UM–SJTU JOINT INSTITUTE

ELECTRONIC CIRCUITS
(VE311)

LABORATORY REPORT

LAB 2: DIODES

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Contents

1 Objectives

- Investigate the full behavior for the diode.

- Calculating the minimum voltage to turn on the diode.

- Analyze the behaviour of two diodes set back to back and face to face.

2 Experiment procedures

2.1 Turn on voltage

According to the follow configuration, we should calculate which is the minimum voltage required to turn on the diode.
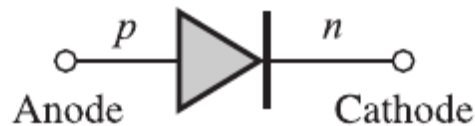

Figure 1: This is a diode

2.2 I-V character of Diode

The second part considers the use the following circuit to corroborate if theory at some point would be close to reality, by using a signal generator and oscilloscope. An $I - V$ curve should be got in this way.
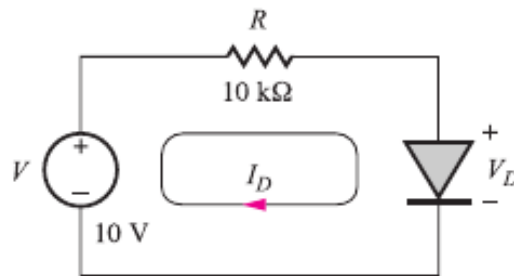

Figure 2: Diode circuit

2.3   Behavior of back-to-back diodes

The third part considers to put tow diodes back to back. We are required to measure the behavior of the system by sweeping it with the peak-to-peak $A\sin(377t)$, where $A = 1, 2, 5 and 10$.
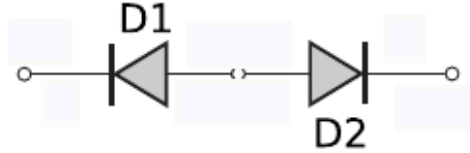
Figure 3: 2 diodes back-to-back

2.4   Behavior of face-to-face diodes

The fourth part analyze the same diodes with putting them face-to-face. The same simulation of peak-to-peak value should be applied in this part as well.
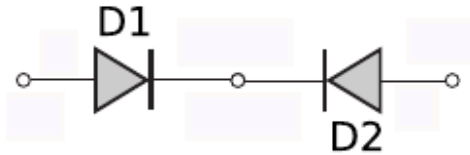
Figure 4: 2 diodes face-to-face

3 Experimental results and discussion

3.1 Turn on voltage

We use 2Vpp sine wave to turn on the diode, which was shown in Figure 5.
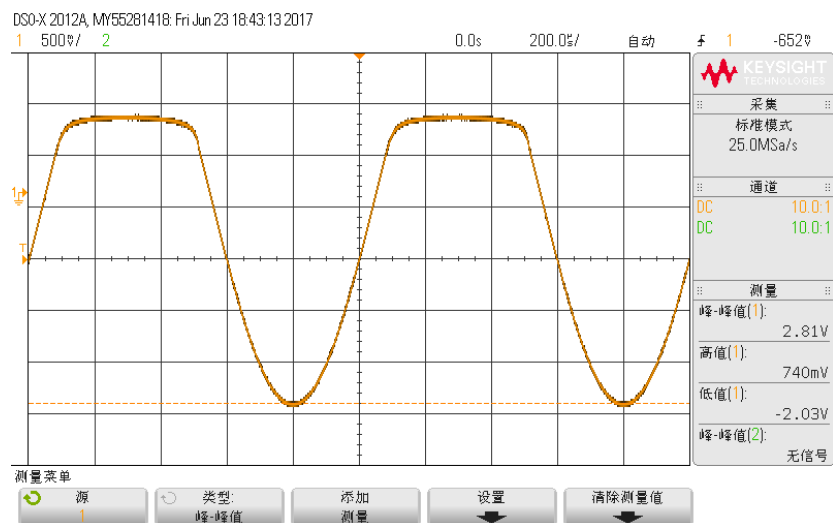

Figure 5: Turn on voltage of the diode.

According to the figure, we found that the high voltage is 0.74 V, so the turn on voltage is 0.74 V.

