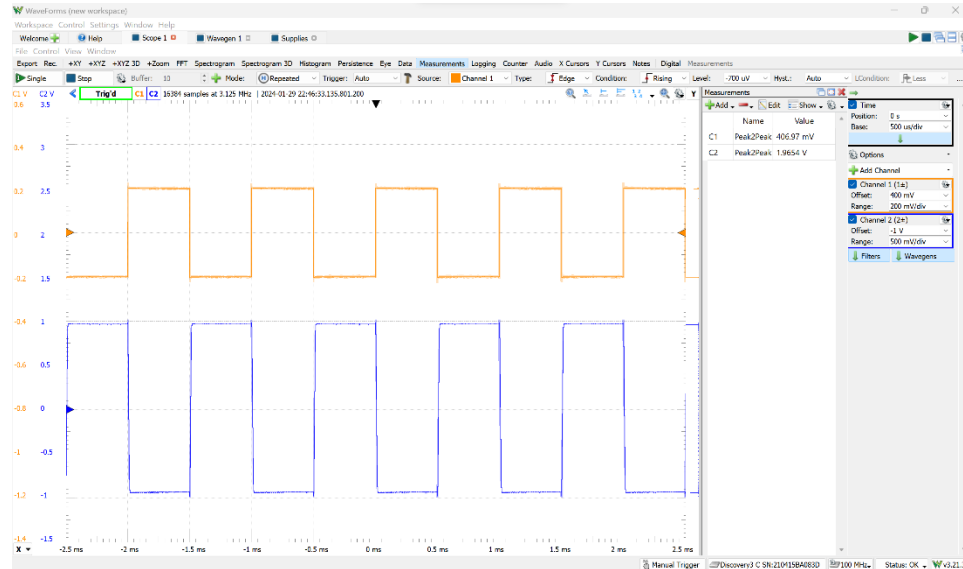


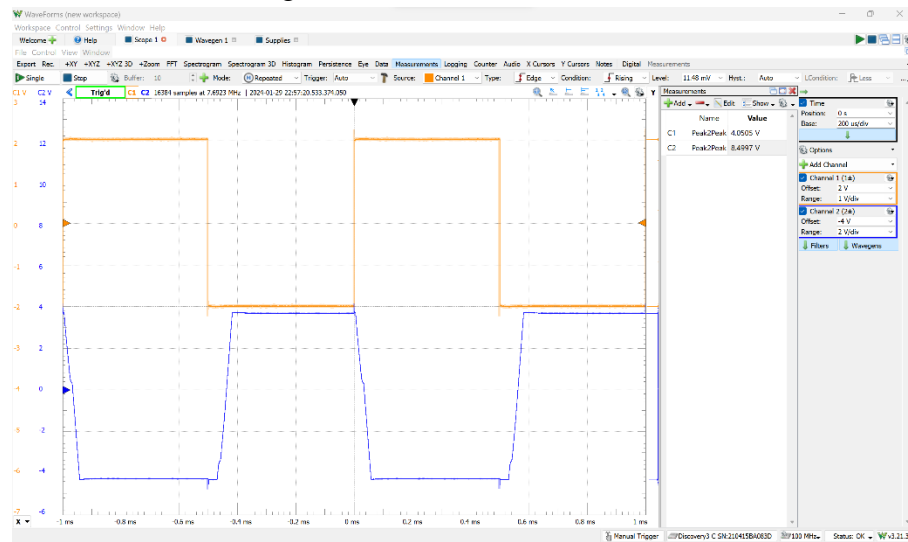
## 2CJ4 - Laboratory Experiments (Set 1)

1.

