

A

A

Arm Block Diagram

B

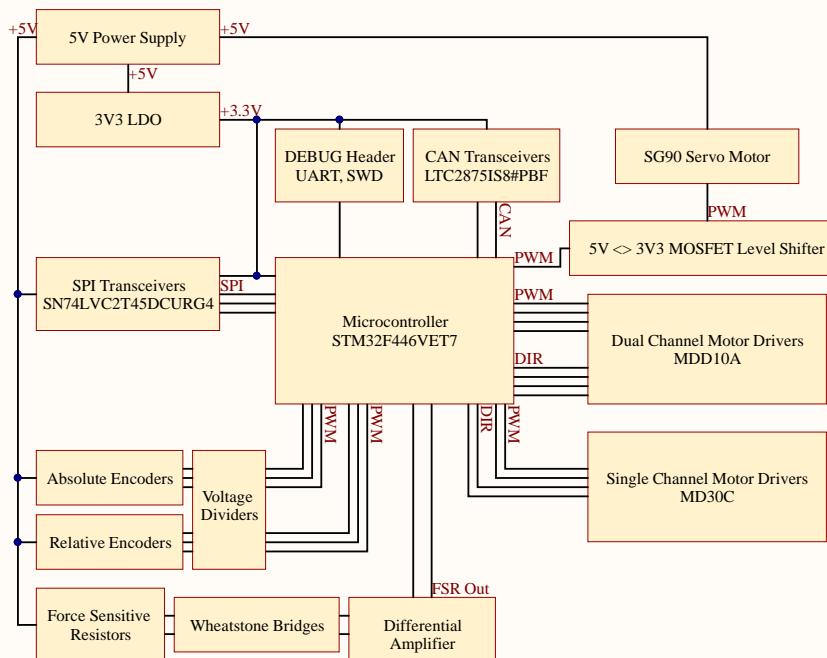
B

C

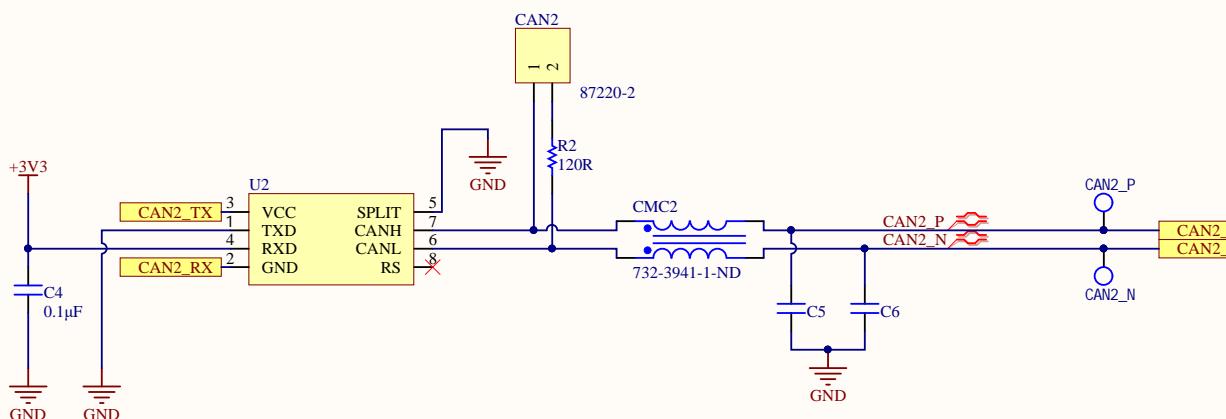
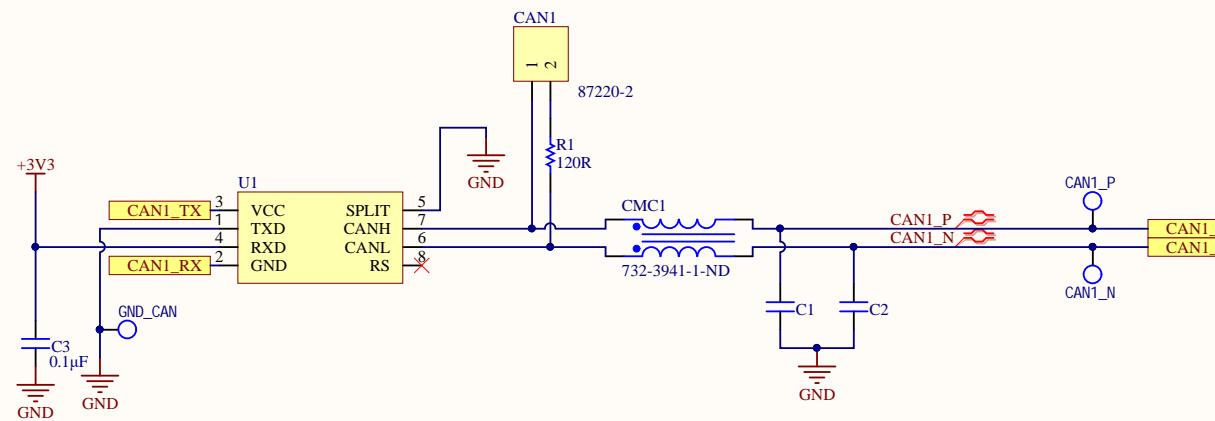
C