3.2 IV-Characteristics

We use a $10\,\text{k}\Omega$ resistor and the a diode to analyze the I-V character of diode.

3.2.1 AC Input

Under this circumstance, we firstly input a $1VPP\ /sin$ wave, to form the "csv" file. With the file, the picture on the oscilloscope was shown in Figure 6.
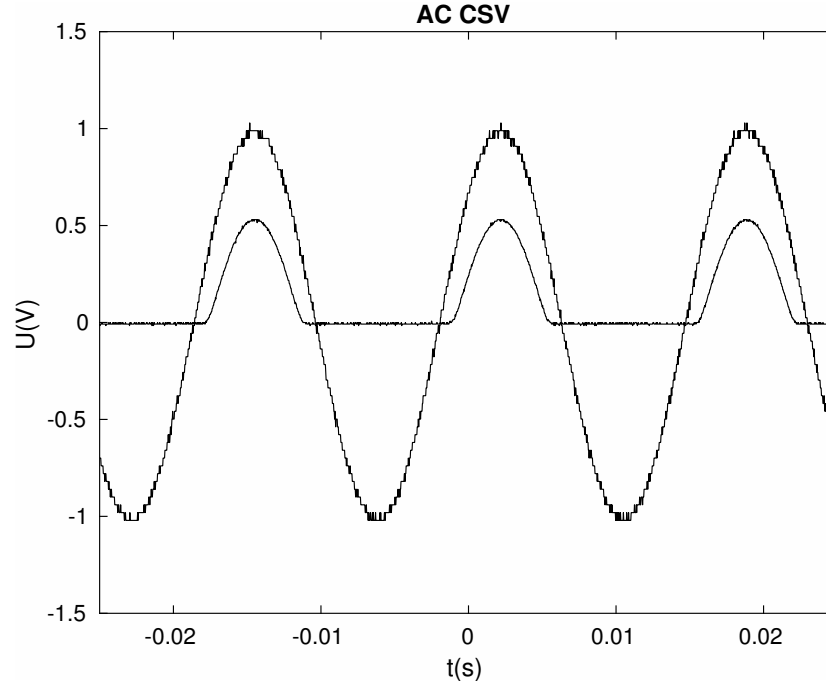

Figure 6: Curve of the csv file

With the following equation:

$$I_d = \frac{V_0 - V_d}{R}$$

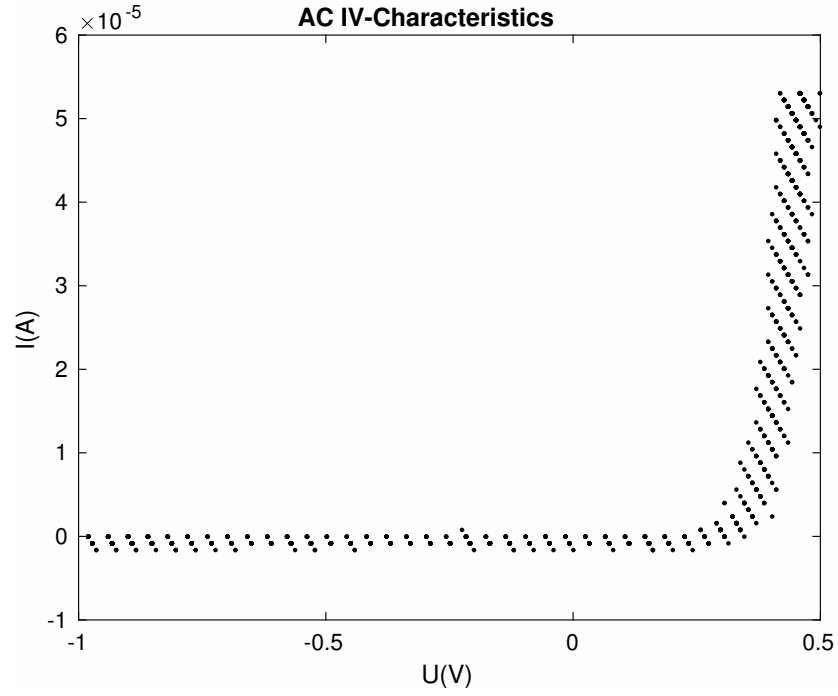The I-V curve of the diode can be shown in Figure 7.

