ELECTRICITY & ELECTRONICS KIT

INSTRUCTION MANUAL
CODE QLN008

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The included components:

- 2 multimeters with their set of cables.
- 1 board for project assembly.
- 2 rectifier bridges.
- 4 L-connectors.
- 2 9V 6F22 batteries.
- 5 2.5V screw-type lamps.
- 2 0N/0FF switches.
- 1 compass.
- 2 transformers
- 1 rheostat.
- 2 red, white, and green LEDs.
- 1 receiver and 1 transmitter.
- 4 holders for halogen lamps.
- 1 capacitor: 1F, 10 F, 500 F and an adjustable capacitor up to 70PF.
- 2 potentiometers of 500 0hms.
- 1 relay.
- 1 DC motor
- 2 100 0hm resistors.
- 2 1K 0hm resistors.
- 1 100K 0hm resistor.
- 1 analog voltmeter: 0-20VDC.
- 1 analog ammeter: 0-20VDC.
- 3 sets of cables
- 2 iron supports, one U-shaped and one l-shaped.

- Electric circuit and electric resistance, divided circuit, electrical power.
- Transistors, semiconductor diode Ohmic.
- Capacitor in DC circuit.
- Capacitor and resistor in AC circuit
- Electric motor

IN ELECTRONICS:

- Coil, capacitor, resistor, transistor, diode
- Logic circuits, and open loop and closed loop, control circuits
- Transistor as amplifier

For the identification of two terminal devices, following characteristics of components can be utilized.

Resistor: When D.C. current is passed through it, it shows a constantcurrent.

Capacitor: When connected in a D.C. circuit, a multimeter set at R initially shows a full scale deflection and suddenly showszero deflection.

Diode: I conduct electricity when forward biased and do not conductwhen reversed biased. When it emits lightthen it is termed as LED (Light Emitting Diode).

Use of Digital Multimeter

Digital multimeter is a very useful tool, which is used to measure many parameters in basic electricity and electronics experiments. It is also used for testing of the connections in experimental kits, electronic devices and in many more uses. It is used for measuring the DC current, AC current, DC voltage, AC voltage, resistances and for the testing of the continuity of circuits etc. To acquaint about the working and familiarization of each control of the multimeter is a must before its use.

Direct Current (DC) Measurement

Digital multimeter is used to measure the direct current. For the measurement of the DC, the multimeter has to be dialed to the DC setting. Two probes are provided along with the multimeter. Put the black probe in the com jack and the red probe in the amps jack. Now insert the red probe in the positive point of the circuit and the black probe in the negative of the circuit and measure the current. Setting of the multimeter on the properscale is necessary for the best measurements.

Alternating Current (AC) Measurement

Digital multimeter is used to measure the alternating current. For the measurement of the AC, the multimeter has to be dialed to the AC setting. Two probes are provided along with the multimeter. Put the black probe in the com jack and the red probe in the amps jack. Now insert the red probe in the positive point of the circuit and the black probe in the negative of the circuit and measure the current. Setting of the multimeter on the proper scale is necessary for the best measurements.

DC Voltage Measurement

Digital multimeter is used to measure the DC voltage. For the measurement of the DC voltage, the multimeter has to be dialed to the DC voltage setting. Two probes are provided along with the multimeter. Put the black probe in the com jackand the red probe in the voltage jack. Now insert the red probe in the positive point of the DC voltage sourceand the black probe in the negative of the DC voltage source and measure the DC voltage. Setting of the multimeter on the proper scale is necessary for the best measurements.

AC Voltage Measurement

Digital multimeter is used to measure the AC voltage. For the measurement of the AC voltage, the multimeter has to be dialed to the AC voltage setting. Two probes are provided along with the multimeter. Put the black probe in the com jackand the red probe in the voltage jack. Now insert the red probe in the positive point of the AC voltage source and the black probe in the negative of the AC voltage source and measure the AC voltage. Setting of the multimeter on the proper scale is necessary for the best measurements. Use of digital multimeter for the measurement of high voltage or current should be avoided.

Resistance Measurement

Digital multimeter is used to measure the resistance. Two probes are provided along with the multimeter. Put the black probe in the com jack and the red probe in the voltage ohm jack. Now hold the red probe on the positive side of the resistance and the black probe on the negative side of the resistance and measure the resistance on the display of the digital multimeter. Setting of the multimeter on the proper scale is necessary for the best measurements. Use of digital multimeter for the measurement of high voltage or current should be avoided.

