

Workshop Skills Logbook

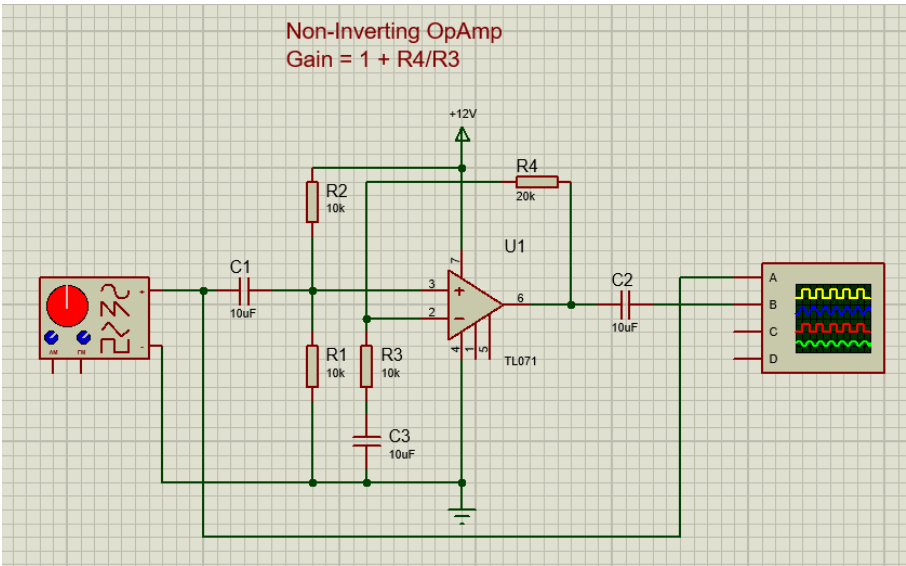
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ACCA4025

Contents:

Proteus	2
Breadboard	3
PCB	6

Below is the circuit we were tasked with building, simulating and testing. It is a single supply non-inverting amplifier with a gain of 3.

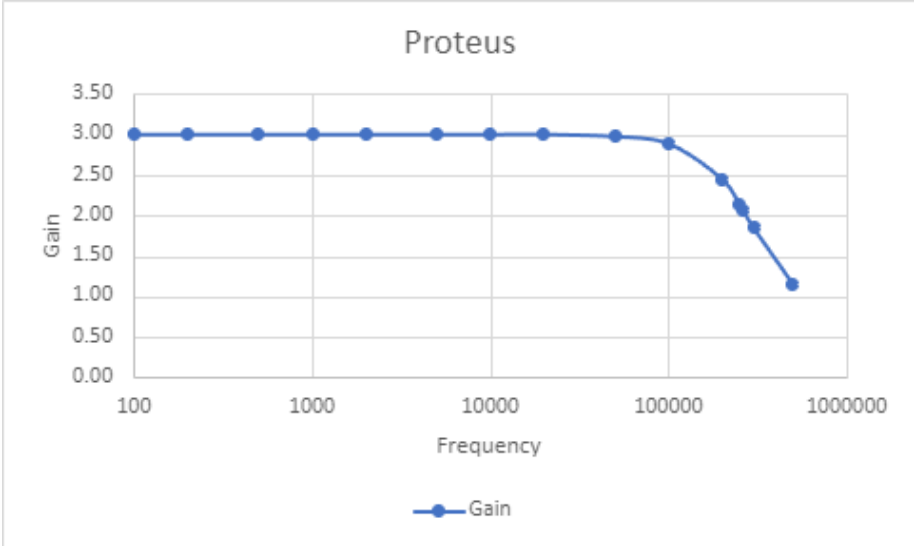


This circuit was used to measure the output voltage over a range of frequencies. The signal generator was used to adjust the input frequency and an oscilloscope was used to measure the voltage.

I started with an input peak to peak voltage (V_{p-p}) of 100mV and measured a frequency range of 100Hz to 500kHz. Based on the equation $\text{Gain} = 1 + R4/R3$ the gain of this Amplifier is 3 and thus will have an output V_{p-p} of 300mV.

Below is the table of my simulated results for this Amplifier and a graph of Gain against Frequency.

