

A

A

Arm Block Diagram

B

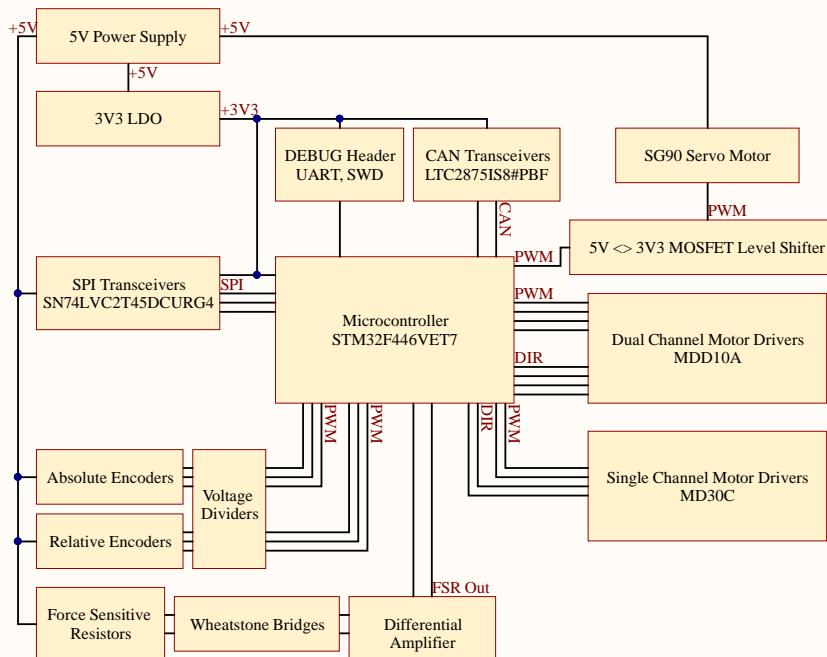
B

C

C

D

D



Title: Arm - Block Diagram

Size: Letter | Drawn By: K. Hong

Date: 2020-02-01

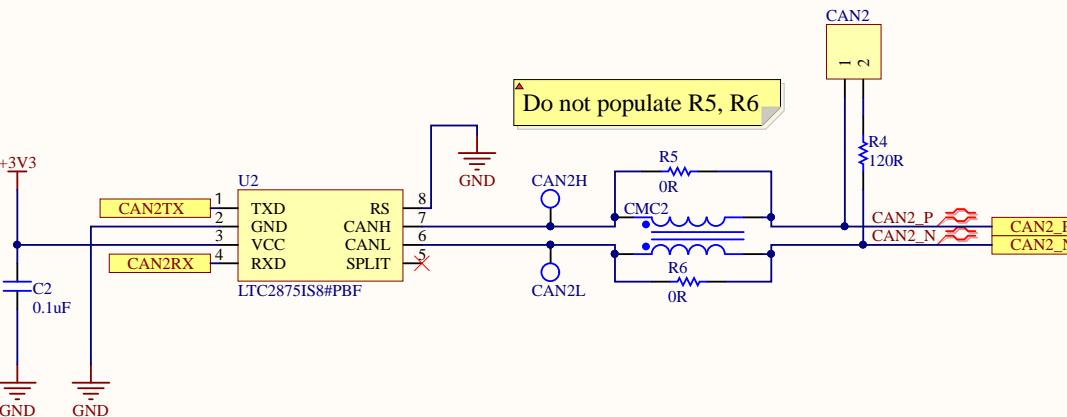
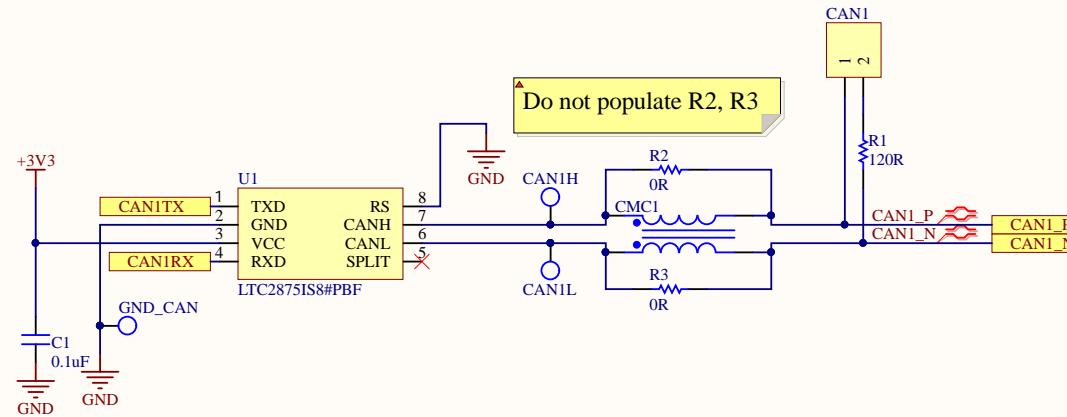
Sheet1 of 9

