

A

A

Arm Block Diagram

B

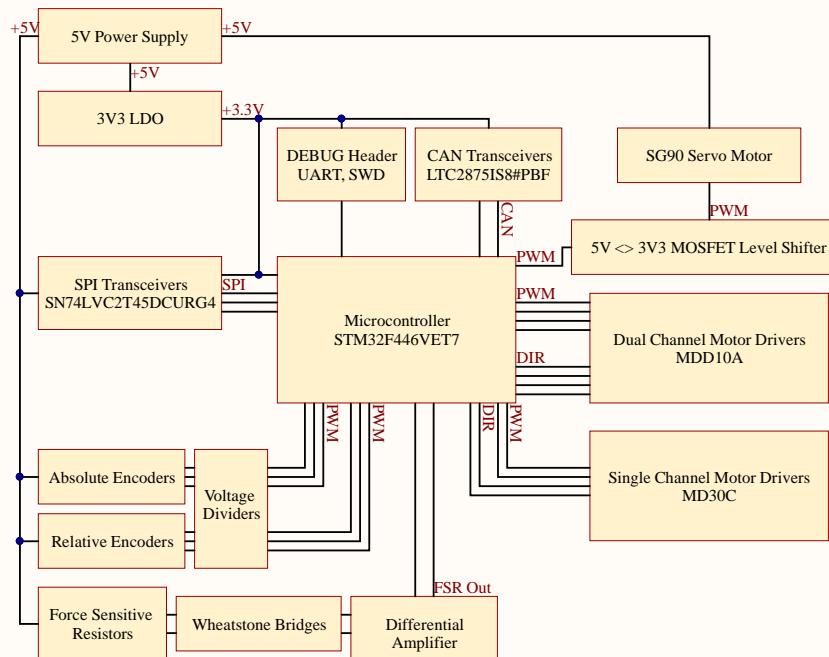
B

C

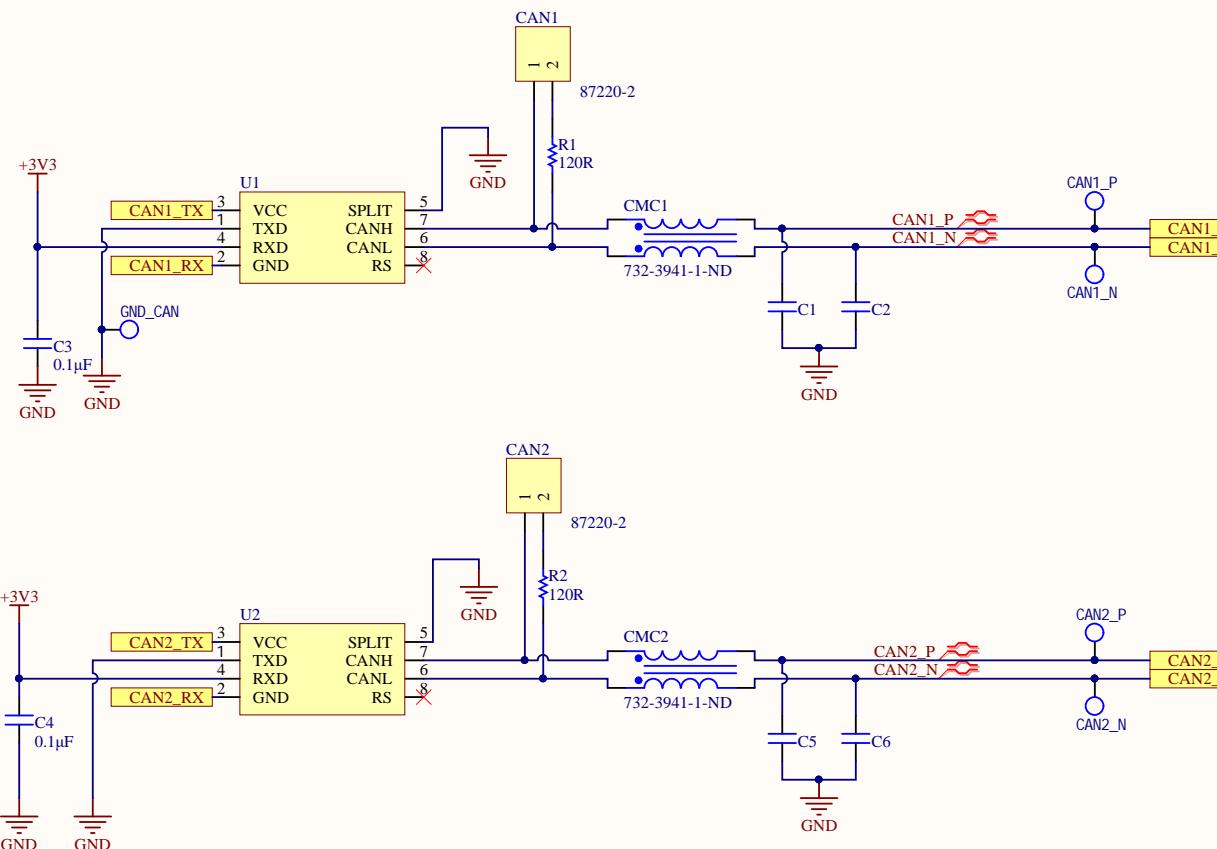
C

D

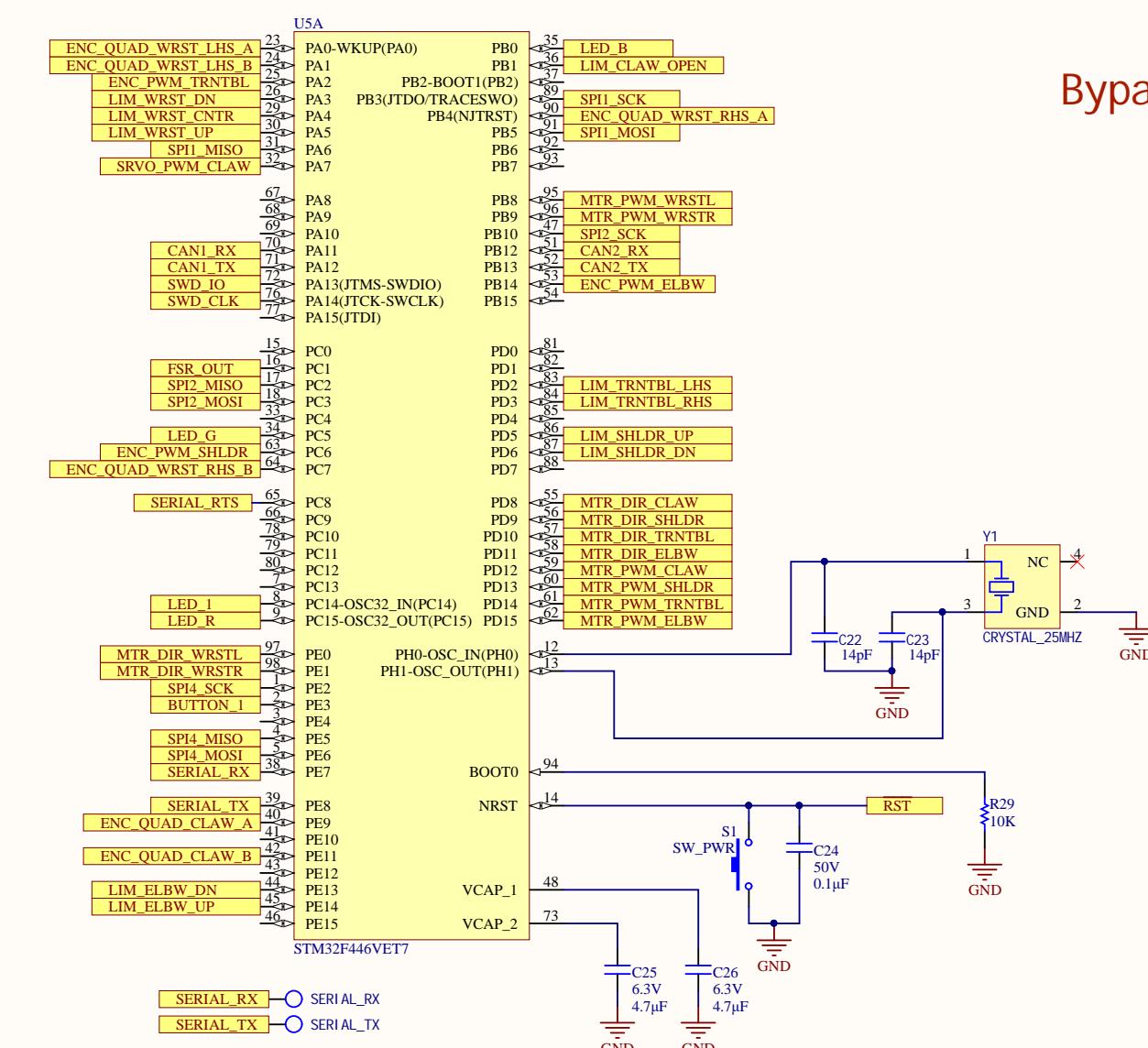
D



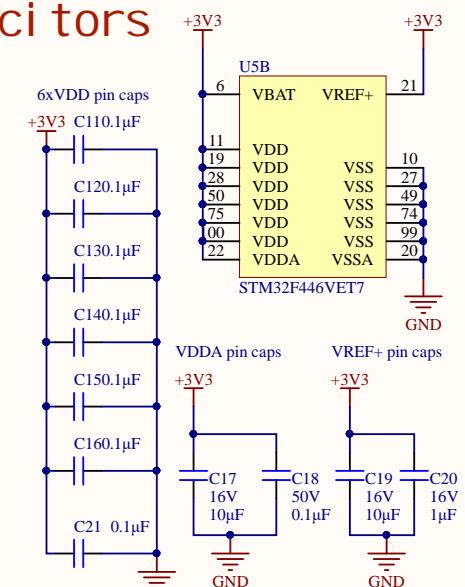
