

## 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

**Kadin Whiting**

Sheet: /

File: Driver Board\_HDDCLKV4.1.kicad\_sch

**Title: Cover Page**

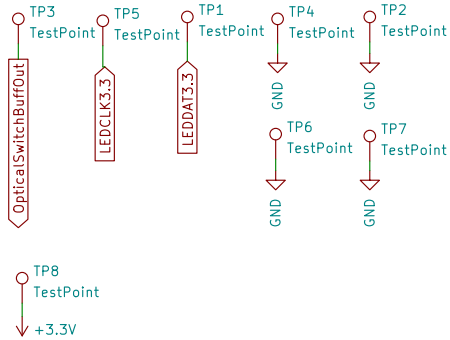
Size: A4 Date: 2022–09–29

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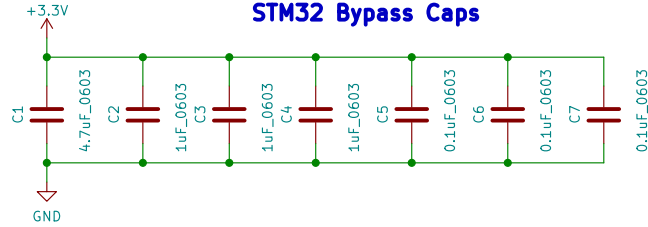
**Rev: 4.1**

