# Contents

## Experiment (1)

## Characteristic curves of Transistor using Point-by-Point Method

**Aim of the Exp.:**

To construct measurement circuit use power supply and Avometer for drawing the important characteristics of transistor.

**Apparatus and Components**

1. Transistor type BC177
2. Constant resistant, 220 Ω, 10 KΩ
3. Two Potentiometers, 1 KΩ
4. Micrometer, CRO

**Note:**

1. The transistor BC177 is of the type PNP and has the following values:

$I_c$(max)= 100 mA  $I_B$(max)= 50 mA  $V_{CBO}$= 45 V

$V_{EBO}$= 5 V  P=300 mW

2. The most widely circuits for the transistor are the Common emitter circuit (CE), so, the characteristic curves of transistor BC177 studied by connect the emitter with the Earth (i.e. reference).

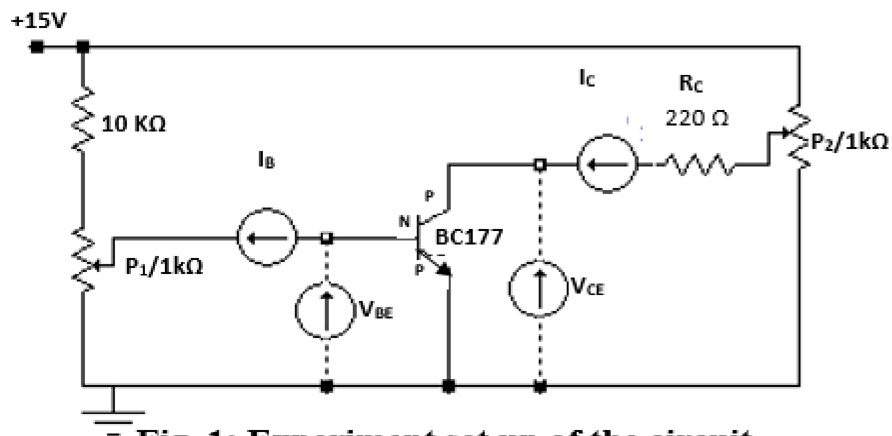



**Fig. 1: Experiment set up of the circuit.**

**Part 1: Input properties**

1. Connect Avometer $V_{BE}$(voltmeter or CRO).
2. For the same values of $I_c$ in Table(1), read $I_B$, $V_{BE}$. Recognize that $I_B$ varies slowly. Why? Write the results according to the Table(2).

**Table (2): Input properties.**

| $I_C$/mA | 0.1 | 0.5 | 1 | 2 | 3 | 4 | 5 | 7 | 10 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|
| $I_B$/µA | | | | | | | | | | |
| $V_{BE}$/Volt | | | | | | | | | | |

3. Plot a graph for input properties according to $I_B=f(V_{BE})$.

**Note**: Recognize that the P2 is in the midpoint of scale, so $V_{CE}$ is constant and the line drawn in the input properties graph is one of the infinite lines for the input property whereas they are very close to each other however, very sensitive instrument is required to distinguish among them whenever $V_{CE}$ varied.

**Part 2: Output properties**

Set values of $I_B$ by $P_1$, and values of $V_{CE}$ by $P_2$ then read values of $I_c$ according to Table(3).

**Table(3): Output properties.**

| $I_B/\mu A$ | 10 | 20 | 50 | 75 | 100 |
|---|---|---|---|---|---|
| $V_{CE}$/Volt | $I_C$/mA | | | | |
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |

**Calculations(using graphs)**

1. Compute input resistance from input properties ($R_{in}=\Delta V_{BE}/\Delta I_B$).
2. Compute forward conversion ratio from control properties($\beta=\Delta I_c/\Delta I_B$).
3. Compute output resistance from output properties($R_{out}=(\Delta V_{CE}/\Delta I_c)_{IB=cost.}$).
4. 4-Compute gain in voltage(static) from output properties($A_v=\Delta V_{CE}/\Delta V_{BE}$).

**Discussion:**

Discuss all the three graphs.

## Experiment (2)

## Common emitter amplifier

**General**

The common emitter circuit is the most widely used for voltage and this circuit gives current amplification, so, the highest power amplification.

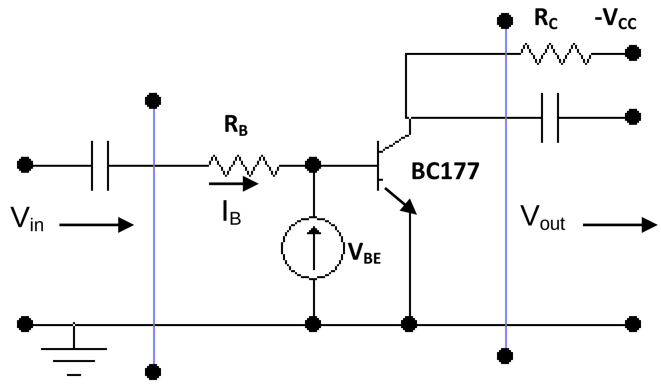



**Fig.(1): shows the principle of the common emitter circuit.**

The voltage amplification is: $A_v=\Delta V_{CE}/\Delta V_{BE}$ …(1)

The current amplification is: $A_i=\Delta I_C/\Delta I_B$ …(2)

The input resistance is: $R_{in}=\Delta V_{BE}/\Delta I_B$ …(3)

The output resistance is: $R_{out}=\Delta V_{CE}/\Delta I_C$ …(4)

The power amplification is: $P_A=A_v.\ A_i$ …(5)

**Note:** The difference of the variables are taken because the elements have Nonlinear properties (see Equations. 1-4).

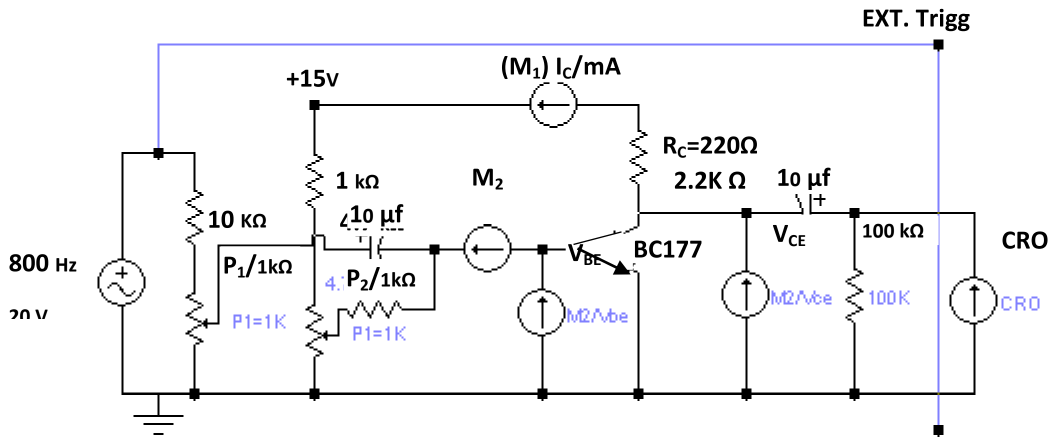
**Aim of the Exp.:**

1. To construct a common emitter circuit and calculate: amplifications of current and voltage, input and output resistance, and amplification of power.
2. Inserting sine wave shapes with frequency 800 Hz and calculating dynamic amplification of voltage.
3. To study the relation between input resistance and amplification of voltage.
4. To study the noise.

