

A

A

Arm Block Diagram

B

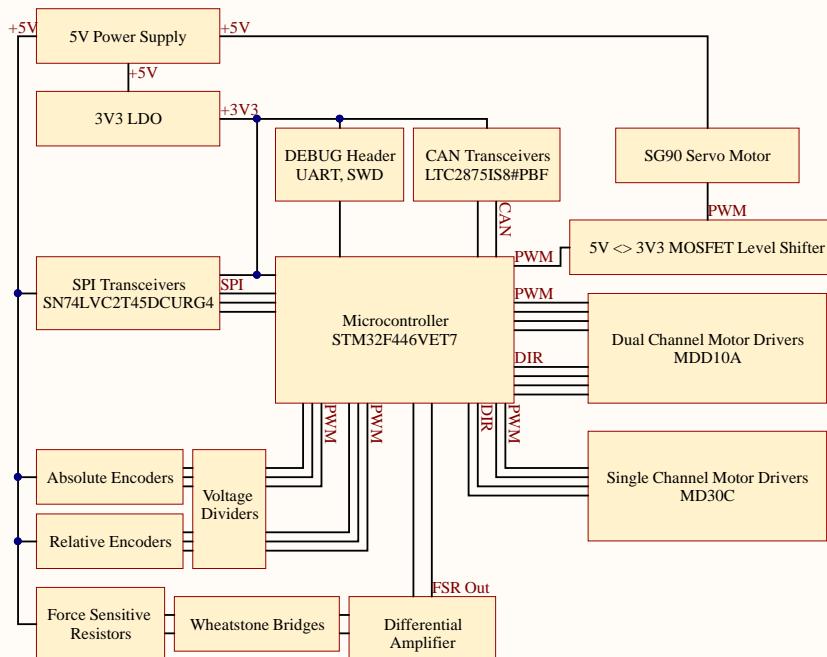
B

C

C

D

D



Title: Arm - Block Diagram

Size: Letter | Drawn By: K. Hong

Date: 2020-02-02

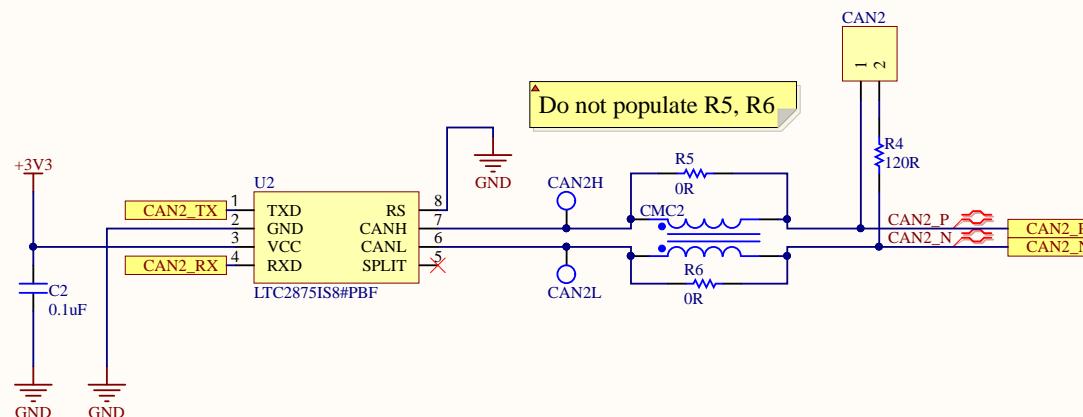
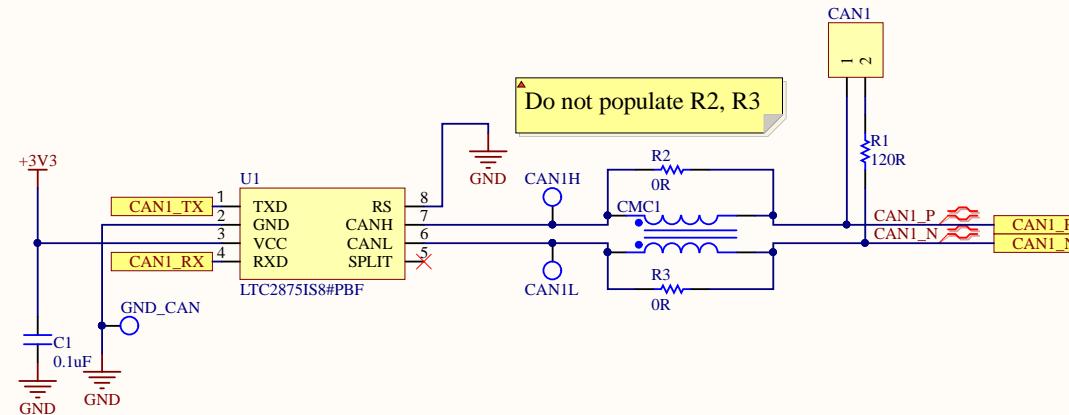
Sheet1 of 9

