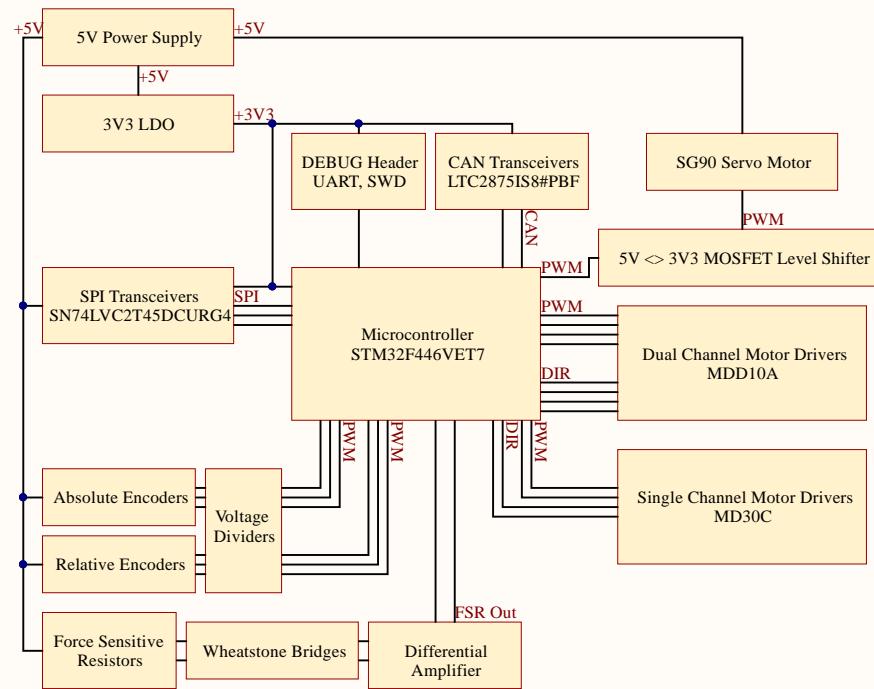
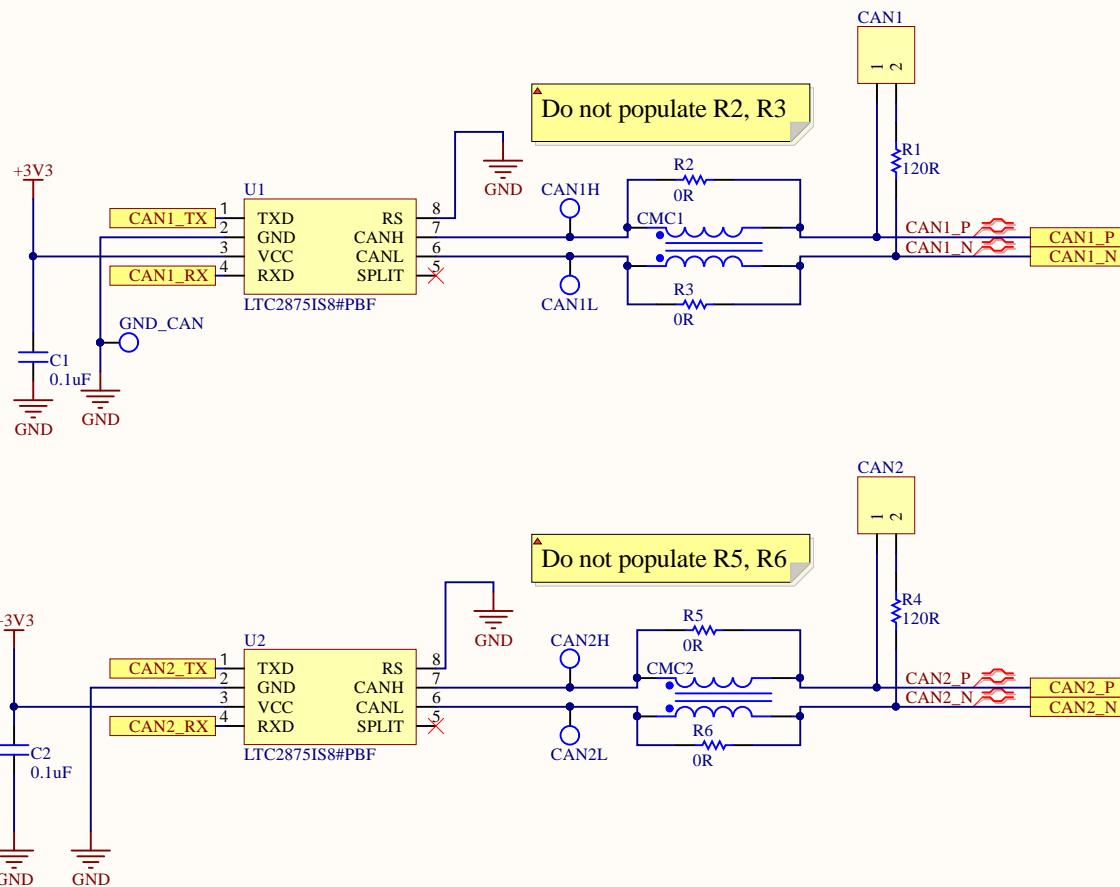
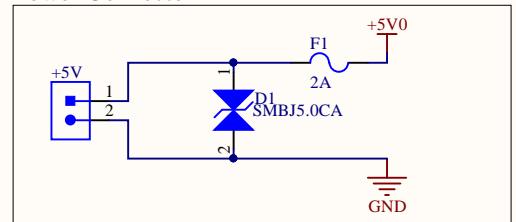
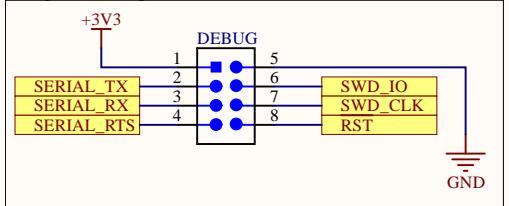
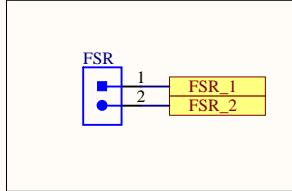


