

A

A

B

B

C

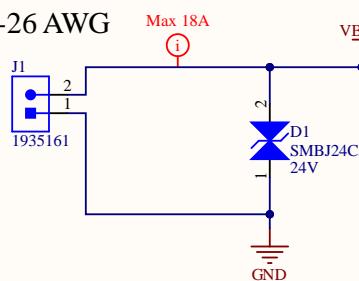
C

D

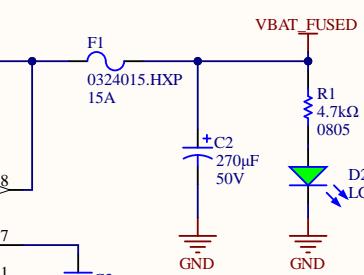
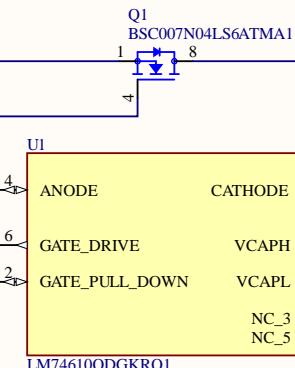
D

Battery Input (6s1p)

12-26 AWG



Ideal Diode Controller



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

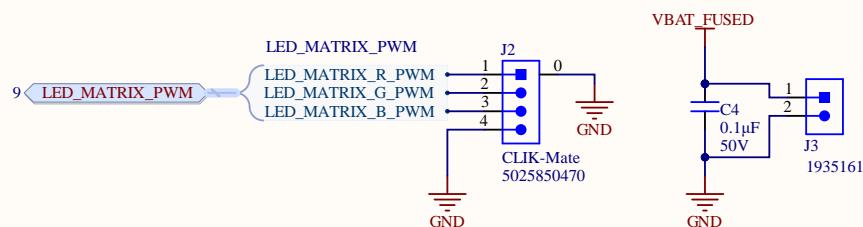
Max LED current = $(24-2)/4700 = 4.7\text{mA}$
Min LED current = $(18-2)/4700 = 3.4\text{mA}$

Title: Power Distribution Board Rev2 - Power	Altium Limited
Size: Letter	Drawn By: Cindy Li
Date: 2020-11-03	Sheet 1 of 12
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH1 - POWER.SchDoc	Australia 2086



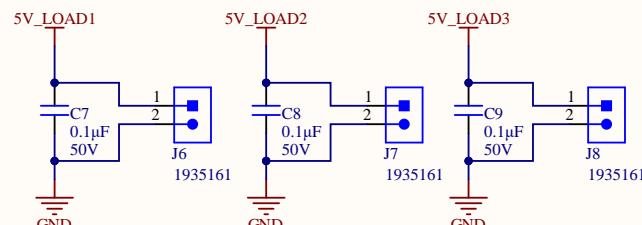
A

LED Matrix

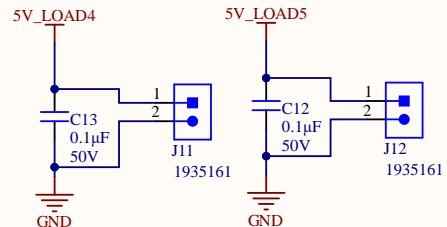


B

5V Output

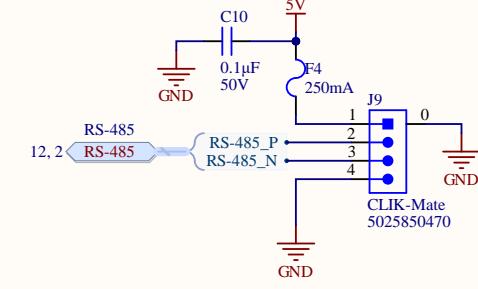
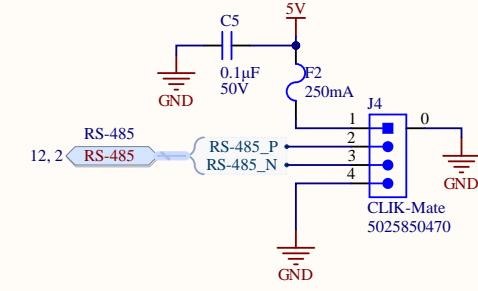
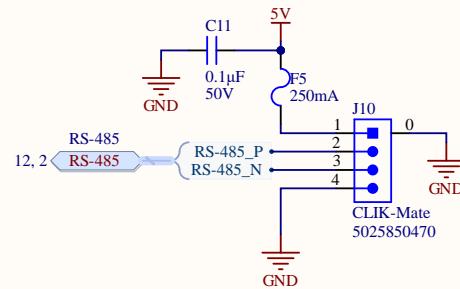
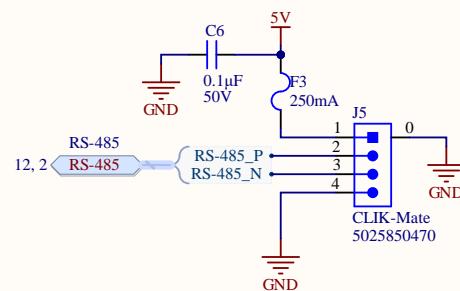


