

A

A

B

B

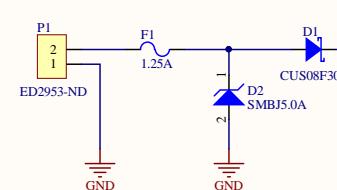
C

C

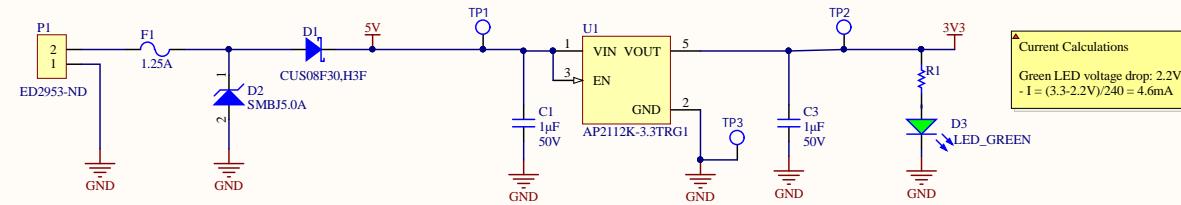
D

D

Power In



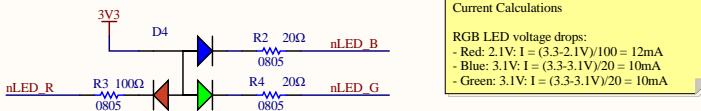
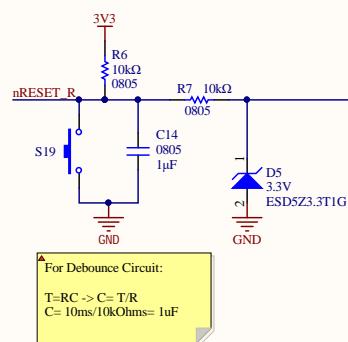
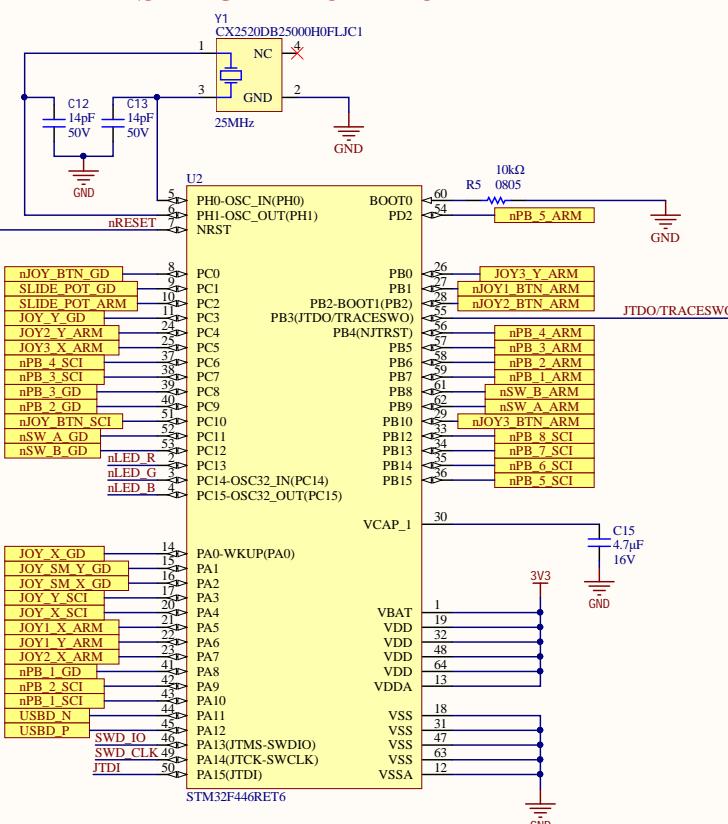
5V to 3V3 LDO