Continuity Test

Digital multimeter is used for the testing of continuity of the circuits, fuses and wires etc. Two probes are provided along with the multimeter. Put the black probe in the com jack and the red probe in the voltage ohm jack. Now hold the red probe on one end of the wire or fuse and the black probe on the other end of the wire or fuse and a beep sound in the digital multimeter confirm the proper connection.

Current: When charge flows through the wires of an electric circuit, current is said to exist in the wires. Electric current is a quantifiable notion which is defined as the rate at which charge flows past a point on the circuit. It can be determined by measuring the quantity of charge that flows past a cross-sectional area of a wire on the circuit. As a rate quantity, current (I) is expressed by the following equation

$$I = Q/t$$

where Q is the quantity of charge flowing by a point in a time period of t. The standard metric unit for the quantity current is the ampere. A current of 1 ampere is equivalent to 1 Coulomb of charge flowing past a point in 1 second. Since the quantity of charge passing a point on a circuit is related to the number of mobile charge carriers (electrons) which flow past that point, the current can also be related to the number of electrons and the time. To make this connection between the current and the number of electrons, one must know the quantity of charge on a single electron.

$$\text{Charge of an electron} = 1.6 \times 10^{-19}\ C$$

Resistance: As charge flows through a circuit, it encounters resistance or a hindrance to its flow. Like current, resistance is a quantifiable term. The quantity of resistance offered by a section of wire depends upon three variables - the material the wire is made out of, the length of the wire, and the cross-sectional area of the wire. One physical property of a material is its resistivity - a measure of that material's tendency to resist charge flow through it. Resistivity values for various conducting materials are typically listed in textbooks and reference books. Knowing the resistivity value (ρ) of the material the wire is composed of and its length (L) and cross-sectional area (A), its resistance (R) can be determined using the equation below.

$$R = \rho L/A$$

The standard metric unit of resistance is the ohm, which is abbreviated by the Greek letter Ω.

The main difficulty with the use of the above equation pertains to the units of expression of the various quantities. The resistivity (ρ) is typically expressed in ohm•m. Thus, the length should be expressed in units of m and the cross-sectional area in m2. Many wires are round and have a circular cross-section. As such, the cross-sectional area in the above equation can be calculated from knowledge of the wire's radius or diameter using the formula for the area of a circle.

$$A = \pi R^2 = (\pi D^2)/4$$

Voltage-Current-Resistance Relationship: The amount of current that flows in a circuit is dependent upon two variables. Current is inversely proportional to the overall resistance (R) of the circuit and directly proportional to the electric potential difference impressed across the circuit. The electric potential difference (ΔV) impressed across a circuit is simply the voltage supplied by the energy source (batteries, outlets, etc.). For homes in the United States, this value is close to 110-120 Volts. The mathematical relationship between current (I), voltage and resistance is expressed using the relation V = IR, which is referred to as the Ohm's law.

Power: Electrical circuits are all about energy. Energy is put into a circuit by the battery or the commercial electricity supplier. The elements of the circuit (lights, heaters, motors, refrigerators, and even wires) convert this electric potential energy into other forms of energy such as light energy, sound energy, thermal energy and mechanical energy. Power refers to the rate at which energy is supplied or converted by the appliance or circuit. It is the rate at which energy is lost or gained at any given location within the circuit. As such, the generic equation for power is

$$P= \Delta E/t= I^2 R= V^2/R$$

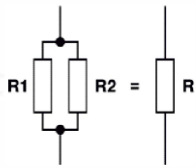
The energy loss (or gain) is simply the product of the electric potential difference between two points and the quantity of charge which moves between those two points in a time period of t. The standard unit of power is the watt. In terms of units, the watt is equivalent to an ampere-volt, or an $ampere^2$-ohm or a $volt^2$/ohm.

Equivalent Resistance: It is quite common that a circuit consist of more than one resistor. While each resistor has its own individual resistance value, the overall resistance of the circuit is different than the resistance of the individual resistors which make up the circuit. A quantity known as the equivalent resistance indicates the total resistance of the circuit. Conceptually, the equivalent resistance is the resistance that a single resistor would have in order to produce the same overall effect on the resistance as the combination of resistors which are present. There are two basicways in which resistors can be connected in an electrical circuit. They can be connected in series or in parallel.

