University of North Carolina at Charlotte
Department of Electrical and Computer Engineering

Laboratory Experiment report # 5-2

Lab Report # 5-2

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Objectives

The objective of this lab is for students to get a better understanding of how to use matlab's simulink hardware section, the ability to make real life measurements based on the auto coder of said hardware section. The ability to check and make sure control panels are in proper working order, and how to interface between matlab simulink, a lab kit, and a control panel. Making real time adjustments that dynamically change the circuit in interesting ways.

Equipment List

- Matlab Simulink
- F28379D Launchpad
- Hands-on Power Electronics
- Oscilloscopes
- 1 10 Ohms Resistor
- 1 0.318 millihenry Inductor

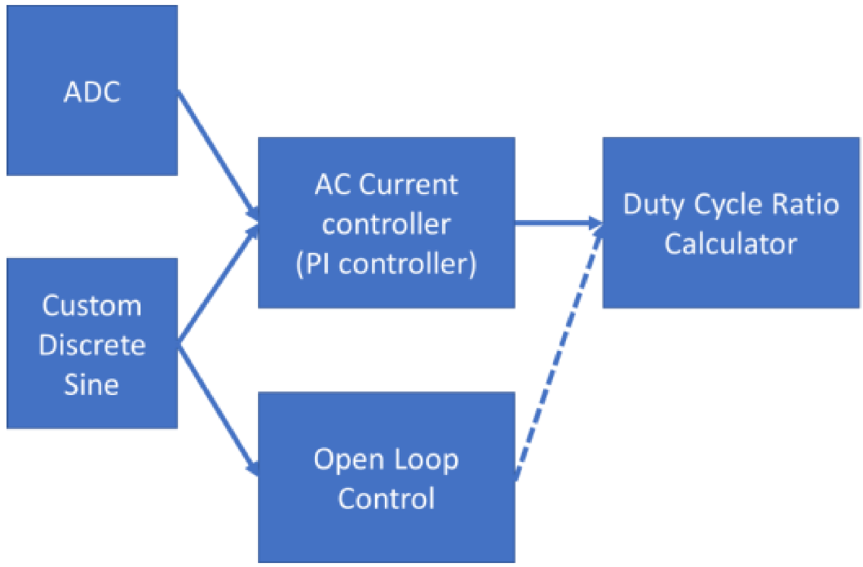
Relevant Theory/Background Information

Matlab Simulink is a powerful tool that, in conjunction with Code composer studio can use digital blocks to interface with real life components through on demand code generation that allows the bypassing of manual code making. By using the Hands-on Power Electronics in conduction with the F28379D Launchpad and an assortment of resistive elements students are able to freely change waveforms in real time and are able to get a feel for dynamic systems. From lab 5-1, this is enhanced with the amount of control the user is given with the closed-loop set-up that is employed making it so the student can see how much each shift in a parameter changes the end result.

Experimental Data/Analysis

Exercise 0

Below, Figure 0-1, is the theoretical set-up in simulink matlab that we have to prepare. Figure 0-1 is the actual set in Simulink, with the components in the same place as the theoretical set-up .



<Five groups in the Triggered Subsystem block>

Figure 0-1

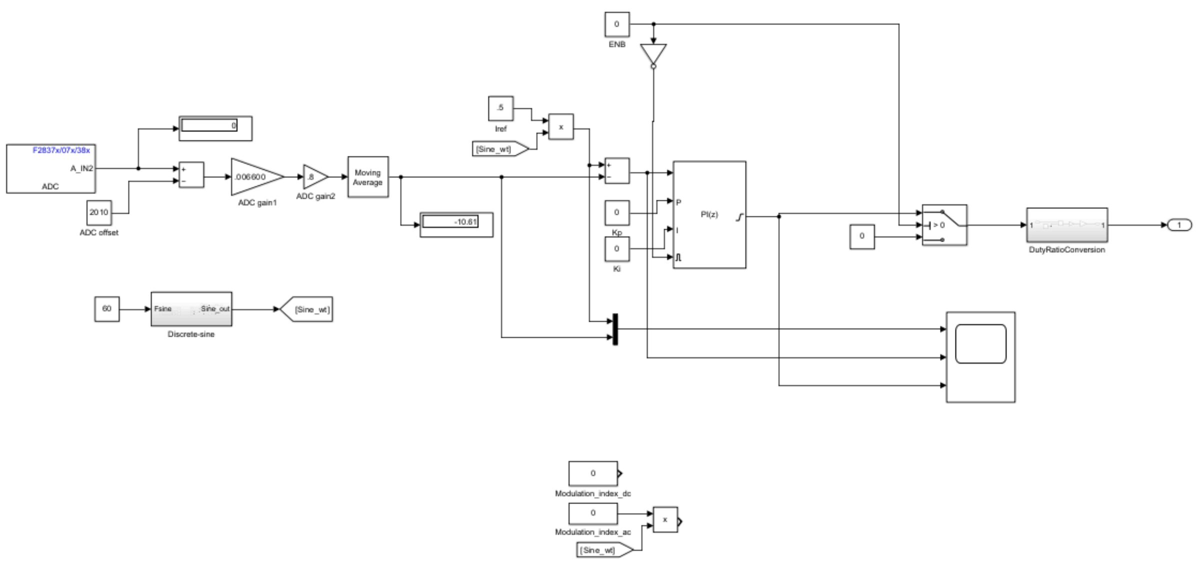


Figure 0-2

Figure 0-2, which can be seen above, is the initial design used in this project. As we go through the lab, we will be swapping the input to the DutyRatioConversion block, which is the right-most subsystem, and adding a gain block to the output of the PI block to complete the lab.