D

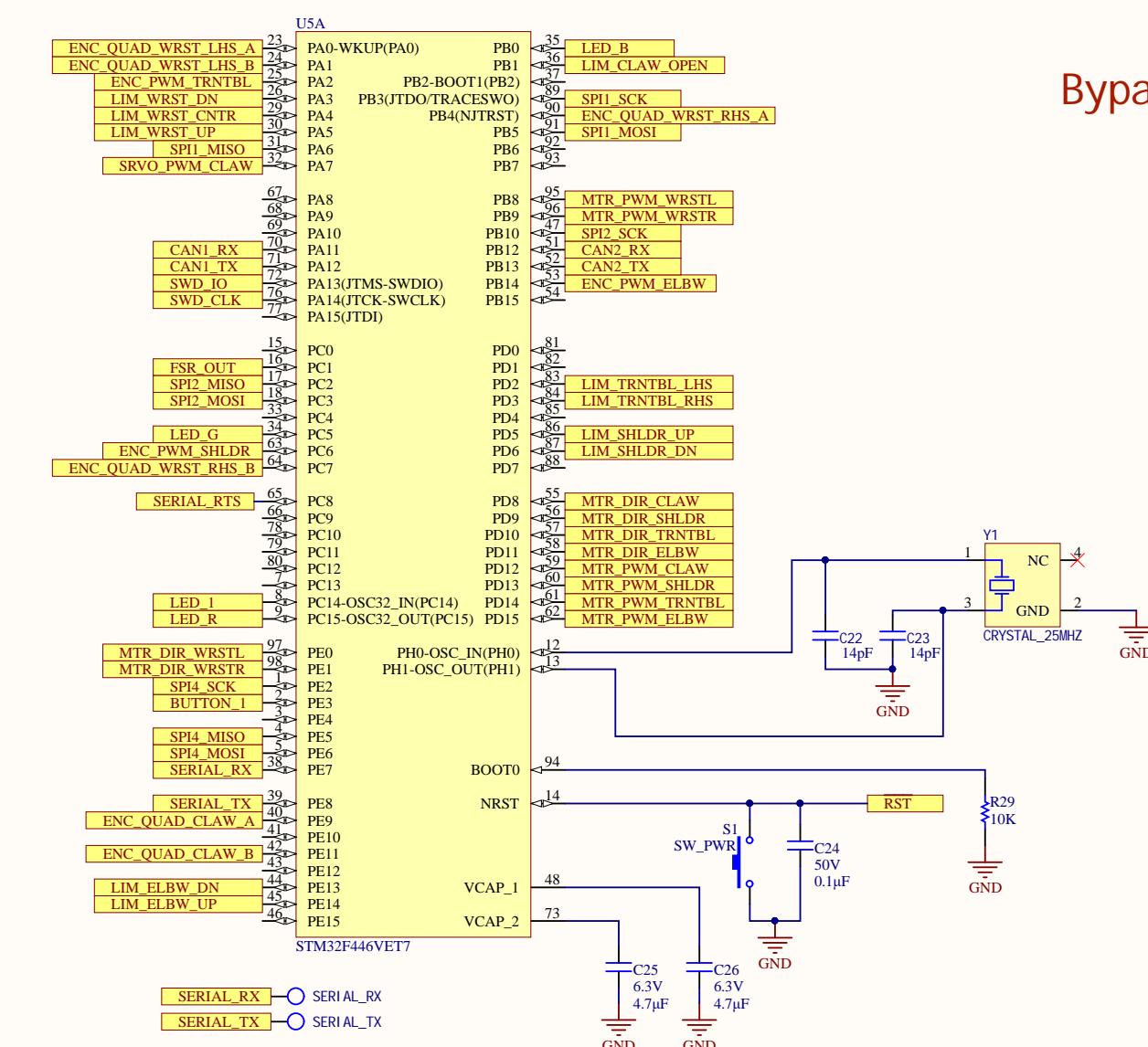
D



CAN Transceivers



STM32F446VET7



A

A

B

B

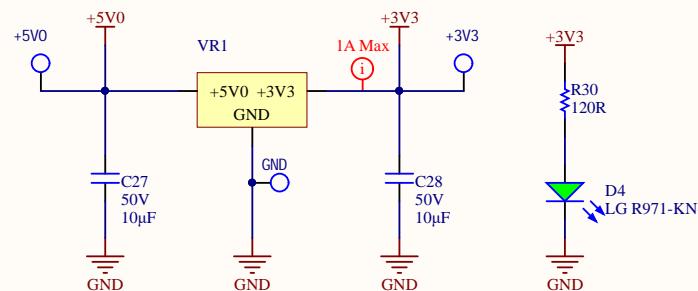
C

C

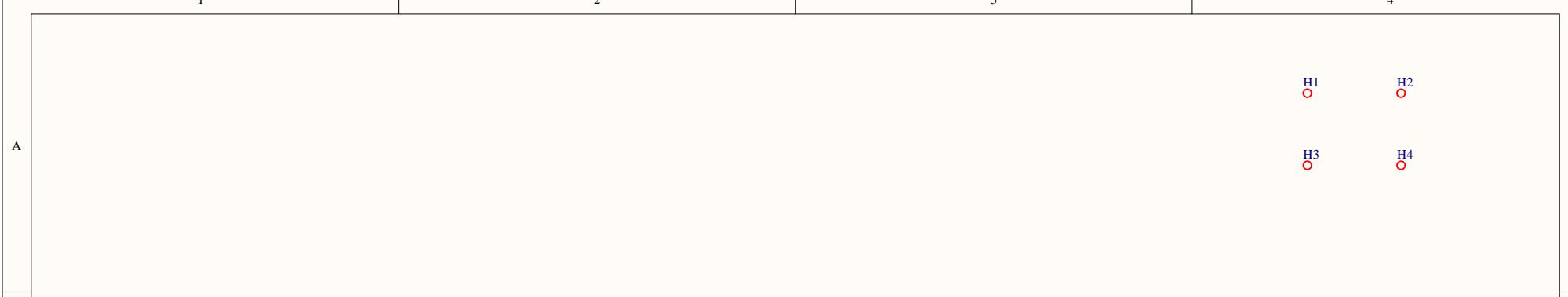