Resistances connected in Parallel:

When resistances are connected in parallel their combined resistance is less than any of the individual resistances. There is a special equation for the combined resistance of two resistances R_1 and R_2:

$$R= (R_1 \times R_2)/(R_1+R_2)$$



For more than two resistances connected in parallel a more difficult equation must be used. This adds up the reciprocal of each resistance to give the reciprocal of the combined resistance, R:

$$1/R= 1/R_1 + 1/R_2 +1/R_3 +\cdots.....$$

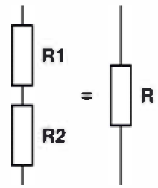
Note that the combined resistance in parallel will always be less than any of the individual resistances.

Resistances connected in Series: In this combination, the resistances are joined end to end, i.e., the second end of each resistance is connected to the first end of the next resistance. A battery is connected between the first end of the first resistance and second end of the last resistance. In this combination, the current flowing through each resistance will be the same and hence the potential difference across them will be different. Let us consider three resistances R1, R2 and R3 connected in series. A battery E is connected in the circuit.

Let V_1, V_2 and V_3 are the potential differences across the resistances R_1, R_2 and R_3, respectively.

The potential difference across R_1 is given by

$$V_1 = iR_1$$



The potential difference across R_2 is given by

$$V_2 = iR_2$$

The potential difference across R_3 is given by

$$V_3 = iR_3$$

Their combined resistance is equal to the individual resistances added together. For example if resistances R1 and R2 are connected in series theircombined resistance, R, is given by:

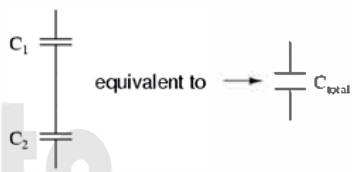
Combined resistance in series: $R = R1 + R2$

This can be extended for more resistors: $R = R1 + R2 + R3 + R4 + ...$

Note that the combined resistance in series will always be greater than any of the individual resistances

Capacitors in series and parallel

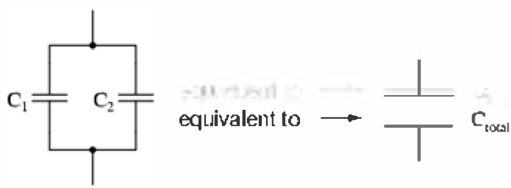
When the capacitors are connected in series, the total capacitance is less than any one of the series capacitors individual capacitances. If two or more capacitors are connected in series, the overall effect is that of a single (equivalent) capacitor having the sum total of the plate spacings of the individual capacitors. As we have just seen, an increase in plate spacing, with all otherfactors unchanged, results in decreased capacitance.



Thus, the total capacitance is less than any one of the individual capacitors capacitances. The formula for calculating the series total capacitance is

$$1/C = 1/C_1 + 1/C_2 + 1/C_3$$

When capacitors are connected in parallel, the total capacitance is the sum of the individual capacitors capacitances. If two or more capacitors are connected in parallel, the overall effect is that of a single equivalent capacitor having the sum total of the plateareas of the individual capacitor. As we've just seen, an increase in plate area, with all other factors unchanged, results in increased capacitance.



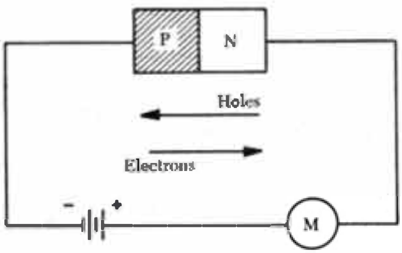
Thus, the total capacitance is more than any one of the individual capacitor's capacitances. The formula for calculating the parallel total capacitance is the same form as for calculating series resistances:

$$C = C_1 + C_2 + C_3$$

V-I characteristics of a forward and reverse bias P-N junction diode: A P-N junction diode is a semiconductor diode. In this diode a layer of P type material is joined to the N type crystal in such a way thatthe atoms in P type material combine across the surface of contact with atoms in the N type crystal and vice-versa. Diode offers nearly zero resistance to the flow of current during forward position bias and nearly infinite resistance when in the reverse bias position. In the forward bias condition, the positive terminal of the battery is connected to the P side of the diode and negative terminal to the N side of the diode. In this case, the electrons move from N side to the P side and the holes shift from P side to the N side and an appreciable current is obtained across the junction. In the reverse bias condition, the positive terminal of the battery is connected to the N side of the diode and negative terminal to the P side of the diode. In this case, the electrons move from N side to the P side and the holes shift from P side to the N side and a very little current is obtained across the junction.