Figure 7: AC IV-Characteristics

According to the curve, the value of V_{on} is around $0.5V$.

3.2.2 DC analysis

In DC part, we input DC signal whose voltage ranges from 0 to $1V$. By measuring the voltage of the diode, we successfully got Table 1

DC Voltage (V)	Resistance Voltage (mV)
1	540.5
0.9	538
0.8	530.5
0.7	525
0.6	501
0.5	478.5
0.4	394.5
0.3	292
0.2	193
0.1	90.5

Table 1: DC measurement of diode.

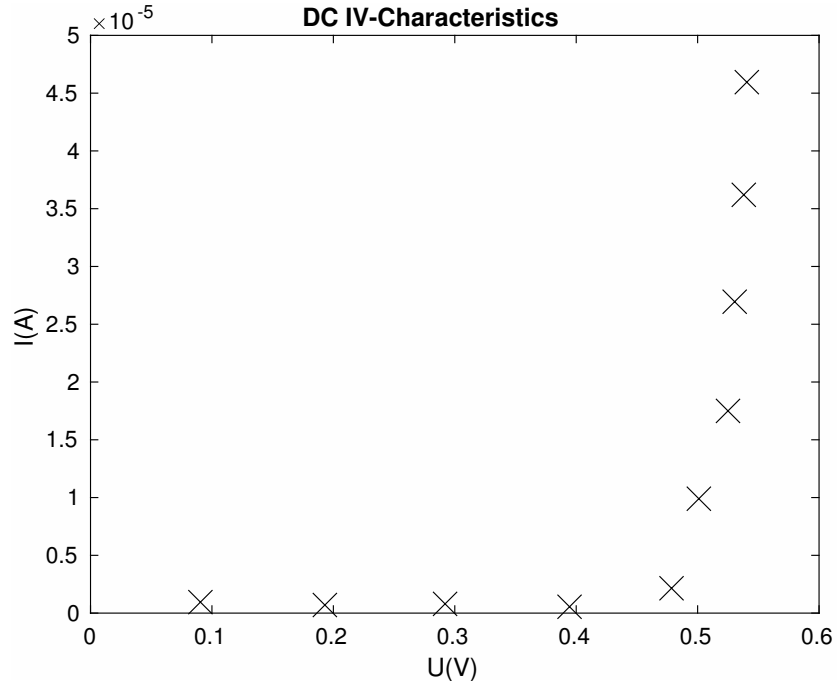Then the I-V character of diode was shown in Figure 8

Figure 8: DC IV-Characteristics

According to the graph, the V_on is around $0.5V$,which corresponding to the value we get in the AC part.
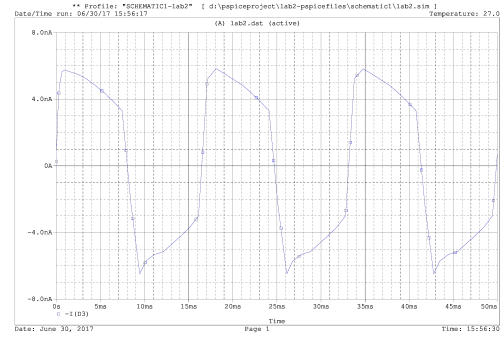
3.3 Back-to-back diodes