D

D

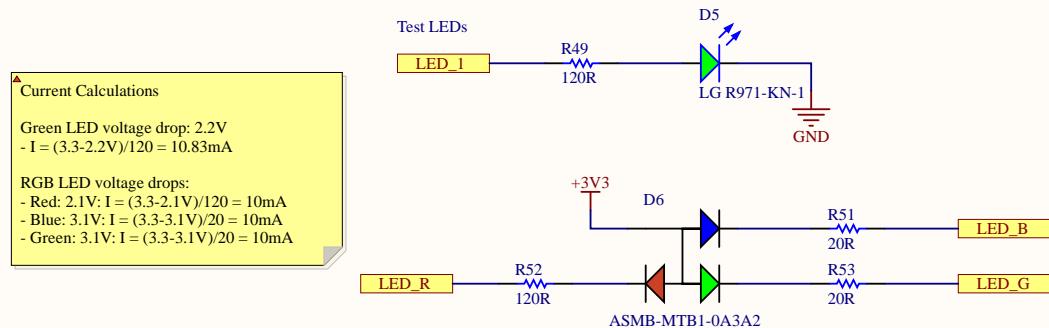
5V-3.3V LDO



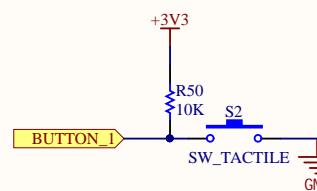
Current Calculations
Green LED voltage drop: 2.2V
- $I = (3.3-2.2V)/120 = 10.83mA$



