2.4 Preliminary Work:

1. Explain the XY operation of the oscilloscope.

When the variation of one voltage waveform, Vy(t), as a function of another, Vx(t), eliminating the parameter time, t, is desired, X-Y mode of operation is used. In X-Y mode, one signal is applied to the vertical deflection plates whereas the other signal is applied to the horizontal deflection plates. The XY button on the front panel of the oscilloscope disconnects the triggering signal from the horizontal deflection system, and connects the second input signal instead. This process is done by using a switch.

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

$$X(t) = X_{peak} \sin\left(t \frac{2\pi}{T}\right)$$

$$X_{RMS} = \sqrt{\frac{1}{T}\int_0^T X_{peak}^2 \sin^2\left(t\frac{2\pi}{T}\right) dt}$$

$$\sin^2 u = \frac{1 - \cos(2u)}{2}$$

$$= \sqrt{\frac{X_{peak}^2}{T}\int_0^T \frac{1}{2}\left(1 - \cos\left(2\frac{2\pi}{T}t\right)\right) dt}$$

$$= \sqrt{\frac{X_{peak}^2}{2T}\left[t\Big|_0^T - \sin\left(\frac{4\pi}{T}t\right)\frac{T}{4\pi}\Big|_0^T\right]}$$

$$= \sqrt{\frac{X_{peak}^2}{2T}\left[T - \frac{T}{4\pi}\underbrace{(\sin(4\pi) - \sin 0)}_{0}\right)}$$

$$= \sqrt{\frac{X_{peak}^2 \cancel{T}}{2\cancel{T}}} = \frac{X_{peak}}{\sqrt{2}}$$

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

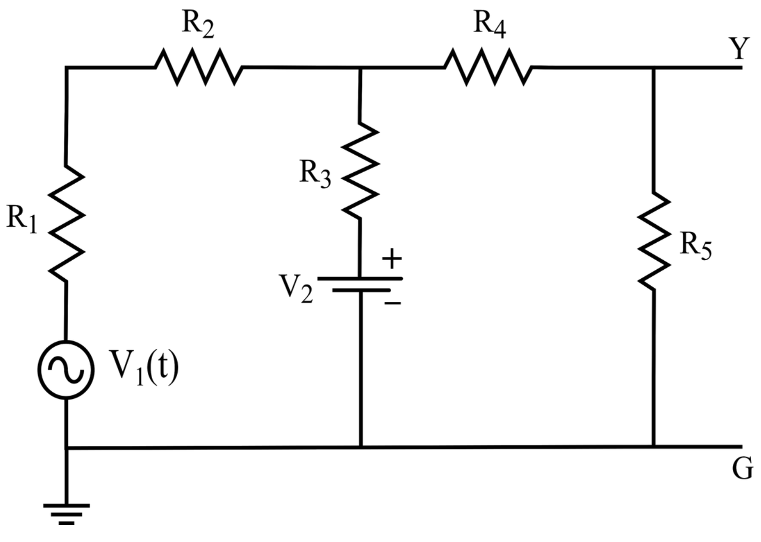
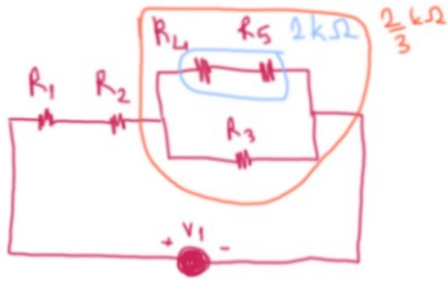
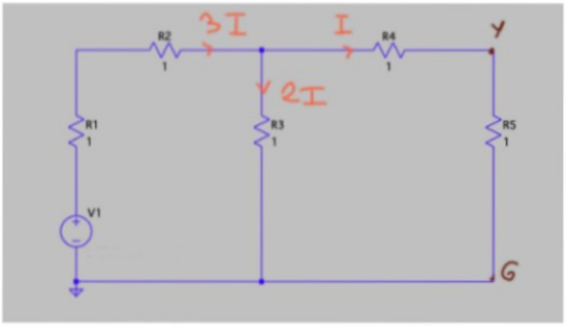


