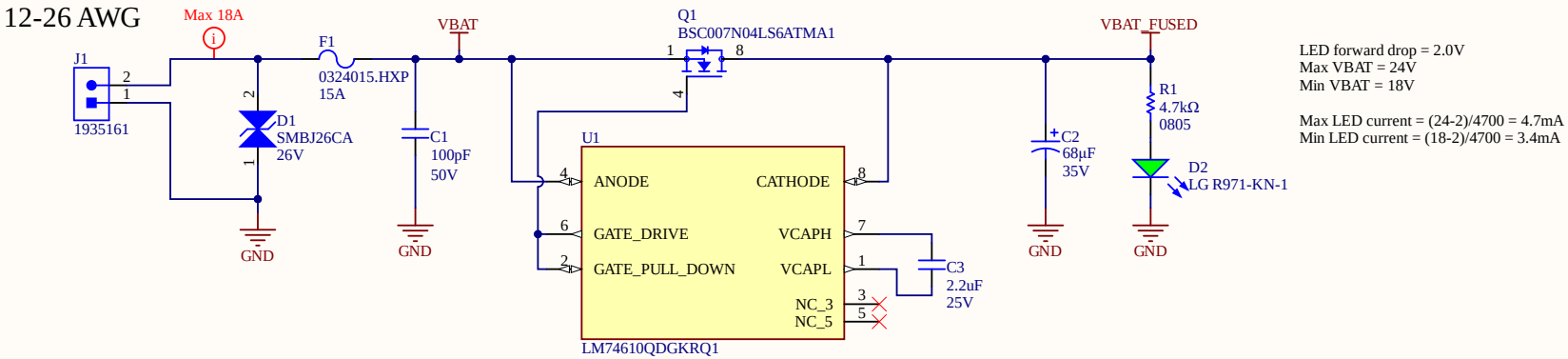
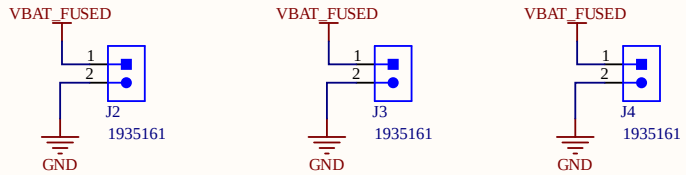
Battery Input (6s1p)

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)

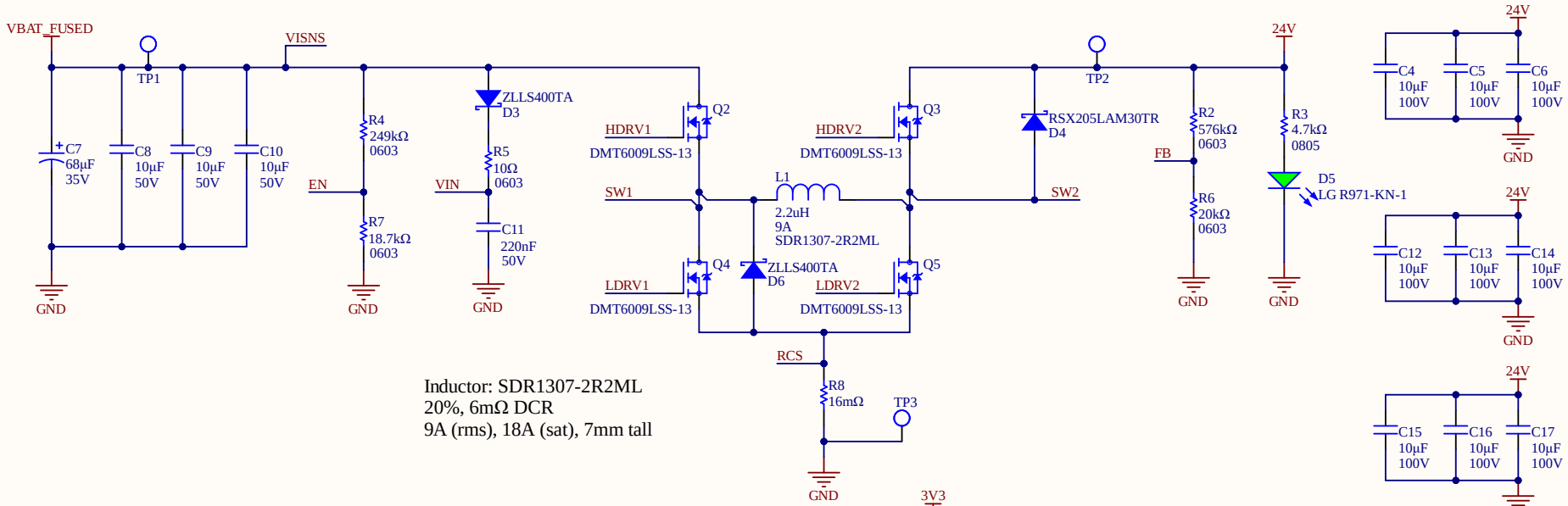
Title Power Distribution Board Rev2 - Power		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-16	Sheet 1 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH1 - POWER.SchDoc		

