HDD Clock V4.1

This is the schematic for the Driver board of my HDD Persistence of Vision Clock V4.1

If a * is placed next to a line it indicates it is new to V4.1

Main improvements and included features of this driver board:

1. Powered fully from 12V DC Jack
   - features a buck converter design capable of 2.4A @ 5V
   - 3.3V LDO capable of 500mA
2. APA102-2020 LEDs instead of WS2812B LEDs
   - The new LEDs are capable of 25x data speed.
   - the 2020 package takes up 60% less area than WS2812B LEDs allowing many more to be placed in the same space (V4.0 of the LED board has 116 LEDs).
   - *Display line SPI capable of driving LEDs at 50Mhz
3. Integrated I2C PCB Temperature sensors.
   - Driver Board PCB temp
   - Ambient air temperature *routing is improved in V4.1
   - LED Board temp (connections for this off-board temp sensor)
4. Multiple light masks and persistence of vision displays.
   - Method 1: The light mask has a slit from the center of the mask to the outer edge. With this light mask an analog clock can be drawn using persistence of vision.
   - Method 2: The light mask is arranged in a pattern of a 'Nipkow Disk'. A Nipkow disk is a disk with holes spiraling at a constant rate away from the center of the disk. Back-lighting these holes using persistence of vision should allow for pixels to be drawn using the spinning disk. Using a light mask between LEDs I should be able to create multiple of these displays using the entire circular area of the spinning light mask. If this works it will be a circular mechanical display. I have 2 Nipkow disks designed. An 8 line tall disk and a 12 line tall disk.
6. Encoder and right angle buttons used for user input.
7. Wires have been removed from the assembly.
   - Connections between this driver board and the LED board are made with SMT spring-loaded PCB pins on the driver board and matching pin target pad on the LED board.
8. *New motor control chip: DRV11873
9. *New DC jack.

STM32F411 + Level shifting

I2C Devices

Motor Driver

Power

Interface

LED Board and Motor Connections

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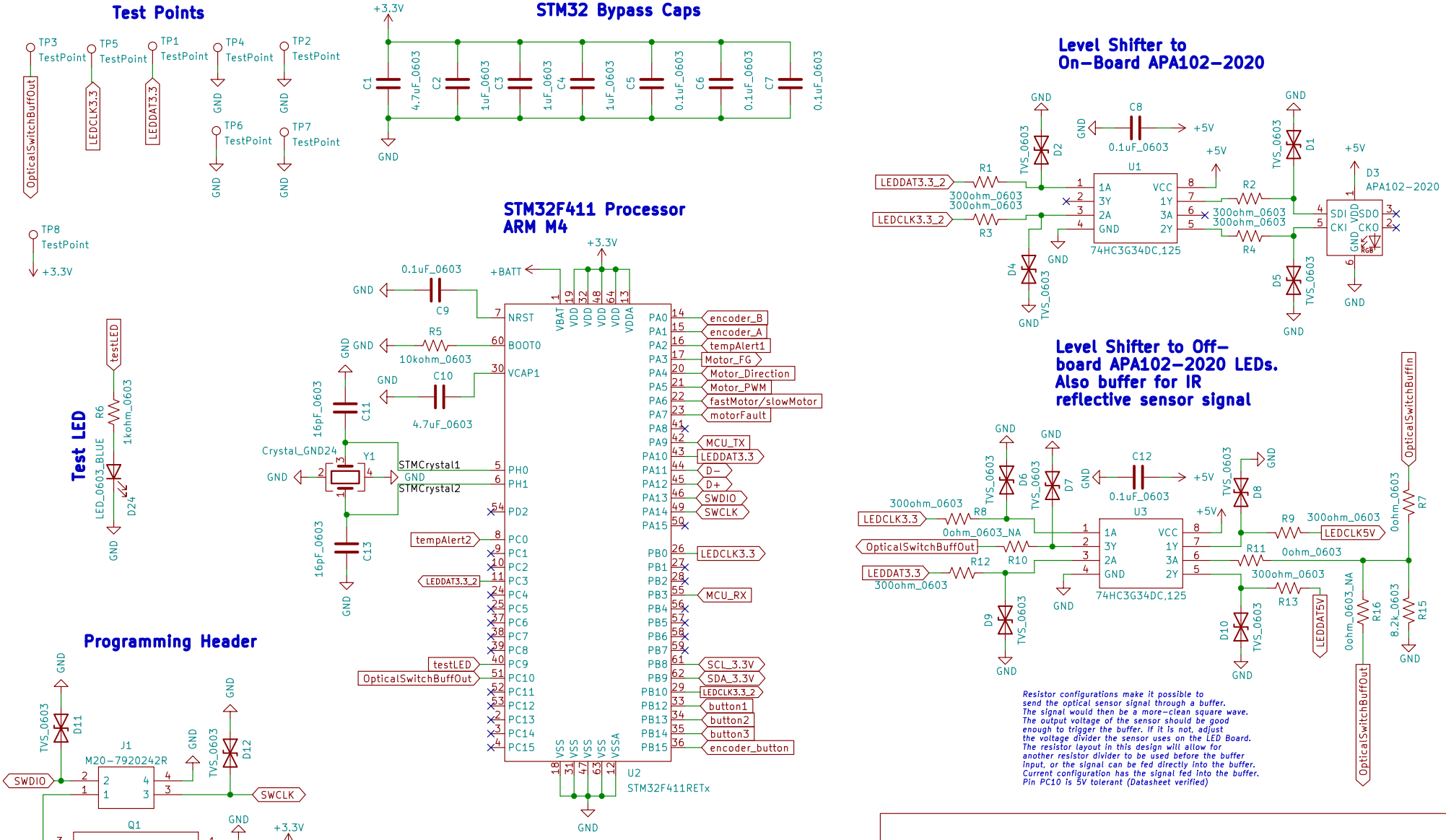
Sheet: /
File: Driver Board_HDDCLKV4.1.kicad_sch