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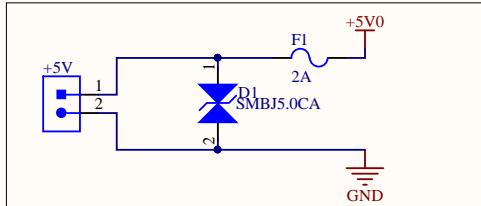
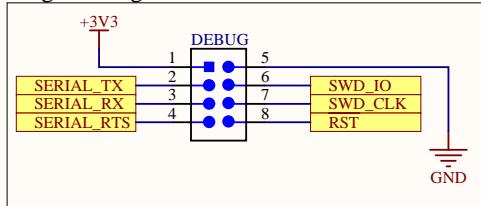
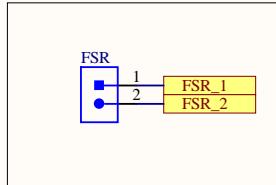
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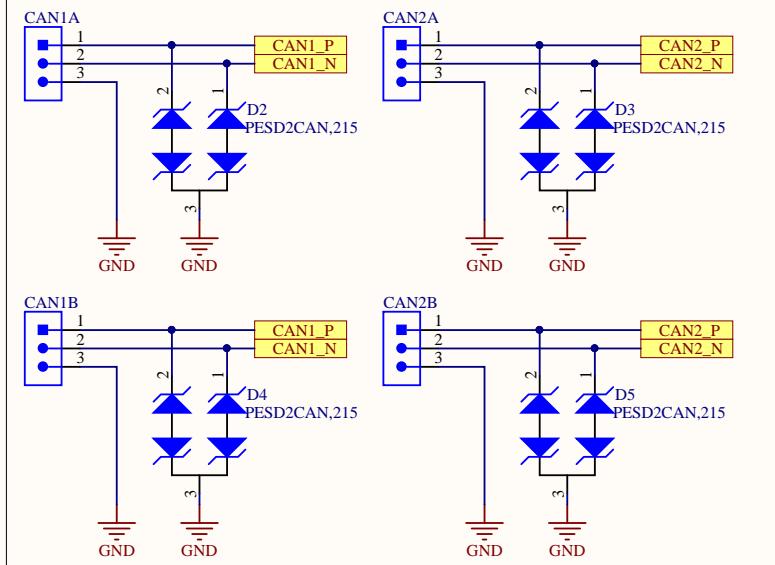
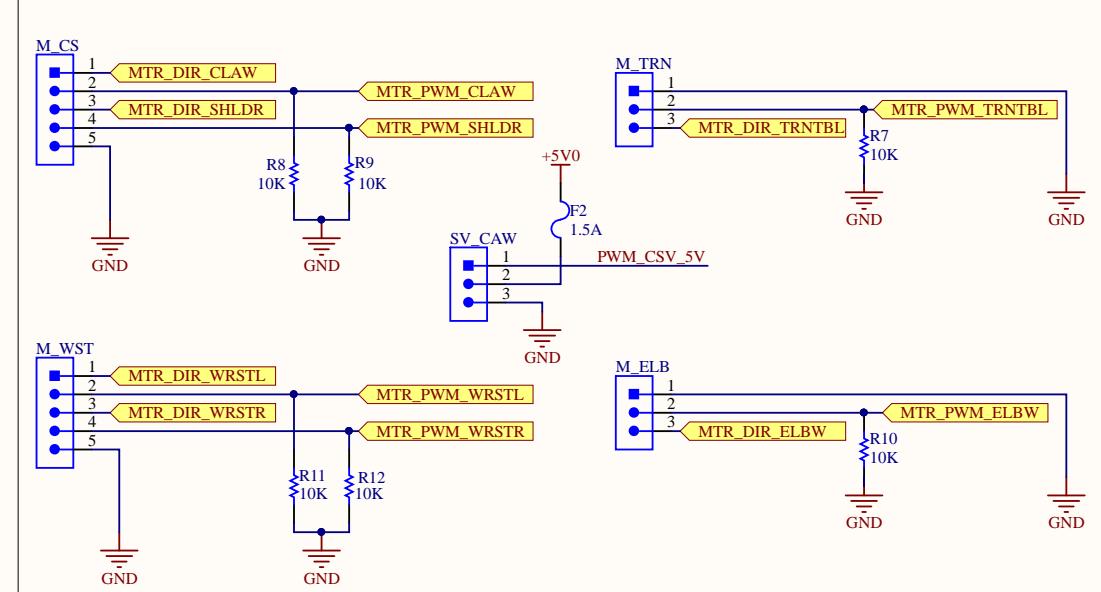
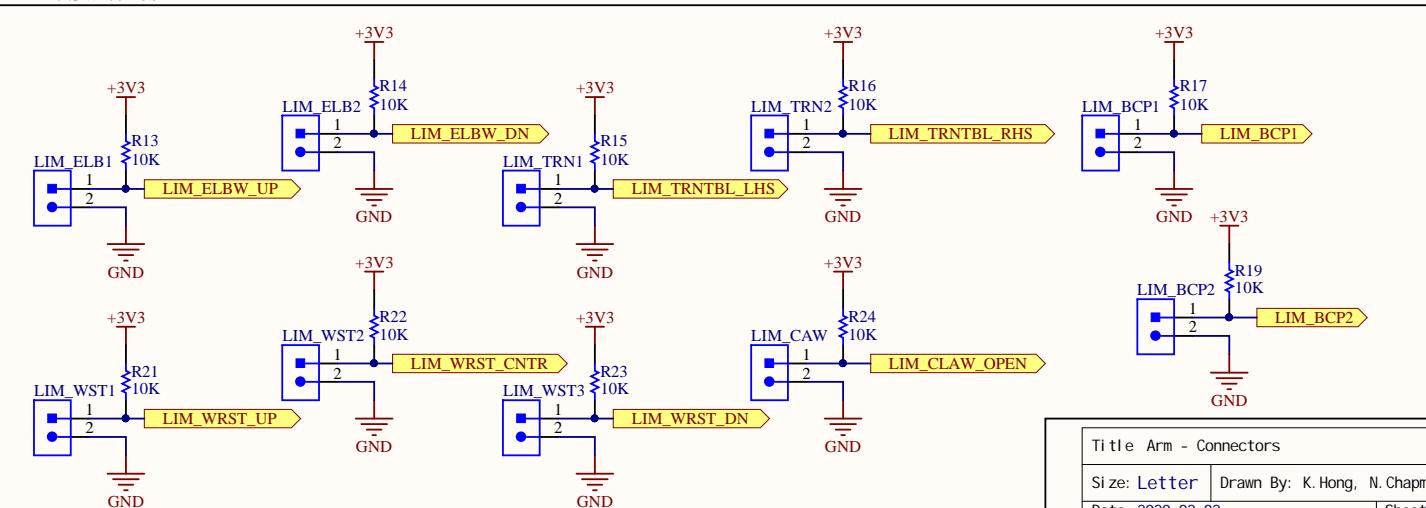
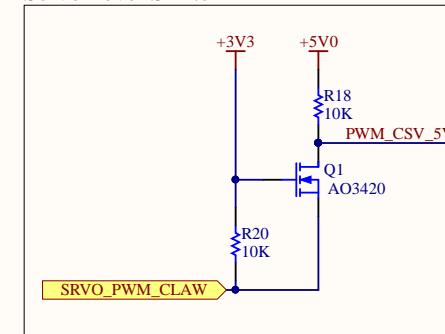
CAN Transceivers