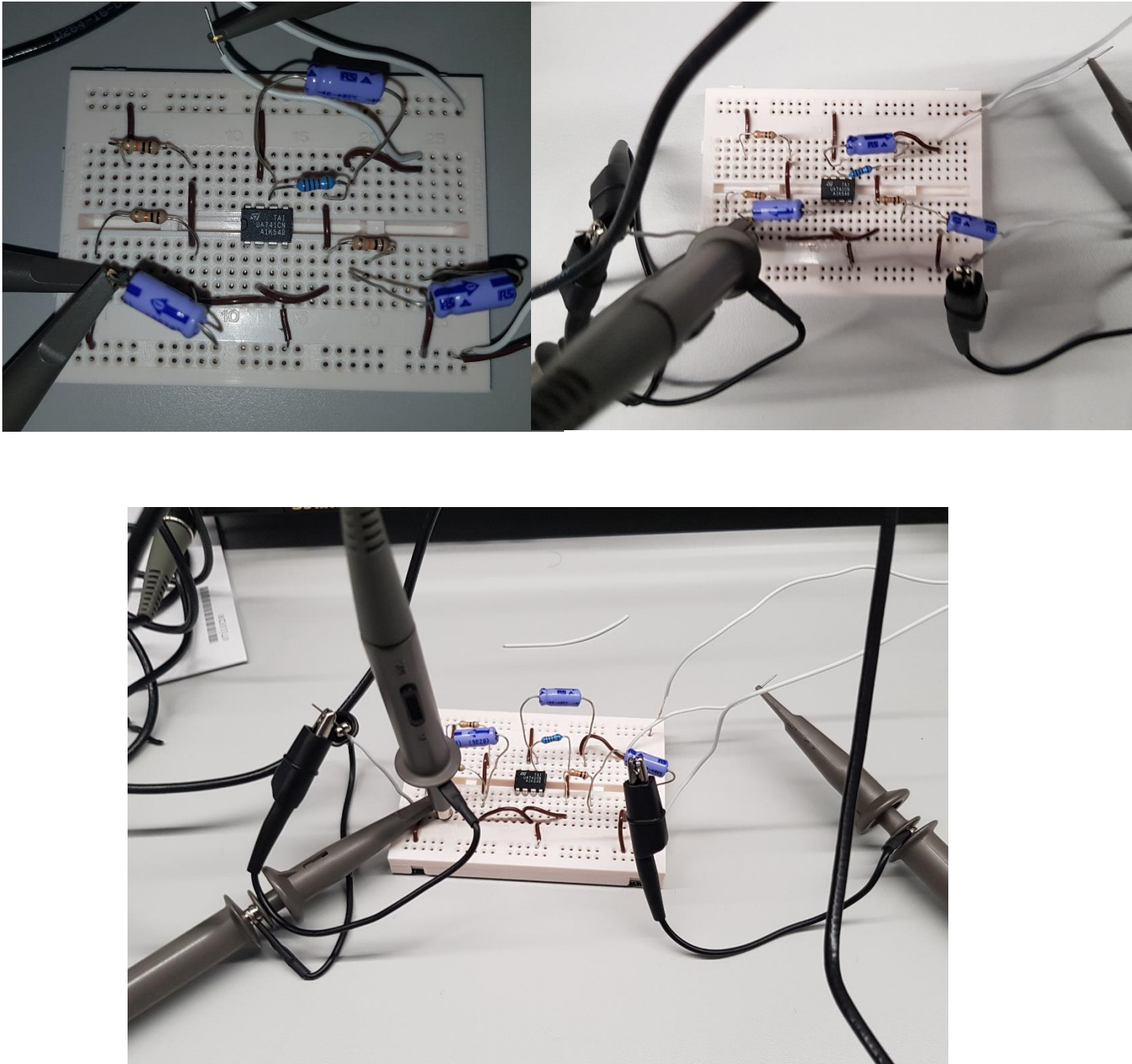
All Values mV			
Frequency		Output Voltage	
100 Hz		300	
200 Hz		300	
500 Hz		300	
1k Hz		300	
2k Hz		300	
5k Hz		300	
10k Hz		300	
20k Hz		300	
50k Hz		297.5	
100k Hz		288.75	
200k Hz		245	
500k Hz		115	
Frequency		Output Voltage	
200k Hz		245	
250k Hz		213.75	
260k Hz		207.5	
300k Hz		185	
500k Hz		115	