Arm Block Diagram

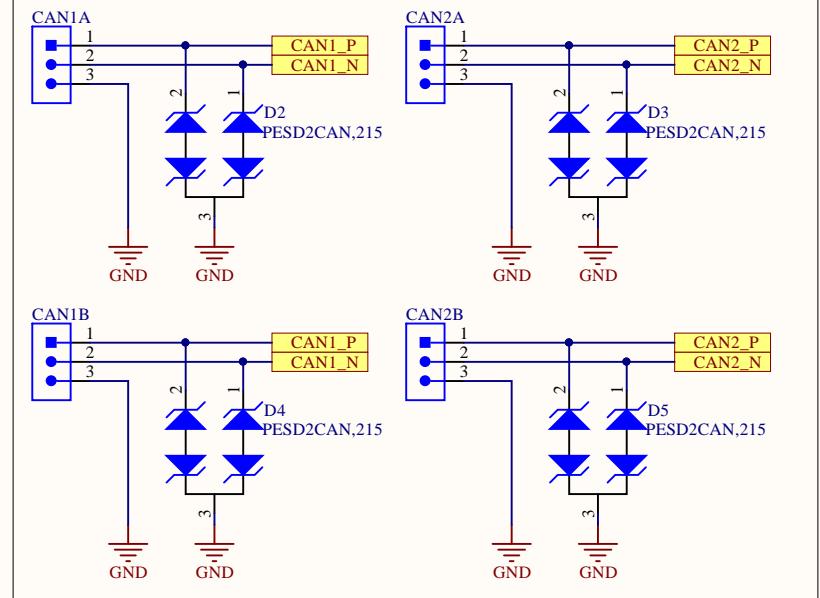
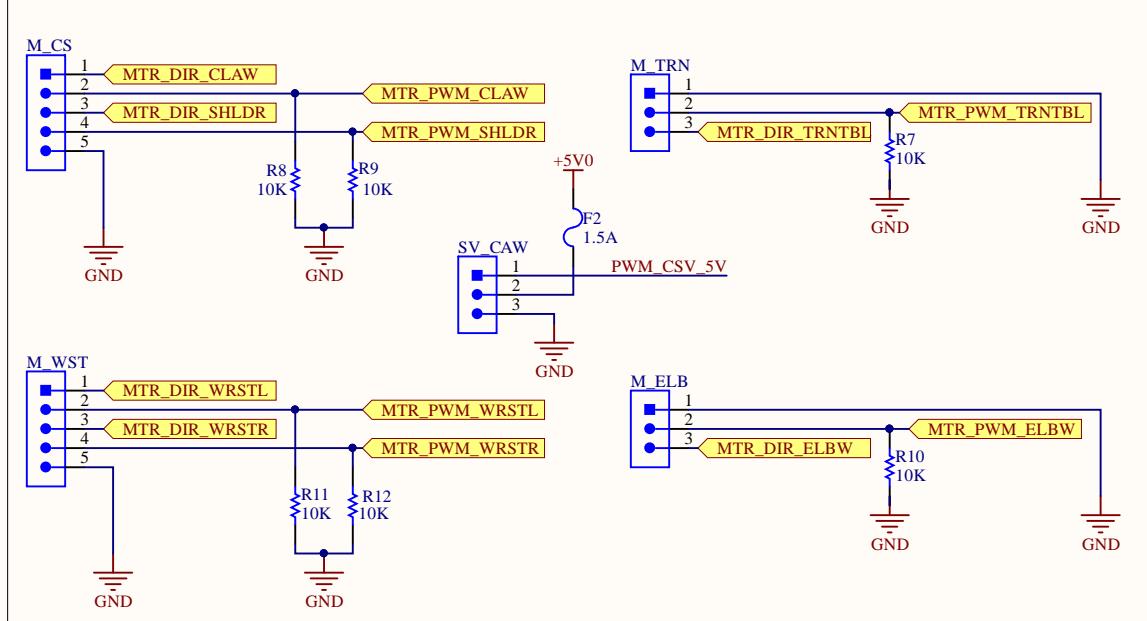