24V Buck-Boost Converter @ 3A Max

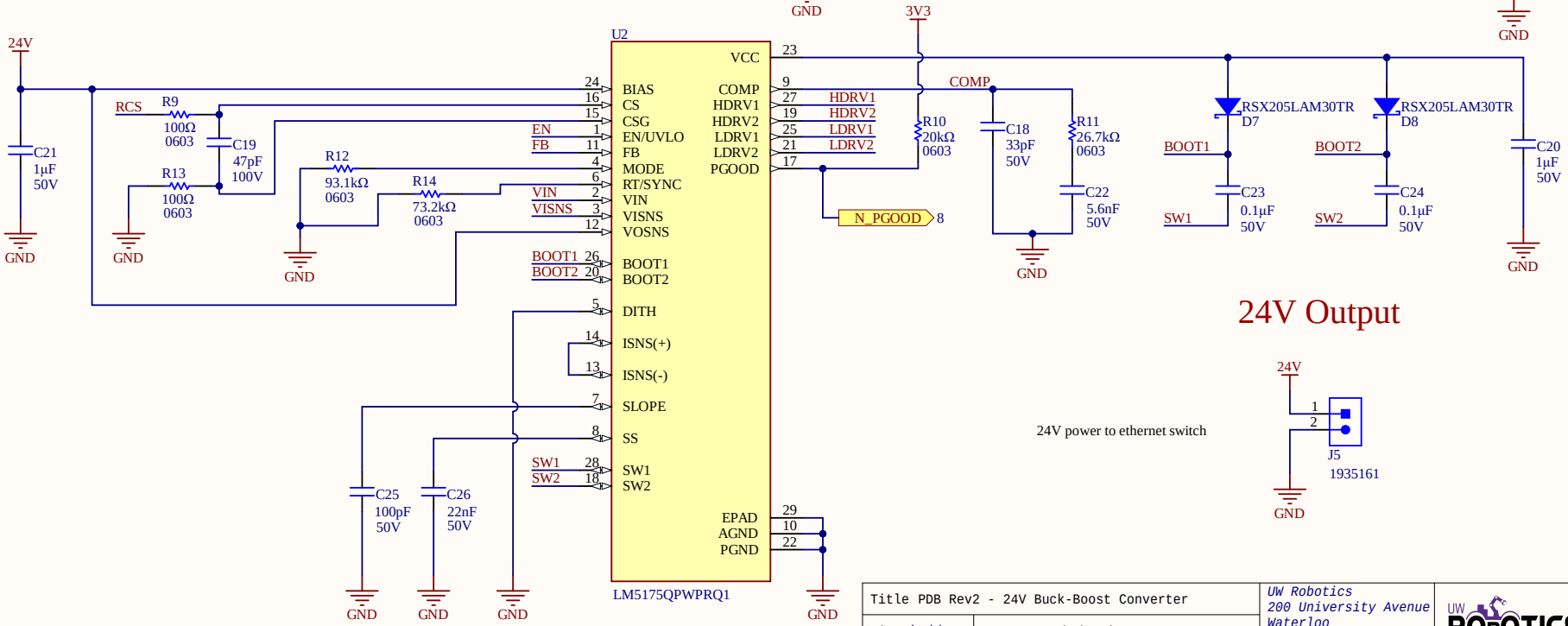
Input voltage range: 18-25.8V

LED forward drop = 2.0V

LED current = (24-2)/4700 = 4.7mA



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



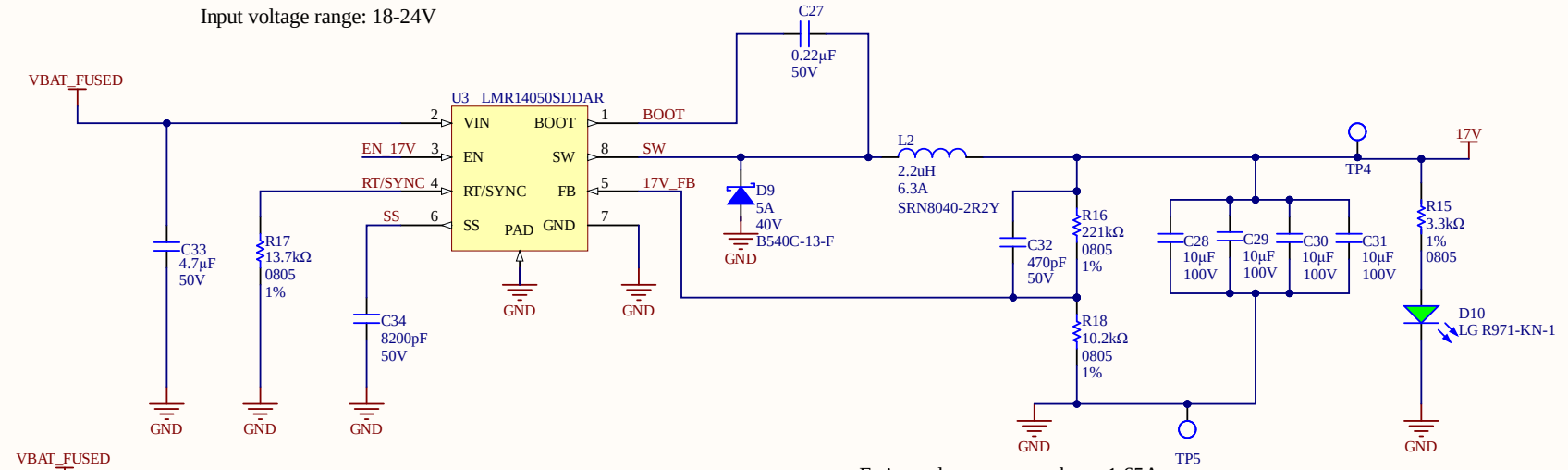
24V Output

24V power to ethernet switch

Title PDB Rev2 - 24V Buck-Boost Converter		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-16	Sheet 2 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH2 - 24V BUCK-BOOST CONVERTER.SchD		

