Daniel Delgado Acosta
Professor Duck Chung
CSE 4030
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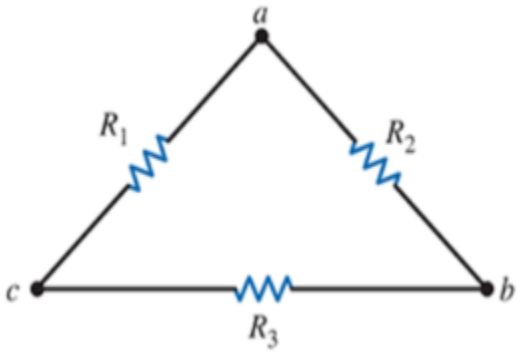
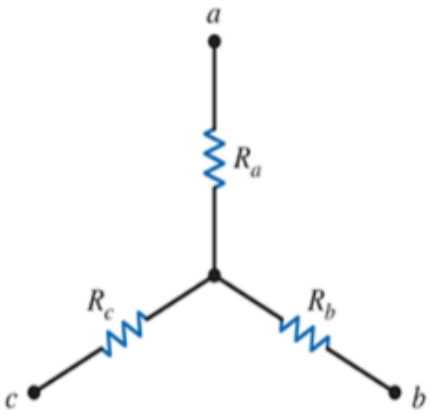
Lab 2: Resistive Circuits

Introduction

In this lab, we have to find the voltage across a resistor of two different circuits using Kirchhoff's voltage and current Law. First, we show our work by hand then use Pspice simulation software to check. The purpose of this lab is to understand Wye delta transformations and circuits with dependent sources.



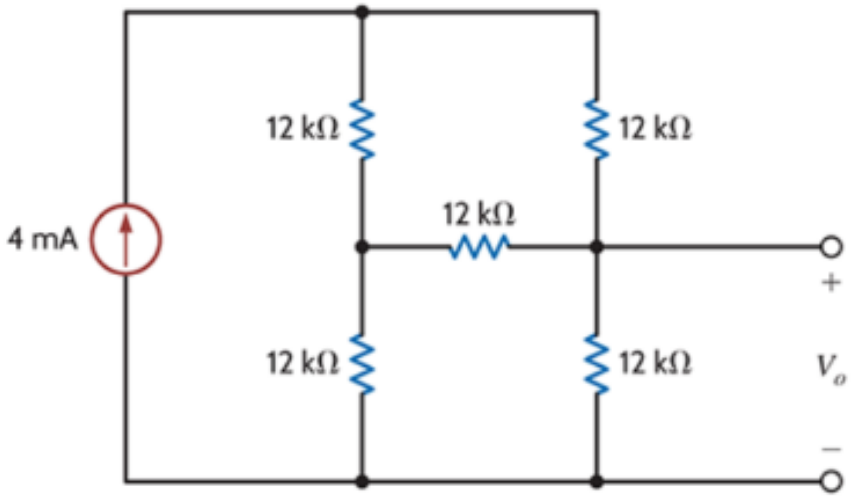


$$R_1 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_b} \qquad R_a = \frac{R_1 R_2}{R_1 + R_2 + R_3}$$

$$R_2 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_c} \qquad R_b = \frac{R_2 R_3}{R_1 + R_2 + R_3}$$

$$R_3 = \frac{R_a R_b + R_b R_c + R_a R_c}{R_a} \qquad R_c = \frac{R_1 R_3}{R_1 + R_2 + R_3}$$

