

## Experiment No. 7

### Transistor Test for Terminal Identification and Type

#### 1. OBJECTIVES

- ❖ To test the transistor as:
  - (i) NPN or PNP.
  - (ii) Identifying its base emitter and collector.

#### 2. COMPONENTS REQUIRED

- ❖ Several transistors of different types.
- ❖ Bread Board.
- ❖ Connecting wires.
- ❖ Digital multimeter.

#### 3. THEORY

##### Bipolar Transistor

In the Diode tutorials we saw that simple diodes are made up from two pieces of semiconductor material, either silicon or germanium to form a simple PN-junction and we also learnt about their properties and characteristics. If we now join together two individual signal diodes back-to-back, this will give us two PN-junctions connected together in series that share a common P or N terminal. The fusion of these two diodes produces a three layer, two junction, three terminal device forming the basis of a **Bipolar Transistor**, or BJT for short. Transistors are three terminal active devices made from different semiconductor materials that can act as either an insulator or a conductor by the application of a small signal voltage. The transistors have two basic functions: "switching" (digital electronics) or "amplification" (analogue electronics).

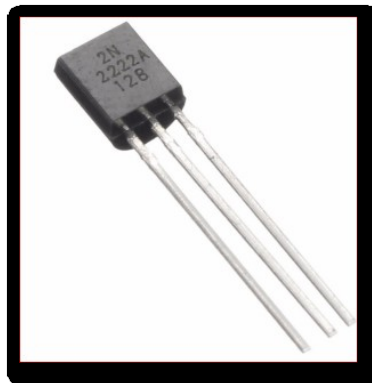


Fig. 1: Bipolar Transistor.

The word Transistor is an acronym, and is a combination of the words Transfer Varistor used to describe their mode of operation way back in their early days of development. There are two basic types of bipolar transistor construction, **NPN** and **PNP**, which basically describes the physical arrangement of the P-type and N-type semiconductor materials from which they are made.

The Bipolar Transistor basic construction consists of two PN-junctions producing three connecting terminals with each terminal being given a name to identify it from the other two. These three terminals are known and labeled as the **Emitter ( E )**, the **Base ( B )** and the **Collector ( C )** respectively.

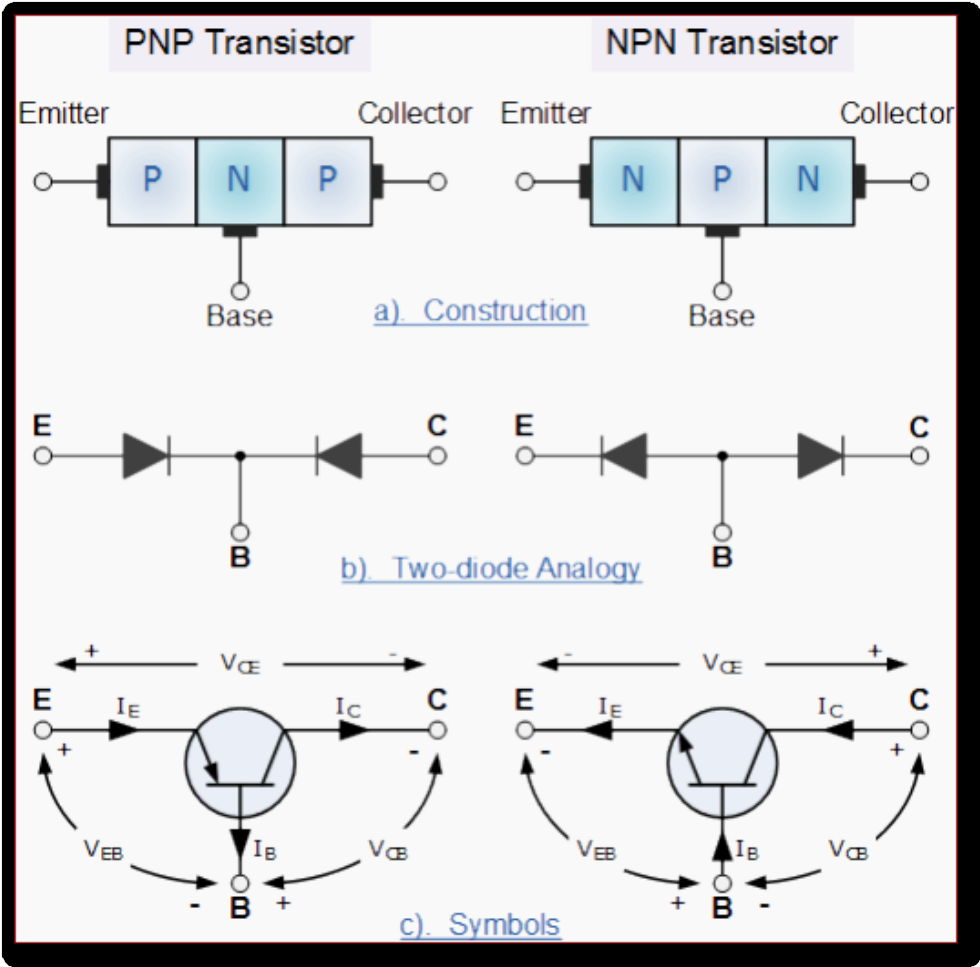


Fig. 2: The construction and circuit symbols for both the NPN and PNP bipolar transistor.