17V Regulator @ 4A Max

Input voltage range: 18-24V

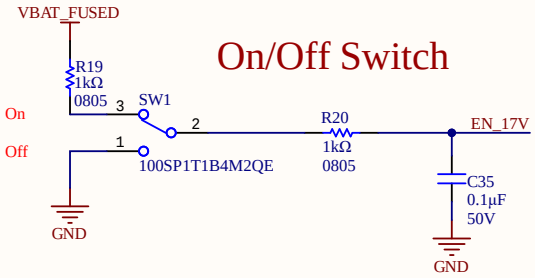


Estimated max current draw: 1.65A
Peak efficiency: 94.8%
Output voltage ripple: 19.45mVpp

LED forward drop = 2.2V

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

On/Off Switch

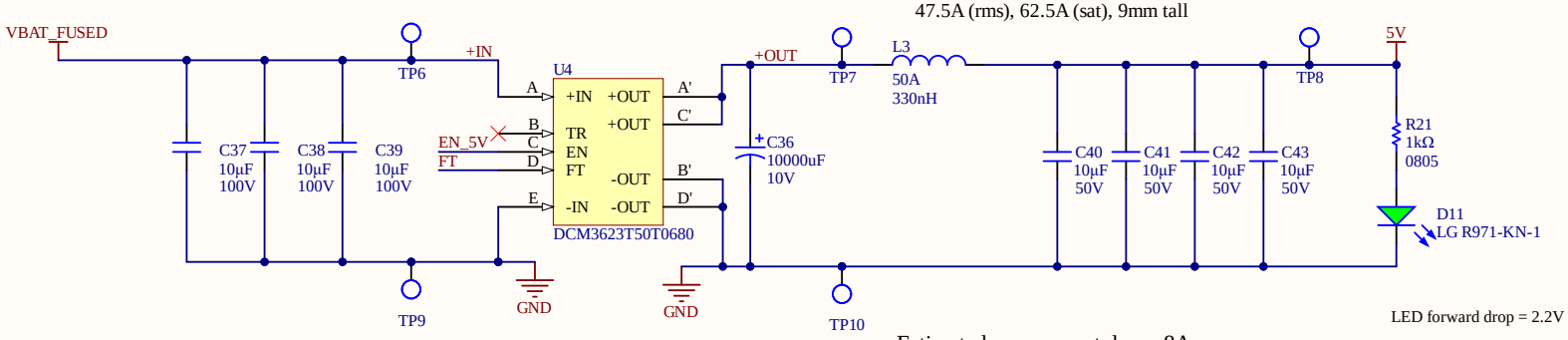


Internally pulled up
Pull below 1.2V to disable.
Float or connect to VIN to enable.
Debounce time: 100k * 0.1µ = 10ms

Title Power Distribution Board Rev2 - 17V Buck Converter			UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-16	Sheet 3 of 10		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH3 - 17V BUCK CONVERTER.SchDoc			

5V Regulator @ 16A Max

Input voltage range: 9-50V



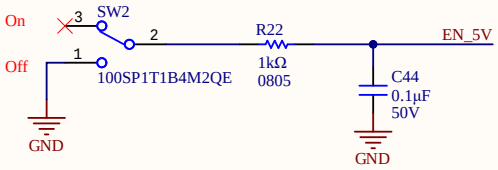
Inductor: 744309033
20%, 0.165mΩ DCR
47.5A (rms), 62.5A (sat), 9mm tall

LED forward drop = 2.2V

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

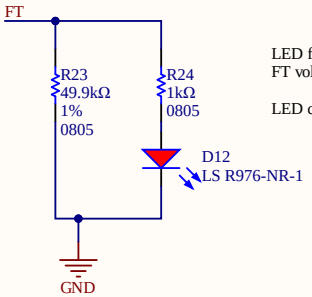
Estimated max current draw: 8A
Maximum expected output power: 40W
Peak efficiency: 88% @ 16A
Output voltage ripple: 277mVpp

On/Off Switch



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

Fault Indicator

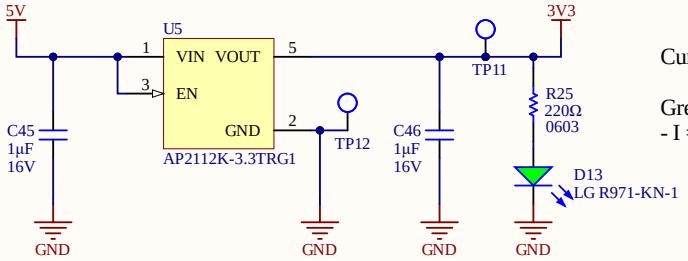


LED forward drop = 2.0V
FT voltage = 3.3V (from internally generated VCC)

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
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-16	Sheet 4 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH4 - 5V VICOR DCDC.SchDoc		

