EXPERIMENT 2
REPORT SHEET

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Date: 09/11/2020

Important Notes:

- You will be expected to provide screenshots of your simulation results. You have to take full screenshots for all of them. You can use the full-screen mode of the Snipping Tool for this. DO NOT crop any image.
- If the image is too dense or too small that makes it difficult to view, then add zoomed-in images as EXTRAS (again full screenshots).
- You will name your report as "**Exp#_Design#_StudentID.pdf**"

Preliminary Work:

1. Explain the XY operation of the oscilloscope.

It eliminates the parameter time and draws a graph of a waveform as a function of another one. For example, instead of V vs. t, it can draw V vs. I, or V_1 vs V_2.

2. What is the root means square (RMS) of a sinusoidal waveform?

For an alternating current, it is the direct current value that produces the same amount of power at the average.

3. Find the voltage between nodes Y and G in Figure 2, where $R_1= R_2= R_3= R_4= R_5= 1k\Omega$ and $V_1=4.5\sin(4000\pi t)$ Volts and $V_2=10$ Volts

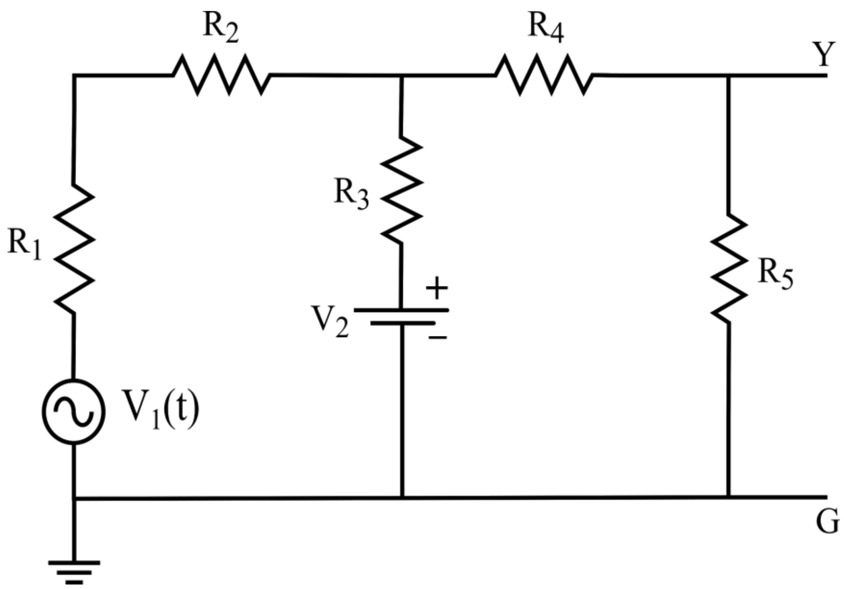


Figure 2

By using nodal analysis method:

At the node n001, between AC source and R_1: $V(n001) = V_1 = 4.5\sin(4000\pi t)$
At the node n002, between R_1 and R_2: $0 = (V(n002) – V_1)/R_1 + (V(n002) – V(n003))/R_2$
At the node n003, between R_2 and R_4: $0 = (V(n003) – V(n002))/R_2 + (V(n003) – V_2)/R_3 + (V(n003) – V(n004))/R_4$
At the node n004, between R_4 and R_5: $0 = (V(n004) – V(n003))/R_4 + V(n004)/R_5$
At the node n005, between DC source and R_3: $V(n005) = V_2 = 10V$

We have the known values and the system

$V_1 = 4.5\sin(4000\pi t)$
$V_2 = 10V$
$2V(n002) – V(n003) = 4.5\sin(4000\pi t)$
$–V(n002) + 3V(n003) – V(n004) = 10V$
$–V(n003) + 2V(n004) = 0$

Solving the system, we get

$V(n002) = 2.5V + (2.81V)\sin(4000\pi t)$
$V(n003) = 5V + (1.13V)\sin(4000\pi t)$
$V(n004) = 2.5V + (0.56V)\sin(4000\pi t)$