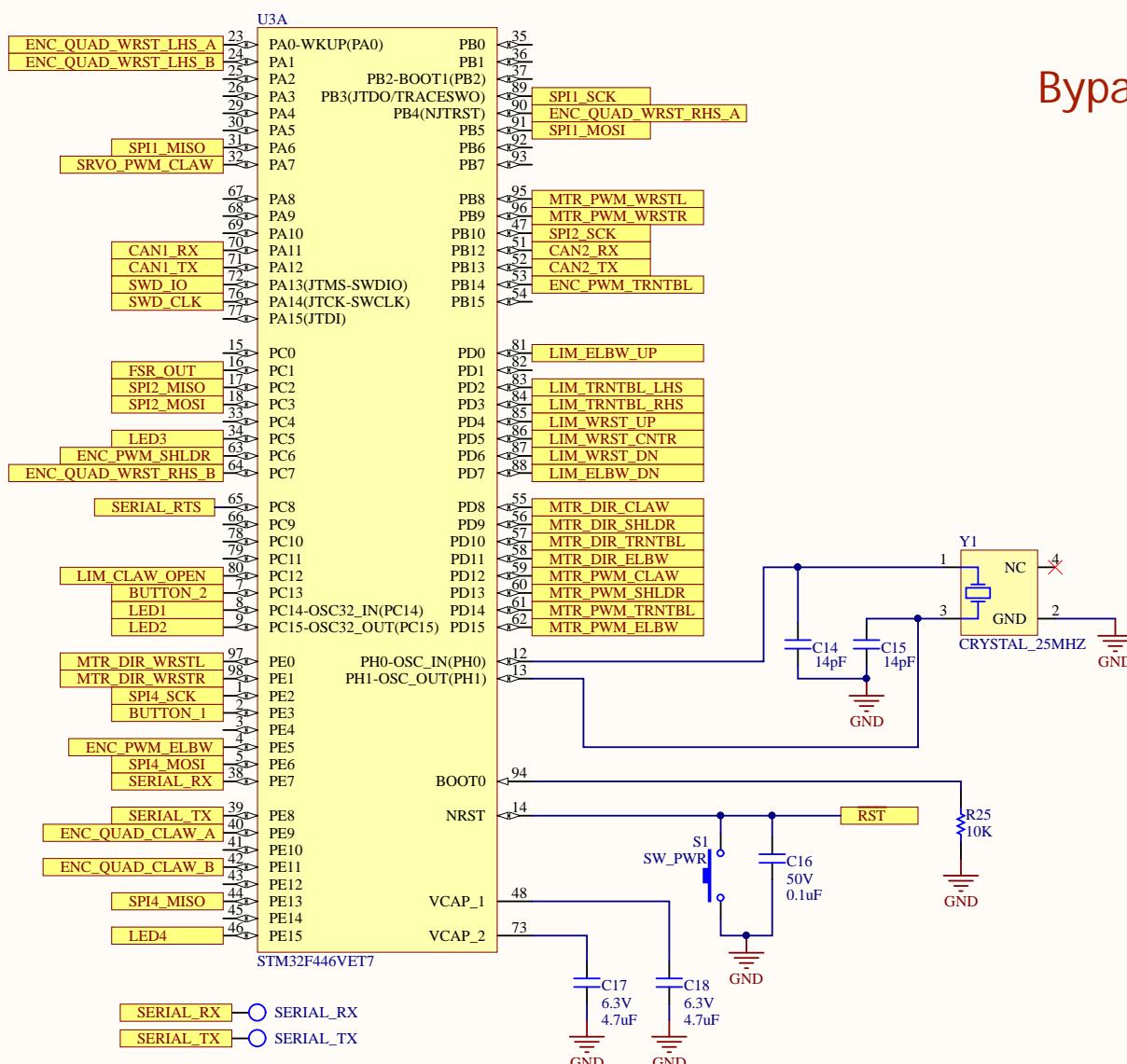
Title: Arm - CAN Transceivers		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter		Drawn By: P. Onai fo, K. Hong	
Date: 2020-02-02		Sheet 2 of 9	
File: C:\Users\lance\Desktop\MarsRover2020-PCB\Projects\Arm\Rev1\sch\CAN.SchDoc			