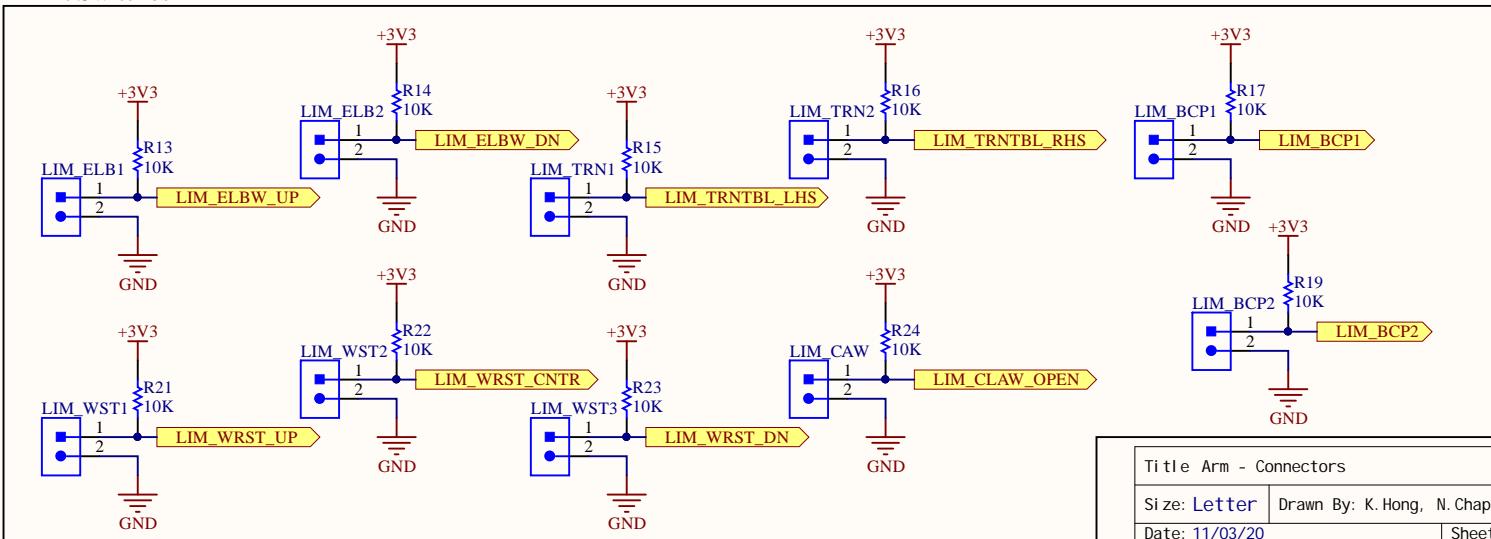
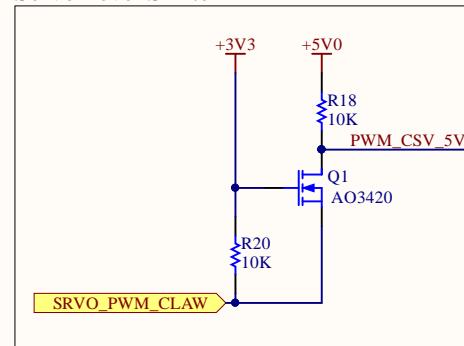