Id: 1/12

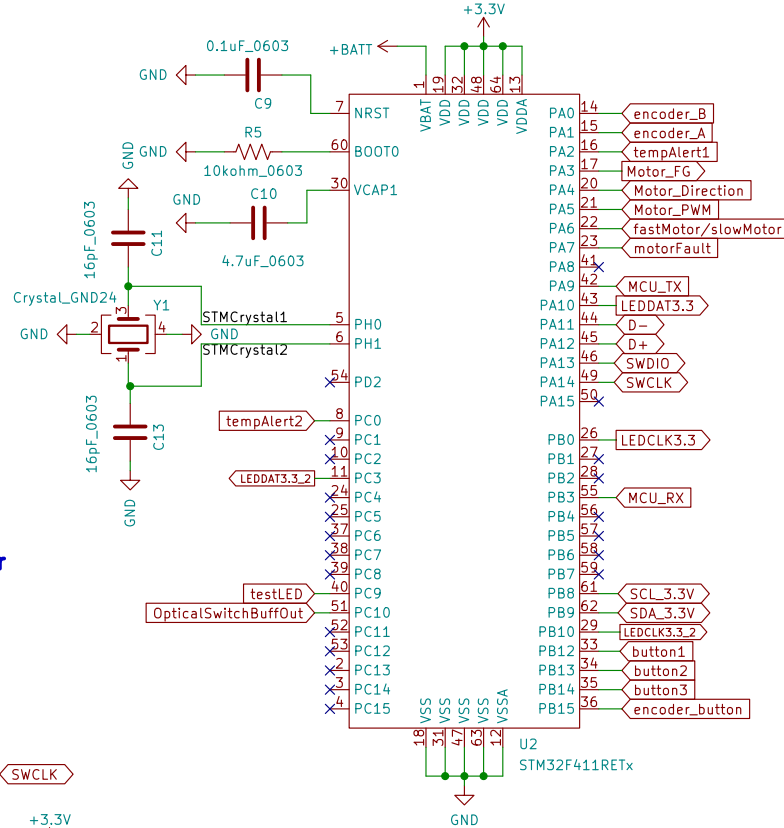
## Test Points



## STM32 Bypass Caps



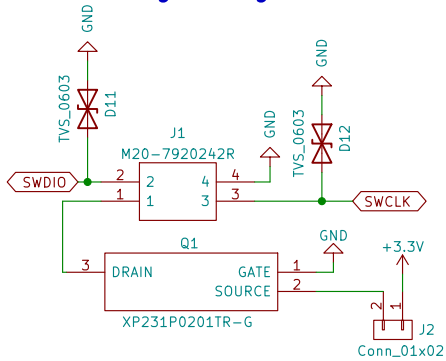
## STM32F411 Processor ARM M4



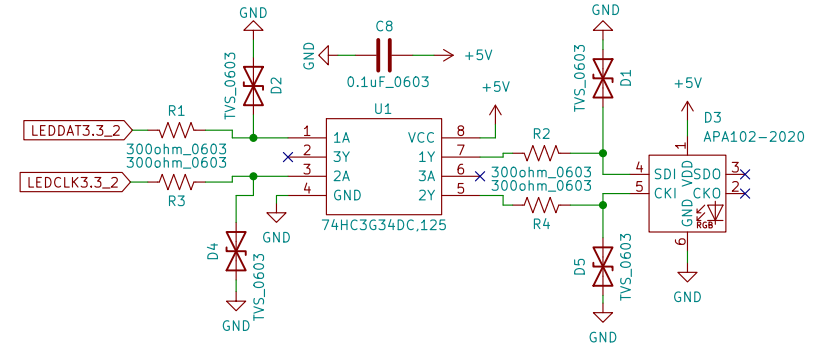
## Test LED



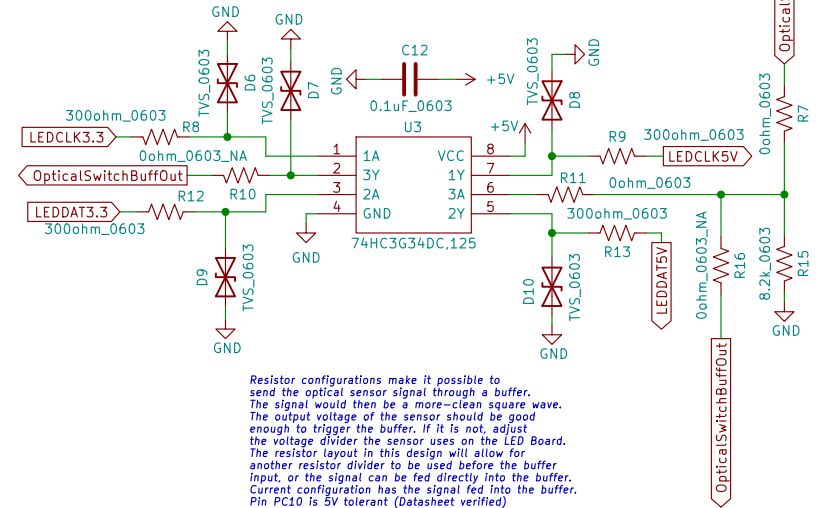
## Programming Header



## Level Shifter to On-Board APA102-2020



## Level Shifter to Off-board APA102-2020 LEDs. Also buffer for IR reflective sensor signal



Resistor configurations make it possible to send the optical sensor signal through a buffer. The signal would then be a more-clean square wave. The output voltage of the sensor should be good enough to trigger the buffer. If it is not, adjust the voltage divider the sensor uses on the LED Board. The resistor layout in this design will allow for another resistor divider to be used before the buffer input, or the signal can be fed directly into the buffer. Current configuration has the signal fed into the buffer. Pin PC10 is 5V tolerant (Datasheet verified)

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Sheet: /STM32F411 + Level shifting/  
File: STM32F411 + Level shifting.kicad\_sch

Title: STM32F411 & Level Shifting

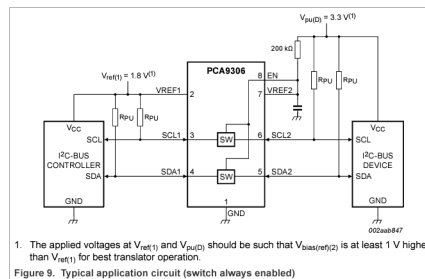
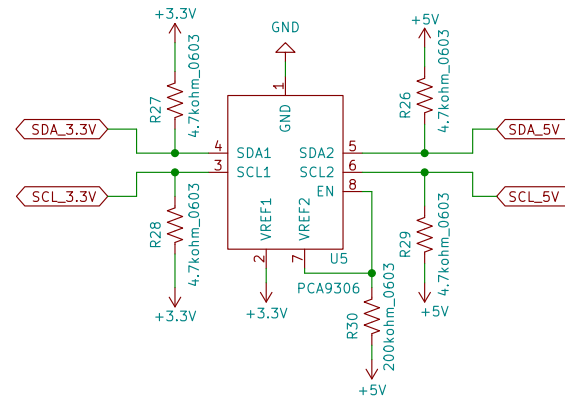
Size: A4 Date: 2022-09-29