$V_{YG} = V(n004) = 2.5V + (0.56V)\sin(4000\pi t)$

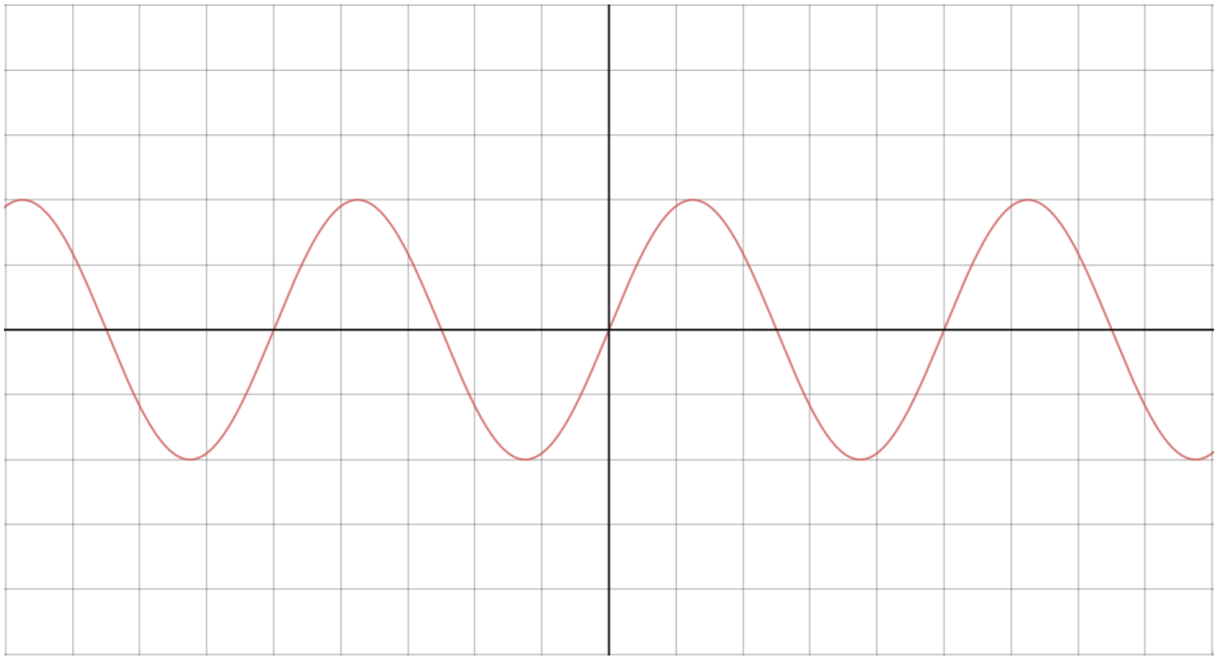
4. Calculate the period of the signals given in the Table 1, and fill the period column.

Table 1

$V_1(t)= V_{peak} \sin(2\pi ft)$ volts		
V_{peak}	f(Hz)	T=1/f (msec)
3	250	4
6	1250	0.8
6	5000	0.2

5. $V_1(t)=2\sin(4000\pi t)$ volts ie. $V_1(t)$ is a sinusoidal signal with frequency 2 kHz and peak amplitude 2V. According to following DSO settings of CH1, sketch the waveform, $V_1(t)$. (Be neat, pay attention to positions of maxima, minima of the waveform)

DSO Settings:
CH: CH1, **MODE:** YT**, COUPLING:** AC**, VOLTS/DIV:** 1V**, TIME/DIV:** 0.1ms



6. For the waveform in the Figure 4, write the peak value, the period and the frequency of this signal by considering DSO settings.