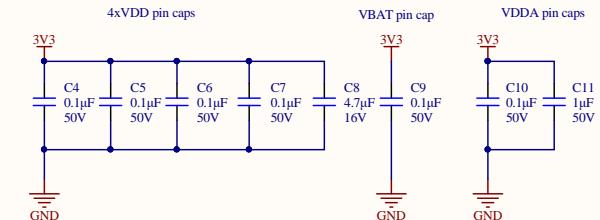
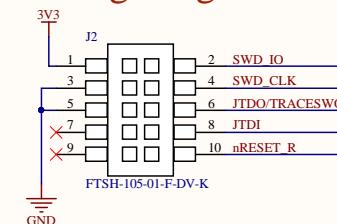
Current Calculations
Green LED voltage drop: 2.2V
 $- I = (3.3 - 2.2V) / 240 = 4.6mA$

Title: Power	
Project: Robot Controller.PrjPcb	
Rev: 1	Checker: Lance Bantoto
	Engineer: Christopher Arjune
Date: 2021-01-17	Sheet: 1 of 6



RGB LED**Reset Button****STM32F446RET6**

MOUNTING_HOLE_M3
TP4
GND

Decoupling Caps**Debug/Programming**

Title: Microcontroller

Project: Robot Controller.PrbPcb

Rev: 1 Checker: Lance Bantoto

Engineer: Christopher Arjune

Date: 2021-01-17 Sheet: 2 of 6

A

A

B

B

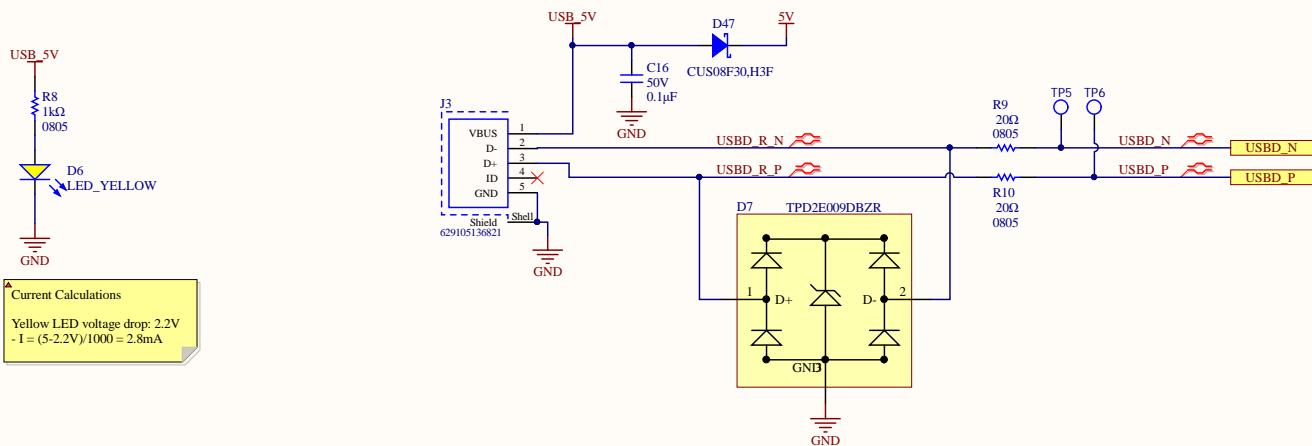
C

C

D

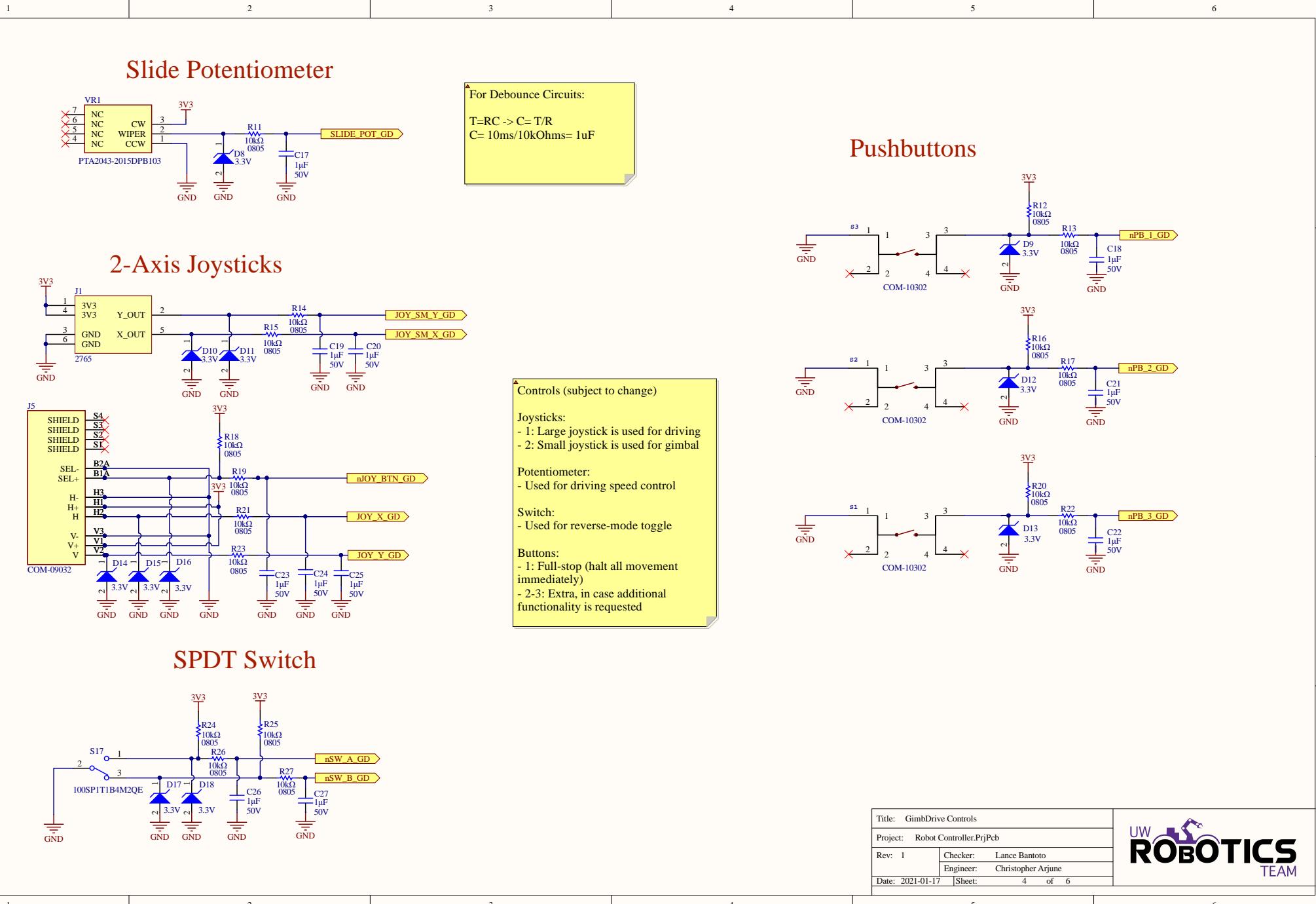
D

USB Connector

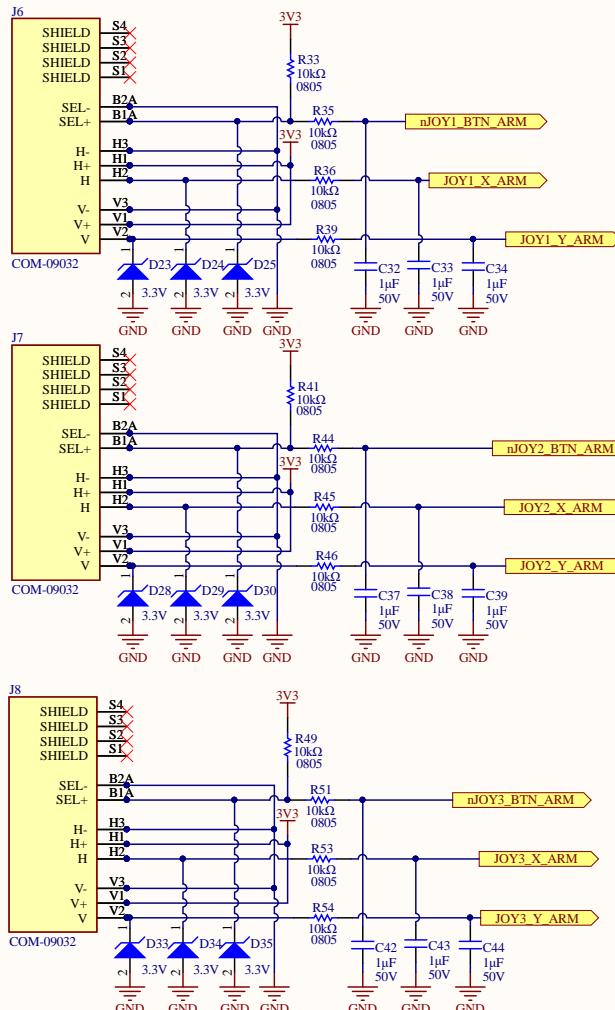


Title: USB	
Project: Robot Controller.PnjPcb	
Rev: 1	Checker: Lance Bantoto
Engineer: Christopher Arjune	
Date: 2021-01-17	Sheet: 3 of 6

