Feng Chia University

Electrical Engineering Fundamentals II Lab

Laboratory 11

BJT Switching Circuit Design and Characterization

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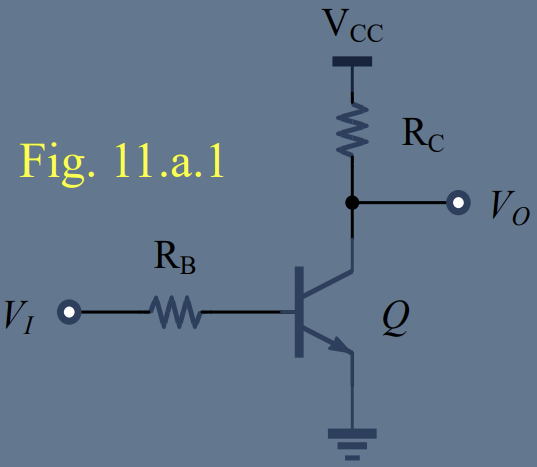
1. Introduction
2. To observe the behavior of BJT amplifier circuits.
3. Materials
   1. Power supply
   2. Digital multimeter
   3. Function generator
   4. Oscilloscope
   5. Devices

Q: 2SC1815 ×1

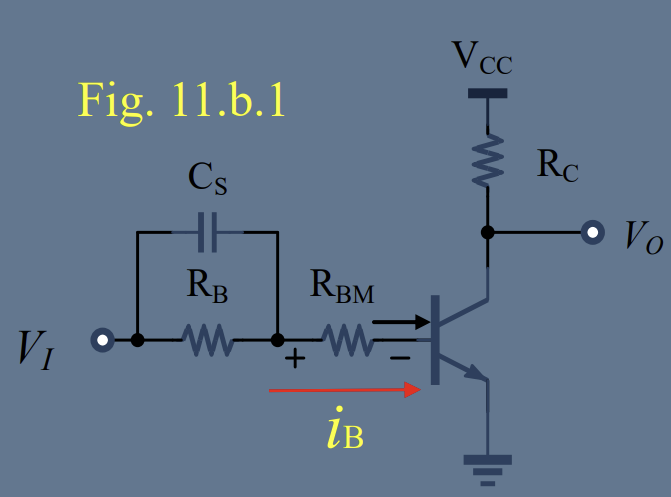
Resistors: R = 100 Ω ×1, 1.2 kΩ ×1, 3 kΩ ×1, 30 kΩ ×1

Capacitor: C = 100 pF ×1

1. 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

1. Methods

Using Oscilloscope to observe voltage.

1. 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 |
| RC | 11.8 kΩ |
| IB(min) | 0.0318 mA |
| IB1 | 0.0955 mA |
| I­B2 | 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 |

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

Table 3: Theoretical of BJT with Capacitor on Switching Speed

|  |  |
| --- | --- |
| RC | 1.2 kΩ |
| RB | 3 kΩ |
| RBM | 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 |

1. Results

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

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

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

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

1. 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.

* 1. **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.

* 1. **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.

* 1. **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.

1. Conclusion

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