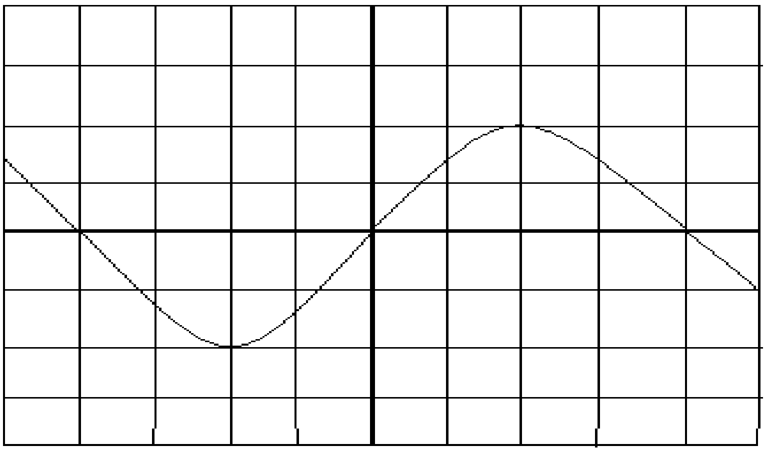


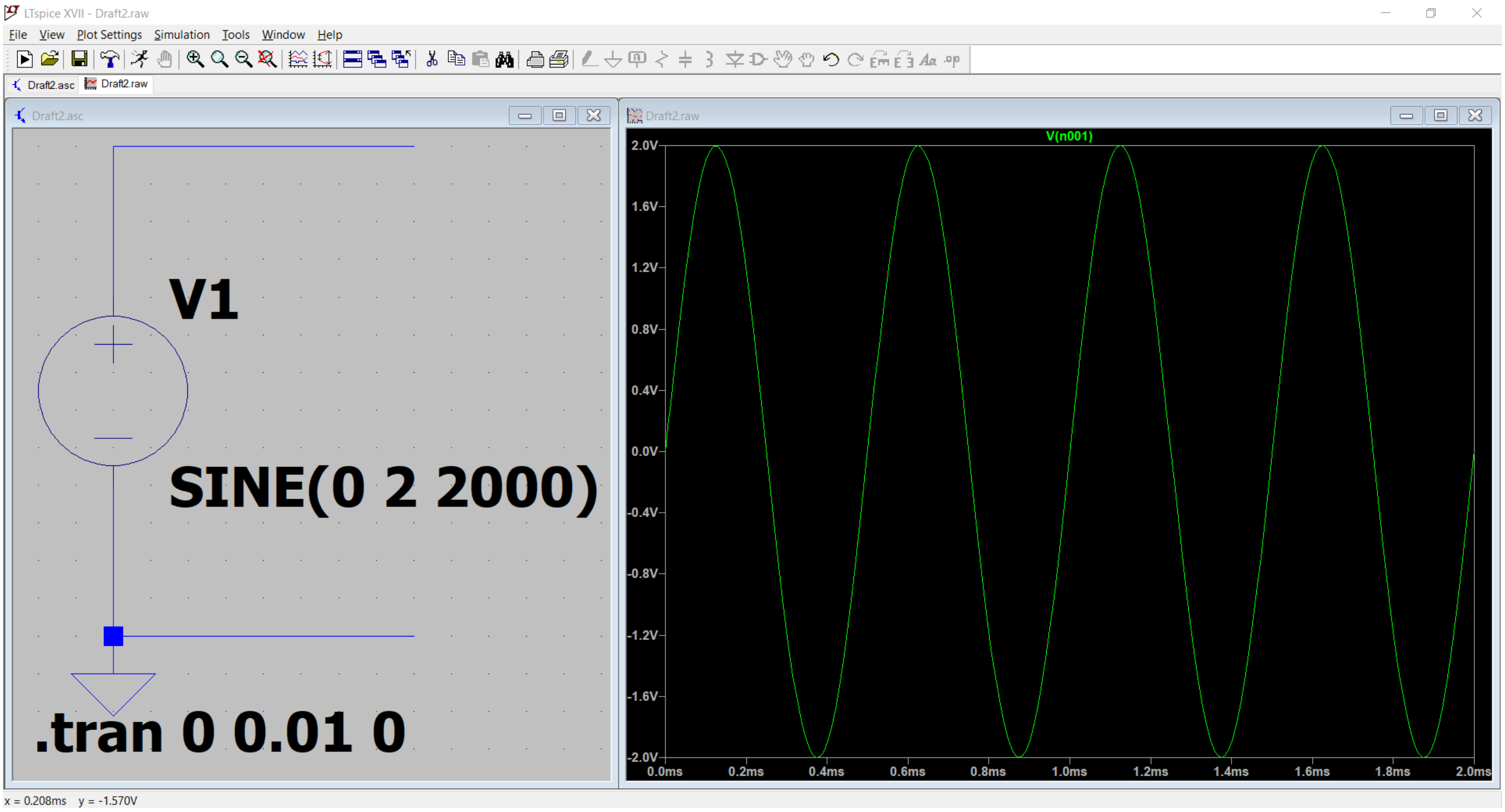
Figure 4

DSO Settings:
CH: CH1, **MODE:** YT**, COUPLING:** AC**, VOLTS/DIV:** 2V**, TIME/DIV:** 0.5ms

$V_{peak} = 4V$
$T = 4ms$
$f = 250Hz$

Experimental Work:

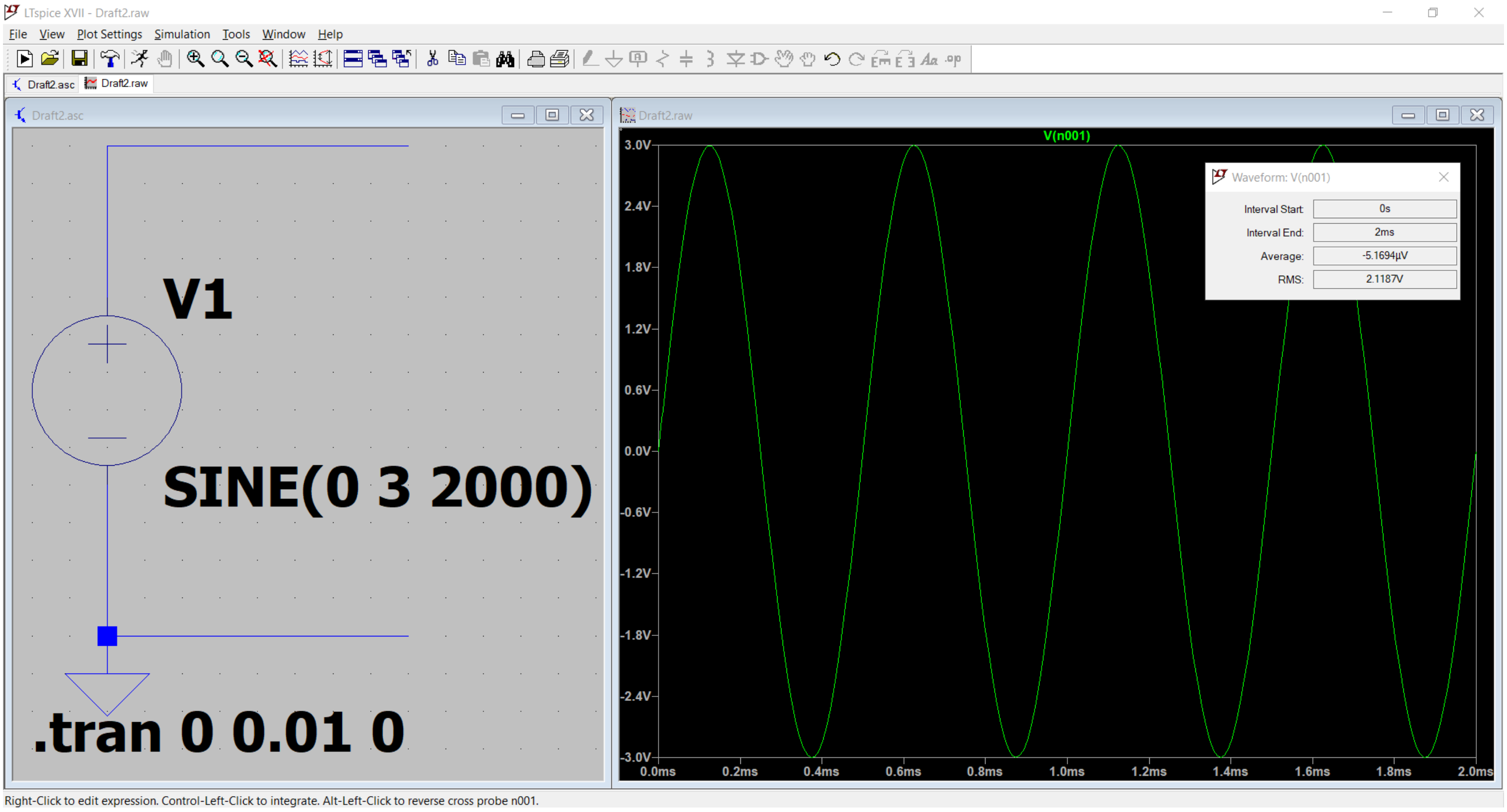
1. Take the screenshot of the signal and write the period and amplitude of this signal by using the cursor in LTSpice.