3.3V LDO @ 600mA Max



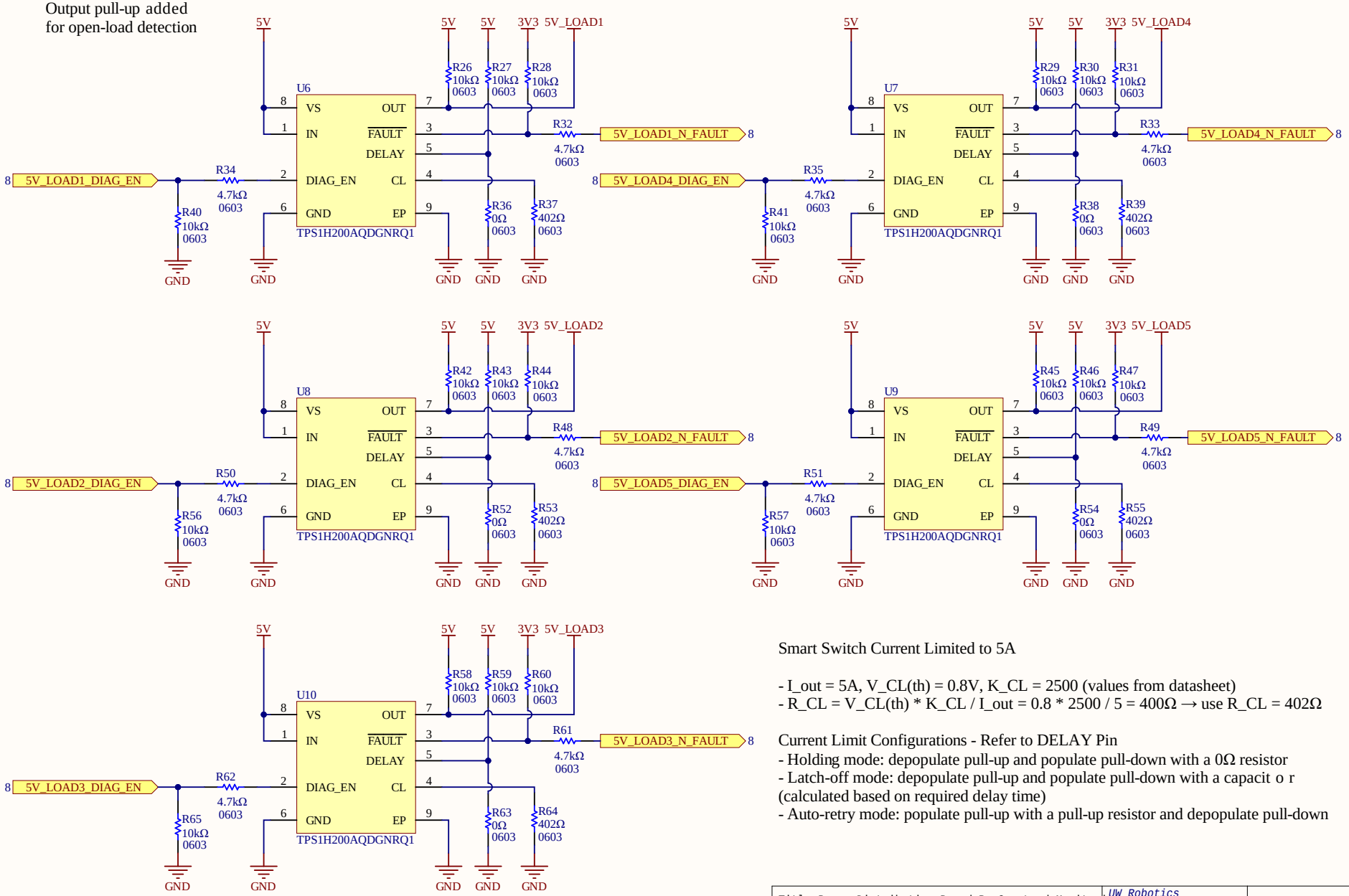
Current Calculations

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

Title: Power Distribution Board Rev2 - 3.3V Linear Regulator			UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-16	Sheet 5 of 10		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH5 - 3.3V LINEAR REGULATOR.SchDoc			