Test LEDs



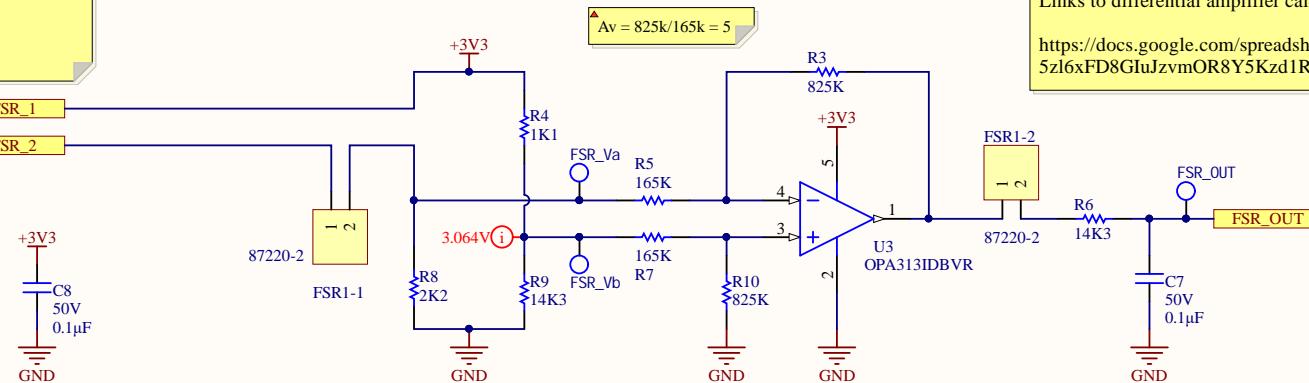
Test Button



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

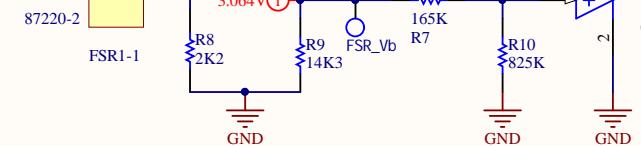
Wheatstone bridge voltage output values:
 At 20N, Vout = 3.2V
 At 100N, Vout = 0.5V

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

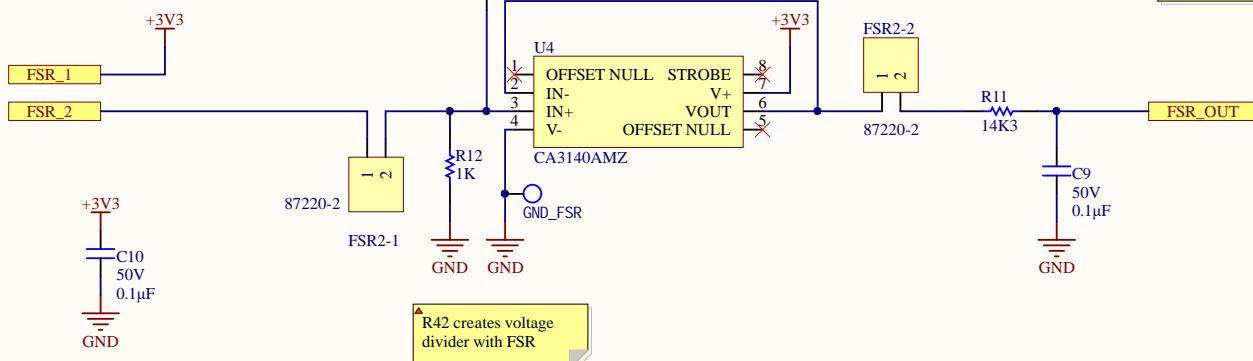
Links to differential amplifier calculations and documentation
<https://docs.google.com/spreadsheets/d/1JzRwpCH-aMdlyAMP5zl6xFD8GluJzvmOR8Y5Kzd1RN0/edit#gid=0>

