To Use a Multimeter to (a) Identify Base Of Transistor, (b) Distinguish Between npn & pnp Type Transistors, (c) See the Unidirectional Flow Of Current In Case Of a diode & An LED, (d) Check Whether a Given Electronic Component (e.g., diode, transistor Or IC) Is In Working Order

Aim

To use a Multimeter to:
(a) identify base of transistor
(b) distinguish between npn and pnp type transistors.
(c) see the unidirectional flow of current in case of a diode and an LED.
(d) check whether a given electronic component (e.g., diode, transistor or IC) is in working order.

Apparatus

A multimeter, transistors, npn and pnp, an IC (integrated circuit 7408 or 7432 each with 14 legs), a diode and an LED.

Theory

1. A transistor is a three terminal device. It can be regarded as a combination of two junction diode joined in an opposite manner such that the middle part is common to both. When an n-type of semi-conductor is sandwitched between two p-type of semiconductors, the transistor is p-n-p type but when p-type of semi-conductor, the transistor is npn transistor. Input section is forward biased and output section of a transistor is reversed biased. The base current is small but emitter and collector current is large. $I_c = I_b + I_c$.

   (a) Identify the base: If one of the three terminals of the transistor is so chosen that conduction take place in both the cases when a multimeter is connected between the chosen terminal and either of the remaining two terminals, then the chosen terminal is the base.

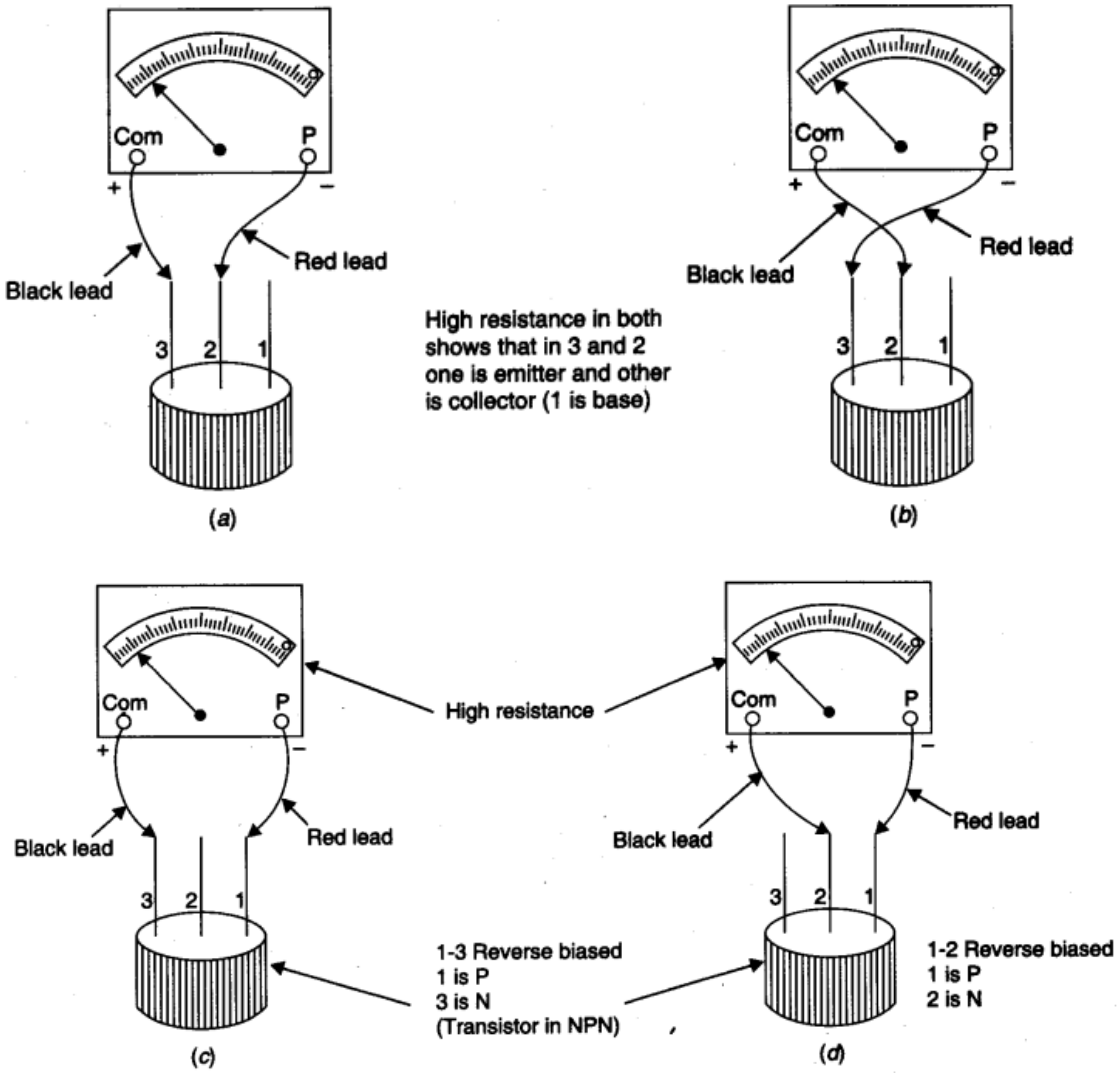
   (b) To find out whether the transistor is p-n-p or n-p-n: For conduction to be possible in both the above said cases, if the common terminal of the transistor has to be
   connected to +ve, then the transistor is n-p-n type. But if the common terminal has to be connected to -ve for making the conduction possible in both the case, then the transistor is p-n-p type.