Figure 2



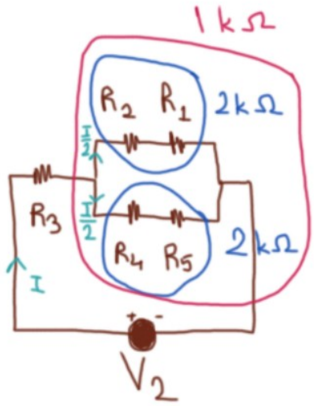


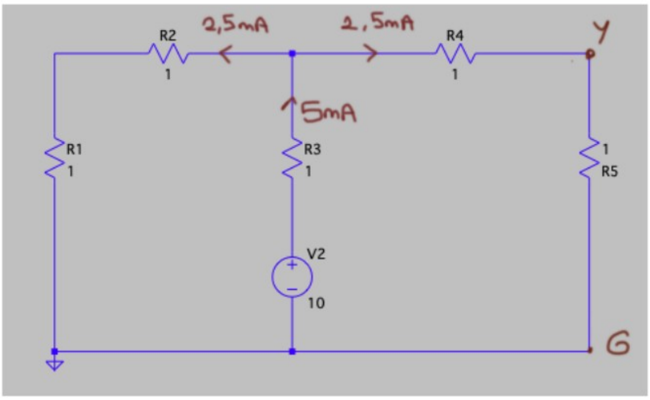
$$R_{eq} = R_1 + R_2 + \frac{2}{3}k\Omega = \frac{8}{3}k\Omega$$

$$4.5\sin(4000t)V = 3I \cdot \frac{8}{3}k\Omega$$

$$I = 0.56\sin(4000t)\ mA$$

$$V_{YG} = I.R_5 = 0.56\sin(4000t)\ V$$





$$R_{eq} = R_3 + 1k\Omega = 2k\Omega$$

$$V_2 = I.R_{eq} \quad I = 5mA$$

$$V_{YG} = R_5.\frac{I}{2} = 2.5V$$

$$V_{YG} = V_{YG1} + V_{YG2} = \left(0,56\sin(4000t) + 2.5\right)V$$

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 ms
6	1250	0.8 ms
6	5000	0.2 ms