Exercise 1

Below in Figure 1, the set up for the lab can be seen where, just like lab 5-1, the 10 ohm resistor is situated on the cardboard plate and the induction is wound to the right of it. This setup was used due to a previous mishap with the lab equipment so the TA made this for demonstration purposes.Using the formula $L = \frac{d^2 * N^2}{18d+401}$ the inductor had 44 turns using copper wire that has a permeability of 1.256629e-6, with a radius of .5 cm, and a length of 6 cm, the inductor's inductance is 0.318 millihenry. For the measurements taken in the rest of the lab, the oscilloscope was placed across the resistor.

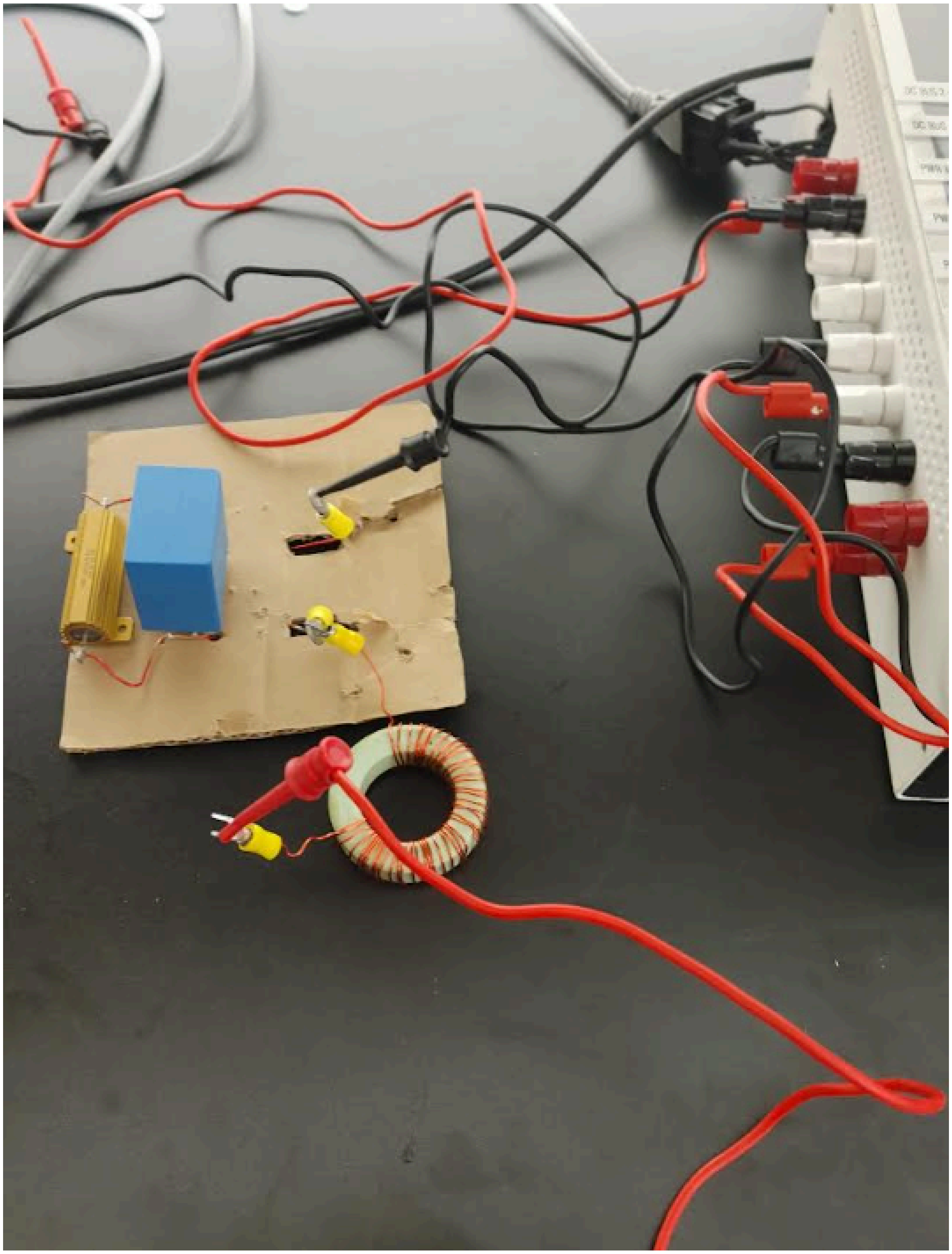


Figure 1

Exercise 2

Below in figure 2 where the Launchpad is correctly connected to the Hands-on Power Electronics Console