CAN Transceivers

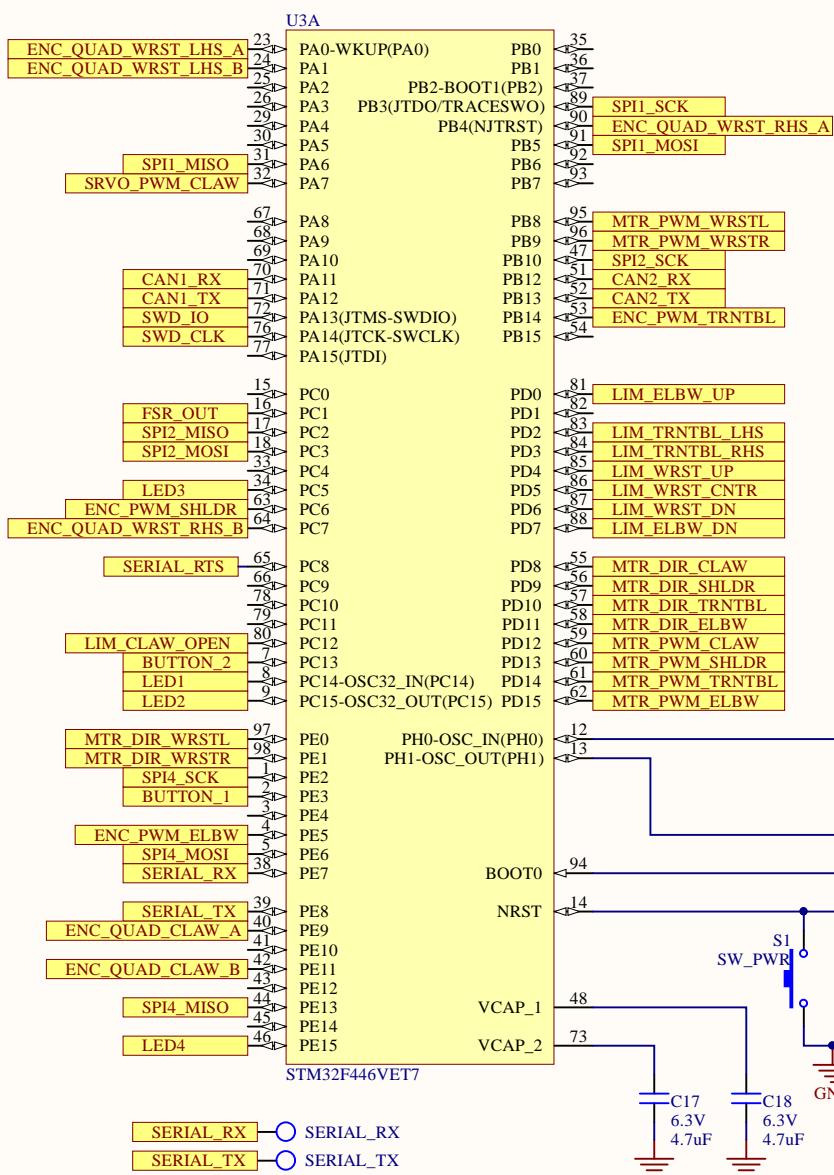


Power Connector**Programming Connector****Force Sensitive Resistor**

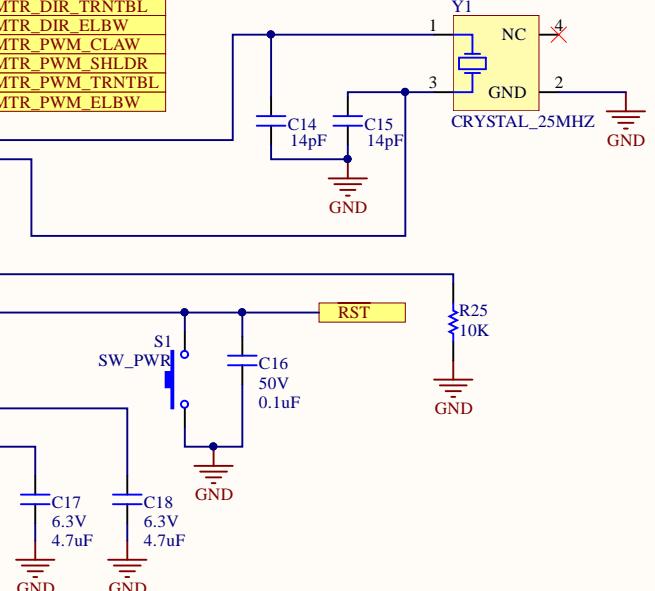
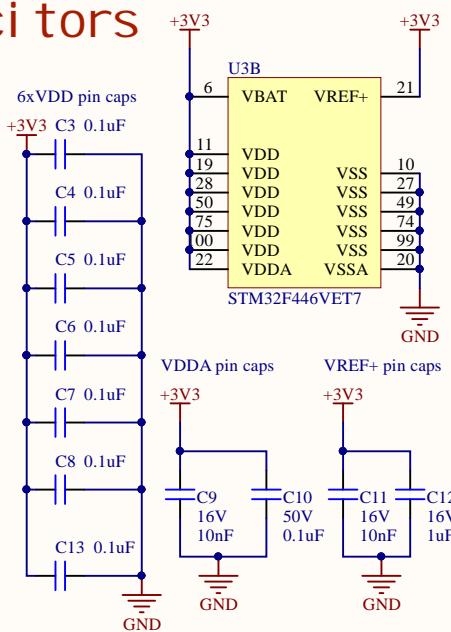
Acronyms Explained
FSR: Force Sensitive Resistor
CAW: Claw
WST: Wrist
BCP: Bicep (Shoulder)
ELB: Elbow
TRN: Turntable
DIR: Direction for motors

CAN Connections**Motors****Limit Switches****Servo Level Shifter**