CAN Transceivers



STM32F446VET7



Bypass Capacitors



A

A

B

B

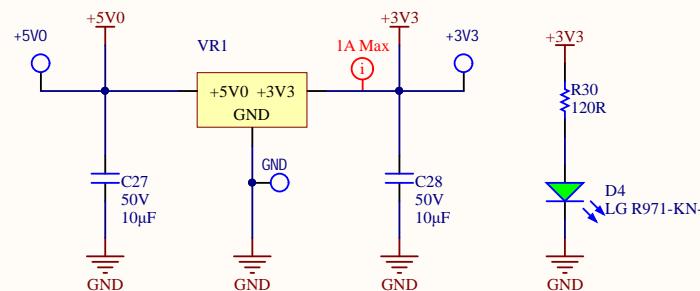
C

C

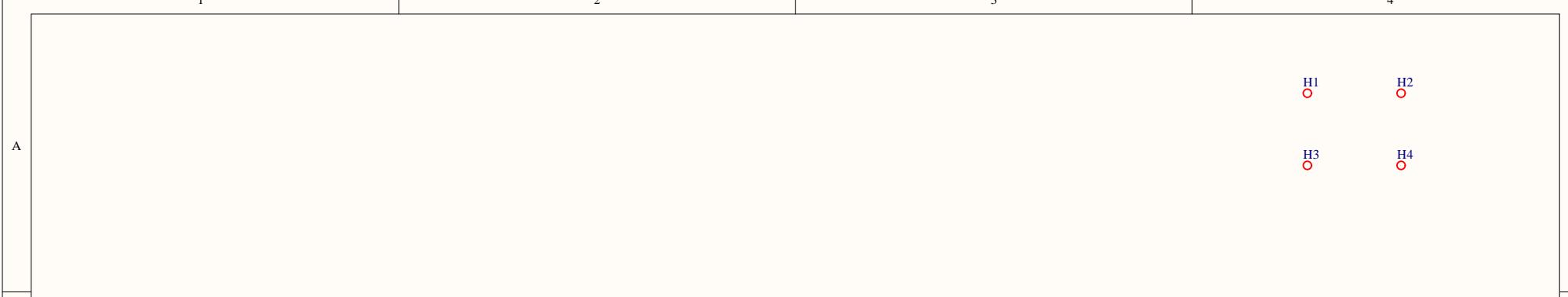
D

D

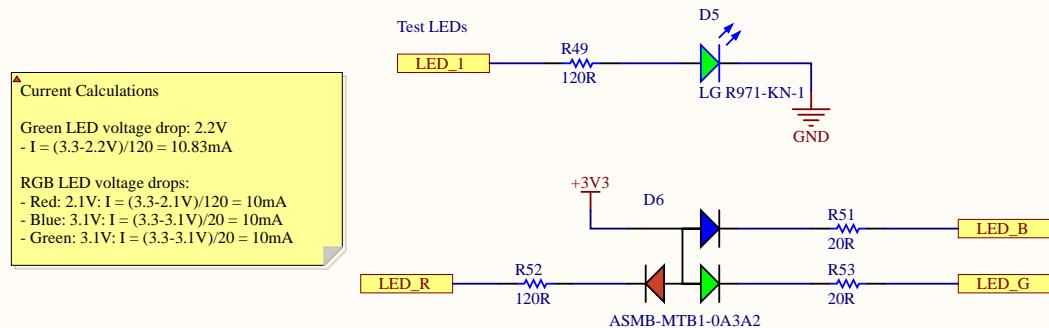