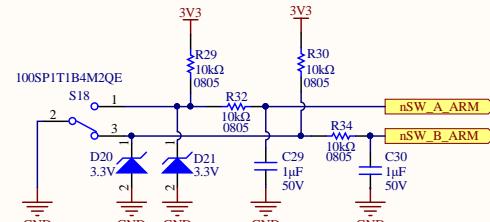




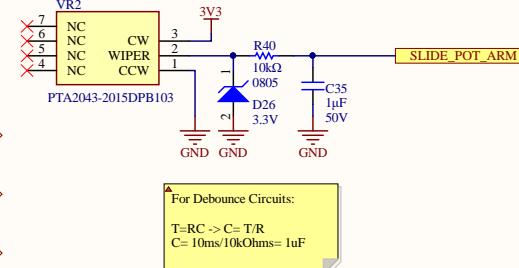
2-Axis Joysticks



SPDT Switch



Slide Potentiometer



Controls

Joysticks: (in joint-control mode)

- 1: Up/Down is for shoulder, Left/Right is for turntable
- 2: Up/Down is for elbow
- 3: Up/Down is for wrist pitch, Left/Right is for wrist roll

Switch:

- Used to toggle between joint-control and inverse-kinematics

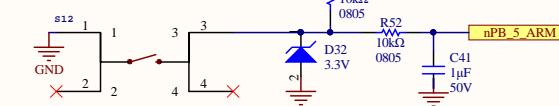
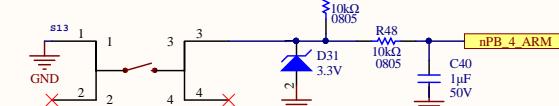
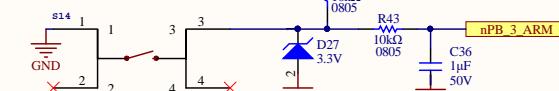
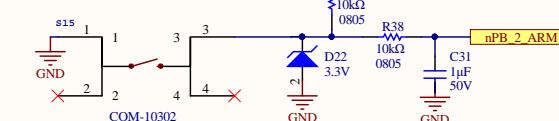
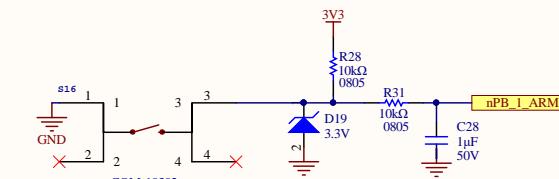
Potentiometer:

- Used to adjust movement speed of joints/arm (depending on control mode)

Buttons:

- 1/2: Open/close claw
- 3/4: Sel/Go to home position
- 5: Extra, in case extra functionality is requested later

Pushbuttons



Title: Arm Controls

Project: Robot Controller.PrbPcb

Rev: 1	Checker: Lance Bantoto
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Engineer: Christopher Arjune

Date: 2021-01-17

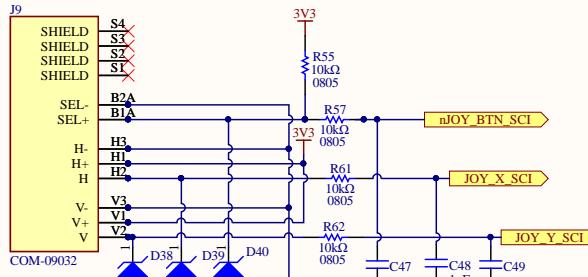
Sheet: 5 of 6



A

1

2-Axis Joystick



Controls

Joystick

- Up/Down is for elevator, Left/Right is for opening/closing shovel
 - Button should be used to choose between L/R and U/D, since the science mechanism may be damaged if too many things are moving at once