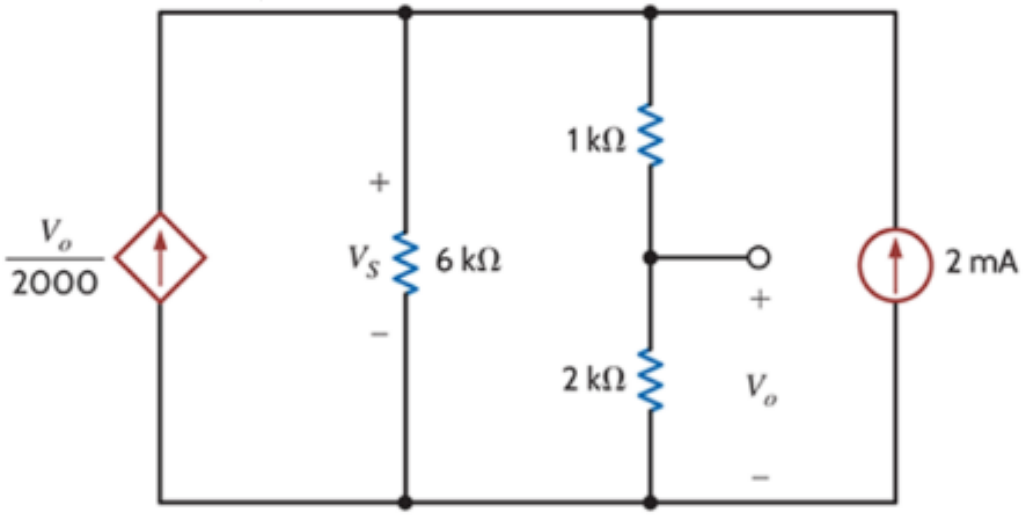
1-1 Wye Delta Transformations



Preparation

1. Find Vo by hand calculations.
2. By using pspice simulation, find Vo

1-2 Circuits with dependent sources

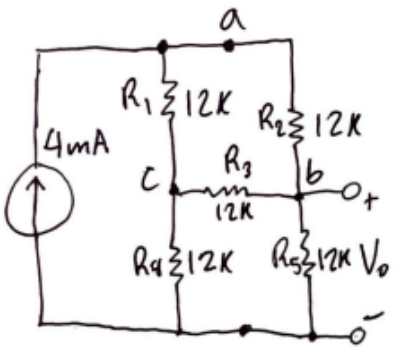


Preparation

1. Find Vo by hand calculation.
2. By using pspice simulation, find Vo.

Work

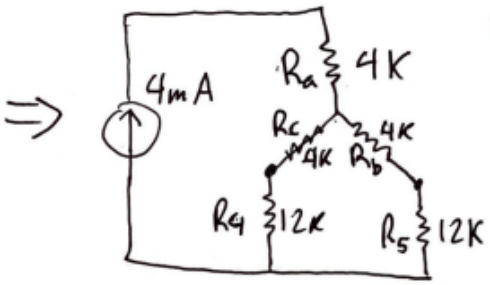
Circuit 1:



$$R_a = \frac{R_1 R_2}{R_1+R_2+R_3} = \frac{(12)(12)}{12+12+12} = 4K\Omega$$

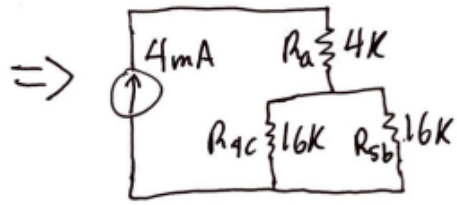
$$R_b = 4K\Omega$$

$$R_c = 4K\Omega$$



$$R_{4c} = 4K + 12K = 16K\Omega$$

$$R_{5b} = 4K + 12K = 16K\Omega$$



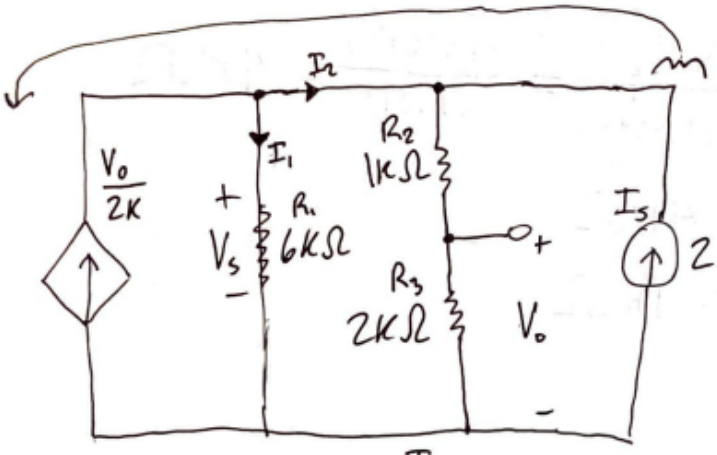
$$R_T = R_a + \left(\frac{1}{R_{4c}} + \frac{1}{R_{5b}}\right)^{-1} = 4 + \left(\frac{1}{16} + \frac{1}{16}\right)^{-1} = 12K\Omega$$