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

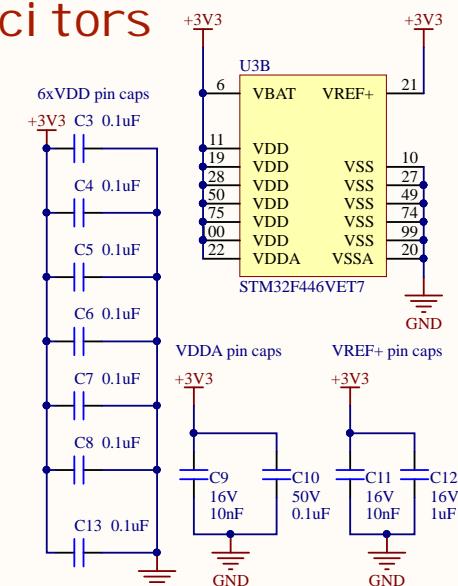
Acronyms Explained
FSR: Force Sensitive Resistor
CAW: Claw
WST: Wrist
BCP: Bicep (Shoulder)
ELB: Elbow
TRN: Turntable
DIR: Direction for motors

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

STM32F446VET7



Bypass Capacitors



A

A

B

B

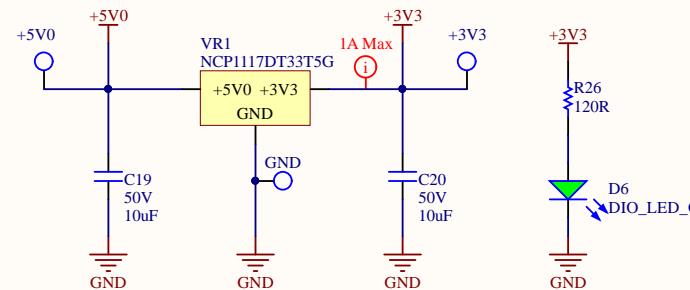
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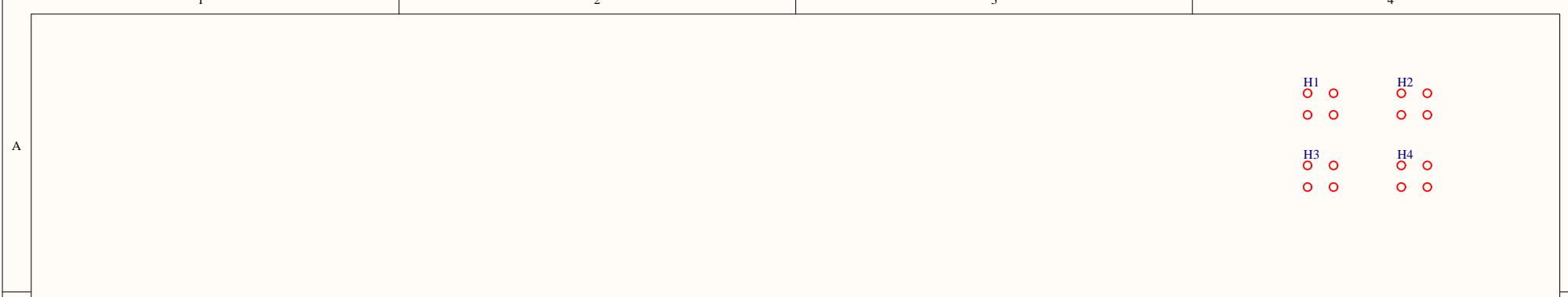
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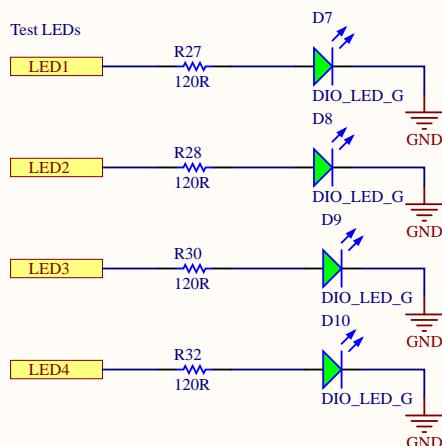
5V-3.3V LDO



Title: Arm - Power		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
Size: Letter	Drawn By: K. Hong		
Date: 2020-02-02	Sheet 5 of 9		
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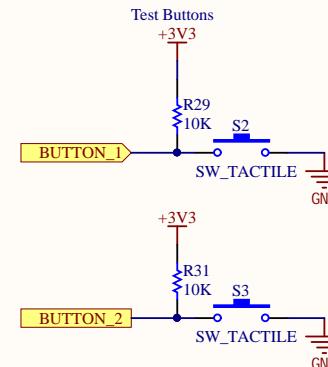