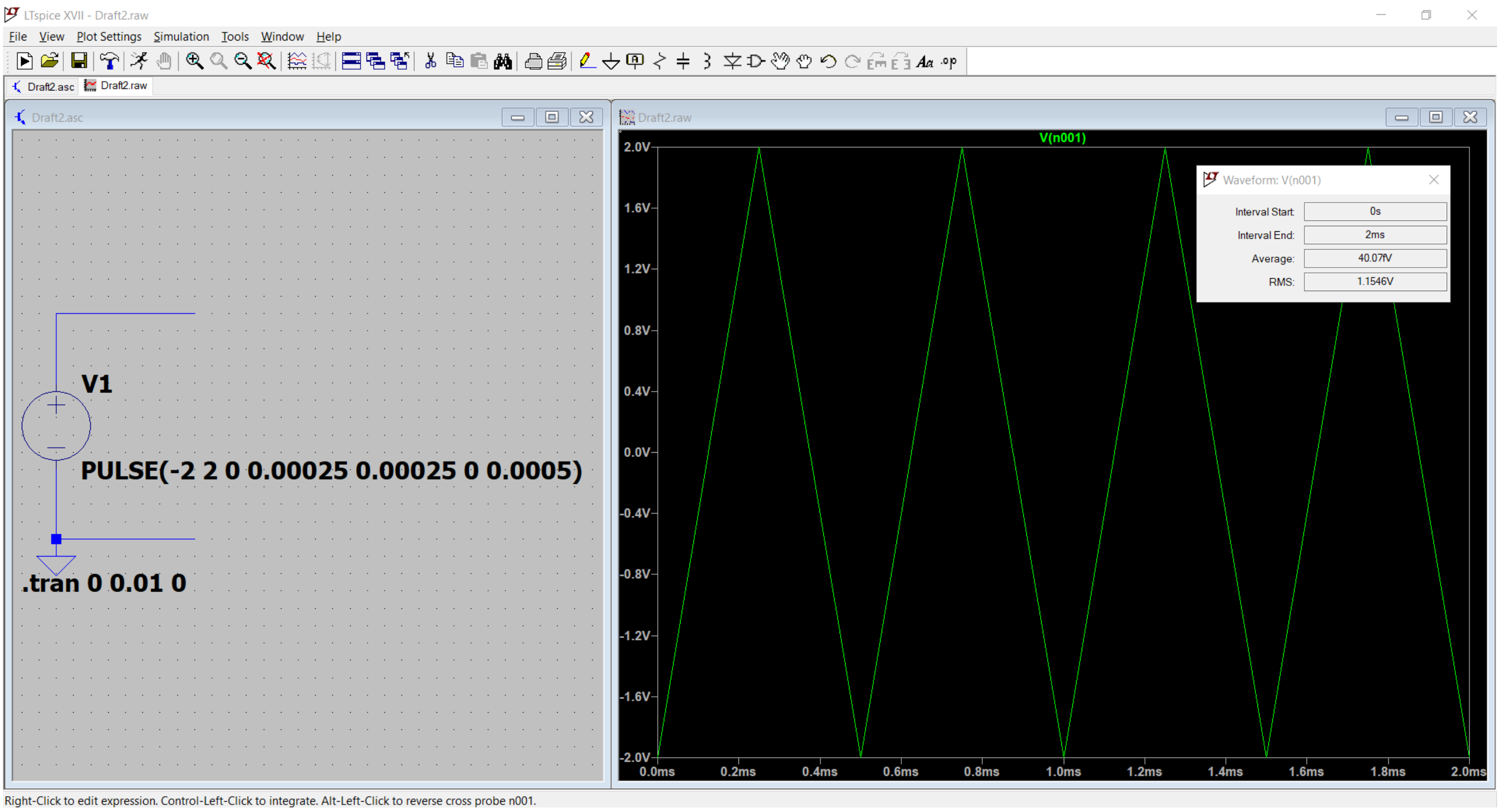
Period: 0.5ms
Amplitude: 2V

Comment: The graph for this alternating voltage source is a sinusoidal waveform with period 0.5ms and amplitude 2V and without any offset or phase difference. This means the waves will reach at most 2V at peak, and there will be 0.5ms time gaps between two consecutive peak points.