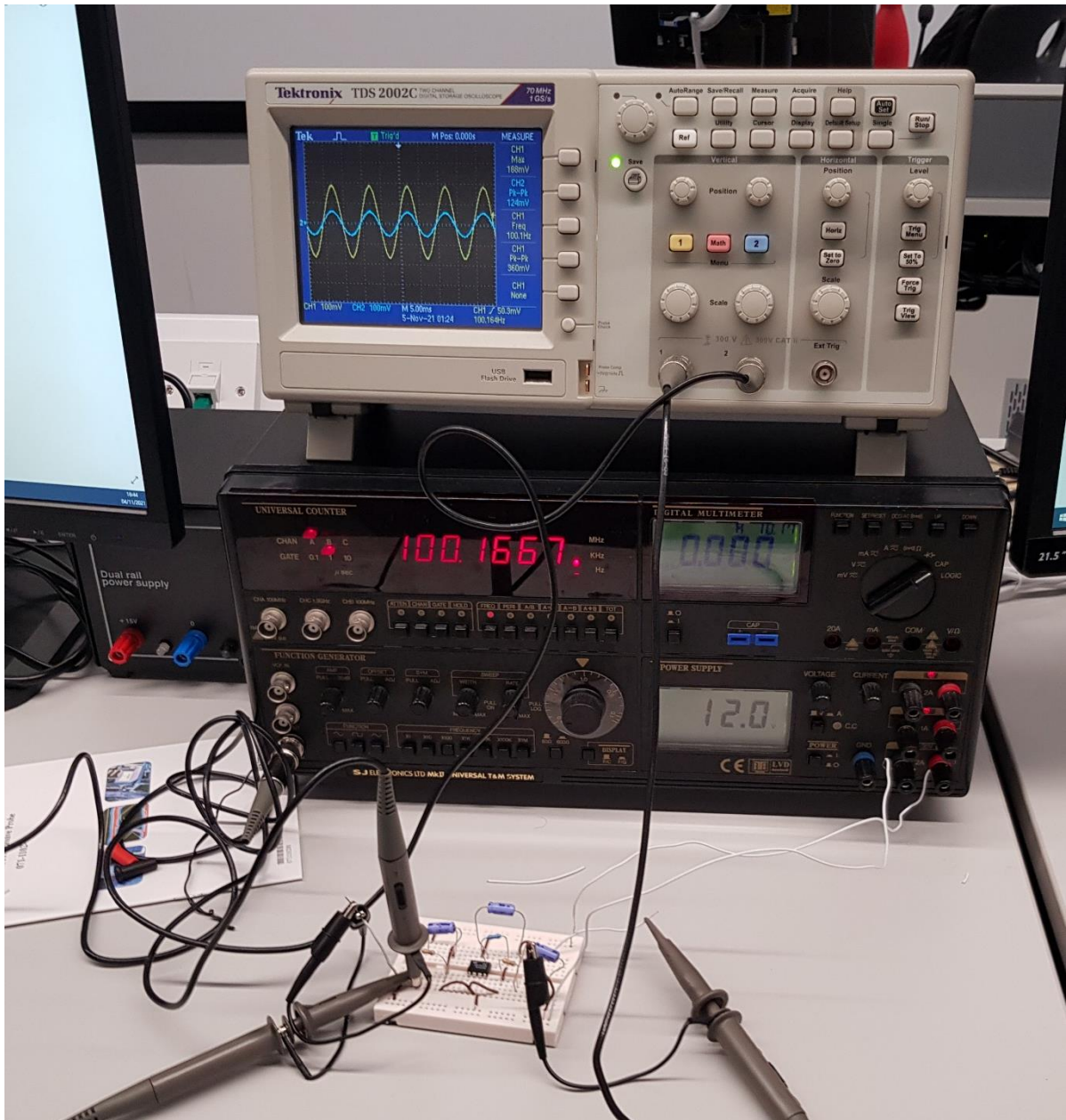
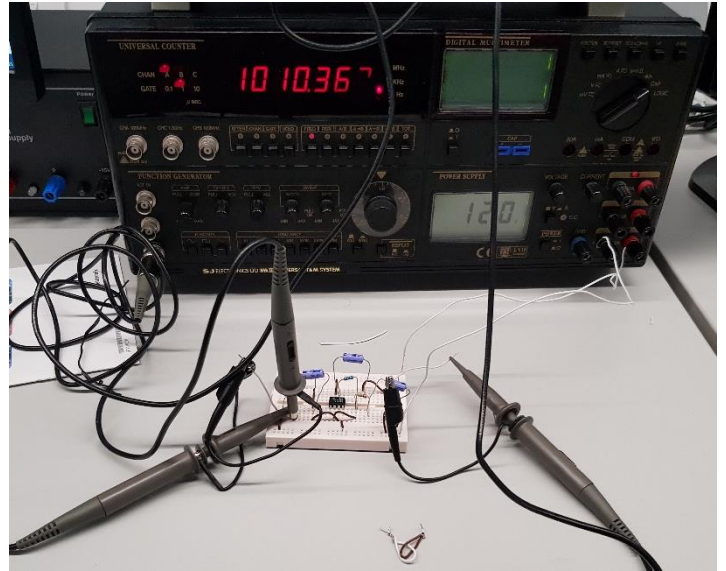
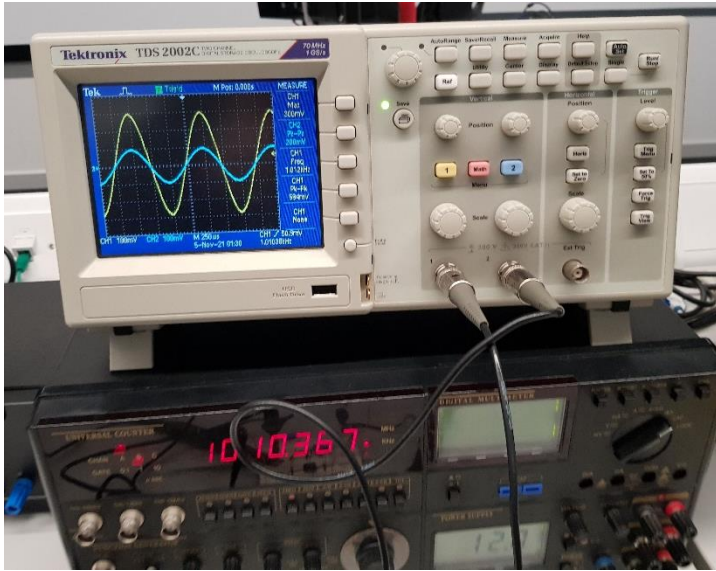


