UM–SJTU JOINT INSTITUTE
ELECTRONIC CIRCUIT LABORATORY
(ECE3110J)

LABORATORY REPORT

Lab 1

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1 Voltage regulator

1.1 Obtain the value of V_L under DC voltage

According to the experiment we implement, the value of V_L is $2.860V$, which is not reasonable compared to the V_Z in the datasheet since it's smaller than 3.3 V. The simulation is shown below.

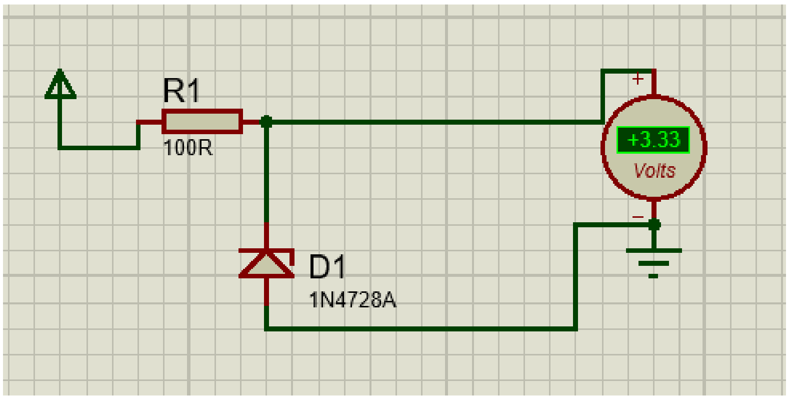

Figure 1: Simulation of 1.1

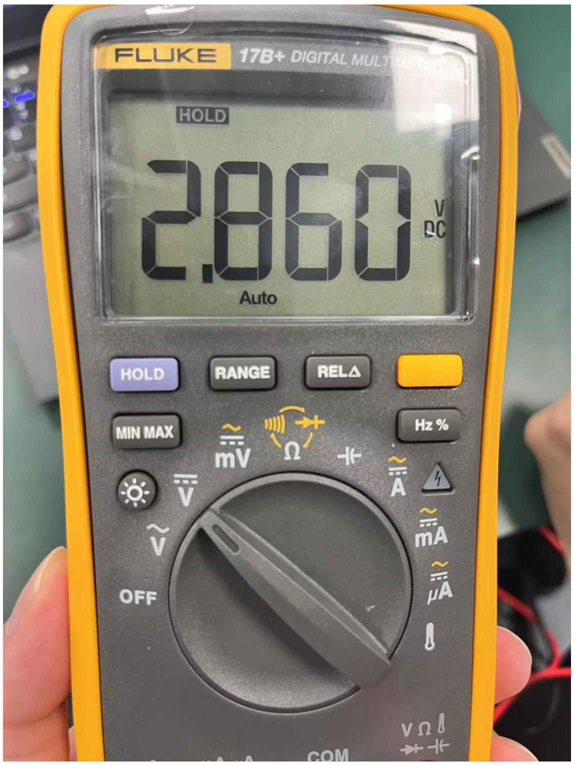

Figure 2: Result of 1.1 experiment

1.2 Obtain the value of V_L under sine wave voltage

We repeat the experiment of 1.1 by representing the DC voltage source with a sine wave $5 + 0.5sin(120\pi t)$. With the help of oscilloscope, we obtain that $V_spp = 730mV$ and $V_Lpp = 302.5mV$.

However, V_spp should be $1mV$ theoretically. According to the definition of line regulation:

$$\frac{\partial V_s}{\partial V_L} = \frac{R_Z}{R + R_Z}$$

Since the phase and frequency of V_L and V_S are the same, we can derive that:

$$\frac{R_Z}{R + R_Z} = \frac{302.5}{730} = 0.414$$
$$R_Z = 70.7\Omega$$

The simulation is shown below:

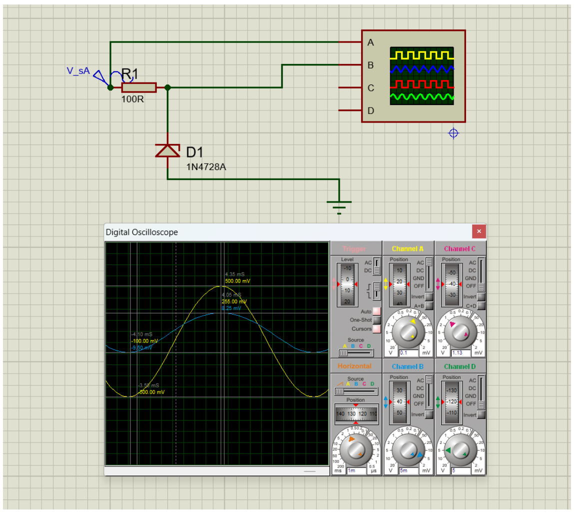

Figure 3: Simulation of 1.2

If we change the voltage source to $2 + 3sin(120\pi t)$, the result should be:

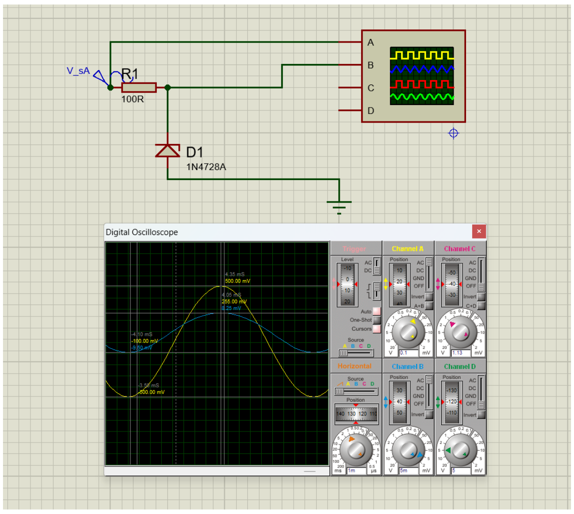

Figure 4: Simulation of 1.2 discussion

1.3 Voltage regulator stops working

According to our experiment, the voltage regulator stops working when $R_L = 71.1\Omega$, which is shown below:

In order to make $R_{L,min}$ 2 times smaller, the R should be 2 times smaller.

Figure 5: Experiment of 1.3

2 Half-Wave Rectifier

According to our experiment, the capacitor should bigger than $660\mu F$, the ripple voltage is smaller than $0.1mV$, which is similar to the result of simulation.

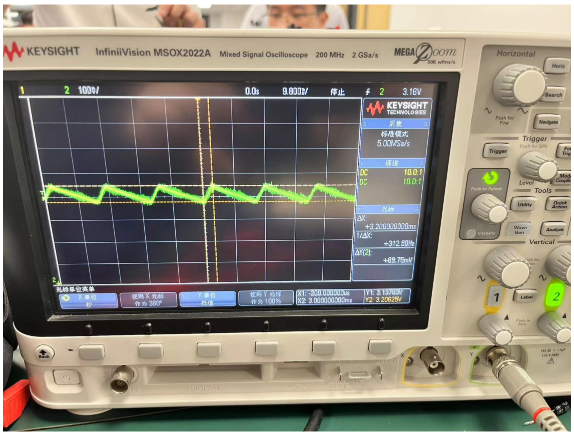

Figure 6: Result of Half-Wave Rectifier experiment

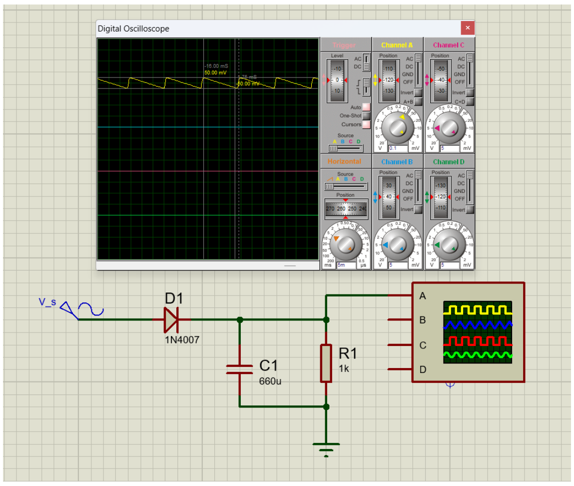

Figure 7: Simulation of Half-Wave Rectifier experiment

According to calculation:

$$
\begin{aligned}
V_r &\leq (V_s - V_{on})(\frac{T}{RC}) \\
C &\leq 700\mu F \\
V_{dc} &= 5 - 0.8 = 4.2V \\
I_{dc} &= \frac{V_{dc}}{R} = \frac{4.2}{1000} = 4.2mA \\
\theta_c &= \sqrt{\frac{2V_r}{V_s}} = 0.2rad \\
\Delta T &= \frac{\theta_c}{\omega} = \frac{0.2}{120\pi} = 5.3 \times 10^-4s \\
I_{peak} &= \frac{2I_{dc}T}{\Delta T} = 0.264A \\
I_{surge} &= \omega C V_s = 1.319A \\
PIV &= 2V_s - V_r = 9.9V
\end{aligned}
$$

If the input change to $5sin(240\pi t)$, the V_r will be halved since the period T is halved.

3 Reference

Xuyang, L. ECE3110J TA Group. ECE3110J 2024SU Lab1Manual, 2024