Institute of Technology of Cambodia

Department Telecommunication and Networking

Report: Analog Electronic

Lab2: NPN Transistor

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Contents:

I. Objective

The objective of this experiment is to understand and demonstrate how an NPN transistor can function as an electronic switch.

II. Material

This experiment requires the following components:

Figure 1: Analog experimental board

• **Analog experimental board** is used for prototyping electronic circuits. It allows for quick construction of temporary circuits with components and jumper wires. Breadboards enable testing and modifying designs before creating a permanent PCB version.

Figure 2: Wire connector

• **Wire connector** is used for temporary connections in a circuit. It usually has connectors at both ends and is often used in prototyping and troubleshooting.

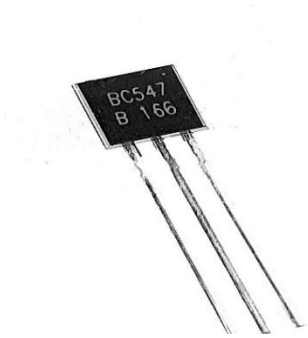

Figure 3: NPN transistor(2N2222)

• **NPN transistor (2N2222)** is used for amplification we can amplify weak electrical signals, making them stronger or as switching we can act as electronic switches, controlling the flow of current.

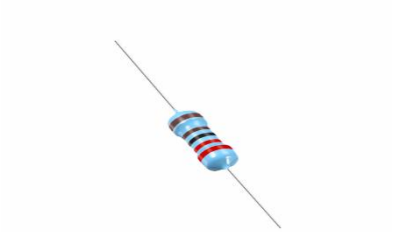

Figure 4: Transistor

• **Resistors** is important in electrical circuits for current limiting, voltage division, signal conditioning, power dissipation, biasing components, impedance matching, pull-up/down, timing circuits, and temperature sensing.

Figure 5: Oscilloscope

• **Oscilloscope** is a key electronic tool for observing and measuring changing voltage signals over time.

Figure 6: Multimeter

• **Multimeter** is a versatile electronic measuring instrument used for diagnosing electrical circuits and components.

Figure 7: LED

• **LED is** typically used as an indicator to demonstrate the switching action of the transistor.

III. Procedure

B. NPN transistor as a switch

We will construct a circuit as shown in Figure 8. Then, we will vary the input voltage as detailed in Table 2 while measuring the output voltage and current accordingly.

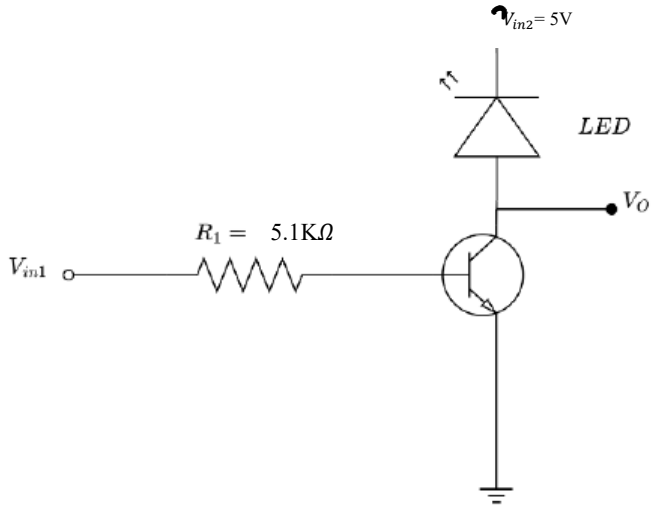

Figure 8: Transistor used as a switch

• This is the process in this experiment:

We take all the components from teacher. Then, we test it does it work or not by using multimeter if it doesn't work, we should tell teacher and change it. After that, we start ware the circuit on the **Analog experimental** that we need to input voltage one for 5V and one more is the input voltage that we can change value. when we use transistor, we should know which one is Emitter, Base, and Collector by using **datasheet** for the P2N2222A based on the datasheet we will know. Based on the Figure8 we connect the input voltage with resistor ($5.1K\Omega$) and connect from resistor to transistor (Base). Before we use the LED, we should know that which one is (+) and (-) by its leg length: The longer leg is the anode (+) and the shorter leg is the cathode (-). Then we connect anode of LED to Collector of the transistor and cathode to the input 2 (5V). For the Emitter of transistor to the ground. After we finished wire on the Analog experimental, we use Oscilloscope for measure the input voltage and output voltage that we use two oscilloscope probes by using one for signal input and one more use for signal output and we connect to Oscilloscope in CH1 and CH2. we open the both Chanels and we put it in the same voltage for CH1 and CH2. Finally, we observe to the voltage in screen of Oscilloscope.

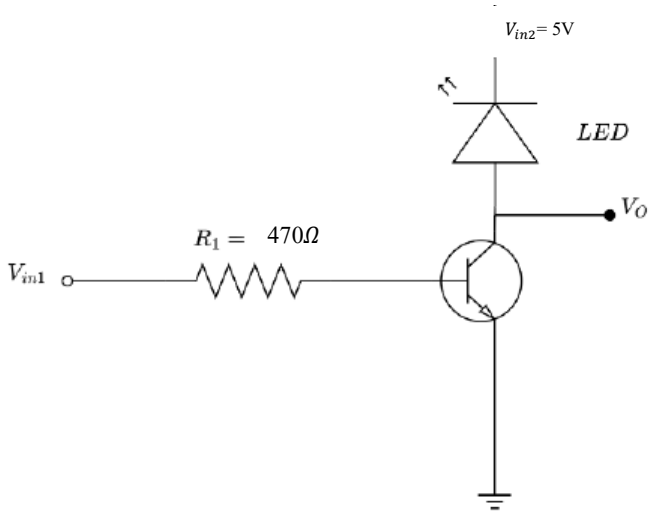

Figure 9 Transistor used as a switch

• The process of the Figure 9 as the experiment in the Figure 8 but we change resistor from $5.1K\Omega$ to 470Ω.

IV. Result and Conclusion

Here is my result for current $5.1K\Omega$:

Table1: Measurement result

Vin1[V]	Vout[V]	Current [A]
1	2.41	5.8×10^{-5}
2	2.25	0.00025
3	2.16	0.00045
4	2.05	0.00064
5	2	0.00084
6	1.92	0.001
7	1.84	0.0012
8	1.81	0.0014
9	1.80	0.0016
10	1.78	0.0018
11	1.72	0.002
12	1.71	0.0022

For calculate current we use this formula: $I_B = \frac{V_{in} - V_{BE}}{5.1K}$

Since: $V_{BE} = 0.7$

Here is my result for current 470Ω:

Table2: Measurement result

Vin1[V]	Vout[V]	Current [A]
1	2.39	0.00064
2	1.92	0.0028
3	1.66	0.0049
4	1.59	0.007
5	1.49	0.0091
6	0.1	0.011
7	0.089	0.013
8	0.078	0.015
9	0.062	0.017
10	0.061	0.02
11	0.06	0.021
12	0.052	0.024

For calculate current we use this formula: $I_B = \frac{V_{in} - V_{BE}}{470}$

Since: $V_{BE} = 0.7$

Operating the NPN transistor with an LED shows quite well its basic function of an electronic switch. A small current forwarded to the base amplifies the signal and permits a larger current to flow through the path from collector to emitter. This is enough to light up the LED, and by doing so, to turn it on. The efficiency of the circuit is that it can drive a comparatively large load-the LED-with a very small input signal, which is one of the useful properties of a transistor in many electronic applications.