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## I2C Level Shifter



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Sheet: /I2C Devices/  
File: I2C Devices.kicad\_sch

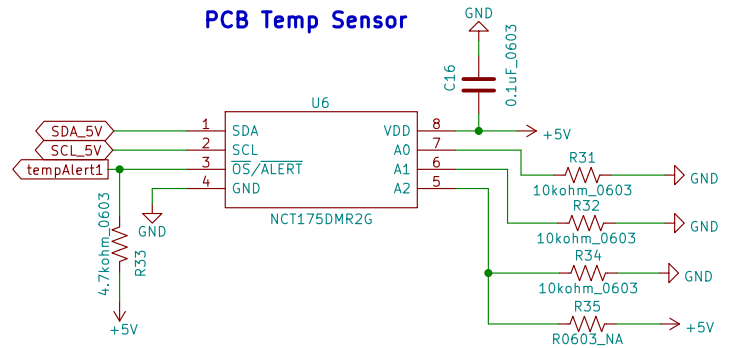
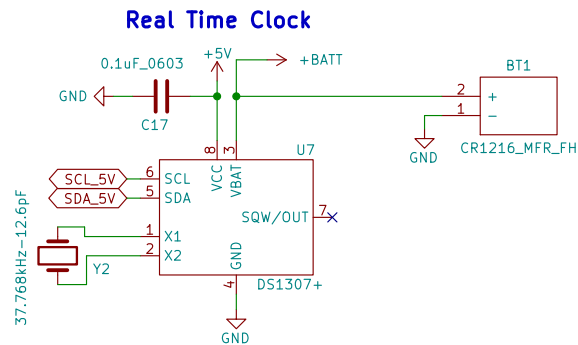
**Title: I2C Level Shifting**

Size: A4 Date: 2022-09-29

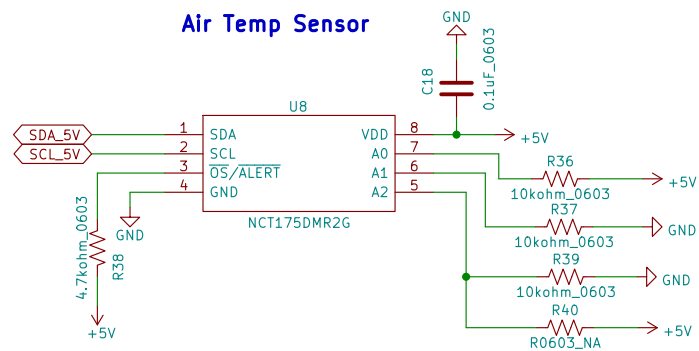
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address setting resistors



address setting resistors

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Sheet: /I2C Devices/5V I2C Devices/  
File: 5V I2C Devices.kicad\_sch