Test LEDs



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

Test Buttons



Title: Arm - Support		UW Robotics 200 University Avenue Waterloo Ontario Canada N2L 3G6	UW ROBOTICS TEAM
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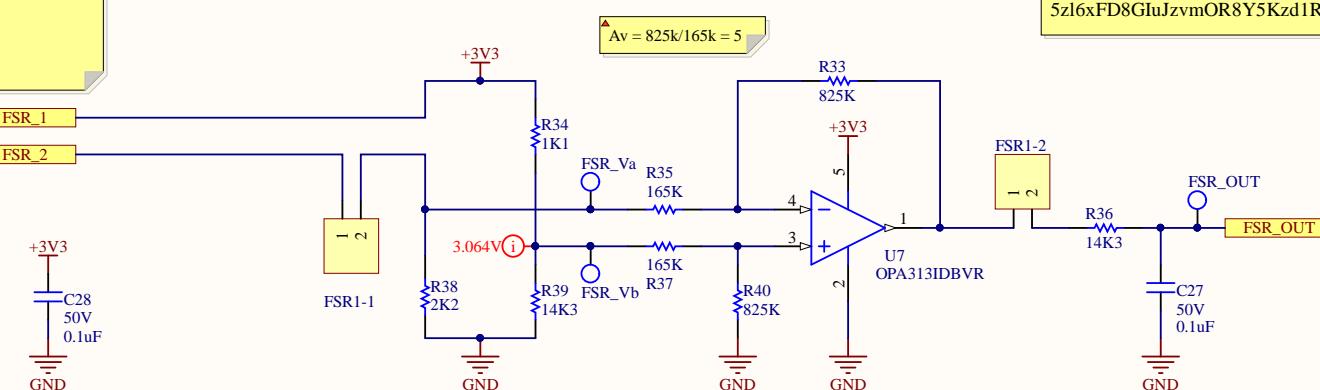
Force Sensitive Resistor

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

R38 2K2
 R39 14K3
 GND

3.064V(i)
 FSR_Va
 FSR_Vb
 R37 165K
 R40 825K
 GND

Av = 825k/165k = 5

R33 825K
 +3V3
 GND

FSR1-2

GND

1

2

3

4

5

6

7

8

FSR_OUT
 FSR_OUT

GND

14K3

C27
 50V
 0.1uF
 GND

C

+3V3
 FSR_1
 FSR_2
 GND

+3V3
 C30 50V 0.1uF
 GND

FSR_BUFF

FSR2-1

GND_FSR

R42 1K
 GND

R42 creates voltage
 divider with FSR

U8
 OFFSET NULL STROBE
 IN- IN+ V+ VOUT
 OFFSET NULL
 CA3140AMZ

FSR2-2

GND

R41 14K3

FSR_OUT
 FSR_OUT

GND

14K3

C29
 50V
 0.1uF
 GND

D

Title: Arm - Claw Sensor

Size: Letter

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

Date: 2020-02-02

Sheet 7 of 9

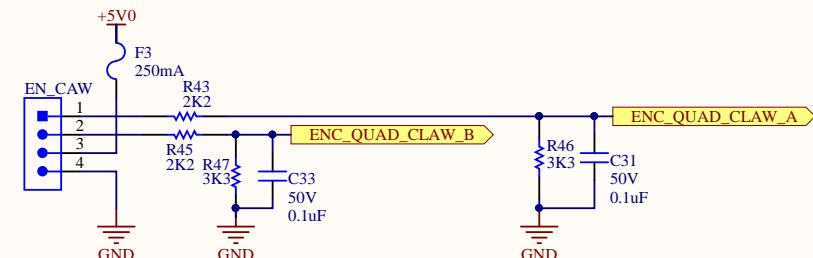
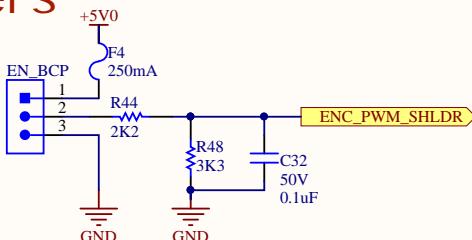
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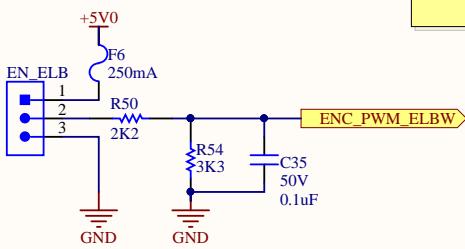
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PWM Encoders