**Apparatus and components:**(See Fig.(2))

## Part 1: Static properties

1. Construct the circuit as in Fig.(2) and remove Oscillator and voltmeter $V_{BE}$ and $V_{CE}$.




**Fig(2): Circuit diagram of the common emitter circuit and the measuring circuit.**

**Note:** You need only two Multimeters, M1 and M2. M1 set to milliamper for measuring $I_C$ while M2 for measuring current and voltage. When remove M2 where used to measure $I_B$, its place must be short-circuited.

2. Set $I_B$ as in following table and measure $I_C$, $V_{BE}$, and $V_{EC}$.
3. Calculate $A_i$, $A_v$, $R_{in}$, $R_{out}$, and $P_A$.

| $I_B/\mu A$ | $I_C/mA$ | $V_{BE}/V$ | $V_{CE}/V$ |
|---|---|---|---|
| 25 | | | |
| 50 | | | |

## Part 2: Dynamic properties

1. Remove M2, which used to measure $V_{CE}$ and $V_{BE}$. Connect the oscillator and input sine wave shape with amplitude 50 mV and frequency 800 Hz. Its amplitude controlled by P1.
2. Connect CRO instead of voltmeter $V_{BE}$, plot input wave, and calculate their amplitude $V_{1p-p}$.
3. Connect CRO in the output of the circuit and using P2 to varying base current $I_B$ to obtain the maximum output amplitude without noise.
4. Plot the output wave and write value of $I_B$, their amplitude $V_{2p-p}$.
5. Use the following equation to calculate dynamic voltage amplification:

$$\grave{A}_v = V_{2p-p}/V_{1p-p} \qquad \ldots(6)$$

## Part 3: Effect of collector resistance $R_c$

1. Set $R_c$=2.2 KΩ.
2. Try to obtain maximum output voltage without noise by varying P2, than write $I_B$, $V_{2p-p}$ and plot the curve.
3. Use Equ.(6) to calculate $\grave{A}_v$.

## Part 4: Studying of Noise

1. Set $R_c$=2.2 KΩ.
2. Answer the following question: you get noise for the wave shape for values $I_B \leq \ldots \mu A$ and for $I_B \geq \ldots \mu A$ [use P2 to vary $I_B$]. Why?

**Discussion:**

1. What is the time relation(phase difference) between $V_1$ and $V_2$?
2. Why amplification of voltage increased by increasing $R_c$?
3. Can use transistor in this circuit to obtain amplifications in D.C. voltage and current? Why?
4. Is there difference between $A_v$ and $A`_v$?
5. What are the reasons of noise in this amplifier?

## Experiment (3)

## Common base amplifier

**General:**

In the common base circuit (Fig.(1)) the base of the transistor is the common reference potential for the emitter electrodes as the input and the collector electrode as the output. Compared with other basic circuits, control of the common base circuit requires the largest control current, since the sum of the collector current and the base current takes effect in the emitter. The current amplification is therefore less than one. The input resistance is lowest with this circuit arrangement.

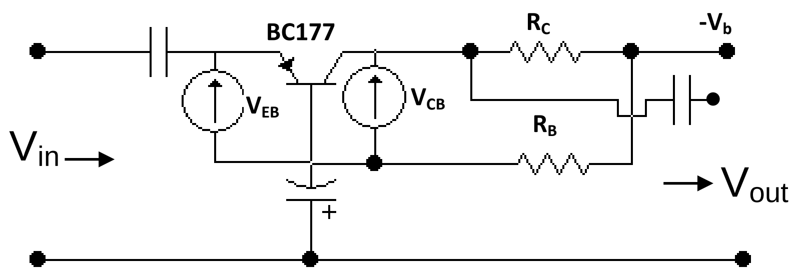



**Fig.(1): shows the principle of the common base circuit.**

The following Equations are necessary:

The voltage amplification is: $A_v=\Delta V_{CB}/\Delta V_{EB}$ …(1)

The current amplification is: $A_i=\Delta I_C/\Delta I_E$ …(2)

The input resistance is: $R_{in}=0.025\ v/I_E$ …(3)

The power amplification is: $A_P=A_v.\ A_i$ …(4)

**Note:** Equ.(3)is empirical equation and it more accurate than ($R_{in}=\Delta V_{EB}/\Delta I_E$)
Because ($V_{EB}$) is very small.

**Aim of the Exp.:**

1. Construct a common base circuit for measuring the characteristic values of transistor BC177.
2. Insert sine wave shape with frequency 800 Hz and finding amplification of voltage and study the noise.
3. Study the frequency response curve for amplifier.

**Apparatus and Components:**(see Fig.(2)

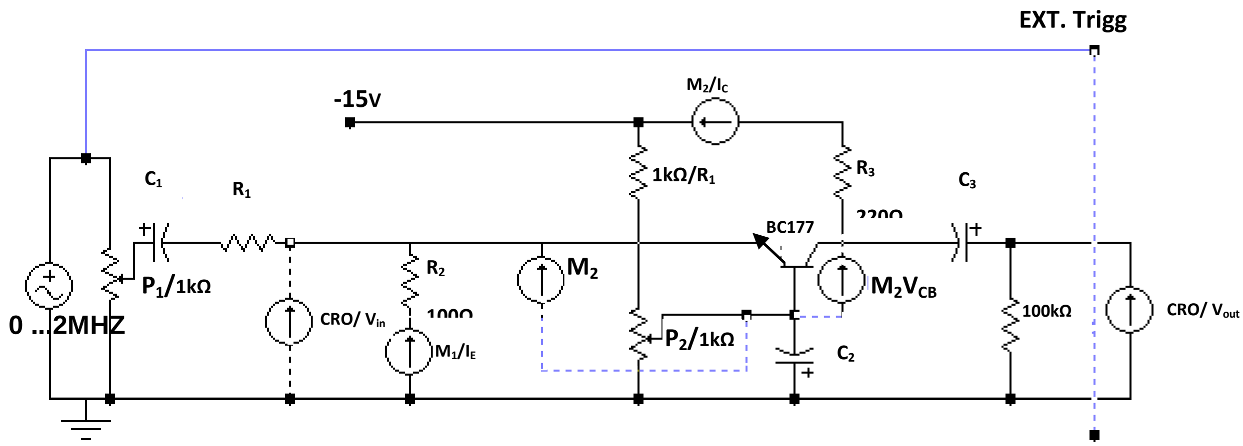
**Part 1: Static properties**

1. Construct the circuit as in Fig.(2) and remove the dotted parts.
2. Set $I_E$=20 mA by P2 and read $I_c$ by ammeter M2.