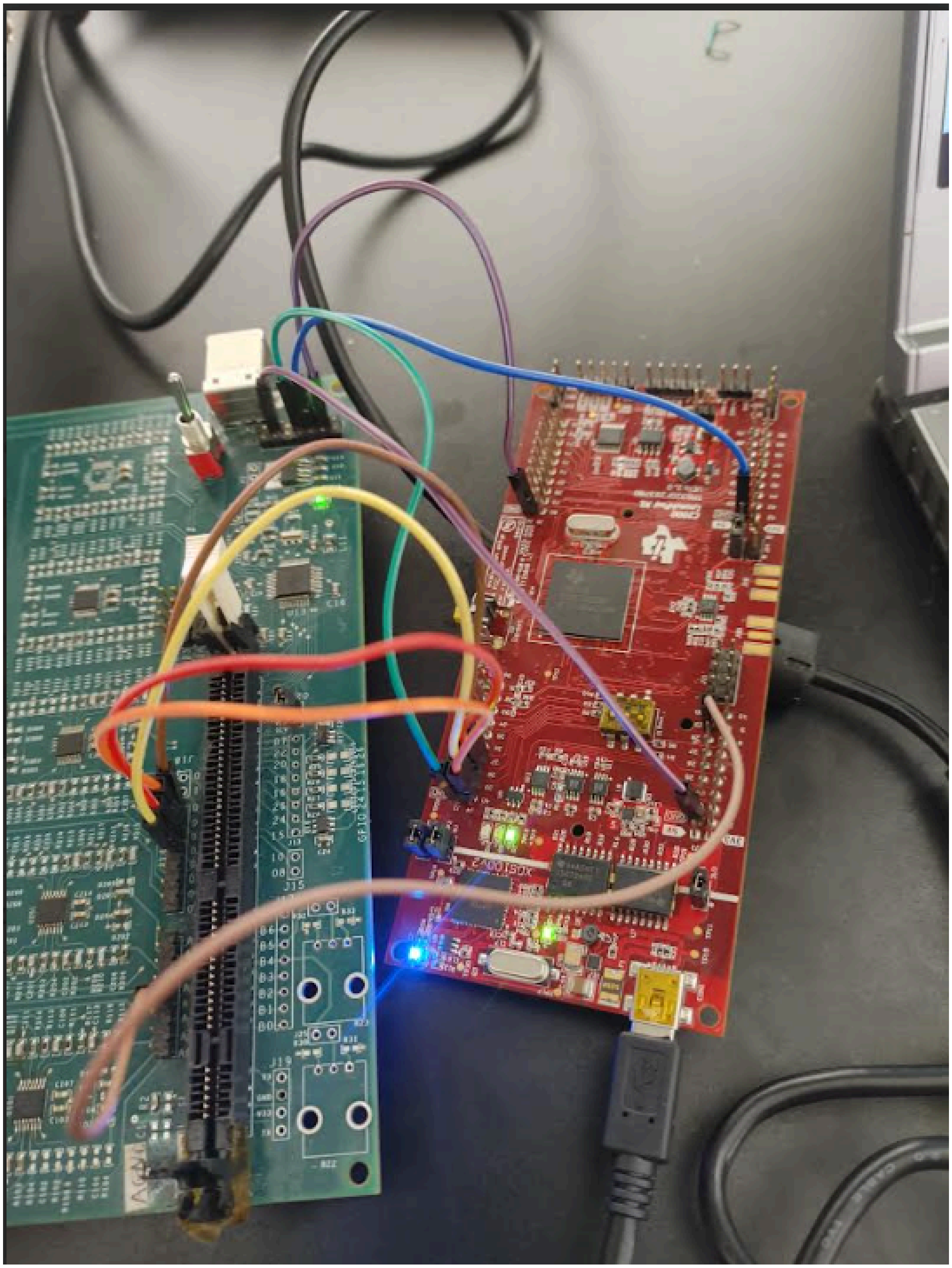


Figure 2

Exercise 3

Below is the open loop control in Figure 3-0-1 you can see the dc modulation being connected with a .5 giving us a 10 dc peak wave in Figure 3-0-2

