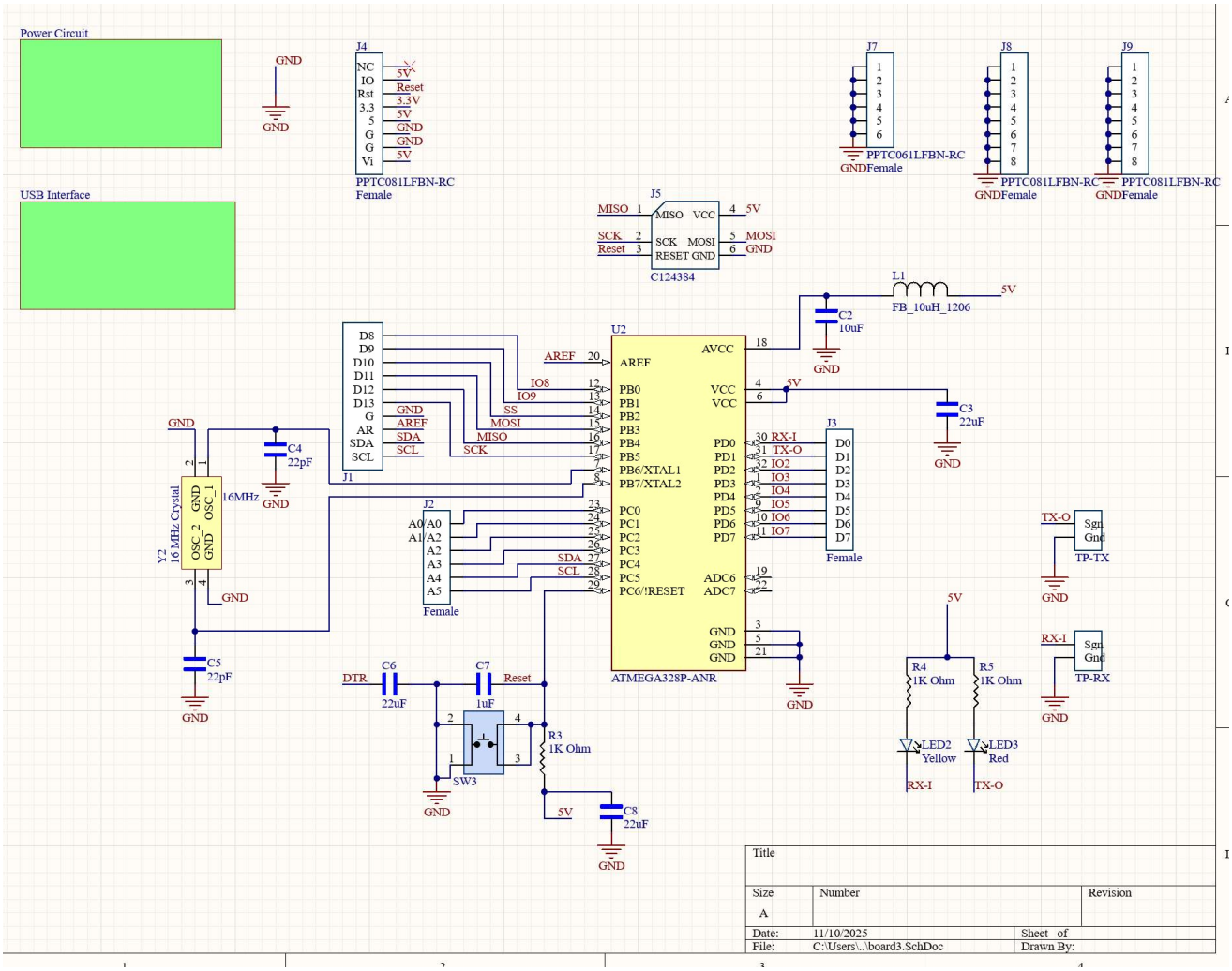
Board 3 - Golden Arduino

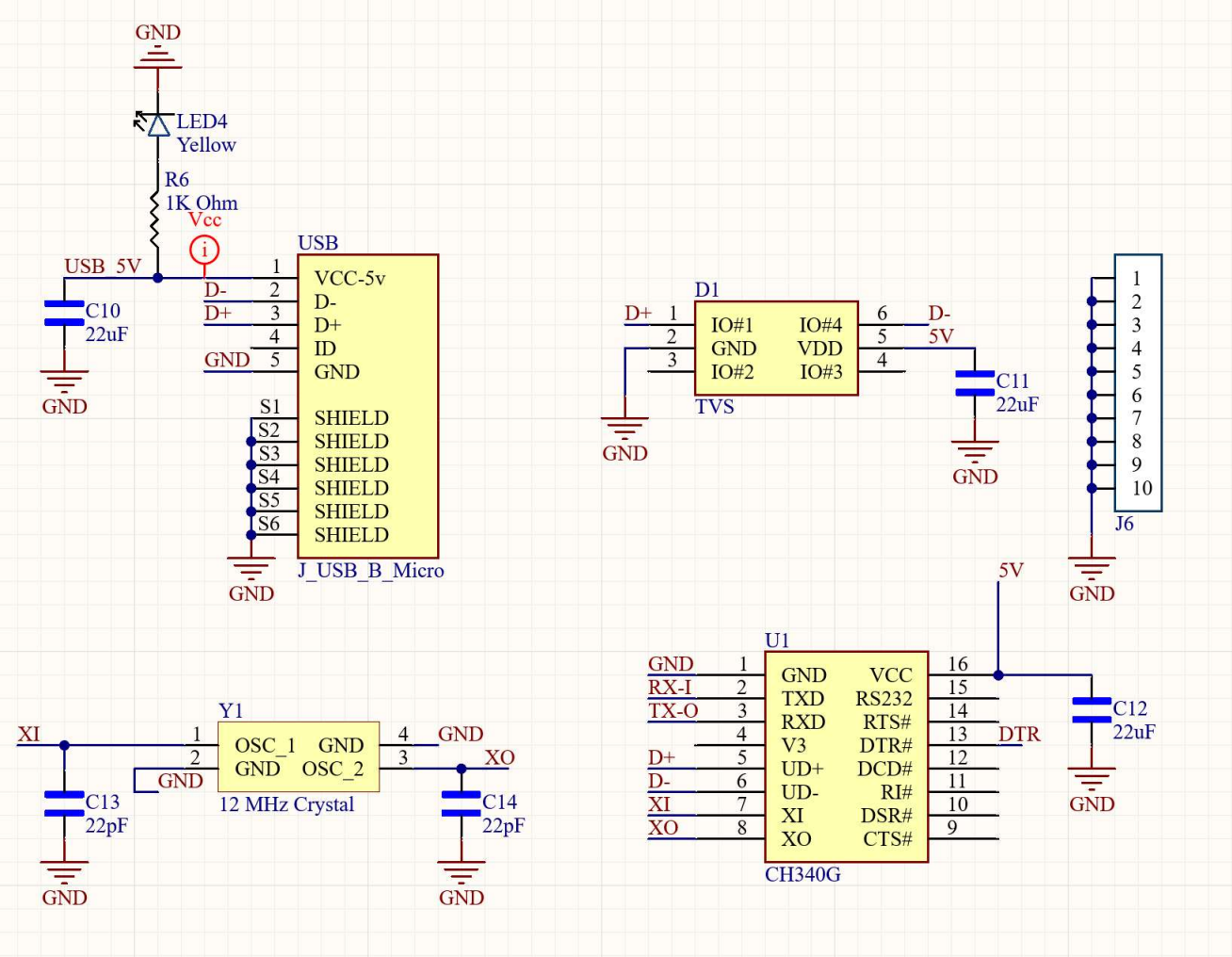
Project Overview

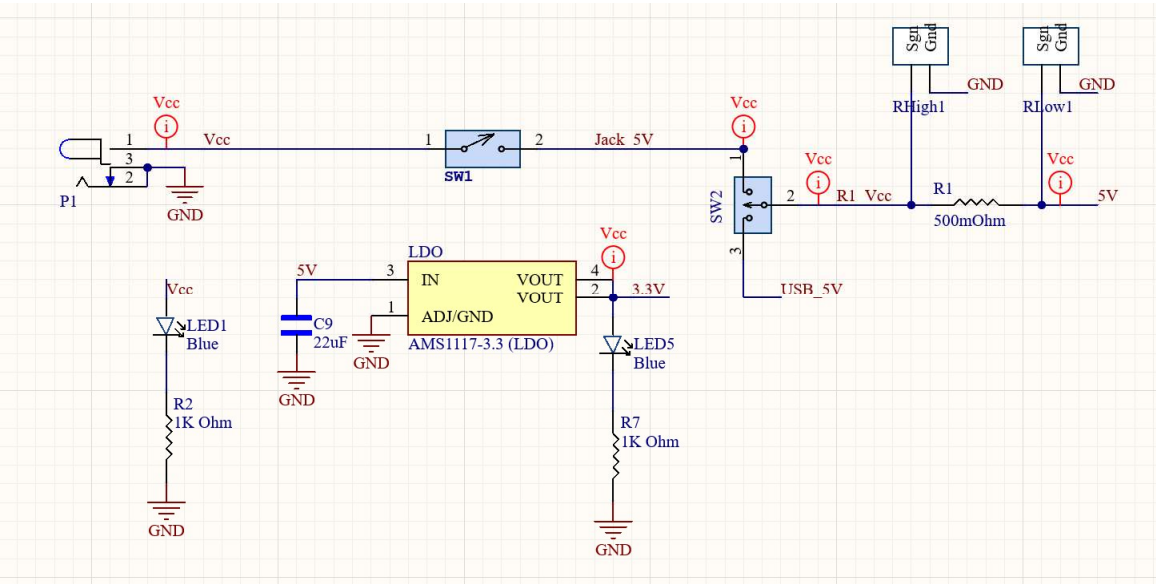
The purpose of this board was to design a "Golden Arduino" board with a ground plane under the whole board that would improve our switching noise measurements. We also added in test points to measure the in rush current across a sense resistor.