3. Connect short circuit instead of M2 and use it to measure $V_{EB}$ and $V_{CB}$. Then, return M2 for measuring $I_c$.
4. Set IE= 30 mA. Repeat the work…read $I_c$ then $V_{EB}$ and $V_{CB}$. Arrange the results in a table.

**<u>Note</u>** that $V_{EB}$ and $V_{CB}$ measured relative to the base not to the earth.

5. Calculate $A_v$, $A_v$, $A_p$ and $R_{in}$. Arrange the results in a table.




**Fig(2): Circuit diagram of the common emitter circuit and the measuring circuit.**

## <u>Part 2: Dynamic properties and study the Noise</u>

1. Prepare CRO for measuring and return M2 to measure $I_c$.
2. Set $I_E$=25 mA by P2 (i.e. between 20-30 mA).
3. Set the voltage of input signal 50 mV by P1, and then draw the output wave.

$V_{in}$=50 mV $\quad$ $V_{out}$ = ( $\quad$ ) $V_{p\text{-}p}$ $\quad$ $A_v^- = \frac{V_{out}\ p-p}{V_{in}\ p-p}$ …(5)

**<u>Noise(Clipping Distortion)</u>**

**Introduction:** This type of noise occur when the transistor go out from their operating range as a result of several reasons like nearly large amplitude wave input, low or large emitter current which lead to going the transistor to cut-off region or saturation region.

1. Decrease $I_E$ by P2 in steps to obtain the noise of the wave, write $I_E$, the increase $I_E$ by P2 to obtain noise again and write $I_E$, so:

Whenever $I_E <$ …… mA there be noise in the output wave.

Whenever $I_E >$ …… mA there be noise in the output wave.

## <u>Part 3: Frequency Response</u>

**Introduction:** There are special response curves for each transistor which depend on the several parameters like configuration of the circuit and the type of the transistor (NPN or PNP). As known, the carriers of Bipolar Junction Transistors (BJT) are electrons and holes. If type of the transistor is NPN, the signal propagates from emitter to base dependent on the mobility of electrons. There are some limits for the permission frequencies depend on the thickness of the base and mobility of the electrons (which depend on the type of the semiconductor). In general, the mobility of the electrons larger than holes because the holes are more weighted from the electrons. Therefore, the response of the hole is slower than electron for signals. In the amplifier circuit, the response also depend on the magnitude of the capacitors and resistors connected with the terminals of the transistor where they work as in the High pass or Low pass RC circuits. Therefore, the frequencies for the amplifier must not be very low or very high, which lower the gain (in current, voltage, and power). In this experiment, these limits must identify.

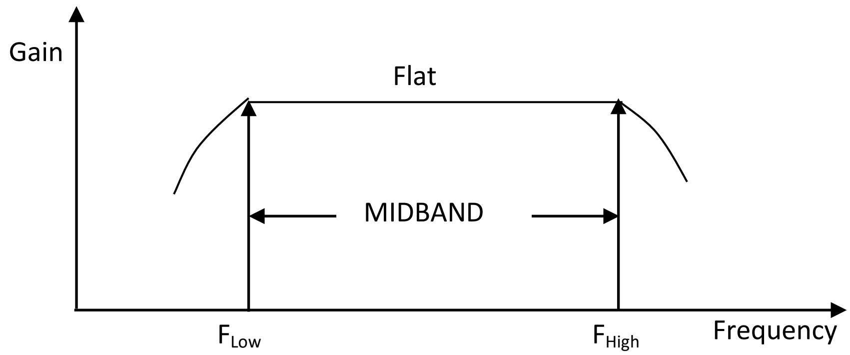



Fig.(3): Typical Amplifier Gain vs Frequency plot.

1. Prepare the amplifier to obtain output pulse without noise for an input sine wave has amplitude 50 mV.
2. Set the following frequencies and calculate $\mathbf{A}_v^{/}$ from Eq.(5) and find $F_{Low}$ and $F_{High}$ :

(0.1, 0.2, 0.3, 0.7, 1, 3, 5, 10, 15, 20, 30, 50, 100, 200, 300, 400, 600, 800) KHz, (1.2, 1.4, 1.6, 1.8, 2) MHZ.

**Discussion:**

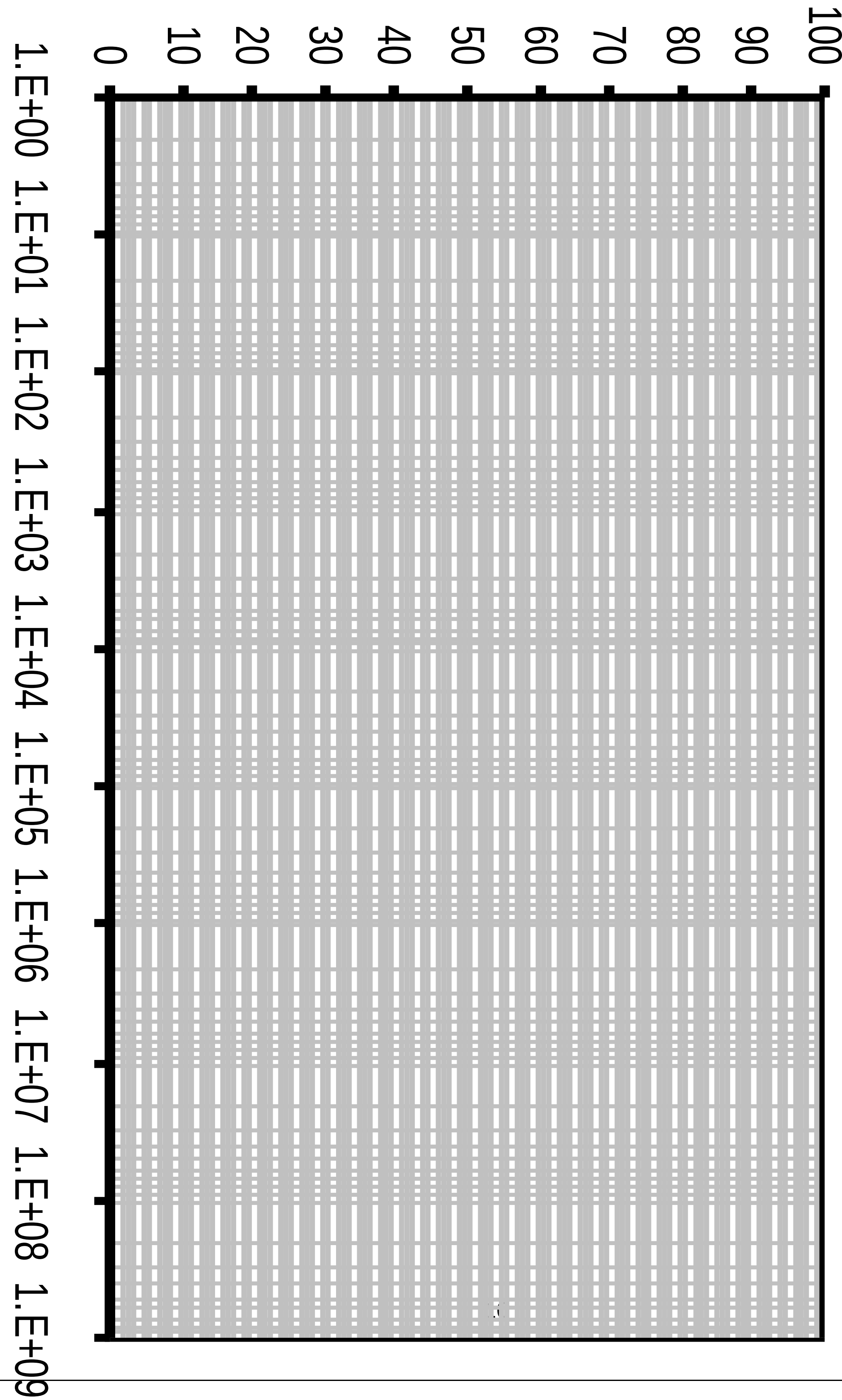
1. Insert these and previous results into the following table and the compare between them and discuss it.

