HDD Clock V4.0

This is the schematic for the Driver board of my HDD Persistence of Vision Clock V4.0
V3.0 never got completely finished. I have decided to aproach power in a different way so
I've moved the project to V4.0.

If a * is placed next to a line it indicates it is new to V4.0

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 (V3.0 had this idea too, but was never finished)
   –The new LEDs are capable of 25x data speed.
   –the 2020 package takes up 60% less area allowing many more to be placed in the same space.
   *–Lessons learned from V3.0 is these are a bit tricky to assemble. Take great care when installing these LEDs. Very prone to shorts.
3. Integrated I2C PCB Temperature sensors.
   –Driver Board PCB temp
   –Ambient air temperature
   –LED Board temp (connections for this off–board temp sensor)
4. Upgraded light mask and persistence of vision method.
   –This version uses several holes in the spinning light mask rather than 1 large slit. precise tracking of the holes and lighting of specific LEDs should allow for 'pixels' to be drawn around the spinning platter rather than just being able to draw a line from the center. STILL NEEDS VALIDATION.
5. Potentiometer was replaced with an encoder.
   –It wasnt always clear to every user that there was an end to the travel of the potentiometer on V1 and V2. An encoder will remove this problem.
6. Right angle buttons replace the old buttons. Buttons reduced from 4 to 3.
   –Finding the old buttons was often difficult. Spacing the buttons out further and making them more visible should help this problem.
   *–I messed up the design of these buttons. The same buttons can be used as V3.0, just fix the design. See notes from V3.0
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.