5V-3.3V LDO



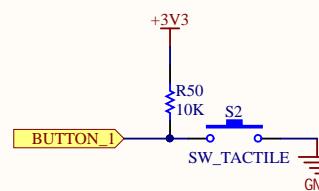
Current Calculations
Green LED voltage drop: 2.2V
- $I = (3.3-2.2V)/120 = 10.83mA$



Test LEDs



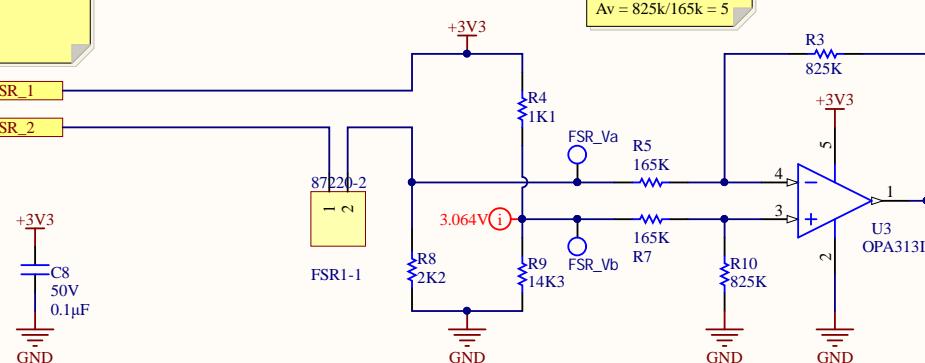
Test Button



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:
 $A_v = 825k/165k = 5$

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>

B

+3V3
 C8 50V 0.1μF
 GND

FSR1-1

87220-2

3.064V(i)