Title: Cover Page

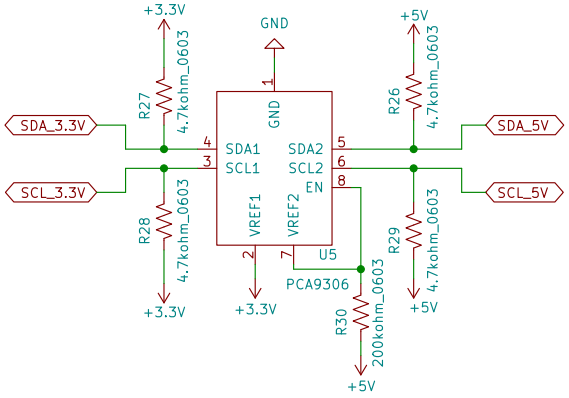
Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 1/12

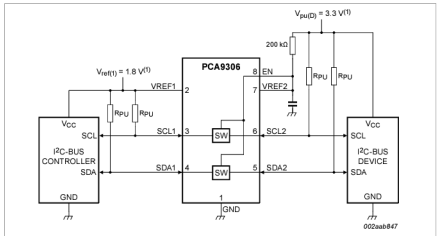


Kadin Whiting	
Sheet: /STM32F411 + Level shifting/	
File: STM32F411 + Level shifting.kicad_sch	
Title: STM32F411 & Level Shifting	
Size: A4	Date: 2022-07-03
KiCad E.D.A. kicad (6.0.1)	Rev: 4.1
	Id: 2/12

5V I2C Devices

I2C Level Shifter





1. The applied voltages at $V_{ref(1)}$ and $V_{pu(D)}$ should be such that $V_{bias(ref)(2)}$ is at least 1 V higher than $V_{ref(1)}$ for best translator operation.

Figure 9. Typical application circuit (switch always enabled)

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Sheet: /I2C Devices/
File: I2C Devices.kicad_sch

Title: I2C Level Shifting

Size: A4	Date: 2022-07-03	**Rev: 4.1**
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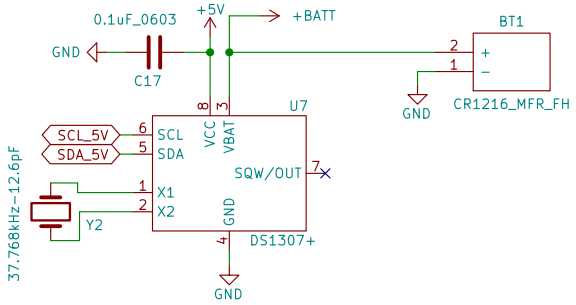
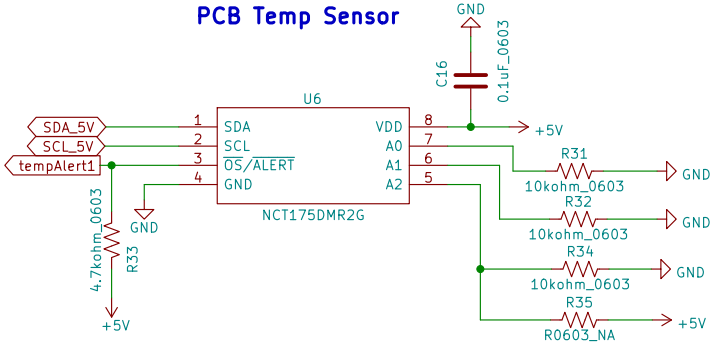
Real Time Clock