In Pspice, we simulate the behavior of two diodes which is connected back to back under different amplitudes, which was shown in Figure 9, Figure 10, Figure 11 and Figure 12.
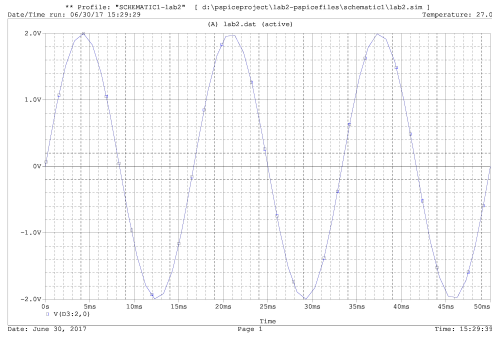
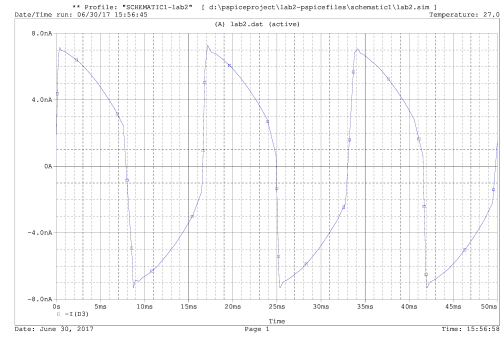The chosen diode is D1N4148.
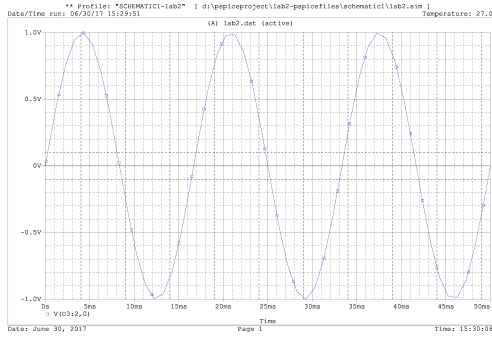
(a) Voltage

(b) Current

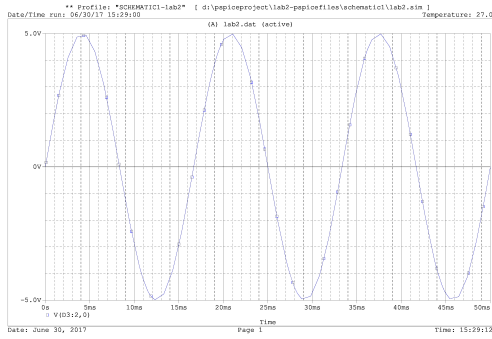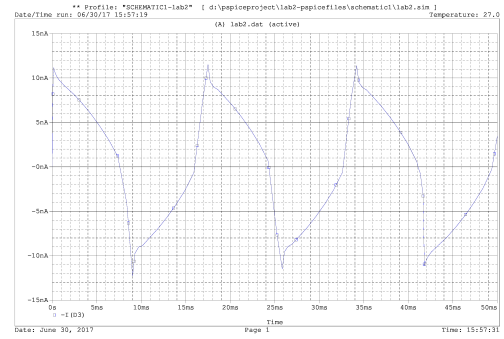Figure 9: 1 Vpp Back-to-back diodes

(a) Voltage
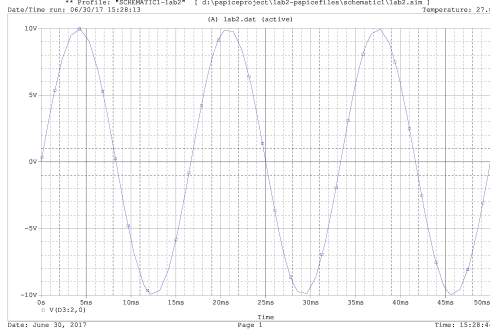
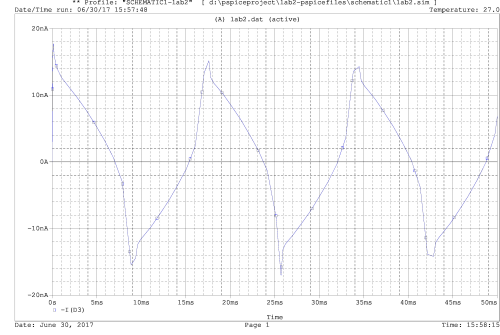(b) Current

Figure 10: 2 Vpp Back-to-back diodes

(a) Voltage

(b) Current
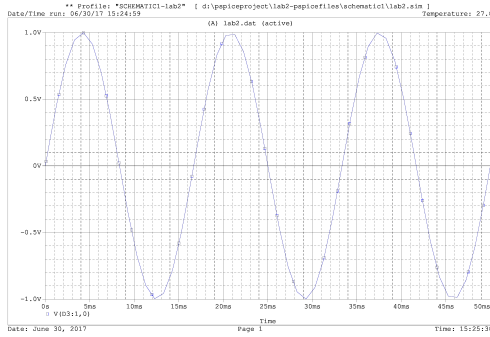
Figure 11: 5 Vpp Back-to-back diodes
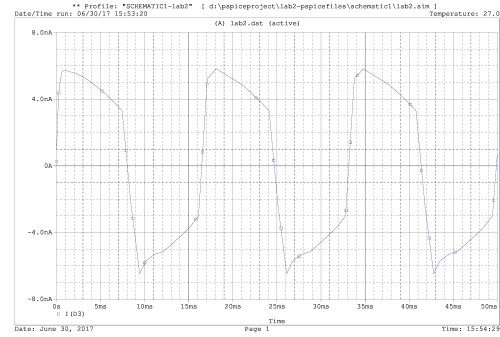
(a) Voltage