POR: What it means to "work"

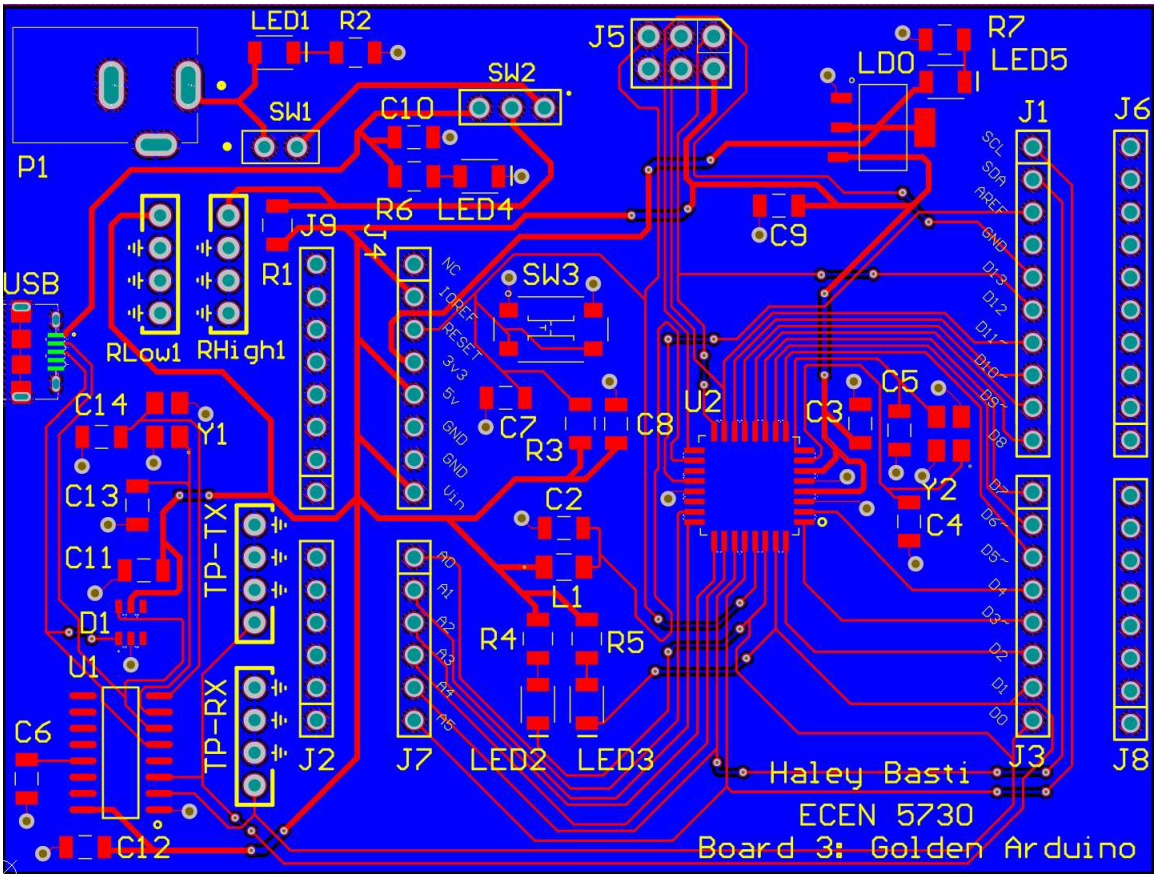
- Board powers on
- ATMEGA328 successfully bootloads
- Successful communication with Arduino IDE application and uploading of code
- Add a ground plane in order to improve switching noise and other various test points such as TX and RX test points and a sense resistor to measure in-rush current