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: 2020-02-01	Sheet 2 of 9
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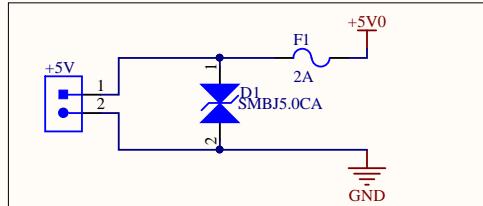
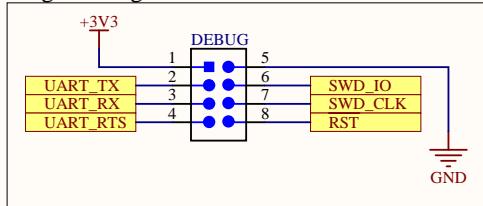
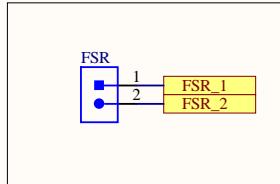


1

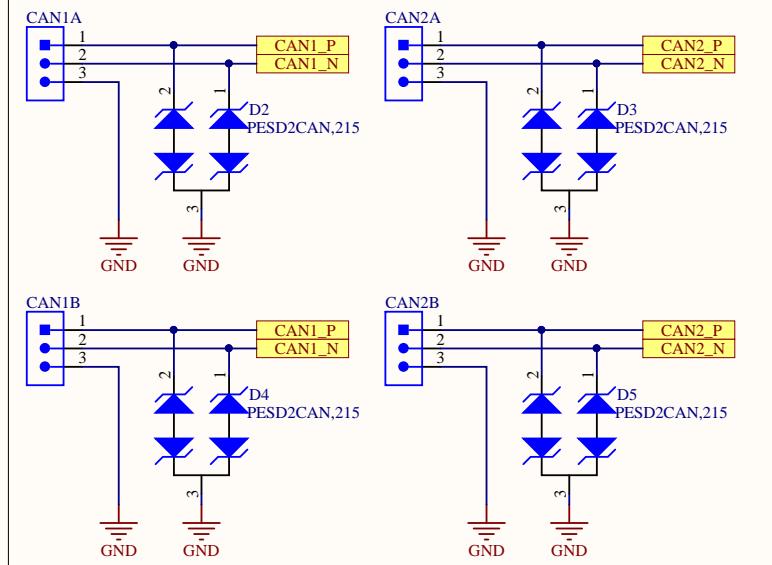
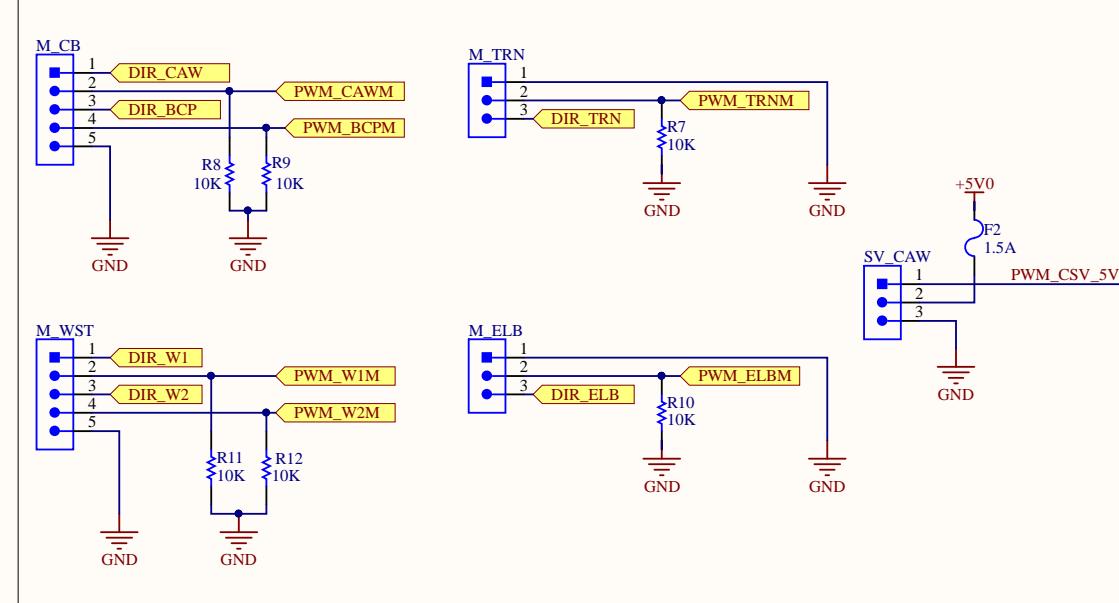
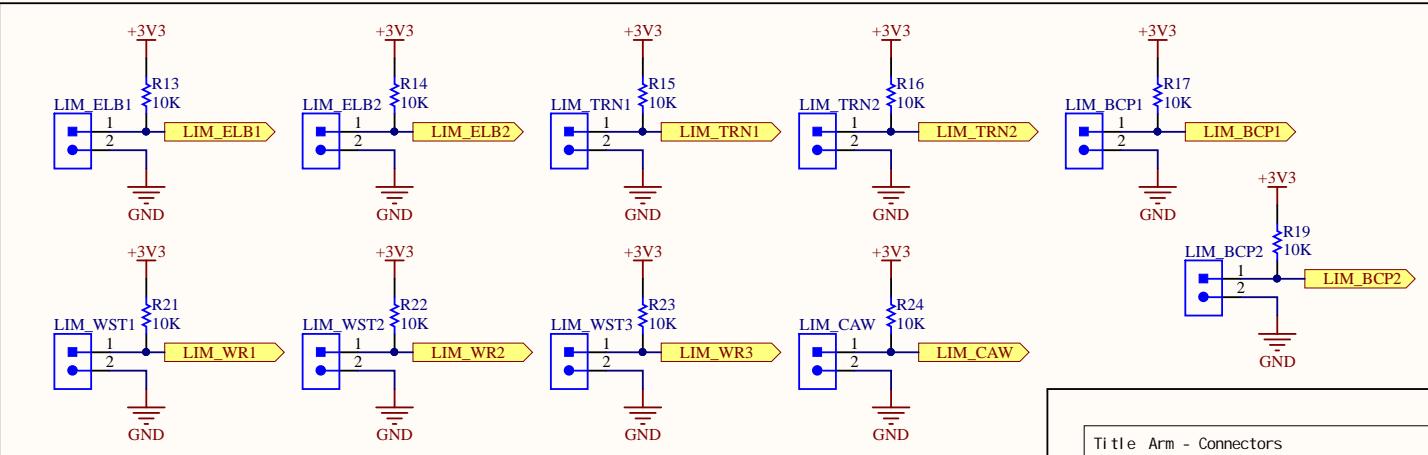
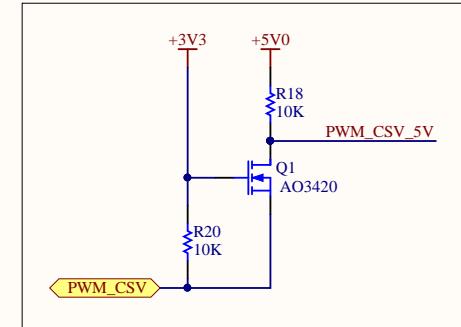
2