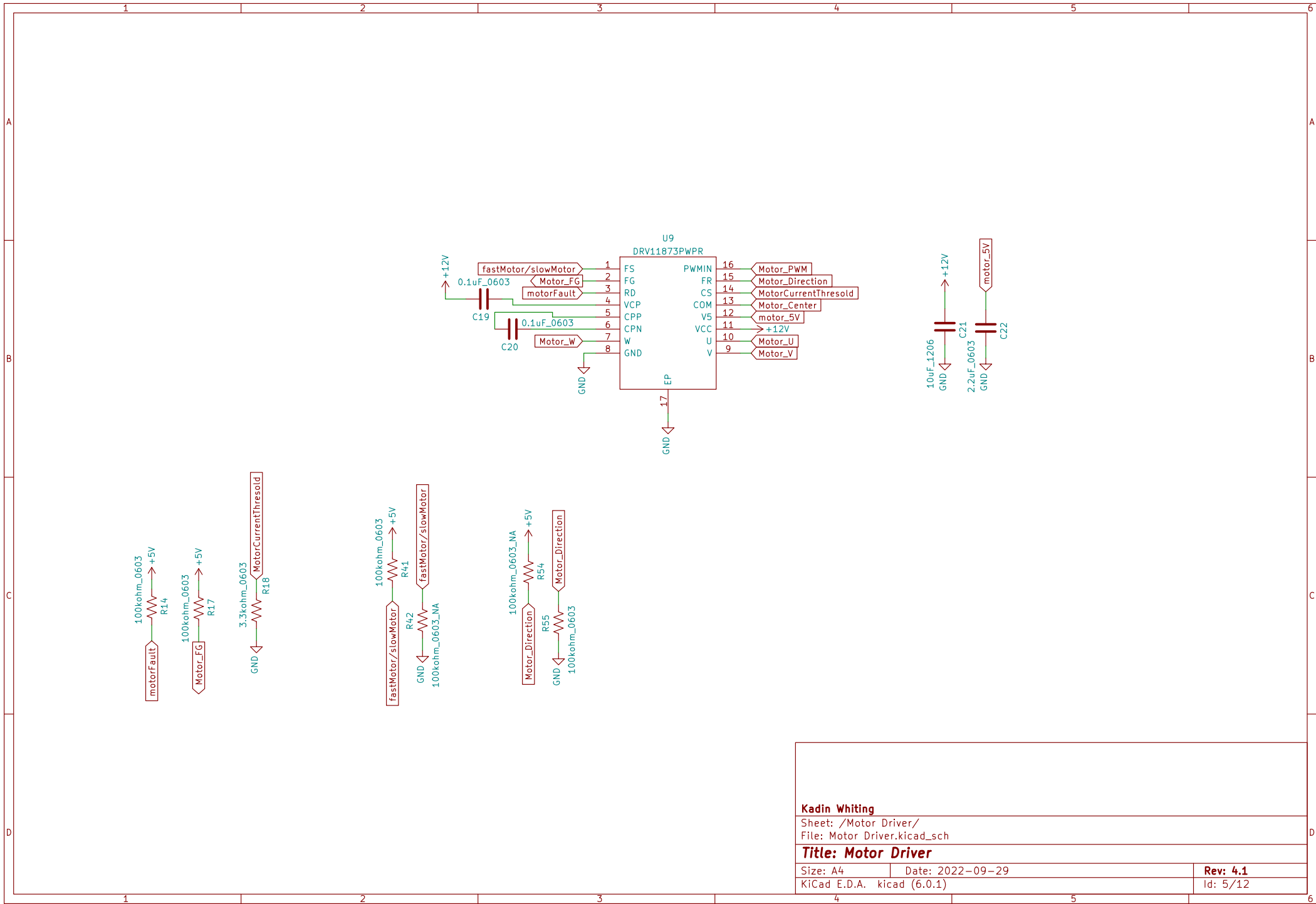
**Title: +5V I2C Devices**

Size: A4 Date: 2022-09-29

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**Rev: 4.1**

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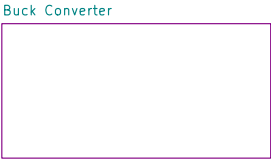
POWER:

12V -> 5V -> 3.3V

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


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

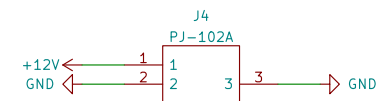
This version of the HDD Persistence of vision clock takes 12V in from a DC jack. The motor driver uses the 12V to drive the motor. The 12V is fed into a buck converter circuit. This circuit is capable of 2.5A @ 5V output. 5V powers the RTC, temp sensors and LEDs. 5V is fed into a 3.3V regulator capable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