From this data we can calculate the Gain Bandwidth Product (GBP). The GBP is the frequency when the output voltage is $1/\sqrt{2}$ multiplied by the gain. The cut off voltage for this amplifier is $300\text{mV} \times 1/\sqrt{2} = 212.1\text{mV}$. From the table we can see that the frequency when the output voltage is 212.1mV is $\sim 255\text{kHz}$. Therefore, the GBP is $255\text{kHz} \times 3 = 765\text{kHz}$.

Breadboard

After I simulated the amplifier on Proteus, I created a physical version on a breadboard. Below is a group of photos documenting my set-up.

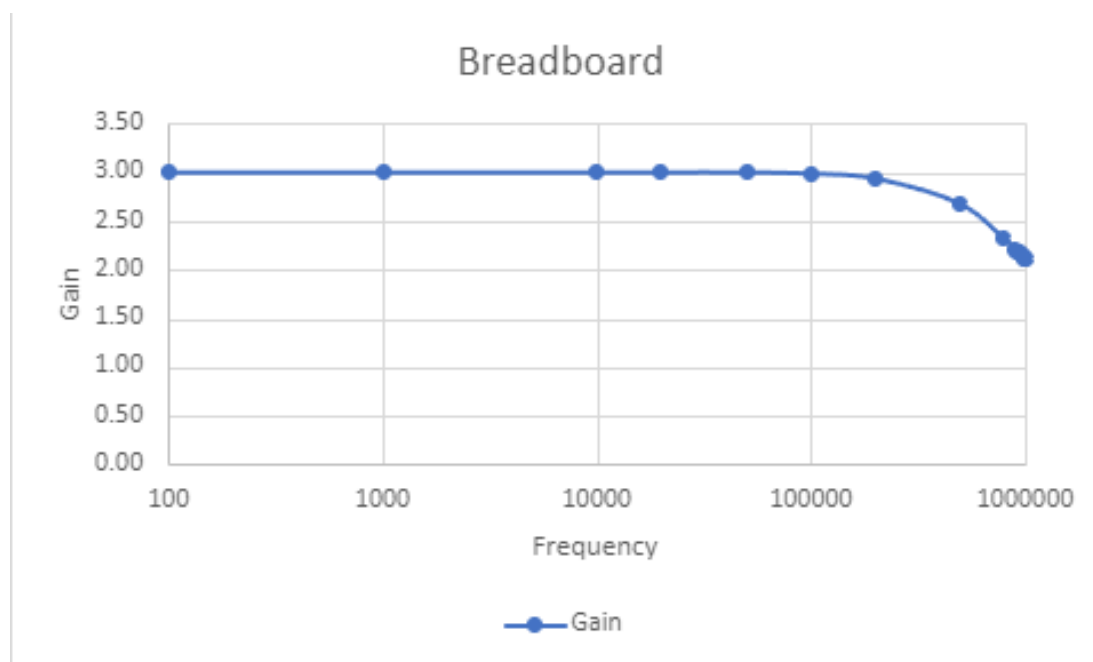




I used the Universal Test & Measure system to generate the 12v for the power rail and the range of frequencies at 300mVp-p. The oscilloscope was used to measure the input and output voltages.