$$V_T = I_T R_T = 4(12) = 48V$$

$$V_o = V_{ST}\left(\frac{R_5}{R_2+R_5}\right) = 48\left(\frac{12}{24}\right) = \boxed{24V}$$

$$I = V/R = 24/12K = \underline{2mA}$$

Circuit 2:



$$I_2 = \left(\frac{V_0/2K + I_s}{R_1 + R_2 + R_3}\right) R_1 = \left(\frac{\frac{V_0}{2K} + \frac{1}{2K}}{9K}\right) 6K = \left(\frac{V_0 + 4}{2K}\right)\frac{2}{3} = \underbrace{\frac{V_0 + 4}{3K}}_{1}$$

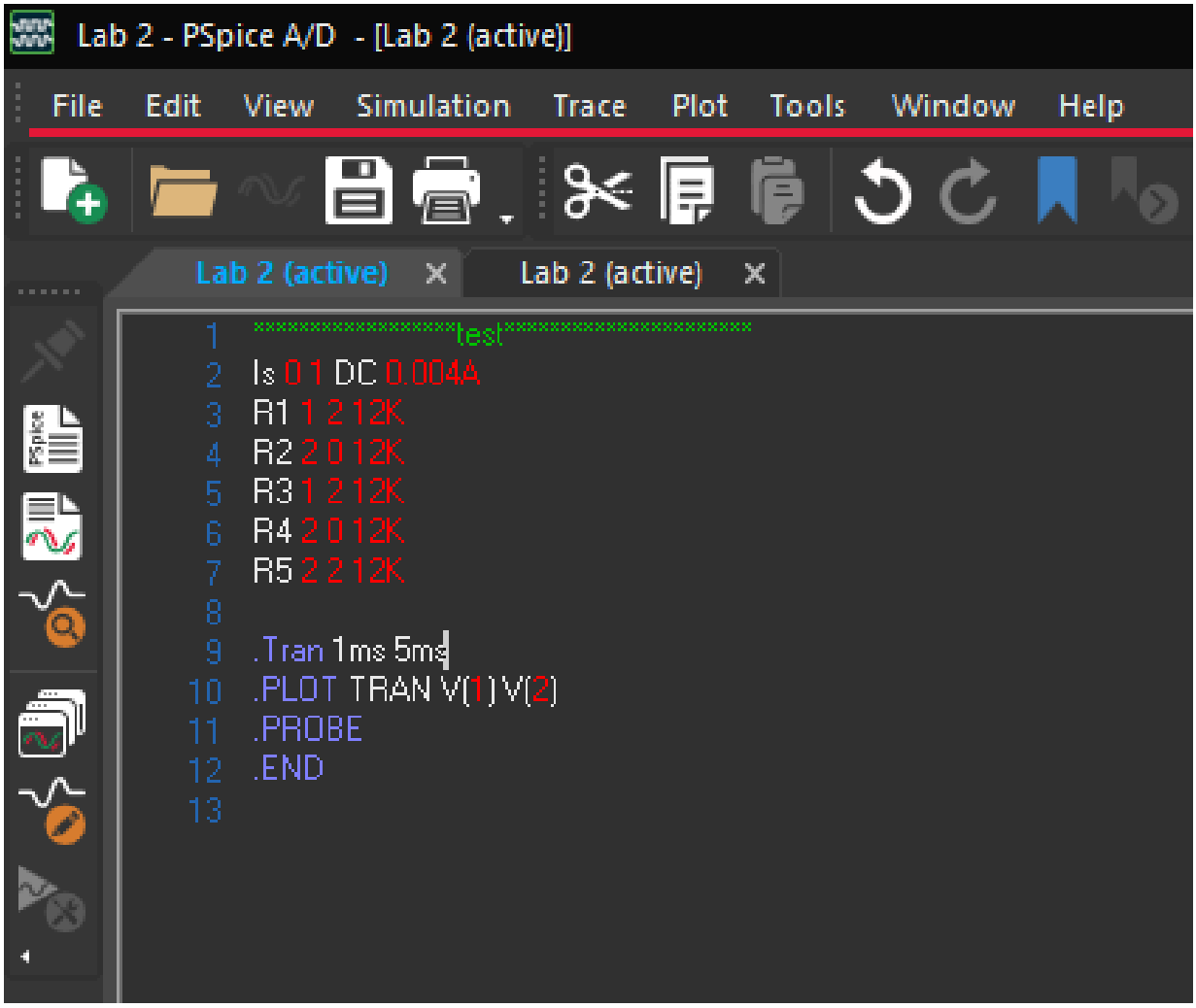
$$V_0 = I_2 R_3 \Rightarrow \underbrace{I_2 = \frac{V_0/2K}{2}}$$

