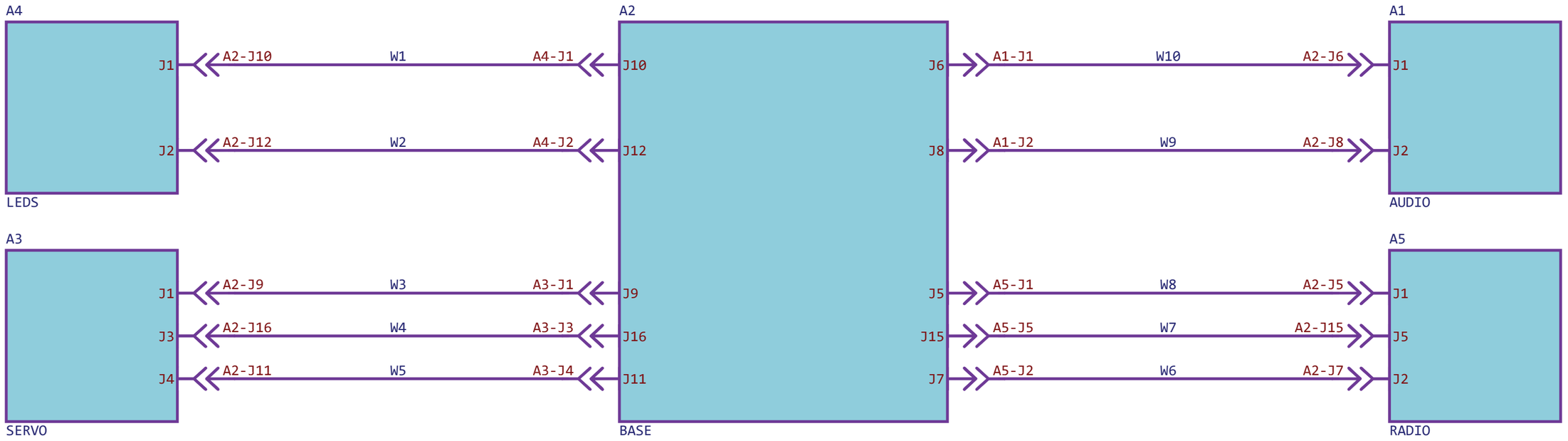
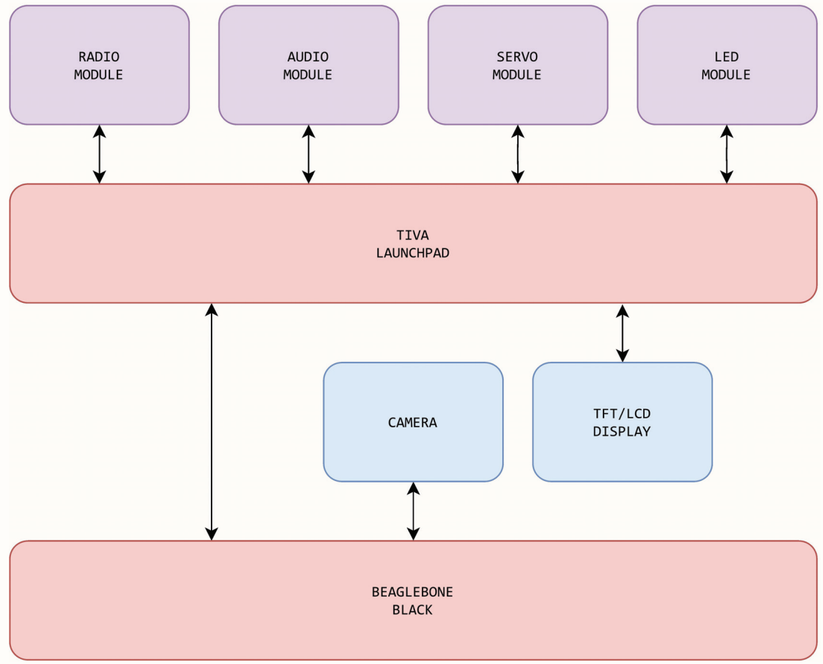
MULTIMOD REVISION 1
WIRING DIAGRAM



INDEX	SCHEMATIC	DESCRIPTION
01	S01-LAUNCHPAD	EK-TM4C123GXL LAUNCHPAD HEADERS
02	S02-BEAGLEBONE	BEAGLEBONE BLACK HEADERS
03	S03-BEAGLEBONE	BEAGLEBONE BLACK INTERFACES
04	S04-INTERFACES	RADIO/AUDIO MODULE INTERFACES
05	S05-INTERFACES	SERVO/LED MODULE INTERFACES
06	S06-PERIPHERALS	JOYSTICK/CAMERA/TFT PERIPHERAL INTERFACES

SYSTEM DIAGRAM



△
NOTES

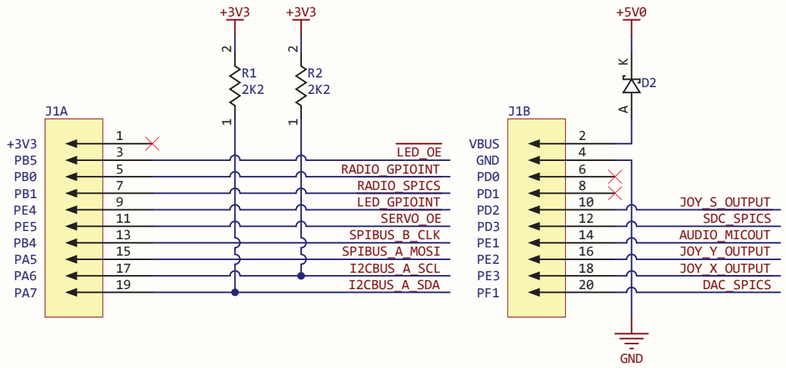
[1] CONNECTION TYPES AND IMPLEMENTATION DETAILS HAVE BEEN OMITTED FROM THE SYSTEM DIAGRAM

