

A

17V Load Smart Switch

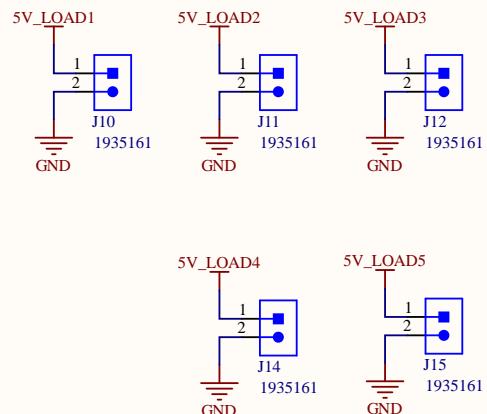


17V Output



17V power to Nvidia Jetson board

5V Outputs

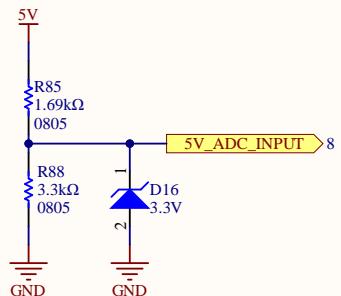


5V power to Arm, Science, Gimbal, and Localization boards (plus one spare)

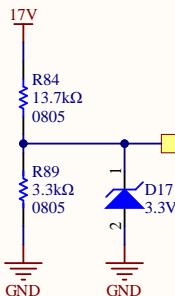
B

B

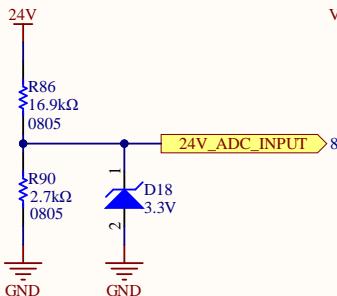
Power Rail Voltage Monitoring



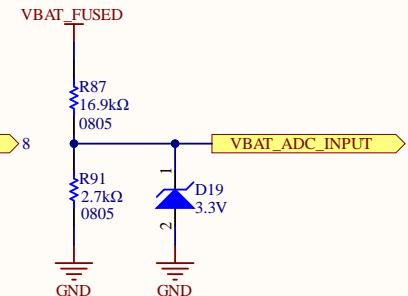
Divides 5V to 3.3V



Divides 17V to 3.3V



Divides 24V to 3.3V



Divides 24V to 3.3V

D

D

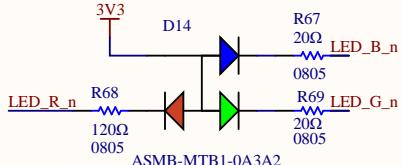
1

2

3

4

Status LED

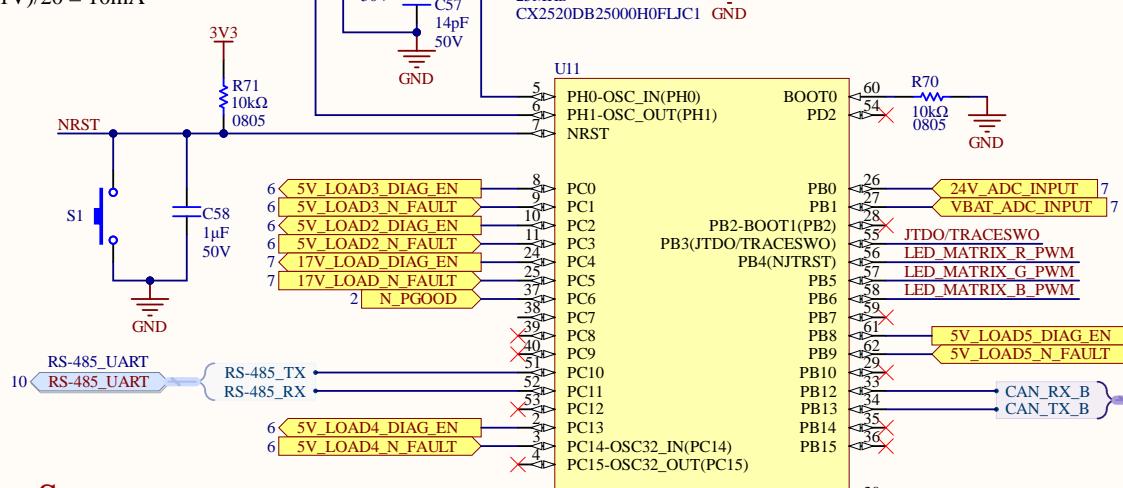


Current Calculations