The construction and circuit symbols for both the NPN and PNP bipolar transistor are given above with the arrow in the circuit symbol always showing the direction of "conventional current flow" between the base terminal and its emitter terminal. The direction of the arrow always points from the positive P-type region to the negative N-type region for both transistor types, exactly the same as for the standard diode symbol.

## 4. PROCEDURE

The transistor test uses the Diode test function of the Multimeter. So, For the sake of this transistor test, you need to know about the **Diode Test**.

### **Diode Test Mode:**

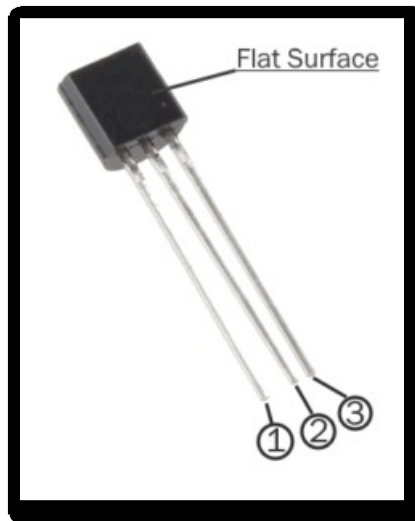
Forward bias P-N junction: Multimeter reads some voltage & beeps.

Reverse bias P-N junction: Multimeter reads OL (Over Limit)

### ❖ **Terminal's Identification**

The first step in the transistor test is to identify the terminals (**Base, Emitter & Collector**) of the transistor.

First, you need to mark the terminals of the transistor with numbers **1,2,3**. In order to do that, hold the transistor's flat side facing towards you and start from the left side as shown in the figure below.



**Fig. 3: The first step in the transistor test.**

### **Base Terminal Identification**

- Put Multimeter in **Diode Test Mode**.
- Place black (common) probe & red probe on any two terminals at a time.
- Test all possible terminal combinations i.e. **1-2, 1-3, 2-1, 2-3, 3-1, 3-2**.
- Two of these combinations should pass diode test (reading shows voltage **0.5v to 0.8v**), the **common terminal** in these two combinations is the **Base terminal**.

- Suppose, 2-1 & 2-3 combinations pass diode test then 2 is the base terminal.



Fig. 4: The second step in the transistor test.

### Emitter & Collector Identification

With the successful identification of the base terminal, two terminals (1 & 3) remain unknown. if you identify the second terminal, subsequently you will also know the third terminal.

- Set the Multimeter in **Diode Test Mode**.
- Record the voltage reading of base terminal with both terminals **1 & 3** one by one.
- The terminal having a **higher voltage** between the two is the **Emitter**.
- The terminal with **lower voltage** compared to the other is **Collector**.

In this example, suppose the 2-1 voltage reading = **0.6v** & 2-3 voltage reading = **0.7v**

- So the **Emitter** is terminal 3 & **Collector** is terminal 1.

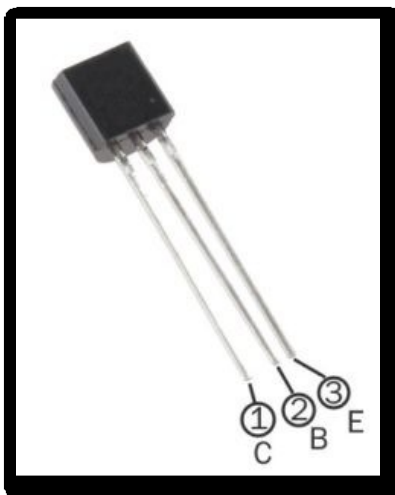


Fig. 5: The third step in the transistor test.

### ❖ Type: NPN or PNP Identification

The next step in the **transistor test** is to know whether the transmitter is **NPN** or **PNP**.

This step depends on the results of the above transistor test.

#### NPN Test

- Put Multimeter in **diode test mode**.
- Place the **Red** (positive) probe on **Base terminal** & the **black** (common or negative) terminal on **Emitter & Collector** one by one.
- If they pass the diode test, it means the junctions are forward bias & it is an **NPN** transistor.

#### PNP Test

**PNP** transistor test is a little different than the **NPN** transistor test.

- Put the Multimeter in **diode test mode**.
- Connect the **Black** (common) probe with **Base** & the **Red** probe with **Emitter & Collector** one at a time.
- If these both combinations pass the diode test, the Transistor is **PNP**.