STM32F446VET7



Bypass Capacitors



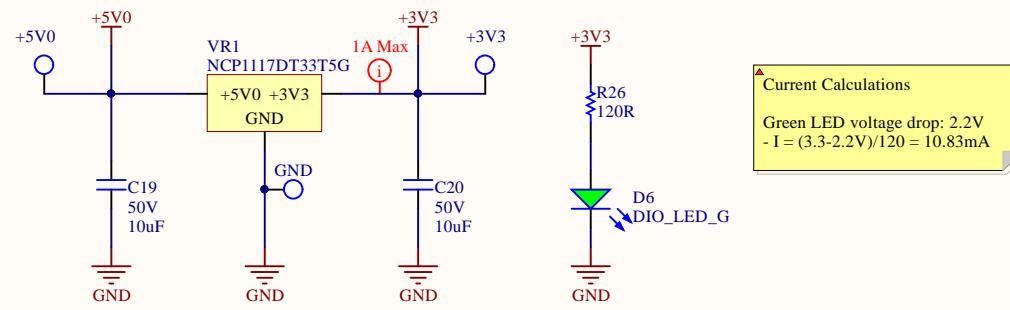
A

A

5V-3.3V LDO

B

B



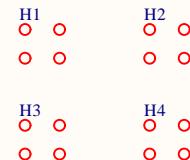
C

C

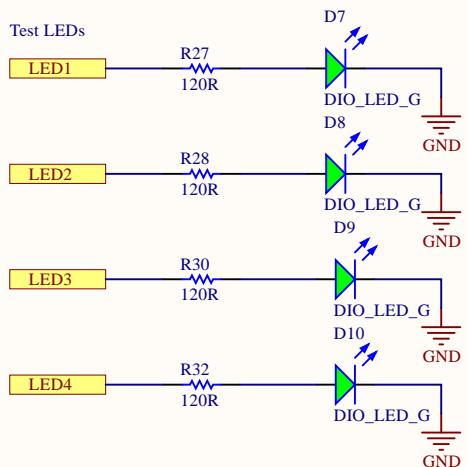
D

D

Title: Arm - Power		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: K. Hong		
Date: 11/03/20	Sheet 5 of 9		
File: C:\Users\Adrianna\Documents\MarsRover2020-PCB\Projects\Arm\Rev2\POWER.SchDoc			



