

A

A

Arm Block Diagram

B

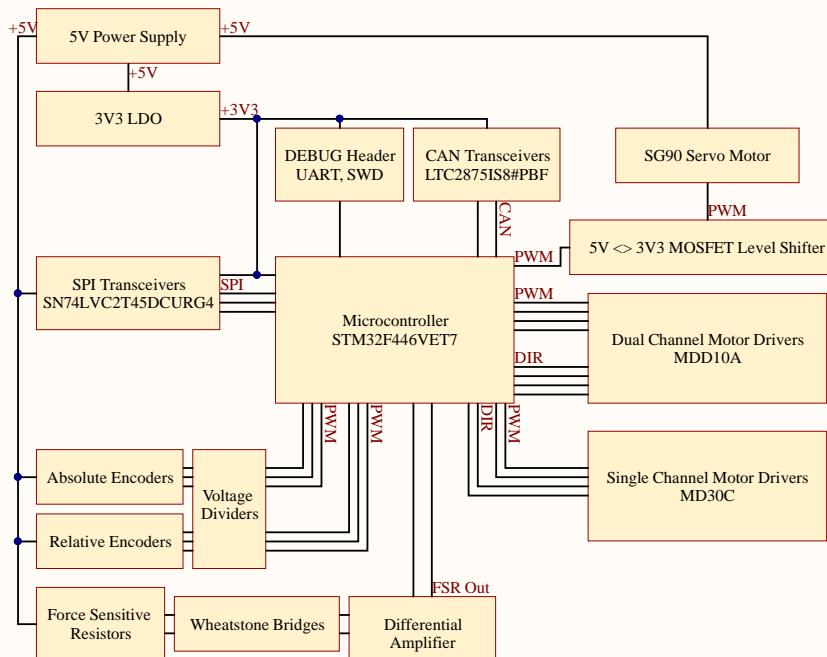
B

C

C

D

D



Title: Arm - Block Diagram

Size: Letter | Drawn By: K. Hong

Date: 2020-01-28

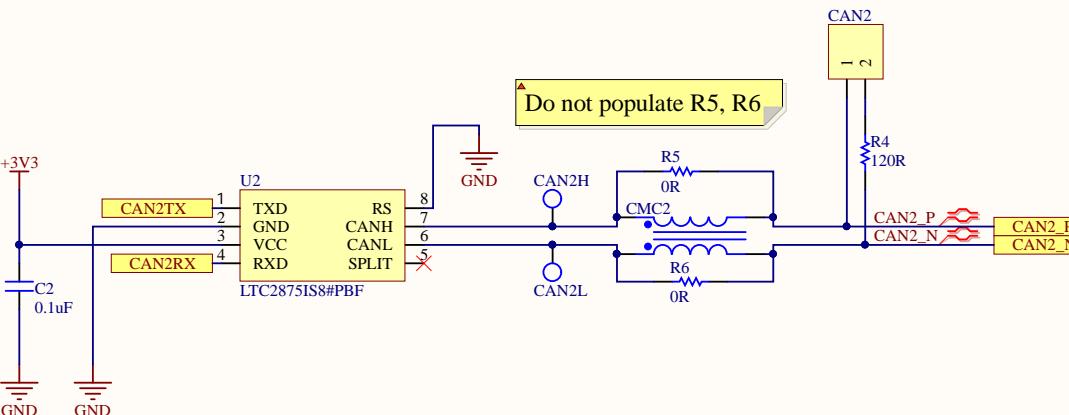
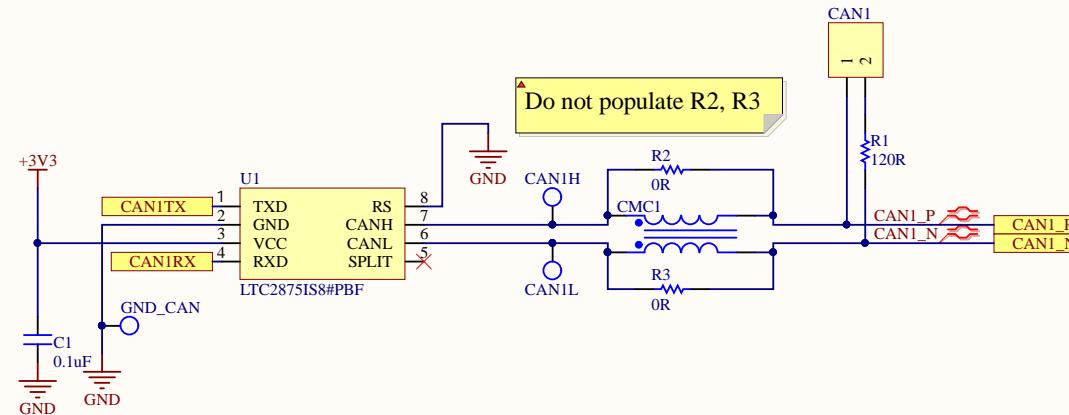
Sheet1 of 9