M is multimeter used for measuring current

Figure 1: Circuit for Forward Bias Characteristic



M is multimeter used for measuring current

Figure 2: Circuit for Reverse Bias Characteristic

Procedure:

Forward Bias Characteristics:

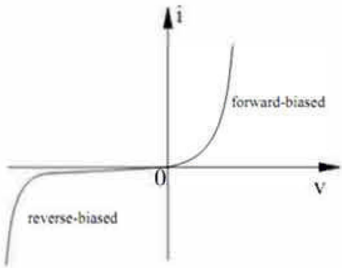
1. Makethe connections as shown in Figure 1.
2. Connectthe power supply to 220 volt 50Hz AC and switch on the supply.
3. Now change the voltage in small steps with the knob provided on the front panel of the apparatus and note down the corresponding currents.
4. Draw a graph between the voltagetaken on X-axis and current on Y-axis.

Reverse Bias Characteristics:

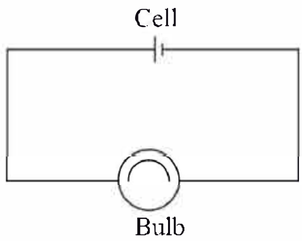
1. Makethe connections as shown in Figure 2.
2. Connect the powersupply to 220 volt 50Hz AC and switch on the supply.
3. Now change the voltage in small steps with the knob provided on the front panel of the apparatus and note down the corresponding currents.
4. Draw a graph between the voltage taken on X-axis and current on Y-axis on the same graph paperthat is used in the forward bias characteristics.

Observations:

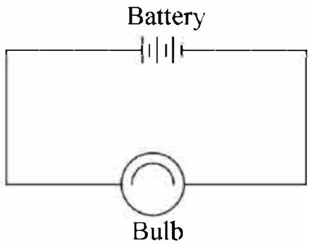
S. No.	Forward Bias		Reverse Bias	
	Voltage (volt)	Current (mA)	Voltage (volt)	Current (μA)
1				
2				
3				
4				
5				
6				
7				
8				



Making light in a Dark Room: This experiment is to make a light in a dark room by using one cell and one bulb. Reversethe cell in the circuit and find does it make any differences.

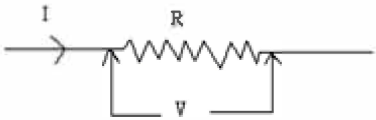


Making intense light: Light becomes intense when two or more cells are added in line to make a battery for making the bulb brighter. Check your result using with one cell, two cells and finally with three cells.



Aim: To perform an experiment for the verification of Ohm's Law

Theory: Ohm's law is valid for both alternating current (AC) and direct current (DC) circuits. When an electric current (I) is passed through a resistance (R), an electric potential difference (V) is created across the resistance as shown in figure below.



According to Ohm's law, the current (I) is directly proportional to the potential difference (V) across the resistance (R).

$$I = V/R$$

Ohm's law may also be stated as the potential difference (V) across a resistance (R) is directly proportional to the current (I) flowing through the resistance

$$V = IR$$

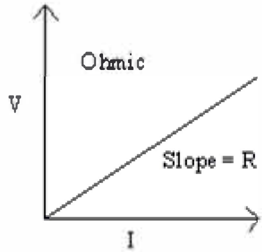
Unit of potential difference is volt (V).

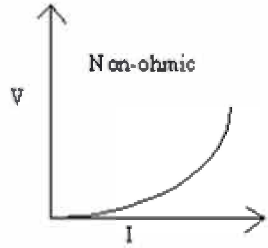
Unit of current is ampere (A).

Unit of resistance is Ohm (Ω).

For ohmic resistances, the graph between voltage (V) and current (I) comes out to be a straight line and they have a constant resistance. The slope of this curve gives the value of resistance (R). For non-ohmic resistances, the graph between the voltage (V) and current (I) is comes out to be non-linear and they have a varying resistance. The resistance can be determined at a particular point using Ohm's law

$$R = V/I \text{ ohms}$$





Aim: To find the current by measuring voltage across a given resistor.

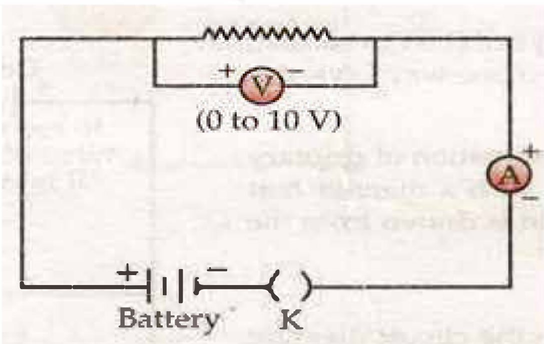
Apparatus: Two multimeters, a resistor, a battery, a key, connecting wires etc.