TITLE OVERVIEW AND TITLE PAGE

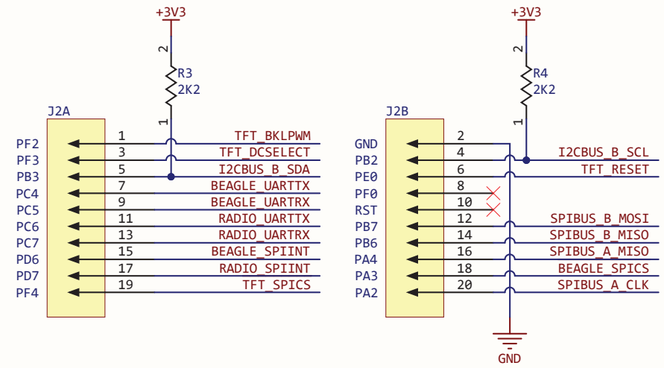
SIZE	PROJECT	REVISION
B	MULTIMOD BASE	1

ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

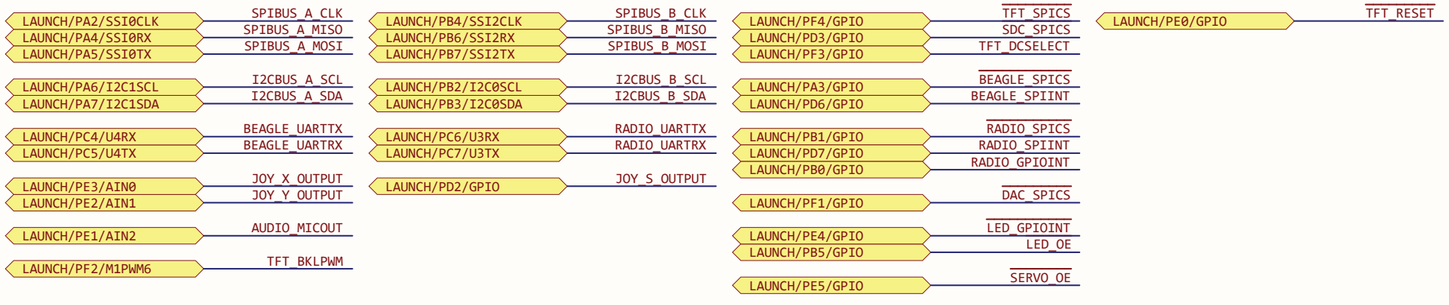
(1) LAUNCHPAD J1/J3



(1) LAUNCHPAD J2/J4



(1) GLOBAL NETS

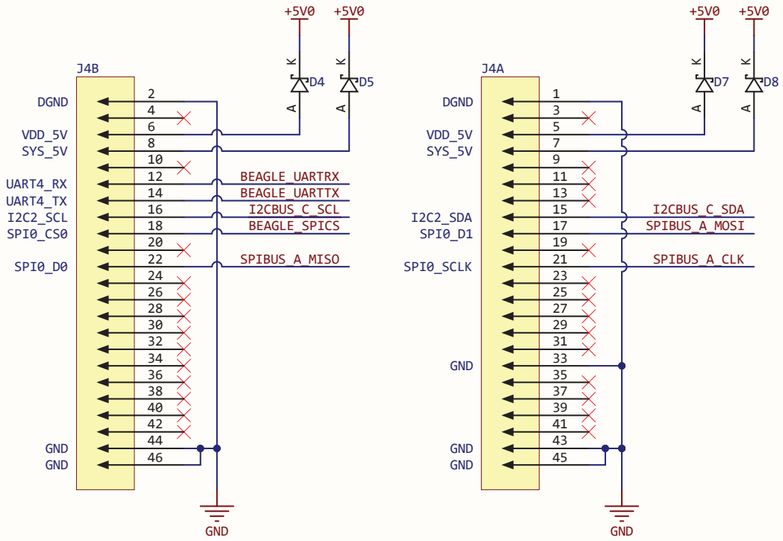


NOTES

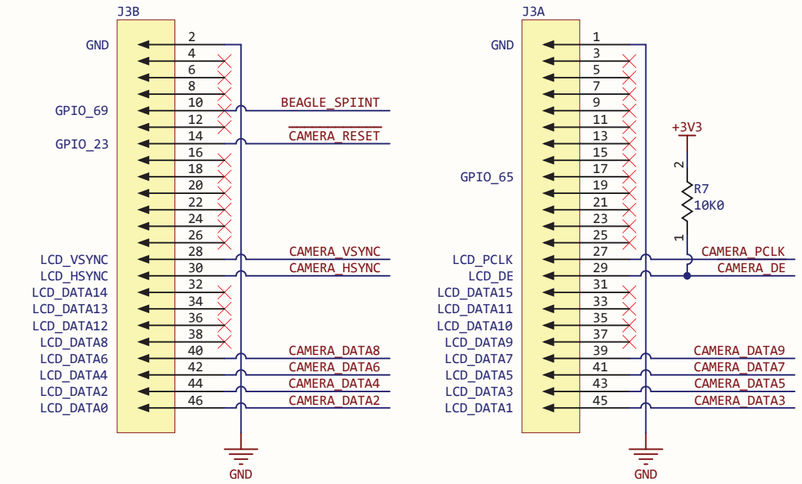
[1] INTERRUPTS ON SENSORS BOOSTERPACK CANNOT BE USED DUE TO INTERFERENCE WITH PIN ASSIGNMENTS AT PE4, PA2, PA3, PA4, AND PA5!
[2] SENSORS BOOSTERPACK I2C ADDRESSES: OPT3001 = 0x47 / TMP007 = 0x40 / BMI160 = 0x69 / BMM150 = 0x13 / BME280 = 0x77

TITLE	EK-TM4C123GXL LAUNCHPAD HEADERS		
SIZE B	**PROJECT** MULTIMOD BASE		**REVISION** 1
ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

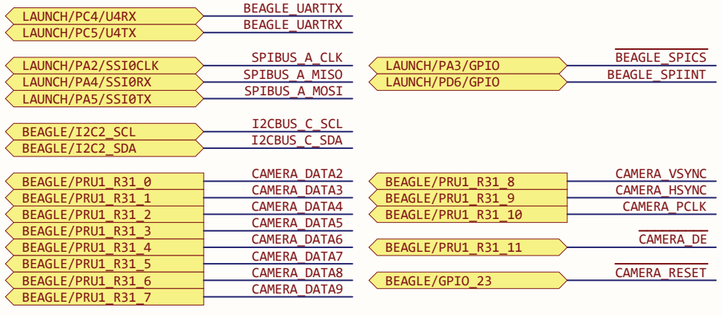
(1) BEAGLEBONE P9



(1) BEAGLEBONE P8



(1) GLOBAL NETS

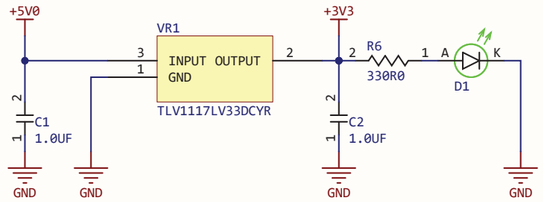


NOTES

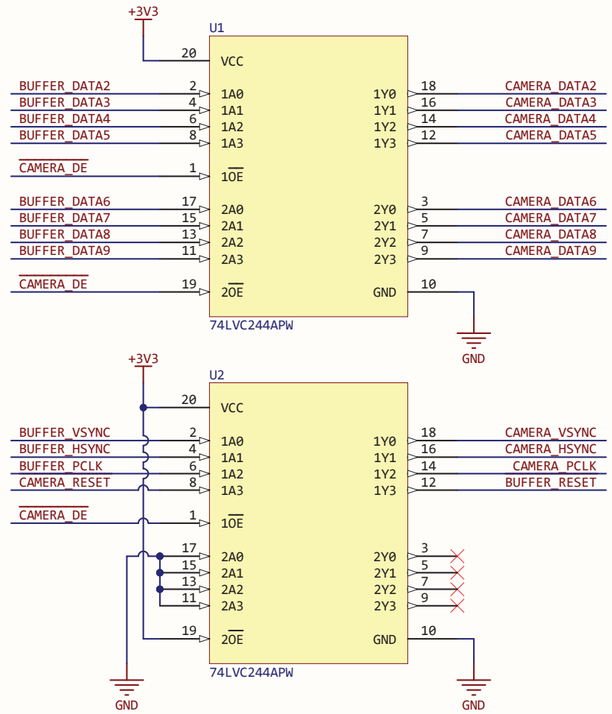
[01] LINK TO BEAGLEBONE BLACK DESIGN FILES: https://github.com/beagleboard/beaglebone-black
[02] VEXT PROVIDES +5V0 FROM THE BARREL JACK CONNECTOR ON THE BEAGLEBONE
[03] PIN ORDERING IS FLIPPED WRT OFFICIAL BEAGLEBONE PIN NUMBERS (I.E. EVEN PINS ARE ODD HERE AND ODD PINS ARE EVEN HERE)

TITLE	BEAGLEBONE BLACK HEADERS		
SIZE	**PROJECT**		**REVISION**
B	MULTIMOD BASE		1
ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

(1) +3V3 VOLTAGE REGULATOR

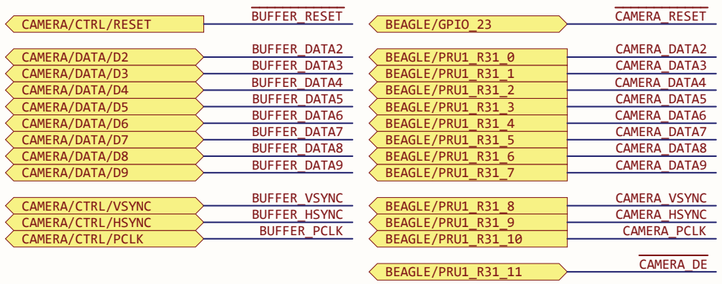


(2) CAMERA I/O BUFFER



(1) GLOBAL NETS

(2) GLOBAL NETS

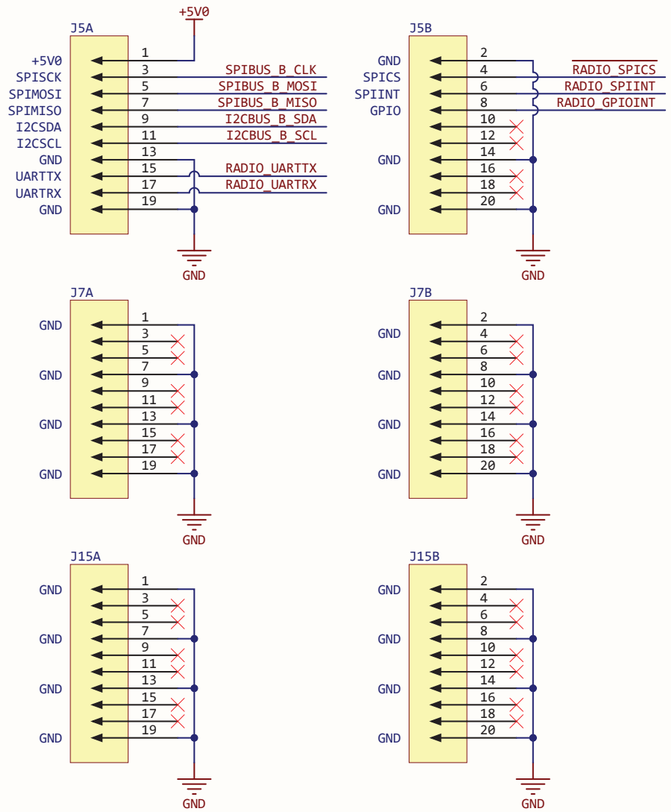


NOTES

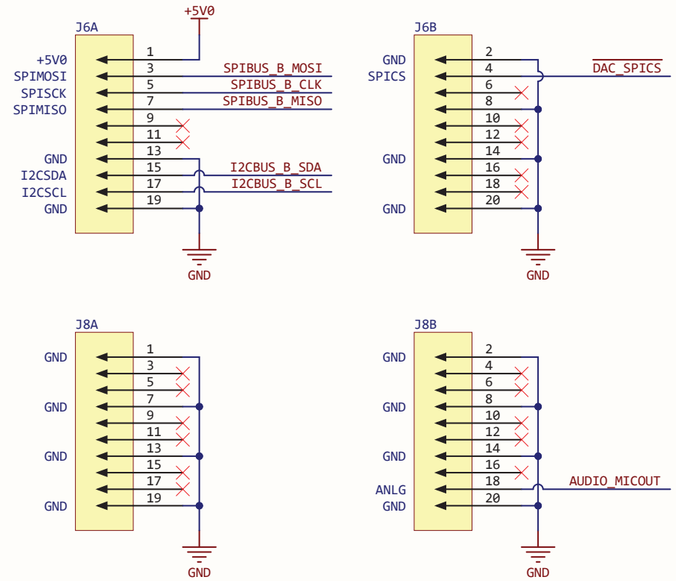
N/A

TITLE BEAGLEBONE BLACK INTERFACES		
SIZE B	PROJECT MULTIMOD BASE	REVISION 1
ORGANIZATION UNIVERSITY OF FLORIDA		DESIGNER MEHRON TALEBI
IDENTIFIER SUMMER 2023		REVIEWER MIKE STAPLETON