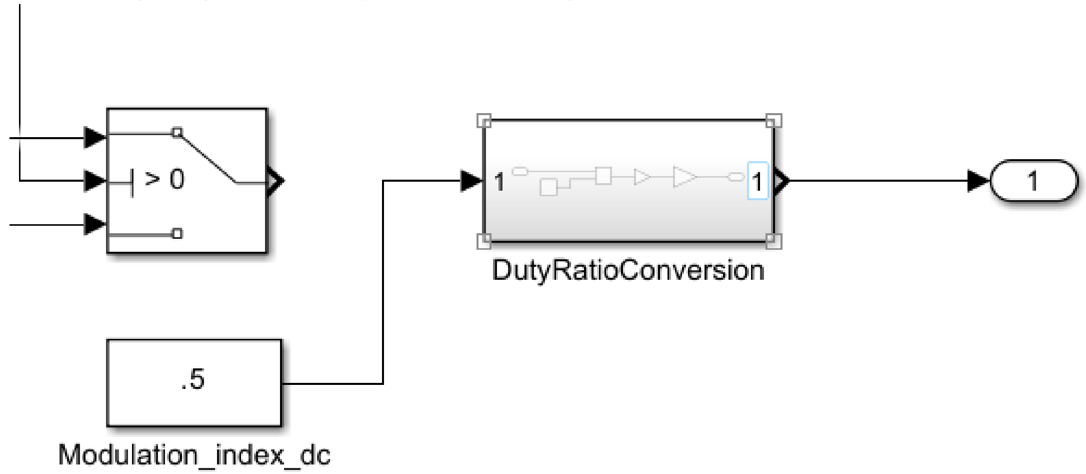


Figure 3-0-1

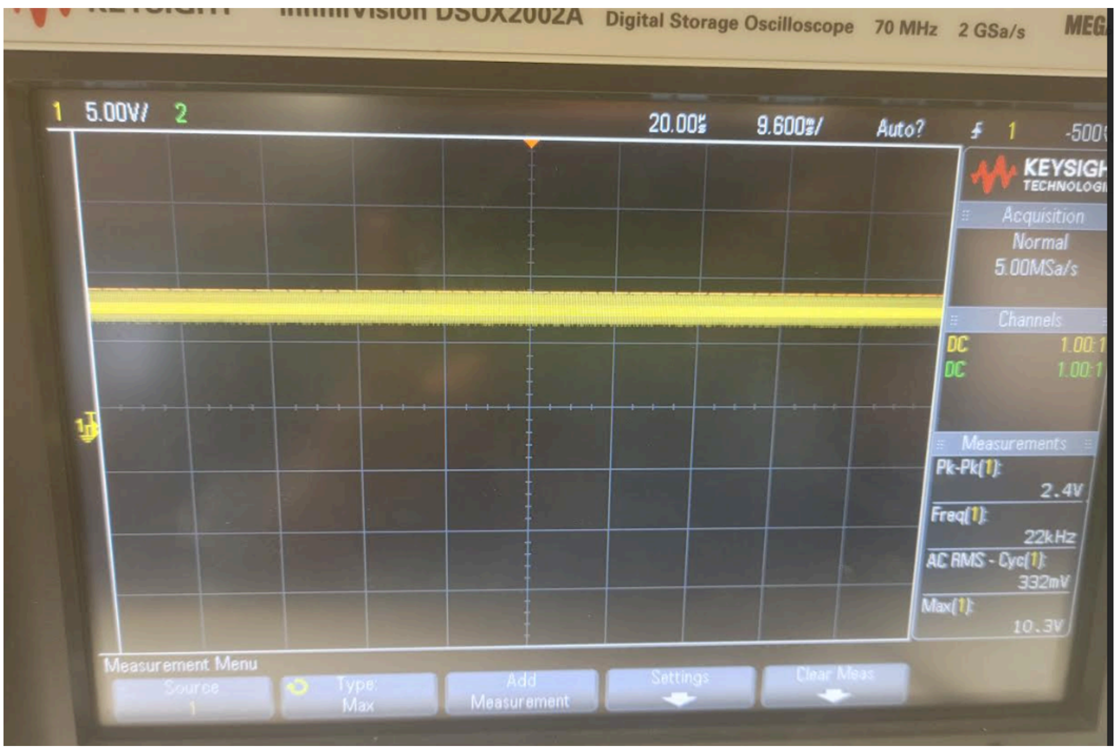


Figure 3-0-2

Below is the open loop with the AC modulation block being connected to the out in Figure 3-1-1 giving us a 10 v peak sine wave that is a little unstable. This instability is likely due to the connection of the resistor and capacitor as can be seen in Figure 2-1.