Theory: In case of D.C. circuit-when the voltage (V) is developed and current (I) starts flowing through the circuit then resistance of coil without the core is given by:

$$R = V/I \ \Omega$$

Procedure:

1. Draw a neat and labeled circuit diagram as shown in figure below.



2. Use multimeters for measuring voltage and current.
3. Now apply Ohm's law to find the value current (I).
4. Compare this value with the observed value.

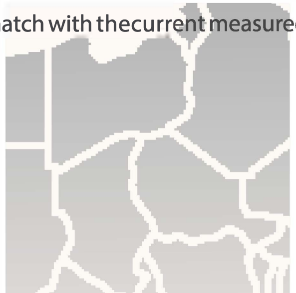
5. Increase the applied potential to 4V and 6V.
6. Repeat step 3 and 4 and take your readings.

Observations:

Value of resistor used R =

Sr. No.	Applied p. d. from battery (Volt)	Voltage drop across resistor (volt)	Current I= V/R (ampere)	Actual current (I_0) (ampere)	Error (I_0 - I) (ampere)
1					
2					
3					

Conclusion: The current determined by Ohm's law I=V/R should match with the current measured by multimeter.



Aim: To assemble the components of a given electrical circuit.

Apparatus: Resistor, two multimeters, battery, key etc.

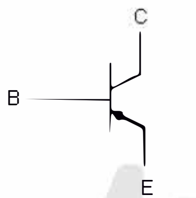
Procedure:

1. Connect the resistor and inductor in series with each other and then in series with the battery as shown in above figure.
2. For measurement of current, connect the multimeter in series.
3. For measurement of potential drop, connect the multimeter in parallel with the circuit.
4. Assembly of electrical component is complete.

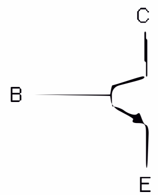
Working of DC Motor: Working principle of DC motor mainly depends upon Fleming's left hand rule. In a basic dc motor, an armature is placed in between magnetic poles. If the armature winding is supplied by an external dc source, current starts flowing through the armature conductors. As the conductors are carrying current inside a magnetic field, they will experience a force which tends to rotate the armature. Suppose armature conductors under N poles of the field magnet, are carrying current downwards and those under S poles are carrying current upwards. By applying Fleming's left hand rule, the direction of force F, experienced by the conductor under N poles and the force experienced by the conductors under S poles can be determined. It is found that at any instant the forces experienced by the conductors are in such a direction that they tend to rotate the armature.

Aim: To draw common base characteristics of a p-n-p transistor and calculate transistor constants.

Apparatus required: Transistor (n-p-n type), audio frequency signal generator, stabilized power supplyof 9 volt, multimeter, capacitors and resistors etc.



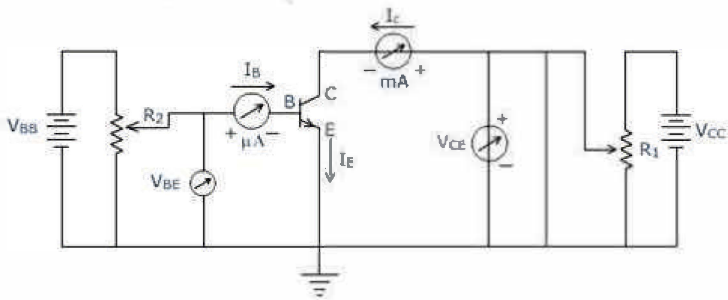
PNP Transistor



NPN Transistor

Procedure:

1. Make the connections as shown in the circuit diagram. In the connections collector bias is negative with respect to the base and the emitter bias is positi ve with respect to the base.



Circuit for obtaining the characteristics of a npn transistor

Input Characteristics:

(1) Adjust the collector to base voltage V_c at some suitable value (say-2V) and keep it constant.

(2) Now change the emitter current I_b and note the emitter base voltage V_b in suitable steps keeping the collector to base voltage constant.

(3) Repeat steps 1 and 2 for other constant values of collector to base voltage.

(4) Now plot graphs keeping the emitter voltage on X-axis and emitter current on Y-axis.

(5) Draw a tangent to this curve and determine its slope. Reciprocal of the slope gives the value of input impedance of transistor.

Output Characteristics

(1) Adjust the emitter current to a suitable value (say 5µA).