| Quantity | Common Emitter Circuit | Common Base circuit |
|---|---|---|
| $A_i$ | | |
| $A_v$ | | |
| $A_p$ | | |
| $A_v^{-}$ | | |
| Φ | | |
| $R_{in}$ | | |

2. Input resistance in the Common Base circuit is low. Why?
3. What is the benefit of $C_3$ in the Fig.(2)?
4. What represent $R_4$ in the Fig.(2)?

5. Discuss the frequency response curve and are you prefer NPN or PNP transistor for amplifying signals with large frequency?

**Note:** Use Semilog paper graph for drawing the frequency response curve.



# Experiment (4)

## Common Collector Amplifier

### General

The name emitter follower, impedance transformer or, better, impedance converter, also knows the common collector circuit. The name impedance converter is attributable to the fact that this circuit has a high input resistance and a low output resistance. This property is due to a high current amplification, whereas the value of the voltage amplifications approximately 1.

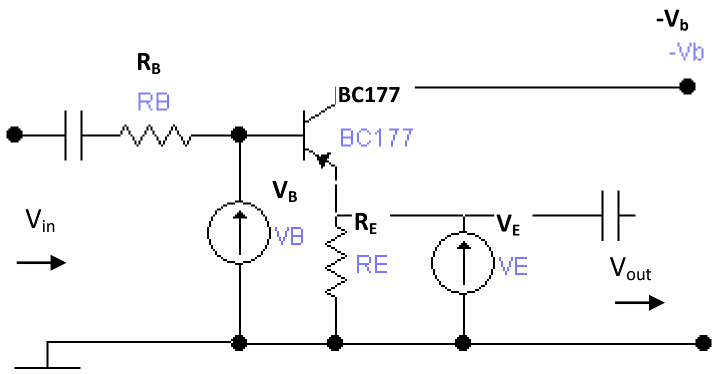



**Fig.(1): shows the principle of the common collector circuit.**

The input resistance $R_{in}$ gives by: $R_{in}=R_B+R_{BE}+R_E\times A_i$ ... (1)

The output resistance gives by: $$\mathbf{R_{out}=\frac{(R_{in}/A_i).R_E}{(R_{in}/A_i)+R_E}}$$ …(2)

The voltage amplification: $\mathbf{A'_v = V_{out}/V_{in}}$ … (3)

The static current amplification: $\mathbf{A_i=\Delta I_E/\Delta I_B}$ … (4)

The resistance between base and emitter: $\mathbf{R_{BE}=\Delta V_{BE}/\Delta I_B}$ … (5)

The base voltage: $V_B=V_E+V_{BE}$ … (6)

### Aim of the Exp.;

To construct a common collector circuit from a given circuit diagram. To measure the values required for the characteristics.

### Apparatus and components

1. resistors: 4.7 KΩ, 220 Ω
2. potentiometer, 1 KΩ, two pieces
3. transistor, BC177
4. capacitor, 10 μF, two pieces, 0.1 μF
5. CRO
6. DC power supply, AC power supply

## Part 1: Static Properties (without AC power supply)

1. Connect the circuit as in Fig.(2) without connecting signal source

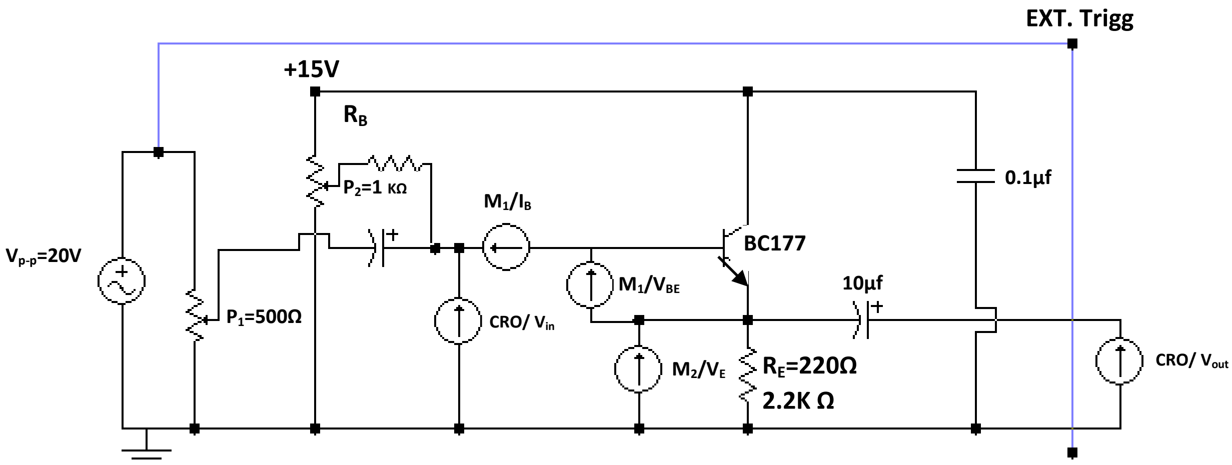



**Fig.(2): Circuit diagram of the common collector circuit and measurement arrangements.**

2. By P2 set $I_B$ about 30 $\mu$A and measure $V_E$ then calculate $I_E$ from the relation $I_E=V_E/R_E$.
3. Measure $V_{BE}$ and calculate $V_B$ from Eq.(6).
4. Set $I_B$=50 $\mu$A and repeat steps 2, 3, and rearrange the results as in the following table.
5. Using Eqs.(1,2,4,5) for calculating $R_{in}$, $R_{out}$, and $A_i$.

| $I_B$ | $I_E$ | $V_E$ | $V_{BE}$ | $R_{in}$ | $R_{out}$ |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

## Part 2: Dynamic Properties(with signal source)

1. Remove the measurements instrument.
2. Set $V_{in}$= 4 $V_{p-p}$.
3. Connect CRO on the output terminals then varying P2 to obtain the maximum output amplitude without noise then write $V_{out}$= … $V_{p-p}$.
4. Use Eq.(3) for calculating $\mathbf{A}_v^{'}$.
5. Set $R_E$=2.2 KΩ and repeat steps 3, 4, and calculate $\mathbf{A}_v^{'}$. Rearrange the results in another table.