C



D

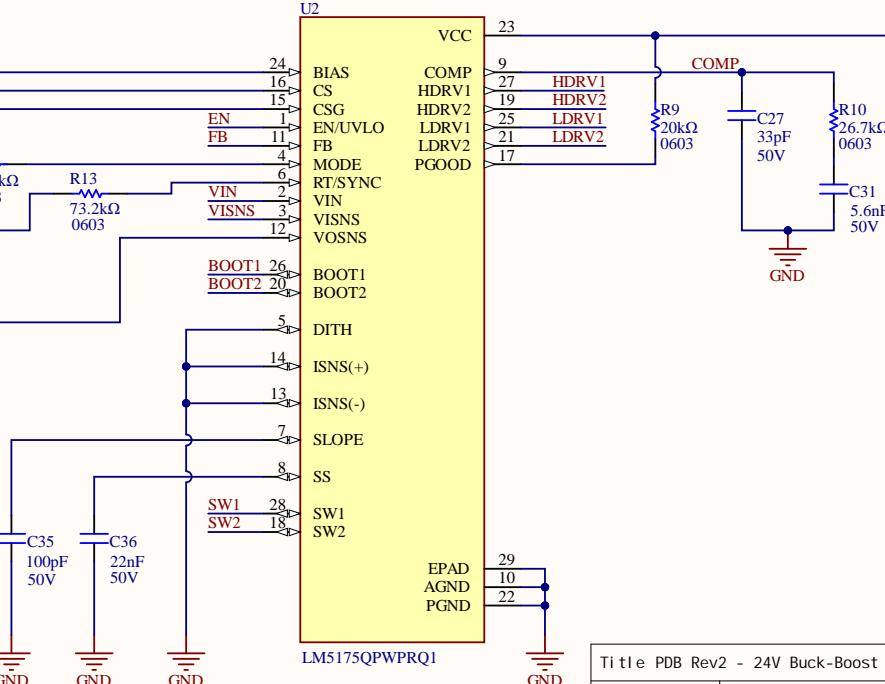
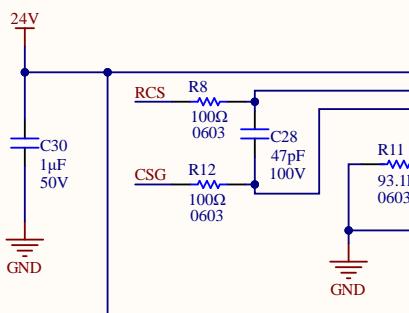
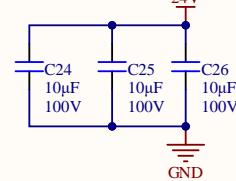
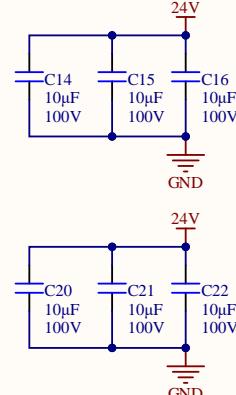
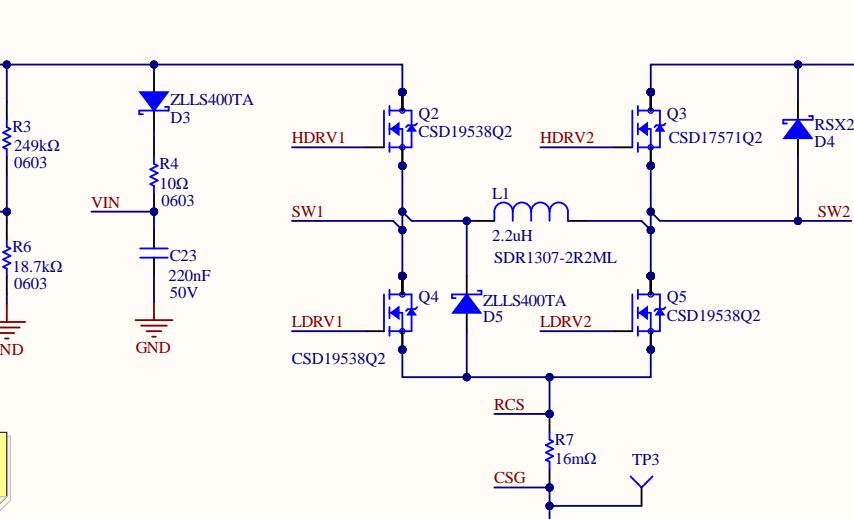
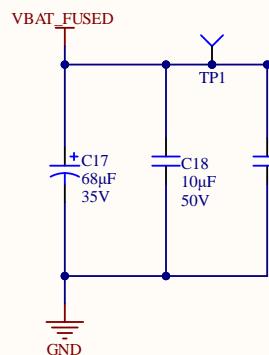
URM04 Ultrasonic Sensors



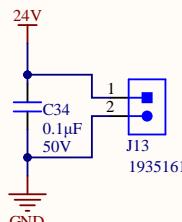
Title Power Distribution Board Rev2 - Connectors		Altium Limited	
Size: Letter	Drawn By: Cindy Li	L3, 12a Rodborough Rd	Frenchs Forest
Date: 2020-11-03	Sheet 1 of 12	NSW	Australia 2086
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH2 - CONNECTORS.SchDoc			