2. Take the screenshots of both signals and write the RMS values of these signals.

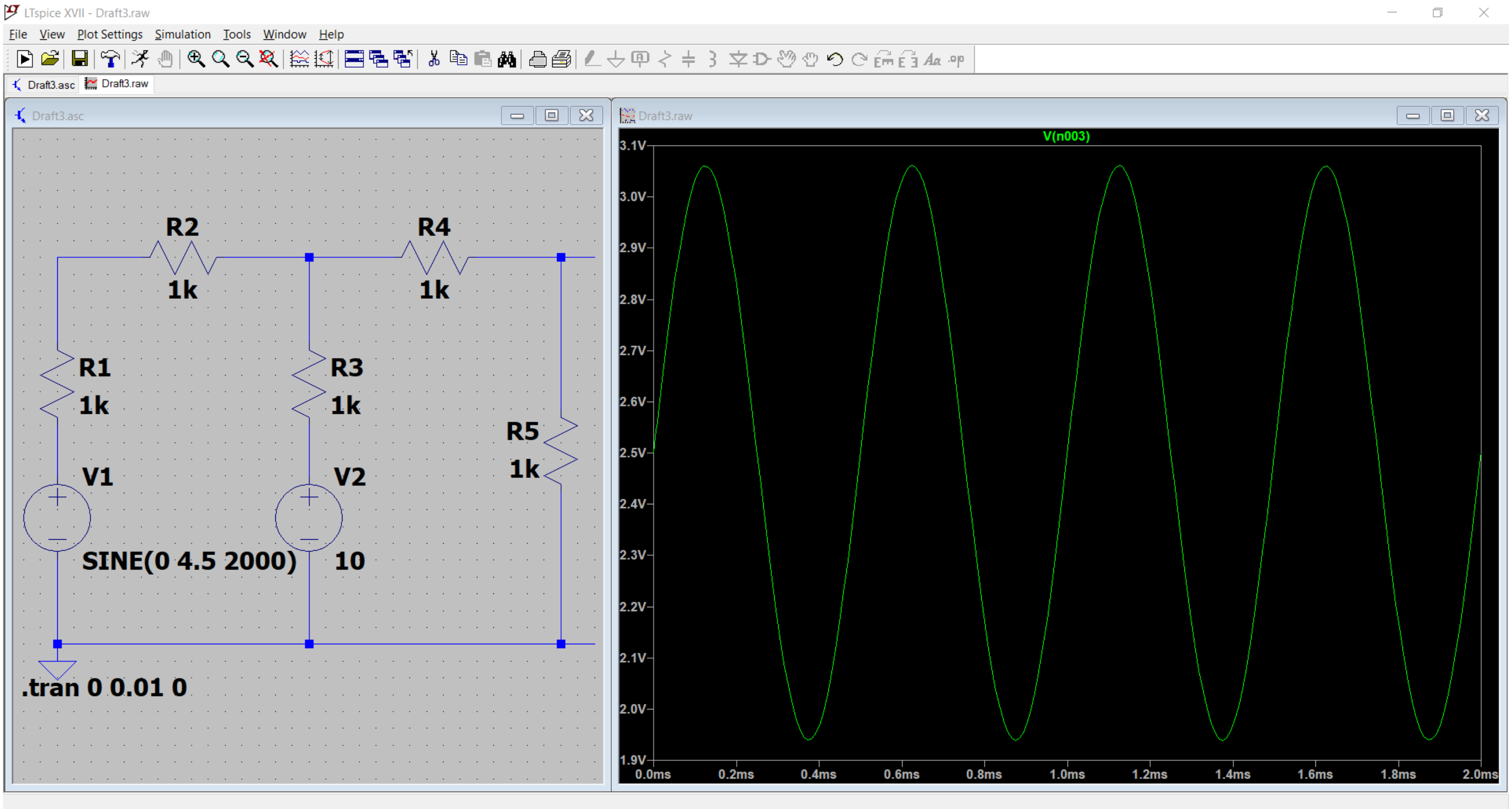


RMS value: 2.12V



RMS value: 1.15V

3. Take the screenshots of both the circuit and voltage waveform and write DC and AC components of the signal between node Y and node G.