## Discuss

1. Compare the input resistance of the Common collector circuit with the common emitter and common base circuits?
2. Compare the output resistance of the Common collector circuit with the common emitter and common base circuits?
3. To which values of V converges when $R_E$ increases?

4. What is the time relation of the $V_{in}$ and $V_{out}$?
5. Are the $V_B$ increases or decreases by increasing $I_E$?

## Experiment (5)

## Two-stage amplification using RC connection

### General

There are several way for connecting amplifier stages with each other like direct connection, RC connection, transformer connection which every connection have its prefer. The application of RC connection helps to reducing the cost and the volume of the amplifier with some dissipation of the amplifier gain. This way of connection useful especially in audio amplifiers which have low-level gain and low noise. The responds of the audio amplifiers using RC connection for the frequencies are more than amplifiers using transformer connection. Figure one shows circuit diagram for two-stage amplifier using RC connection that contains two PNP transistors connecting in common emitter. The value of $C_2$ must be nearly large, 2-10 μF, for low input resistances and low load resistance.

### Aim of the Exp.

To construct two stage amplifier circuit and calculating the amplification of the output voltage.

### Performance of the experiment

1. Construct the circuit diagram as in Fig. 1 and set input voltage as $V_1$=20 $mV_{p-p}$ by P1.
2. Vary P2 to get a wave without noise for the first amplifier stage $V_{2p-p}$ then vary P3 to obtain another wave without noise $V_{3p-p}$. Calculate the gains for the two stages amplifiers in respect to $V_{1p-p}$.

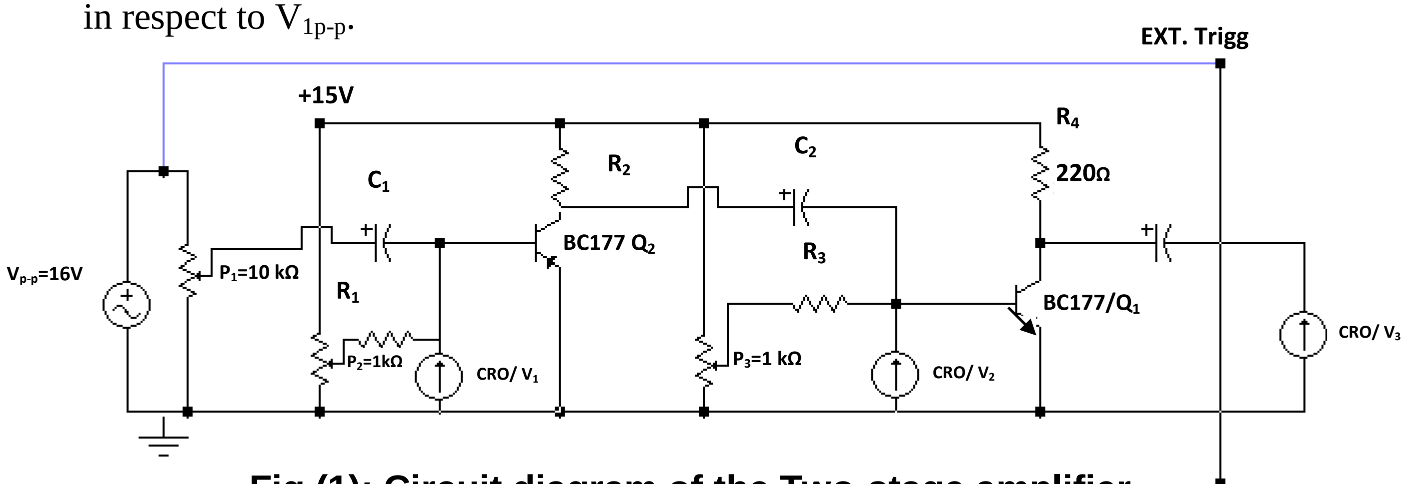



**Fig.(1): Circuit diagram of the Two-stage amplifier.**

### Discuss:

1. Why when the stage of amplifier increased to two stages, the gain not doubled?
2. Why the amplitude of the input wave $V_{1p-p}$ must be small?

## Experiment (6)

## Differential Amplifier

## General

The Differential Amplifier stage in Fig.(1) consists of two common emitter amplifier stages which have a common emitter resistor which acts as current feedback.

If the electrical characteristics of the transistors are identical, the differential voltage amplification given by the ratio of the output voltage V2 to the difference of the two input voltage V11 and V12.

Identical signals, i.e. when the difference between the two input voltages equals zero, virtually cancelled out. The degree of in-phase suppression stated by means of a factor F denoting the ratio of amplification of a differential signal to the unsuppressed amplification when the difference is zero.

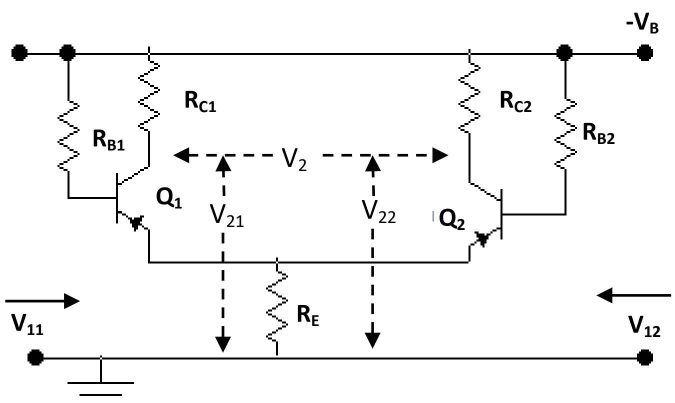



**Fig. (1): The basic circuit diagram of a differential amplifier stage.**

Accordingly the amplification of the differential stage is:

$$A_v = \frac{V_2}{V_{11} - V_{12}} \qquad \ldots(1)$$

The in-phase amplification $A_{IP}$ given by:

$$A_{IP} = \frac{V_2}{V_1} \qquad (V1=V11-V12);\ (V2=V21-V22) \qquad \ldots(2)$$

Moreover, the in-phase suppression by:

$$F = \left(\frac{A_{IP}}{A_v}\right) X100\% \qquad \ldots(3)$$

**<u>Aim of the Exp.:</u>**

To construct a differential amplifier input stage to a given circuit diagram. To measure important characteristics values. The calculated amplification and in-phase suppression.

**Performance of the Exp.:**

**Part I: In-phase case**

1. Construct the circuit as in Fig.(2). Prepare channels ch1 and ch2 and note the polarity of the source.
2. Prepare Q1 and Q2 by P1 and P2 to obtain the following values of collector voltage: $V_{c1}$=5 V $V_{c2}$=5 V $V_{RE}\cong 2$ V.