FSR_Vb

R9 14k3

R8 2k2

GND

R5 165k

R7 165k

R10 825k

GND

R3 825k

+3V3

FSR1-2

87220-2

FSR_OUT

U3 OPA131IDBVR

1 2 3 4 5

C

+3V3
 FSR_1
 FSR_2
 GND

FSR_BUFF

87220-2

1 2 3 4

FSR2-1

87220-2

FSR2-2

U4

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

CA3140AMZ

1 2 3 4 5 6 7 8

GND_FSR

R11 14k3

FSR_OUT

C9 50V 0.1μF

LSB = 3.3V/(2^12-1)
 = 805.86 μV

D

R42 creates voltage divider with FSR

Title: Arm - Claw Sensor

Size: Letter

Date: 2020-06-02

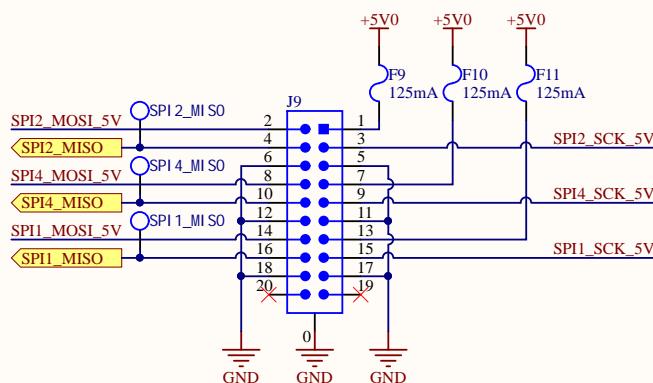
File: C:\Users\pkmn0\Desktop\Document Archive\Other\Electrical Git Repo\MarsRover2020-PCB\Projects\Arm\Rev2\FSR.SchD