Buttons:

- 1/2: Move left/right 1 index
 - 3/4: Move to leftmost/rightmost index
 - 5/6: Open/close lid
 - 7: Pre-programmed mixing sequence
 - 8: Extra, in case additional functionality is requested later

Pushbuttons

For Debounce Circuits:

$$C = \frac{10\text{ms}}{10\text{kOhms}} = 1\mu\text{F}$$

B

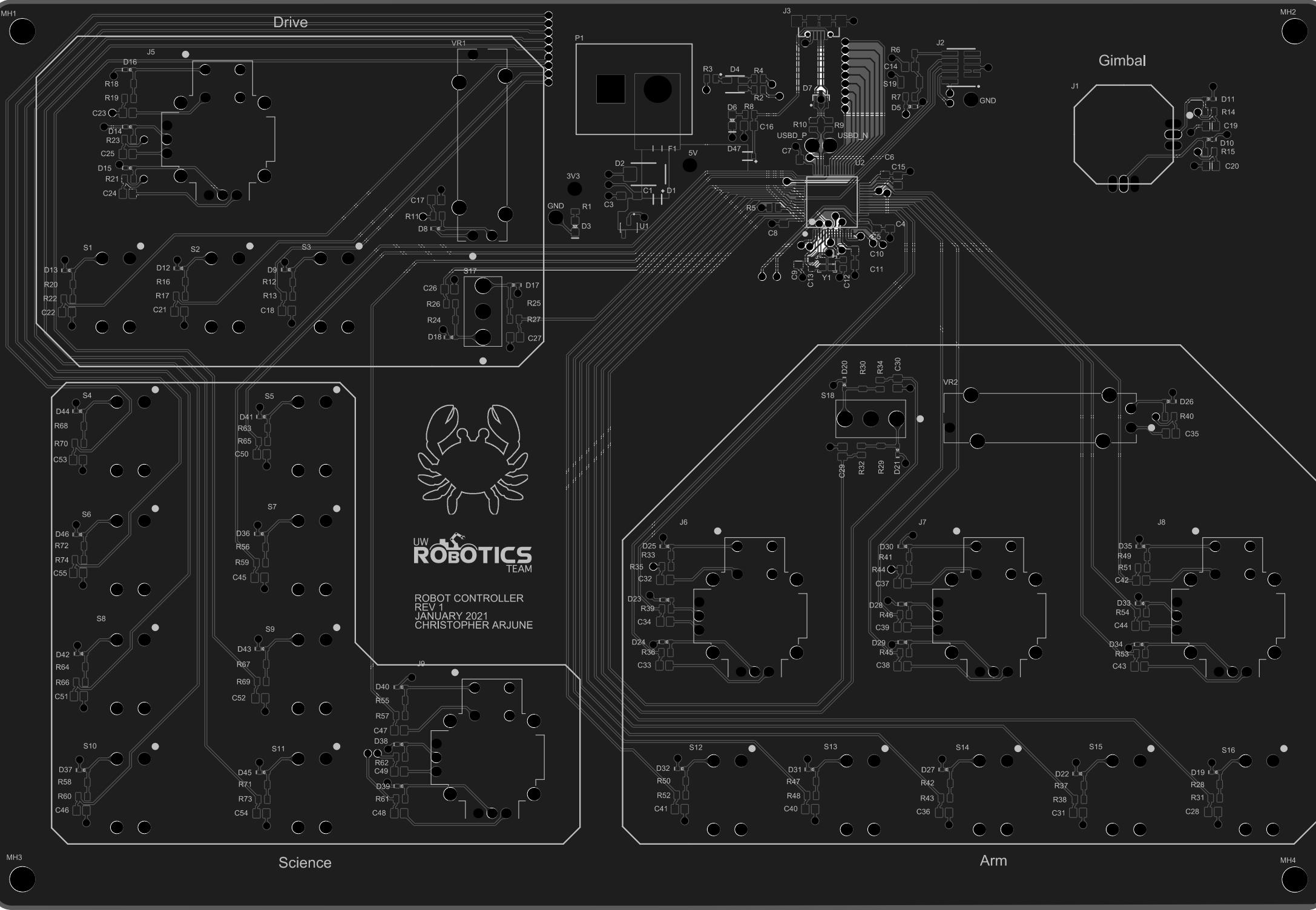
1

The schematic diagram illustrates the nPB SCI section, which contains eight parallel driver circuits (nPB_1 to nPB_8). Each circuit is powered by a 3V3 voltage source. The driver ICs used are COM-10302. The connections for each driver are as follows:

- nPB_1 SCI:** Power source 3V3, Resistor R56 (10kΩ, 0805), Diode D36 (3.3V, 0805), Capacitor C45 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.
- nPB_2 SCI:** Power source 3V3, Resistor R63 (10kΩ, 0805), Diode D41 (3.3V, 0805), Capacitor C50 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.
- nPB_3 SCI:** Power source 3V3, Resistor R67 (10kΩ, 0805), Diode D43 (3.3V, 0805), Capacitor C52 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.
- nPB_4 SCI:** Power source 3V3, Resistor R71 (10kΩ, 0805), Diode D45 (3.3V, 0805), Capacitor C54 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.
- nPB_5 SCI:** Power source 3V3, Resistor R58 (10kΩ, 0805), Diode D37 (3.3V, 0805), Capacitor C46 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.
- nPB_6 SCI:** Power source 3V3, Resistor R64 (10kΩ, 0805), Diode D42 (3.3V, 0805), Capacitor C51 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.
- nPB_7 SCI:** Power source 3V3, Resistor R72 (10kΩ, 0805), Diode D46 (3.3V, 0805), Capacitor C55 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.
- nPB_8 SCI:** Power source 3V3, Resistor R68 (10kΩ, 0805), Diode D44 (3.3V, 0805), Capacitor C53 (1μF, 50V), Zener diode 50V, Driver IC COM-10302, Pin 1 to GND, Pin 2 to Pin 4, Pin 3 to Pin 1.