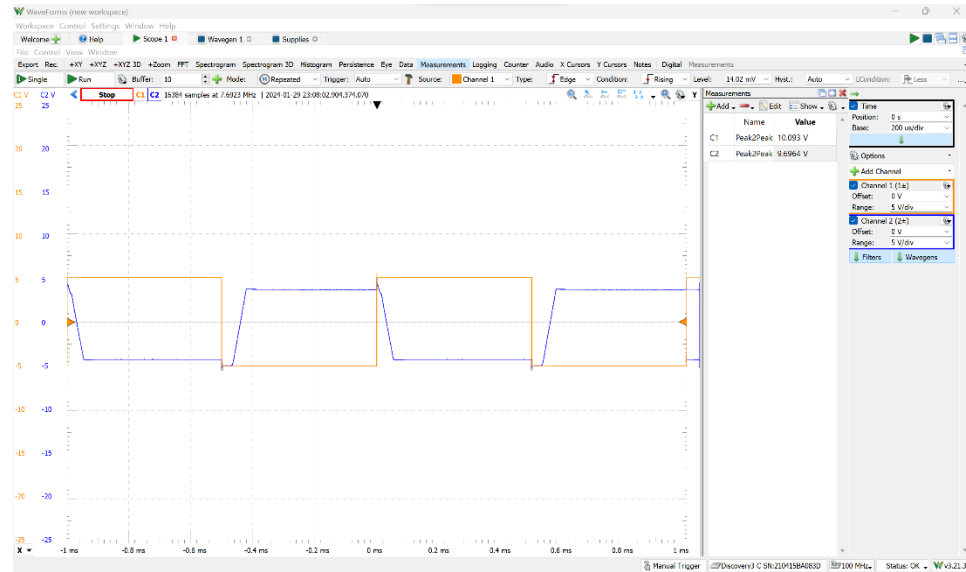
- a. 200mV with  $+V_{cc} = 5V$  and  $-V_{cc} = -5V$ . When the output is greater than the  $V_{cc}$ , we are in the saturation region; however, when the output is less than the  $V_{cc}$ , we are in the linear active region.



- b. 2V with  $+V_{cc} = 5V$  and  $-V_{cc} = -5V$ . When the output is greater than the  $V_{cc}$ , we are in the saturation region; however, when the output is less than the  $V_{cc}$ , we are in the linear active region.



- c. 5V with  $+V_{cc} = 5V$  and  $-V_{cc} = -5V$ . When the output is greater than the  $V_{cc}$ , we are in the saturation region; however, when the output is less than the  $V_{cc}$ , we are in the linear active region.



2.

- a. 200mV with  $+V_{cc} = 5V$  and  $-V_{cc} = -5V$

1. 200 mV

experimental:

$$A = \frac{V_o}{V_{in}} = \frac{1.9651V}{406.97mV} = 4.829$$

calculated:

$$V_o = \frac{47K\Omega}{10K\Omega} \cdot 200mV = 940mV$$

$$A = \frac{V_o}{V_{in}} = \frac{940mV}{200mV} = 4.7$$

% difference:  $\frac{|V_1 - V_2|}{\left[\frac{V_1 + V_2}{2}\right]} \times 100$

$$= \frac{|4.7 - 4.829|}{\left[\frac{4.7 + 4.829}{2}\right]} \times 100$$

$$= 2.71\% \text{ difference}$$

- b. 2V with  $+V_{cc} = 5V$  and  $-V_{cc} = -5V$ . We cannot calculate the gain in this scenario because of the characteristics of an op-amp. The gain is present; however, it results in an output voltage greater than the amplitude. The calculations result in an inaccurate gain.

i. 2V

experiment:

$$A = \frac{V_o}{V_{in}} = \frac{8.4997V}{4.0508V} = 2.098$$

calculated:

$$V_o = \frac{47K\Omega}{10K\Omega} \cdot 2V = 9.4V$$

$$A = \frac{V_o}{V_{in}} = \frac{9.4V}{2V} = 4.7$$

% difference:  $\frac{|4.7 - 2.098|}{\left(\frac{4.7 + 2.098}{2}\right)}$

$$= 76.55\%$$

- c. 5V with  $+V_{cc} = 5V$  and  $-V_{cc} = -5V$ . We cannot calculate the gain in this scenario because of the characteristics of an op-amp. The gain is present; however, it results in an output voltage greater than the amplitude. The calculations result in an inaccurate gain.