File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\Block Diagram.SchDoc

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CAN Transceivers



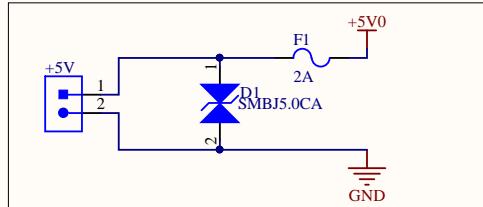
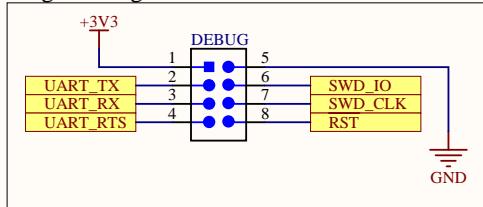
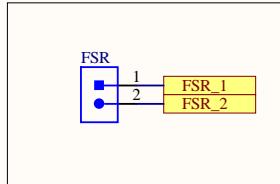
Title: Arm - CAN Transceivers	UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6
Size: Letter	Drawn By: P. Onai fo, K. Hong
Date: 2020-01-28	Sheet 2 of 9
File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\sch\CAN.SchDoc	

1

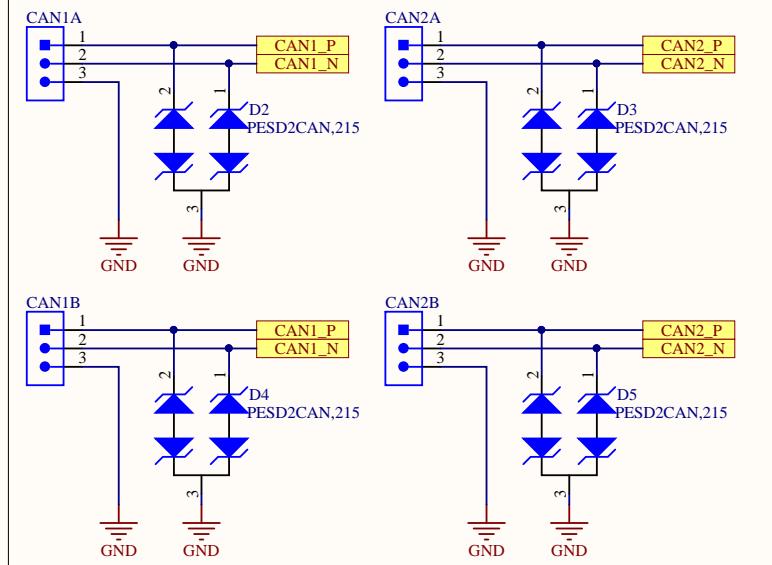
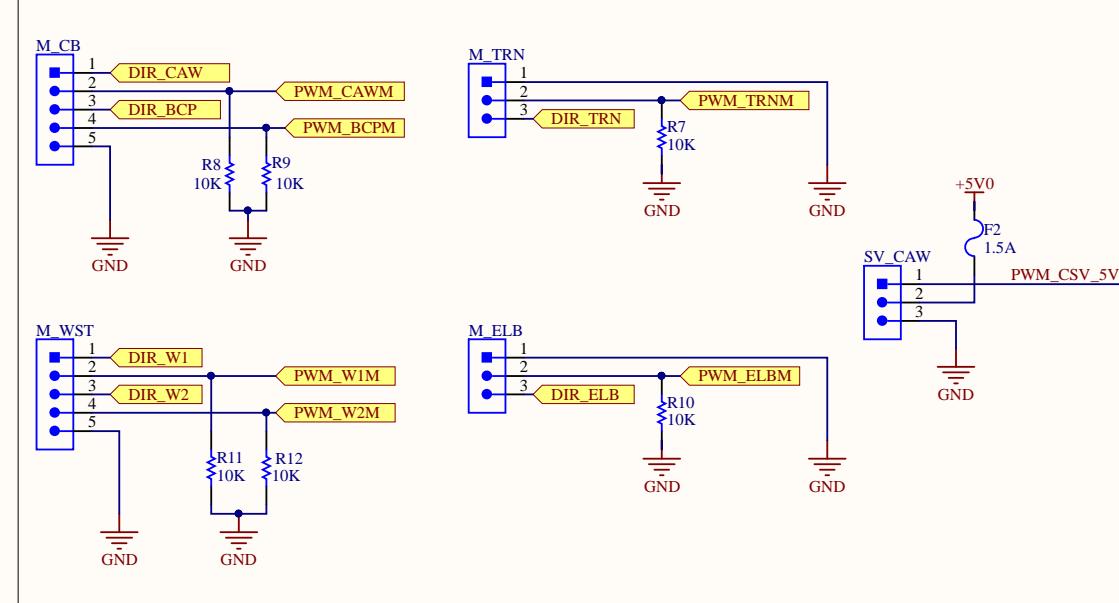
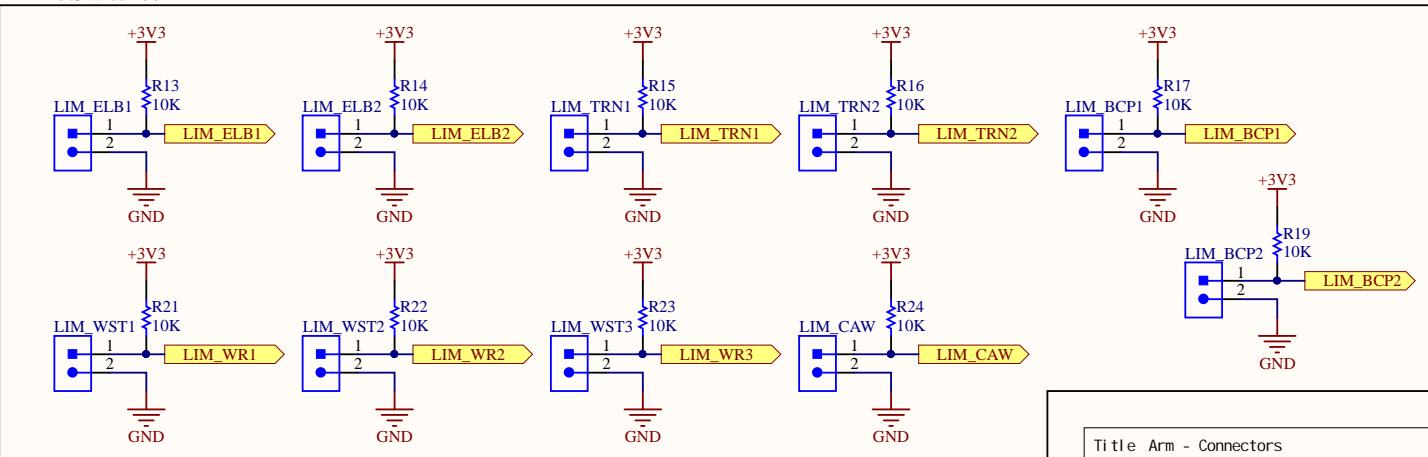
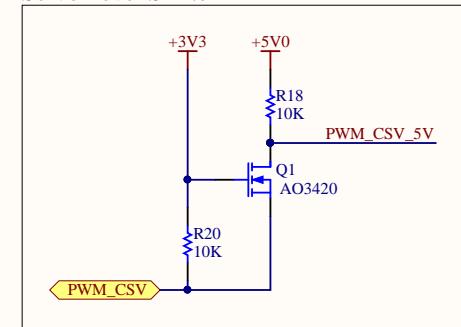
2