   (c) Identifying an IC. An IC has minimum of eight legs. Most of the IC packages

have flat back.
(d) A diode or an LED conducts only when forward biased and in reverse biasing, there is no flow of current.
(e) When a diode is in working order, it will allow the current to flow in one direction, when forward biased.

Procedure

1. Use the selector switch and put the Multimeter in ohm range (R).
2. Insert the metallic end of the back lead in common terminal of the Multimeter and that of the red in the terminal marked P.



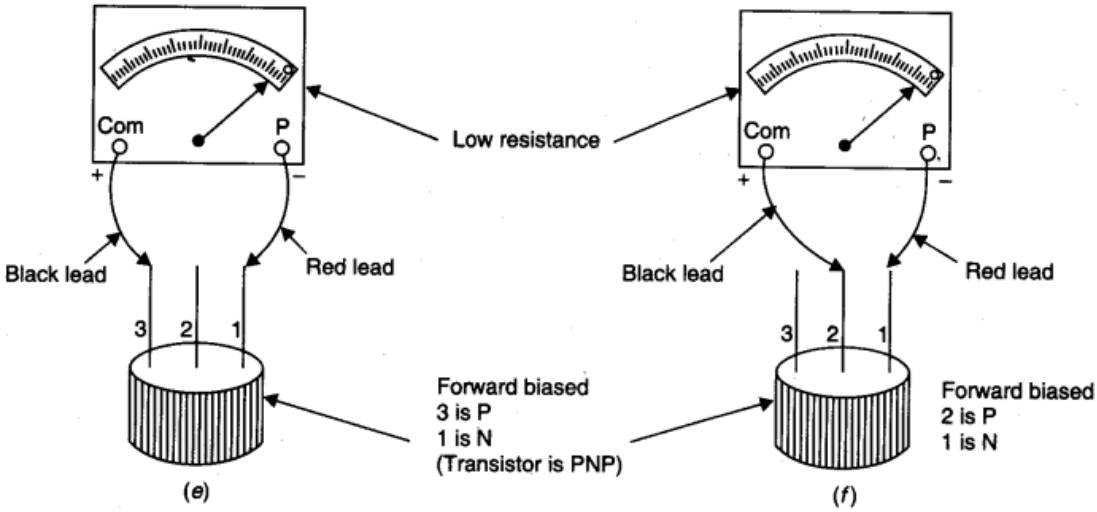


Fig. Identifying the base of transistor.

3. Connect the other metallic end of the black lead to the leg of the transistor marked '3' and the red lead to the leg marked '2' as shown in Figure (a) and note whether the resistance shown by the pointer is high or low. Now reverse the contacts of the leads with the legs '2' and '3' i.e., leg (3) to -ve and (2) to + ve as shown in Figure (b) and note again whether the resistance shown in high or low.

To possibilities arise

1. The resistance is high in both cases in figure (a) and figure (b). Then proceed as explained further in figure (c), (d), (e) and (f) and locate the base leg and the type of transistor n-p-n or p-n-p.

If resistance shown as in figure (a) is high in one when 3 is +ve and 2 is -ve and low in other [3 is -ve and 2 is + ve figure (b)], then proceed as explained in part II of the Figure. Connect 3 to -ve by red lead and 1 to +ve black lead as in figure (c) and (d).