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: 2020-11-03 Sheet 8 of 12

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

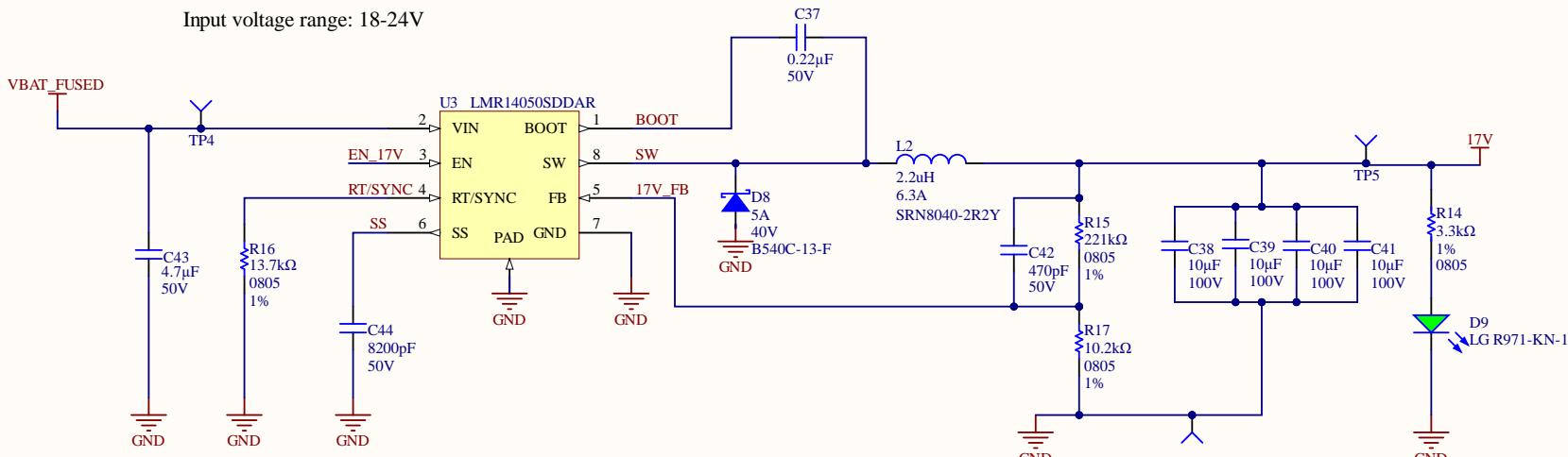
Altium Limited
L3, 12a Rodborough Rd
Frenchs Forest
NSW Australia 2086

