Feng Chia University

Electrical Engineering Fundamentals II Lab

Laboratory 11

BJT Switching Circuit Design and Characterization

Instructor: Prof. Shyan-Lung Lin

Student Name: 周嘉禾

Student ID: D1166506

Experiment Date:30/05/2024

I. Introduction

a. To observe the behavior of BJT amplifier circuits.

II. Materials

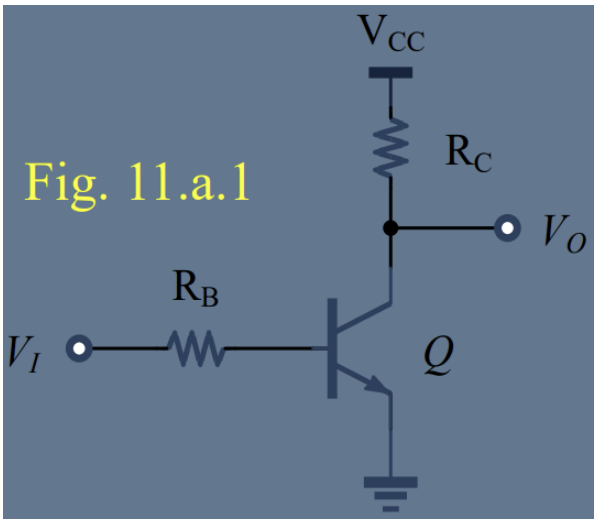
1. Power supply
2. Digital multimeter
3. Function generator
4. Oscilloscope
5. Devices

   Q: 2SC1815 ×1

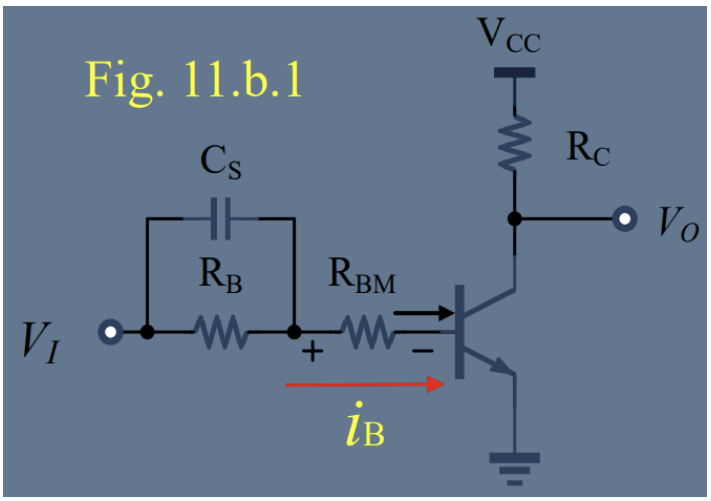
   Resistors: R = 100 Ω ×1, 1.2 kΩ ×1, 3 kΩ ×1, 30 kΩ ×1

   Capacitor: C = 100 pF ×1

III. Circuit diagram



▲ Figure 1. Circuit of Experiment 11.a Effects of the Saturation Level on Switching Speed



▲ Figure 2. Circuit of Experiment 11.b Effects of Speed-up Capacitor on Switching Speed

IV. Methods

Using Oscilloscope to observe voltage.

V. Experiments data

1. Experiment 11.a Effects of the Saturation Level on Switching Speed

Table 1: Theoretical of BJT in Saturation Level on Switching Speed

B	309
R_C	11.8 kΩ
$I_{B(min)}$	0.0318 mA
I_{B1}	0.0955 mA
I_{B2}	0.9547 mA

Table 2: Measurement of BJT in Saturation Level on Switching Speed

	$T_{(ON)}$	$T_{(S)}$	$T_{(OFF)}$
Shallow	710 ns	730 ns	1250 ns
Deep	170 ns	630 ns	1000 ns

2. Experiment 11.b Effects of Speed-up Capacitor on Switching Speed

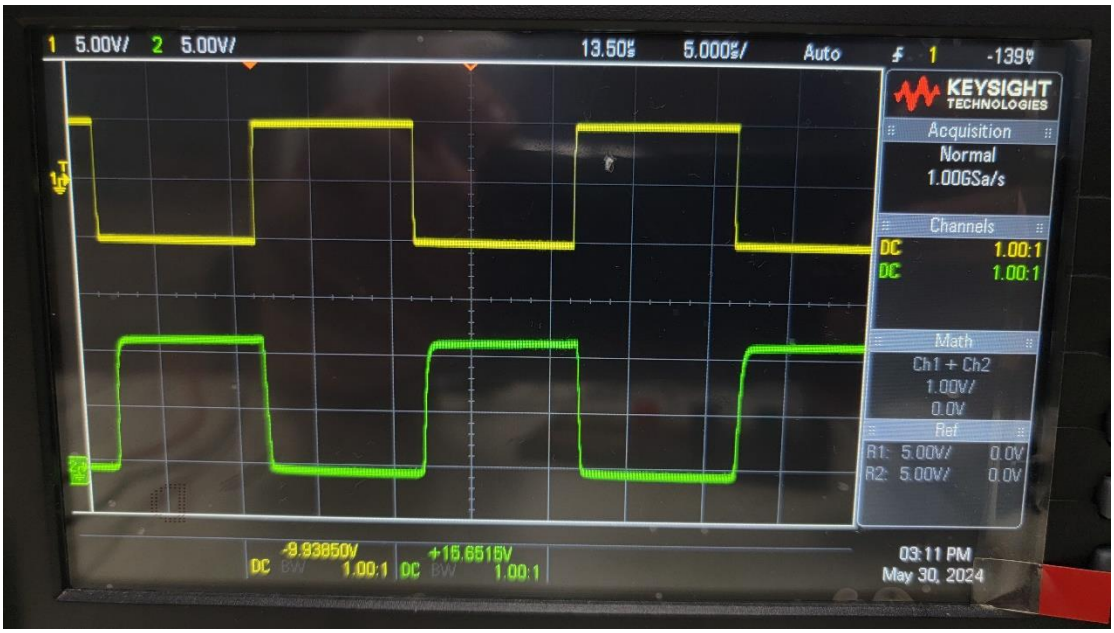
Table 3: Theoretical of BJT with Capacitor on Switching Speed