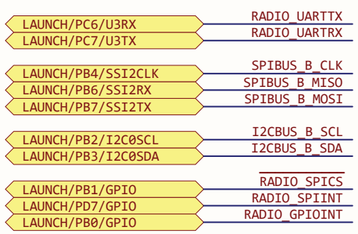
(1) RADIO MODULE



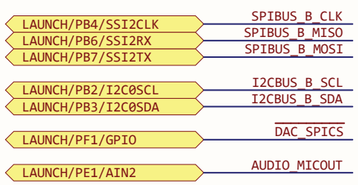
(2) AUDIO MODULE



(1) GLOBAL NETS



(2) GLOBAL NETS

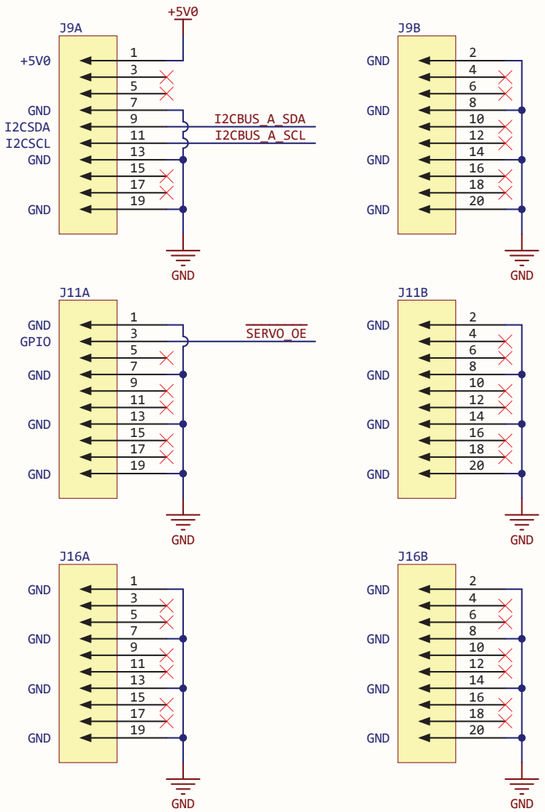


NOTES

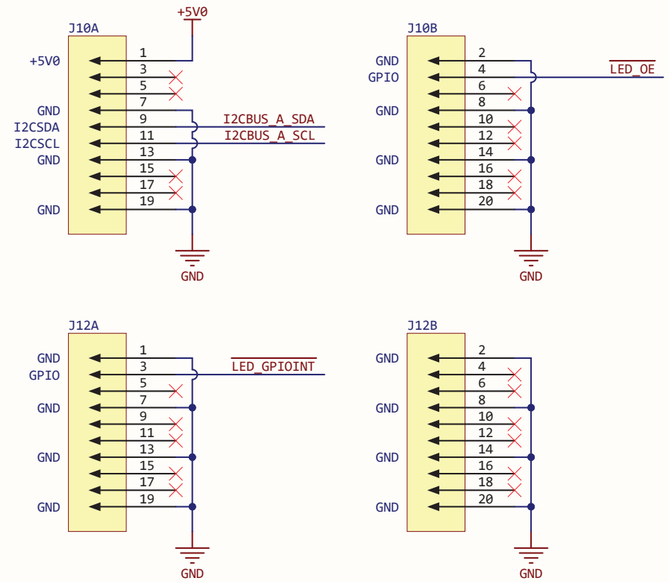
N/A

TITLE	RADIO/AUDIO MODULE INTERFACES		
SIZE B	**PROJECT** MULTIMOD BASE		**REVISION** 1
ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

(1) SERVO MODULE



(2) LED MODULE



(1) GLOBAL NETS

LAUNCH/PA6/I2C1SCL	I2CBUS_A_SCL
LAUNCH/PA7/I2C1SDA	I2CBUS_A_SDA
LAUNCH/PE5/GPIO	SERVO_OE

(2) GLOBAL NETS

LAUNCH/PA6/I2C1SCL	I2CBUS_A_SCL
LAUNCH/PA7/I2C1SDA	I2CBUS_A_SDA
LAUNCH/PB5/GPIO	LED_OE
LAUNCH/PE4/GPIO	LED_GPIOINT

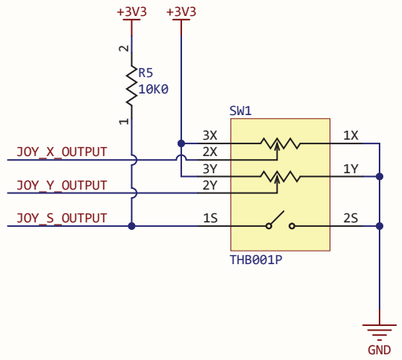
NOTES

N/A

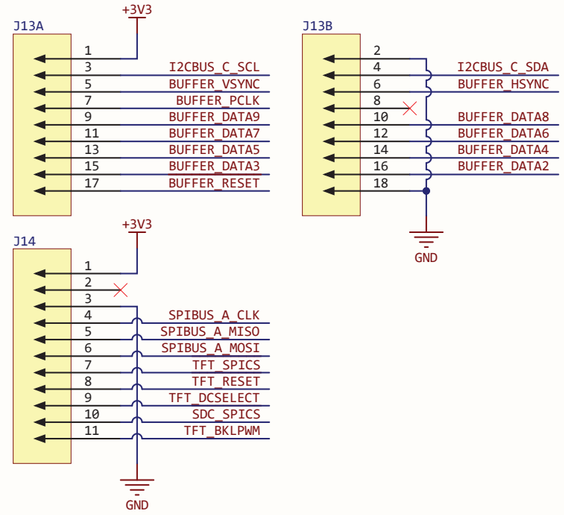
TITLE SERVO/LED MODULE INTERFACES

SIZE B	**PROJECT** MULTIMOD BASE	**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON

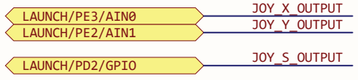
(1) JOYSTICKS



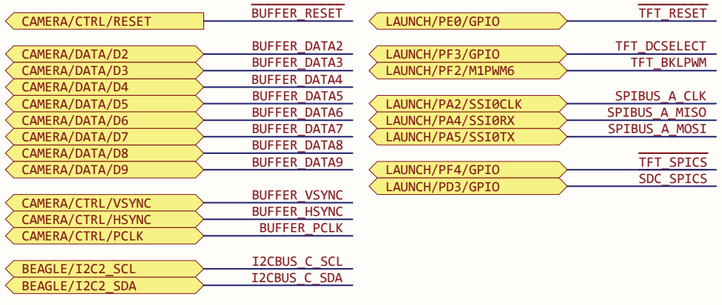
(2) CAMERA/TFT



(1) GLOBAL NETS



(2) GLOBAL NETS



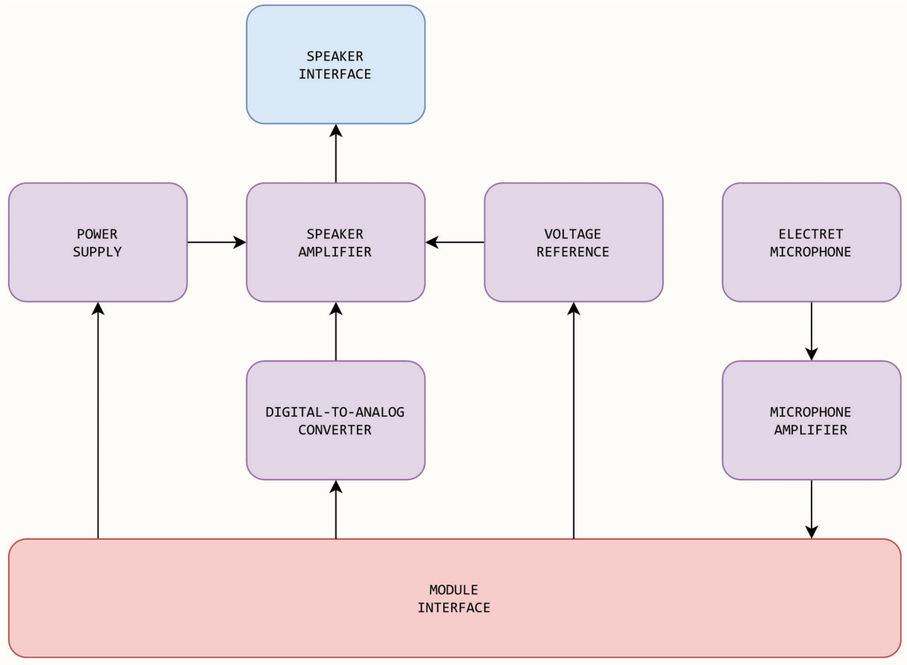
NOTES

N/A

TITLE	JOYSTICK/CAMERA/TFT PERIPHERAL INTERFACES		
SIZE B	**PROJECT** MULTIMOD BASE		**REVISION** 1
ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