(2) Set the collector voltage to zero volt and note the collector current I_c.

(3) Increase the collector voltage in steps and note the corresponding collector current keeping the emitter current constant.

(4) Repeat steps 1 to 3 for other values of the emitter current.

(5) Now plot graphs keeping the collector voltage on X-axis and collector current on Y-axis.

(6) Draw a tangent to this curve and determine its slope. The slope gives the output conductance and the reciprocal of it gives the output impedance. Also determine the reverse voltage transfer ratio from the curves.

Transfer Characteristics

(1) Adjust the collector voltage at suitable value (say -2V) and keep it constant.

(2) Adjust the emitter current to a suitable small but measurable value and note the corresponding collector current. Increase the emitter current in small steps and note the corresponding collector current each time.

(3) Now plot graphs keeping the emitter current on X-axis and collector current on Y-axis. The slope of this curve gives the value of the current gain α or the forward current transfer ratio hfb.

Observations

For the input characteristics

Sr. No.	Base voltage V_b (volt)	Base current I_b (µA) when		
		V_c = 0 volt	V_c = -2 volt	V_c = -4 volt
1				
2				
3				
4				
5				

For output characteristics

S. No.	Collector voltage V_c (volt)	Collector current I_c (mA) when		
		I_b= ….µA	I_b= ….µA	I_b= ….µA
1				
2				
3				
4				
5				

For transfer characteristics

Constantvalue of collectorvoltage V_c = ...volt

Sr. No.	Base current I_b (mA)	Collector current I_c (mA)
1		
2		
3		
4		
5		

Calculations:

2 Plot graphs keeping the emitter voltage Vb on X-axis and emitter current Ib on Y-axis. Draw a tangent and find the slope $(\Delta I_b)/(\Delta V_b)$.

∴ Input impedance of the transistor $h_{ib} = (\Delta I_b)/(\Delta V_b)$ .... ohms.

3 Plot graph between V_c and I_c. In the region where the current is increasing on increasing the voltage, draw a tangent on a graph and determine its slope $(\Delta I_c)/(\Delta V_c)$. It is the output conductance.

∴ Input impedance of the transistor hoe= $(\Delta V_c)/(\Delta I_c)$ .... ohms.

4 Plot a graph between I_b and I_c. Find its slope $(\Delta I_c)/(\Delta I_b)$

∴ Current gain β, i.e., forward currenttransfer ratio $h_{fe} = (\Delta I_c)/(\Delta I_b)$

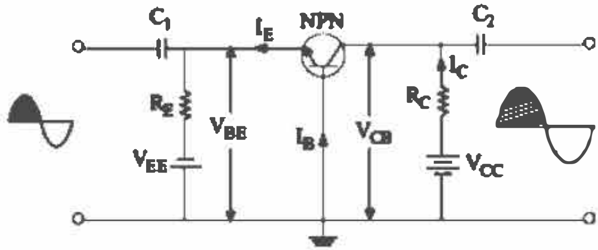
Aim: To study a transistor as voltage amplifier in common emitter configuration.

Apparatus required: Transistor (n-p-n type), audio frequency signal generator, stabilized power supplyof 9 volt, multimeter, capacitors and resistors etc.

Formula used:-

$$\text{Voltage gain of amplifier} = \frac{\text{outputvoltage as obtained in collectorcircuit of amplifier}}{\text{(input signal voltage applied in emitter circuit of amplifier}}$$

Procedure:



1. Complete the electronic circuit arrangement. Check the connection thoroughly before switching on the power supplies.

2. Connect the signal generator across input terminals of the amplifier. Join the signal generator to A.C. mains supply too. Set the signal generator (also known as frequency oscillator) to obtain at a frequency of 1000 Hz at a suitable output.
3. Measure the output of the signal generator (i.e. the input signal applied to the amplifier) by the use of voltmeter joined between the terminal marked X and Y. the ratio of the amplification input signal voltage amplification at 1000 Hz.
4. Keep the output of signal generator at suitable level, measure it and maintain it at that level, starting from 50 Hz gradually increase the frequency of input signal supplied by the signal generator in small steps of 50-100 Hz and every time measure the output voltage of the amplifier by use of voltmeter beyond 2000 Hz increase the signal frequency in step of 500 Hz and beyond 5000 Hz increase the signal frequency in steps of 1000 Hz. In this manner measure the output voltage for frequencies of up to about 20 KHz or even more.
5. Plot a graph by taking log of frequency of input signal along X-axis and output voltage along Y-axis. The graph shows variation of output voltage with frequency. From this graph obtain the operative band width.