B
 $+3V3$
 $C8$ 50V 0.1μF
 GND

FSR1-1



Buffer



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

$+3V3$
 $C10$ 50V 0.1μF
 GND

FSR2-1

R42 creates voltage
 divider with FSR

C
 $+3V3$
 $C10$ 50V 0.1μF
 GND

U4
 OFFSET NULL STROBE
 IN- IN+ V+ VOUT OFFSET NULL
 CA3140AMZ

Title

Arm - Claw Sensor

UW Robotics

200 University Avenue
 Waterloo
 Ontario
 Canada N2L 3G6

ROBOTICS
 TEAM

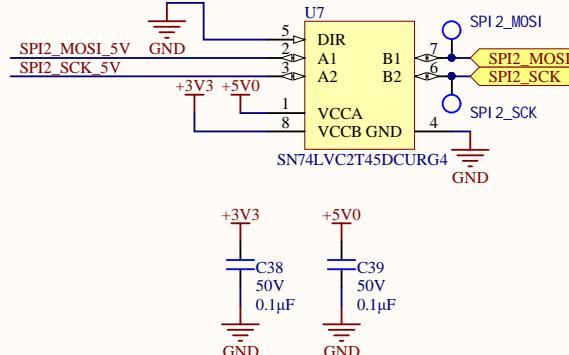
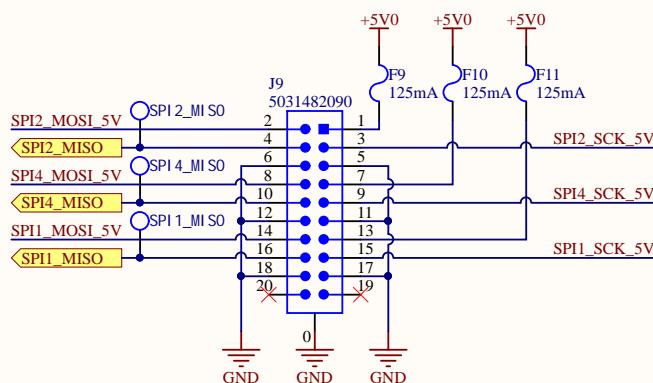
Size: Letter Drawn By: N. Chapman, A. Ebrahimi, K. Hong

Date: 2020-06-02 Sheet 7 of 9

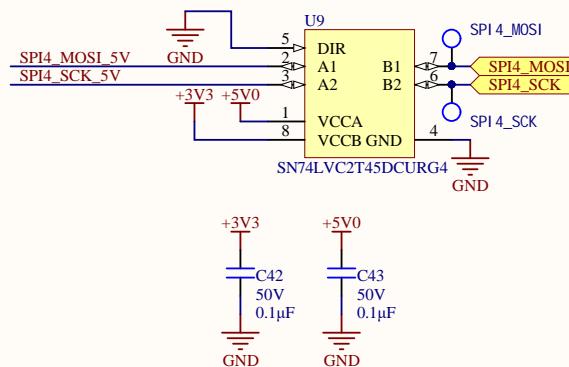
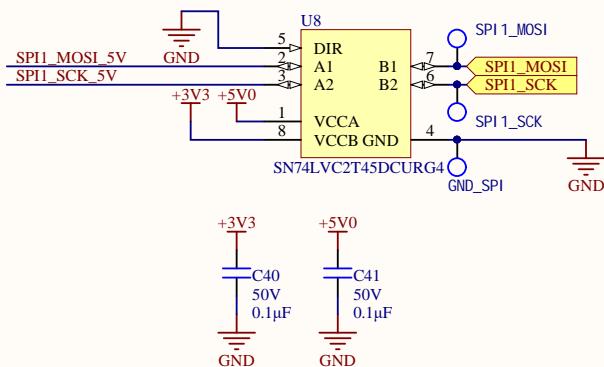
File: C:\Users\pkmn0\Desktop\Document Archive\Other\Electrical Git Repo\MarsRover2020-PCB\Projects\Arm\Rev2\FSR.SchD