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

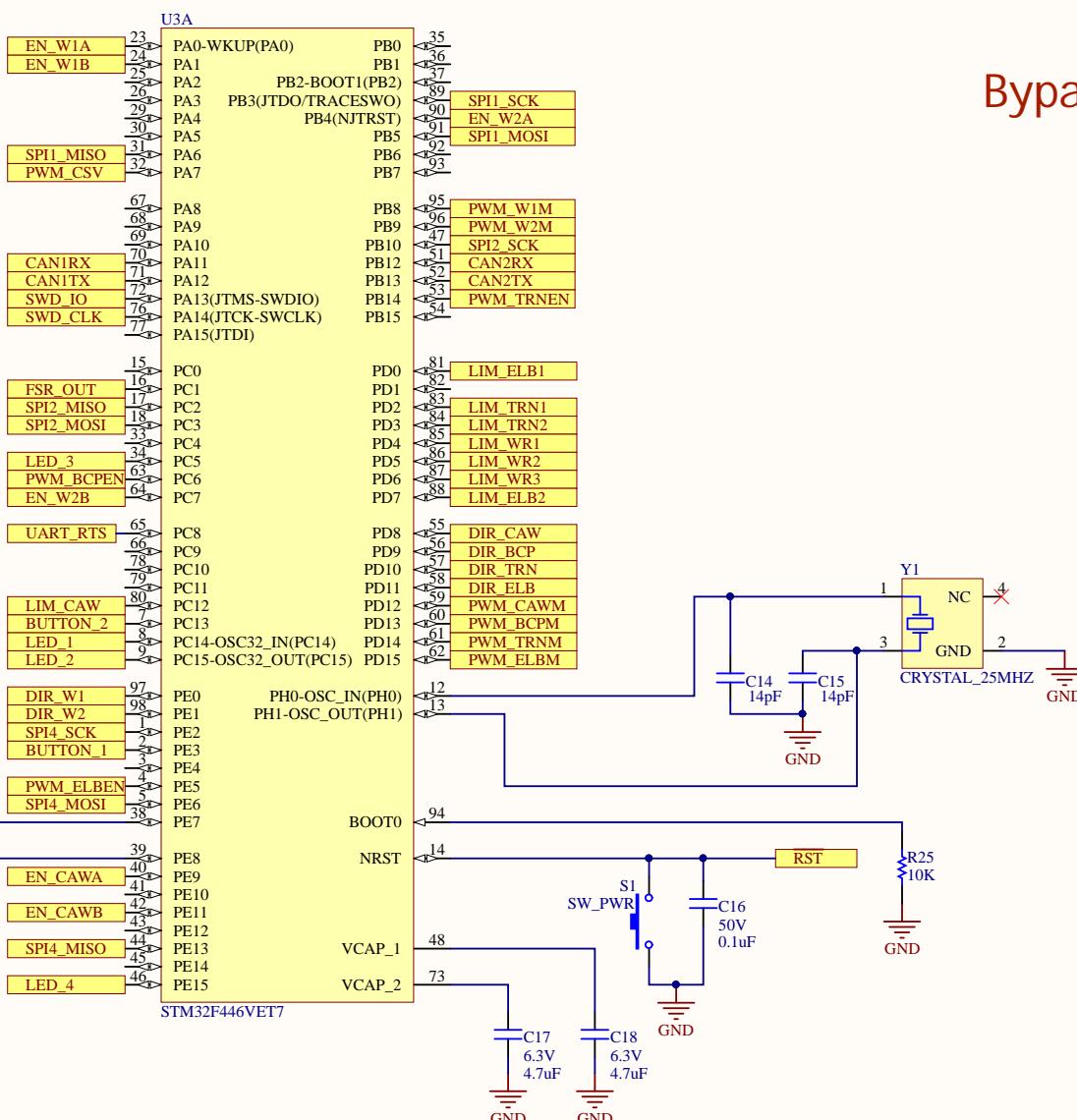
Date: 2020-02-01 | Sheet 3 of 9

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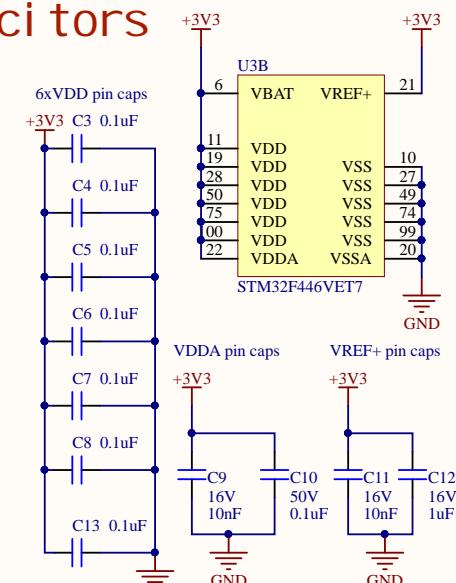
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STM32F446VET7



Bypass Capacitors



A

A

B

B

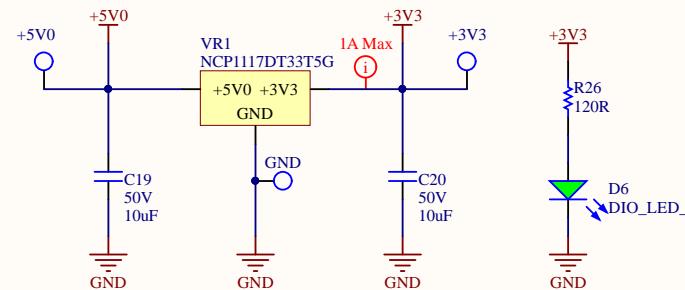