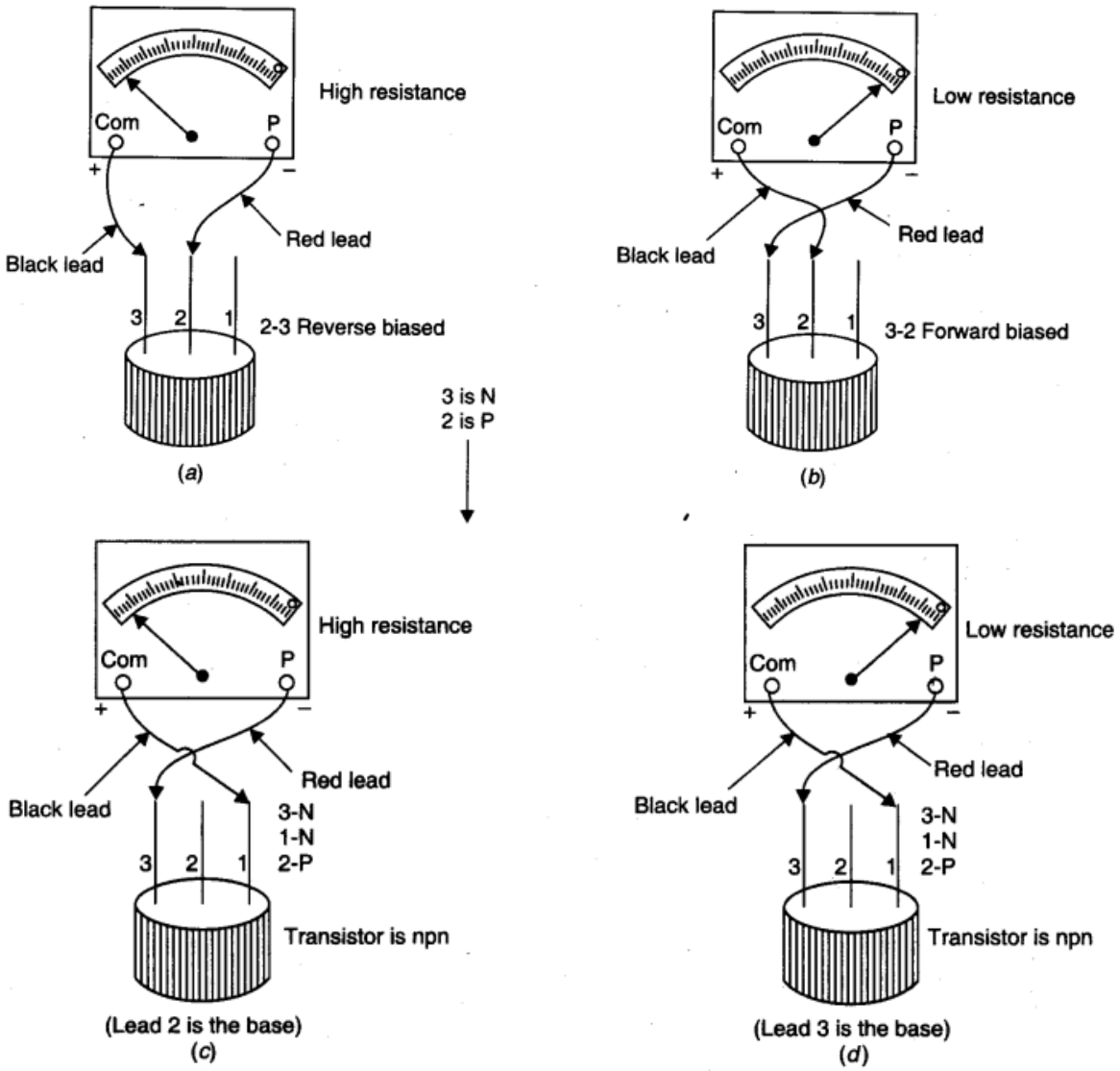


Fig. Indentifying the transistor if it is a *p-n-p* transistor.

(a)A high resistance would mean 3 and 1 are both n-type and 2 is p-type the base.

(b) A low resistance would mean a forward biasing of 3 and 1 (i.e., 3 is n, 1 is p and 2 is p). It means base is 3 and the transistor is p-n-p type.

Identifying the emitter and collector leads (Having known the base). In a transistor, the emitter region is heavily doped relative to the collector region. Therefore, the forward resistance of emitter base should be lower than that of collector base. Using ohm-meter (Multimeter set at R) the forward resistance of the lead with base having lower value implies that the lead is Emitter and the other offering higher forward with base is the collector.

When reverse biased, a diode does not conduct. An LED behaves the same way except that a diode when conducts emits light.

A transistor conducts only when base-emitter is forward biased and does not conduct when base-collector is forward biased.

(c) IC (integrated circuit). Look for number of legs of the device. Eight or more than eight legs imply that the component is an IC.

(d) Unidirectional flow of current

Case of junction diode

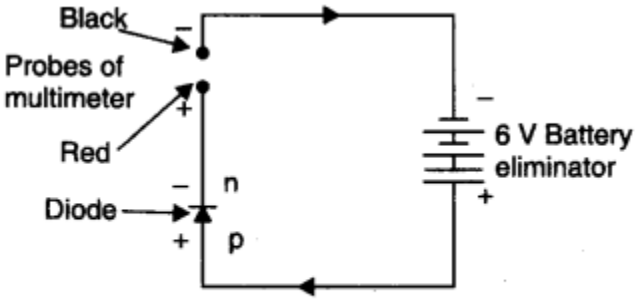


Fig. Testing unidirectional current in a diode.