3

4

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**

Title: Arm - Connectors

Size: Letter | Drawn By: K. Hong, N. Chapman

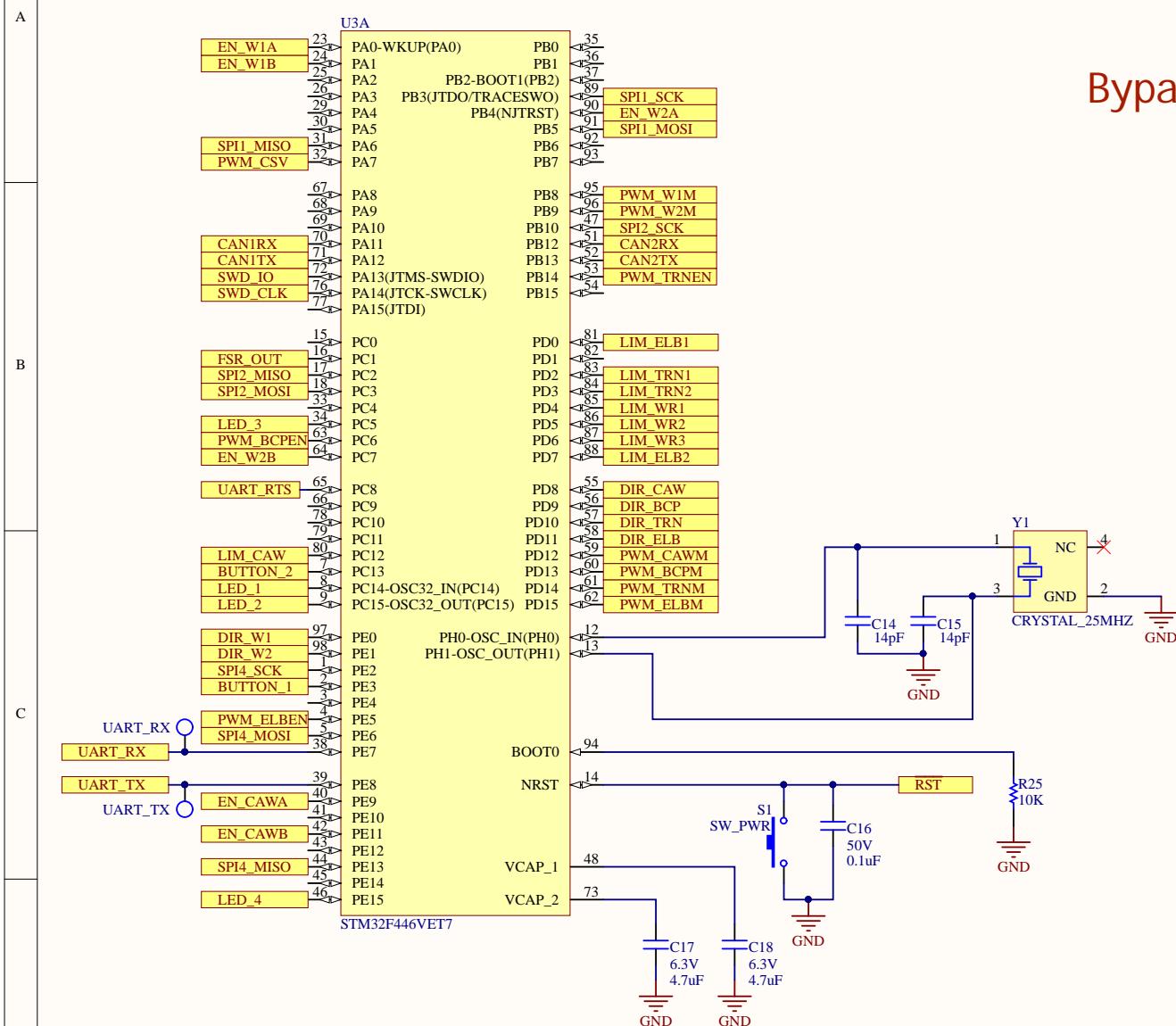
Date: 2020-01-28 | Sheet 3 of 9

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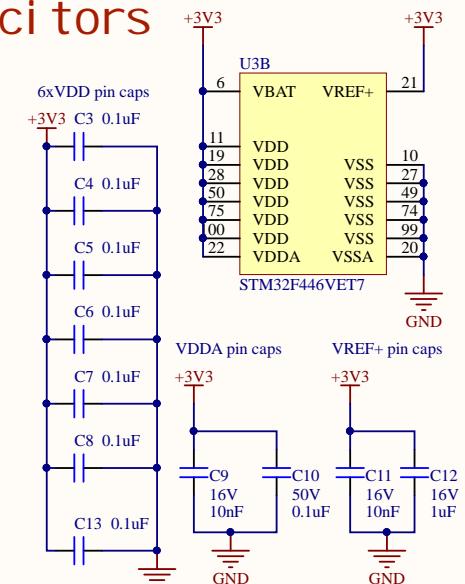
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STM32F446VET7



Bypass Capacitors



A

A

B

B

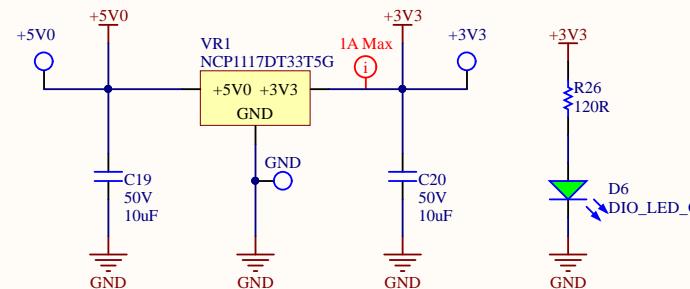
C

C

D