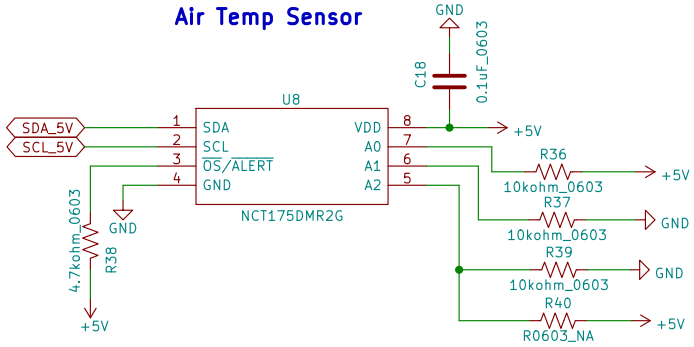


PCB Temp Sensor



address setting resistors

Air Temp Sensor



address setting resistors

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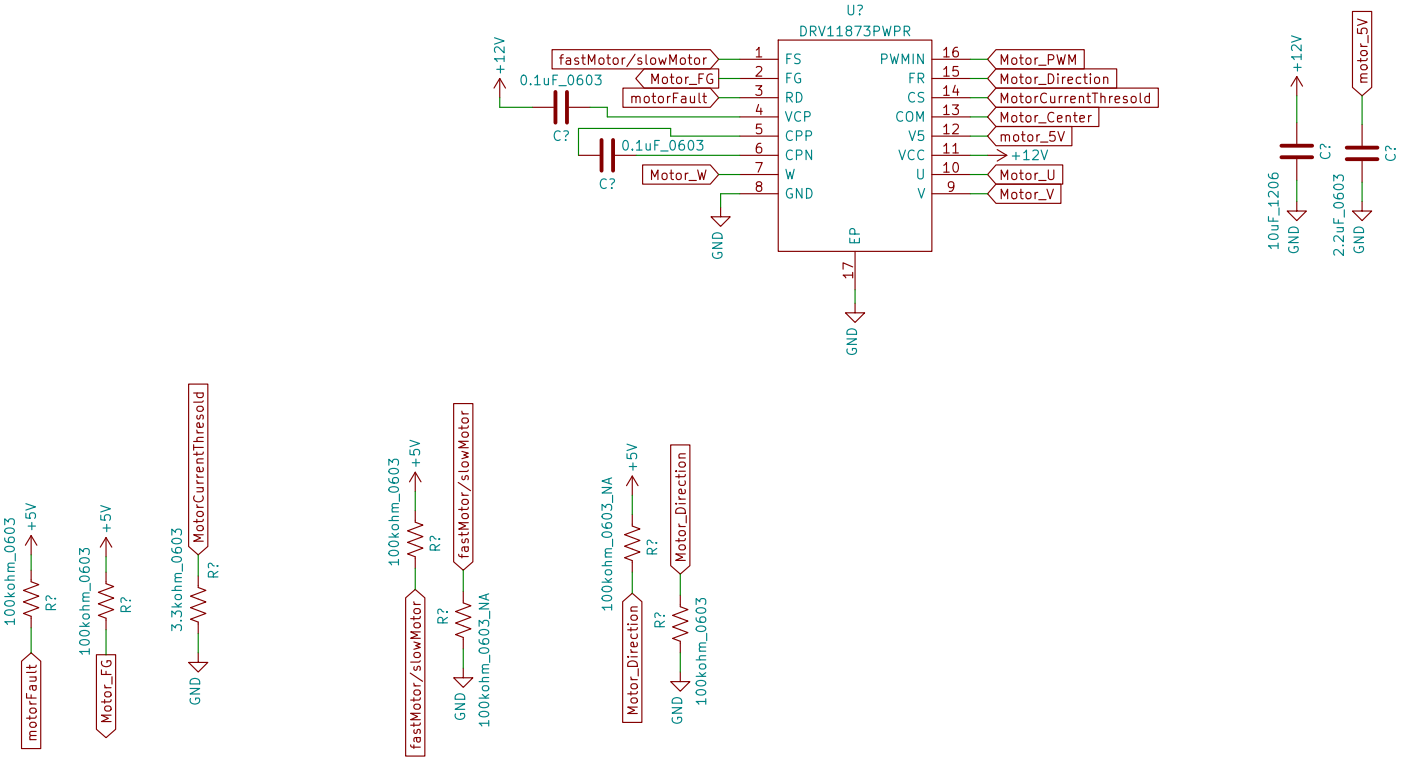
Sheet: /I2C Devices/5V I2C Devices/
File: 5V I2C Devices.kicad_sch

