Feng Chia University

Electrical Engineering Fundamentals I Lab

Laboratory 10

Diodes Switching Speed and LED

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1. Introduction
2. What is Switching Time and Switching Speed
3. How to Speed up the Switching Time
4. What is LED (Light-Emitting-Diode)
5. Materials
   1. Oscilloscope
   2. Digital multimeter
   3. Waveform Generator
   4. Devices
      1. Resistors: R = 1 kΩ ×1

Diode: D 1N4001 ×1

* + 1. Resistors: R = 300 Ω ×1, 1 kΩ ×1

LED ×1

1. Circuit diagram

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自動產生的描述

▲ Figure 1. Circuit of Experiment 10.a.1 Effects of conduction current ID(ON)

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自動產生的描述

▲ Figure 2. Circuit of Experiment 10.a.2 Effect of Switch-OFF Voltage VR

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▲ Figure 3. Circuit of Experiment 10.b.1 LED Measurements

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▲ Figure 4. Circuit of Experiment 10.b.2 LED Driving Circuit

1. Methods

Use Digital multimeter and Waveform Generator to observe the results.

1. Experiments data
   1. Experiment 10.a Measurement of Diode Switching Speed
      1. Effects of conduction current ID(ON)
         1. +2 V → 0 V

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自動產生的描述

Scale: 200 μs/Div

500 mV/Div

tOFF: 16.9 μs

tS: 10.4 μs

tT: 6.5 μs

* + - 1. +4 V → 0 V

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自動產生的描述

Scale: 200 μs/Div

1 V/Div

tOFF: 24.7 μs

tS: 16.8 μs

tT: 7.9 μs

* + - 1. +10 V → 0 V

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自動產生的描述

Scale: 200 μs/Div

2 V/Div

tOFF: 33.4 μs

tS: 24.8 μs

tT: 8.6 μs

* + 1. Effect of Switch-OFF Voltage VR
       1. +4 V → 0 V

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自動產生的描述

Scale: 200 μs/Div

1 V/Div

tOFF: 24.7 μs

tS: 16.8 μs

tT: 7.9 μs

* + - 1. +4 V → -2 V

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自動產生的描述

Scale: 200 μs/Div

1 V/Div

tOFF: 14 μs

tS: 7.3 μs

tT: 6.7 μs

* + - 1. +4 V → -6 V

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自動產生的描述

Scale: 200 μs/Div

2 V/Div

tOFF: 8.7 μs

tS: 6 μs

tT: 2.7 μs

* 1. Experiment 10.b LED Measurements and Driving Circuit
     1. LED Measurements
        1. Forward Bias

100 Ω: Light

1 kΩ: Light

10 kΩ: Dark

100 kΩ: Dark

* + - 1. Reverse Bias

100 Ω: Dark

1 kΩ: Dark

10 kΩ: Dark

100 kΩ: Dark

* + 1. LED Driving Circuit

300 Ω: Light

1 kΩ: Light

N/A Ω: Dark

1. Results

None

1. Discussion

* What is the effect of the diode conducting current ID(ON) on the resulting switching time tOFF? Why?

tOFF becomes greater by the time because when a diode is switched from the conducting state (ON) to the blocking state (OFF), it doesn’t immediately stop conducting. This is due to the stored charge in the junction region that needs to be removed. The time it takes for the diode to fully switch off is known as the reverse recovery time. The magnitude of the conducting current ID(ON) can affect this time, as a higher current can lead to more stored charge and thus a longer recovery time

* How to utilize your oscilloscope to observe a waveform in a tiny period of time range?

To observe tiny period of time on Oscilloscope, just adjust horizontal time per division and the wave can be easy to observe.

* What is the difference between this waveform and the normal waveform from oscilloscope?

The waveform we observe is not a pure square wave. Instead, it’s a square wave with a recovery time when the diode switched OFF.

* What is the effect of the switching off voltage VR on the resulting switching speed of the diode? Why?

When the diode switches from forward bias (conducting state) to reverse bias (blocking state), the reverse voltage helps to remove the stored charge in the junction, thus speeding up the switching process.

* How does the LED behave?

When the resistor increases, LED becomes darker and can’t see the light.

* Compare the emitted lightness of LED under different Ω-scales

100 Ω: Lightest

1 kΩ: Light

10 kΩ: Dark

100 kΩ: Dark

* What is the relationship between the switch and the LED?

When switch is open, LED won’t emit light.

When switch is closed, LED will emit light.

* What is the relationship between the resistor and the LED?

When the resistor increases, the current will decrease and make LED become darker.

1. Conclusion

With Oscilloscope, we can easily observe the wave go through the diode.