INDEX	SCHEMATIC	DESCRIPTION
01	S01-INTERFACES	AUDIO MODULE INTERFACES AND GPIO EXPANSION
02	S02-POWER	POWER SUPPLY AND ANALOG VOLTAGE REFERENCE
03	S03-MICROPHONE	MICROPHONE AND ADJUSTABLE GAIN AMPLIFIER
04	S04-SPEAKER	DAC AND SPEAKER OUTPUT DRIVER

SYSTEM DIAGRAM

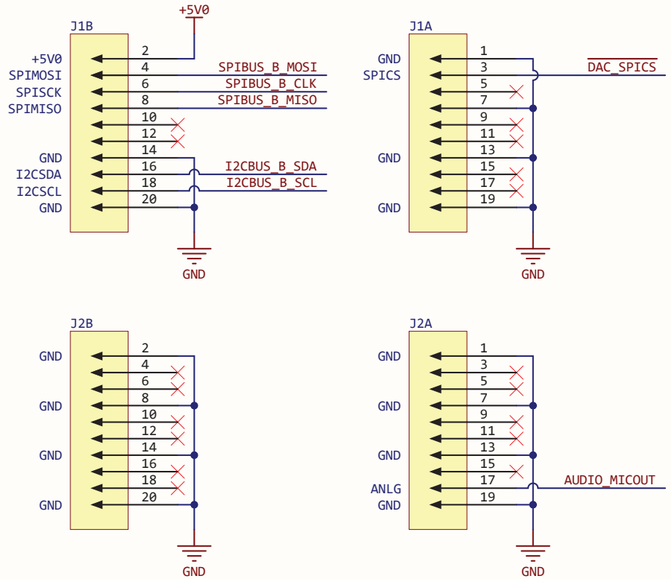


NOTES

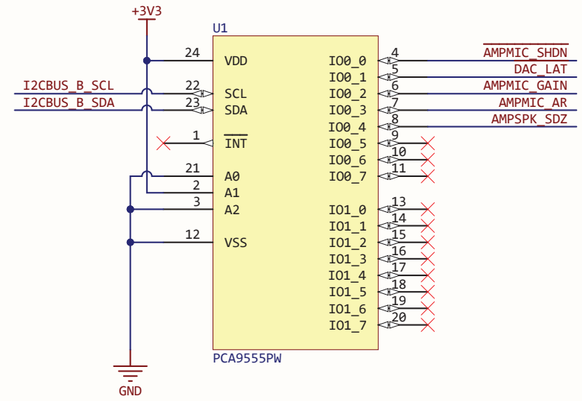
[1] CONNECTION TYPES AND IMPLEMENTATION DETAILS HAVE BEEN OMITTED FROM THE SYSTEM DIAGRAM

TITLE	OVERVIEW AND TITLE PAGE		
SIZE	PROJECT		REVISION
B	MULTIMOD AUDIO MODULE		1
ORGANIZATION	UNIVERSITY OF FLORIDA	DESIGNER	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	REVIEWER	MIKE STAPLETON

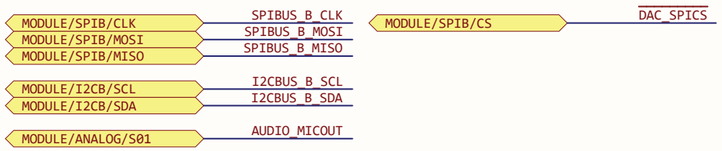
(1) MODULE INTERFACE



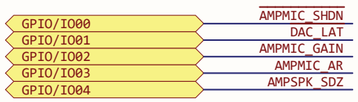
(2) GPIO/SPEAKER OUTPUT



(1) GLOBAL NETS



(2) GLOBAL NETS

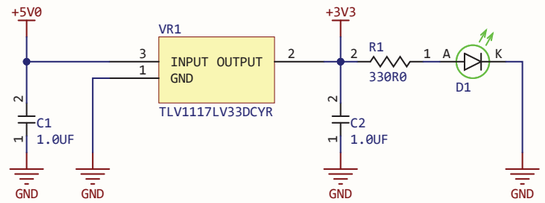


NOTES

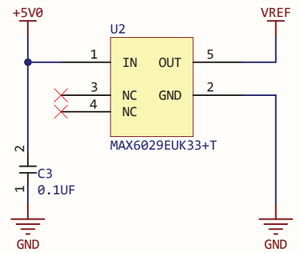
[1] 7-BIT GPIO EXPANDER I2C ADDRESS (P.6 OF PCA9555PW DATASHEET REV 08) = 0x22

TITLE AUDIO MODULE INTERFACES AND GPIO EXPANSION			
SIZE B	**PROJECT** MULTIMOD AUDIO MODULE		**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI	
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON	

(1) +3V3 VOLTAGE REGULATOR



(2) +3V3 VOLTAGE REFERENCE



(1) GLOBAL NETS

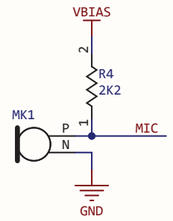
(2) GLOBAL NETS

NOTES

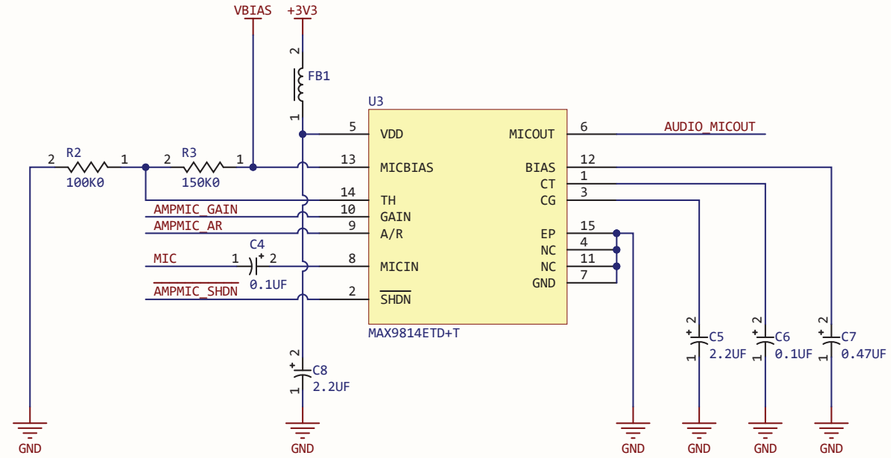
N/A

TITLE POWER SUPPLY AND ANALOG VOLTAGE REFERENCE		
SIZE B	**PROJECT** MULTIMOD AUDIO MODULE	**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON

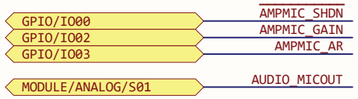
(1) ELECTRET MICROPHONE



(1) MICROPHONE AMPLIFIER



(1) GLOBAL NETS

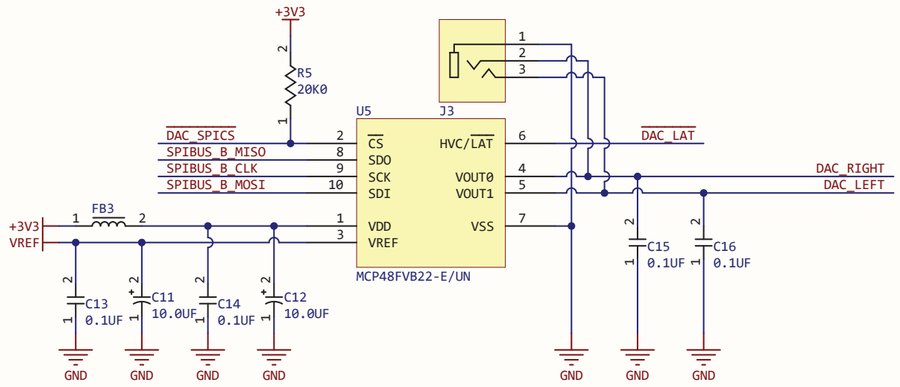


NOTES

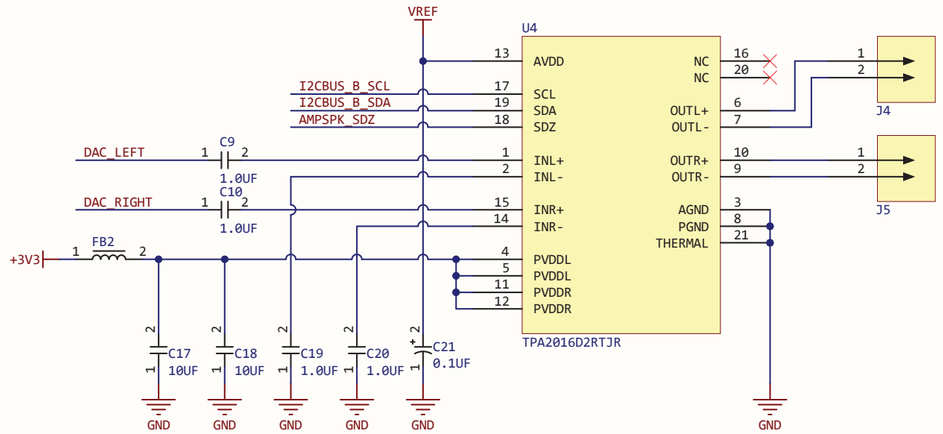
N/A

TITLE MICROPHONE AND ADJUSTABLE GAIN AMPLIFIER			
SIZE B	**PROJECT** MULTIMOD AUDIO MODULE		**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI	
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON	

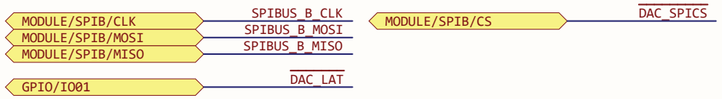
(1) DIGITAL-TO-ANALOG CONVERTER



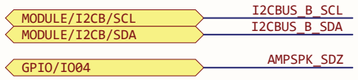
(2) CLASS-D AMPLIFIER



(1) GLOBAL NETS



(2) GLOBAL NETS



NOTES

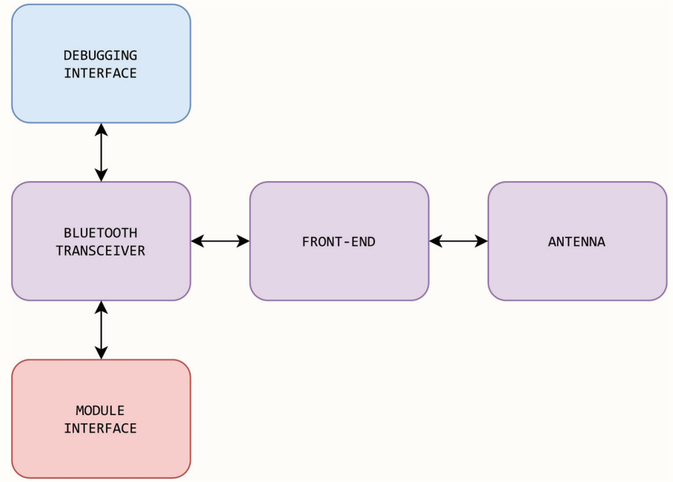
[1] BARREL JACK ON BEAGLEBONE SHOULD BE CONNECTED TO EFFECTIVELY DRIVE SPEAKER AMPLIFIER

[2] CLASS-D AMPLIFIER I2C ADDRESS (P.24 OF TPA2016D2RTJR DATASHEET) = 0x58

TITLE DAC AND SPEAKER OUTPUT DRIVER		
SIZE B	**PROJECT** MULTIMOD AUDIO MODULE	**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON

INDEX	SCHEMATIC	DESCRIPTION
01	S01-INTERFACES	RADIO MODULE INTERFACES AND GPIO EXPANSION
02	S02-INTERFACES	TRANSCEIVER SERIAL WIRE DEBUG PORT
03	S02-TRANSCEIVER	BLUETOOTH RADIO TRANSCEIVER

SYSTEM DIAGRAM

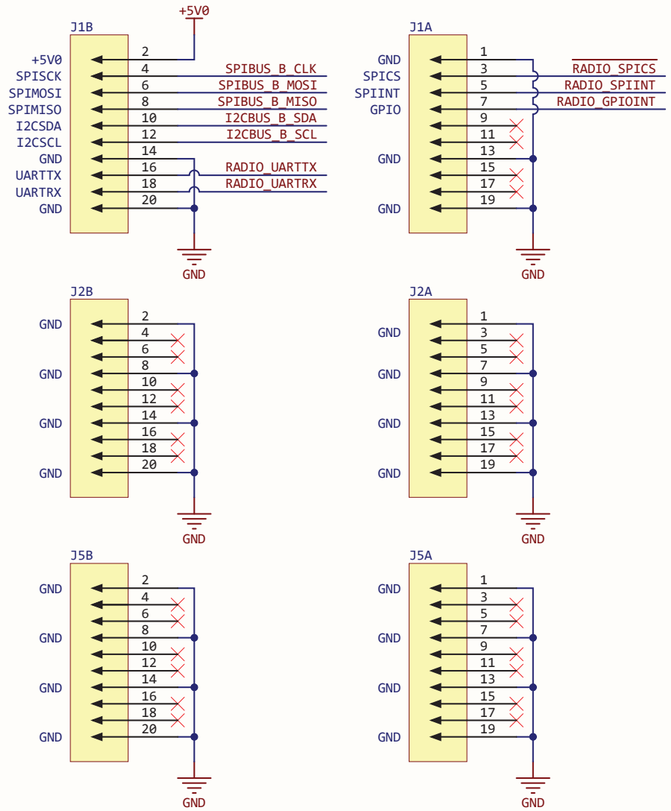


NOTES

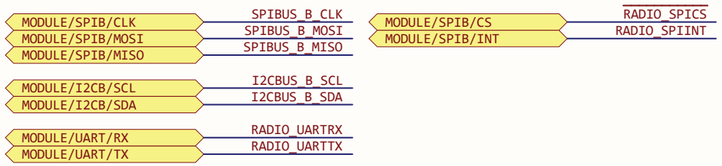
[1] CONNECTION TYPES AND IMPLEMENTATION DETAILS HAVE BEEN OMITTED FROM THE SYSTEM DIAGRAM

TITLE OVERVIEW AND TITLE PAGE			
SIZE B	**PROJECT** MULTIMOD RADIO MODULE		**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI	
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON	

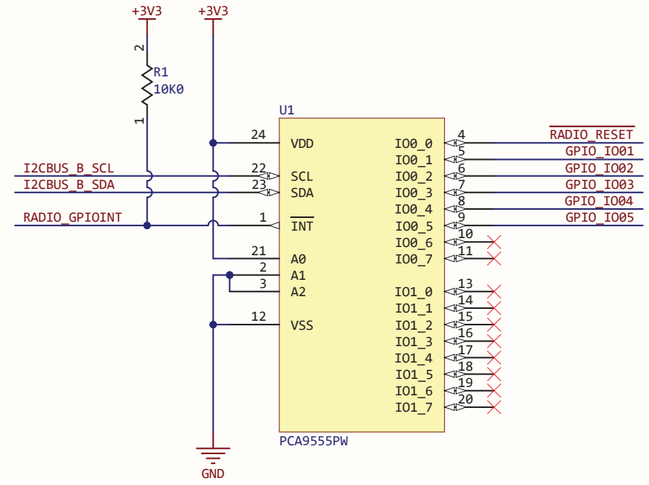
(1) MODULE INTERFACE



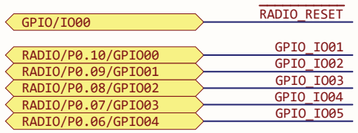
(1) GLOBAL NETS



(1) GPIO INTERFACE



(1) GLOBAL NETS

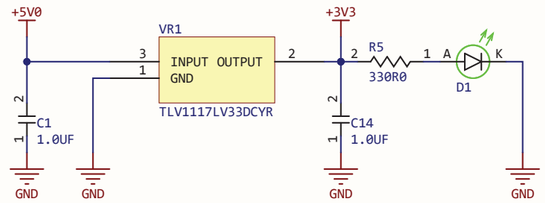


NOTES

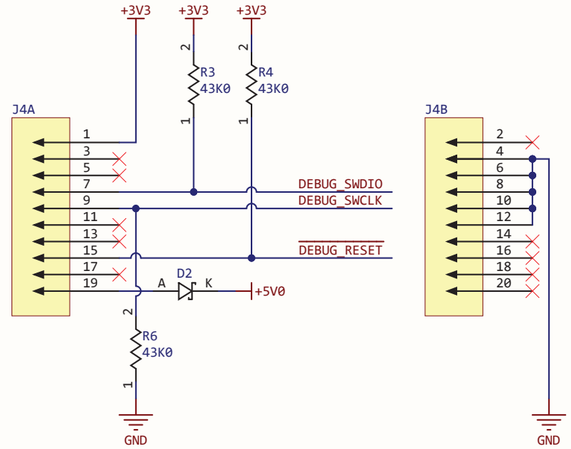
[1] 7-BIT GPIO EXPANDER I2C ADDRESS (P.6 OF PCA9555PW DATASHEET REV 08) = 0x21

TITLE	RADIO MODULE INTERFACES AND GPIO EXPANSION	
SIZE B	PROJECT MULTIMOD RADIO MODULE	REVISION 1
ORGANIZATION	UNIVERSITY OF FLORIDA	DESIGNER MEHRON TALEBI
IDENTIFIER	SUMMER 2023	REVIEWER MIKE STAPLETON