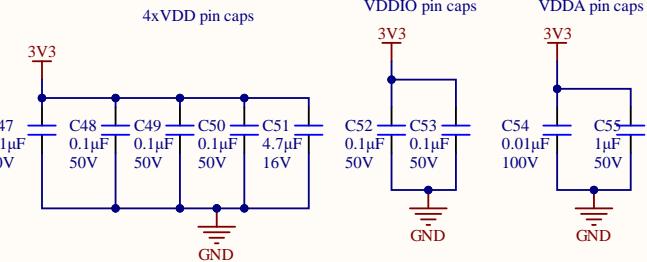
RGB LED voltage drops:

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

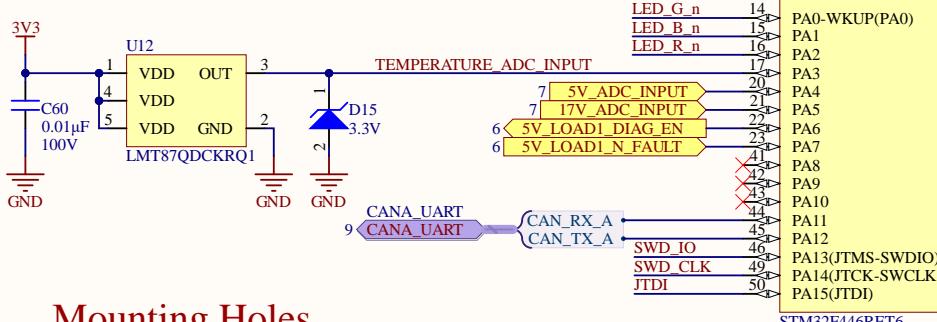
STM32F446RET6



Decoupling Caps



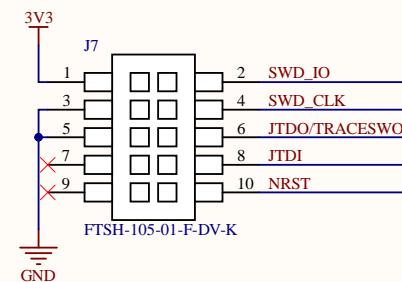
Temperature Sensor



Mounting Holes

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

Debug/Programming



Title Power Distribution Board Rev2 - MCU

Size: Letter Drawn By: Cindy Li

Date: 2020-11-20 Sheet 8 of 10

File: C:\UWR\ MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH8 - MICROCONTROLLER.schDoc

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Waterloo
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A