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Sheet: /Power/		
File: Power.kicad_sch		
Title: Power Overview		
Size: A4	Date: 2022-09-29	Rev: 4.1
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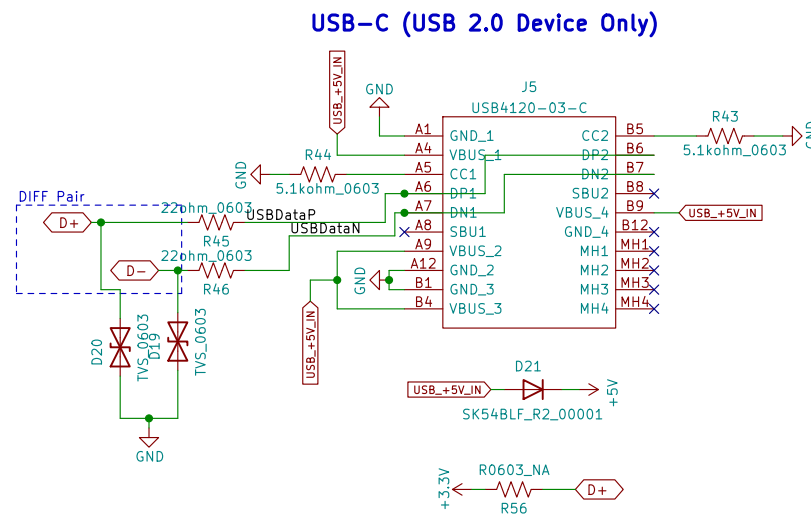
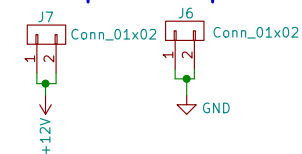
SCHEMATIC	
Model	PJ-102A
Center Pin	Ø2.0 mm



### Ordered Cable Polarity



### Backup Power Input



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Sheet: /Power/Power Connectors/  
File: Power Connectors.kicad\_sch

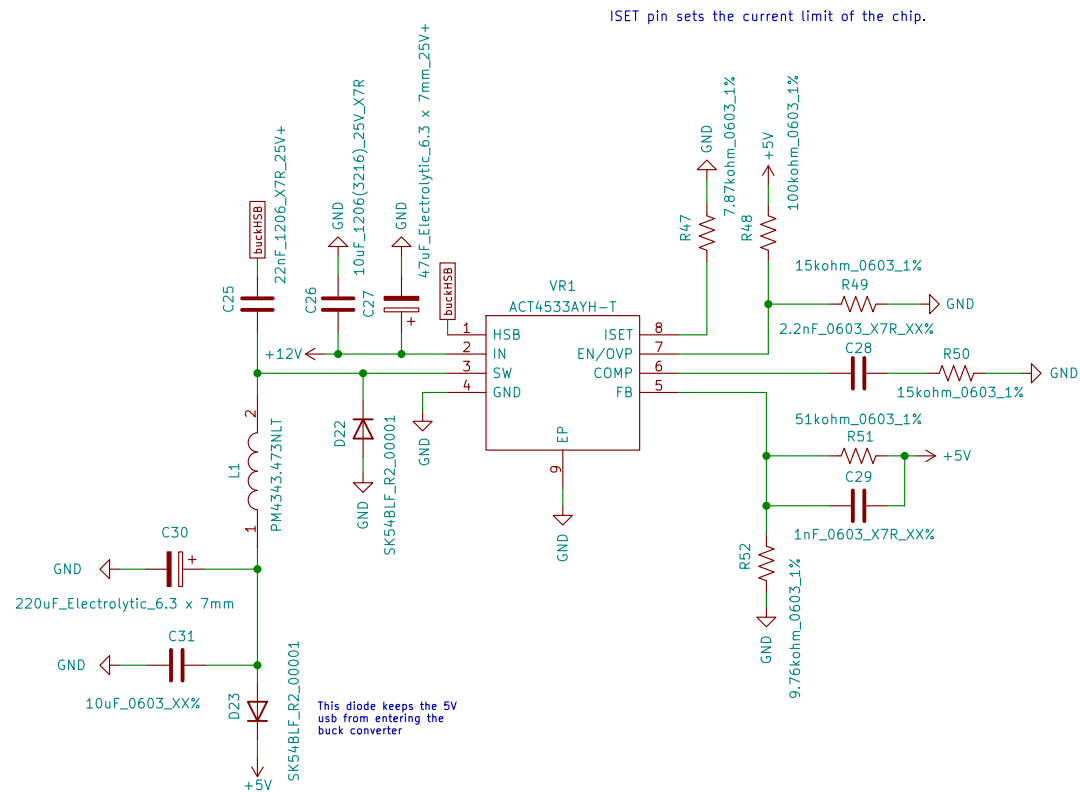
**Title: Power Connectors**

Size: A4	Date: 2022-09-29
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Sheet: /Power/Buck Converter/  
File: Buck Converter.kicad\_sch