5V Loads Smart Switches

Output pull-up added
for open-load detection



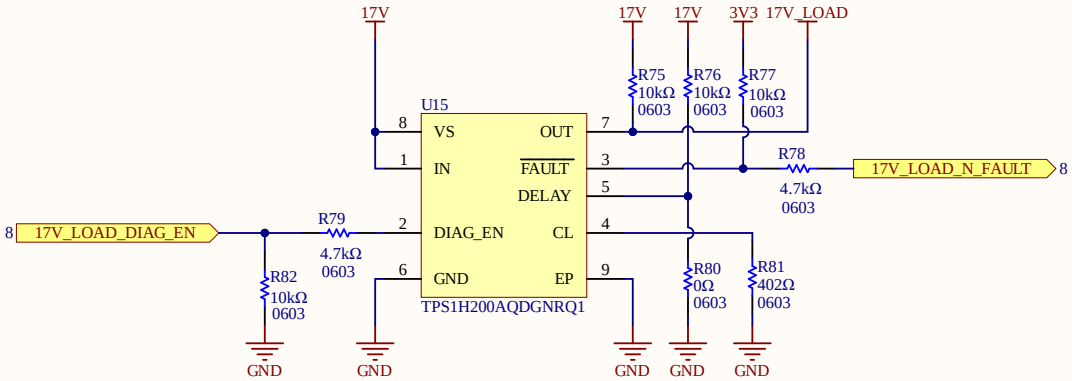
Smart Switch Current Limited to 5A

- 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

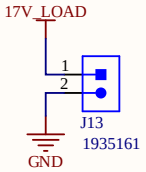
Current Limit Configurations - Refer to DELAY Pin
- Holding mode: depopulate pull-up and populate pull-down with a 0Ω resistor
- Latch-off mode: depopulate pull-up and populate pull-down with a capacit o r (calculated based on required delay time)
- Auto-retry mode: populate pull-up with a pull-up resistor 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: 2020-11-16	Sheet 6 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH6 - LOAD MONITORING 1.SchDoc		

17V Load Smart Switch

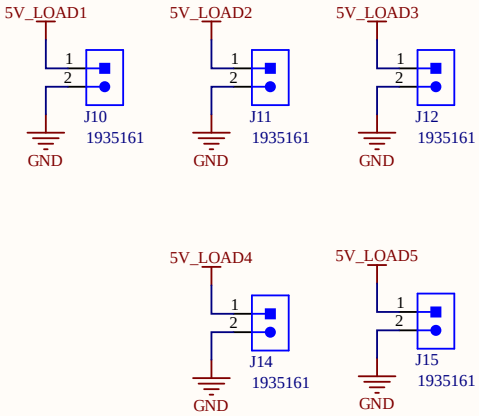


17V Output



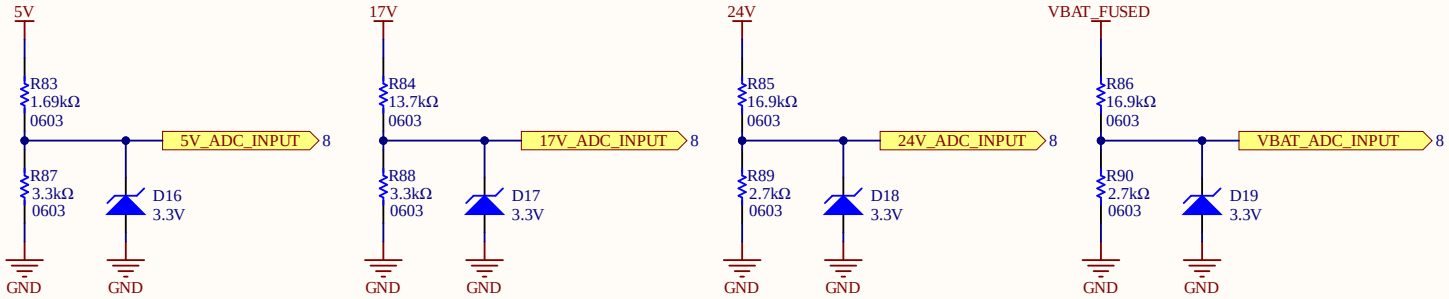
17V power to Nvidia Jetson board

5V Outputs



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

Power Rail Voltage Monitoring



Divides 5V to 3.3V

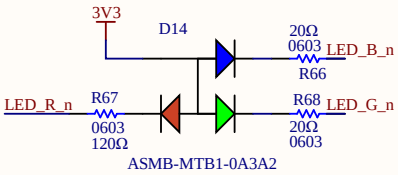
Divides 17V to 3.3V

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: 2020-11-16	Sheet 7 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH7 - LOAD MONITORING 2.SchDoc		