(1) +3V3 VOLTAGE REGULATOR

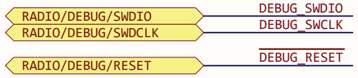


(2) DEBUG INTERFACE



(1) GLOBAL NETS

(2) DEBUG INTERFACE



NOTES

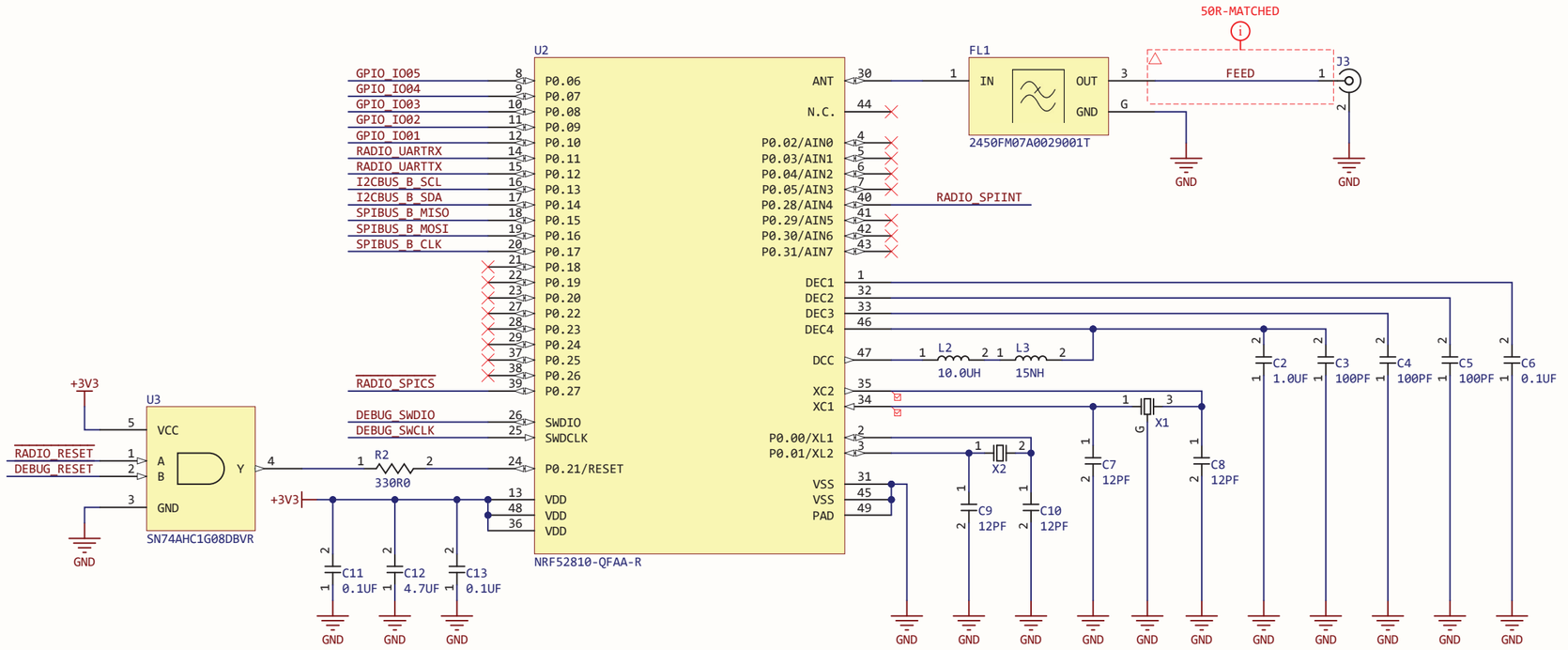
N/A

TITLE TRANSCEIVER SERIAL WIRE DEBUG PORT

SIZE	PROJECT	REVISION
B	MULTIMOD RADIO MODULE	1

ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

(1) BLUETOOTH TRANSCEIVER



(1) GLOBAL NETS

- GPIO/IO00 — RADIO_RESET
- RADIO/DEBUG/RESET — DEBUG_RESET
- RADIO/P0.10/GPIO00 — GPIO_IO01
- RADIO/P0.09/GPIO01 — GPIO_IO02
- RADIO/P0.08/GPIO02 — GPIO_IO03
- RADIO/P0.07/GPIO03 — GPIO_IO04
- RADIO/P0.06/GPIO04 — GPIO_IO05
- MODULE/SPIB/CLK — SPIBUS_B_CLK
- MODULE/SPIB/MOSI — SPIBUS_B_MOSI
- MODULE/SPIB/MISO — SPIBUS_B_MISO
- MODULE/SPIB/CS — RADIO_SPICS
- MODULE/SPIB/INT — RADIO_SPIINT
- RADIO/DEBUG/SWDIO — DEBUG_SWDIO
- RADIO/DEBUG/SWDCLK — DEBUG_SWCLK
- MODULE/I2CB/SCL — I2CBUS_B_SCL
- MODULE/I2CB/SDA — I2CBUS_B_SDA
- MODULE/UART/RX — RADIO_UARTRX
- MODULE/UART/TX — RADIO_UARTTX

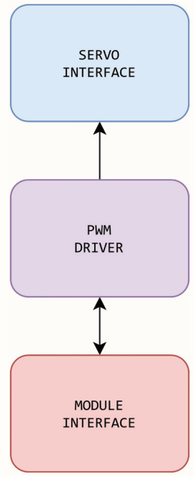
NOTES

[01] LINK TO NRF CONNECT SDK: https://www.nordicsemi.com/Products/Development-software/nRF-Connect-SDK
[02] LINK TO NRF5 SDK: https://www.nordicsemi.com/Products/Development-software/nrf5-sdk
[03] LINK TO NRF COMMAND LINE TOOLS: https://www.nordicsemi.com/Products/Development-tools/nRF-Command-Line-Tools
[04] LINK TO DATASHEET: https://infocenter.nordicsemi.com/pdf/nRF52810_PS_v1.4.pdf

TITLE	BLUETOOTH RADIO TRANSCEIVER		
SIZE B	**PROJECT** MULTIMOD RADIO MODULE		**REVISION** 1
ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