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TEAM

A

A

17V Regulator @ 4A Max



Estimated max current draw: 1.65A

Peak efficiency: 94.8%

Output voltage ripple: 19.45mVpp

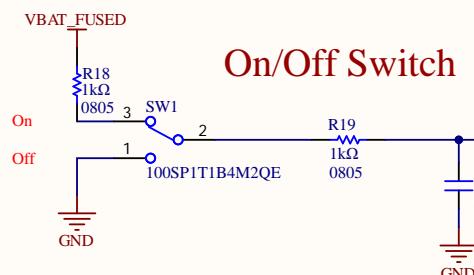
LED forward drop = 2.2V

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

C

C

On/Off Switch

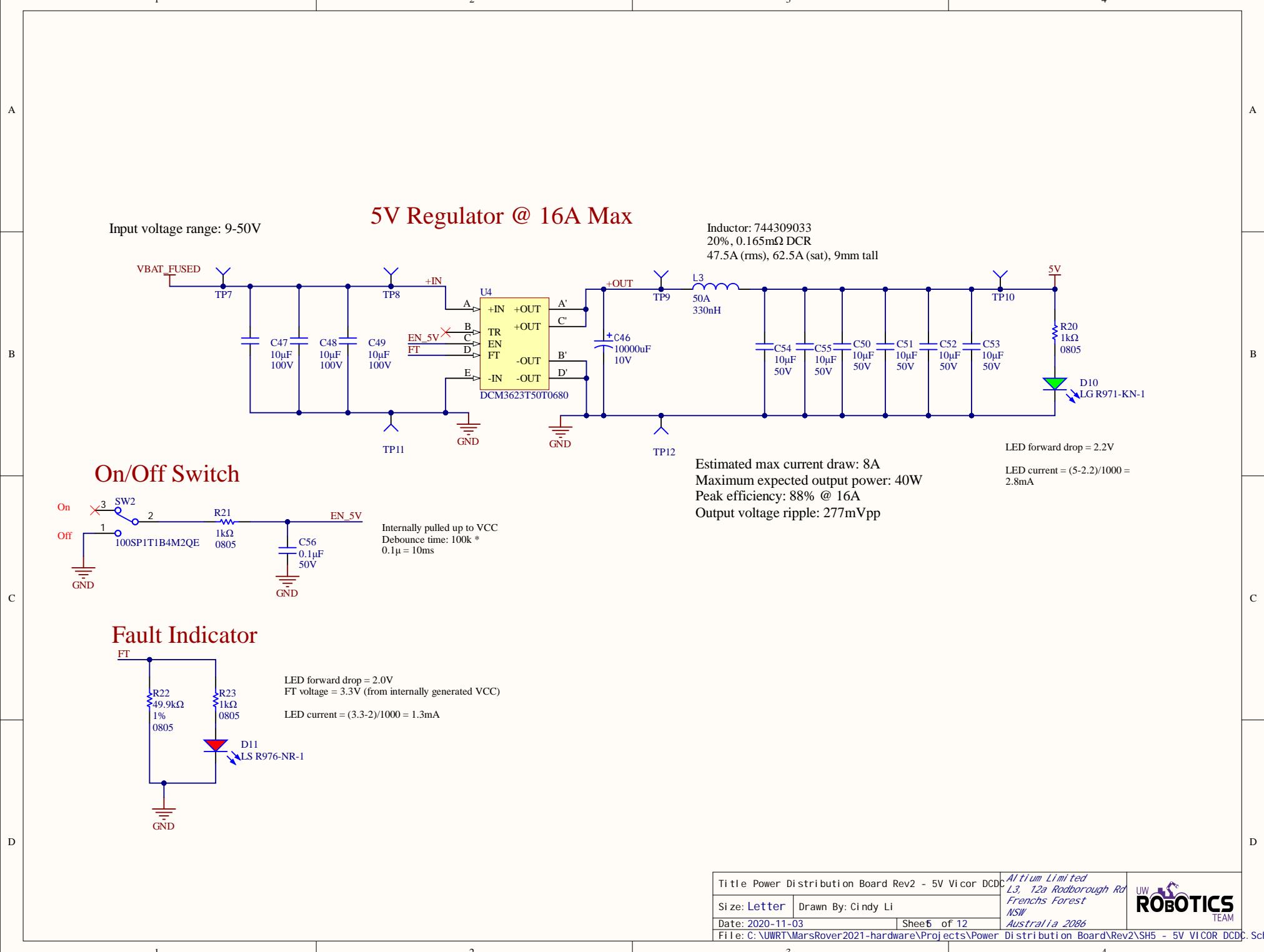


Internally pulled up
Pull below 1.2V to disable.
Float or connect to VIN to enable.
Debounce time: $100\text{k} \times 0.1\mu = 10\text{ms}$

D

D

Title: Power Distribution Board Rev2 - 17V Buck Converter		Altium Limited
Size: Letter	Drawn By: Cindy Li	L3, 12a Rodborough Rd Frenchs Forest NSW Australia 2086
Date: 2020-11-03	Sheet 1 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH4 - 17V BUCK CONVERTER.SchDoc		UW ROBOTICS TEAM



A

A

B

B

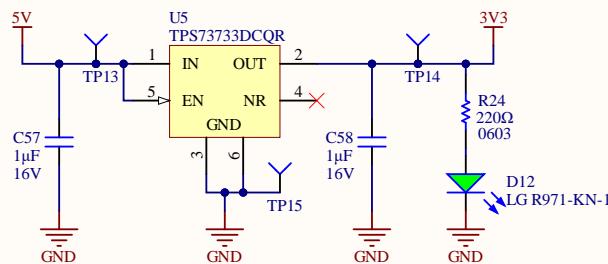
C

C

D

D

5V to 3.3V LDO (Max 1A)



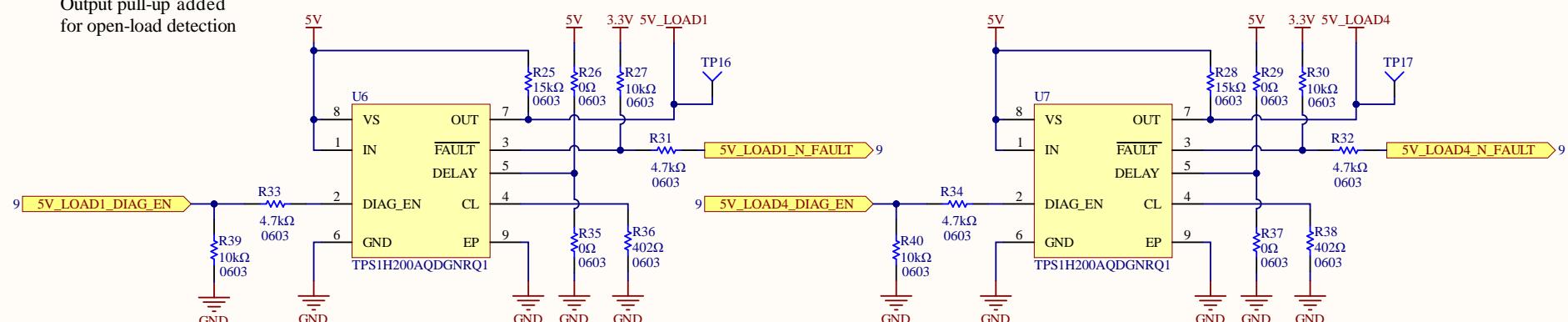
Current Calculations

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

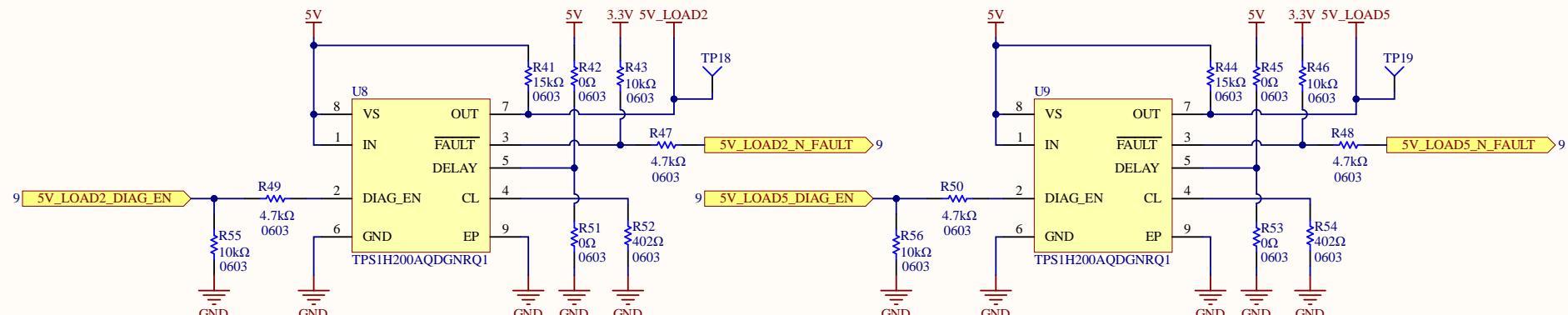
Title Power Distribution Board Rev2 - 3.3V Linear		Altium Limited 23/728 Rodborough Rd Frenchs Forest NSW Australia 2086
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-03	Sheet 6 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH6 - 3.3V LINEAR REGULATOR.SchDoc		UW ROBOTICS TEAM