$\frac{1}{250\,Hz} = 0,004\,s = 4\,ms$

$\frac{1}{1250\,Hz} = 0,0008\,s = 0,8\,ms$

$\frac{1}{5000\,Hz} = 0,0002\,s = 0,2\,ms$

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

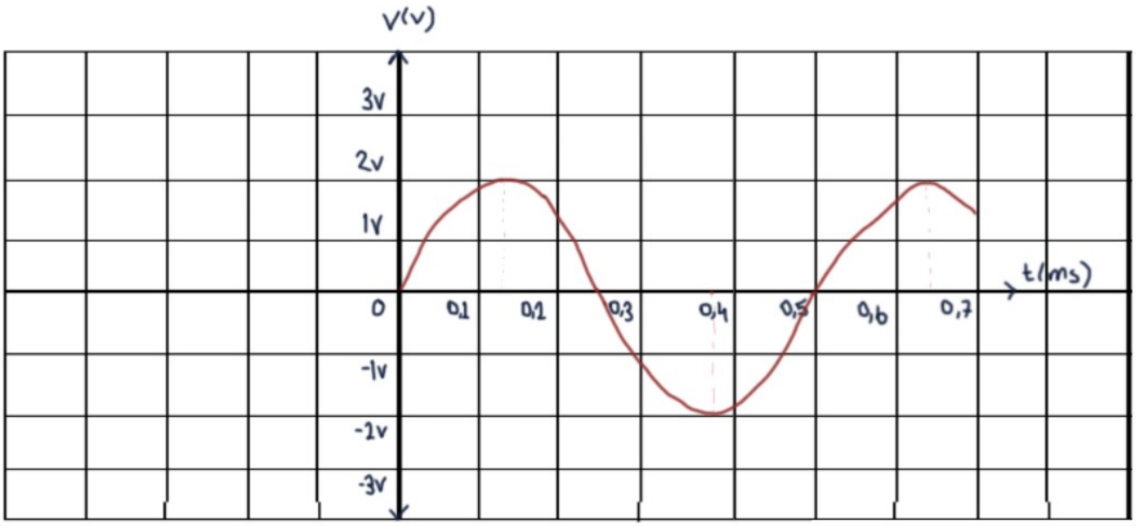


Figure 3

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

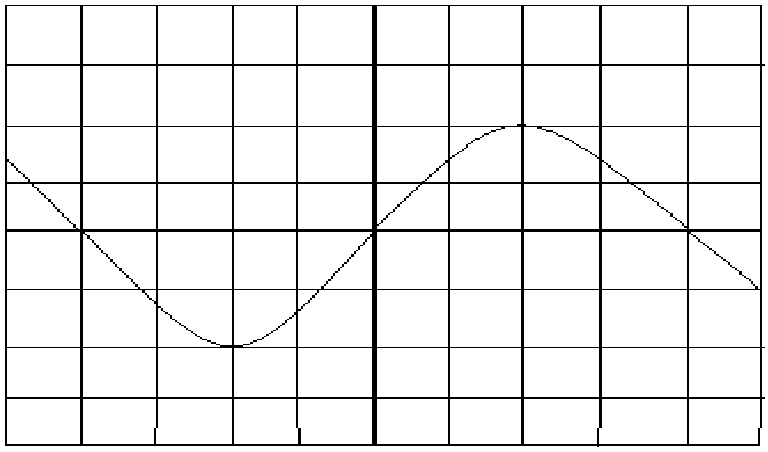


Figure 4

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

the peak value $= 2 . 2V = 4V$

the period $= 8 . 0,5ms = 4ms$

the frequency $= \frac{1}{4ms} = 0,25\ kHz$

EXPERIMENT 2
REPORT SHEET

Name & Surname: DERYA TINMAZ

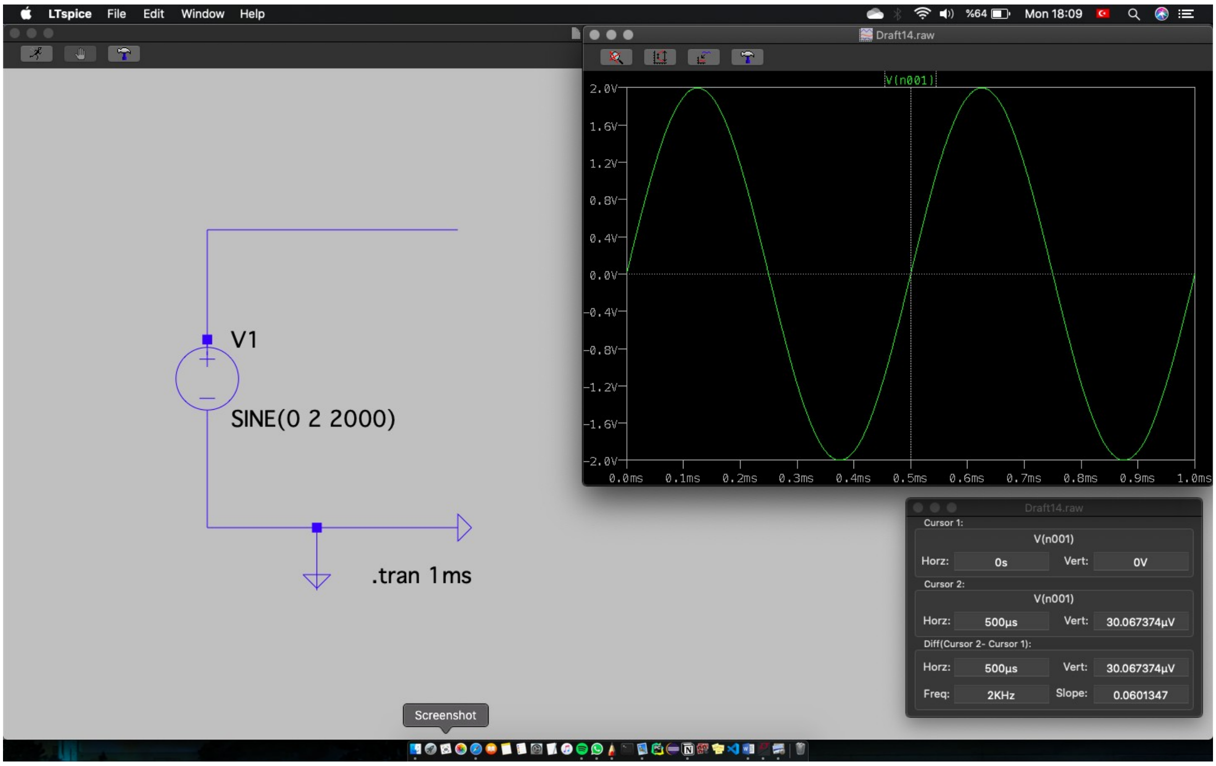
Date: 09.11.2020

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**"

Experimental Work:

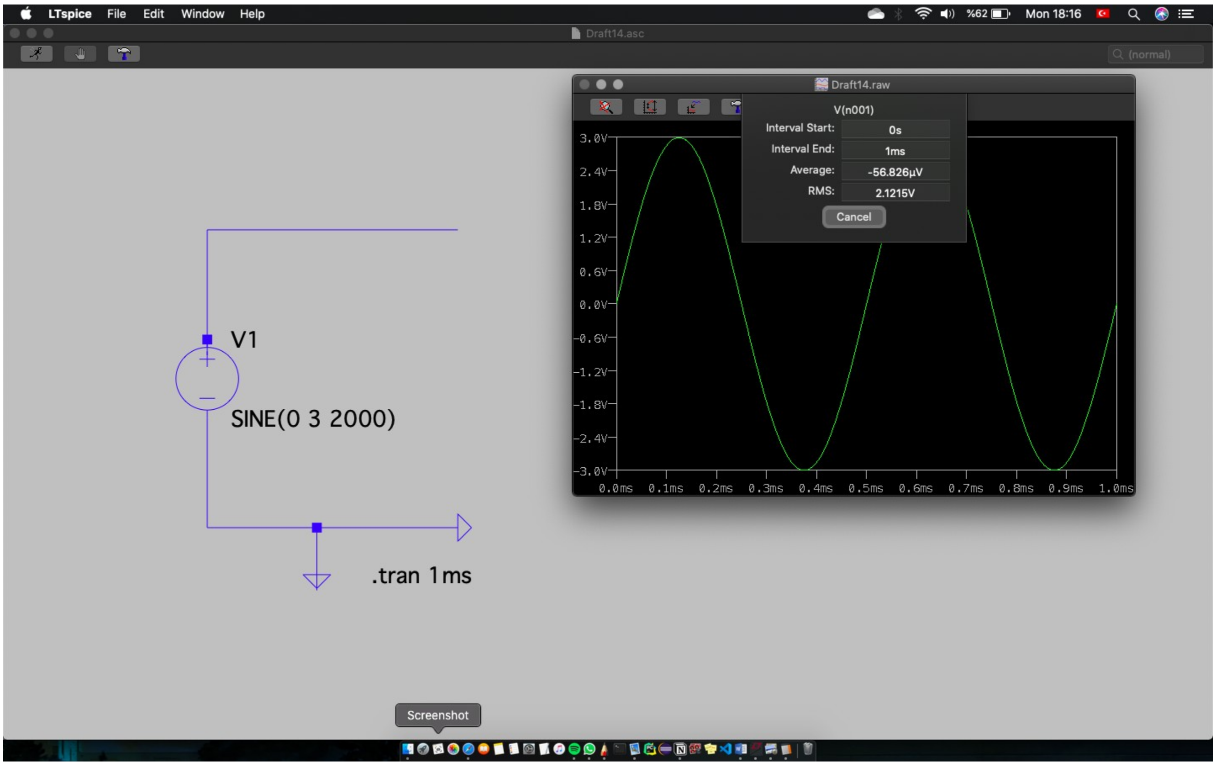
1. Take the screenshot of the signal and write the period and amplitude of this signal by using the cursor in LTSpice.