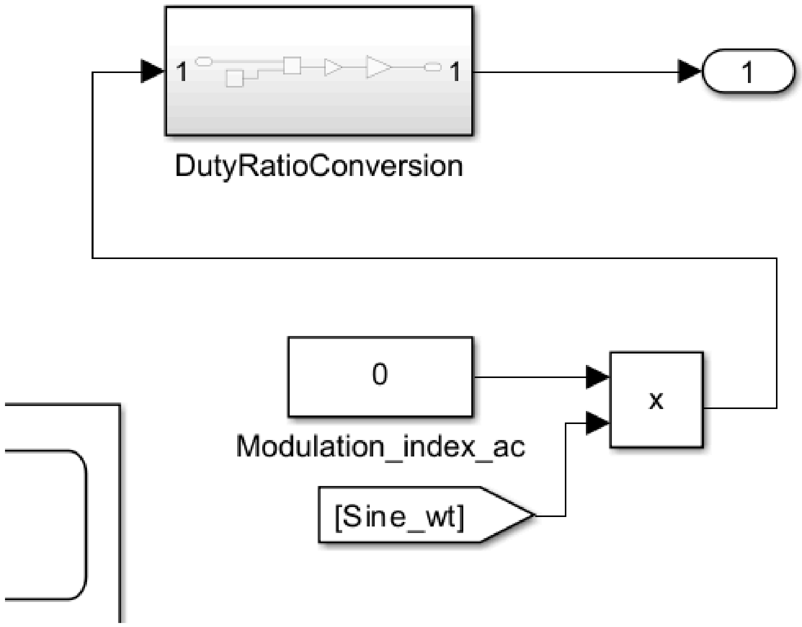


Figure 3-1-1

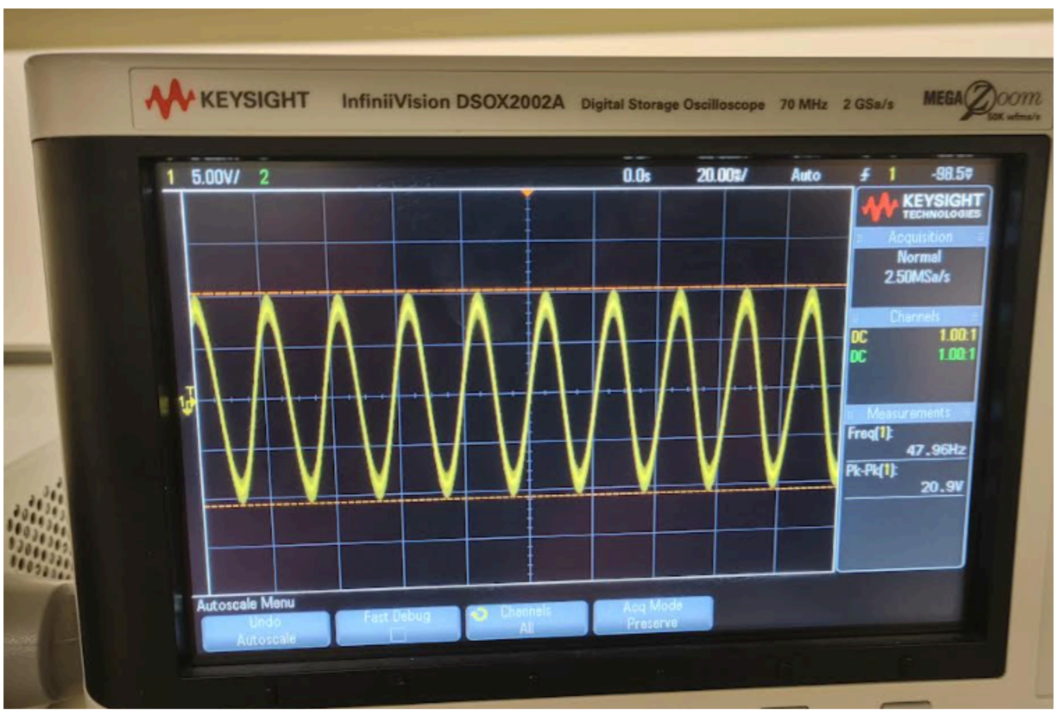


Figure 3-1-2

Exercise 4

Below, in Figure 4-0, is the closed loop control set up in Simulink:

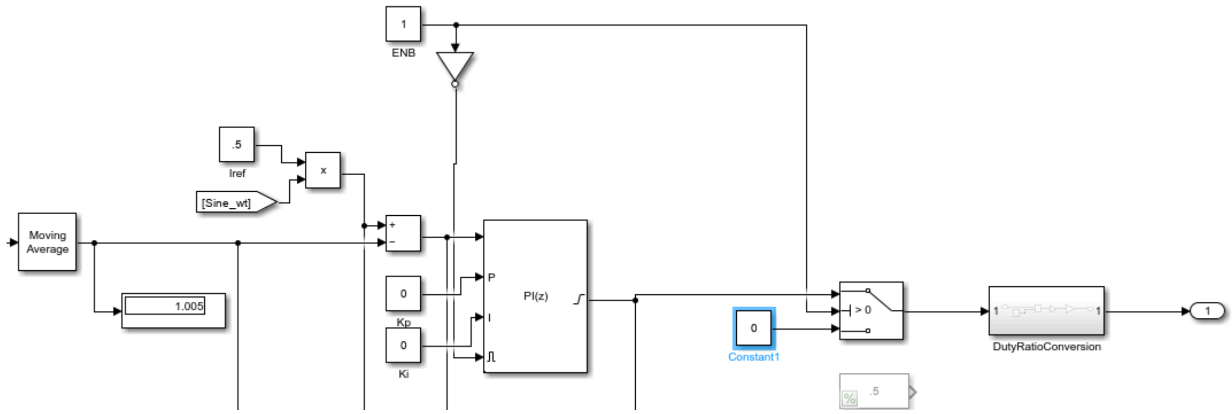


Figure 4-0

As can be seen, the feedback is 1.005 which is close enough to the 1.0 target, Kp and Ki are 0, and the ENB is 1 as per specification. The gain inside ADC gain2, which influences the feedback, is 1/-13.2 which can be seen in Figure 4-0-1. Using this circuit gives Figure 4-0-2 which is not a proper sine wave nor is it the correct frequency. This wave form is due to the fact that the signame given from the PI is too low to change anything so the wave that is being seen is from the other components in the system.