5V Loads Smart Switches

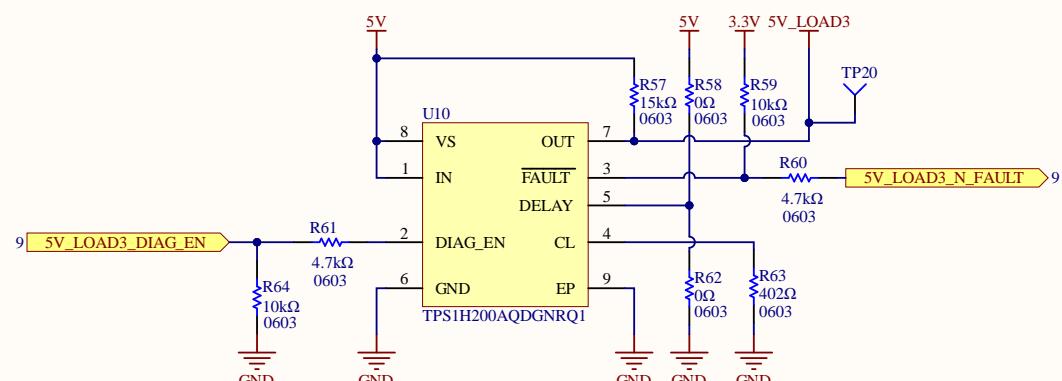
A
Output pull-up added
for open-load detection



B



C



Smart Switch Current Limited to 5A

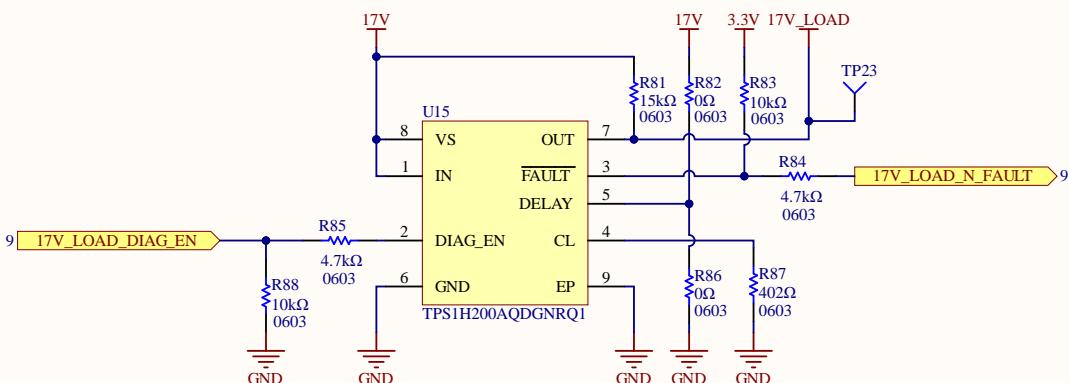
- $I_{out} = 5A$, $V_{CL(th)} = 0.8V$, $K_{CL} = 2500$ (values from datasheet)
- $R_{CL} = V_{CL(th)} * K_{CL} / I_{out} = 0.8 * 2500 / 5 = 400\Omega \rightarrow$ use $R_{CL} = 402\Omega$

Current Limit Configurations - Refer to DELAY Pin

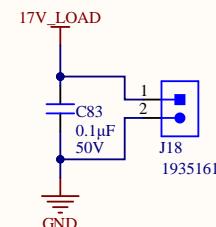
- Holding mode: depopulate pull-up and populate pull-down with a 0Ω resistor
- Latch-off mode: depopulate pull-up and populate pull-down with a capacitor or (calculated based on required delay time)
- Auto-retry mode: populate pull-up with a pull-up resistor and depopulate pull-down