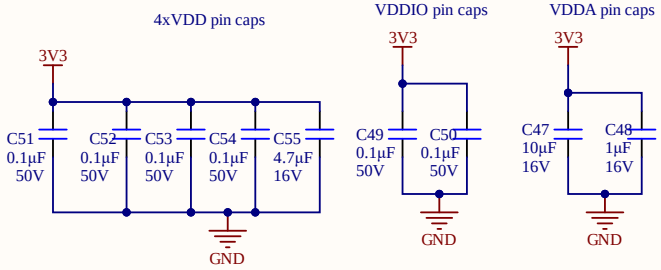
Status LED



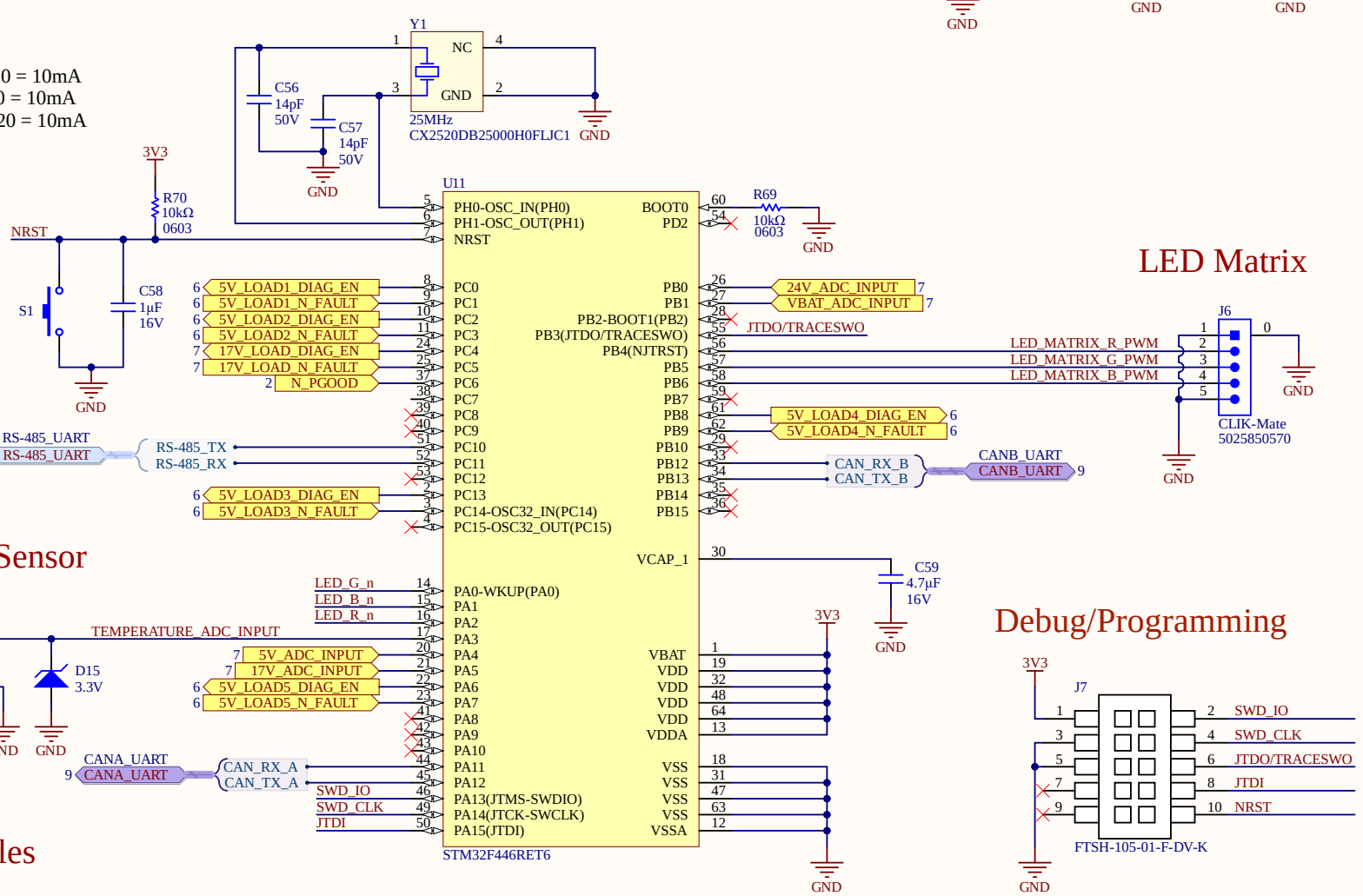
Current Calculations

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

Decoupling Caps

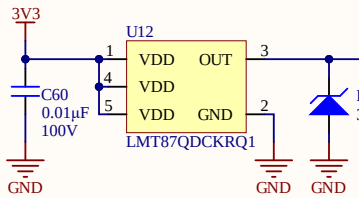


STM32F446RET6



LED Matrix

Temperature Sensor



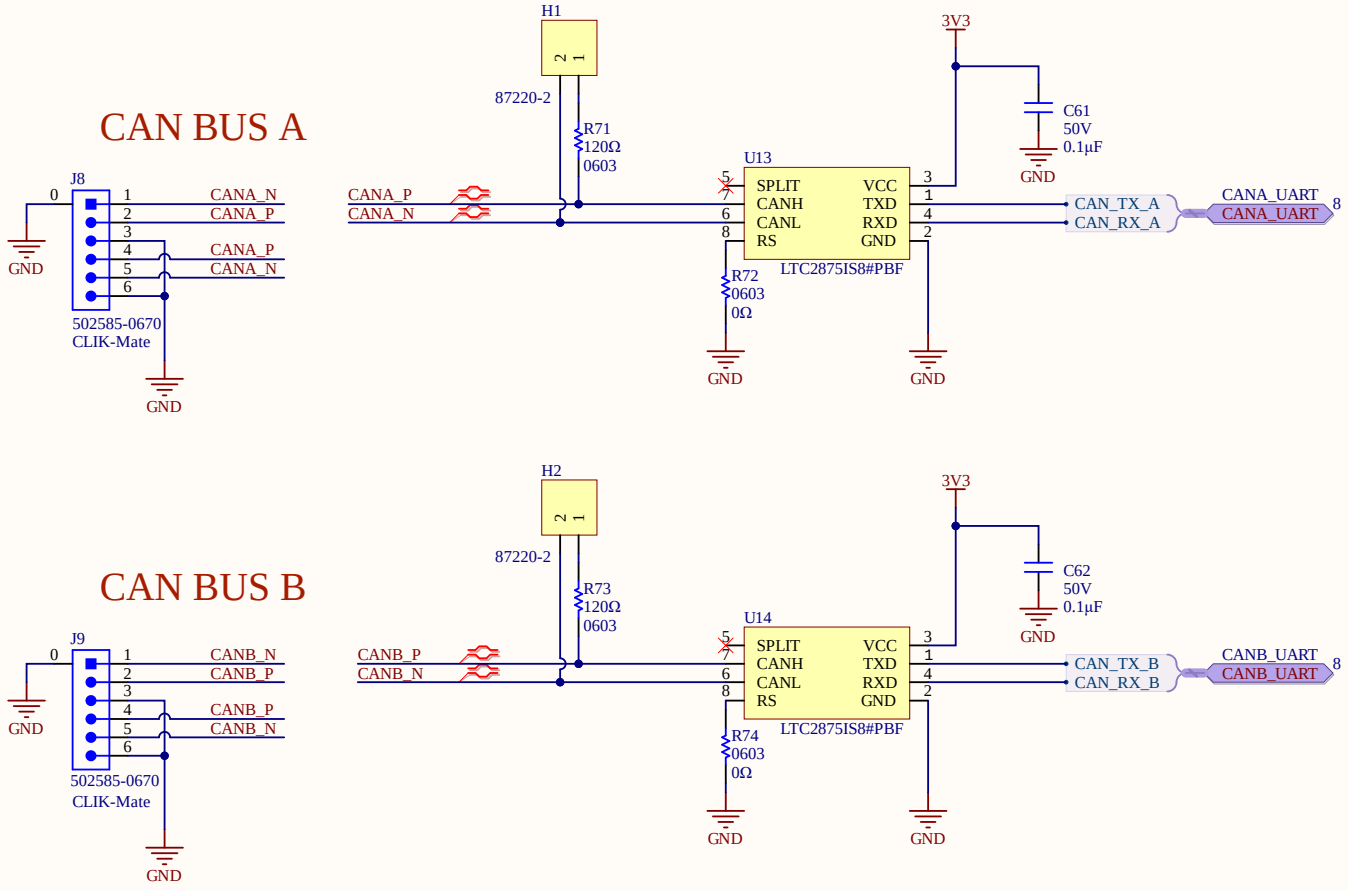
Debug/Programming

Mounting Holes

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

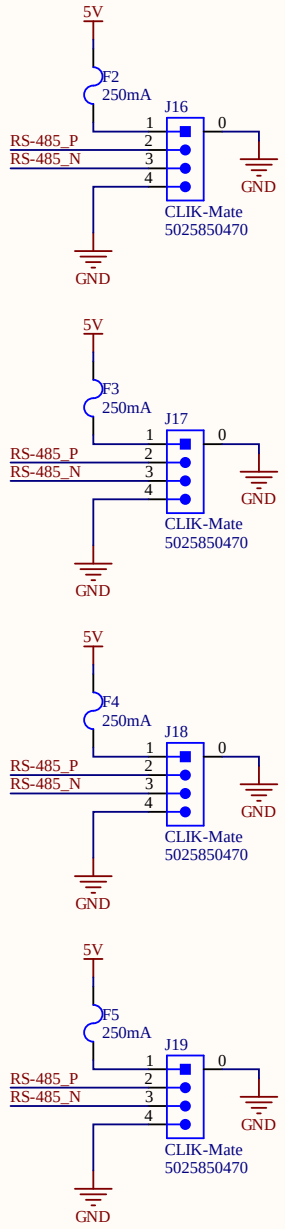