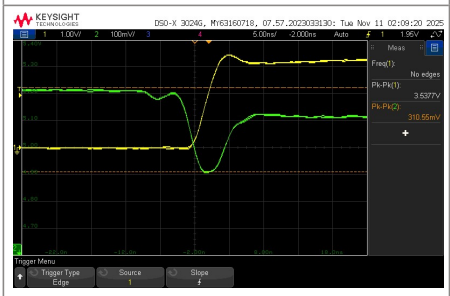
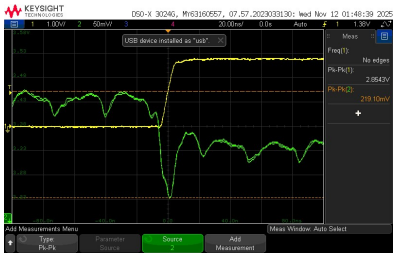
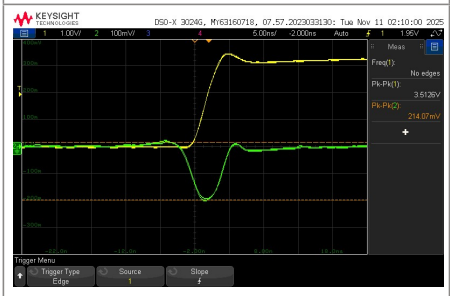
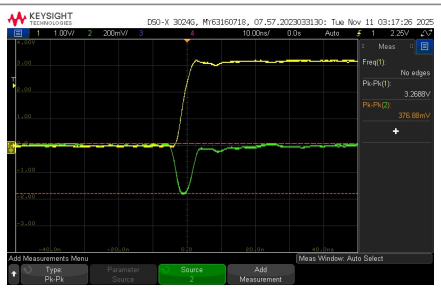
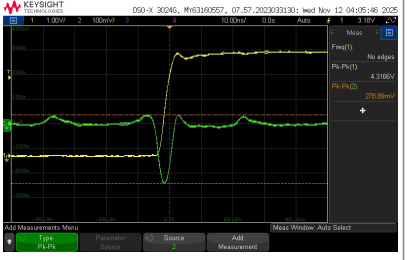


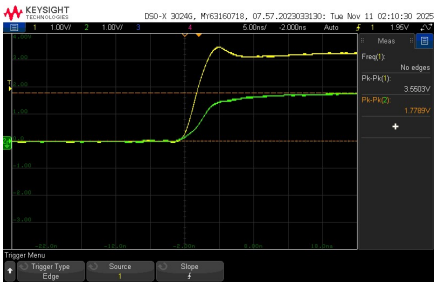
The board layout I ended up with is seen below.



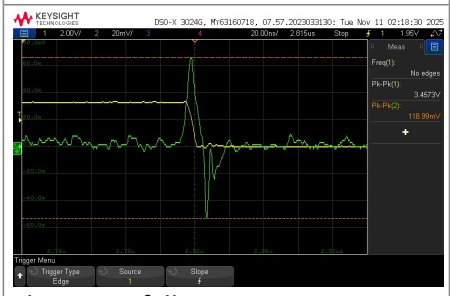
Unfortunately, I ran into issues with my USB interface, so I was only able to upload code using a programmer Arduino. The

1. With three I/O switching simultaneously: pins 12, 11, 10, measure the quiet hi and quiet low noise.

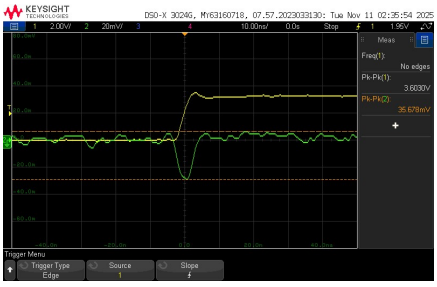
Jordan's Board	Commercial Arduino	My Board
		