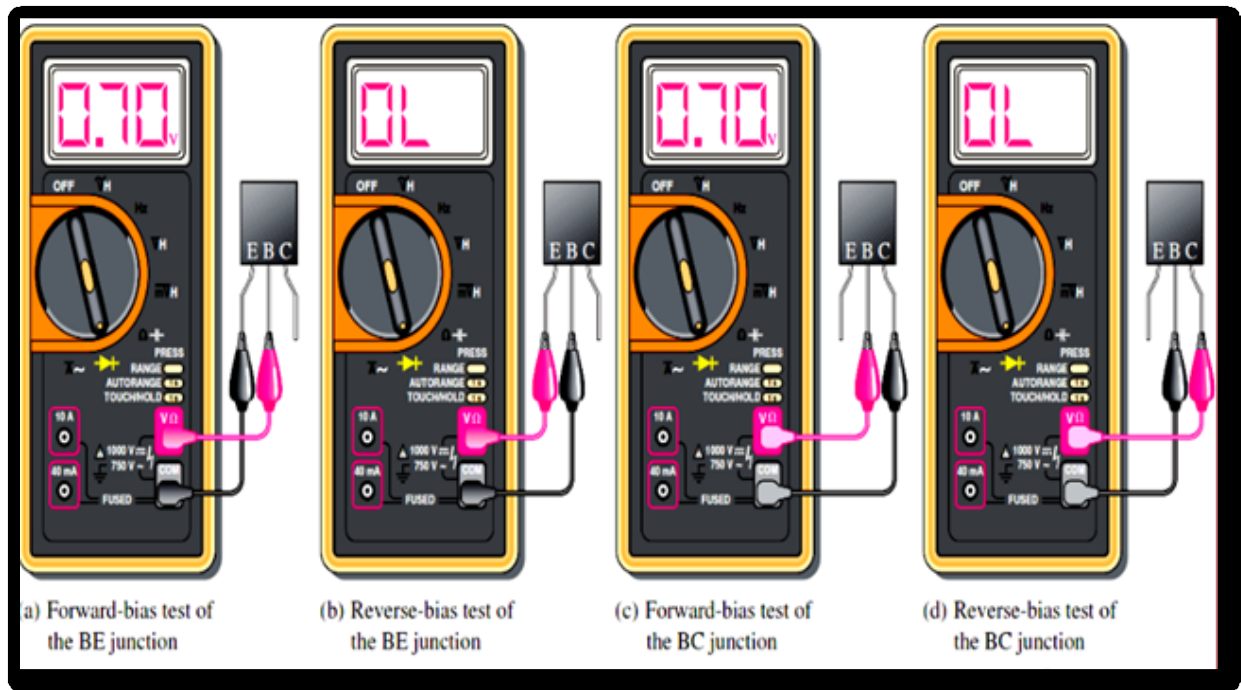
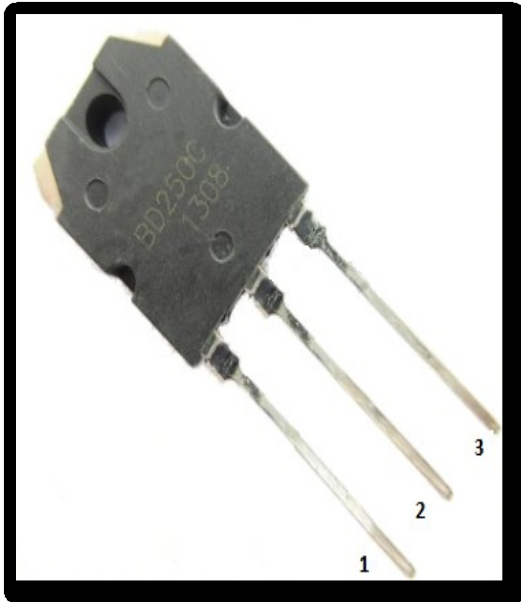


Fig. 6: Typical multimeter test of npn transistor.

➤ For the first transistor:



1	2	Reading
-	+	
+	-	
2	3	
-	+	
+	-	
1	3	
-	+	
+	-	

\*Identify the three terminal.....

\*Identify the type.....

➤ For the second transistor:

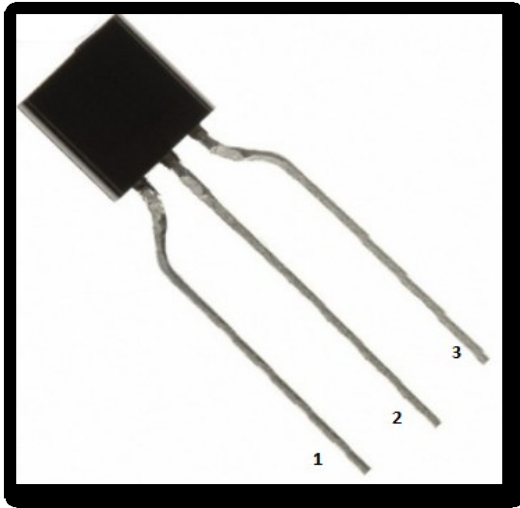


1	2	Reading
-	+	
+	-	
2	3	
-	+	
+	-	
1	3	
-	+	
+	-	

\*Identify the three terminal.....

\*Identify the type.....

➤ For the third transistor:



1	2	Reading
-	+	
+	-	
2	3	
-	+	
+	-	
1	3	
-	+	
+	-	

\*Identify the three terminal.....

\*Identify the type.....