Title Power Distribution Board Rev2 - MCU		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: Cindy Li	
Date: 2020-11-16	Sheet 8 of 10	
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH8 - MICROCONTROLLER.SchDoc		

CAN Transceivers

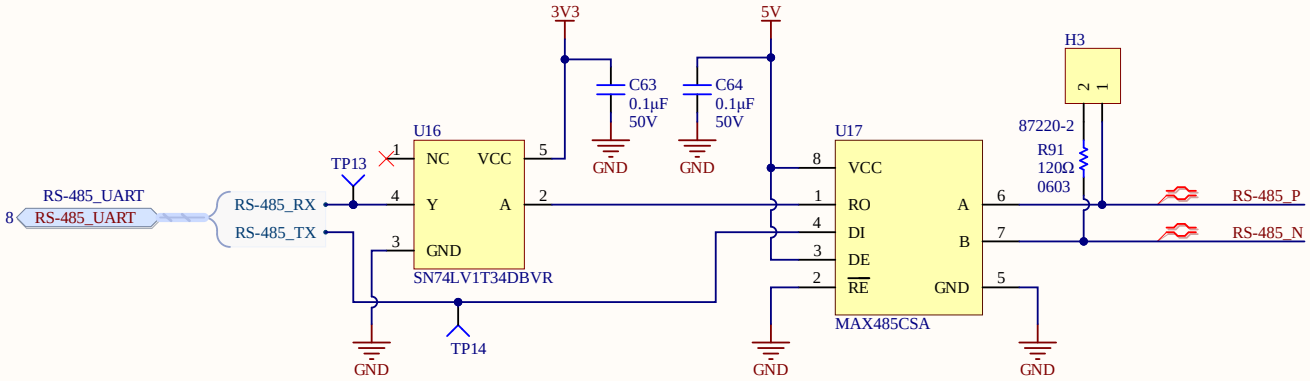


Title Power Distribution Board Rev2 - CAN		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: Cindy Li		
Date: 2020-11-16	Sheet 9 of 10		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH9 - CAN.SchDoc			