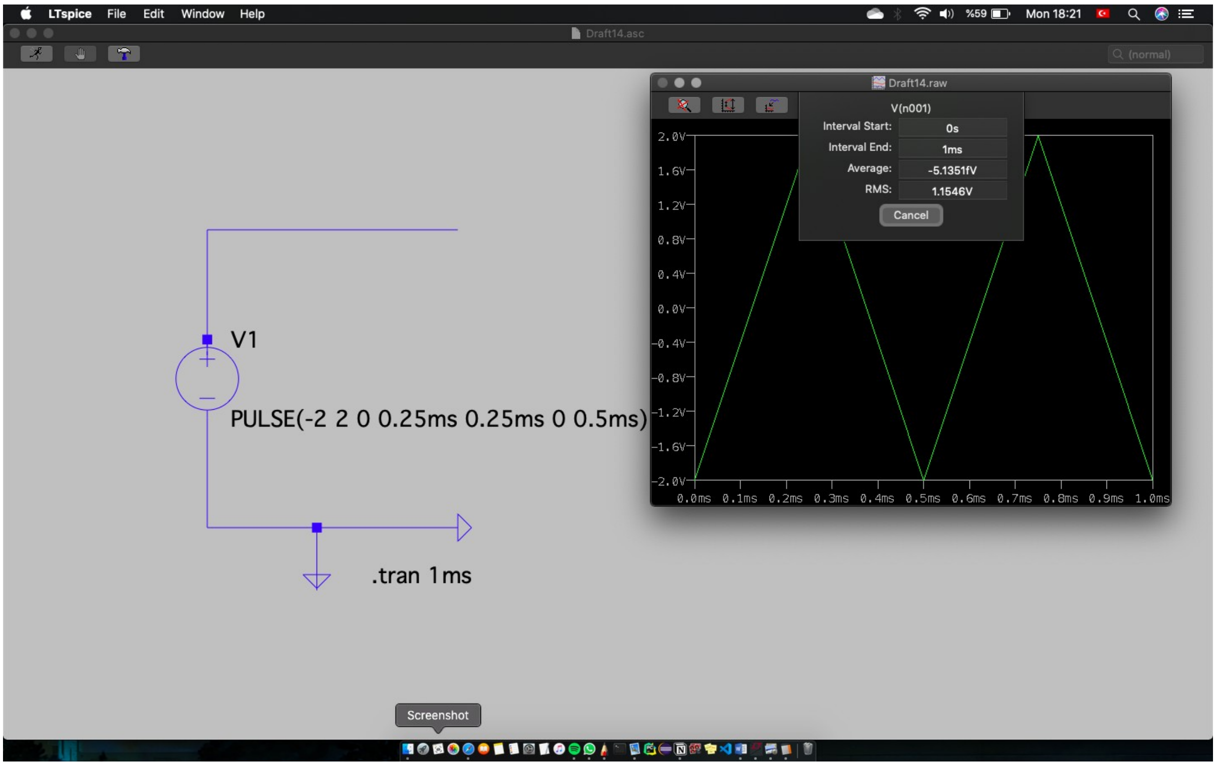
Period: 0.5 ms Amplitude: 2V

Comment: We can see that period is 0.5ms, because the wave repeats itself every 0.5ms. Since voltage value changes between -2V and 2V, its amplitude is 2V.