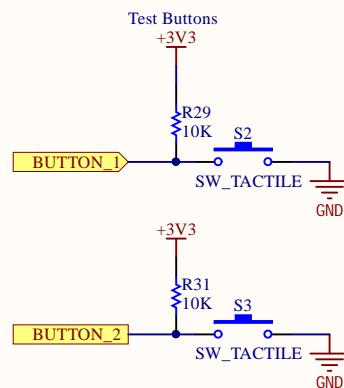
Test LEDs



Current Calculations

Green LED voltage drop: 2.2V
 $- I = (3.3 - 2.2V) / 120 = 10.83mA$

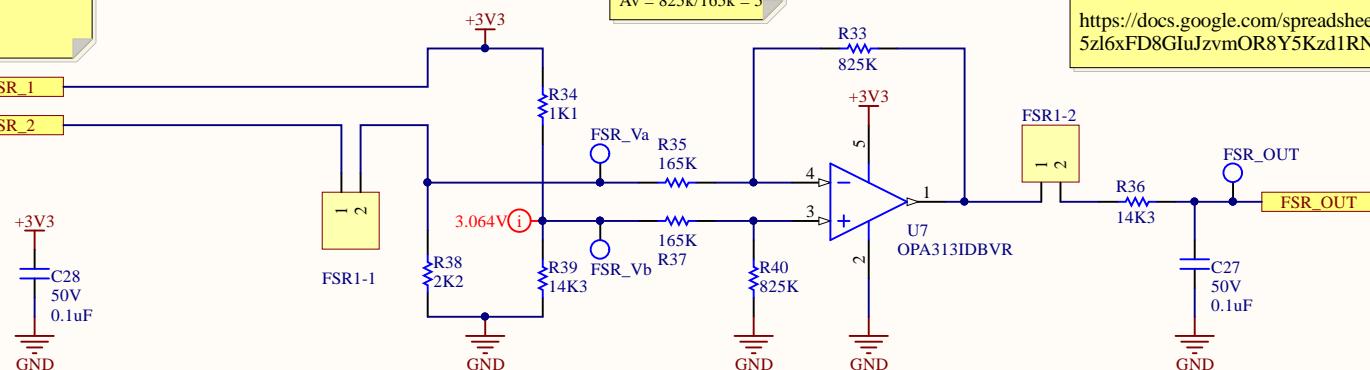
Test Buttons



Force Sensitive Resistor

Sensor:
 Manufacturer: Interlink Electronics
 Manufacturer Part Number: 30-81794
 Supplier: Digi-Key
 Supplier Part Number: 1027-1001-ND
<https://cdn.sparkfun.com/assets/8/a/1/2/0/2010-10-26-DataSheet-FSR402-Layout2.pdf>
 Resistance at 20N = 800 ohms
 Resistance at 100N = 250 ohms

Wheatstone Bridge



Differential Amplifier

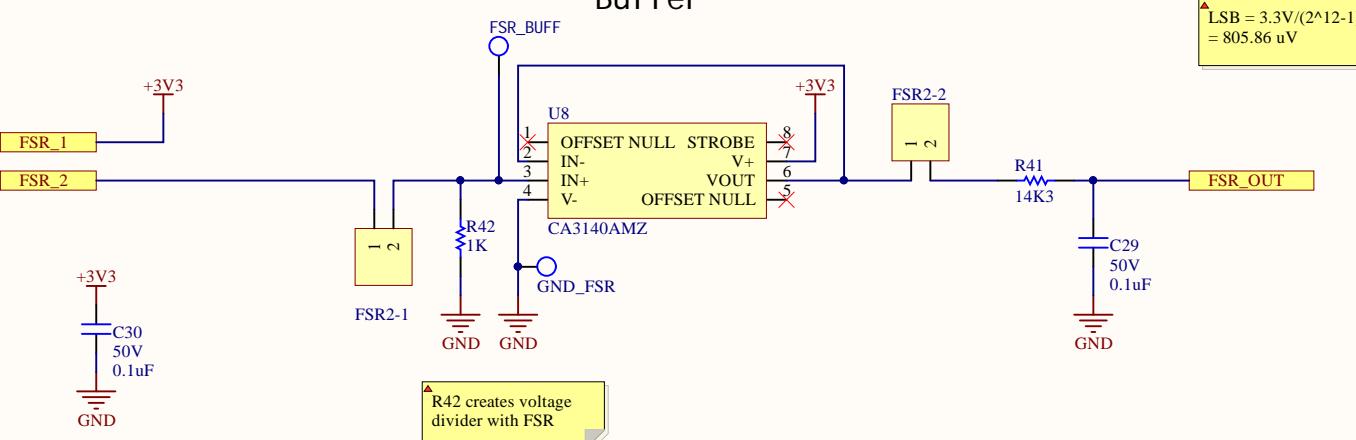
Differential amplifier gain:
 $A_v = 825k/165k = 5$

Wheatstone bridge voltage output values:
 At 20N, $V_{out} = 3.2V$
 At 100N, $V_{out} = 0.5V$

Low pass filter cutoff frequency:
 $f_c = 1/(2\pi \cdot 14.3k \cdot 0.1\mu F) = 111.30 \text{ Hz}$