$$I_2 = I_2 \Rightarrow \frac{V_0}{2K} = \frac{V_0 + 4}{3K} \Rightarrow 2V_0 + 8 = 3V_0 \Rightarrow \boxed{V_0 = 8V}$$

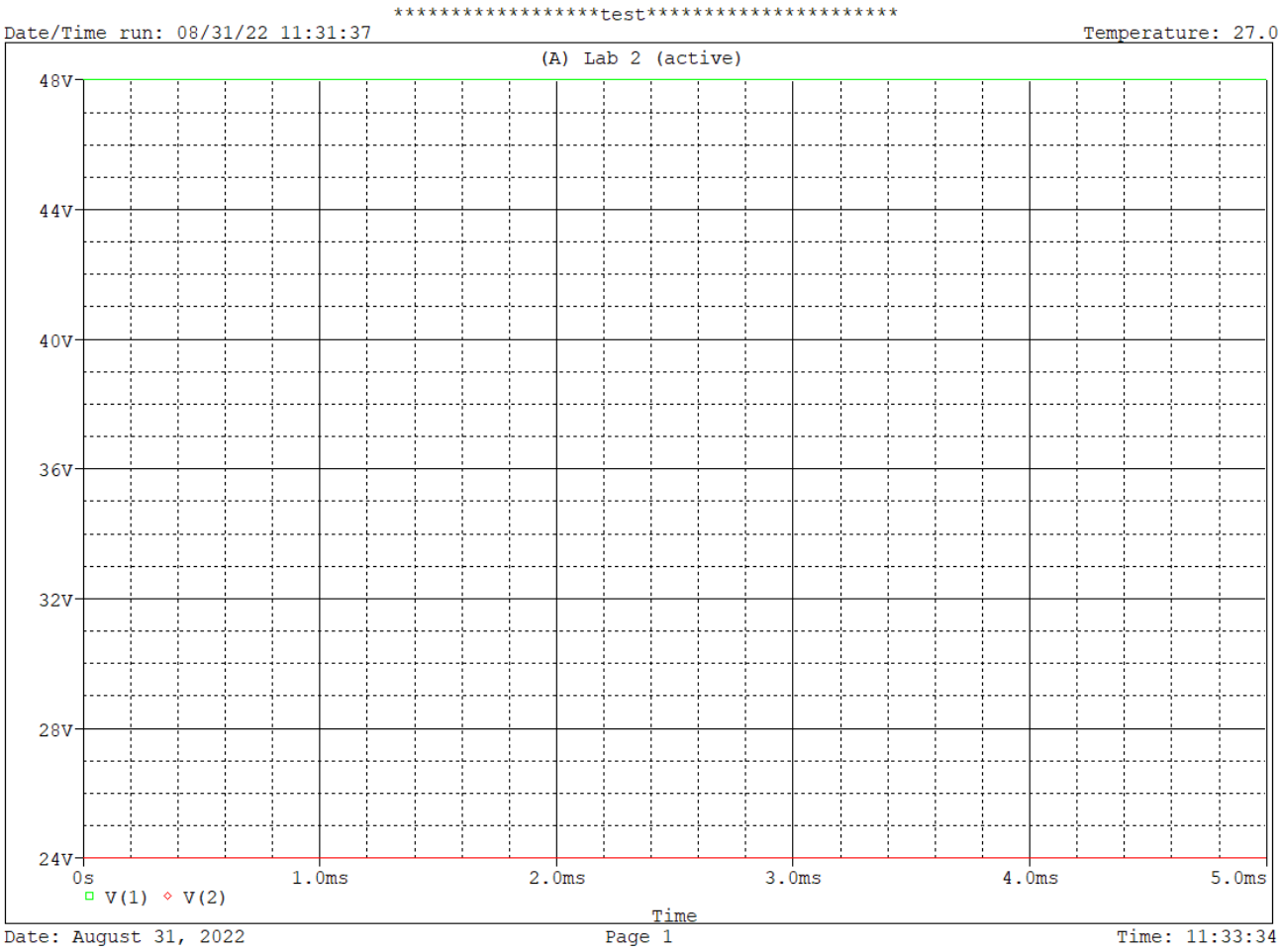
$$I_2 = (8)/(2K) = \underline{4mA}$$