C

C

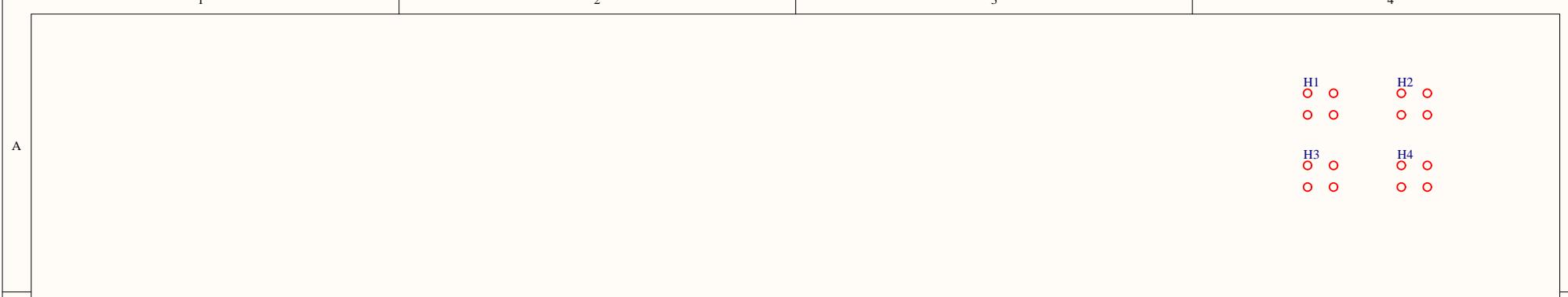
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D

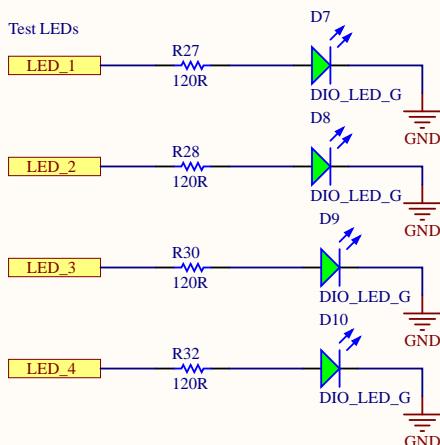
5V-3.3V LDO



Title: Arm - Power		UW Robotics
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Date: 2020-02-01	Sheet 5 of 9	
File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\sch\POWER.SchDoc		UW ROBOTICS TEAM