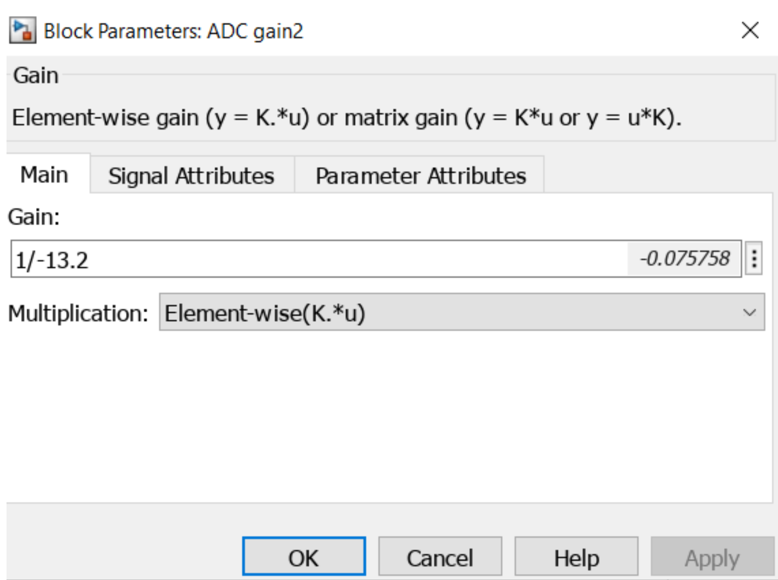


Figure 4-0-1

Figure 4-0-2

Below is Figure 4-1 Is the set up needed to create a proper sine wave that is more inline with the target in both form and frequency. Figure 4-1-1 is a close-up shot of the changes with Figure 4-1-2 showing the inside of the gain block, which is an added gain block which allows the signal from the Launchpad to be large enough to influence the final wave form. In addition, Alter Ki did nothing to alter the wave and only caused the system shift up or down the on oscilloscope, Kp worked in a similar fashion to the gain block as it added necessary boasting to the PI output system for what can be seen in Figure 4-1-3 which is ref .5 and Figure 4-1-4 which is ref 1. The Kp has a value of .001.