Due to not having the correct amplifier on hand, the results from the breadboard circuit varies from the simulated results.

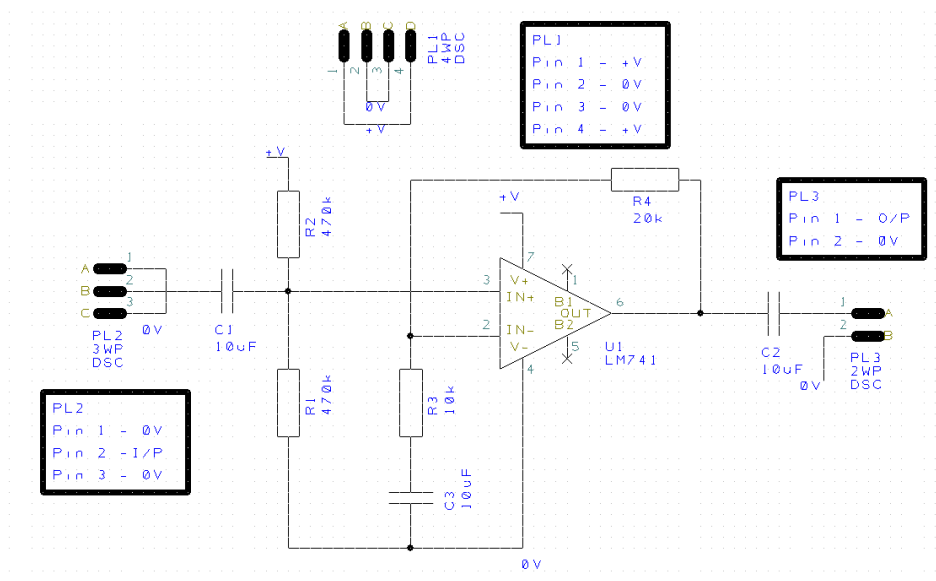
All Values mV					
Frequency		Output Voltage			
100 Hz		300			
1k Hz		300			
10k Hz		300			
20k Hz		300			
50k Hz		300			
100k Hz		298.75		Frequency	Output Voltage
200k Hz		293.75		920k Hz	218.75
500k Hz		267.5		940k Hz	217.5
800k Hz		231.25		960k Hz	215
900k Hz		221.25		980k Hz	212.5
1M Hz		210		990k Hz	211.25



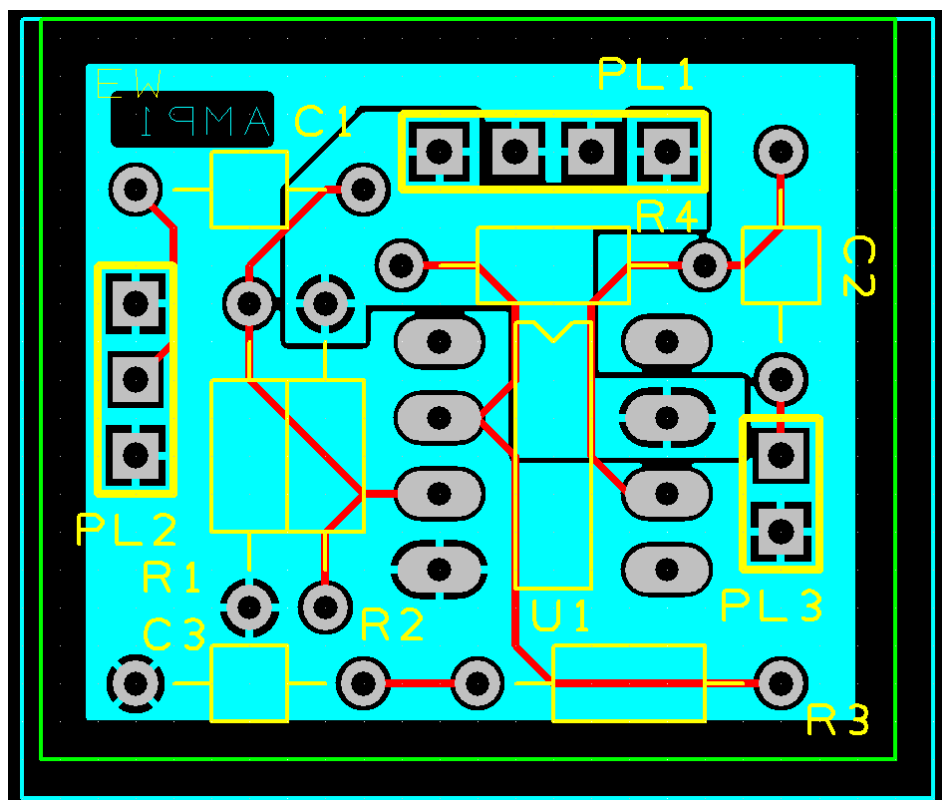
The cut off voltage for this circuit remains the same due to the equivalent input voltage. Therefore, the GBP for this amplifier circuit is $\sim 985\text{kHz} \times 3 = \sim 2.955\text{MHz}$.