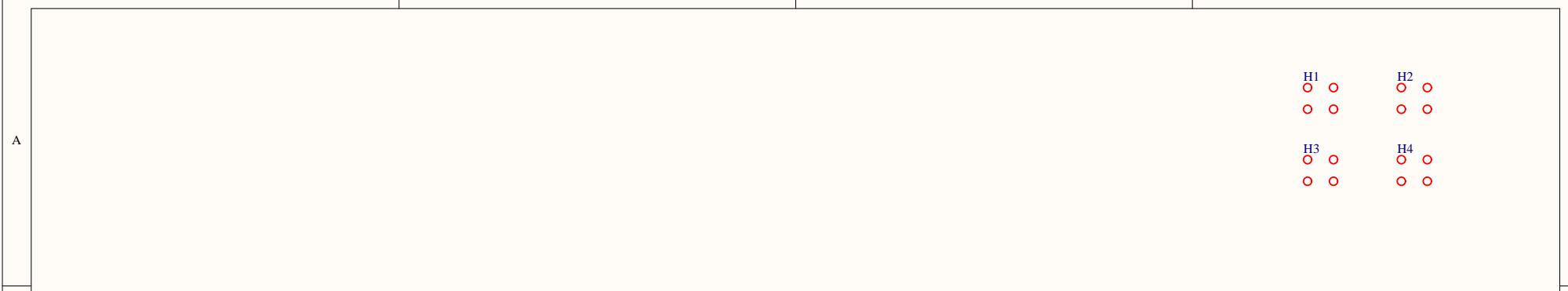
D

5V-3.3V LDO

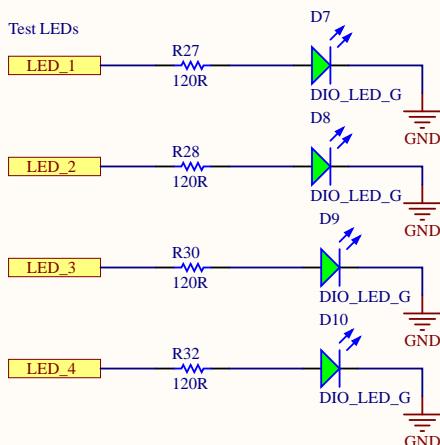


Current Calculations
Green LED voltage drop: 2.2V
- $I = (3.3-2.2V)/120 = 10.83mA$

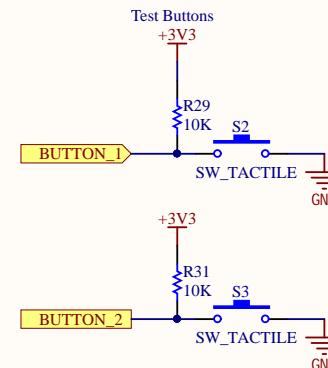
Title: Arm - Power		UW Robotics
Size: Letter	Drawn By: K. Hong	200 University Avenue Waterloo Ontario Canada N2L 3G6
Date: 2020-01-28	Sheet 5 of 9	
File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\sch\POWER.SchDoc		UW ROBOTICS TEAM