**Title: Buck Converter (5V@2.4A)**

Size: A4 Date: 2022-09-29

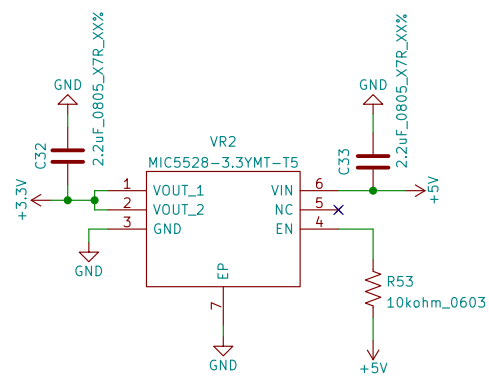
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# 3.3V LDO



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Sheet: /Power/LDO/

File: LDO.kicad\_sch

**Title: +3.3V LDO (500mA)**

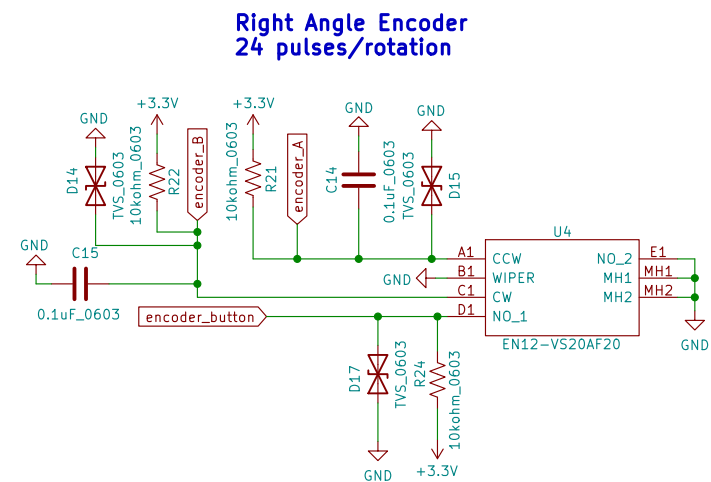
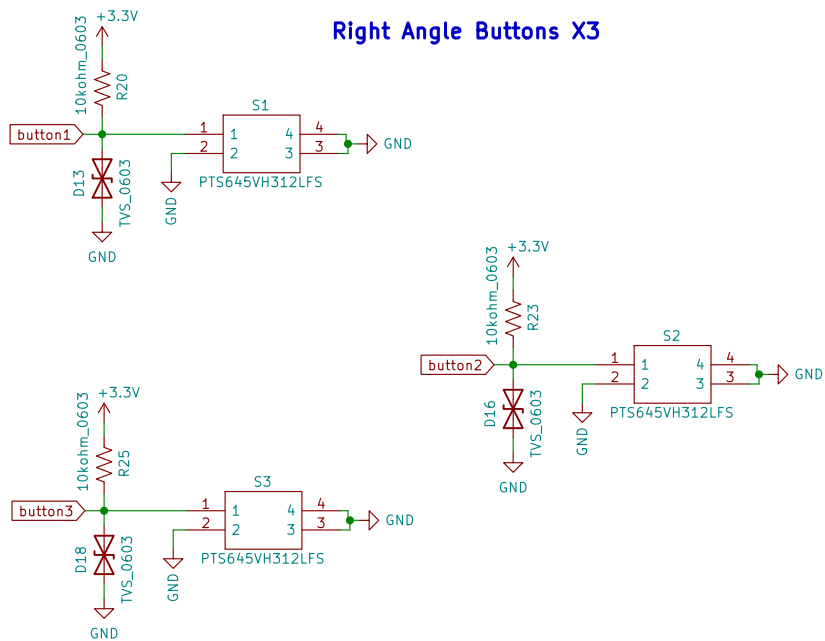
Size: A4