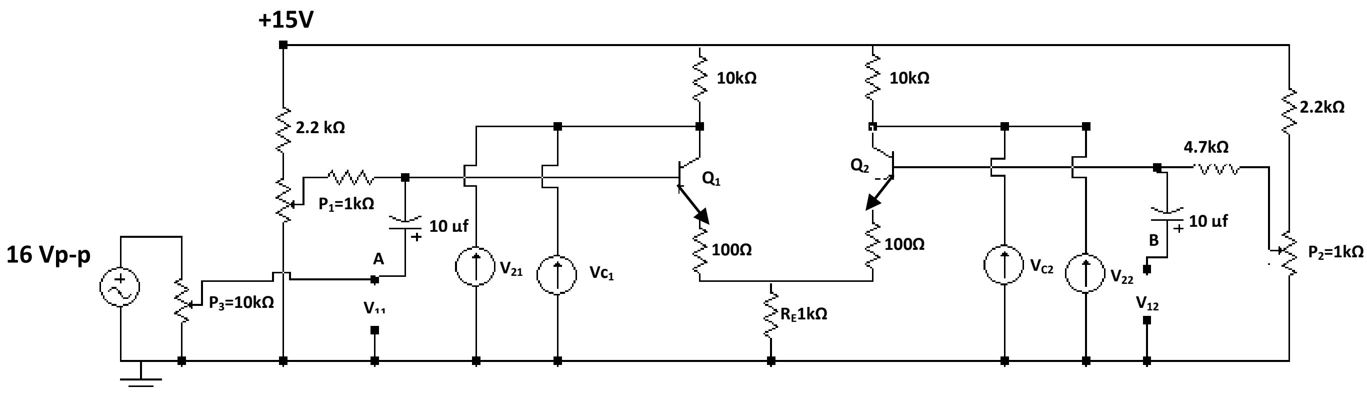



**Fig.(2): Circuit diagram of the differential amplifier and measuring arrangements.**

3. Now connect the CRO between point A and the ground and set input voltage: $V_{11p\text{-}p}$=40 mV then return to their original place.
4. Connect points A with B (i.e. connect input of Q1 with the input of Q2 then repeat the measurements of step 2).
5. If there is no difference between Vc1 and Vc2, see CRO. Is there are phase difference between the output voltages? Now write the values:

$V_{21p\text{-}p}$=….V, $V_{22p\text{-}p}$=….V, $\Phi_{11}$=….(phase difference between output voltages)

Calculate $V_{2p\text{-}p}=V_{21p\text{-}p}-V_{22p\text{-}p}$=……V, A(in phase)=$V_{2p\text{-}p}/V_{1p\text{-}p}$

**Part II: Difference phase case**

6. Remove the connection of point A with B.
7. Connect point B with the ground and recognize the existence of the phase difference between output voltages. Write the following values:
   $V_{21p\text{-}p}$=….V, $V_{22p\text{-}p}$=….V, $\Phi_{12}$=…. $V_{2p\text{-}p}$(Diff.)=$V_{21p\text{-}p}-V_{22p\text{-}p}$=……V,
   $A_v$(diff. phase)=$V_{2p\text{-}p}$(Diff.)/$V_{1p\text{-}p}$
8. Calculate the percentage ratio for coefficient F.

**Important Note:** In step 7, reversed the sign of the output when there happen some phase difference. So, recognize this when you write V21p-p and V22p-p and in the calculation of difference between them.

**Discuss:**

1. What is the benefit of the difference amplifier? Where it used?
2. What is the purpose of connecting $R_E$ in the emitter circuit of the Q1 and Q2? Is this connection necessary?
3. How you can to reduce the coefficient of F?
4. What is the purpose of step 6?

## Experiment (7)

## RC phase-shift oscillator

**General**

The RC oscillator Fig.(1) consists of an amplifier stage with feedback circuit. The feedback circuit consists of a multi-element circuit with RC elements lying between the output and input of the amplifier.

In order to fulfill the positive feedback condition (output and input voltage
The transistor oscillation phase) the RC networks must cancel out the 180$^o$ phase shift that occurs.

If there are three phase networks, the minimum number, the individual RC networks have to shift the phase by 60$^o$. Four RC networks require a phase shift of 45$^o$ per element. This phase shift achieved when the reactance of the capacitor is exactly equal to the value of the resistor, which corresponds at the same time to the cut-off frequency of the RC network.

The power gain must exceed one to conserve the oscillation process. Whenever, it lowers than one, the oscillation decrease exponentially with time to stop. The oscillator circuits need power gain more than one because the output power divides between the load and feedback circuit.

The frequency of the circuit determined by RC circuit, LC circuit, and crystal. They put in the base or collector circuit.

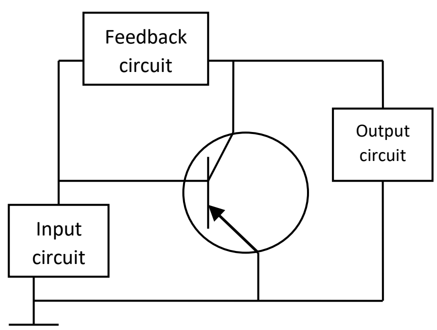



**Fig. (1): A simple circuit diagram shows that the output power divided between the load and feedback circuit.**

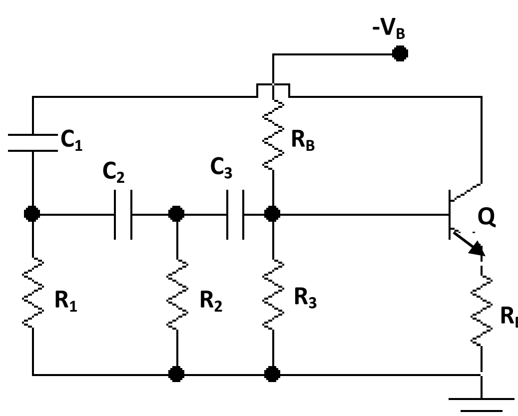


**Fig.(2): RC phase-shift oscillator.**

**Aim of the Exp.:**

To construct an RC phase-shift oscillator to given data and to measure the oscillation that is generated with the CRO.

**Performance of the Exp.:**

1. Prepare CRO and construct the circuit as in Fig.(3).

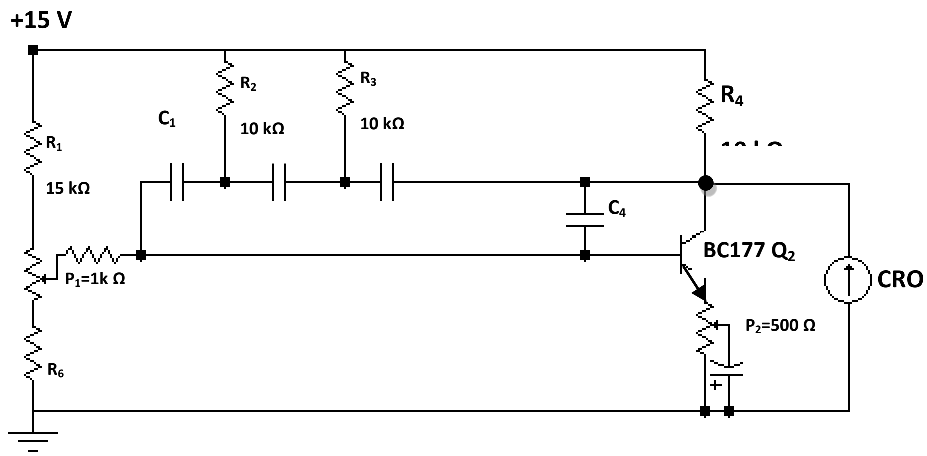



Fig.(3): Arrangement for testing the phase-shift oscillator.