A

B

B

C

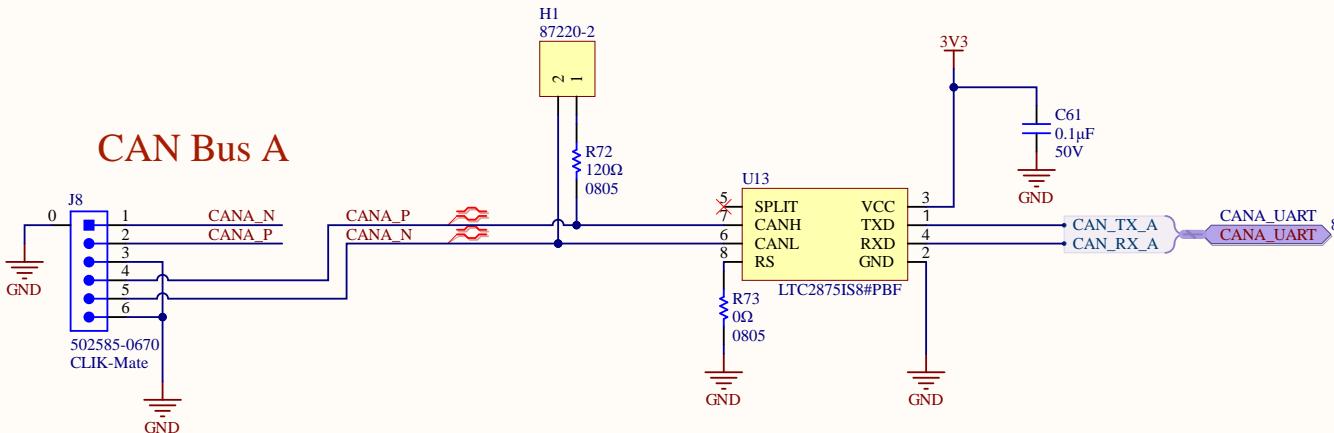
C

D

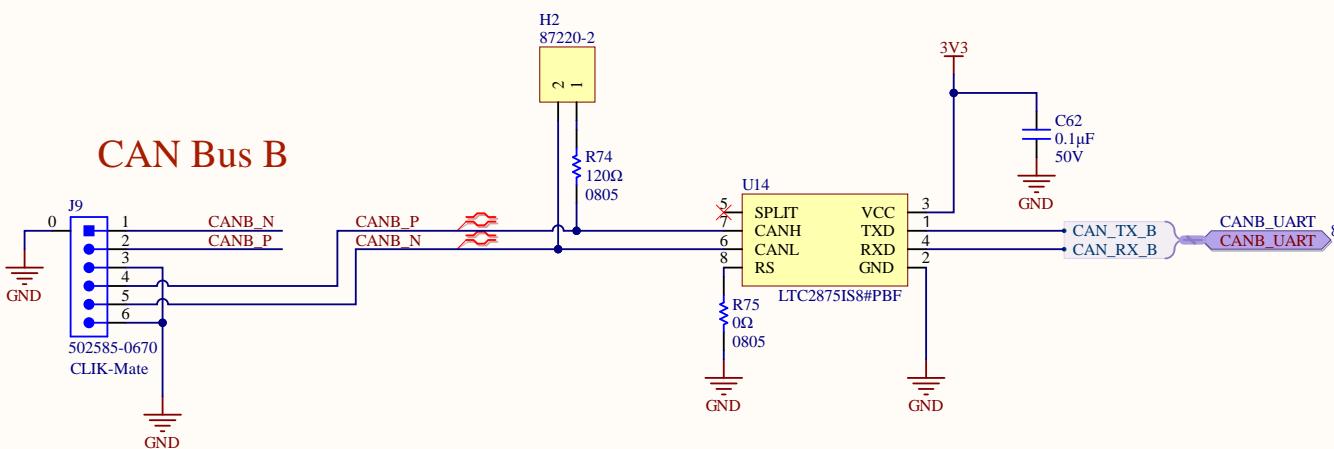
D

CAN Transceivers

CAN Bus A



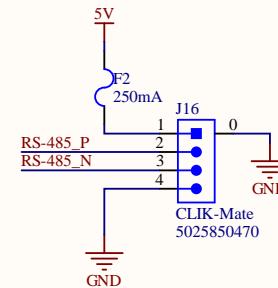
CAN Bus B



URM04 Ultrasonic Sensors

A

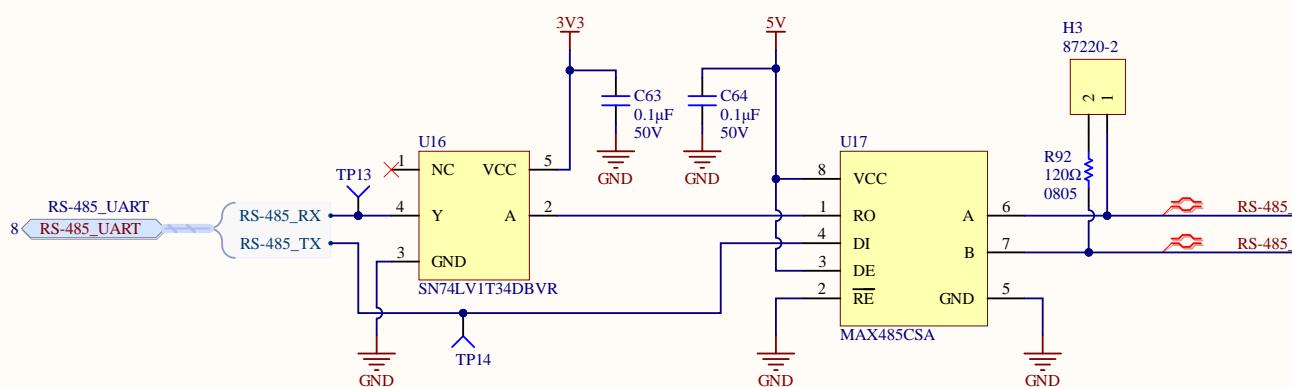
A



B

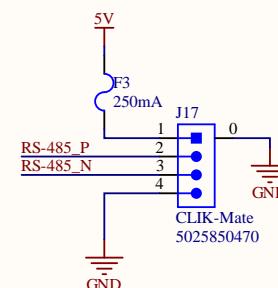
B

RS-485 Transceiver



C

C



D

D