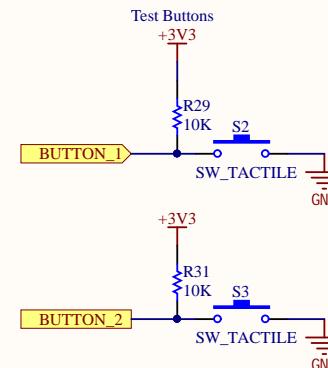


Test LEDs



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

Test Buttons



Title: Arm - Support		UW Robotics
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File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\sch\Support.SchDoc		UW ROBOTICS TEAM

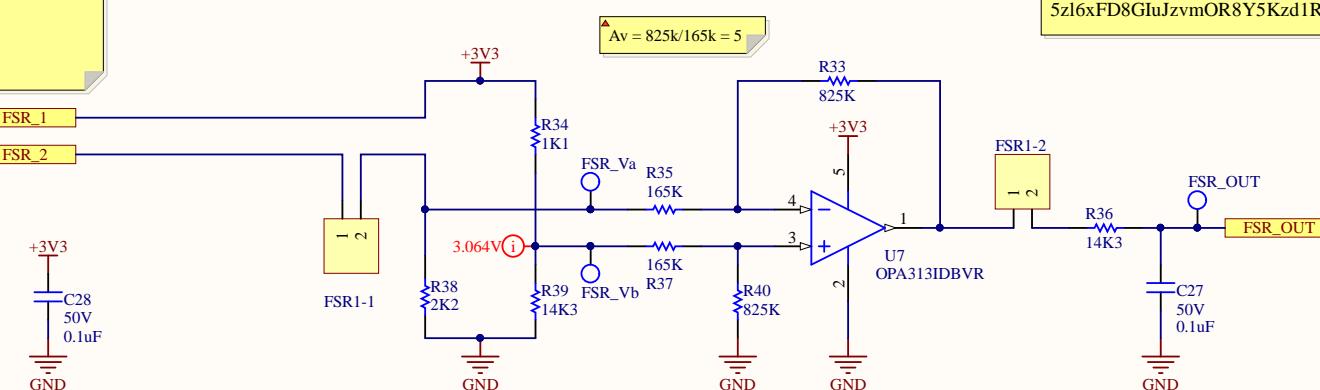
Force Sensitive Resistor

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:
 $f_c = 1/(2\pi f_1 \cdot 14.3k \cdot 0.1\mu F) = 111.30 \text{ Hz}$

Links to differential amplifier calculations and documentation
<https://docs.google.com/spreadsheets/d/1JzRwpCH-aMdlyAMp5zI6xFD8GluJzvmOR8Y5KzdIRN0/edit#gid=0>