1. Connect the +ve marked end of the diode to +ve terminal of a 6 V variable D.C. battery adjusted to minimum voltage.
2. Select the D.C. current at 10 mA range by using the selector switch. Insert one the metallic ends of probe in terminal P (+) and the black metallic end into the terminal marked common.
3. Connect the other metallize end of red probe to the free end of the diode and the metallic end of black probe into the -ve terminal of the battery eliminator and read the value of current by varying the output of the eliminator. Since the diode is forward biased, it allows the current to pass.
4. Now reverse the terminals of the diode such that the end marked -ve is at higher potential* and the one marked + is at lower potential. Again observe the current in Multimeter on the appropriate D.C. milliamp ere scale. No current reading in the Multimeter would indicate that the diode allows the flow of current in one direction only, i.e., the current is unidirectional in a diode.
5. Now replace the diode by the LED and repeat the steps to establish that an LED also allows the flow of current only when it is forward biased as well as emits light.

(e) Checking whether diode, transistor in IC is in working order

1. A diode will conduct only in one direction i.e., first connect the ends of diode to the two metal ends of the probes and reverse the connecting points. If it conducts in one case, then diode is in working order. If conducts in both cases or does not conduct in both cases, then it is damaged.

2. Select any two terminals between which there is no conduction in forward or reverse biasing, these will be emitter and collector, if it is not so transistor is damaged. Now use third terminal as base and check whether it conducts with one of the terminals and does not conduct with other terminal showing lower resistance in forward biasing between base-emitter end higher resistance in forward biasing between base and collector.

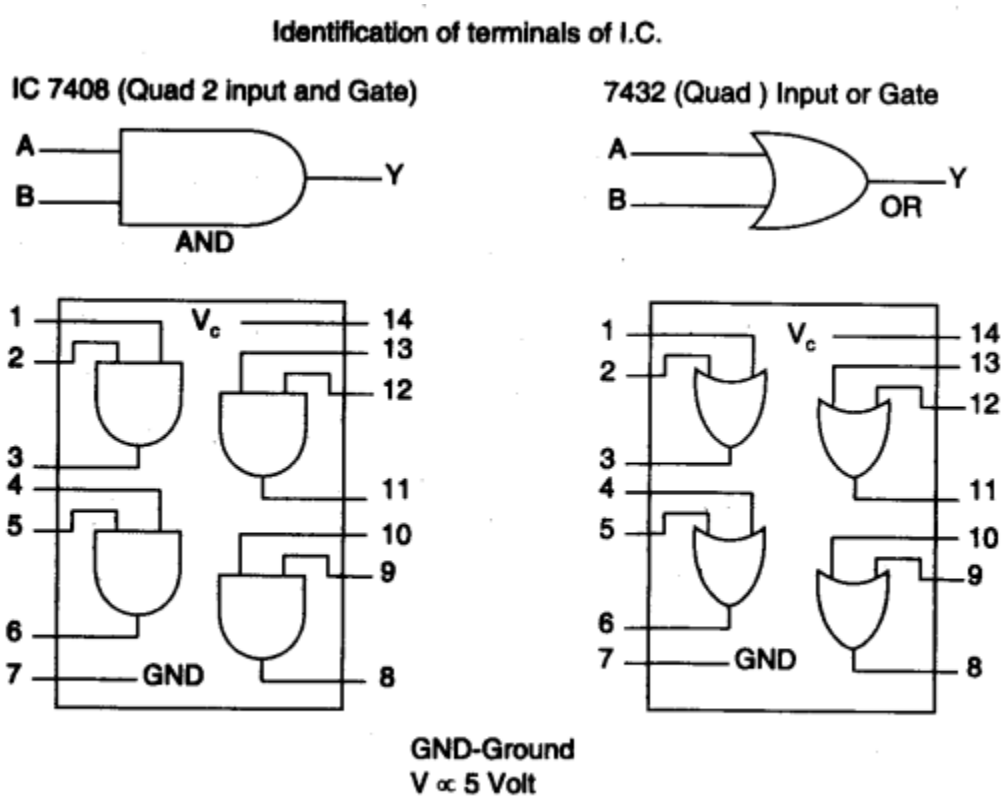


Fig. (*a*) IC 7408, (*b*) IC 7432.

3. See the number marked on IC 7408 or 7432 Fig. (a) and (6) and its specification from the manual. Check the functioning of various gates e.g., four AND gates on 7408 or four OR gates on 7432 (14 terminals on each). On 7408, two terminals for 0 V and 5 V and 4 gates (AND) each gate with input A, B and output Y, i.e.,. 3 terminals or 2 + 4 x 3 = 14 terminals in all.