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

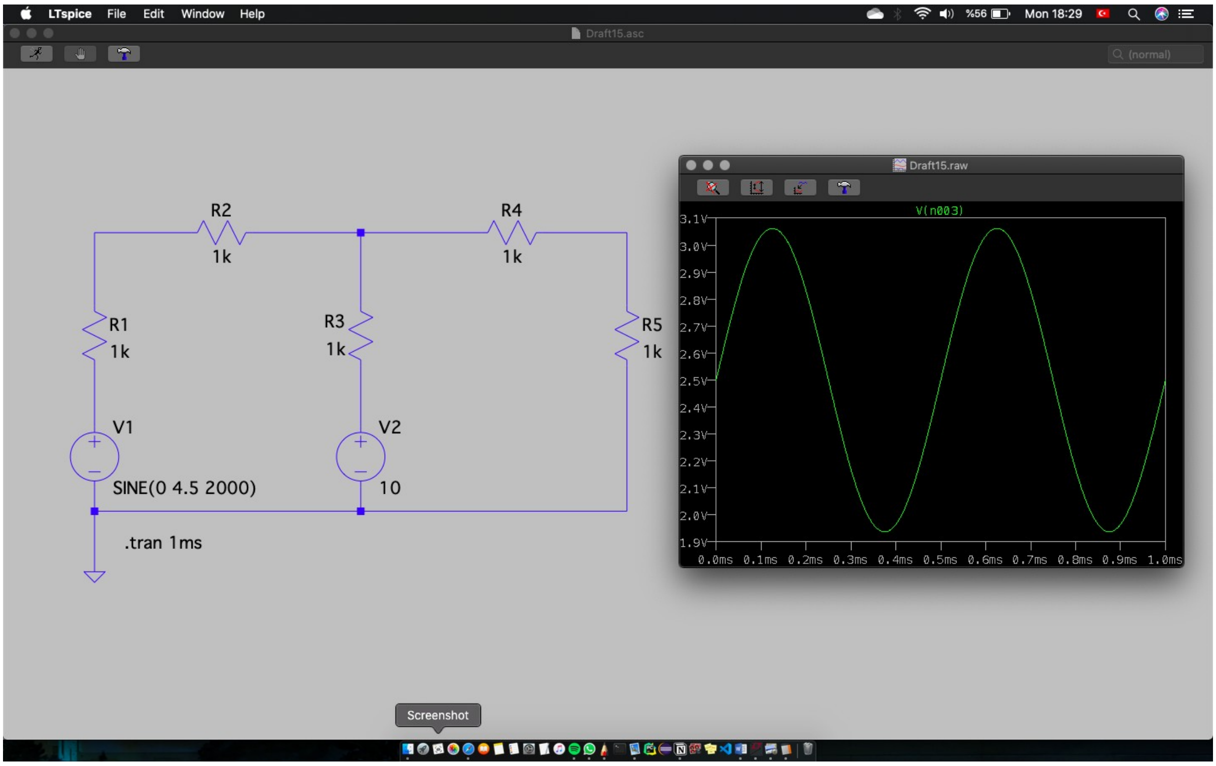


RMS value:2.1215V



RMS value:1.1546V

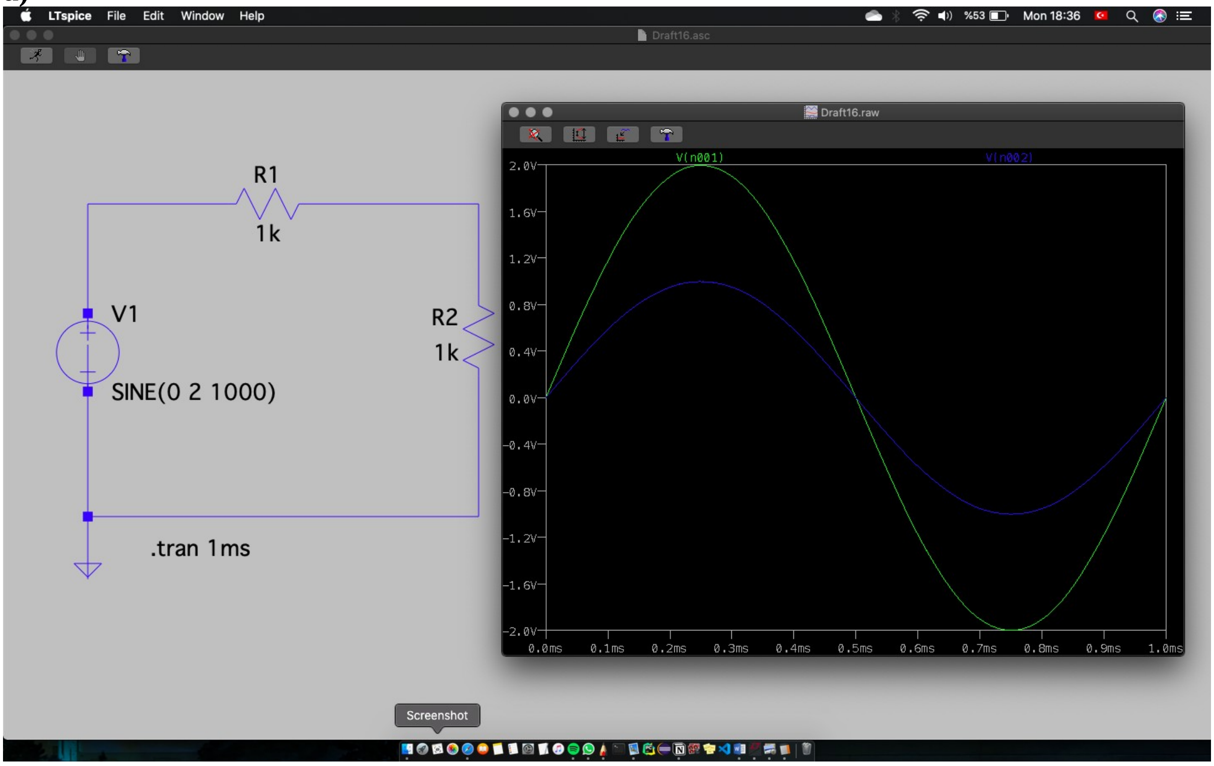
3. Take the screenshots of both the circuit and voltage waveform and write DC and AC components of the signal between node Y and node G.