Set P2 in the middle (i.e. 5) and vary P1 to get 12 $V_{p\text{-}p}$. Then adjust P2 to obtain a sine wave without noise.

2. Calculate the frequency.
3. Repeat the processes for the following cases:

| $C_1$ | $C_5$ | T | F=1/T |
|---|---|---|---|
| 0.1µf | 10µf | | |
| 0.1µf | 2µf | | |
| 10nf | 10µf | | |
| 10nf | 2µf | | |

4. Vary the values of $R_2$, $R_3$, and $R_4$ to 4.7 KΩ then set $C_1$= 10 nF and $C_5$=10µF. calculate the frequency and describe the results.

| $C_1$ | $C_5$ | T | F=1/T |
|---|---|---|---|
| 10nf | 10µf | | |

5. Remove $C_4$ what happened? Discuss it?
6. Remove $C_5$ what happened? Discuss it?

## Experiment (8)

## Colpitts LC Oscillator

### General

The Colpitts oscillator works with a capacitive three-point connection (fig. 1). The resonance voltage, which appears across the oscillatory circuit, split to two component voltages by capacitors $C_1$ and $C_2$.

The voltage across $C_2$ fed to the emitter as positive feedback voltage. As regards alternating voltage, the base lies at zero potential via capacitor $C_B$, as a result of which the transistor works in the common base configuration in which no phase shift occurs between the input and output voltages.

The advantage of this circuit arrangement lies in the fact that the base is at zero potential and thus acts as an electrical separator between the output and input. Capacitive reactive effects are thereby avoided, resulting in a raising of the upper limiting frequency of the amplifier.

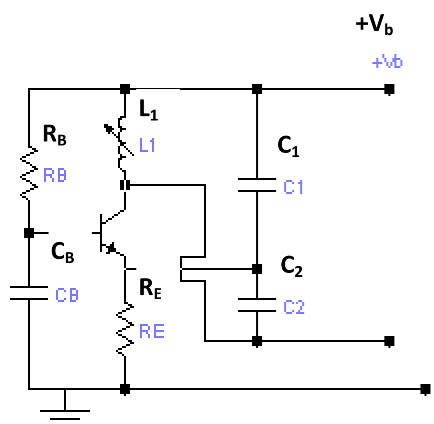


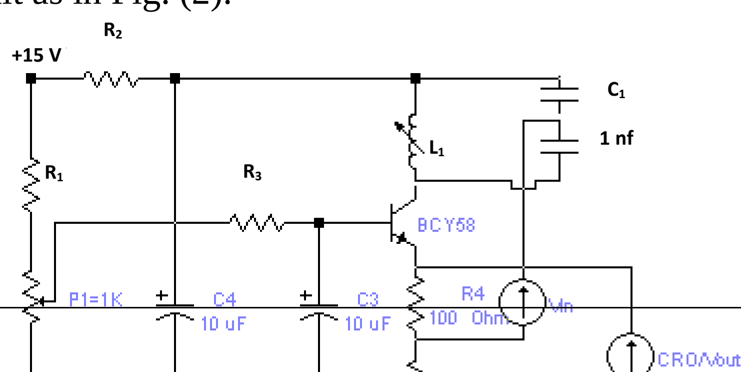

**Fig.(1): Colpitts Oscillator**

### Aim of the Exp.:

To construct a Colpitts LC oscillator to given data, and to measure the oscillation generated with the oscilloscope.

### Performance of the Exp.:

1. Construct the circuit as in Fig. (2).



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$P_1=1k\Omega$ $C_4$ $C_3$ $R_4$ $V_{in}$

CRO/ $V_{out}$

$P_2=500\Omega$

**Fig.(2): Arrangement for testing the Colpitts Oscillator.**

Rotate $P_2$ to the end of right side (position ze

2. Rotate $P_2$ to the end of right side (position zero). Adjust P2 to obtain maximum output amplitude and calculate the amplitude and frequency of the signal:
   $V_o$=…….. $V_{p-p}$ F=……….Hz
3. Calculate the alternating voltage across the emitter resistor $R_E$: $V_i$=……..$V_{p-p}$ And the gain coefficient: $A_v^{-} = V_o / V_i$
4. Rotate $P_L$ slowly toward left and right and release the CRO. What happened?.
5. Repeat calculations $V_o$, $V_i$ and $A'_v$. What happened to $A'_v$? Why?
6. Rotate $P_2$ toward the end of left side, then measure the alternating voltage from the collector. Vary $P_1$ to obtain maximum amplitude. Remove $C_3$. What happened?
7. Measure the alternating voltage from emitter, remove C3, and note the changes.

## Experiment (9)

# HARTLY LC OSCILLATOR

## General

In the Hartley circuit two coils, $L_1$ and $L_2$ are connected together in series (fig 1). Consequently, the junction forms a tapping of the total winding thus created (principle of the autotrans former). As regards A.C. voltage, the tapping lies at zero potential.

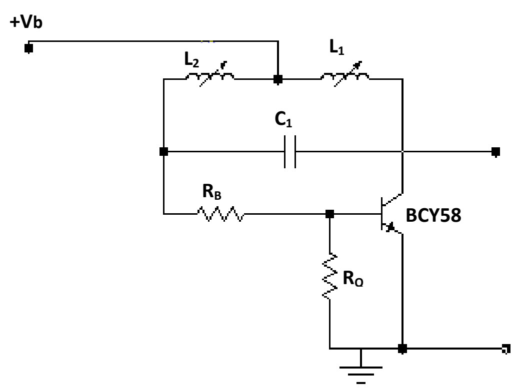



**Fig (1): Hartly oscillator (inductive three-point connection)**

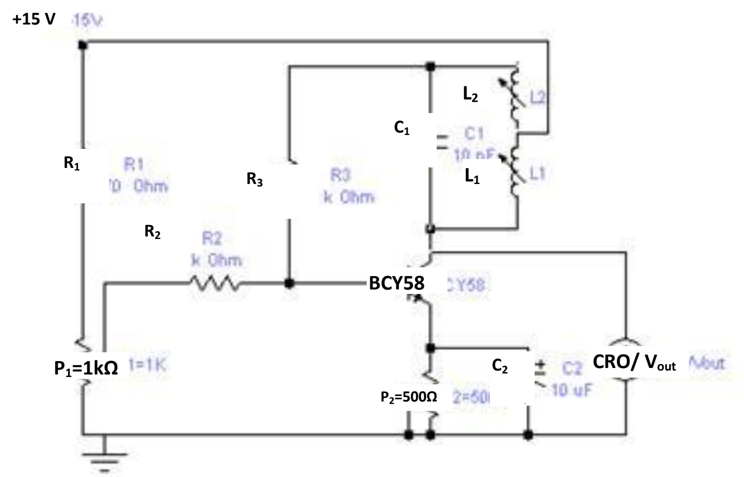
Two alternating voltages which are $180^0$ out of phase with reference to the center tap are produced in the component windings $L_1$and $L_2$.the voltage across coil is the out put voltage of the amplifier .the voltage induced in coil $L_2$ is fed to the amplifier as positive feedback voltage via the potential divider $R_{B,}R_{Q.}$ the frequency of oscillation is determined by the total inductance,$L_1$and $L_2$. And capacitor $C_{1.}$ By virtue of the way in which the coils are connected, the Hartley oscillator is also called an inductive therr-point connection.