PCB

I then drew the amplifier circuit in EasyPC. This means I could convert the schematic into a PCB design and have it manufactured.

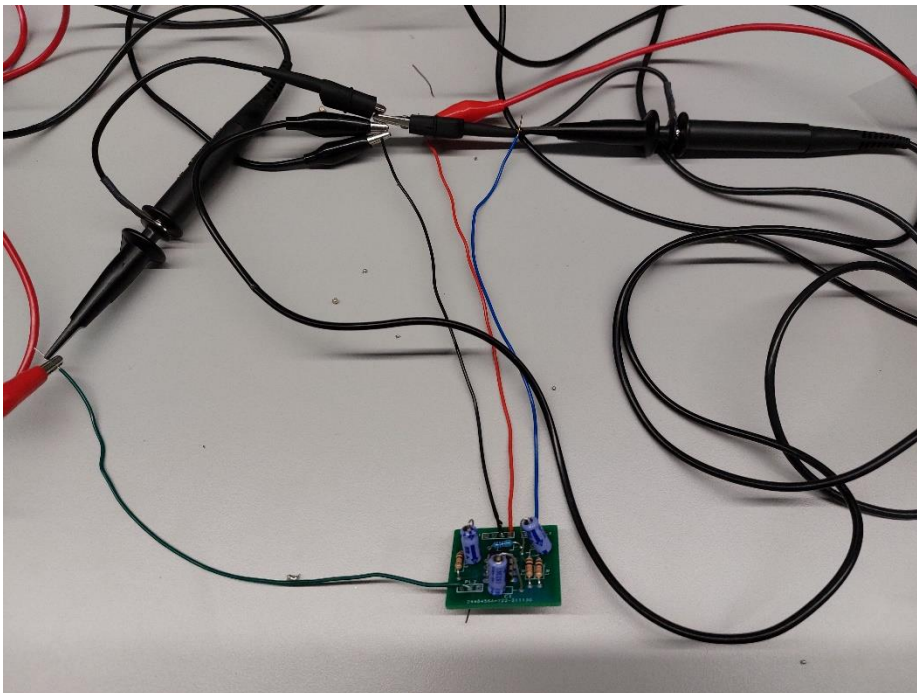
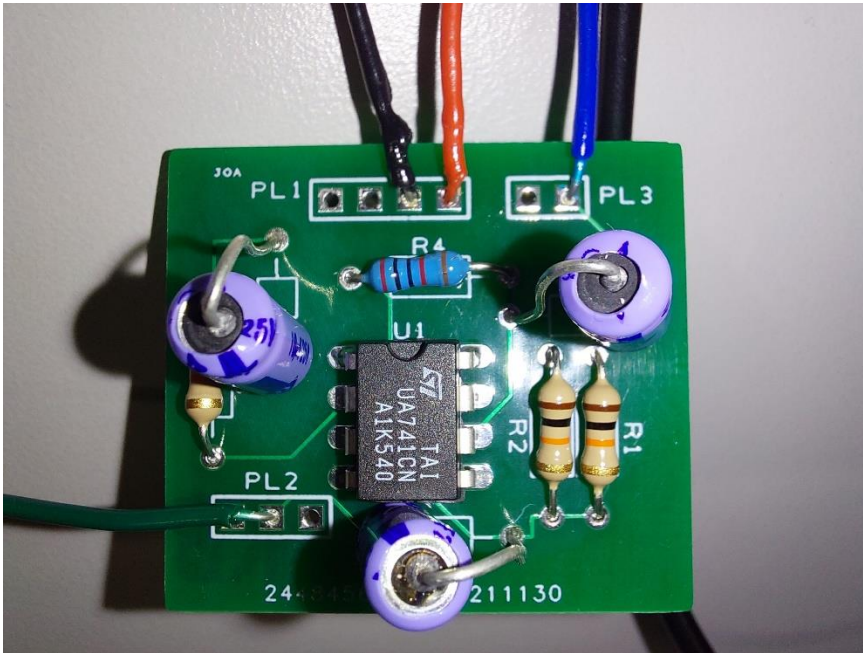