A

17V Load Smart Switch

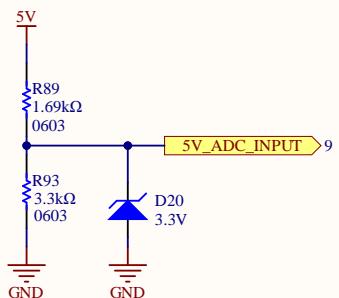


17V Output

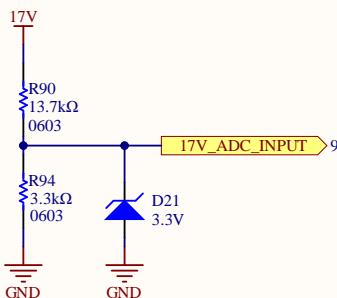


B

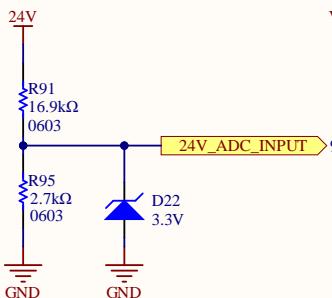
Power Rail Voltage Monitoring



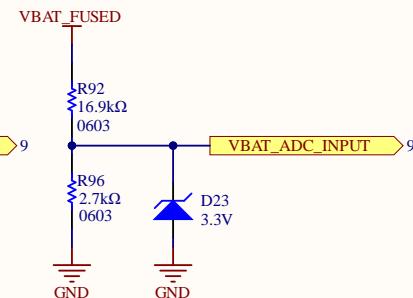
Divides 5V to 3.3V



Divides 17V to 3.3V



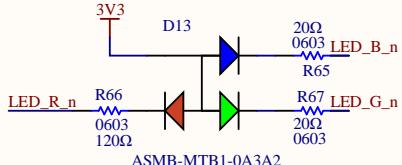
Divides 24V to 3.3V



Divides 24V to 3.3V

D

Status LED



Current Calculations

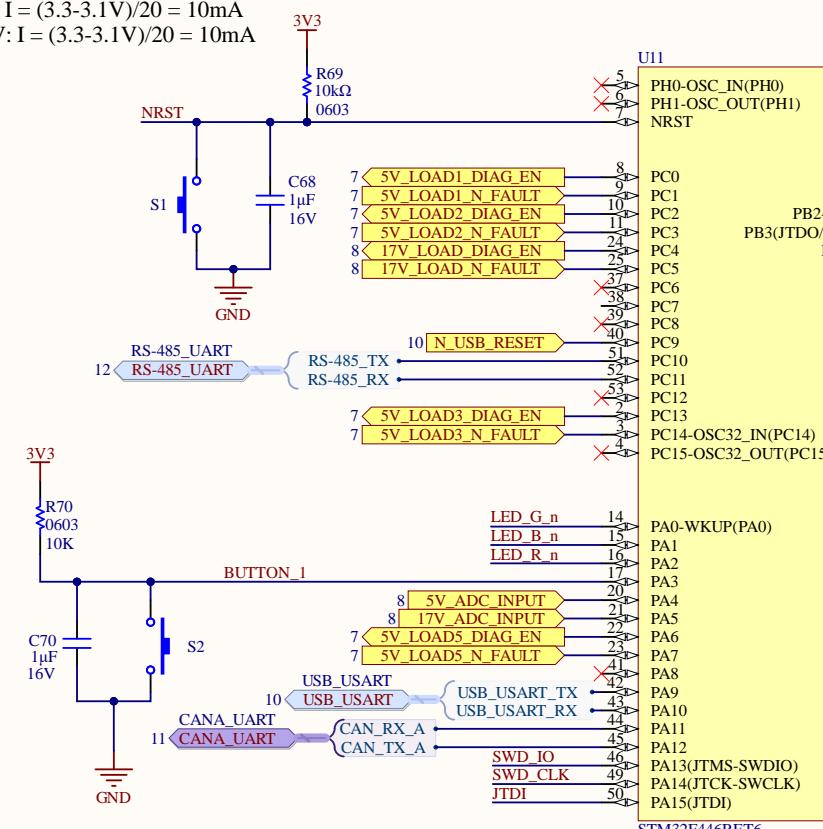
Green LED voltage drop: 2.2V

$$- I = (3.3 - 2.2V) / 120 = 9.17mA$$

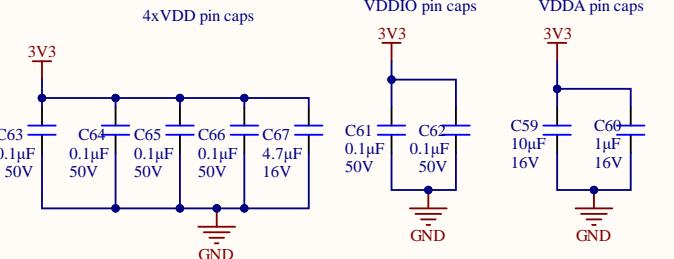
RGB LED voltage drops:

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

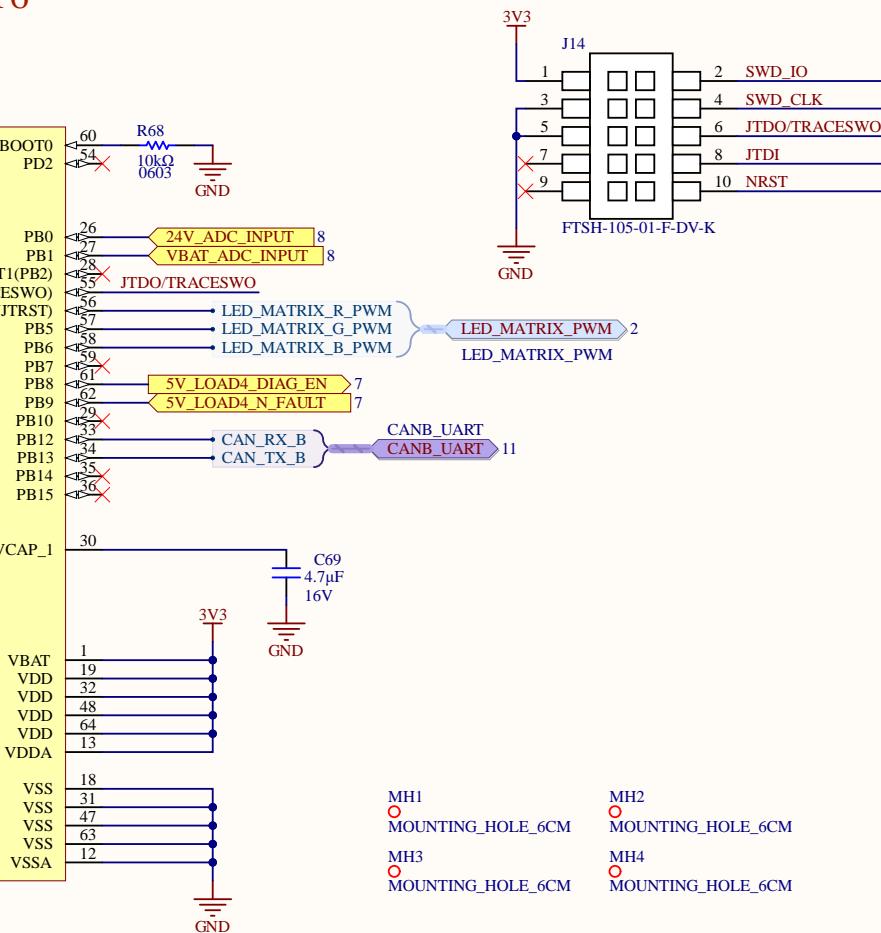
STM32F446RET6



Decoupling Caps



Debug/Programming



Title Power Distribution Board Rev2 - MCU

Size: Letter Drawn By: Cindy Li

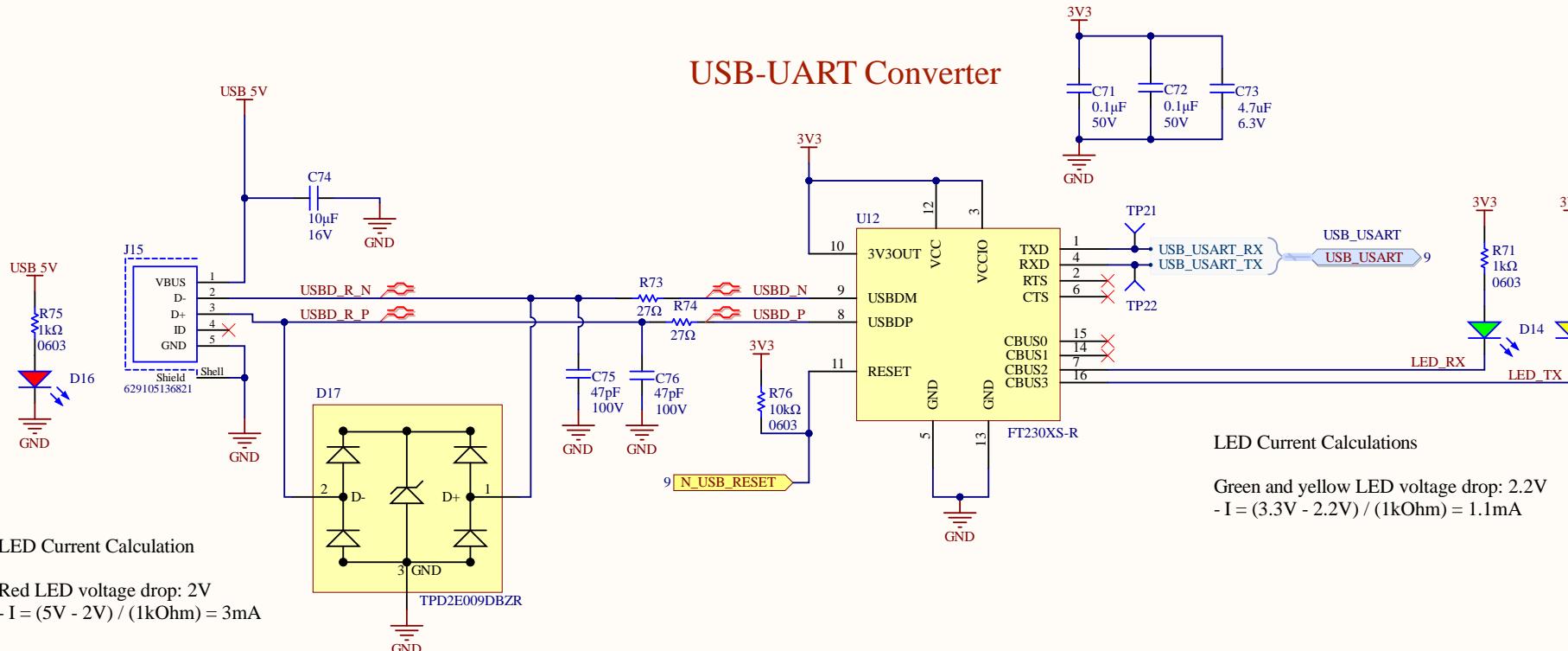
Date: 2020-11-03 Sheet 9 of 12

File: C:\UWRT\火星探测器\Hardware\Projects\Power Distribution Board\Rev2\SH9 - MICROCONTROLLER.schDoc