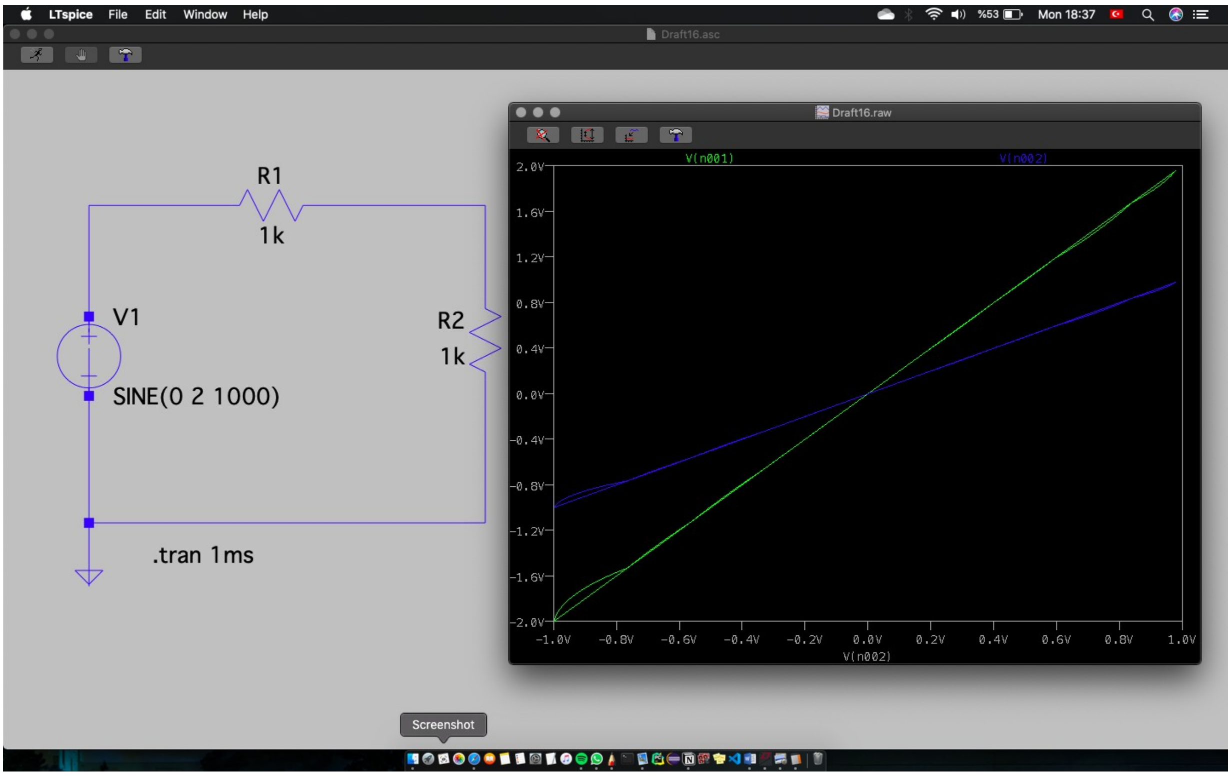
V_{YG} = 4.5 +0.56sin(4000t) V (DC and AC components)

4. Take the screenshots.

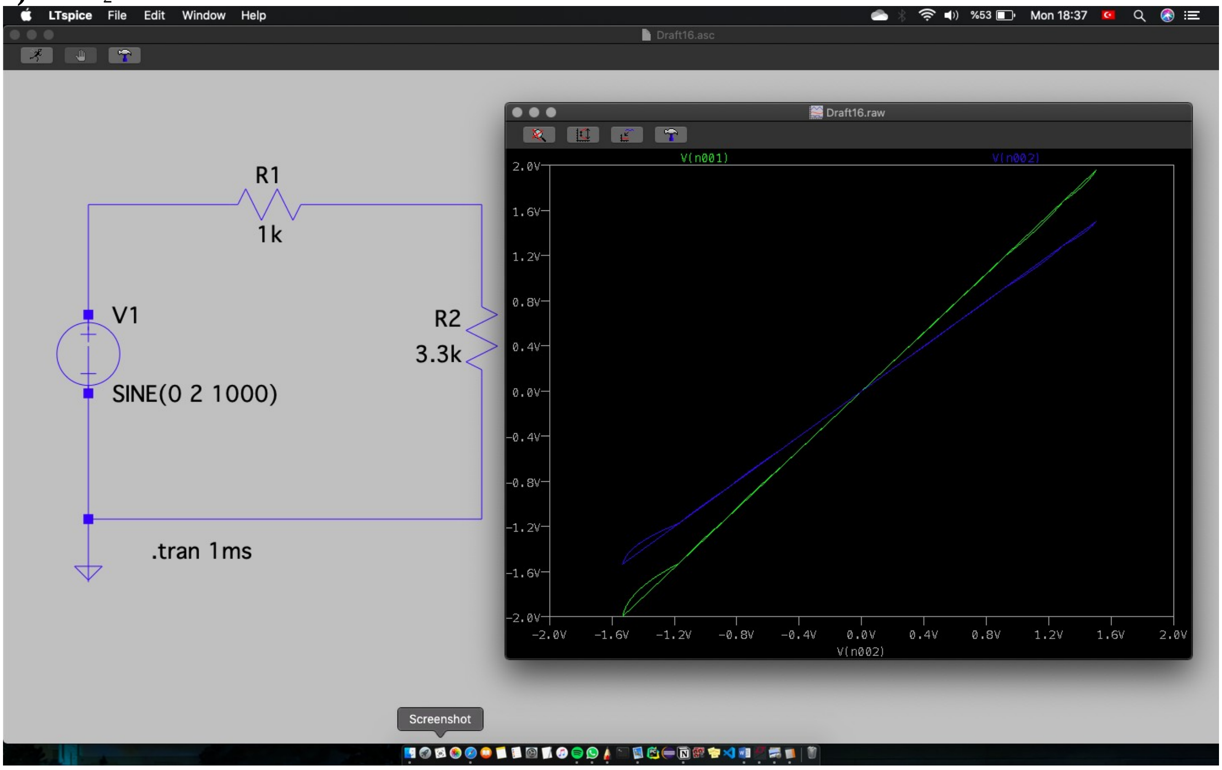
a)