UW Robotics
Waterloo Ontario Canada N2L 3G6

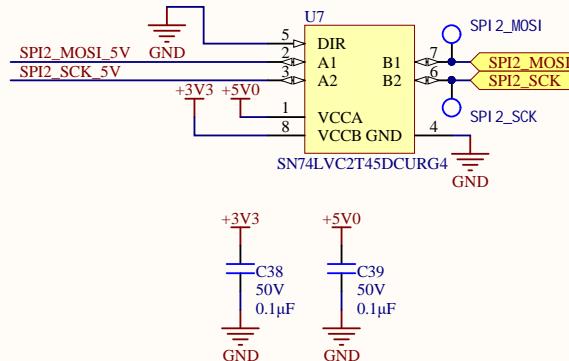
TEAM

A

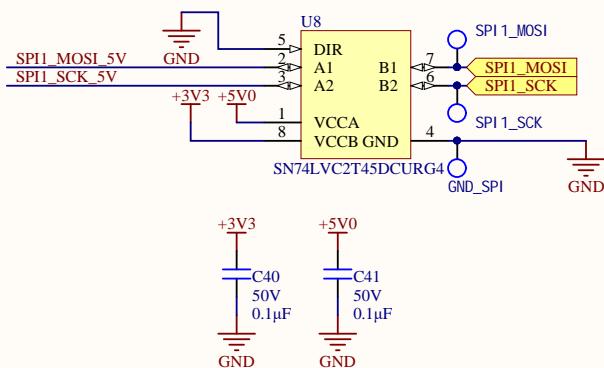
SPI Encoders



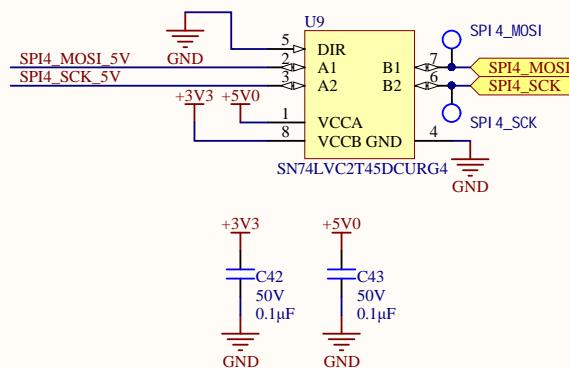
B



C



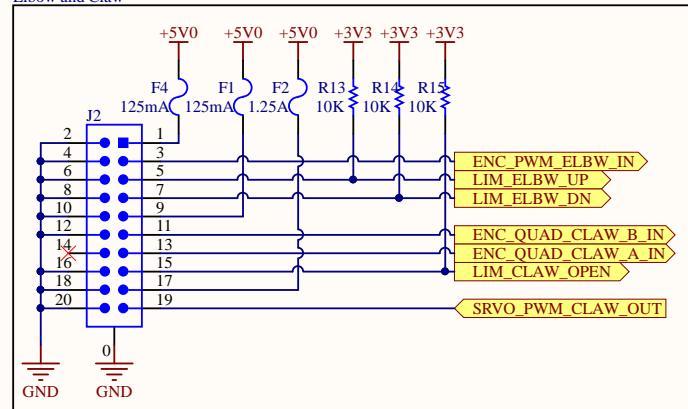
D



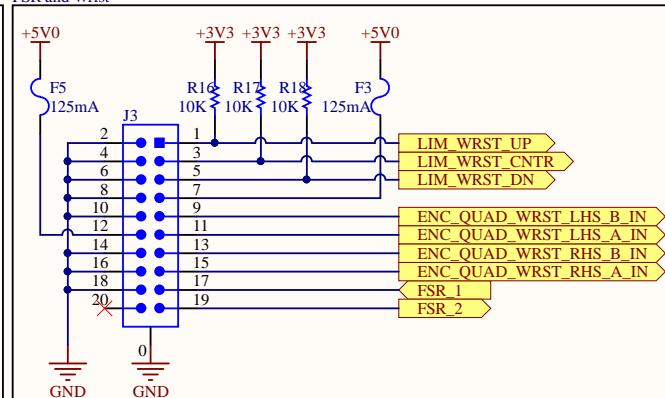
Encoder manufacturer: Broadcom
Encoder part number: AEAT-6012-A06
Did not level shift MISO signals since the STM32 SPI peripheral is 5V tolerant