Quiet High		
		
Quiet Low		



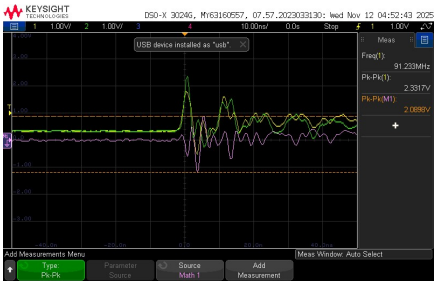
R2



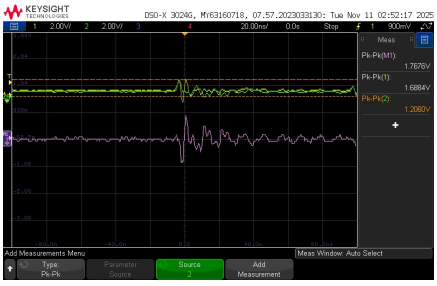
Slammer - fall



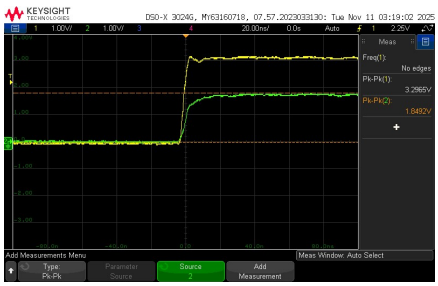
Slammer - rise

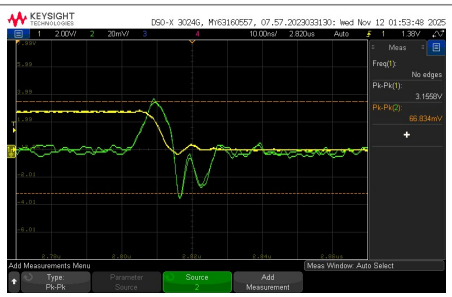


Inrush, power supply

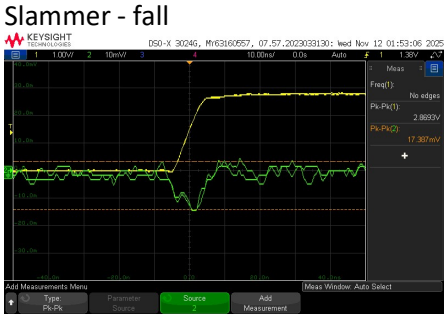


Inrush, USB-C

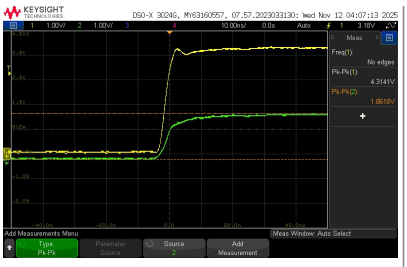


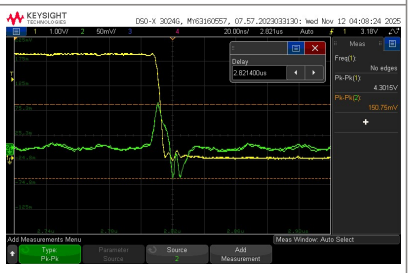


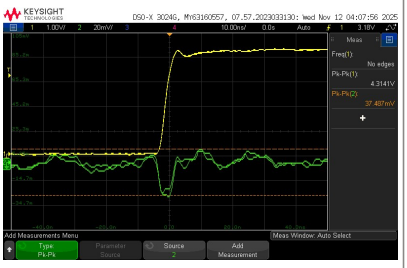
Slammer - fall

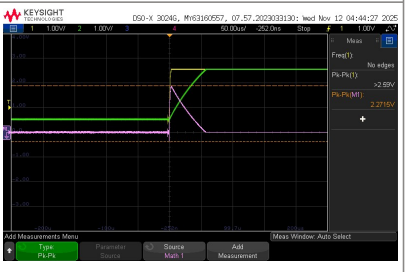


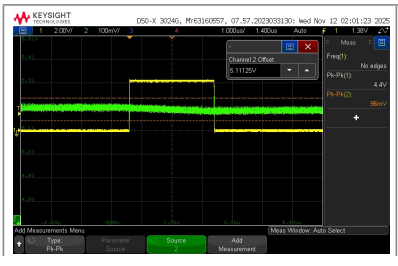
Slammer - rise

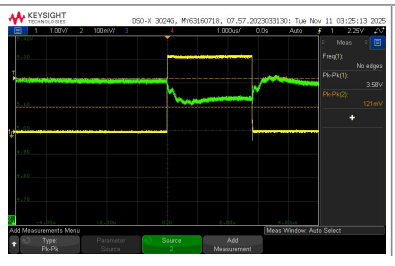


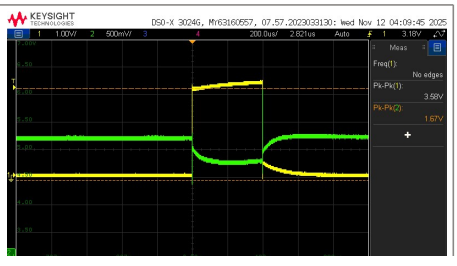












Observations:

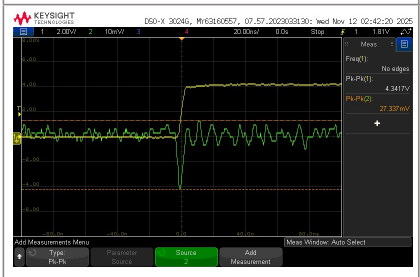
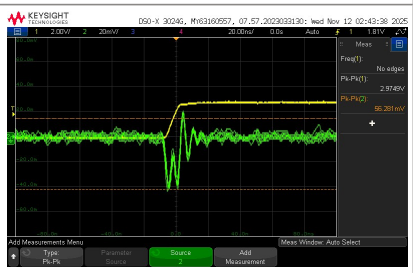
- My and Jordan's boards had higher peak-to-peak voltage measurements for the quiet high, but our pin 13 voltage measurement was high than that of the commercial Arduino
- Both our boards had less switching noise in the quiet low measurement
- Jordan and I had similar switching noise in our slammer circuit rise and fall time, though the commercial arduino had a lower peak value than we did.
- R2 measurements:
  - Jordan:
- In rush current measurement
  - Jordan, USB: 1.2V/ .5 Ohm = 2.4 A
  - Jordan, power supply: 2.09V/ .5 Ohm = 4.18 A
  - Me, power supply: 2.27V/.5 Ohm = 4.54 A

Using pin 7 to drive the slammer circuit, the measured voltage noise on the 5 V power rail on the board and on the quiet high pin was as follows:

Jordan's Board	Commercial Arduino	My Board
5V		
Qhigh		

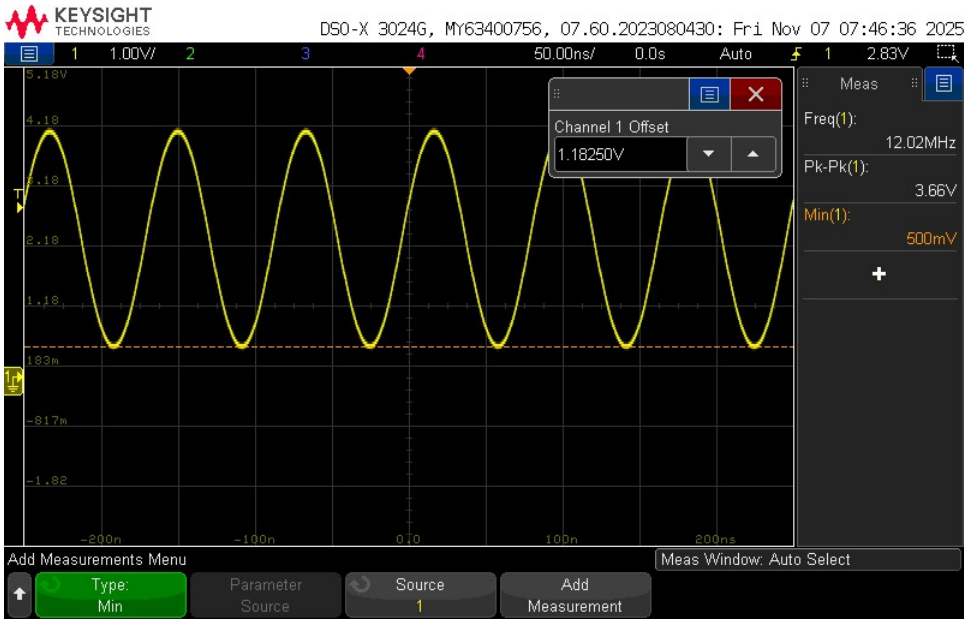
It seems like Jordan and I had similar noise and peak voltage measurements in our switching noise, but as a percentage it seems like the commercial arduino had better values.