This is the circuit schematic in EasyPC.

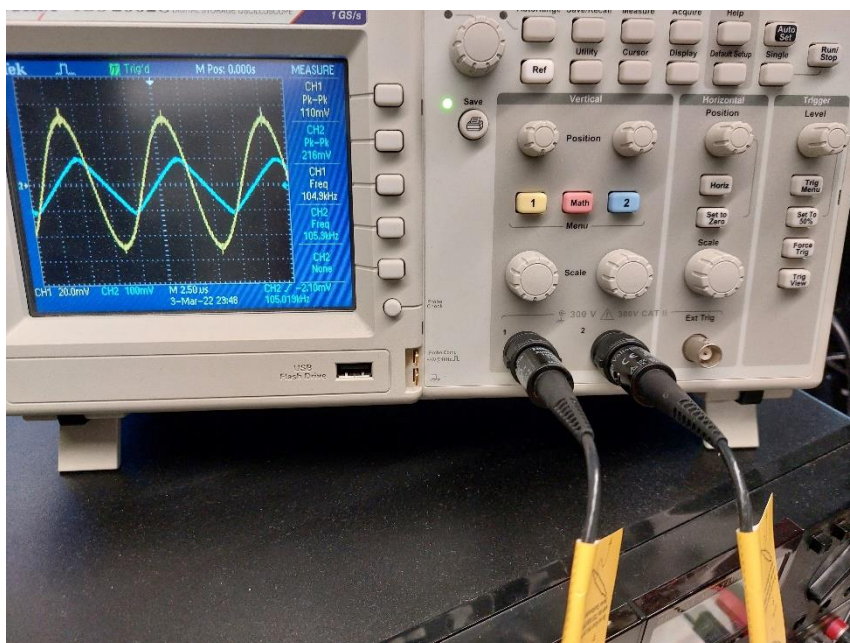


This is the subsequent PCB Design.

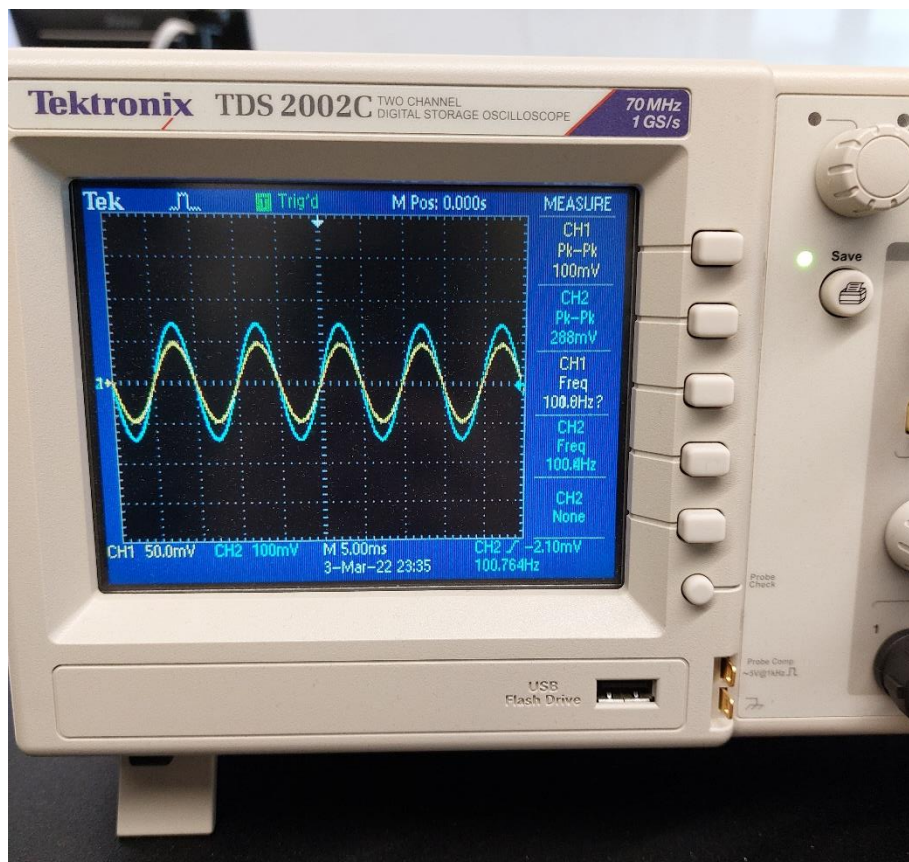
Due to issues in the ordering process, I did not end up receiving the board I had designed. However, I was able to use the board of a fellow student. This board is the exact same apart from the component layout. The board I received was blank and had to be populated with the components. I used the components from the breadboard and soldered them into the PCB.