(b) Current

Figure 12: 10 Vpp Back-to-back diodes

3.4 Face-to-face diodes

We simulate the behavior of two diodes connected face to face under different amplitudes, which was shown in Figure 13, Figure 14, Figure 15 and Figure 16.
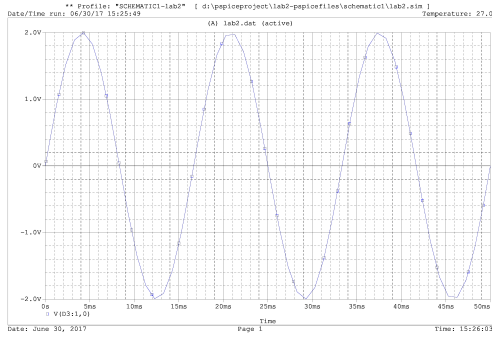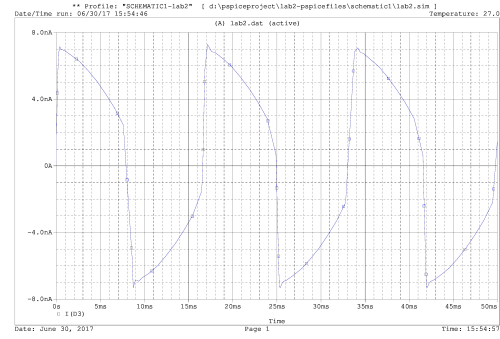

(a) Voltage

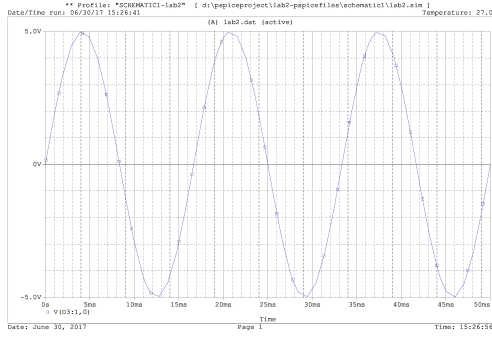(b) Current

Figure 13: 1 Vpp Face-to-face diodes
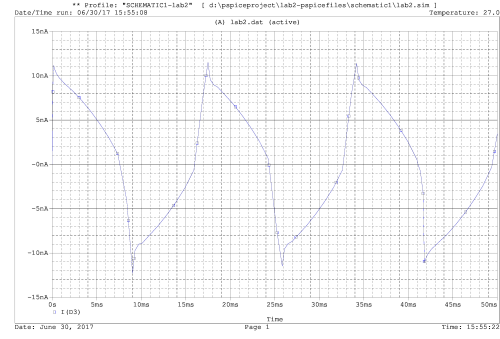
(a) Voltage

(b) Current

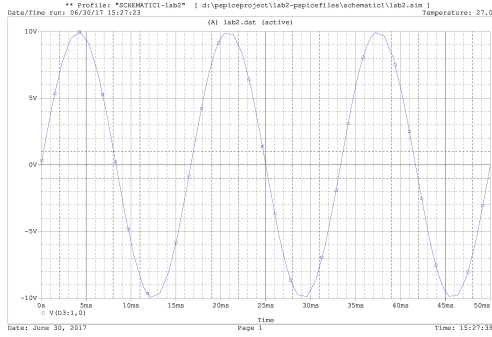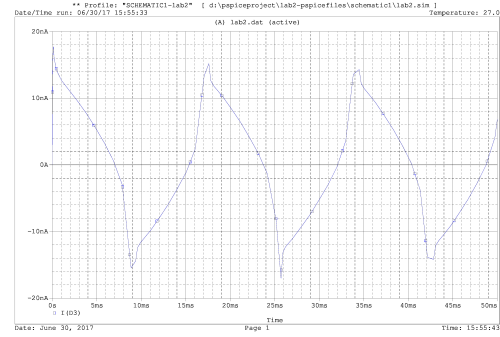Figure 14: 2 Vpp Face-to-face diodes