Links to differential amplifier calculations and documentation
<https://docs.google.com/spreadsheets/d/1JzRwpCH-aMdlyAMP5zl6xFD8GluJzvmOR8Y5Kzd1RN0/edit#gid=0>

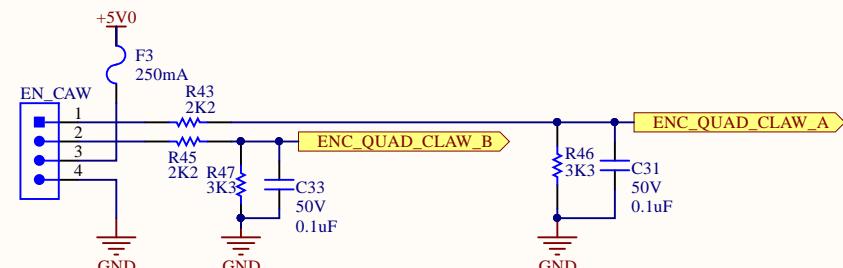
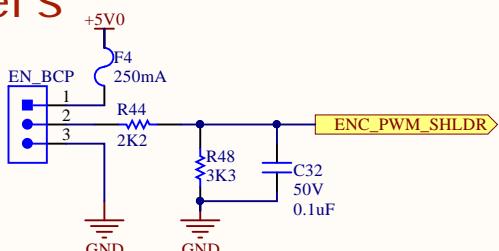
Buffer



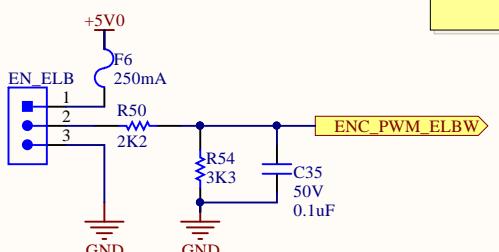
$\text{LSB} = 3.3V/(2^{12}-1)$
 $= 805.86 \mu V$

PWM Encoders

A

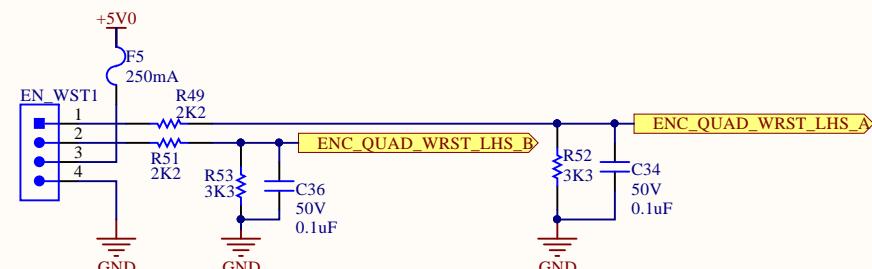


B

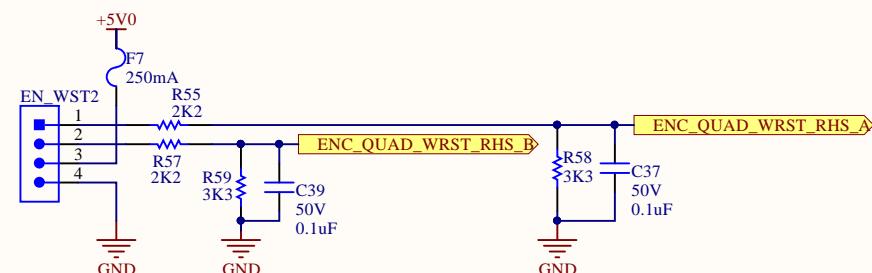
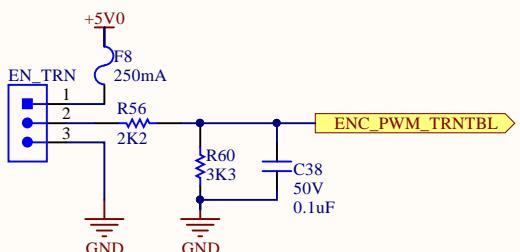


Low pass filter cut-off frequency:
 $f_c = 1/(2\pi \cdot 3.3k \cdot 0.1\mu F) = 482.29 \text{ Hz}$