STM32F411 + Level shifting

I2C Devices

Power

Interface

LED Board and Motor Connections

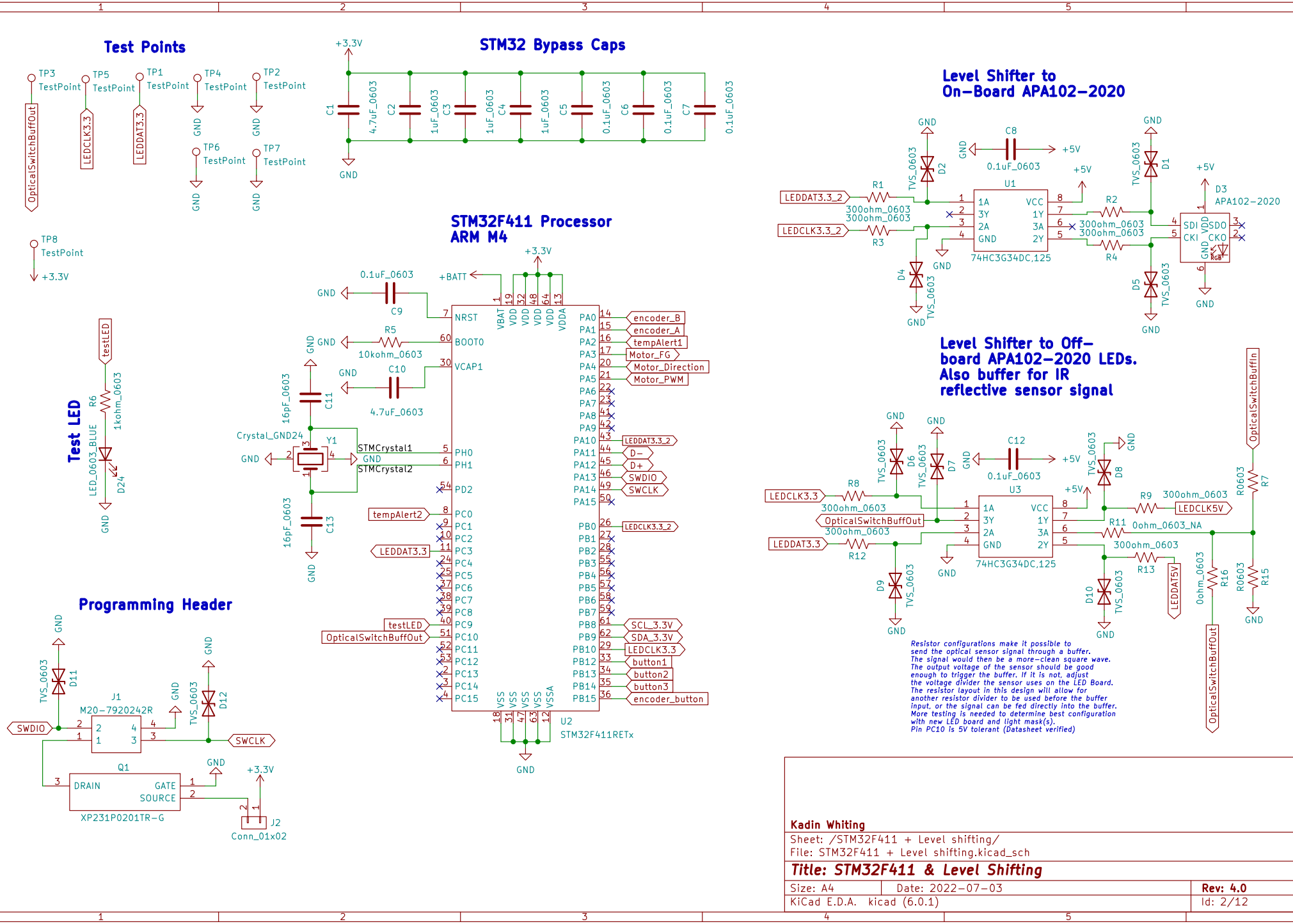
Mounting Holes

Kadin Whiting

Sheet: /
File: Driver Board_HDDCLKV4.0.kicad_sch

Title: Cover Page

Size: A4	Date: 2022–07–03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 1/12

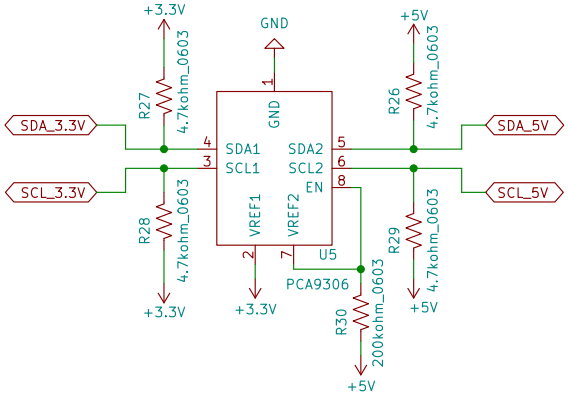


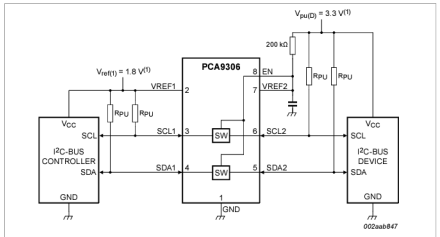
Kadin Whiting	
Sheet: /STM32F411 + Level shifting/	
File: STM32F411 + Level shifting.kicad_sch	
Title: STM32F411 & Level Shifting	
Size: A4	Date: 2022-07-03
KiCad E.D.A. kicad (6.0.1)	Rev: 4.0
	Id: 2/12

5V I2C Devices

3V3 I2C Devices

I2C Level Shifter





1. The applied voltages at $V_{ref(1)}$ and $V_{pu(D)}$ should be such that $V_{bias(refj(2)}$ 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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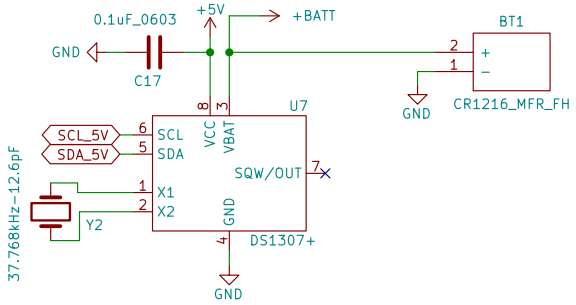
Sheet: /I2C Devices/