% i) 5V

experimental:  $A = \frac{V_o}{V_{in}} = \frac{9.6969V}{10.093V} = 0.9607$

calculated:  $V_o = \frac{47K\Omega}{10K\Omega} \times 5V = 23.5V$

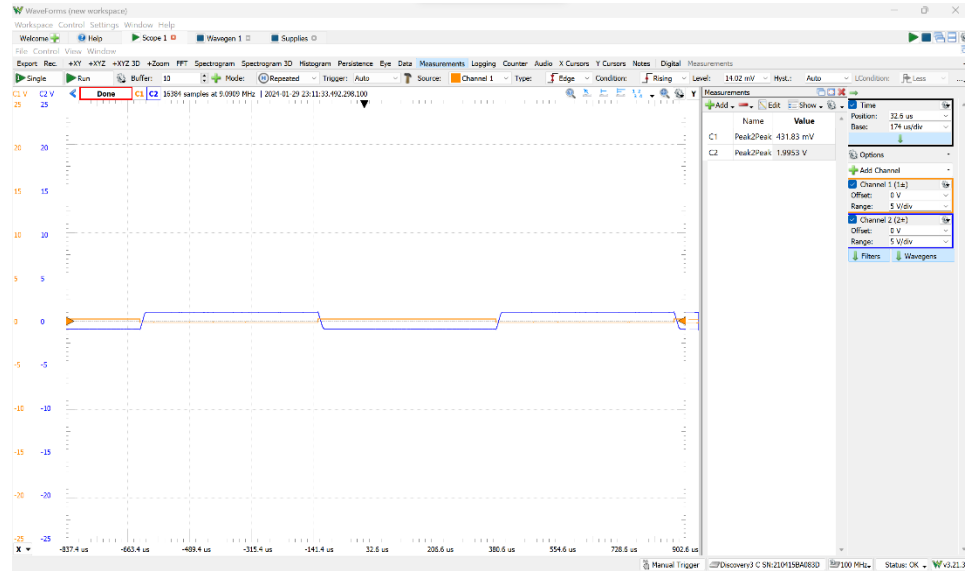
$$A = \frac{V_o}{V_{in}} = \frac{23.5V}{5V} = 4.7$$

% difference:  $\frac{|4.7 - 0.9607|}{\left(\frac{4.7 + 0.9607}{2}\right)}$

$$= 132.11\% \text{ difference}$$

3.

- a. 200mV with  $+V_{cc} = 2.5V$  and  $-V_{cc} = -2.5V$ . When the output is greater than the  $V_{cc}$ , we are in the saturation region; however, when the output is less than the  $V_{cc}$ , we are in the linear active region. The gain is also the same regardless of the value of the values of  $\pm V_{cc}$  as it is not taken into consideration when performing calculations.



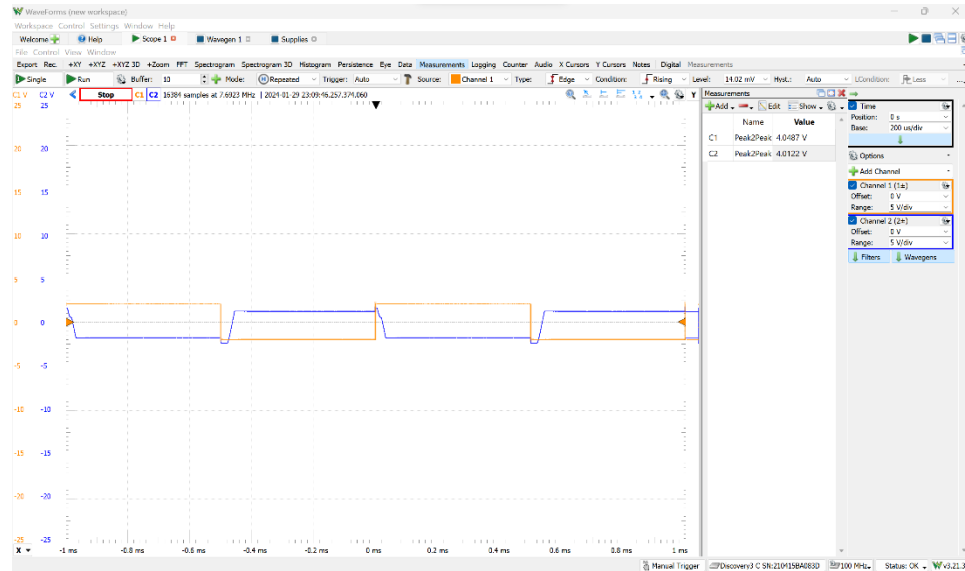
iii. 200 mV

experimental:  $A = \frac{V_o}{V_{in}} = \frac{1.9953V}{431.83mV} = 4.62$

calculation:  $V_o = 47K\Omega \cdot 200mV = 9.40mV$   
 $A = \frac{9.40mV}{200mV} = 4.7$

percent difference:  $\frac{|4.7 - 4.62|}{\frac{4.7 + 4.62}{2}} = 1.72\%$  difference with experimental value