Consolidated Connectors

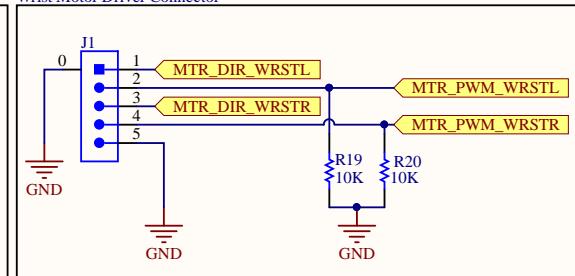
Elbow and Claw



FSR and Wrist



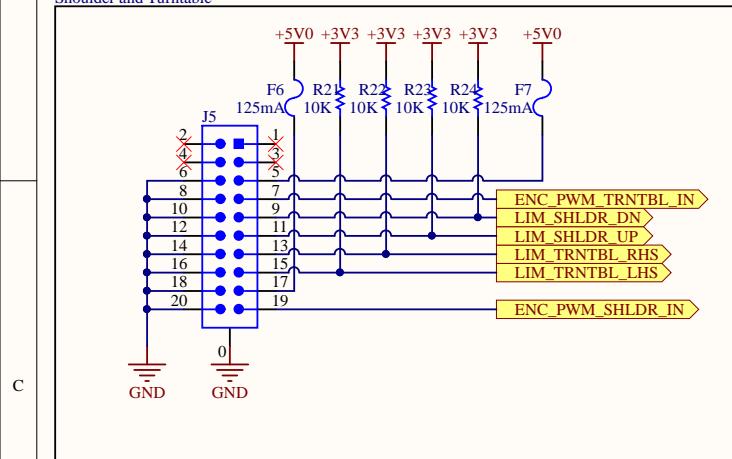
Wrist Motor Driver Connector



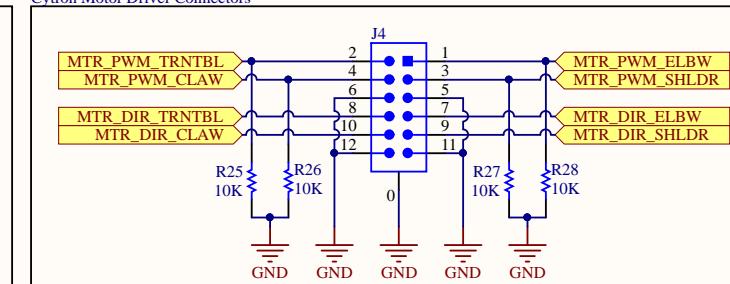
A

A

Shoulder and Turntable

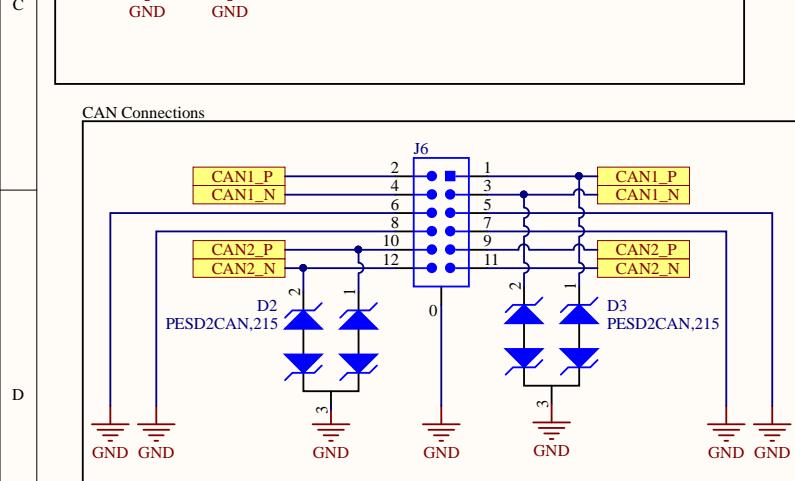


Cytron Motor Driver Connectors

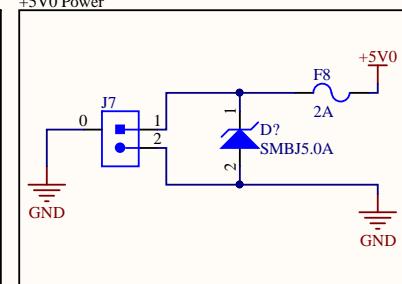


B

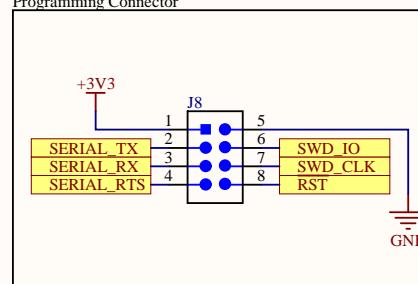
CAN Connections



+5V0 Power



Programming Connector



Acronyms Explained
 FSR: Force Sensitive Resistor
 CLAW: Claw
 WRST: Wrist
 SHLDR: Shoulder
 ELBW: Elbow
 TRNTBL: Turntable
 DIR: Direction for motors

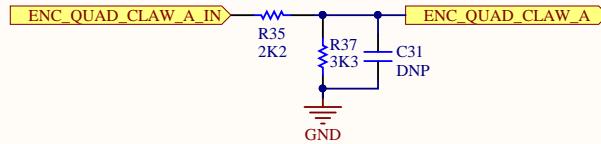
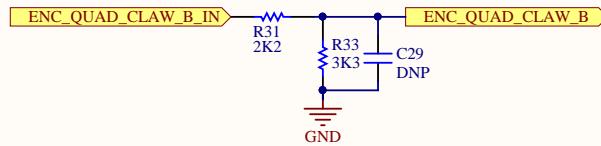
C