B

+3V3
 C28 50V 0.1uF
 GND

FSR1-1

-

i

3.064V

R38
2K2

14K3

GND

FSR_Va

R35
165K

165K

R37

825K

GND

FSR_Vb

R40
825K

GND

FSR1-2

-

i

U7
OPA313IDBVR

1

2

3

4

5

GND

FSR_OUT

-

C

+3V3
 FSR_1
 FSR_2
 GND

+3V3
 C30 50V 0.1uF
 GND

FSR_BUFF

-

i

FSR2-1

-

GND_FSR

GND

GND

R42
1K

GND

GND

U8
CA3140AMZ

OFFSET NULL

IN+

V+

VOUT

OFFSET NULL

IN-

STROBE

V-

R41
14K3

GND

FSR_OUT

-

i

C29
50V 0.1uF

GND

D

R42 creates voltage
divider with FSR

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

Title: Arm - Claw Sensor

Size: Letter

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

Date: 2020-02-01

Sheet 7 of 9

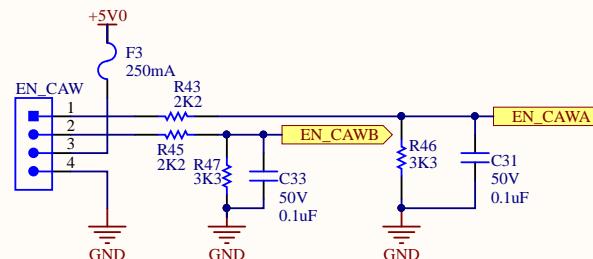
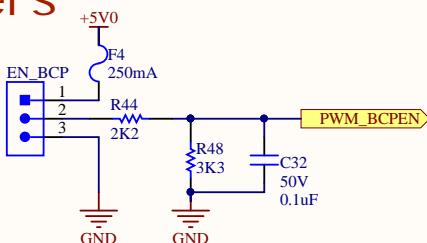
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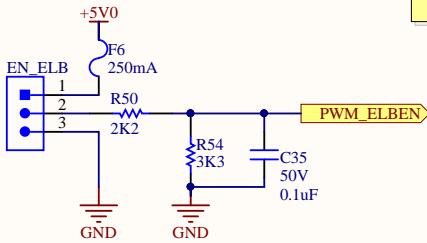
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PWM Encoders

A

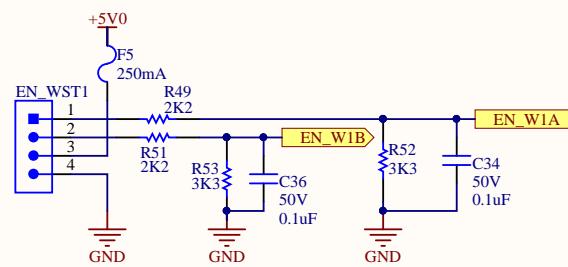


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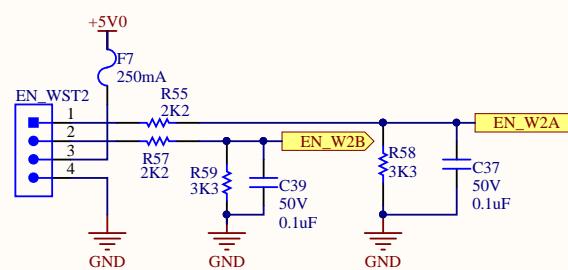
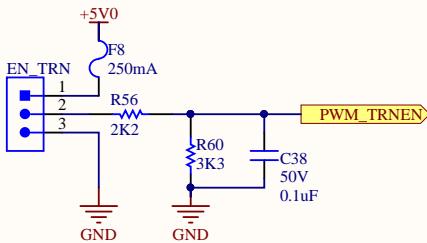


Low pass filter cut-off frequency:
 $f_c = 1/(2\pi \cdot 3.3k \cdot 0.1\mu F) = 482.29 \text{ Hz}$

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



C



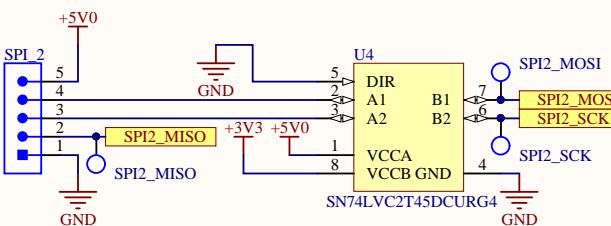
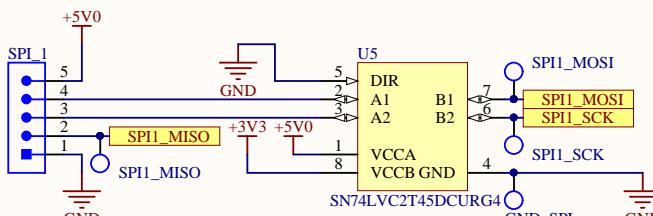
D

Title: Arm - PWM Encoders		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: K. Hong		
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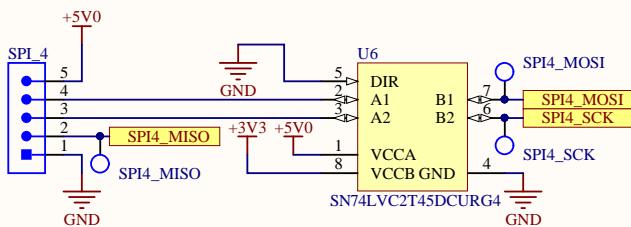
A

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