INDEX	SCHEMATIC	DESCRIPTION
01	S01-INTERFACES	SERVO MODULE INTERFACES
02	S02-DRIVER	PWM SIGNAL DRIVER

SYSTEM DIAGRAM

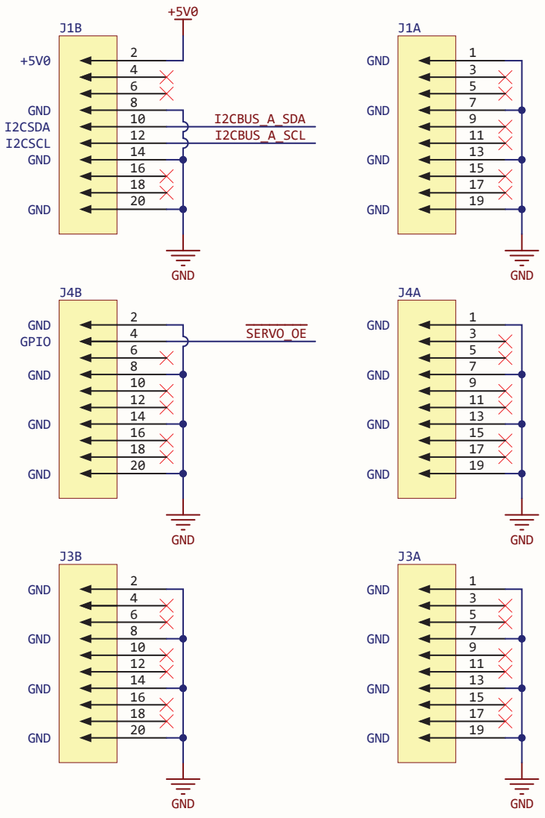


△
NOTES

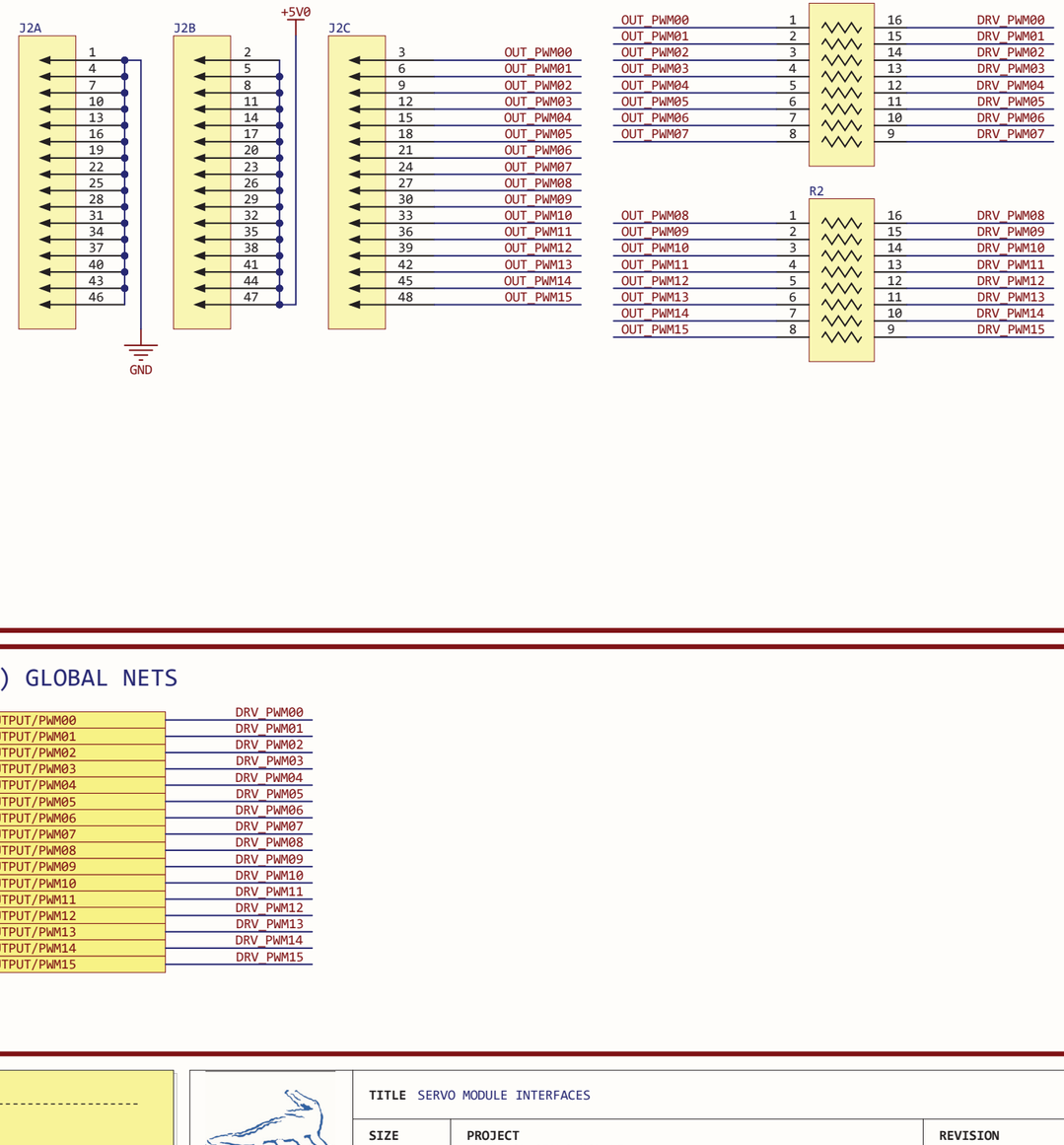
[1] CONNECTION TYPES AND IMPLEMENTATION DETAILS HAVE BEEN OMITTED FROM THE SYSTEM DIAGRAM

TITLE OVERVIEW AND TITLE PAGE			
SIZE B	**PROJECT** MULTIMOD SERVO MODULE		**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI	
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON	

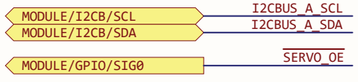
(1) MODULE INTERFACE



(2) SERVO INTERFACE



(1) GLOBAL NETS



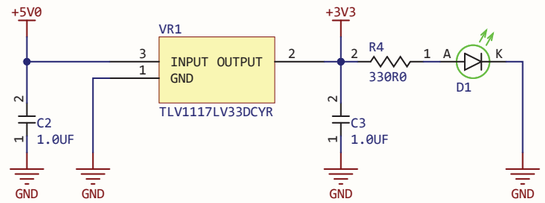
(2) GLOBAL NETS

NOTES

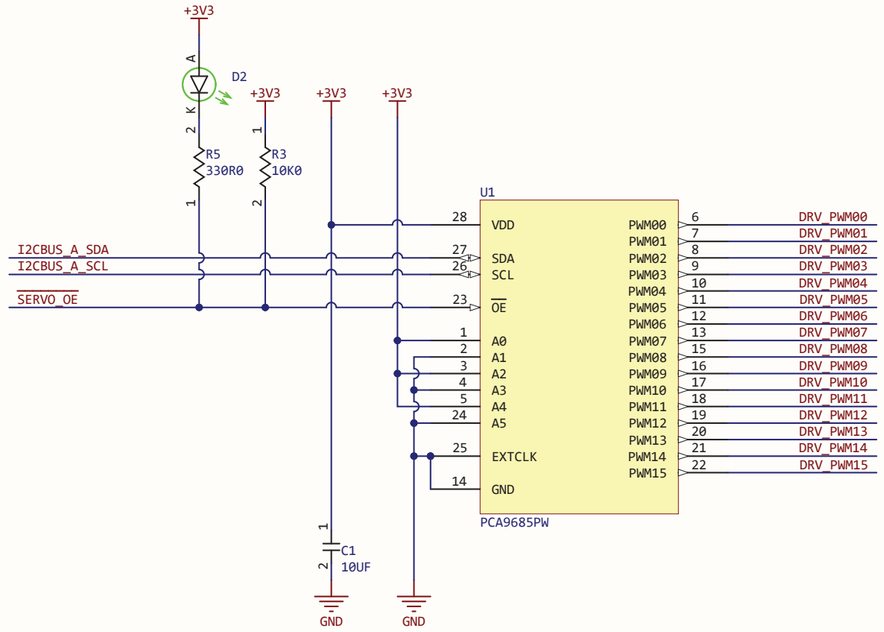
[1] VEXT (BARREL JACK ON BEAGLEBONE) MUST BE CONNECTED TO DRIVE SERVO POWER OUTPUT

TITLE SERVO MODULE INTERFACES		
SIZE B	**PROJECT** MULTIMOD SERVO MODULE	**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON

(1) +3V3 VOLTAGE REGULATOR

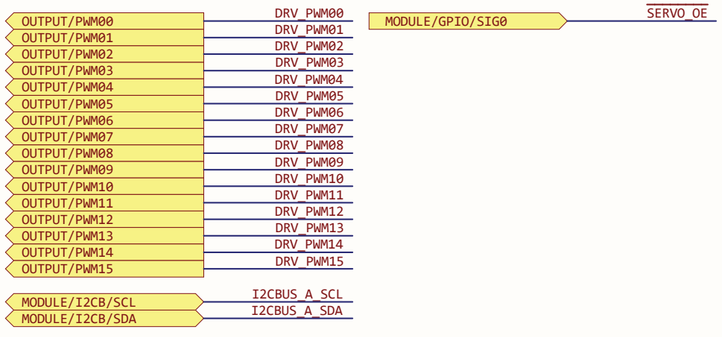


(2) PWM DRIVER



(1) GLOBAL NETS

(2) GLOBAL NETS



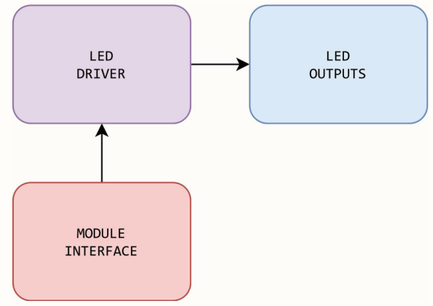
NOTES

[1] PWM DRIVER I2C ADDRESS (P.8 OF PCA9685PW DATASHEET REV 4) = 0x55

TITLE PWM SIGNAL DRIVER		
SIZE B	**PROJECT** MULTIMOD SERVO MODULE	**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON

INDEX	SCHEMATIC	DESCRIPTION
01	S01-INTERFACES	LED MODULE INTERFACES
02	S02-DRIVER	LED OUTPUT DRIVER
03	S03-LEDS	LED OUTPUT ARRAY AND TACTILE BUTTONS