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Frenchs Forest
NSW Australia 2086

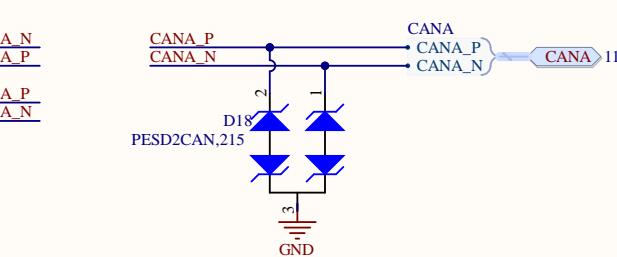
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USB-UART Converter

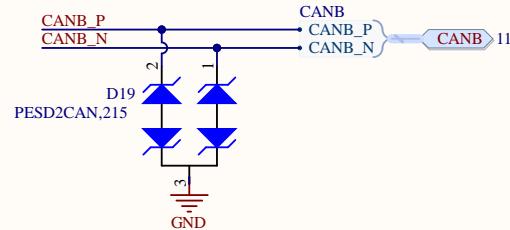


Title Power Distribution Board Rev2 - USB		Altium Limited
Size: Letter	Drawn By: Cindy Li	L3, 12a Rodborough Rd Frenchs Forest NSW Australia 2086
Date: 2020-11-03	Sheet 10 of 12	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH10 - USB.SchDoc		UW ROBOTICS TEAM

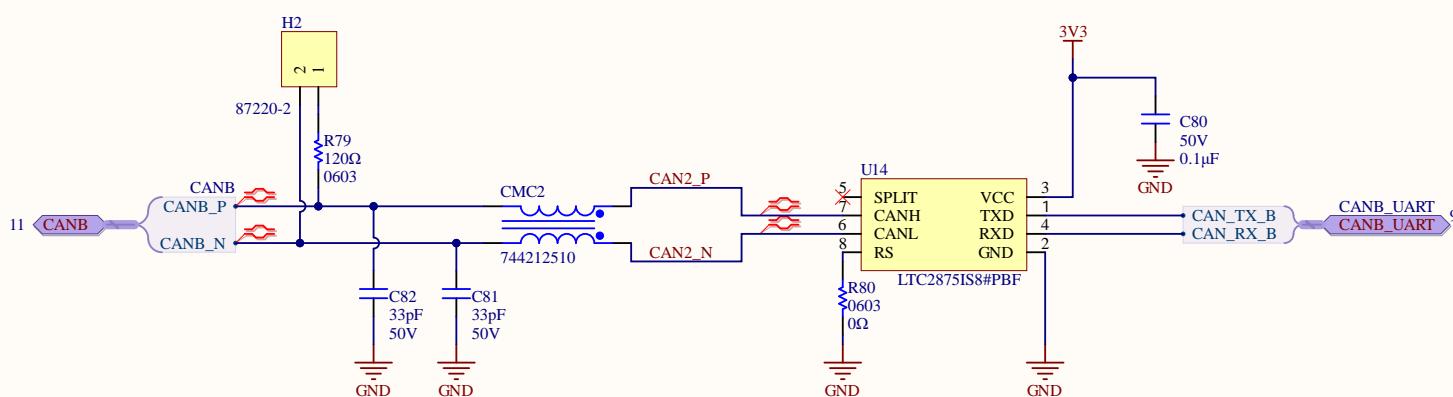
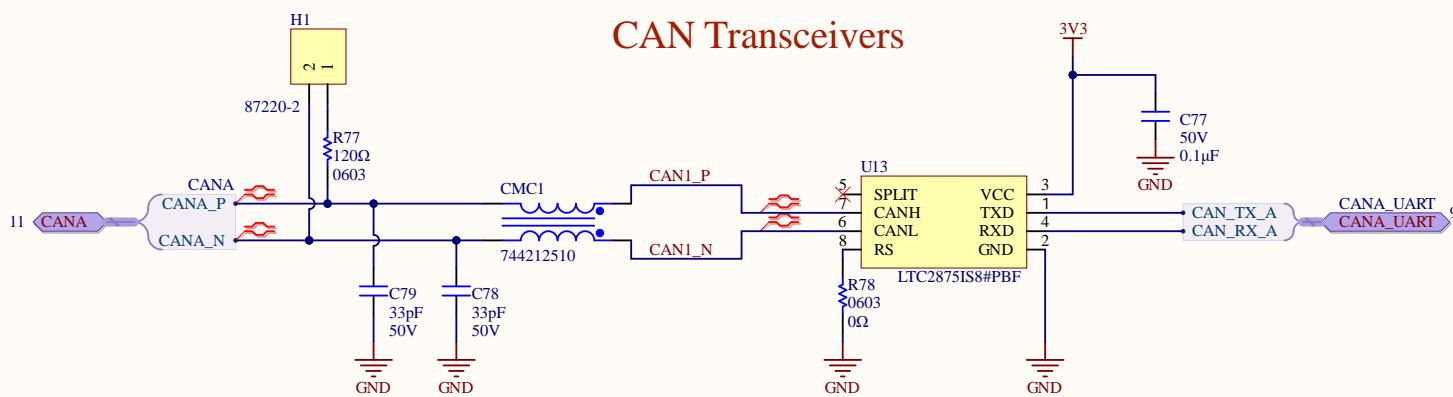
CAN BUS A



CAN BUS B



CAN Transceivers



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