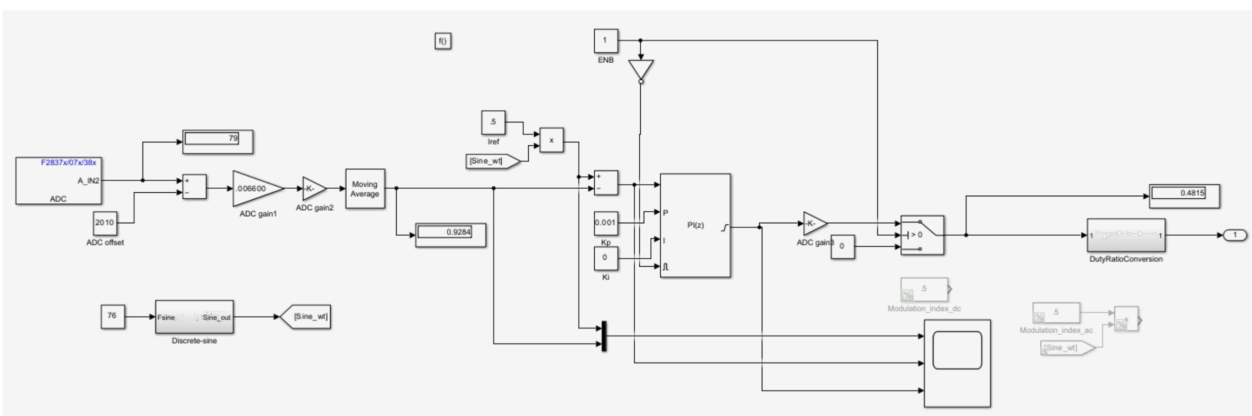


Figure 4-1

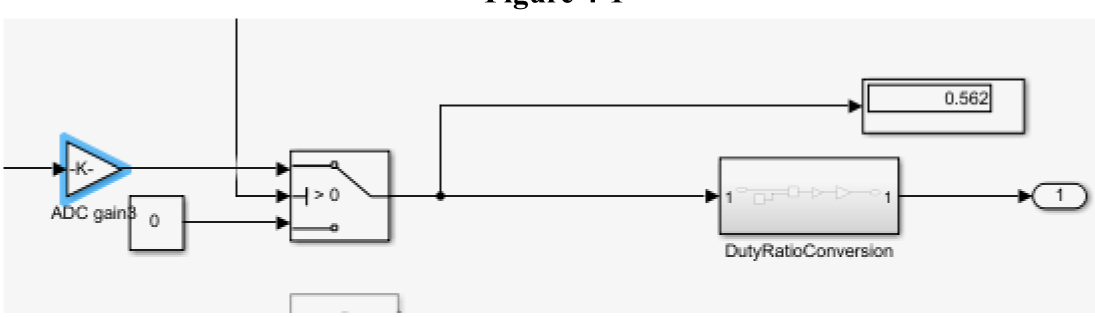


Figure 4-1-1

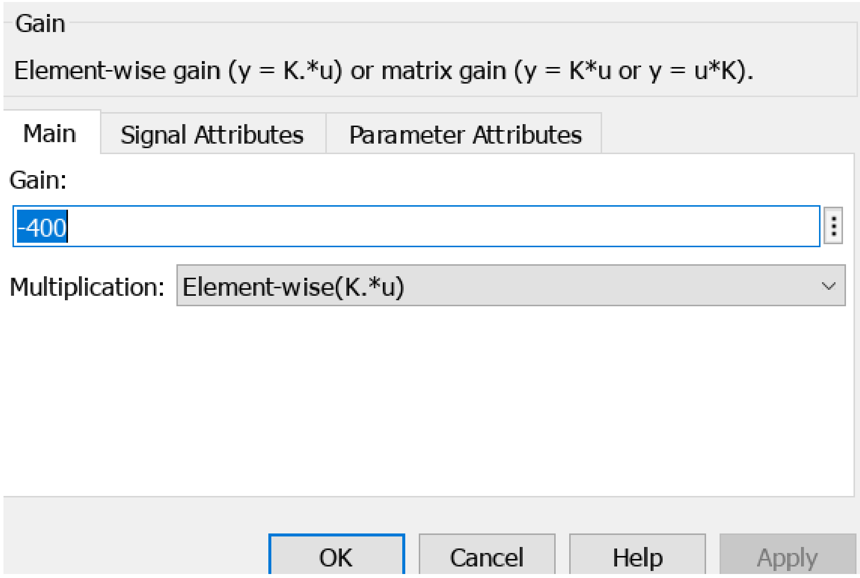


Figure 4-1-2

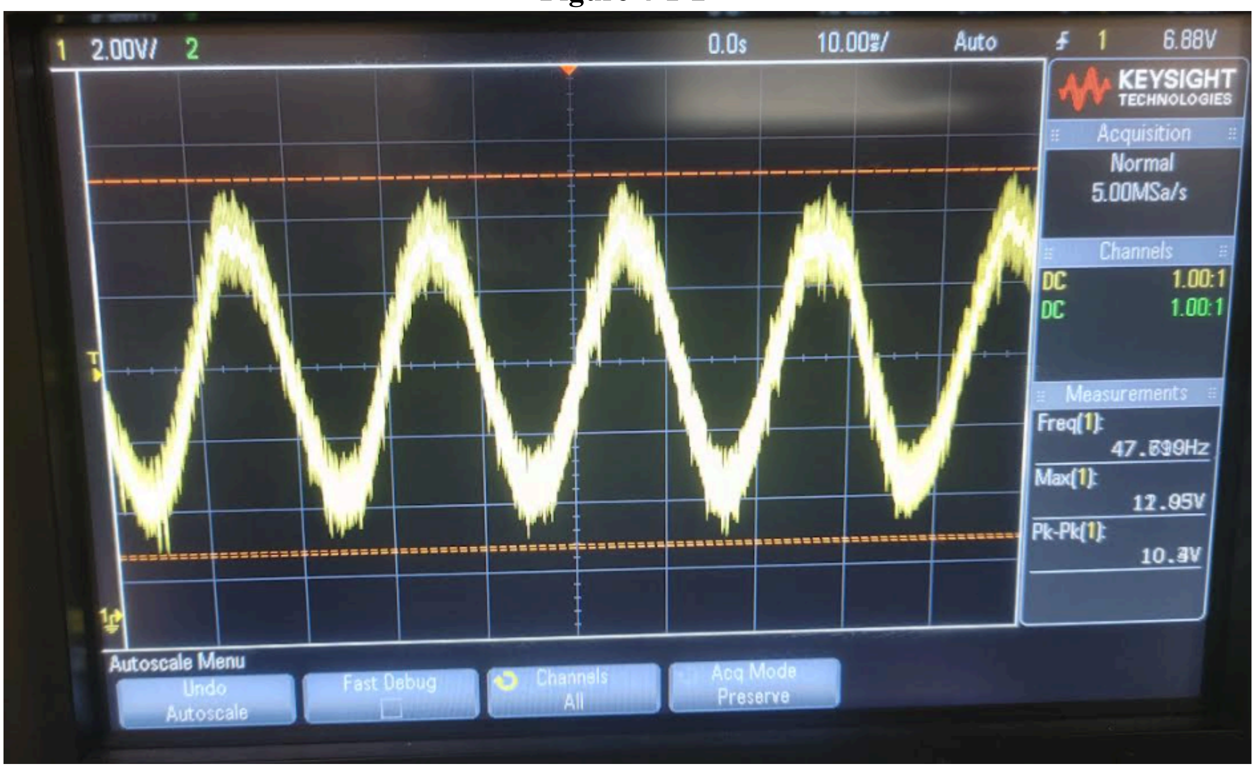


Figure 4-1-3

Figure 4-1-4

As can be seen above, the waves are around 48 HZ instead of 60 HZ, while I was not able to figure out where the dissonance was coming from as my Sine wave generator was set to 60, I altered the Sine generator to 76 which can be seen in Figure 4-2, and the same waves can be seen in 4-2-1 and 4-2-2 where they are at the proper frequency.