- b. 2V with  $+V_{cc} = 2.5V$  and  $-V_{cc} = -2.5V$ . When the output is greater than the  $V_{cc}$ , we are in the saturation region; however, when the output is less than the  $V_{cc}$ , we are in the linear active region. Again, we cannot calculate the gain in this scenario because of the characteristics of an op-amp. The gain is present; however, it results in an output voltage greater than the amplitude. The calculations result in an inaccurate gain. The gain is also the same regardless of the value of the values of  $\pm V_{cc}$  as it is not taken into consideration when performing calculations.



iii. 2V experiment:  $A = \frac{V_o}{V_{in}} = \frac{9.0122V}{9.0487V} = 0.991$

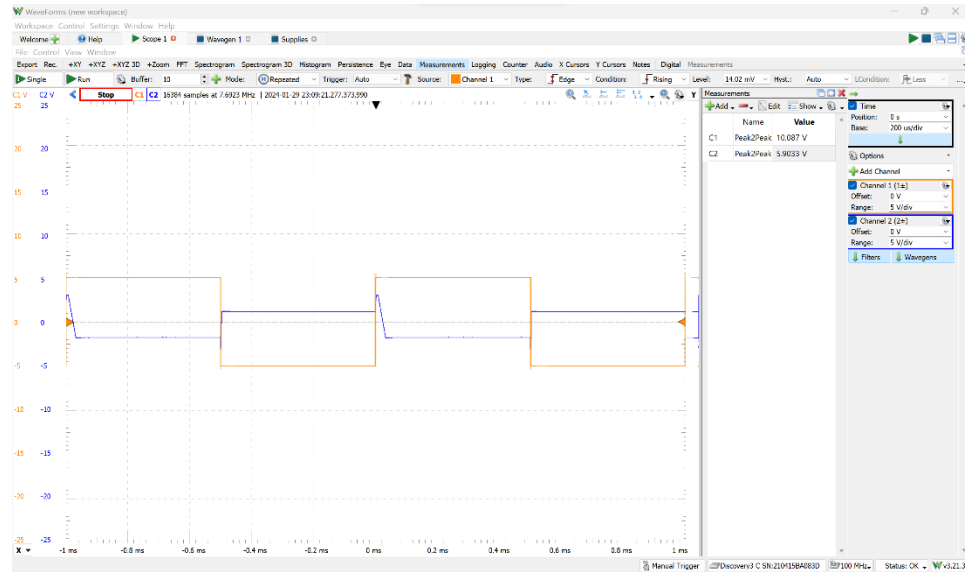
calculation:

$$V_o = \frac{47K\Omega}{10K\Omega} \cdot 2V = 9.4V$$

$$A = \frac{V_o}{V_{in}} = \frac{9.4V}{2V} = 4.7$$

% diff:  $\frac{|4.7 - 0.991|}{\left(\frac{4.7 + 0.991}{2}\right)} = 130\% \text{ difference}$

- c. 5V with  $+V_{cc} = 2.5V$  and  $-V_{cc} = -2.5V$ . When the output is greater than the  $V_{cc}$ , we are in the saturation region; however, when the output is less than the  $V_{cc}$ , we are in the linear active region. We cannot calculate the gain in this scenario because of the characteristics of an op-amp. The gain is present; however, it results in an output voltage greater than the amplitude. The calculations result in an inaccurate gain. The gain is also the same regardless of the value of the values of  $\pm V_{cc}$  as it is not taken into consideration when performing calculations.



iii) 5V

experiment:  $A = \frac{V_o}{V_{in}} = \frac{5.9033V}{10.087V}$

$= 0.585$

calculations:  $V_o = \frac{47K\Omega}{10K\Omega} \times 5V = 23.5V$

$A = \frac{23.5V}{5V} = 4.7$

% difference:  $\frac{|0.585 - 4.7|}{\left(\frac{4.7 + 0.585}{2}\right)}$

$= 155.7\%$  difference.