Pspice simulation

Circuit 1:
Code used

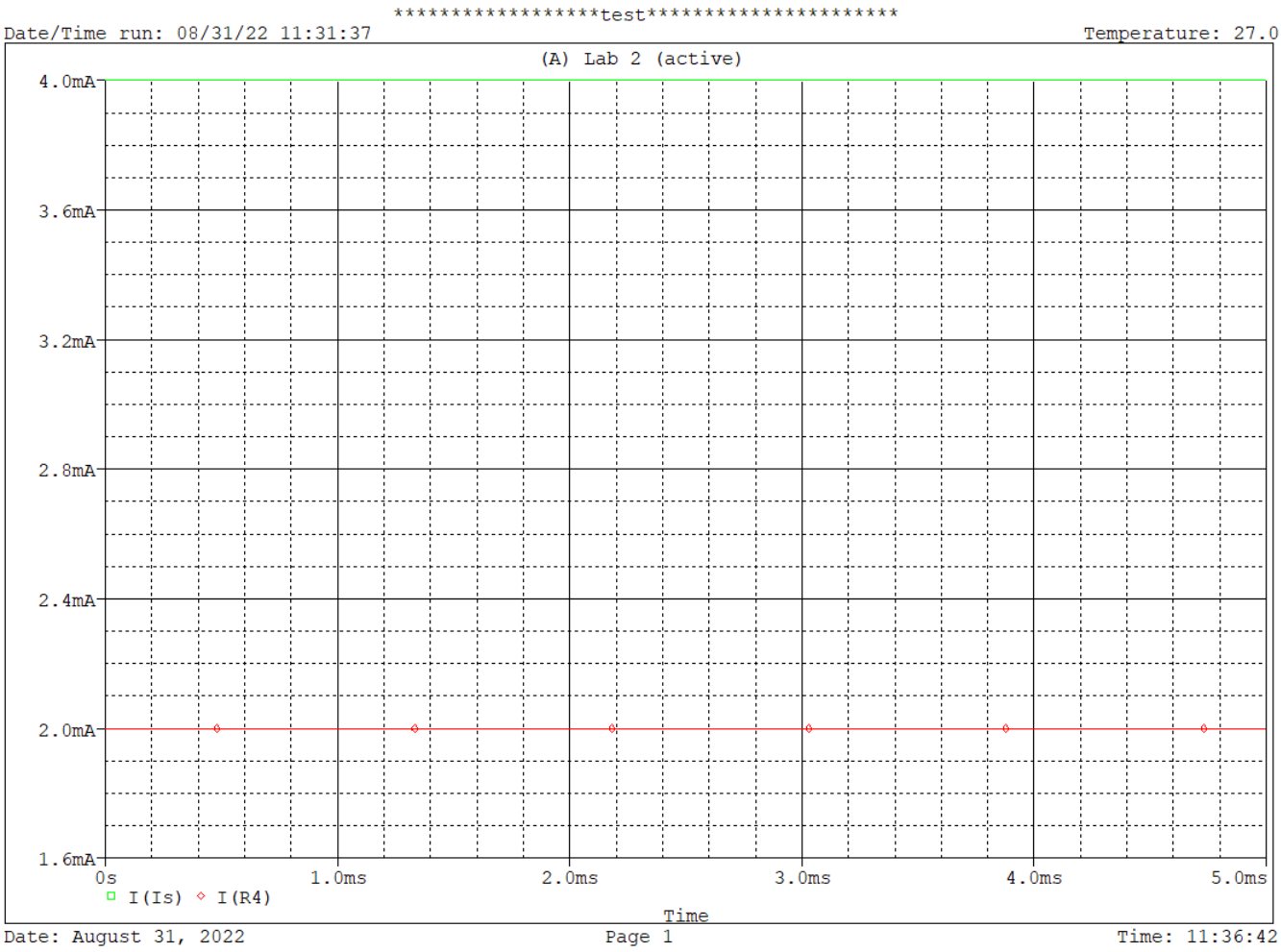


Voltage traces



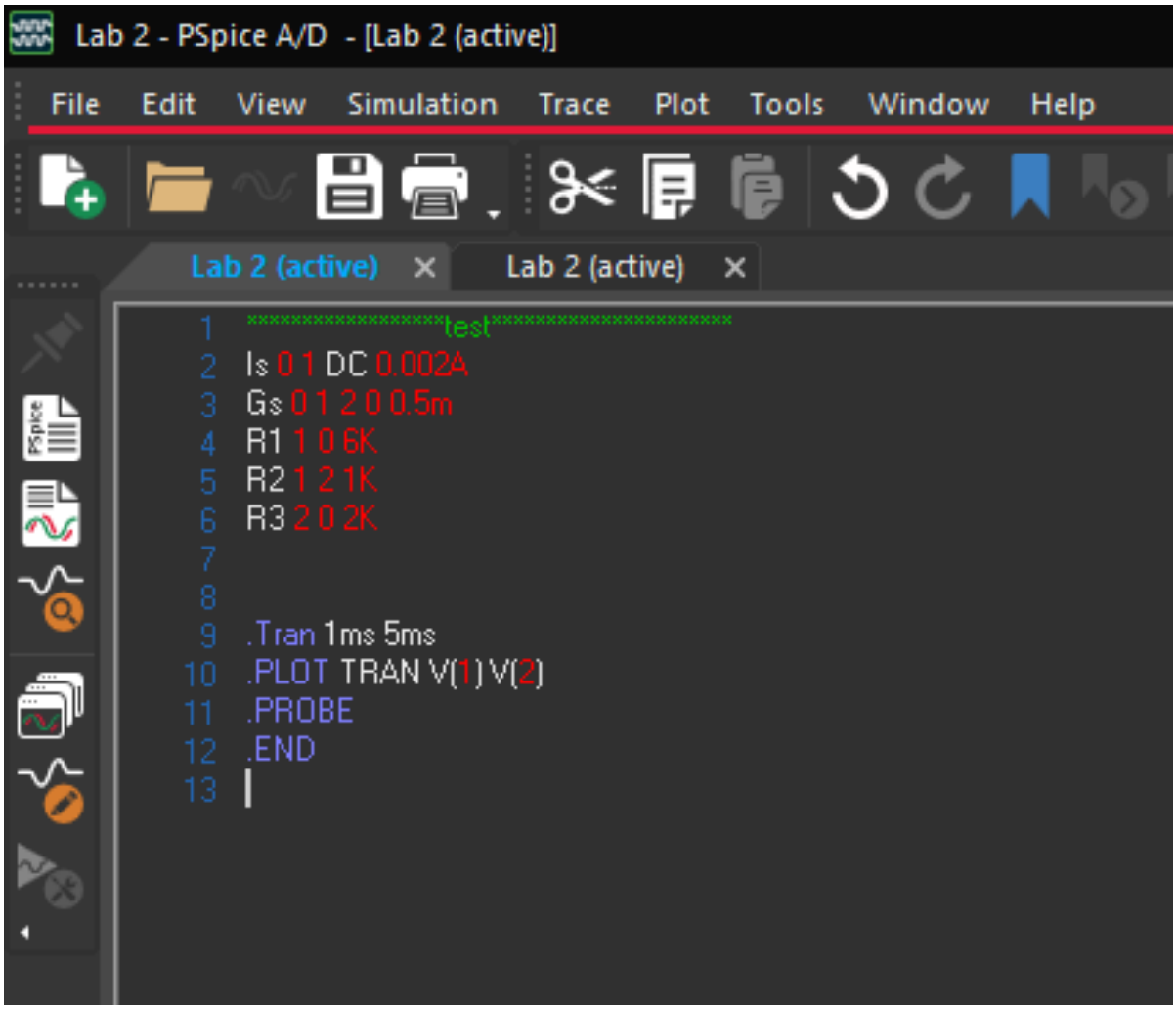
$V_T = 48V,\ V_0 = 24V$

Current traces

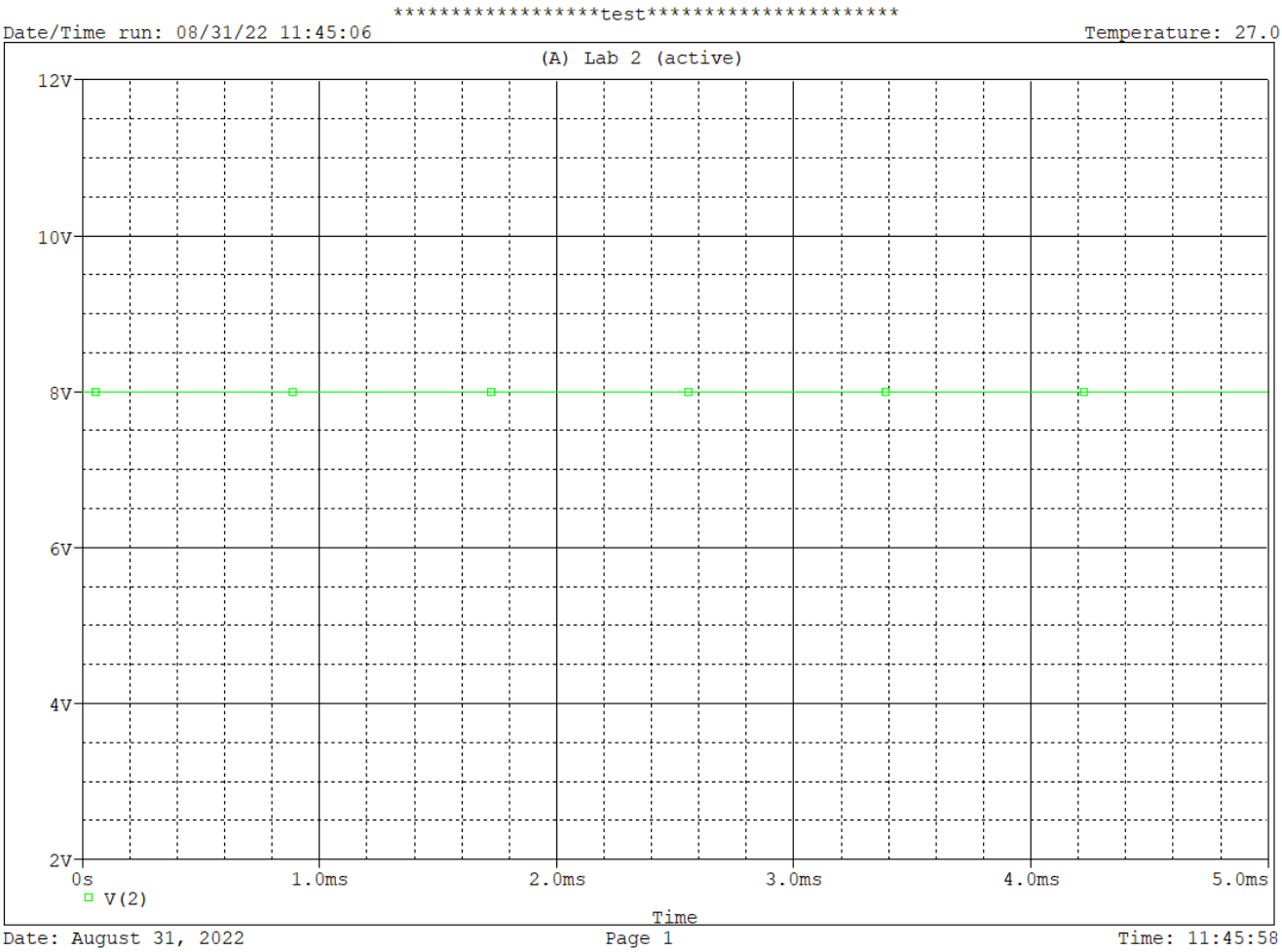