Test LEDs



Test Buttons



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Date: 2020-01-28		Sheet 6 of 9	
File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\sch\Support.SchDoc			

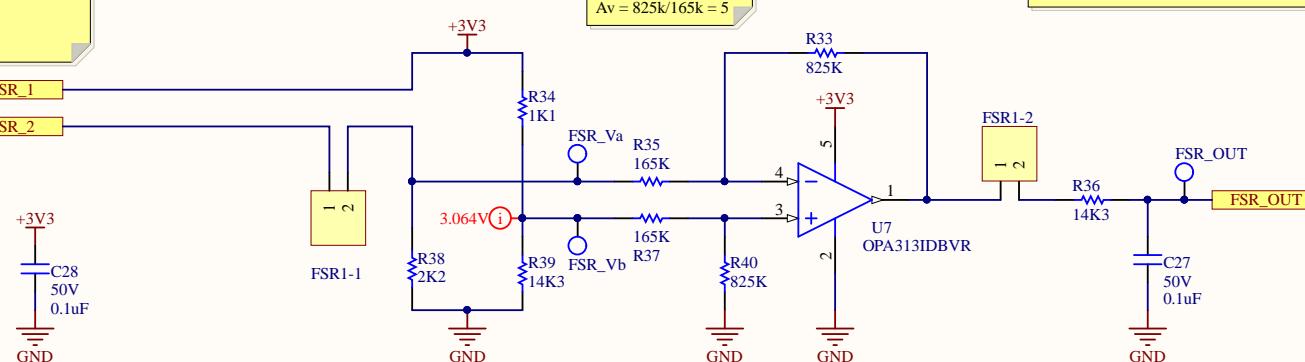
Force Sensitive Resistor

A

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:
 At 20N, Vout = 3.2V
 At 100N, Vout = 0.5V

Low pass filter cutoff frequency:
 $f_c = 1/(2\pi R_36 C_{27}) = 111.30 \text{ Hz}$

Links to differential amplifier calculations and documentation
<https://docs.google.com/spreadsheets/d/1JzRwpCH-aMdlyAMp5zl6xFD8GluJzvmOR8Y5KzdIRN0/edit#gid=0>