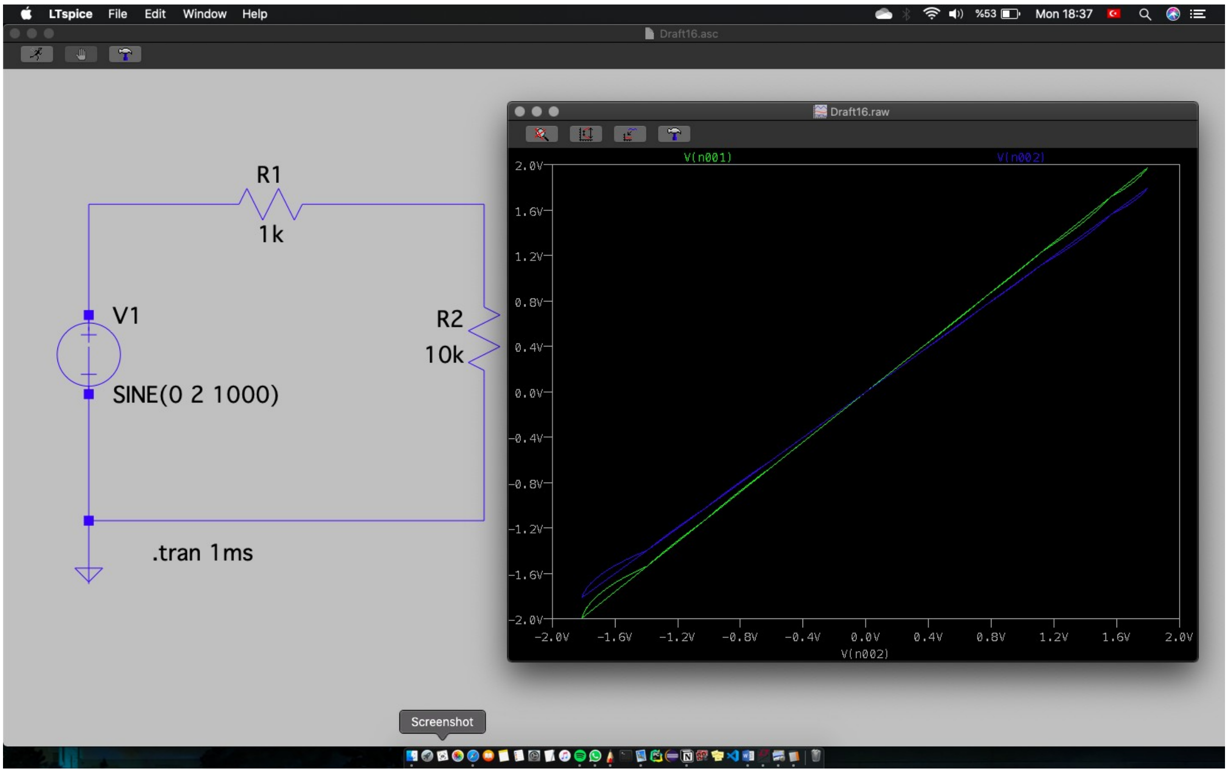
b)



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 we rotate time division button, the vertical scale is decreased or increased. We can set fever or more volt per division.

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 we rotate time division button, the horizontal scale is decreased or increased. The number of times each division represent will change. We will zoom out or zoom in on the time scale.

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

   The vertical position control allows us to move the waveform up and down so it’s exactly where we want it on the screen.

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

   The horizontal position control moves the waveform left and right to exactly where we want it on the screen.