File: I2C Devices.kicad_sch

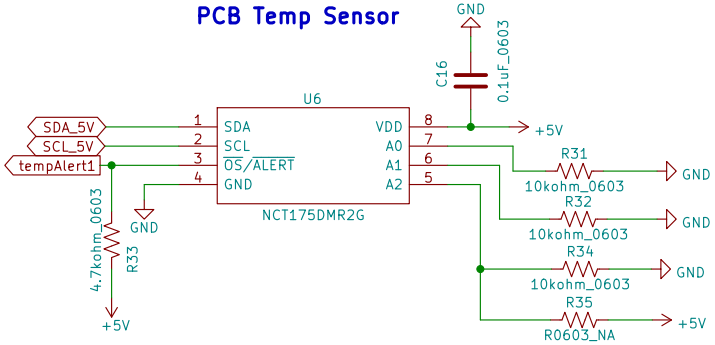
Title: I2C Level Shifting

Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 3/12

Real Time Clock

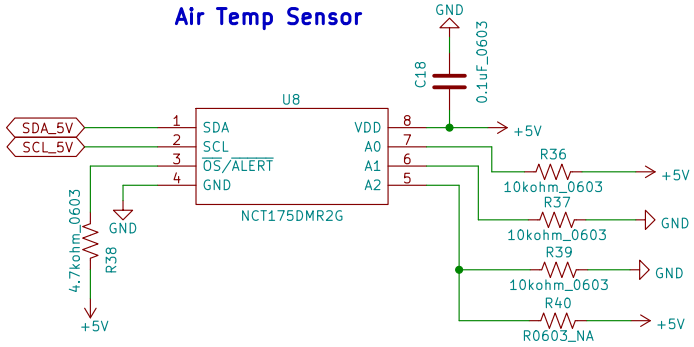


PCB Temp Sensor



address setting resistors

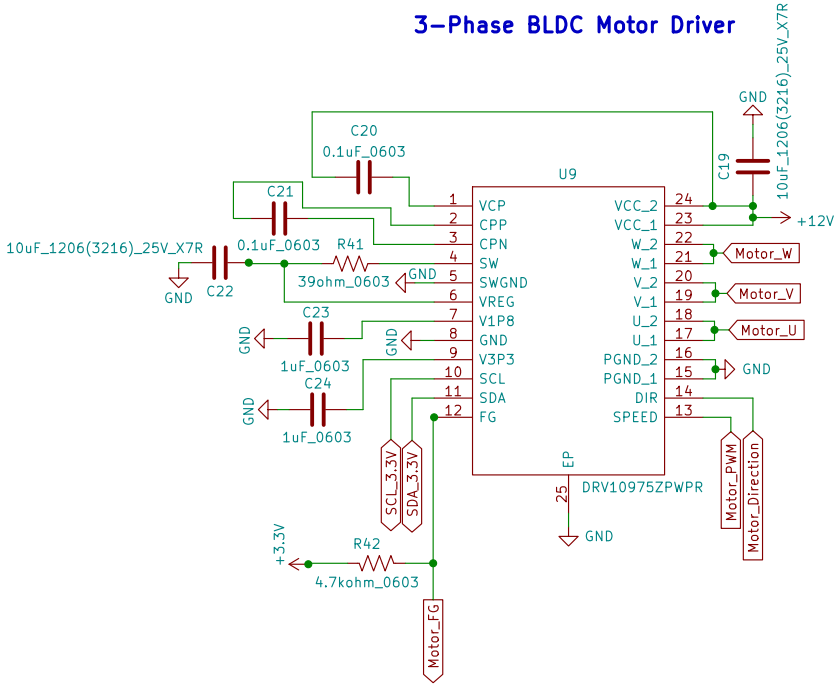
Air Temp Sensor



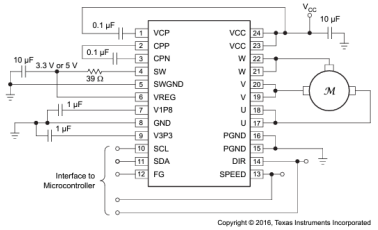
address setting resistors

Kadin Whiting		
Sheet: /I2C Devices/5V I2C Devices/		
File: 5V I2C Devices.kicad_sch		
Title: +5V I2C Devices		
Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 4/12