A

SPI Encoders



B



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

A

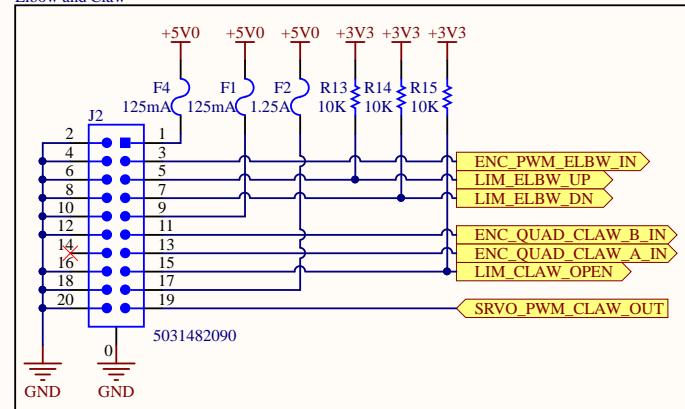
B

C

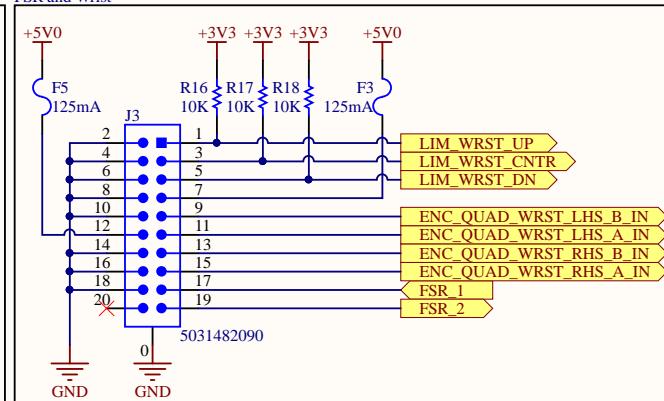
D

Consolidated Connectors

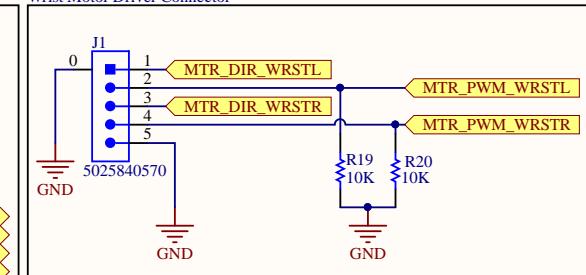
Elbow and Claw



FSR and Wrist



Wrist Motor Driver Connector



A

A

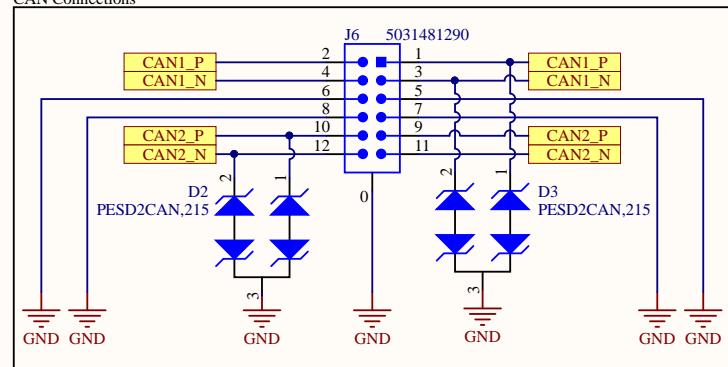
B

B

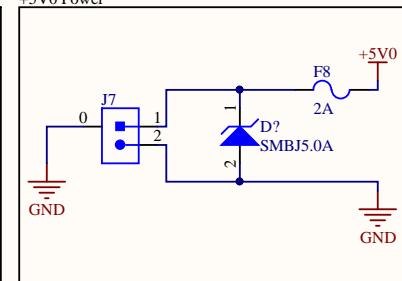
C

C

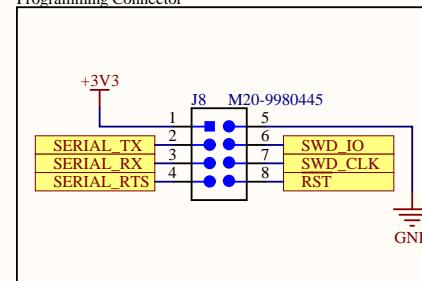
CAN Connections



+5V0 Power



Programming Connector



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

D

D

Title: *

Size: Letter

Date: 2020-06-02

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