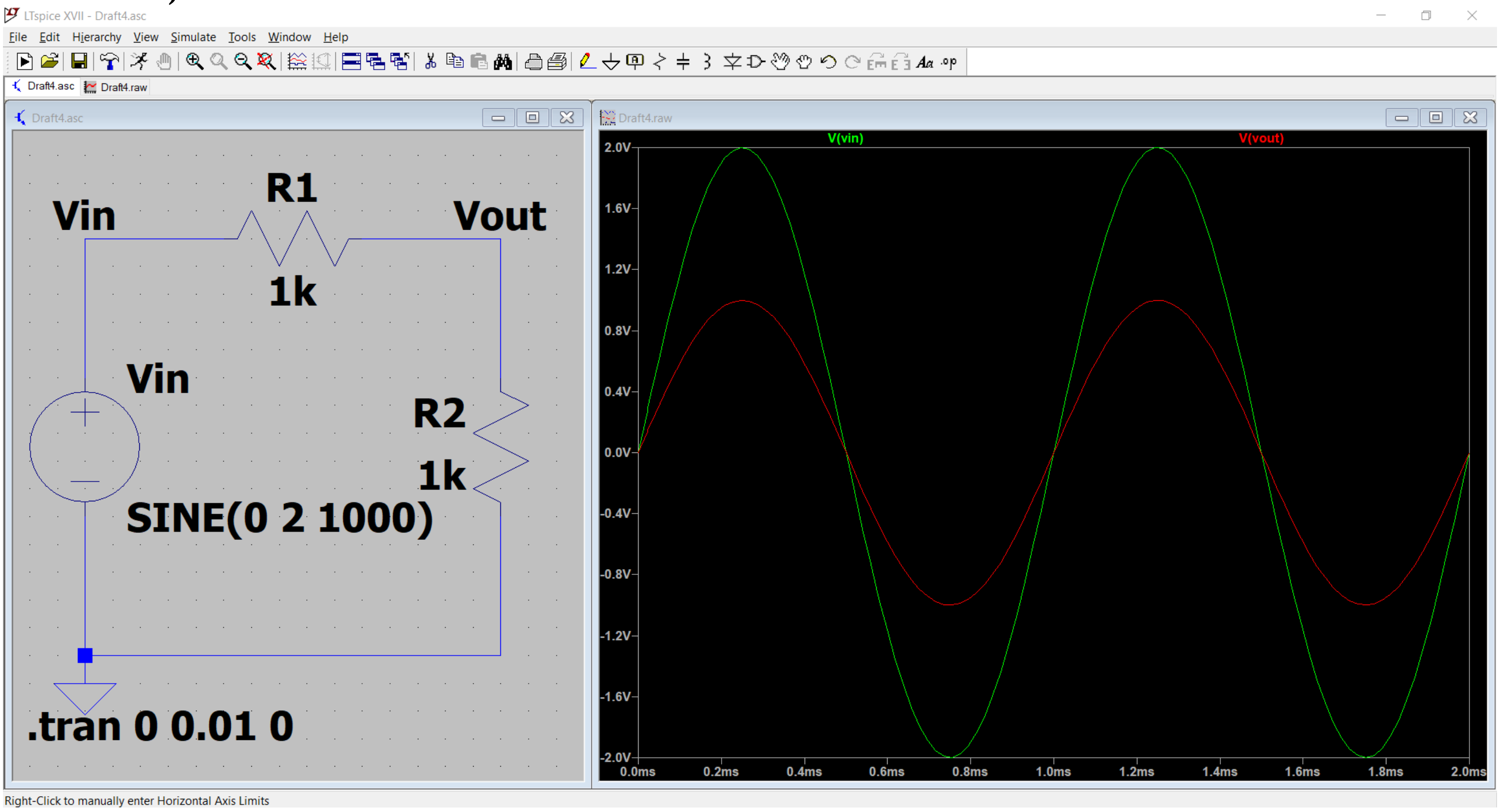


V_{YG} = 2.5 + (0.56)sin(4000πt) V (DC and AC components)

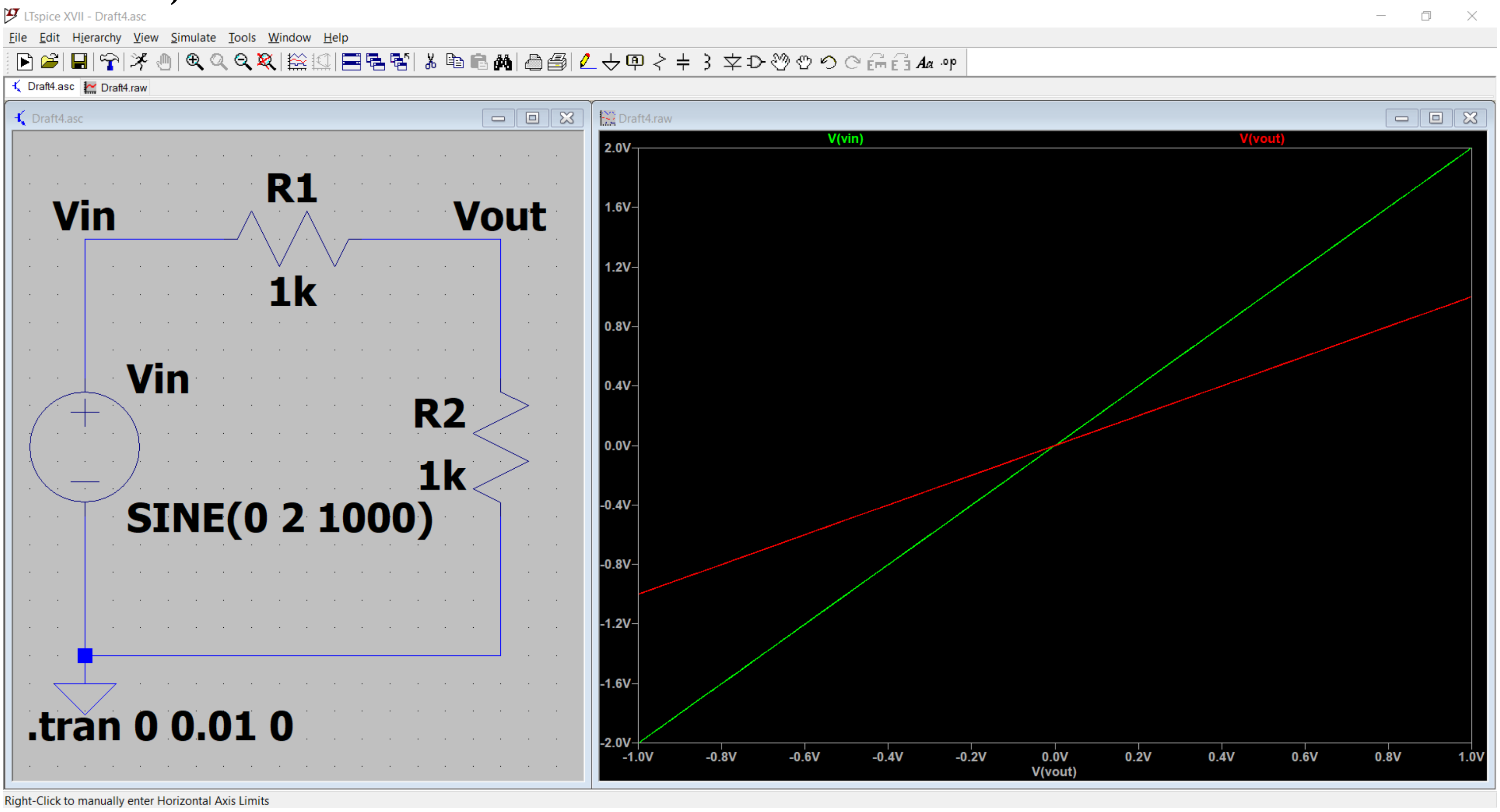
The simulation results and calculated results are consistent to each other.