3-Phase BLDC Motor Driver



Application Schematic



Kadin Whiting		
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File: 3V3 I2C Devices.kicad_sch		
Title: +3.3V I2C Devices		
Size: A4	Date: 2022-07-03	**Rev: 4.0**
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. 5V powers the RTC, temp sensors and LEDs. 5V is fed into a 3.3V regulator capable of 500mA. 3.3V powers the stm32 ARM processor and motor chip and communication.

Power Connectors

Buck Converter

LDO

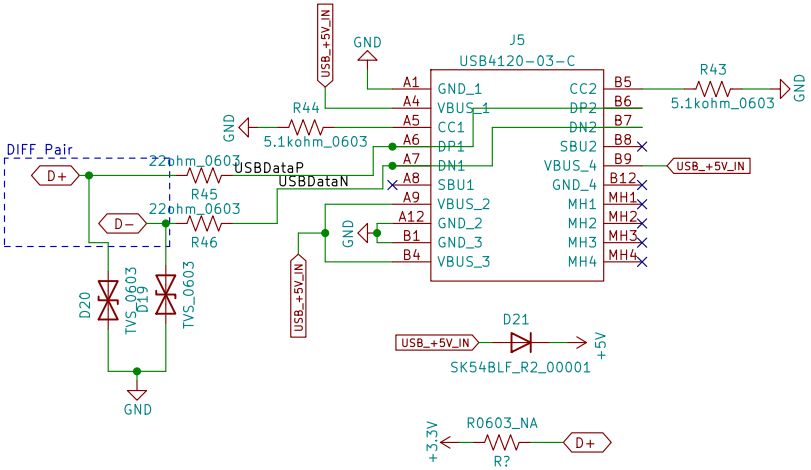
Kadin Whiting

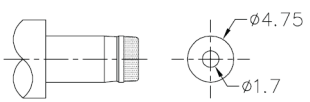
Sheet: /Power/
File: Power.kicad_sch

Title: Power Overview

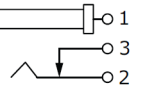
Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 6/12

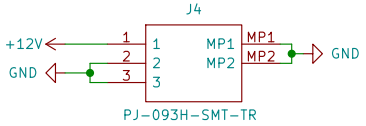
USB-C (USB 2.0 Device Only)