C

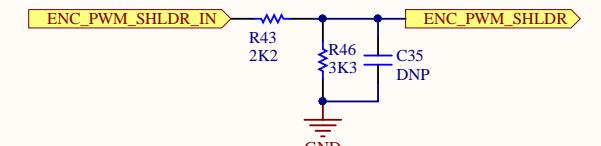
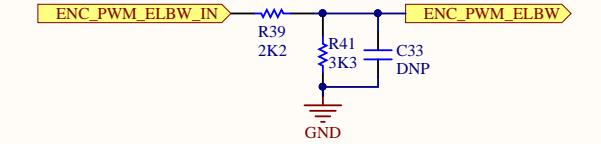
Servo motor and PWM Encoders

A

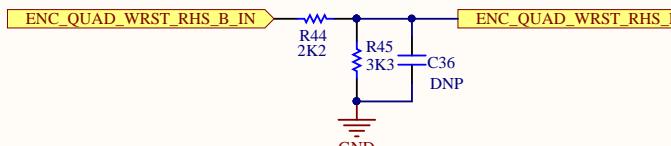
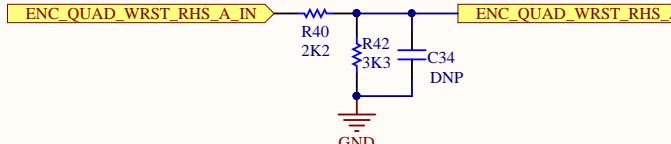
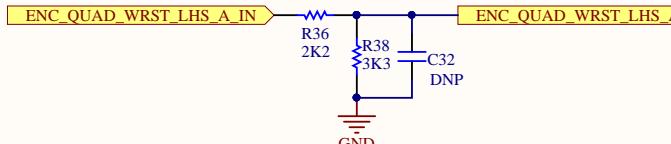
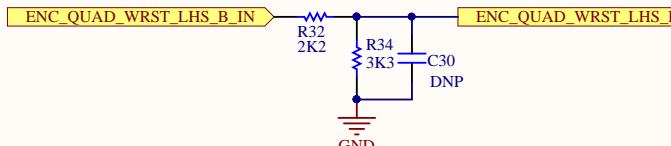
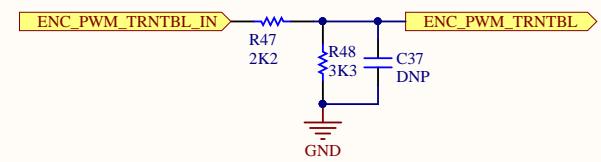
Encoder RC filter & Voltage divider



B



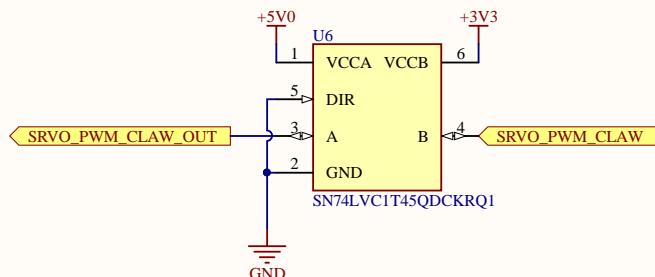
C



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

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

Servo level shifter



▲ To do:
 Spec RC filter capacitor for encoder outputs and redo calculation
 Add filter to level shifter io?

Title *	*	*
Size: Letter	Drawn By: Kyle Hong	*
Date: 2020-06-02	Sheet* of *	*
File: C:\Users\pkmn0\Desktop\Document Archive\Other\Electrical Git Repo\MarsRover2020-PCB\Projects\Arm\Rev2\Servo an		