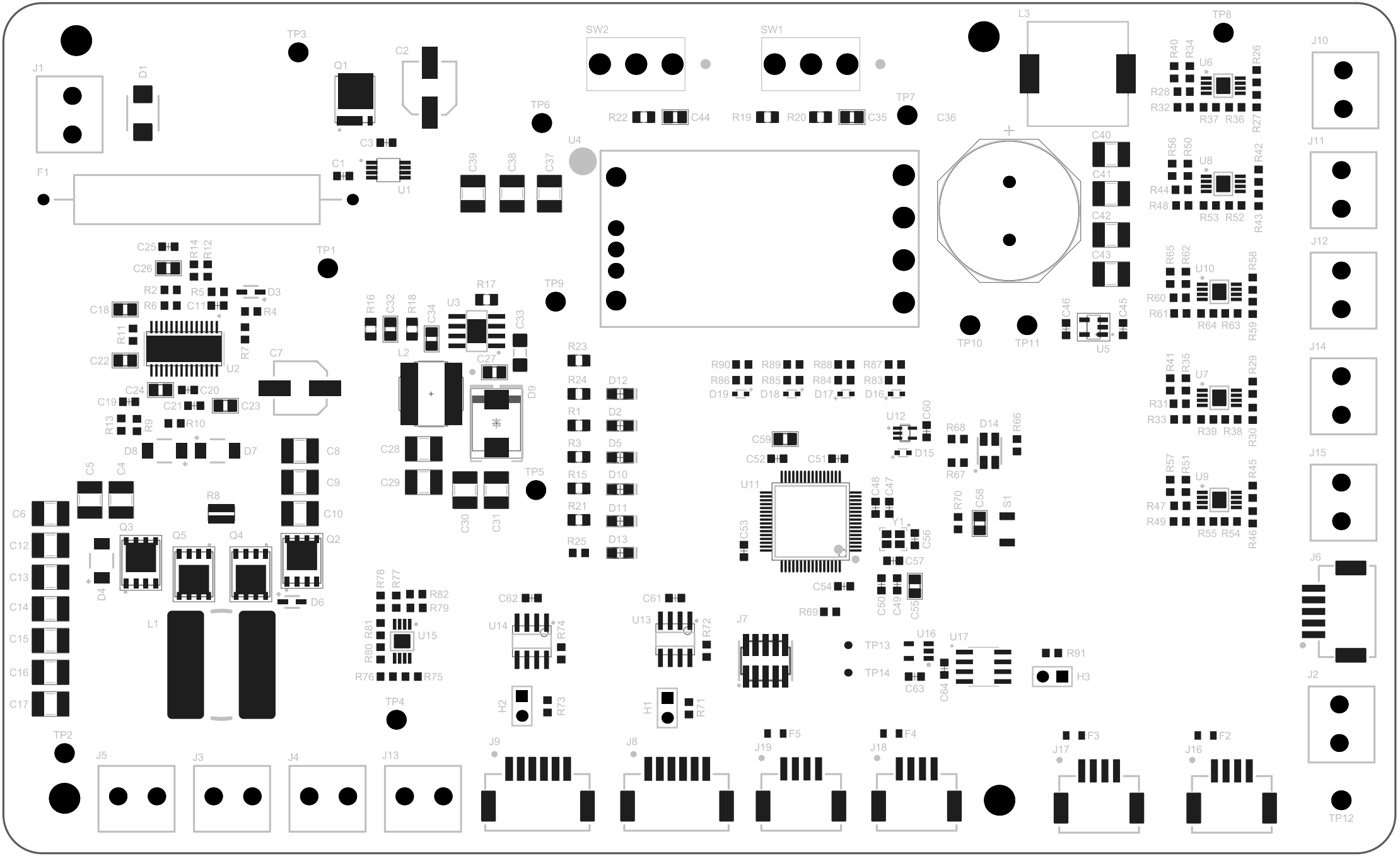
URM04 Ultrasonic Sensors



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: 2020-11-16	Sheet 10 of 10		
File: C:\UWRT\MarsRover2021-hardware\Projects\Power Distribution Board\Rev2\SH10 - RS-485.SchDoc			


J1
D1
TP3
Q1
C2
SW2
SW1
L3
TP8
J10
TP6
TP7
C36
U4
C40
C41
C42
C43
J11
F1
C3
C1
U1
C39
C38
C37
R22
C44
R19
R20
C35
R40
R34
U6
R28
R32
R37
R36
R27
R26
R56
R50
U8
R44
R48
R53
R52
R43
R42
J12
TP1
C25
C26
R14
R12
R2
R5
D3
C18
R6
C11
R4
R11
C22
U2
R7
C7
C24
C20
C19
C21
C23
R13
R9
R10
D8
D7
C8
C9
C10
C5
C4
R8
Q3
Q5
Q4
Q2
D4
D6
C6
C12
C13
C14
C15
C16
C17
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C32
R18
C34
U3
R17
C33
L2
C27
D9
C28
C29
C30
C31
TP5
TP9
R23
R24
D12
R1
D2
R3
D5
R15
D10
R21
D11
R25
D13
R78
R77
R82
R79
R81
U15
R80
R76
R75
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H1
R71
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C64
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R87
R86
R85
R84
R83
D19
D18
D17
D16
C59
C52
C51
U11
U12
C60
D15
R68
D14
R66
R67
C48
C47
C53
Y1
C56
C57
C54
R70
C58
S1
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C49
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J3
J4
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J8
J19
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J18
F4
J17
F3
J16
F2
TP12