$I_T = 4mA,\ I_0 = 2mA$

Circuit 2:
Code used

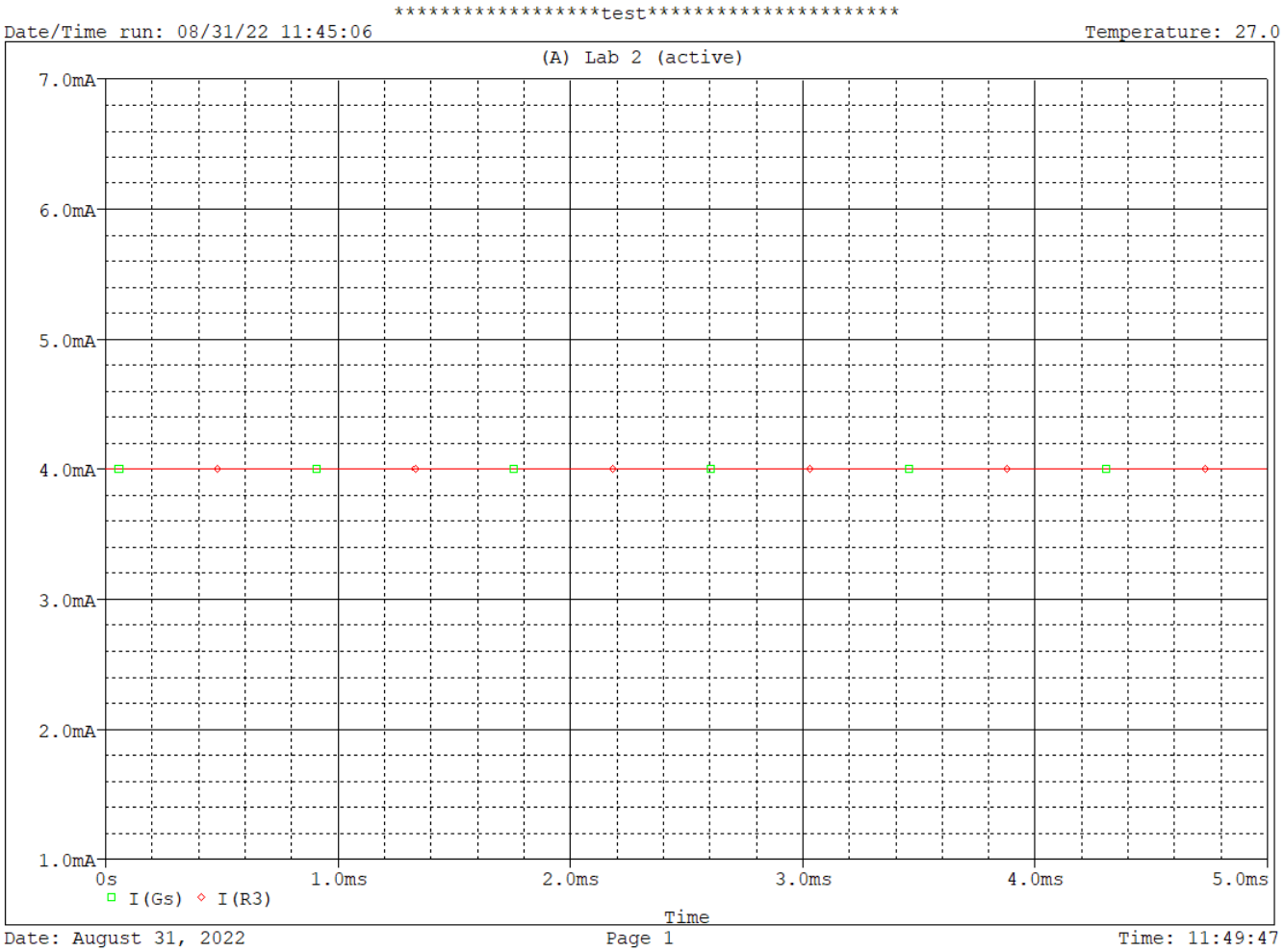


Voltage traces



$$V_0 = 8V$$

Current traces



$$I_s = 4mA,\ I_3 = 4mA$$

Conclusion

In this lab, I learned how to use Wye delta transformations to find the total resistance in a circuit. I also learned about circuits with dependent sources and how they can affect Kirchhoff's voltage and current Law. Looking at the handwritten work for the two circuits and comparing them to the Pspice simulation, we can conclude that both results concur. I found this lab to be both challenging and insightful.