Date: 2022-09-29

Rev: 4.1

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Sheet: /Interface/

File: Interface.kicad\_sch

**Title: Interface**

Size: A4

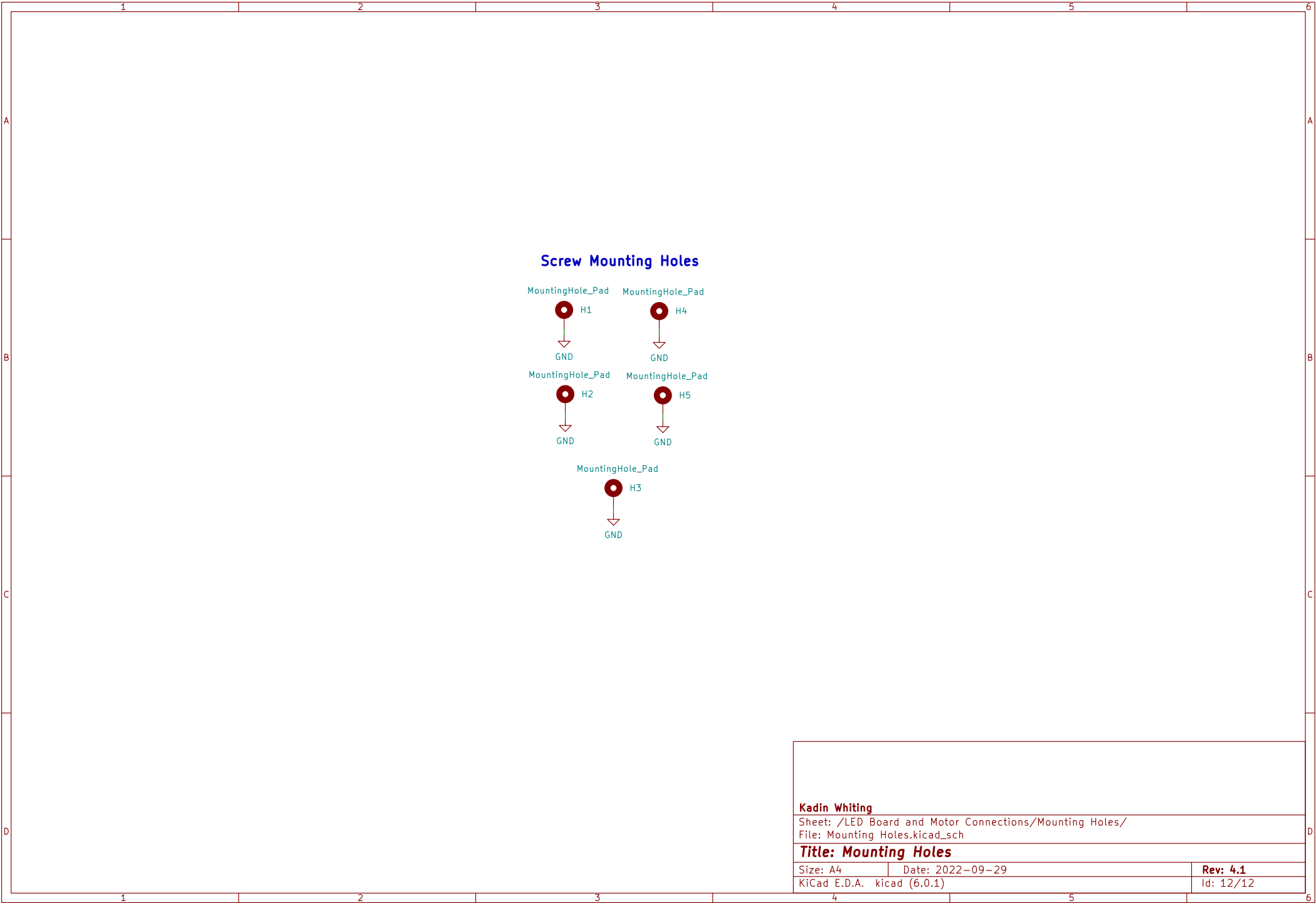
Date: 2022-09-29

KiCad E.D.A. kicad (6.0.1)

**Rev: 4.1**

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