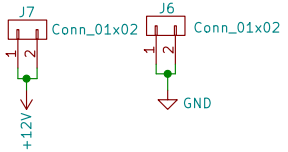
MATING PLUG
Jack Insertion Depth: 8 mm

SCHEMATIC	
Model	PJ-093H-SMT-TR
Center Pin	Ø1.65 mm



Ordered Cable Polarity

Backup Power Input



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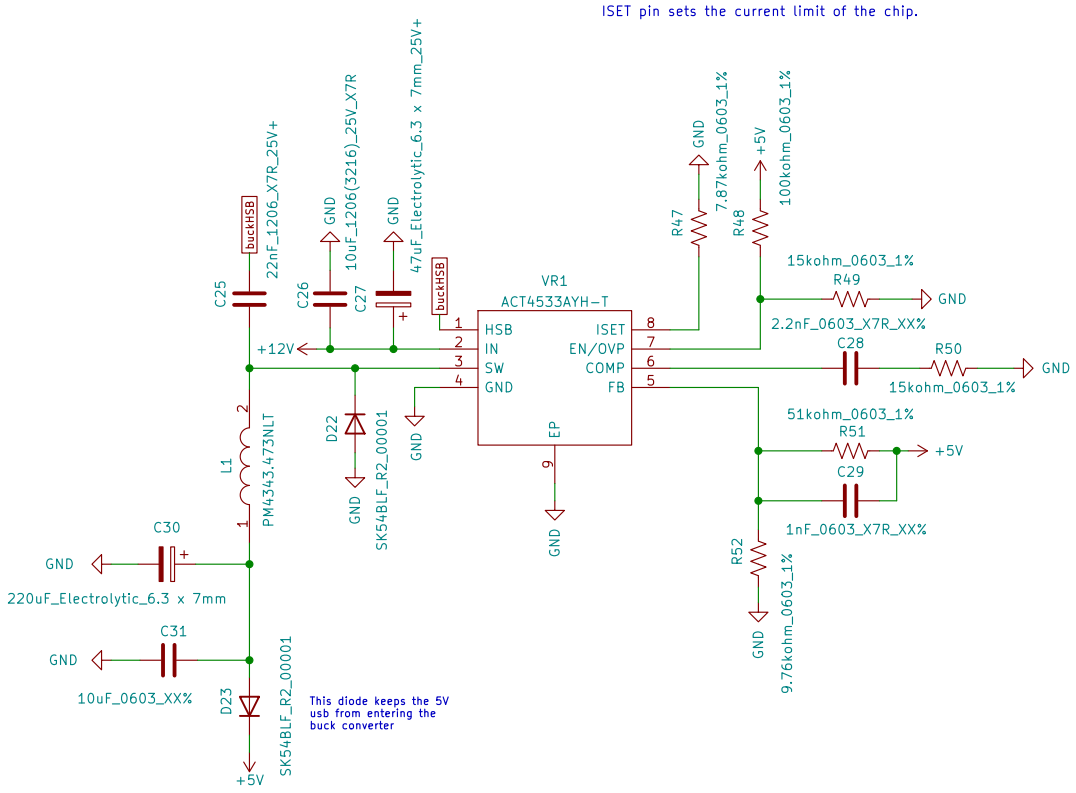
Sheet: /Power/Power Connectors/
File: Power Connectors.kicad_sch

Title: Power Connectors

Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 7/12



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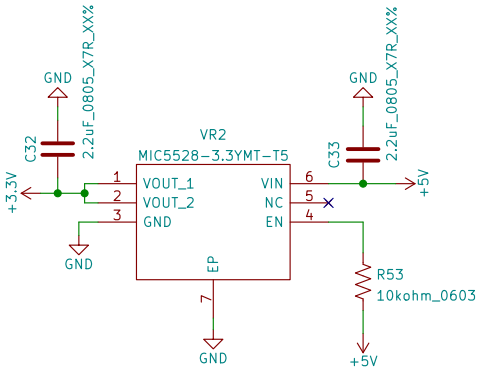
Sheet: /Power/Buck Converter/		
File: Buck Converter.kicad_sch		
Title: Buck Converter (5V@2.4A)		
Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 8/12