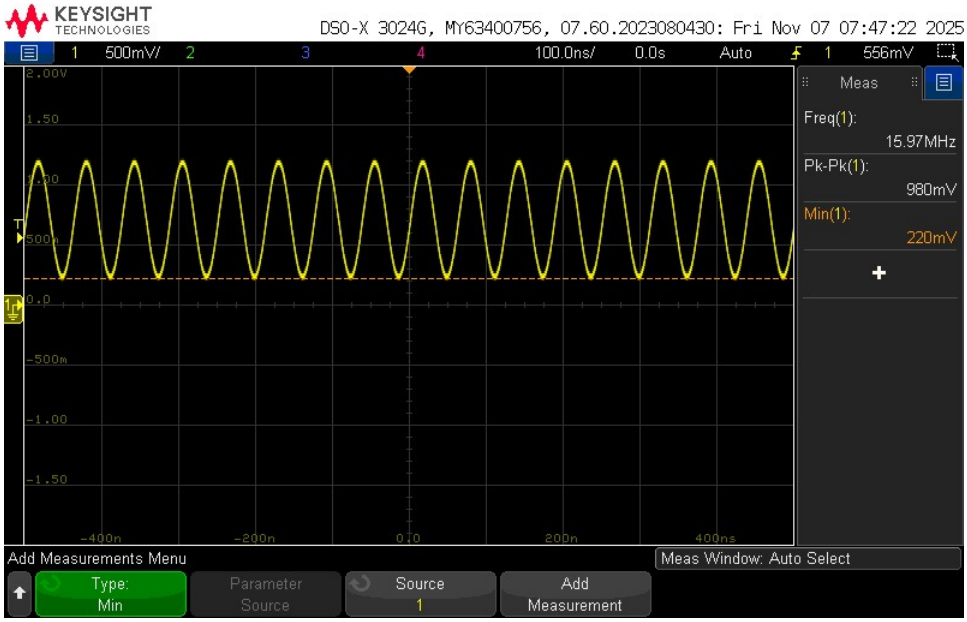
For the loop placed under the board, our switching noise was much less than that of the commercial Arduino despite our higher peak measurements.

Jordan's Board	Commercial Arduino	My Board
		

What worked:

- ☺ Successfully bootloaded ATMEGA328, as indicated by the successful oscillation of the 12 MHz and 16 MHz crystals:

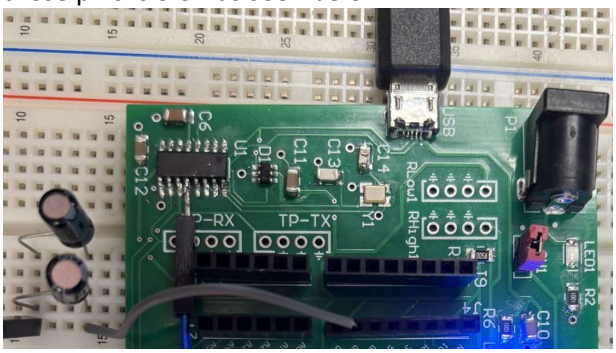


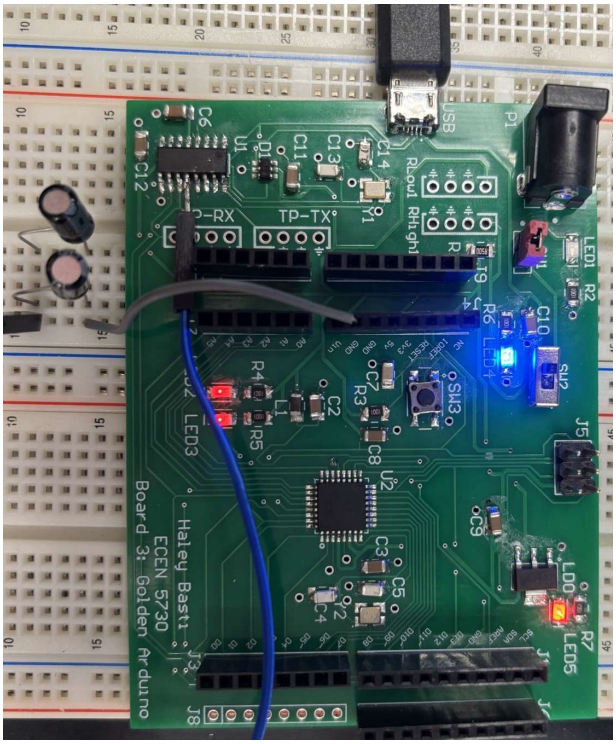


- ☺ Rsense measurement: 28 mV/0.5Ω = 56 mA
- ☺ LDO successfully steps voltage down to 3.3 V
- ☺ ATMEGA can be successfully programmed to any code when connected to a programmer Arduino

What didn't work:

- ☹ Soldering of micro-USB, and CH340
- ☹ TX and RX LED indicators lit up despite the ATMEGA being idle, test points indicate the voltage from these pins is 3.3V as seen below:

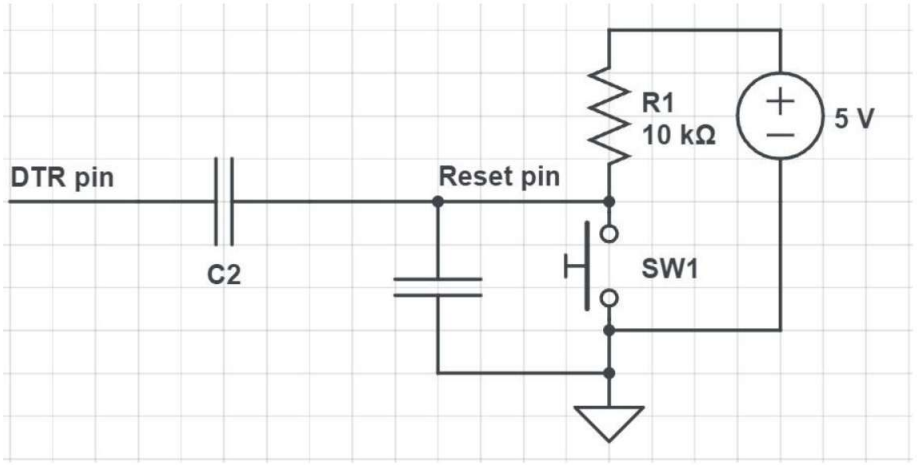


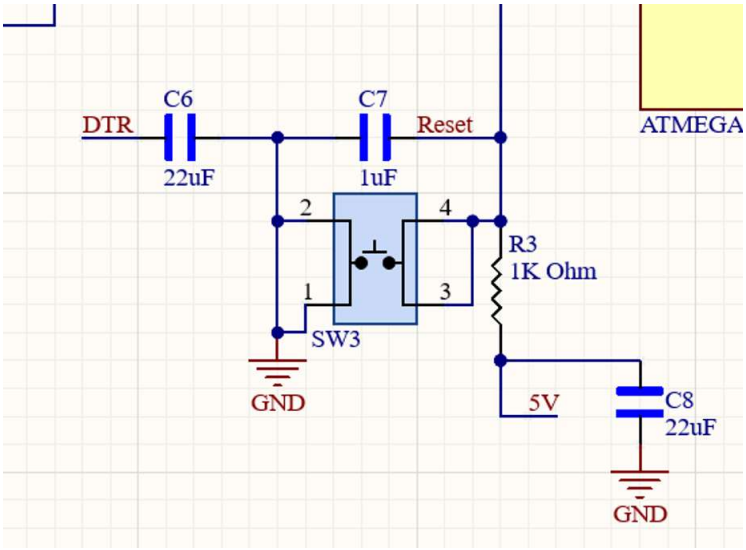
☹ 

☹ Forgot to add decoupling capacitor on 3V output of CH340G

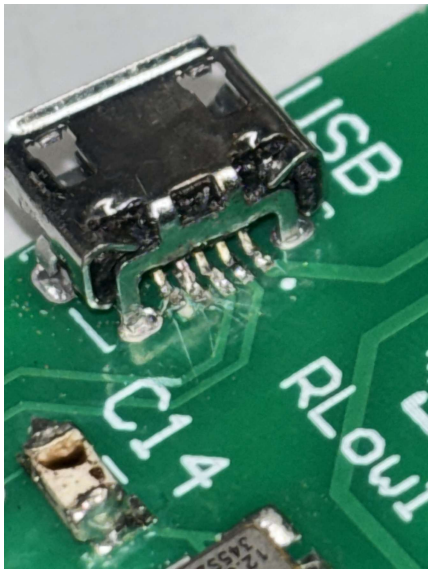
Hard errors:

☹ Incorrectly wired reset switch, other side of C6 should connect to reset, not ground:



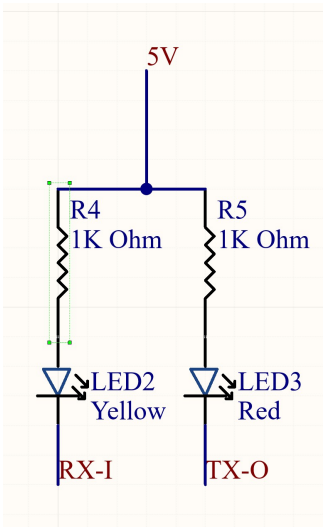


- ☹ USB interface does not work - could be a soft error if hooked up to a programmer Arduino to code my board
    - Photo showing ripped off pad on pin 5 of micro usb (ground connection)



Soft errors:

- ☹ TX and RX pins are putting out 3.3V, but should be putting out 5 so as to not induce a voltage difference across the indicator LEDs → on future designs, I would tie the other end of the indicator LEDs to 3.3V rather than 5 V, so regardless of the voltage on the tx/rx pins, these would not light up unless the TX/RX pins have 0V on them:



Conclusion

This board may not have had a usb interface that worked, but I was still able to bootload the ATMEGA and program it using a programmer Arduino. In the future, I will use the USB-mini type connector because it connects to the board via through hole connections which are much easier to solder, as well as the changes mentioned above.