B

+3V3
 C28 50V 0.1uF
 GND

FSR1-1

GND

3.064V(i)
 R38 2K2
 R39 14K3
 GND

FSR_Va
 R35 165K
 R37 165K
 GND

R40 825K
 GND

R33 825K
 GND

+3V3
 R36 14K3
 GND

U7 OPA313IDBVR
 1 2 3 4 5 6 7 8

FSR1-2
 - 2 1 3 4 5 6 7 8

FSR_OUT
 C27 50V 0.1uF
 GND

Buffer

C

+3V3
 FSR_1
 FSR_2
 GND

+3V3
 C30 50V 0.1uF
 GND

FSR_BUFF

GND

FSR2-1

GND

U8
 OFFSET NULL
 IN-
 IN+
 V-
 V+
 VOUT
 OFFSET NULL
 CA3140AMZ
 1 2 3 4 5 6 7 8

R42 1K
 GND_FSR
 GND

FSR2-2

GND

+3V3
 R41 14K3
 GND

FSR_OUT
 C29 50V 0.1uF
 GND

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

R42 creates voltage
 divider with FSR

D

Title: Arm - Claw Sensor

Size: Letter

Drawn By: N. Chapman, A. Ebrahimi, K. Hong

Date: 2020-01-28

Sheet 7 of 9

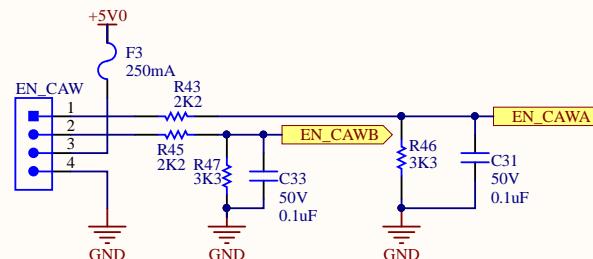
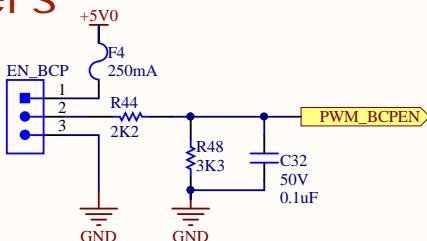
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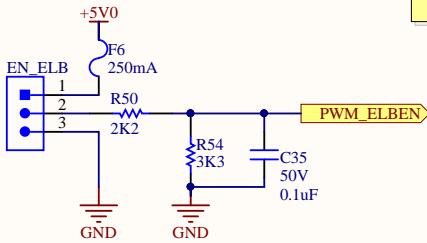
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PWM Encoders

A

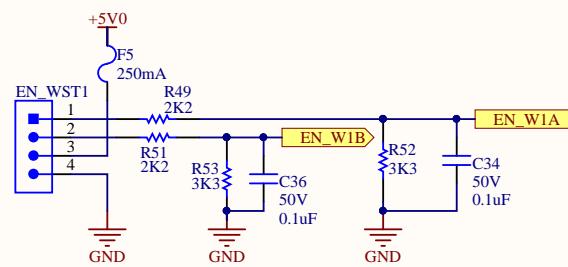


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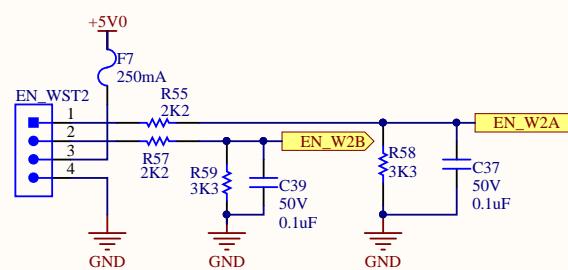
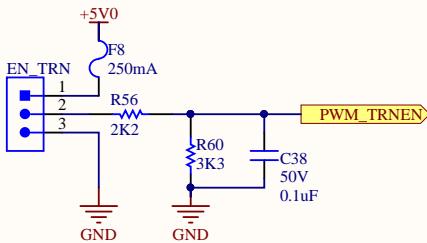


Low pass filter cut-off frequency:
 $f_c = 1/(2\pi \cdot 3.3k \cdot 0.1u) = 482.29 \text{ Hz}$

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



C



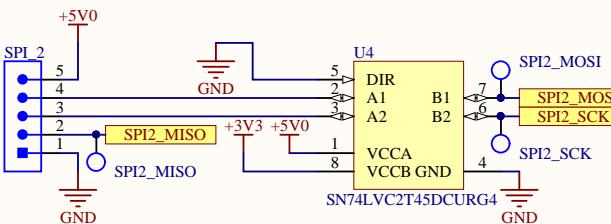
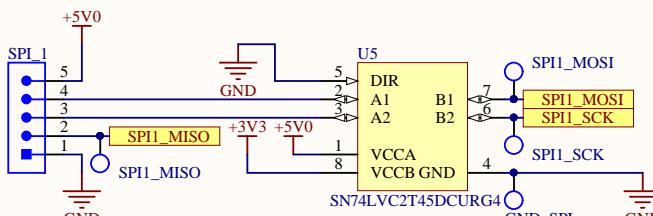
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Title: Arm - PWM Encoders	UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: K. Hong	
Date: 2020-01-28	Sheet 18 of 9	
File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\sch\Encoders.SchDoc		

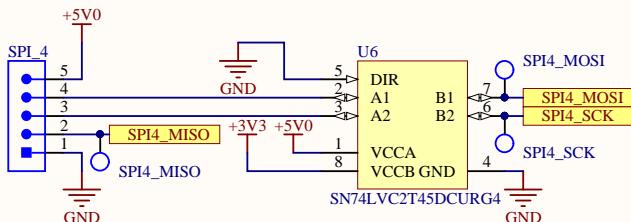
A

SPI Encoders

B



C



Encoder manufacturer: Broadcom
Encoder part number: AEAT-6012-A06

Did not level shift MISO signals since the STM32 SPI peripheral is 5V tolerant

D