Title: +5V I2C Devices

Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 4/12



Sheet: /Motor Driver/ File: Motor Driver.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.1)		Id: 5/12

POWER:

12V -> 5V -> 3.3V

12V DC Jack -> 5V Buck Converter -> 3.3V LDO

5V USB -> 3.3V LDO (no motor power)

This version of the HDD Persistence of vision clock takes 12V in from a DC jack. The motor driver uses the 12V to drive the motor. The 12V is fed into a buck converter circuit. This circuit is capable of 2.5A @ 5V output. 5V powers the RTC, temp sensors and LEDs. 5V is fed into a 3.3V regulator capable of 500mA output. 3.3V powers the stm32 ARM processor.

Power Connectors

Buck Converter

LDO

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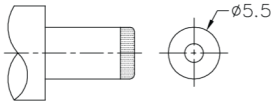
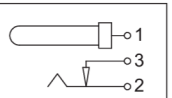
Sheet: /Power/
File: Power.kicad_sch

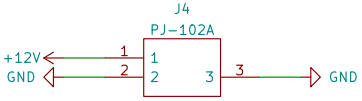
Title: Power Overview

Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 6/12

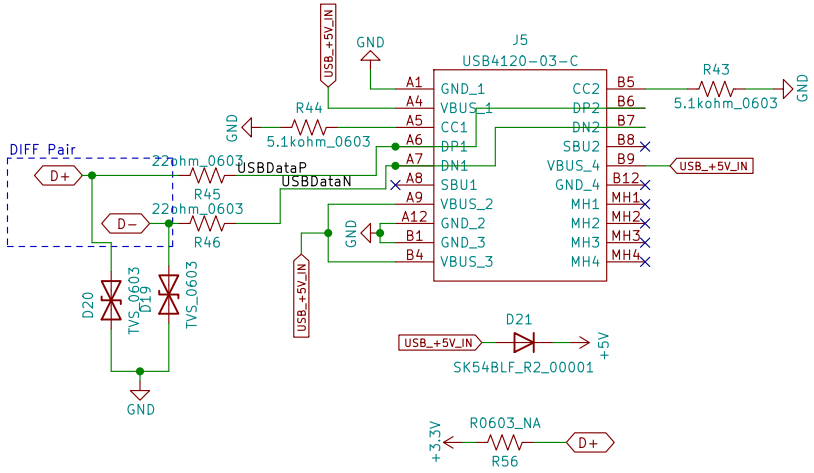


MATING PLUG
Jack Insertion Depth: 9.0 mm

SCHEMATIC	
Model	PJ-102A
Center Pin	Ø2.0 mm

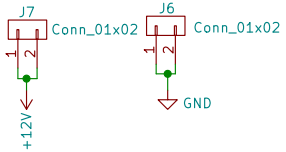


USB-C (USB 2.0 Device Only)