4. Take the screenshots.

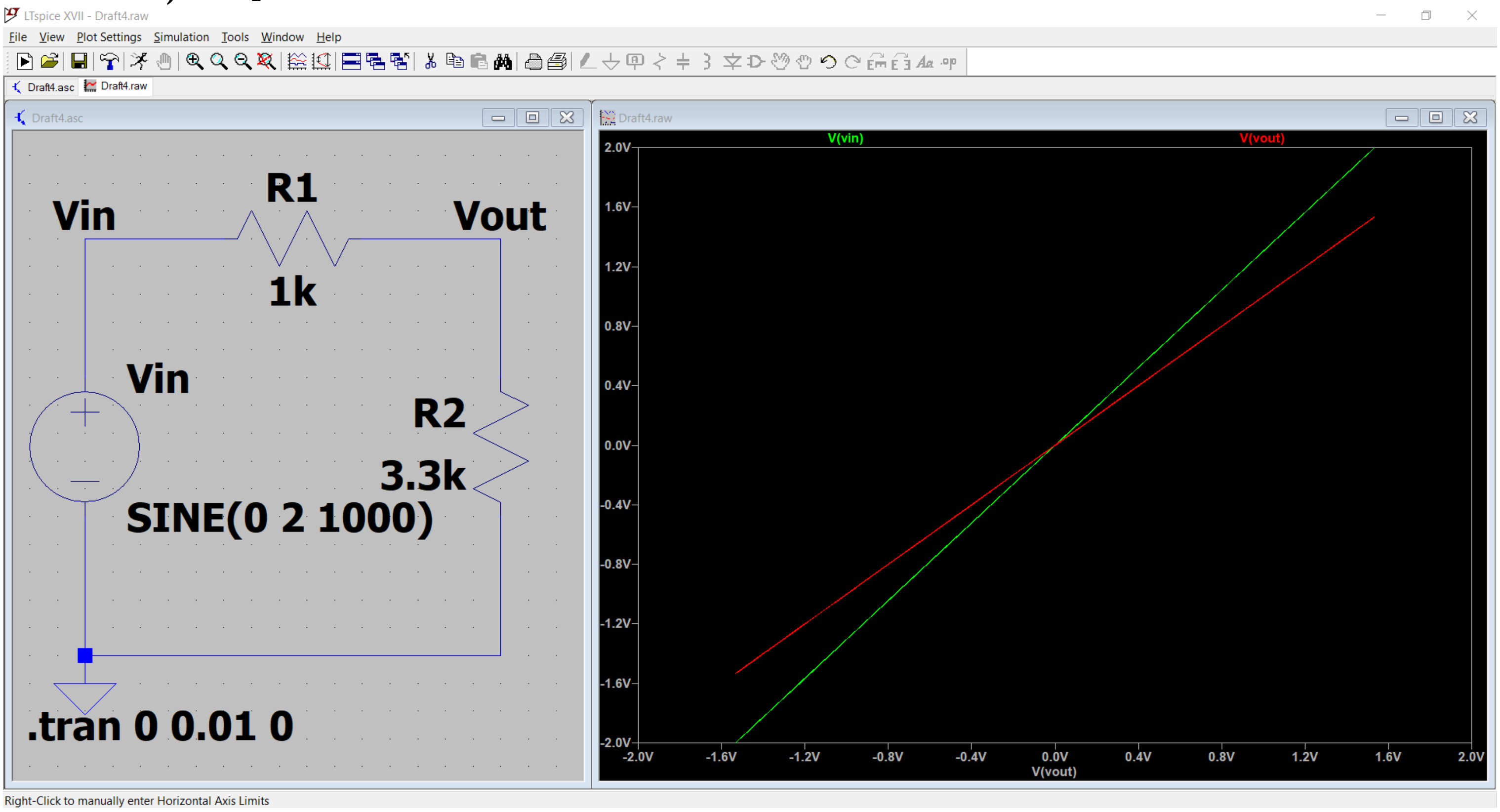
a)



