UM-SJTU Joint Institute

VE311

Laboratory Report

Excercise 1

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[rev4.1]

1 Voltage Regulator

1.1

In this part, we get the following result.

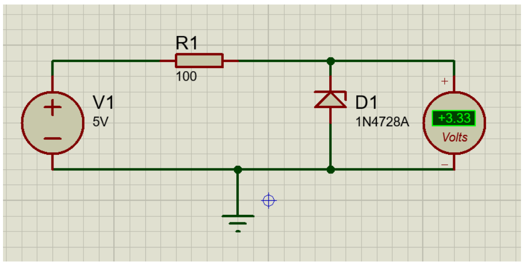

Figure 1: Simulation

Figure 2: Actual Result

The result we have got is $3.672V$, which is close to the theoretical result $3.3V$. Therefore, the result is reasonable.

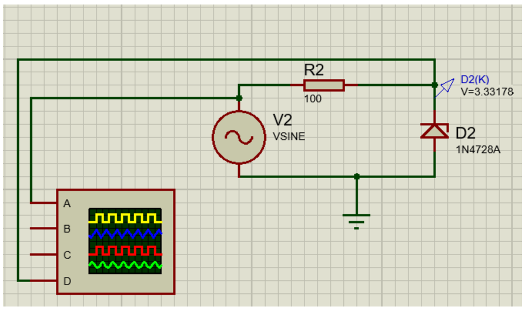

Figure 3: Simulation

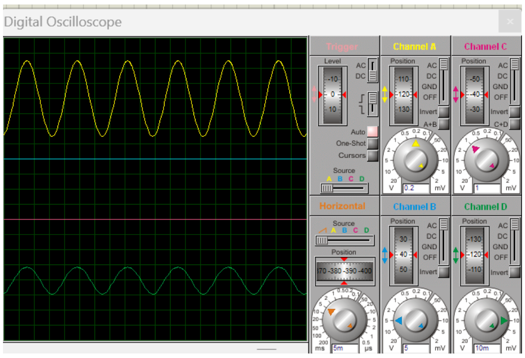

Figure 4: Oscilloscope

1.2

In our experiment, we have measured that $V_{spp} = 1.53V$, $V_{LPP} = 470mV$. Accordingly, we can solve R_Z

$$\text{line regulation} = \frac{R_Z}{R + R_Z} = \frac{0.47}{1.53}$$
$$R_Z = 44.3\Omega$$

After changing the Voltage Source, we can get the following result.

1.3

In our experiment, when $R_L = 109.8V$, V_L reaches $2V$ and the diode stops working.

Based on the theoretical value, it will stop work when $R_L = 66.67V$. The error is a bit large due to the internal instrument bias or aging and the probe or connection issues.

If we want to make R_L two times smaller, R will be two times smaller accordingly.

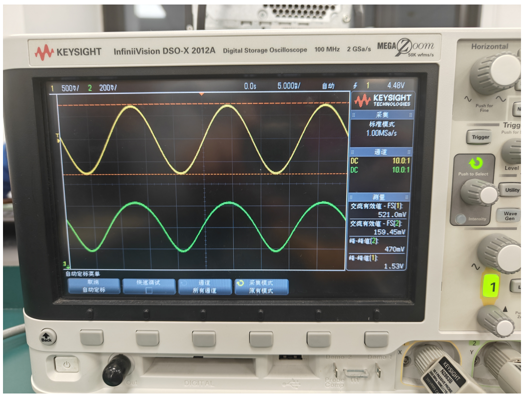

Figure 5: Result

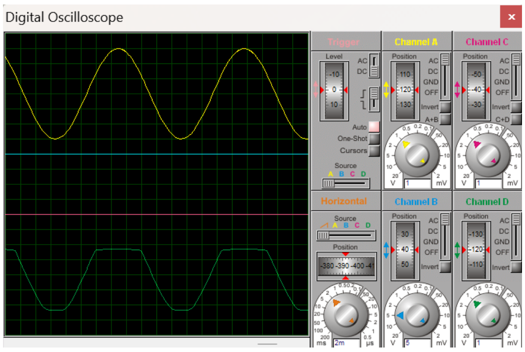

Figure 6: Simulation 2

2 Half-Wave Rectifier

In our experiment, we get the following result.
From the figure we can see that $V_r < 0.1V$, verifying our calculation.
Then, based on the simulation, we can calculate the corresponding value.

Figure 7: Result

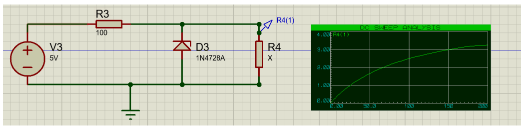

Figure 8: Simulation

$$
\begin{aligned}
V_r &= (V_s - V_{on})\left(\frac{T}{RC_{max}}\right) \\
C_{max} &= 700\mu F \\
V_{dc} &= 5 - 0.8 = 4.2V \\
I_{dc} &= \frac{V_{dc}}{R} = 4.2 \times 10^{-3}A \\
\theta_c &= \sqrt{\frac{2V_r}{V_s}} = 0.2 \\
\Delta T &= \frac{\theta_c}{\omega} = 5.3 \times 10^{-4}s \\
I_{peak} &= \frac{2I_{dc}T}{\Delta T} = 0.264A \\
I_{surge} &= \omega C V_s = 1.319A \\
PIV &= 2V_s - V_r = 9.9V
\end{aligned}
$$

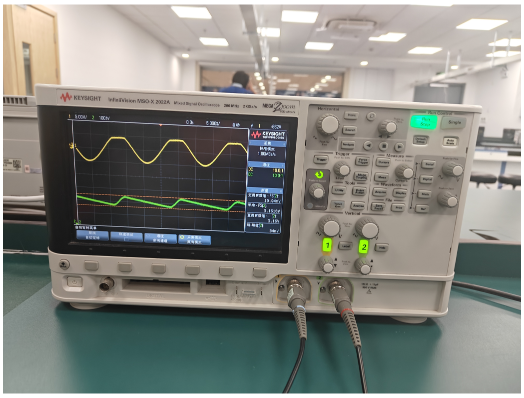

Figure 9: Result

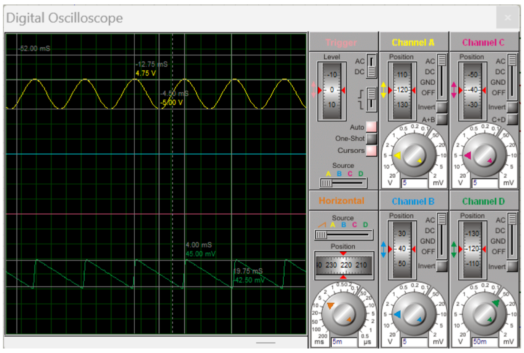

Figure 10: Simulation 1

If we change the frequency to $120Hz$, V_r will be halved accordingly.

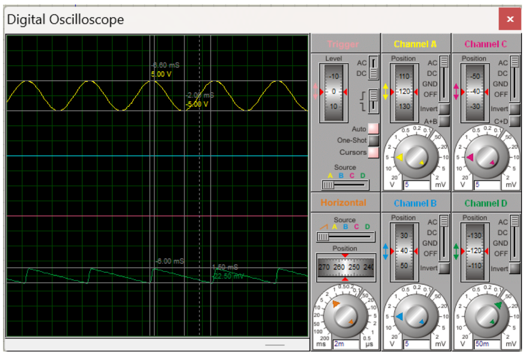

Figure 11: Simulation when $f = 120Hz$