(a) Voltage

(b) Current

Figure 15: 5 Vpp Face-to-face diodes

(a) Voltage

(b) Current

Figure 16: 10 Vpp Face-to-face diodes

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4 Conclusion

In the first part, we measured the turning on voltage of the diode. According to the calculation, its value is 0.74V, which is corresponding to our estimation about 0.6-0.7V.

We analyze the I-V character of diode in the second section. With both AC input and DC input, we get the same value of V_on which is around 0.5V. Though the shape of the graph correspond to the expected I-V character of the diode, the value is smaller than the result in the first part. The problem might be the resistance of the machine and the multimeter. Since we directly apply the value of the input voltage instead of measuring the voltage of the two end of the circuit, some error will occur during the calculation.

The third part measures the behaviour of two face-to-face and back-to-back diodes. As shown in the graph, the shape of current graph is a bit wield. We tried to get its character under DC input, which was shown in Figure 17.
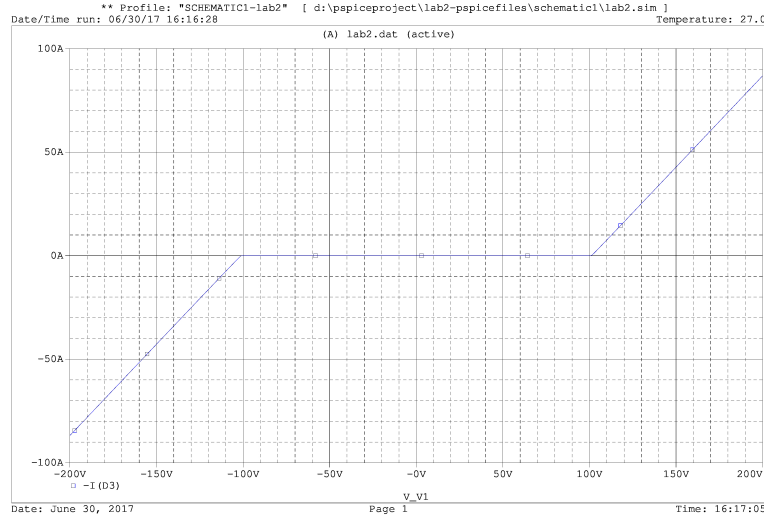

Figure 17: DC IV-Characteristics of Face-to-face diodes

The simulation results indicate that the working voltage of face-to-face circuit becomes extremely large which is equal to the reverse breakdown voltage of the diode. As a result, the value of the current becomes very small. The increasing and decreasing part of the current is almost the same as sine wave. The resistance changing of the two diodes system causes the wield shape of the current flow.

5 Reference

5.1 References

1. Lab2 Manual

5.2 Matlab Code

```matlab
M=csvread('scope_37.csv',2,0);

figure(1);

plot(M(:,1),M(:,2));
hold on;
plot(M(:,1),M(:,3));
hold off;
xlabel('t(s)');
ylabel('U(V)');
axis([-0.025 0.025 -1.5 1.5]);
title('AC CSV');
saveas(gcf,'imgs/ac-csv.eps');

figure(2);

I=M(:,2)./10000;
V=M(:,3)-M(:,2);
plot(V,I,'.');

xlabel('U(V)');
ylabel('I(A)');
axis([-1 0.5 -1e-5 6e-5]);
title('AC IV-Characteristics');
saveas(gcf,'imgs/ac-iv.eps');

figure(3);

V0=1:-0.1:0.1;
V1=[540.5 538 530.5 525 501 478.5 394.5 292 193 90.5]./1000;
I=(V0-V1)./10000;
plot(V1,I,'x','MarkerSize',15);

xlabel('U(V)');
ylabel('I(A)');
title('DC IV-Characteristics');
saveas(gcf,'imgs/dc-iv.eps');
```