Observations:

(A) For voltage gain

Constant frequency of inputsignal = 1000 Hz

Sr. No.	Input signal voltage V_i (in volt)	Amplified output voltage V_o (in volt)	Voltage gain $A_v = V_0/V_1$
1			
2			
3			
4			
5			

(B) For variation of output voltage with signal frequency.

Constant value of input voltage V_i =.........V

Sr. No.	Input signal frequency f (in Hz)	$\log_{10} f$	Output voltage V_o (in volt)
1			
2			
3			
4			
5			

Result: (i) The voltage gain of the common base amplifier (at 1 kHz) is A_v =

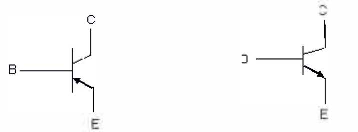
(ii) Lower half frequency v_1 = ...Hz

Higher half frequency, v_2 = ...Hz

Band width, $\Delta v = v_2 - v_1$

Aim: To draw common base characteristics of a p-n-p transistor and calculate transistor constants.

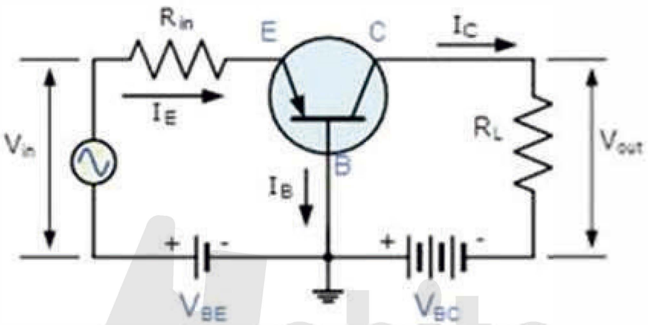
Apparatus required: Transistor (n-p-n type), audio frequency signal generator, stabilized power supply of 9 volt, multimeter, capacitors and resistors etc.



PNP Transistor NPN Transistor

Procedure:

1. Make the connections as shown in the circuit diagram. In the connections collector bias is negative with respect to the base and the emitter bias is positive with respect to the base.



Input Characteristics:

(1) Adjust the collector to base voltage V_C at some suitable value (say-2V) and keep it constant.

(2) Now change the emitter current and note the emitter base voltage in suitable steps keeping the collector to base voltage constant.

(3) Repeat steps 1 and 2 for other constantvalues of collector to base voltage.

(4) Now plot graphs keeping the emitter voltage on X-axis and emitter current on Y-axis.

(5) Draw a tangent to this curve and determine its slope. Reciprocal of the slope gives the value of input impedance of transistor.

Output Characteristics

(1) Adjustthe emitter current to a suitablevalue (say 5mA).

(2) Set the collector voltage to zero volt and note the collector current Ic.

(3) Increase the collector voltage in steps and note the corresponding collector current keeping the emitter current constant.

(4) Repeatsteps 1 to 3 for othervalues of the emittercurrent.

(5) Now plot graphs keeping the collector voltage on X-axis and collector current on Y-axis.

(6) Draw a tangent to this curve and determine its slope. The slope gives the output conductance and the reciprocal of it gives the output impedance. Also determine the reverse voltage transfer ratio from the curves.

Transfer Characteristics

(1) Adjust the collector voltage at suitable value (say -2V) and keep it constant.

(2) Adjust the emitter current to a suitable small but measurable value and note the corresponding collector current. Increase the emitter current in small steps and note the corresponding collector current each time.

(3) Now plot graphs keeping the emitter current on X-axis and collector current on Y-axis. The slope of this curve gives the value of the current gain α or the forward current transfer ratio h_{fb}.

Observations

For the input characteristics

Sr. No.	Emitter voltage V_e (volt)	Emitter current I_e (mA) when		
		V_c = 0 volt	V_c = -2 volt	V_c = -4 volt
1				
2				
3				
4				
5				

For output characteristics

S. No.	Collector base voltage V_C (volt)	Collector current I_c (mA) when		
		I_e= ….mA	I_e= ….mA	I_e= ….mA
1				
2				
3				
4				
5				

For transfer characteristics

Constant value of collector voltage V_c = ………volt

Sr. No.	Emitter current I_e (mA)	Collector current I_c (mA)
1		
2		
3		
4		
5		

1. Plot graphs keeping the emitter voltage V_e on X-axis and emitter current I_e on Y-axis. Draw a tangent and find the slope $(\Delta I_e)/(\Delta V_e)$.