## Aim of the Exp.:

To construct a Hartley LC oscillator to given data, and to measure the oscillation generated with the oscilloscope.

## Performance of the Exp.:

1. Construct the circuit as in Fig.(2).




**Fig(2): Arrangement for testing the hartly LC oscillator.**

2. Rotate $P_2$ to the end of right side (position zero). Adjust $P_1$ to obtain maximum amplitude(20 $V_{p.p}$)with out noise and calculate the amplitude and frequency of the signal:

$V_o$=…….. $V_{p-p}$ F=……….Hz

3. Calculate the alternating voltage across coil $L_2$ V=……..$V_{p-p}$
4. Calculate alternating voltage at the base of $T_1$ V=……..$V_{p-p}$

5. What happens when the core of either coil $L_1$ or coil $L_2$ is screwed out?

## Discuss:

1. Compare between the circuits and output frequency of this oscillator and previous one?

2. Explain reason of changing frequency in step 4 of procedure of the exp.

## Experiment (10)

# Pulse Generator(IC 555)

## General

The 555 timer is one of the most popular and versatile integrated circuits ever produced. It includes 23 transistors, 2 diodes and 16 resistors on a silicon chip installed in an 8 pin mini dual-in-line package (DIP). The 556 is a 24 pin (DIP) that combines two 555 ’s on a single chip. In addition, ultra-low power versions of the 555 are available. The 555 has two principle operating modes.

Mono stable mode: in this mode the 555 functions as a "one-shot". Applications include timers, missing pulse detection, bounce free switches, touch logic locks, tone generation switches …etc.

A stable mode: the 555 can operate as an oscillator. Uses include LED and LAMP flashers, pulse generations, security alarms …etc.

**555 SPECIFICATIONS**

| | |
|---|---|
| Supply voltage ($v_{cc}$) | 4.5 to 15V |
| Supply current ($V_{cc}$=+5V)[2] | 3 to 6 mA |
| Supply current ($V_{cc}$=+15V)[2] | 10 to 15mA |
| Output current | 200mA (maximum) |
| Power dissipation | 600 mw |
| Operating temperature | 0 to $70^0$ C |

1- Values shown apply to NE 555 (8 PIN MINI-DIP)
2- Output current =0

## Aim of the Exp.:

To construct an IC555 pulse generator circuit, and to measure the output frequency by the oscilloscope.

**Performance of the Exp.:**

1. Construct the circuit as in Fig.(2).
2. Change values of R and C according to following table.
3. Draw frequency with resistance curve for different C.

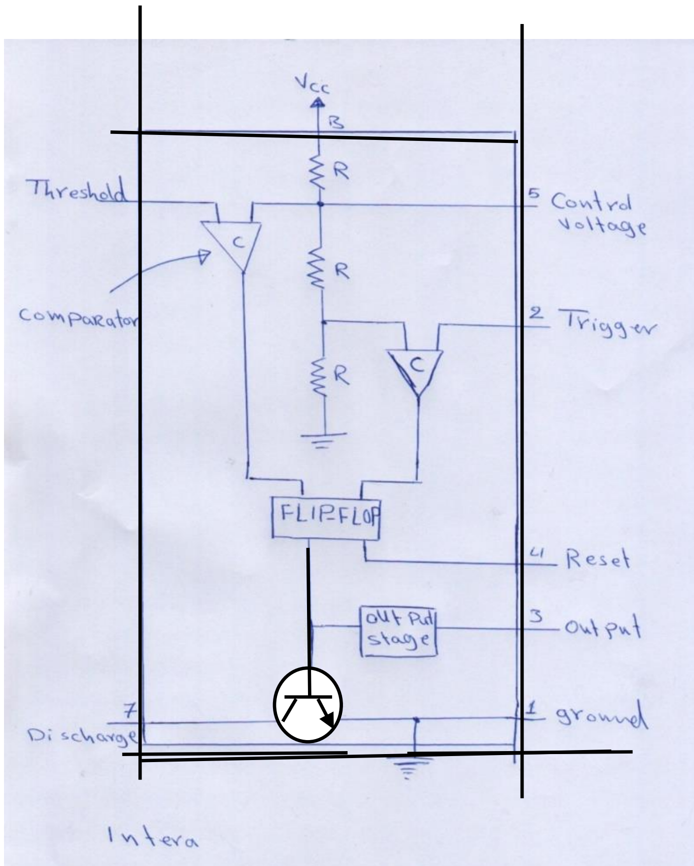



**Fig.(1): Internal block diagram.**

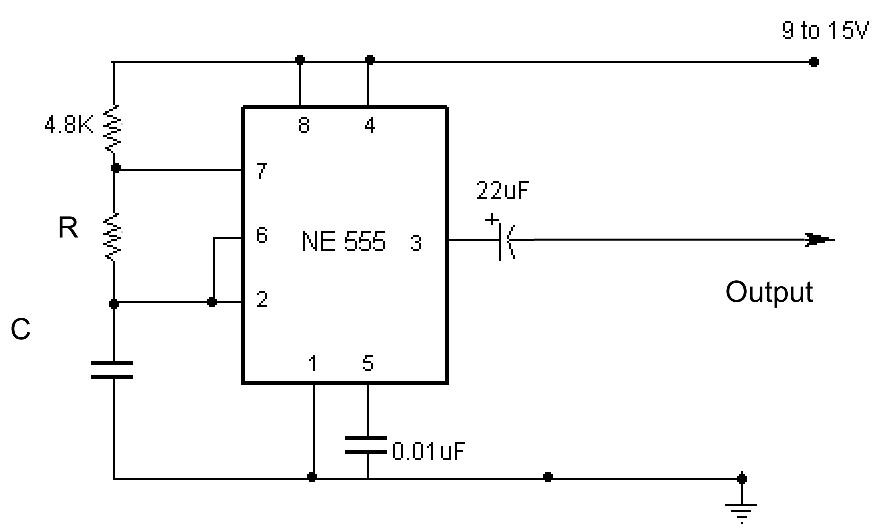



**Fig.(2): /**