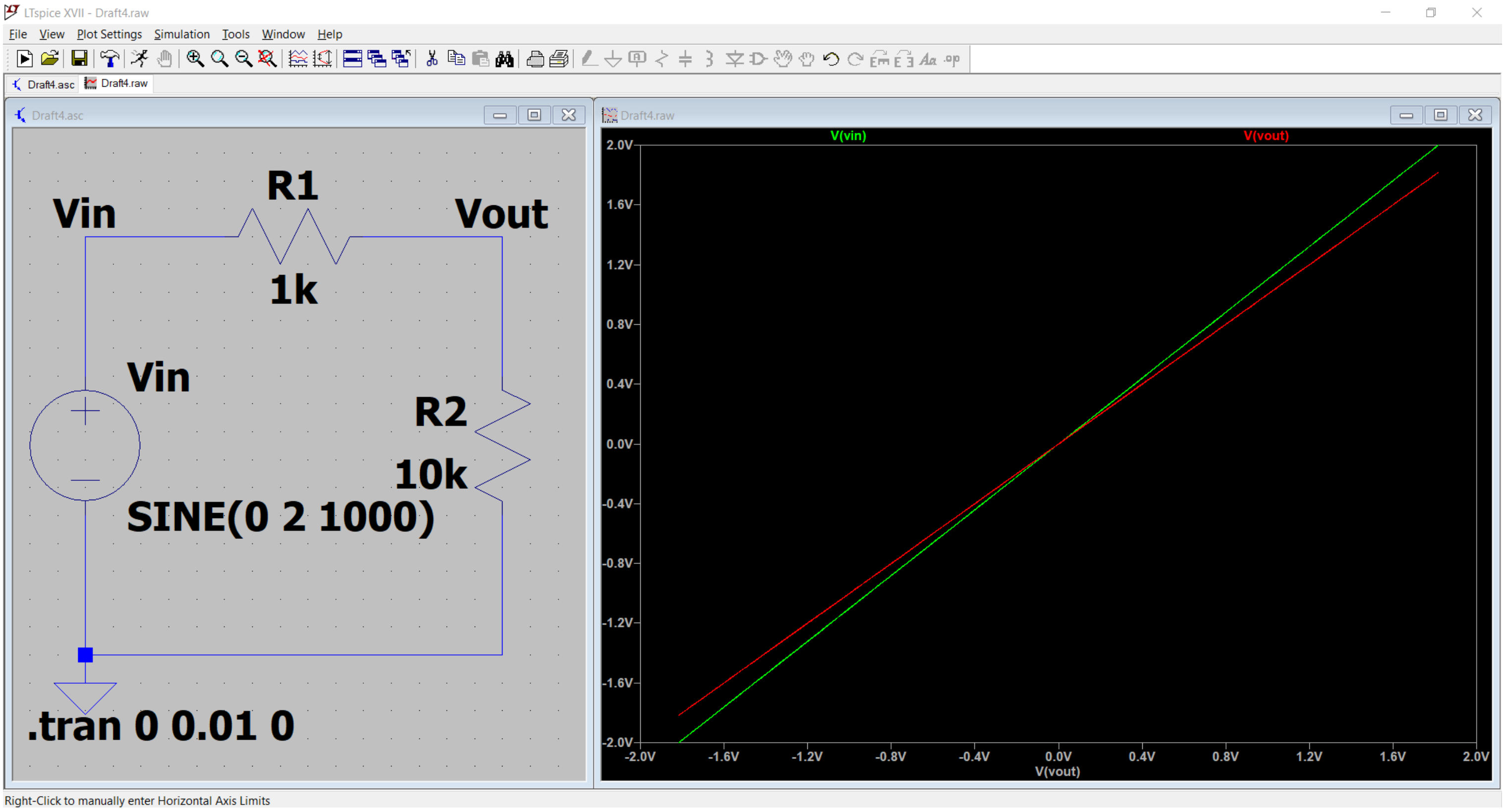
b)



c) for R_2=3.3kΩ



for R_2=10kΩ



Conclusion:

Comment on the below changes,

1) What do you observe when you adjust the “Vertical Division Control” properly by changing the volts/div values of the Channel 1?

   When the vertical division control is adjusted, the waveform stretches or squeezes vertically. The peak points become higher and the trough points become lower, or vice versa. However, nothing changes in horizontal aspect.

2) What do you observe when you adjust the “Horizontal Division Control” properly by changing the time/div values of the oscilloscope and observe the variations in the display?

   When the horizontal division control is adjusted, the waveform stretches or squeezes horizontally. The gap between two peak points or two trough points becomes bigger or smaller. However, nothing changes in vertical aspect.

3) What do you observe when you adjust the “Vertical Position Control” on the screen?

   When the vertical position control is adjusted, the waveform moves up or down vertically as a whole. Since volts/div or time/div does not change, the appearance of the waveform remains unchanged.

4) What do you observe when you adjust the “Horizontal Position Control” on the screen?

   When the horizontal position control is adjusted, the waveform moves to right or left horizontally as a whole. Since volts/div or time/div does not change, the appearance of the waveform remains unchanged.