Title:	Science Controls
Project:	Robot Controller.PrjPcb
Rev:	1
Date:	2021-01-17





DesignItemId	Line	Description	Designator	Quantity	Manufacturer 1	Manufacturer Part Number 1	Supplier 1	Supplier Part Number 1	Supplier Stock 1	Supplier Unit Price 1	Supplier Subtotal 1
CAP_1uF_50V_0805		CAP CER 1uF 50V X7R 0805	C1, C3, C11, C14, C17, C18, C19, C20, C21	43	Samsung	CL21B105KBFNNNG	Digi-Key	1276-6470-1-ND			
CAP_0.1uF_50V_0805		CAP CER 0.1uF 50V X7R 0805	C4, C5, C6, C7, C9, C10, C16	7	Murata	GCM21BR71H104KA37K	Digi-Key	490-8049-1-ND			
CAP_4.7uF_16V_0805		CAP CER 4.7uF 16V X5R 0805	C8, C15	2	Samsung	CL21A475KOFGNNNE	Digi-Key	1276-1065-1-ND			
CAP_14pF_50V_0603		CAP CER 14pF 50V COG/NP0 0603	C12, C13	2	Samsung	CL10C140JB8NNNC	Digi-Key	1276-2187-1-ND			
DIO_SCHOTTKY_30V_800mA		DIODE SCHOTTKY 30V 800mA USC	D1, D47	2	Toshiba	CUS08F30H3F	Digi-Key	CUS08F30H3FCT-ND			
TVS_DIODE_UNIDIR_5V		TVS DIODE 5V 9.2V SMB	D2	1	Bourns	SMBJ5.0A	Digi-Key	SMBJ5.0ABC7-ND			
LED_GREEN		LED GREEN DIFFUSED 0805 SMD	D3	1	Osram Opto	LGR971-KN-1	Digi-Key	475-1410-1-ND			
LED_RGB		LED RGB DIFFUSED 4PLCC SMD	D4	1	Broadcom Avago	ASMB-MTB1-0A3A2	Digi-Key	516-3280-1-ND			
TVS_DIODE_UNIDIR_3.3V		TVS DIODE 3.3V 14.1V SOD523	D5, D8, D9, D10, D11, D12, D13, D14, D15,	40	ON Semiconductor	ESD523.3T1G	Digi-Key	ESD523.3T1GOSCT-ND			
LED_YELLOW		LED YELLOW DIFFUSED 0805 SMD	D6	1	Osram Opto	LYR976-PS-36	Digi-Key	475-2560-1-ND			
TVS_DIODE_USB_5.5V		TVS DIODE 5.5V 8V SOT23-3	D7	1	Texas Instruments	TPD2E009DBZ	Digi-Key	296-24657-1-ND			
FUSE_1.25A_1206		FUSE BOARD MOUNT 1.25A 63VAC/VDC 1206	F1	1	Littlefuse	04661.25NRHF	Digi-Key	F11418CT-ND			
2_AXIS_JOYSTICK_SMALL		JOYSTICK 10K OHM 2 AXIS TH	J1	1	Adafruit Industries	2765	Digi-Key	1528-1730-ND			
CONN_PROGRAMMING		CONN HEADER SMD 10POS 1.27MM	J2	1	Samtec	FTSH-105-01-F-DV-K	Digi-Key	SAM8796-ND			
CMP-1502-03253-1		Micro USB 2.0 Type B Receptacle WR-COM, Horizontal, SMT	J3	1	Wurth Electronics	629105136821					
2_AXIS_JOYSTICK		JOYSTICK 10K OHM 2 AXIS TH	J5, J6, J7, J8, J9	5	SparkFun	9032	Digi-Key	1568-1526-ND			
CONN_TERMINAL_2		Header, 2-Pin	P1	1	On-Shore Technol	OSTYK51102030	Digi-Key	ED2953-ND			
RES_240Ω_0805_1%		RES 240 OHM 1% 1/8W 0805	R1	1	Vishay	CRCW0805240RFKEA	Digi-Key	541-240CCT-ND			
RES_20Ω_0805_1%		RES 20 OHM 1% 1/8W 0805	R2, R4, R9, R10	4	Yageo	RC0805FR-0720RL	Digi-Key	311-20.0CRCT-ND			
RES_100Ω_0805_1%		RES 100 OHM 1% 1/8W 0805	R3	1	Vishay Dale	CRCW0805100RFKEA	Digi-Key	541-100CCT-ND			
RES_10kΩ_0805_5%		RES 10K OHM 5% 1/8W 0805	R5, R6, R7, R11, R12, R13, R14, R15, R16,	67	Panasonic Electron	ERJ-6GEYJ103V	Digi-Key	P10KACT-ND			
RES_1kΩ_0805_1%		RES 1K OHM 1% 1/8W 0805	R8	1	Yageo	RC0805FR-071KL	Digi-Key	311-1.00KCRCT-ND			
SW_MOMENTARY_PUSHBUTTON		TACTILE MOMENTARY PUSHBUTTON SPST	S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12	16	SparkFun	COM-10302	Digi-Key	1568-1332-ND			
SW_SPDT		SWITCH TOGGLE SPDT 5A 120V	S17	1	E-Switch	100SP1T1B4M2QE	Digi-Key	EG2355-ND			
SW_SPDT		SWITCH TOGGLE SPDT 5A 120V	S18	1	E-Switch	100SP1T1B4M2QE	Digi-Key	EG2355-ND			
SW_TACTILE		SWITCH TACTILE SPST-NO 0.05A 12V	S19	1	Omron	B3U-1000P	Digi-Key	SW1020CT-ND			
TESTPOINT_LOOP		TESTPOINT THRUHOLE	TP1, TP2, TP3, TP4, TP5, TP6	6	Keystone Electron	5002	Digi-Key	36-5002-ND			
LDO_3.3V_600mA		IC REG LINEAR 3.3V 600mA SOT25	U1	1	Diodes	AP2112K-3.3TRG1	Digi-Key	AP2112K-3.3TRG1DICT-ND			
MCU_STM32F446RET6		ARM Cortex-M4 32-bit MCU+FPU, 512 KB Flash, 128 KB Inte	U2	1	STMicroelectronics	STM32F446RET6	Digi-Key	497-15376-ND			
POT_10K_SLIDE		SLIDE POT 10K OHM 0.1W TOP 20MM	VR1, VR2	2	Bourns	PTA2043-2015DPB103	Digi-Key	PTA2043-2015DPB103-ND			
CRYSTAL_25MHz		CRYSTAL 25.0000MHz 12PF SMD	Y1	1	Kyocera AVX	CX2520DB25000H0FLJC1	Digi-Key	1253-1724-1-ND			