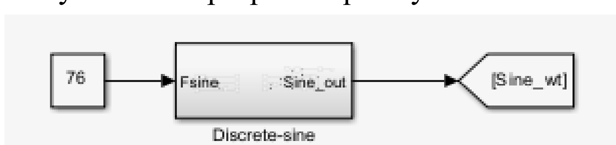


Figure 4-2

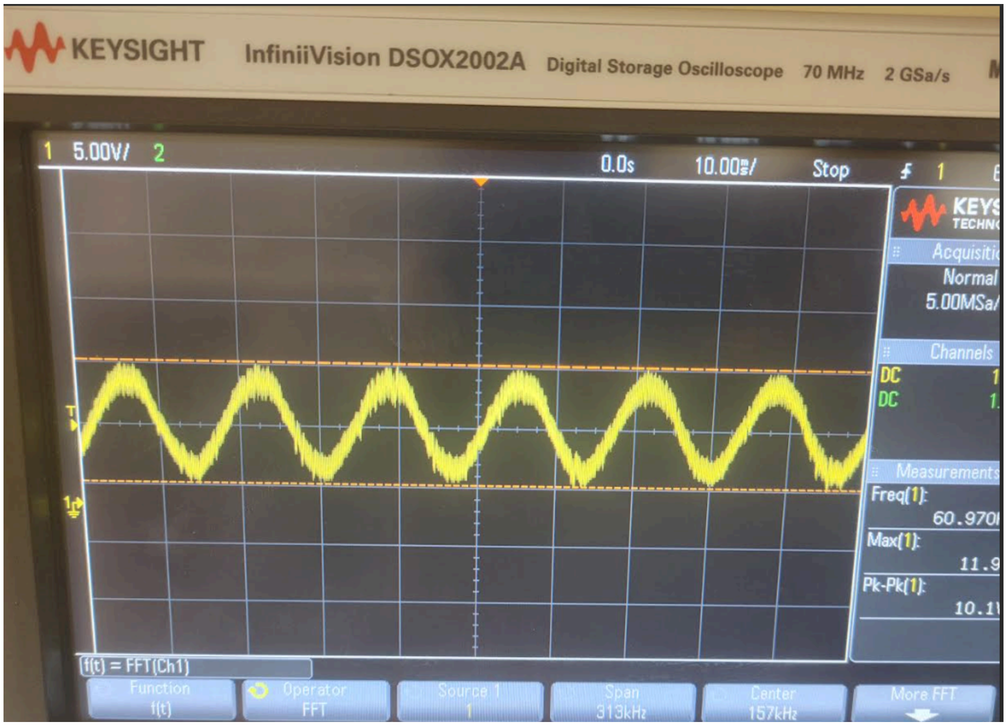


Figure 4-2-1

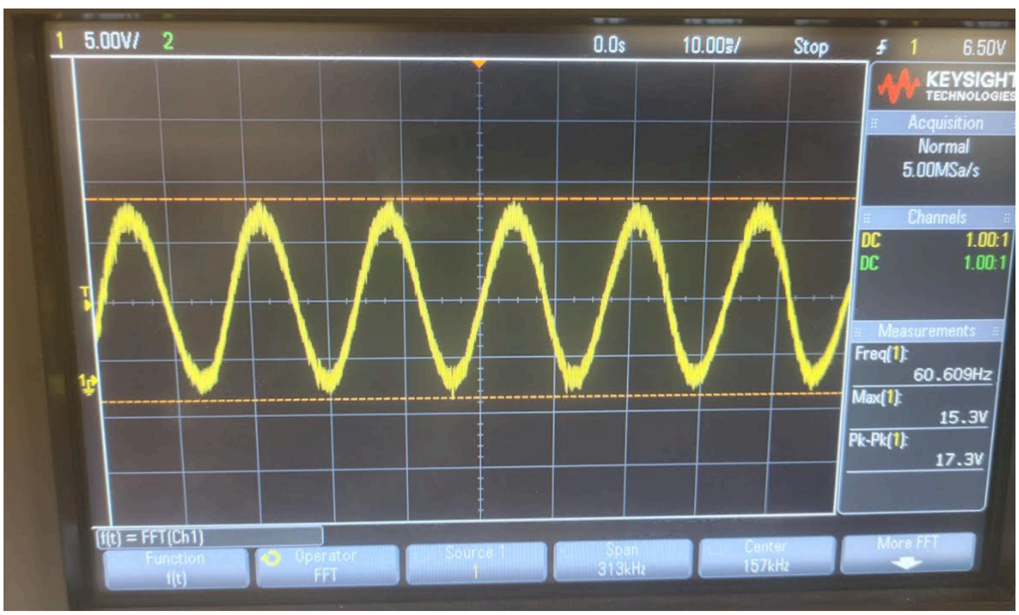


Figure 4-2-2

Conclusion

Going through this lab has taught the group about the intricacies of real time tuning and how to set display blocks in order to properly check what the system is output at key locations which we can change for improvement. In addition, the importance of the placement of jumpers and that placements ability to hamper proper function alongside not using the oscilloscopes auto scale function as it does not capture the sine waves for exercise 4 properly was another thing that was learned during the lab. Lastly, knowing how to change the frequency of the output wave in order to make sure that in real life scenarios where a specific frequency is needed for proper function and understanding that even if the software displays 60 Hz it is important to measure it externally to assure that the output is 60 was learned as well.