   ∴ Input impedance of the transistor hib= $(\Delta V_e)/(\Delta I_e)$

2. Plot graph between Vc and Ic. In the region where the current is increasing on increasing the voltage, draw a tangent on a graph and determine its slope $(\Delta I_c)/(\Delta V_c)$. It is the output conductance.

   ∴ Input impedance of the transistor h_{ib}= $(\Delta V_c)/(\Delta I_c)$

3. Plot a graph between Ie and Ic. Find its slope $(\Delta I_c)/(\Delta I_e)$

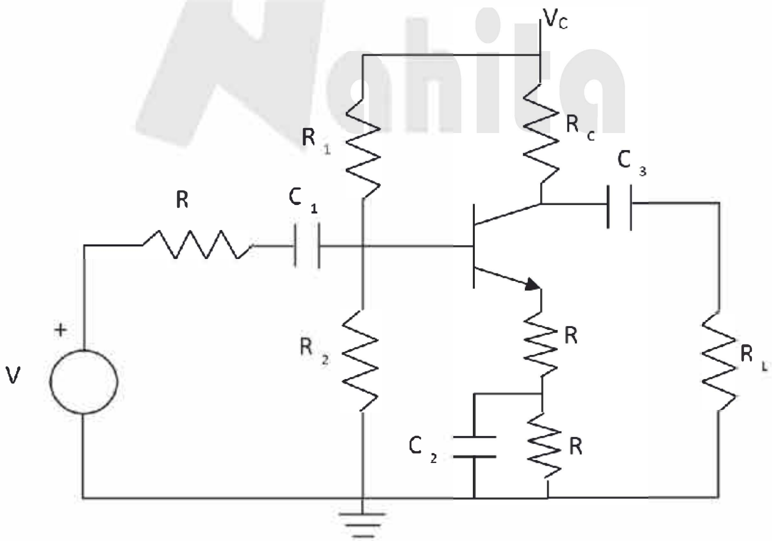
   ∴ Current gain α, i.e., forward current transfer ratio hfb = $(\Delta I_c)/(\Delta I_e)$

Aim: To study a transistor as voltage amplifier in common emitter configuration.

Apparatus required: Transistor (n-p-n type), audio frequency signal generator, stabilized power supply of 9 volt, multimeter, capacitors and resistors etc.

Formula used:-

$$\text{Voltage gain of amplifier} = \frac{\text{output voltage as obtained in collector circuit of amplifier}}{\text{input signal voltage applied in emittercircuit of amplifier}}$$



Procedure:

1. Complete the electronic circuit arrangement. Check the connection thoroughly before switching on the power supplies.

2. Connect the signal generator across input terminals of the amplifier. Join the signal generator to A.C. mains supply too. Set the signal generator (also known as frequency oscillator) to obtain at a frequency of 1000 Hz at a suitable output.
3. Measure the output of the signal generator (i.e. the input signal applied to the amplifier) by the use of voltmeter joined between the terminal marked X and Y. the ratio of the amplification input signal voltage amplification at 1000 Hz.
4. Keep the output of signal generator at suitable level, measure it and maintain it at that level, starting from 50 Hz gradually increase the frequency of input signal supplied by the signal generator in small steps of 50-100 Hz and every time measure the output voltage of the amplifier by use of voltmeter beyond 2000 Hz increase the signal frequency in step of 500 Hz and beyond 5000 Hz increase the signal frequency in steps of 1000 Hz. In this manner measure the output voltage for frequencies of up to about 20 KHz or even more.
5. Plot a graph by taking log of frequency of input signal along X-axis and output voltage along Y-axis. The graph shows variation of output voltage with frequency. From this graph obtain the operative band width.

Observations:

For voltage gain

Constant frequency of input signal – 1000 Hz

Sr. No.	Input signal voltage V_i (in volt)	Amplified output voltage V_o (in volt)	Voltage gain A_v V_0/V_1
1			
2			
3			
4			
5			

For variation of output voltage with signal frequency

Constant value of input voltage V_i =.........V

Sr. No.	Input signal frequency f(in Hz)	$\log_{10}f$	Output voltage V_0 (in volt)
1			
2			
3			
4			
5			

Result: (i) The voltage gain of the common base amplifier (at 1 kHz) is A_V =

(ii) Lower half frequency v_1 = ...Hz

Higher half frequency, v_2 = ...Hz

Band width, $\Delta v = v_2 - v_1$