Voltage divider:
 $V_{out} = 5(3.3k/(2.2k+3.3k)) = 3V$



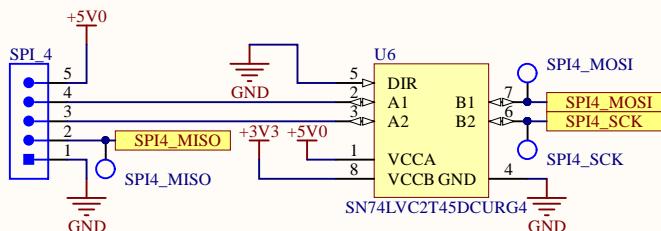
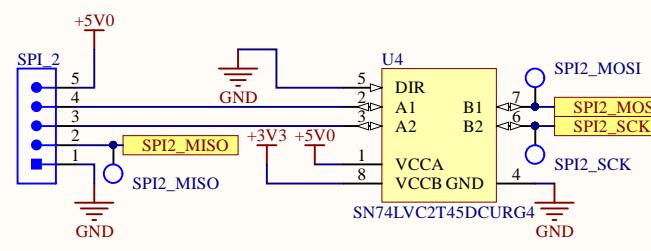
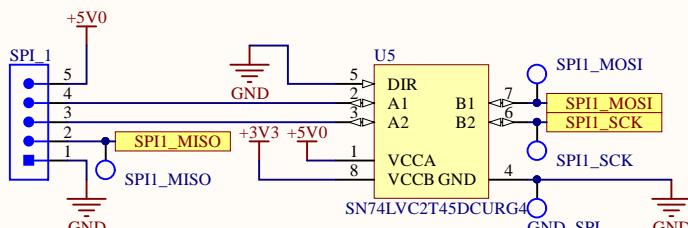
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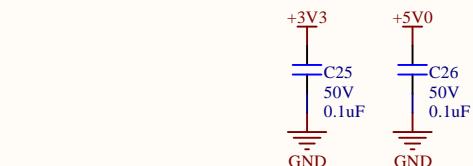
D

Title: Arm - PWM Encoders		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	
Size: Letter	Drawn By: K. Hong		
Date: 11/03/20	Sheet 8 of 9		
File: C:\Users\Adrianna\Documents\MarsRover2020-PCB\Projects\Arm\Rev2\Encoders.SchDoc			

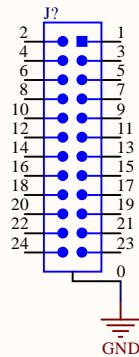
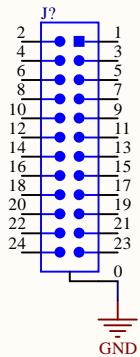
A SPI Encoders



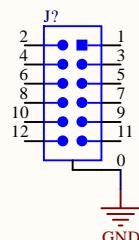
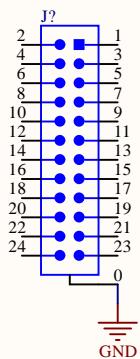
Encoder manufacturer: Broadcom
Encoder part number: AEAT-6012-A06
Did not level shift MISO signals since the STM32 SPI peripheral is 5V tolerant



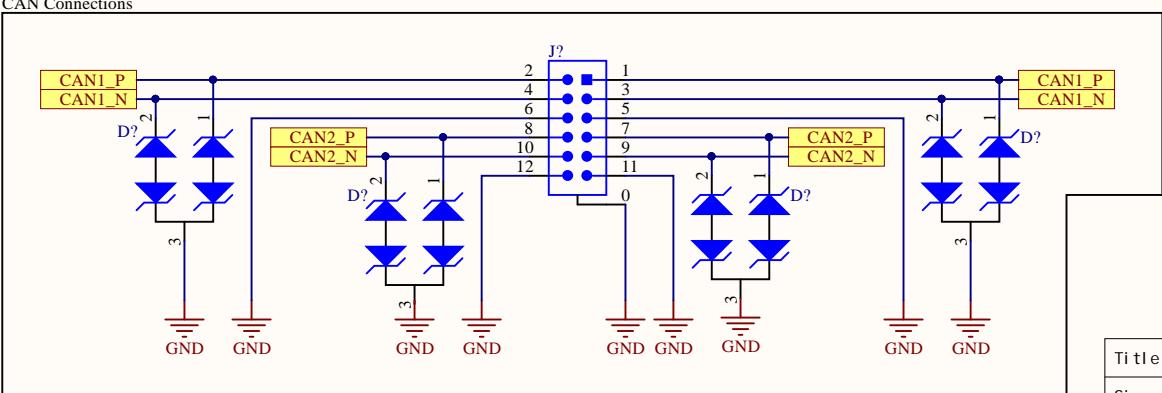
A



B



C

CAN Connections**+5V0 Power**