3.3V LDO



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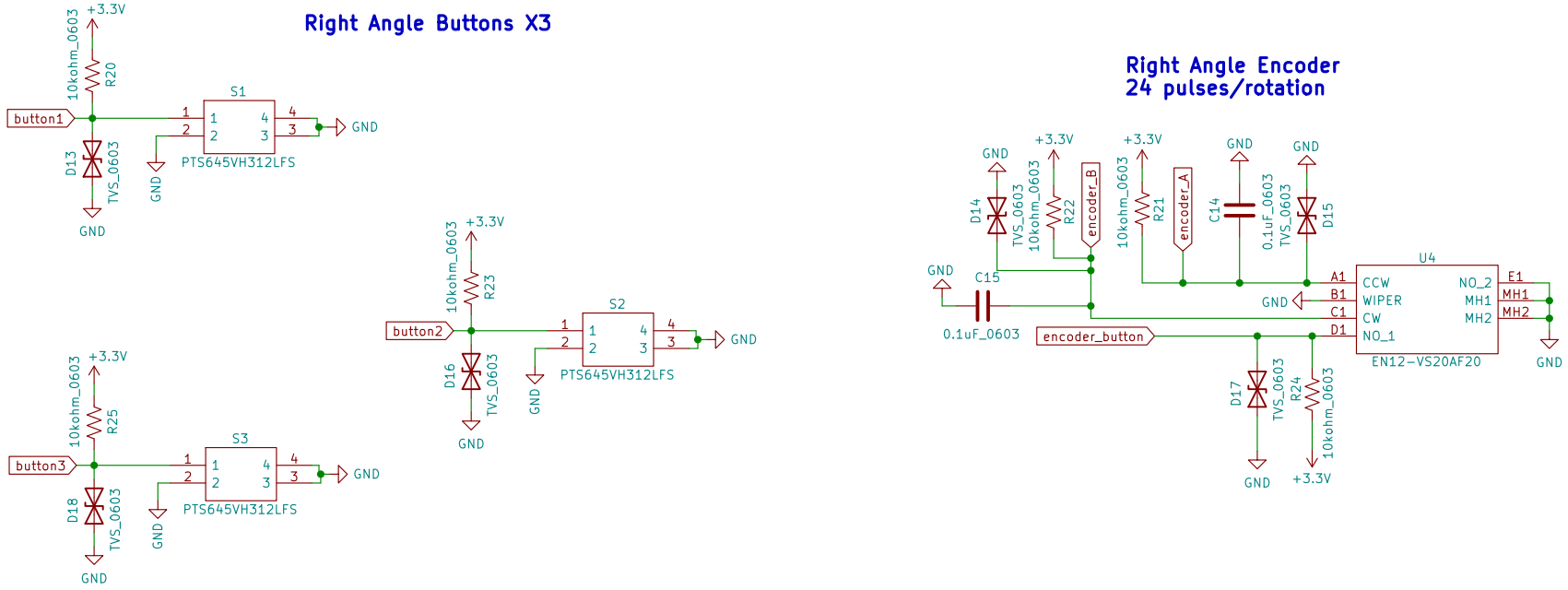
Title: +3.3V LDO (500mA)		
Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 9/12



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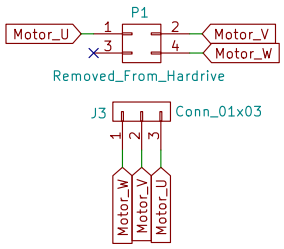
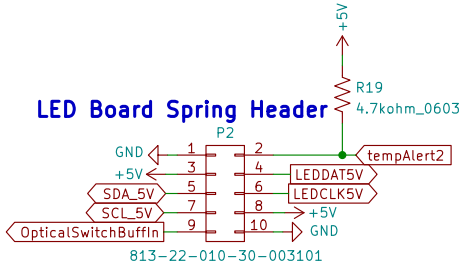
Title: Interface		
Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 10/12

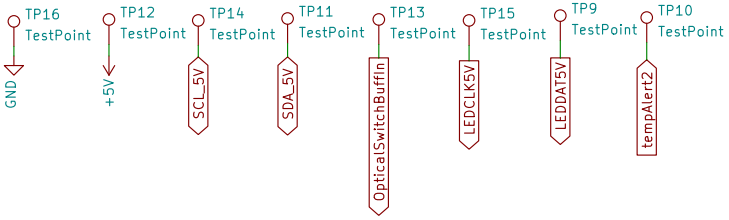
Motor Connections



LED Board Spring Header



Test points for LED Board alignment verification



Kadin Whiting		
Sheet: /LED Board and Motor Connections/		
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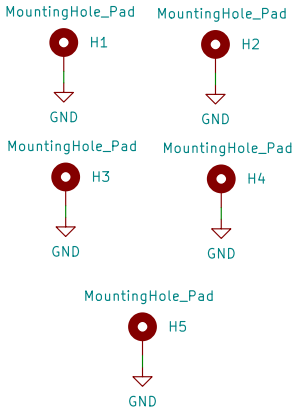
Title: LED Board and Motor Connections		
Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 11/12

Screw Mounting Holes



Kadin Whiting

Sheet: /Mounting Holes/
File: Mounting Holes.kicad_sch

Title: Mounting Holes

Size: A4	Date: 2022-07-03	**Rev: 4.0**
KiCad E.D.A. kicad (6.0.1)		Id: 12/12