A

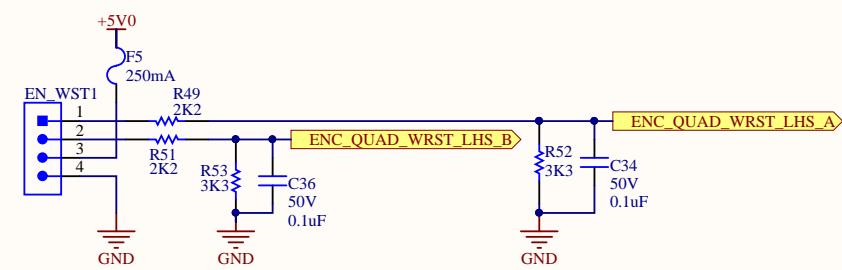


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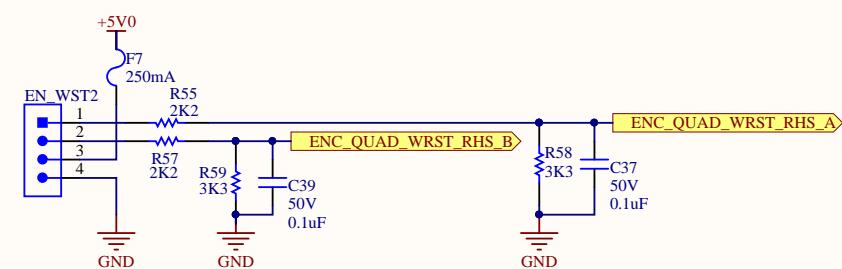
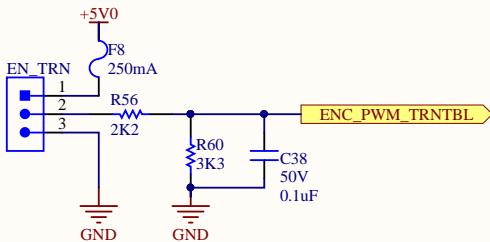


Low pass filter cut-off frequency:
 $f_c = 1/(2\pi \cdot 3.3k \cdot 0.1u) = 482.29 \text{ Hz}$

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



C



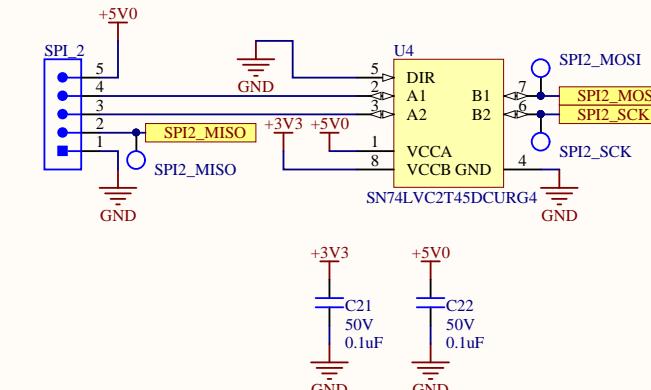
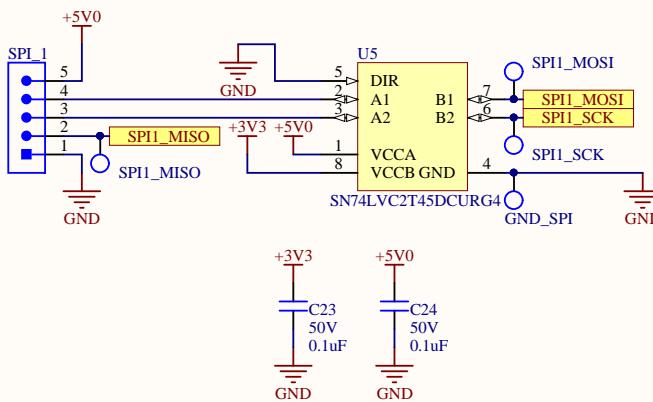
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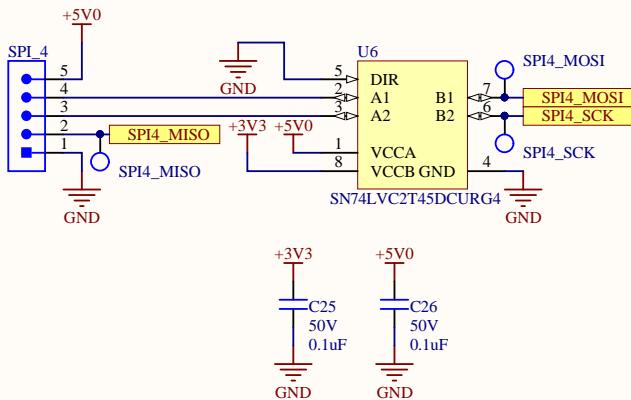
A

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

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