Ordered Cable Polarity

Backup Power Input



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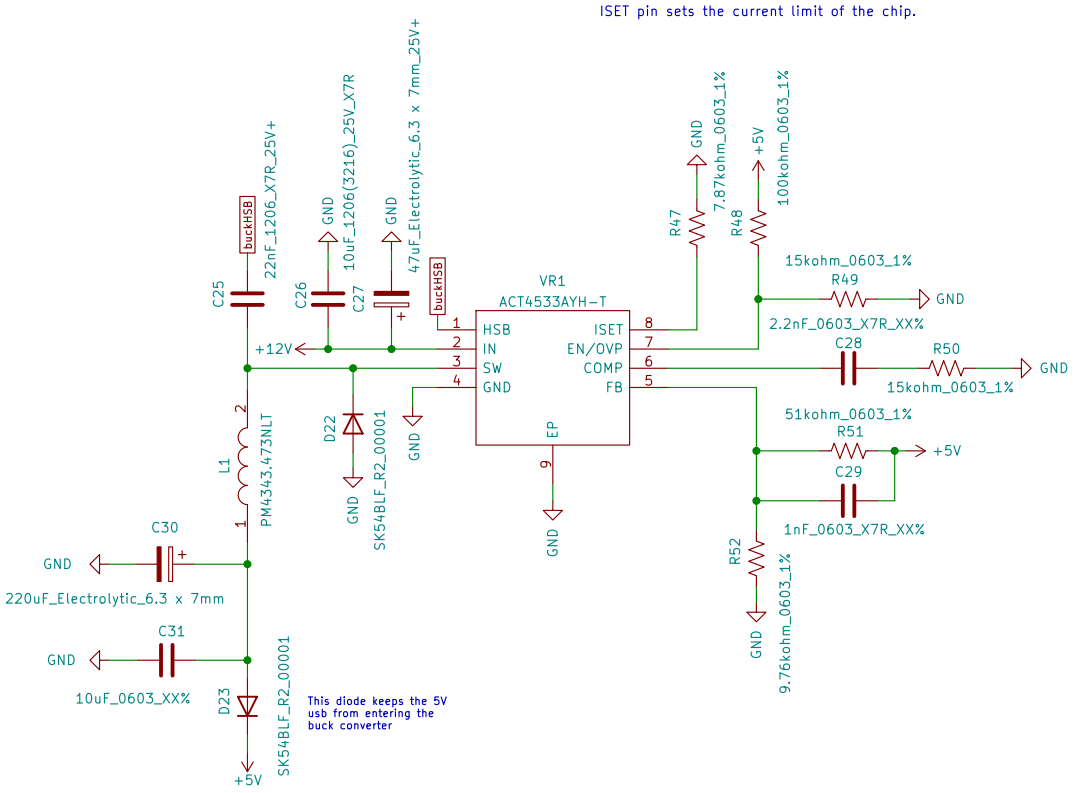
Sheet: /Power/Power Connectors/
File: Power Connectors.kicad_sch