R_C	1.2 kΩ
R_B	3 kΩ
R_{BM}	100 Ω

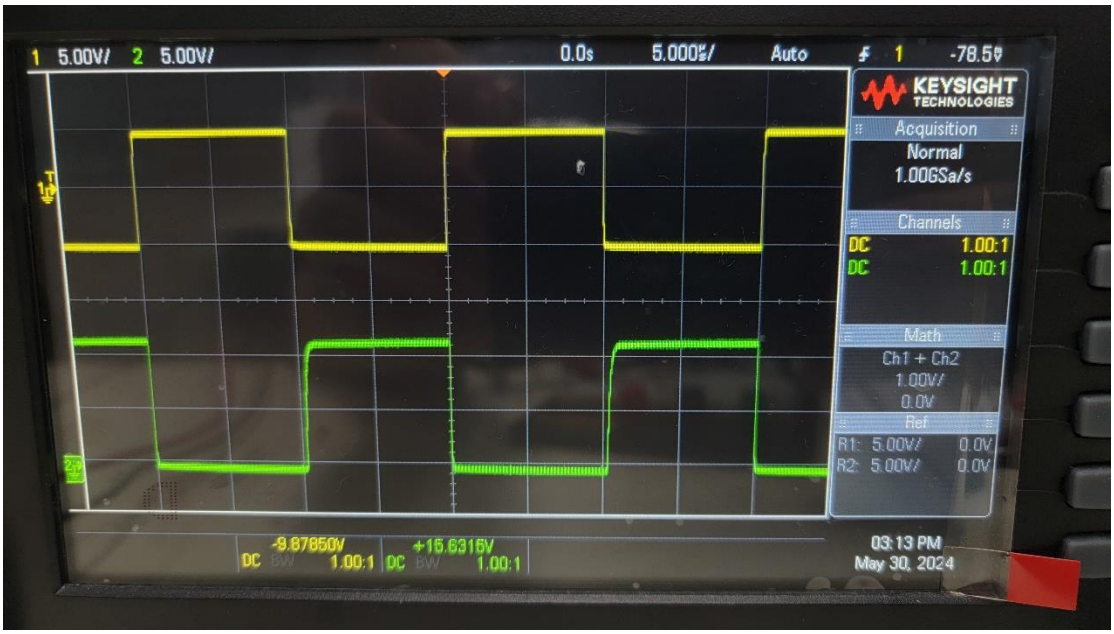
Table 4: Measurement of BJT with Capacitor on Switching Speed

	$T_{(ON)}$	$T_{(S)}$	$T_{(OFF)}$
Shallow	65 ns	280 ns	340 ns
Deep	120 ns	220 ns	470 ns

VI. Results



▲ Figure 3. Waveform of Experiment 11.a with 3 kΩ



▲ Figure 4. Waveform of Experiment 11.a with 30 kΩ

▲ Figure 5. Waveform of Experiment 11.b with 3 kΩ

▲ Figure 6. Waveform of Experiment 11.b with 30 kΩ

VII. Discussion

1. **Compare the experiment results of shallow and deep saturation modes with tabulated switching time and comparison of the resulted waveforms.**

   In shallow saturation mode, switching time is shorter with sharper waveforms compared to deep saturation, which has longer switching times and rounded waveforms due to excess charge removal. Tables should list exact times for comparison.

2. **Discuss the effects of the base resistor (RB) on the switching speed of the transistor inverter.**

   In shallow saturation mode, switching time is shorter with sharper waveforms compared to deep saturation, which has longer switching times and rounded waveforms due to excess charge removal. Tables should list exact times for comparison.

3. **Compare the experiment results of Observation I & II with tabulated switching time and comparison of the resulted waveforms.**

   Observation I shows faster switching times and sharper waveforms compared to Observation II, which has slower switching times and less defined waveforms. Tables should list exact times for precise comparison.

4. **Discuss the effects of speed-up capacitor on switching speed of the transistor inverter.**

   A speed-up capacitor reduces switching time by providing a quick discharge path for the base, thus improving the switching speed of the transistor inverter.

VIII. Conclusion

From the experimental data above, the BJT work in an ideal situation.