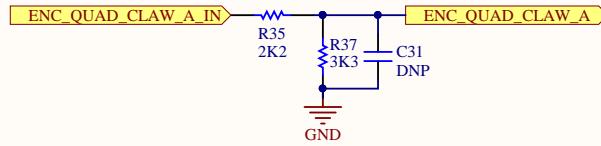
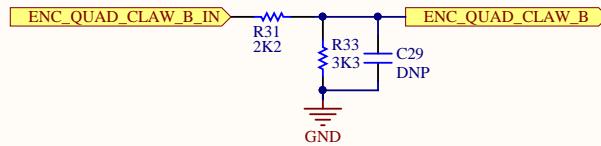
Drawn By: *

Sheet*: of *

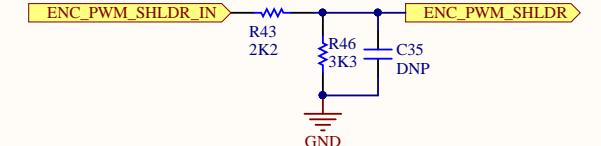
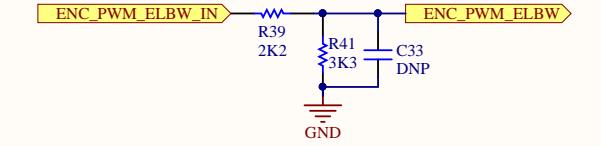
Servo motor and PWM Encoders

A

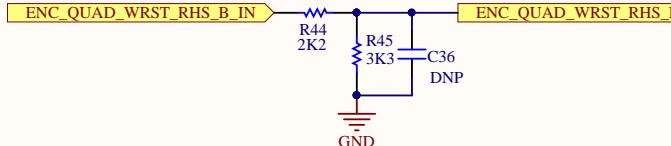
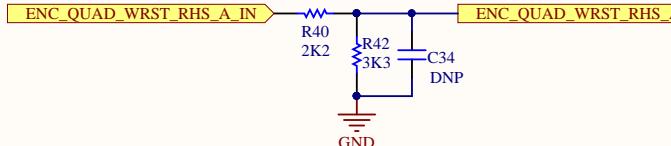
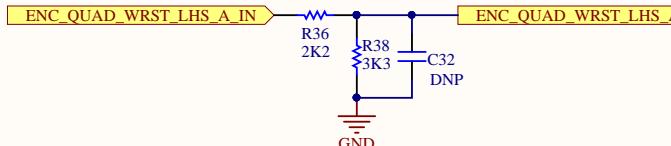
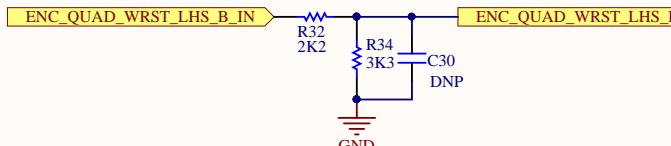
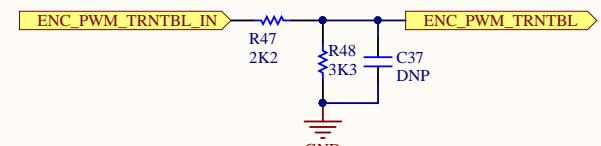
Encoder RC filter & Voltage divider



B



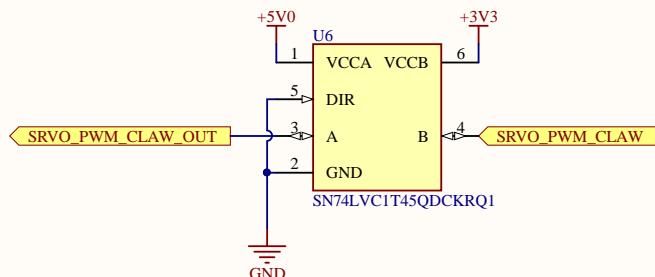
C



▲ 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 be done:
 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		