The same equipment as the breadboard was used for the PCB measurements. With the T&M system created the 12v power rail & signal and the oscilloscope measuring the input & output voltage.

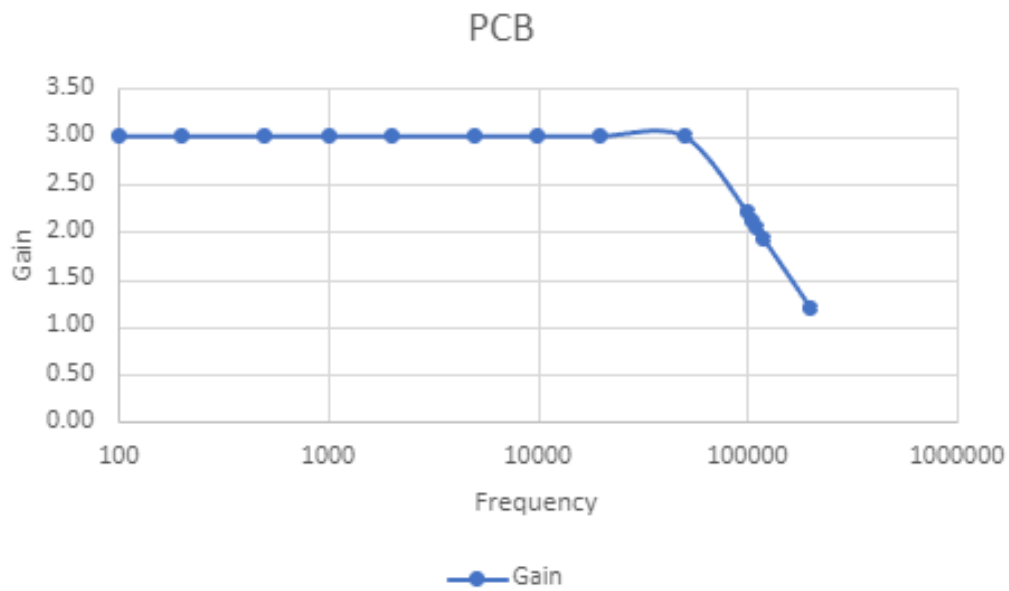


This is an example of how I used the oscilloscope for the PCB and Breadboard stage. I used 2 inputs to measure the input & output voltage. I then used the built-in measure function to measure the signals. This can be seen on the right-hand side of the screen with the yellow text being the input and the blue text the output. Using this we can record the input signal is 100mV peak to peak at a frequency of 100Hz and the subsequent output signal is 288mV peak to peak at 100Hz.



For some reason, the results I received from the PCB varied wildly from the breadboard results. I am not sure where the variation came from as the components and equipment was the same in both tests.

All Values mV			
	Frequency	Output Voltage	
	100 Hz	300	
	200 Hz	300	
	500 Hz	300	
	1k Hz	300	
	2k Hz	300	
	5k Hz	300	
	10k Hz	300	Frequency
	20k Hz	300	Output Voltage
	50k Hz	300	100k Hz
	100k Hz	220	105k Hz
	200k Hz	120	110k Hz
			120k Hz



From these results I calculated the GBP as $\sim 105\text{kHz} \times 3 = \sim 315\text{kHz}$.