SYSTEM DIAGRAM

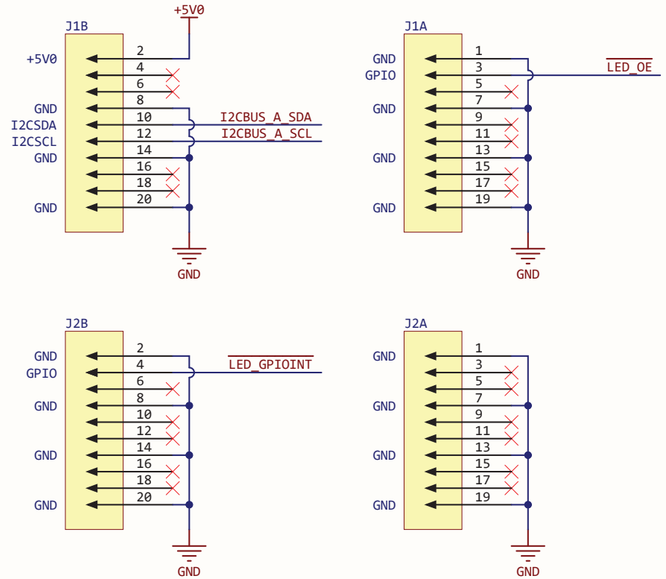


NOTES

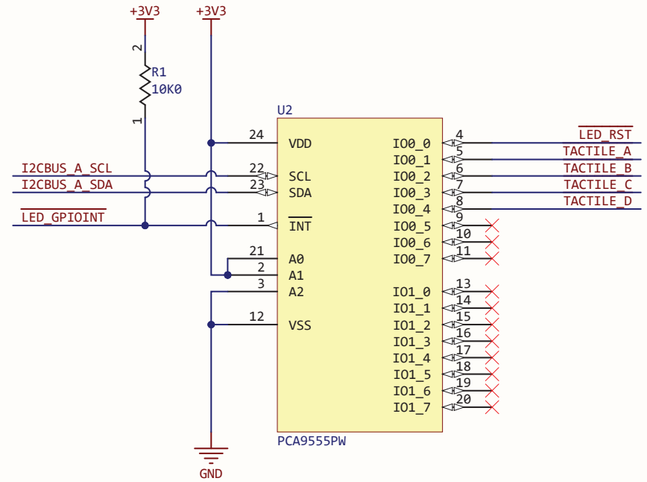
[1] CONNECTION TYPES AND IMPLEMENTATION DETAILS HAVE BEEN OMITTED FROM THE SYSTEM DIAGRAM

TITLE OVERVIEW AND TITLE PAGE			
SIZE B	PROJECT MULTIMOD LED MODULE		REVISION 1
ORGANIZATION UNIVERSITY OF FLORIDA		DESIGNER MEHRON TALEBI	
IDENTIFIER SUMMER 2023		REVIEWER MIKE STAPLETON	

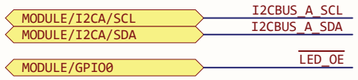
(1) MODULE INTERFACE



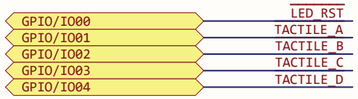
(2) GPIO INTERFACE



(1) GLOBAL NETS



(2) GLOBAL NETS

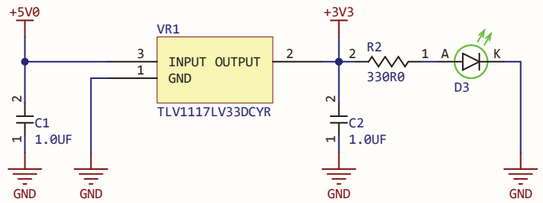


NOTES

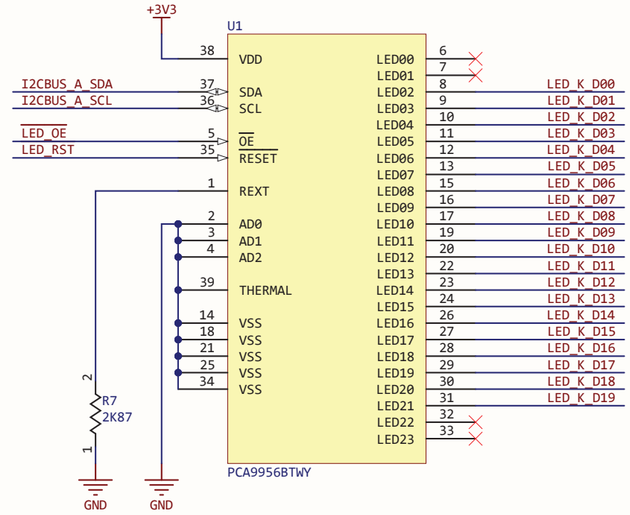
[1] 7-BIT GPIO EXPANDER I2C ADDRESS (P.6 OF PCA9555PW DATASHEET REV 08) = 0x23

TITLE	LED MODULE INTERFACES AND TACTILE BUTTONS		
SIZE B	**PROJECT** MULTIMOD LED MODULE		**REVISION** 1
ORGANIZATION	UNIVERSITY OF FLORIDA	**DESIGNER**	MEHRON TALEBI
IDENTIFIER	SUMMER 2023	**REVIEWER**	MIKE STAPLETON

(1) +3V3 VOLTAGE REGULATOR

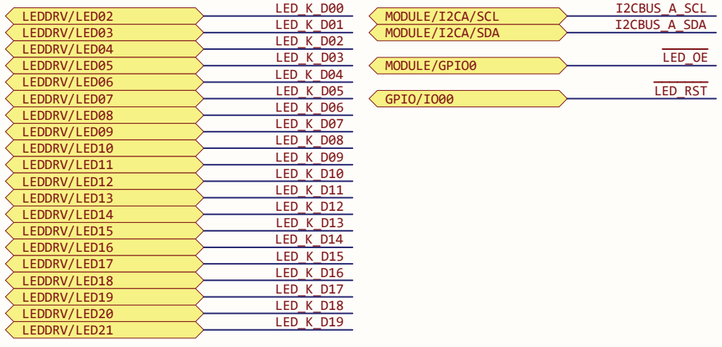


(2) CONSTANT CURRENT LED DRIVER



(1) GLOBAL NETS

(2) GLOBAL NETS



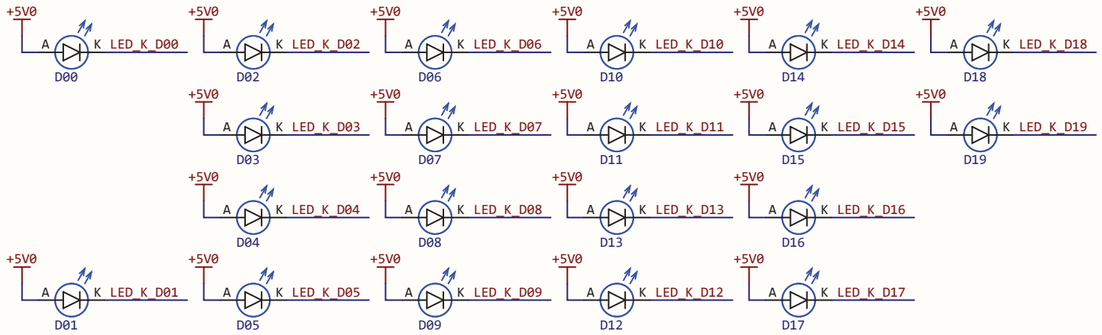
NOTES

[1] REXT CALCULATION (P.24 OF PCA9956BTWY DATASHEET REV 1.1): IOLED = 255 * (0.9 / 4) / REXT ⇒ IOLED ≈ 20 MA ⇒ REXT ≈ 2K87

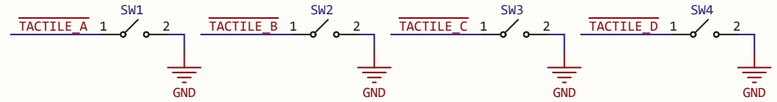
[2] LED DRIVER I2C ADDRESS = 0x01

TITLE LED OUTPUT DRIVER		
SIZE B	**PROJECT** MULTIMOD LED MODULE	**REVISION** 1
ORGANIZATION UNIVERSITY OF FLORIDA		**DESIGNER** MEHRON TALEBI
IDENTIFIER SUMMER 2023		**REVIEWER** MIKE STAPLETON

(1) LED ARRAY



(1) TACTILE SWITCHES



(1) GLOBAL NETS

LEDDRV/LED02	LED_K_D00
LEDDRV/LED03	LED_K_D01
LEDDRV/LED04	LED_K_D02
LEDDRV/LED05	LED_K_D03
LEDDRV/LED06	LED_K_D04
LEDDRV/LED07	LED_K_D05
LEDDRV/LED08	LED_K_D06
LEDDRV/LED09	LED_K_D07
LEDDRV/LED10	LED_K_D08
LEDDRV/LED11	LED_K_D09
LEDDRV/LED12	LED_K_D10
LEDDRV/LED13	LED_K_D11
LEDDRV/LED14	LED_K_D12
LEDDRV/LED15	LED_K_D13
LEDDRV/LED16	LED_K_D14
LEDDRV/LED17	LED_K_D15
LEDDRV/LED18	LED_K_D16
LEDDRV/LED19	LED_K_D17
LEDDRV/LED20	LED_K_D18
LEDDRV/LED21	LED_K_D19

(1) GLOBAL NETS

GPIO/IO01	TACTILE_A
GPIO/IO02	TACTILE_B
GPIO/IO03	TACTILE_C
GPIO/IO04	TACTILE_D

NOTES

N/A

TITLE	LED ARRAY AND TACTILE SWITCHES	
SIZE: B	PROJECT: MULTIMOD LED MODULE	REVISION: 1
ORGANIZATION: UNIVERSITY OF FLORIDA		DESIGNER: MEHRON TALEBI
IDENTIFIER: SUMMER 2023		REVIEWER: MIKE STAPLETON