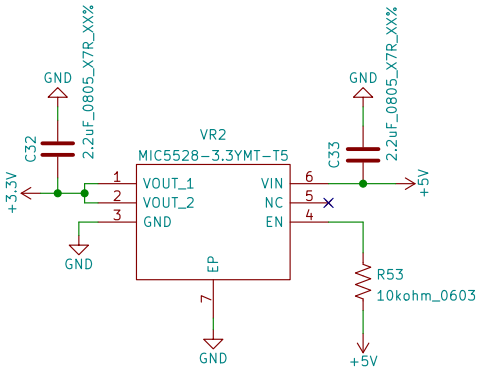
Title: Power Connectors

Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 7/12

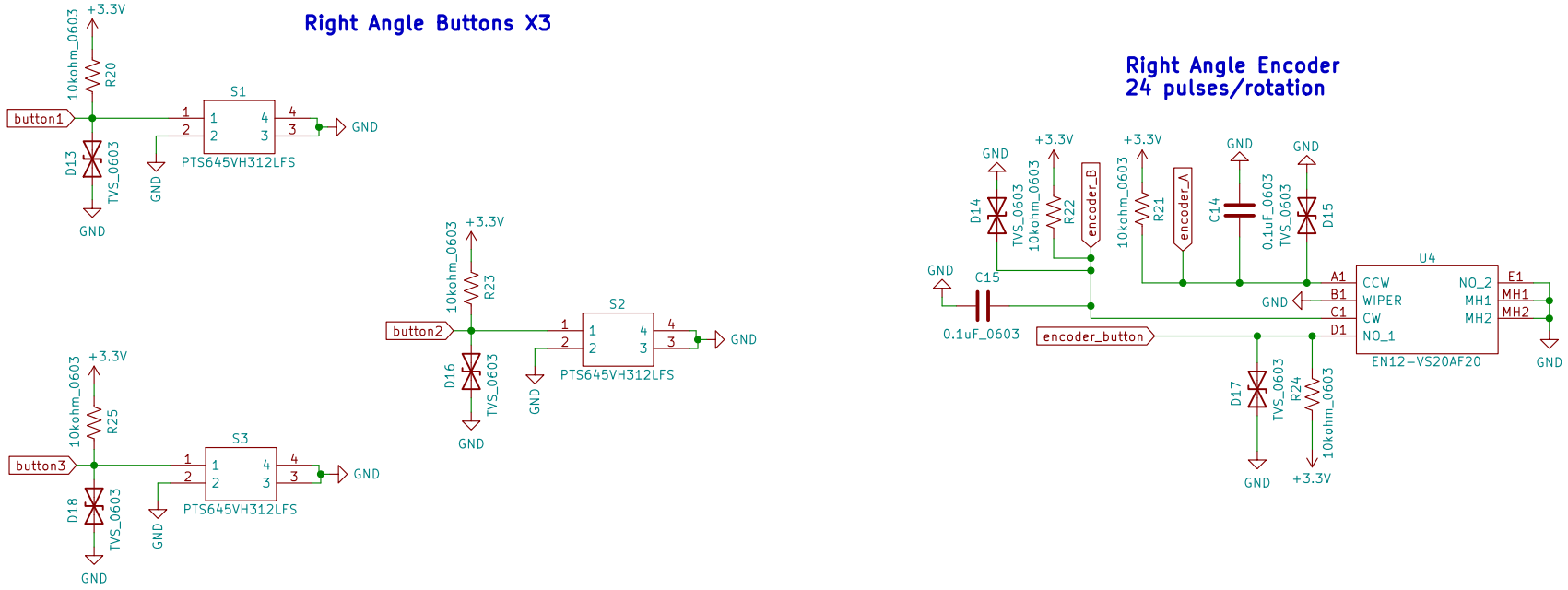


Kadin Whiting		
Sheet: /Power/Buck Converter/		
File: Buck Converter.kicad_sch		
Title: Buck Converter (5V@2.4A)		
Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 8/12

3.3V LDO



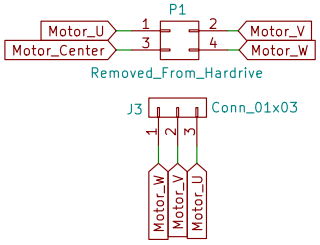
Kadin Whiting		
Sheet: /Power/LDO/ File: LDO.kicad_sch		
Title: +3.3V LDO (500mA)		
Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 9/12



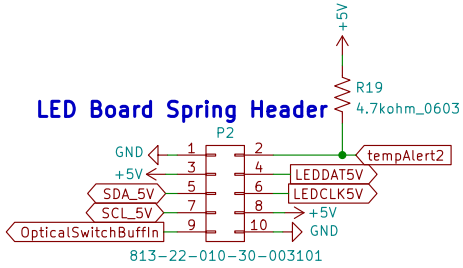
Kadin Whiting		
Sheet: /Interface/		
File: Interface.kicad_sch		
Title: Interface		
Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 10/12

Mounting Holes

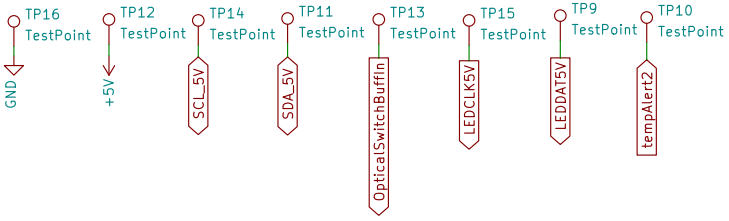
Motor Connections



LED Board Spring Header

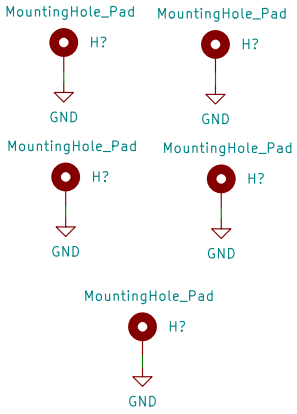


Test points for LED Board alignment verification



Kadin Whiting		
Sheet: /LED Board and Motor Connections/		
File: LED Board and Motor Connections.kicad_sch		
Title: LED Board and Motor Connections		
Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 11/12

Screw Mounting Holes



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Sheet: /LED Board and Motor Connections/Mounting Holes/
File: Mounting Holes.kicad_sch

Title: Mounting Holes

Size: A4	Date: 2022-07-03	**Rev: 4.1**
KiCad E.D.A. kicad (6.0.1)		Id: 12/12