# ANALOG ELECTRONIC CIRCUITS (AEC)

# LABORATORY MANUAL

## II / IV B.E. (ECE) : II - SEMESTER


DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

**SIR C.R.REDDY COLLEGE OF ENGINEERING**
**ELURU – 534 007**

# ANALOG ELECTRONIC CIRCUITS (AEC) - LAB

## II / IV B.E. (ECE) :  II - SEMESTER

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# APPLICATIONS OF

# OPERATIONAL AMPLIFIER

## CIRCUIT DIAGRAM:

### Inverting Amplifier:

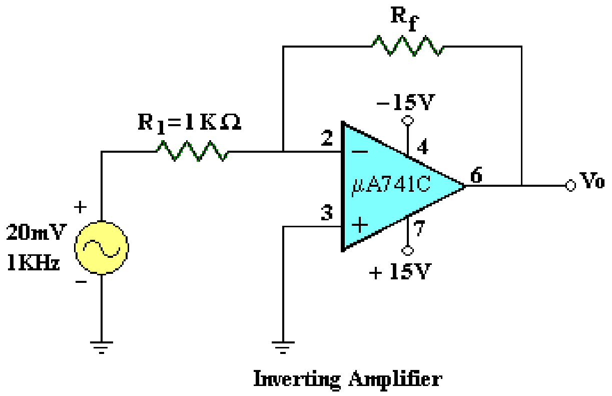


Fig. 1

### Non - inverting Amplifier:

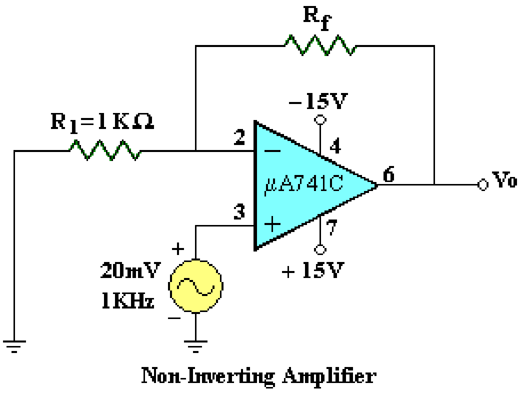


Fig. 2

### Voltage Follower:

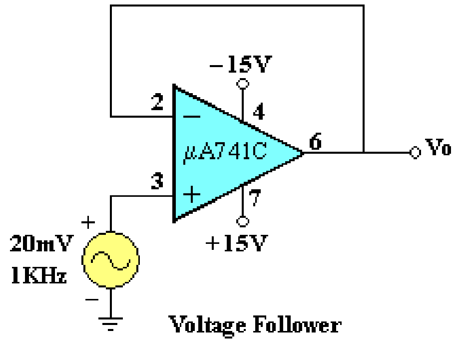


Fig. 3

### Summer:

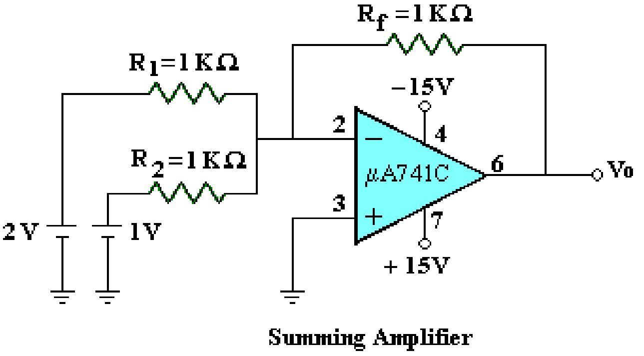


Fig. 4

# APPLICATIONS OF OPERATIONAL AMPLIFIER

**AIM**: To check the following applications of OP-AMP.

a) Inverting Amplifier. b) Non inverting amplifier.
c) Voltage Follower. d) Summer.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Fixed power supply | [- 15V – 0V – +15V] | 1 |
| 2. | OP-AMP | μA741C | 1 |
| 3. | Resistors | 1KΩ, 4.7KΩ, 10KΩ, 33KΩ | Each 1 |
| 4. | Function generator | -- | 1 |
| 5. | CRO | -- | 1 |

**PROCEDURE:**

**INVERTING & NON - INVERTING AMPLIFIER:**

1. Connect the circuit as shown in the figure -1
2. Switch on the power supply and signal generator.
3. Apply a sinusoidal signal with peak to peak amplitude of 20mV at a frequency of 1KHz.
4. Note down the amplitude of O/P signal in the C.R.O.
5. Repeat the above steps for different values of $R_f$.
6. Repeat the above steps for the circuit of fig –2.
7. Tabulate the readings.

**VOLTAGE FOLLOWER:**

1. Connect the circuit as shown in the fig –3 apply a 20 mV sinusoidal signal at a frequency of 1KHz.
2. Vary the frequency in steps of 1KHz and note the amplitude of the O/P wave form.
3. Tabulate the readings.

**SUMMER:**

1. Connect the circuit as shown in the figure-4.
2. Apply the DC signals as shown in the fig-4 and measure the O/P and compare it with the theoretical value.

**INVERTING AMPLIFIER:**

$V_i$ = 20mV

| S.NO | $R_f$ (Ω) | $R_1$(Ω) | $V_0$ (mV) | Gain = $V_0$ / $V_i$ | Theoretical Gain = $(-R_f/R_1)$ |
|---|---|---|---|---|---|
| 1 | 4.7K | 1K | | | |
| 2 | 10K | 1K | | | |
| 3 | 33K | 1K | | | |

**NON-INVERTING AMPLIFIER:**

$V_i$ = 20mV

| S.NO | $R_f$ (Ω) | $R_1$(Ω) | $V_0$ (mV) | Gain= $V_0$ / $V_i$ | Theoretical Gain = $(1+R_f/R_1)$ |
|---|---|---|---|---|---|
| 1 | 4.7K | 1K | | | |
| 2 | 10K | 1K | | | |
| 3 | 33K | 1K | | | |

**VOLTAGE FOLLOWER:**

$V_i$ = 20mV

| S.No | Frequency (Hz) | $V_0$ (mV) |
|---|---|---|
| 1 | 1K | |
| 2 | 2K | |
| 3 | 3K | |
| 4 | 4K | |
| 5 | 5K | |
| 6 | 6K | |
| 7 | 7K | |
| 8 | 8K | |
| 9 | 9K | |
| 10 | 10K | |

**SUMMER:**

$V_0$ (Theoretical) $= -\frac{R_f}{R_1}(V_1 + V_2)$ = --------Volts.

$V_0$ (Practical) = --------Volts.

**RESULT:**

**VIVA QUESTIONS:**

1. What are the ideal Characteristics of an OP-AMP ?
2. Explain the concept of virtual ground?
3. What are the internal stages in an OP-AMP IC ?
4. What type of transistor Configuration is used at the front end of an OP-AMP IC ?
5. Draw the circuit diagram of an integrator and a differentiator using an OP-AMP ?
6. Why square wave is used to test any amplifier ?

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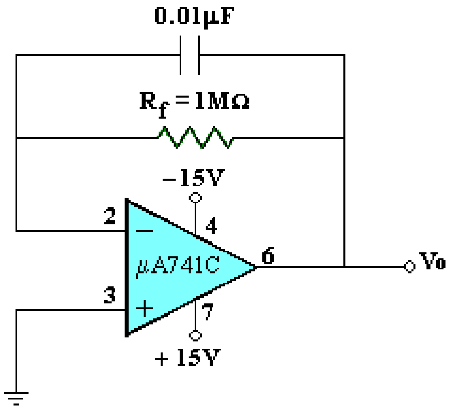
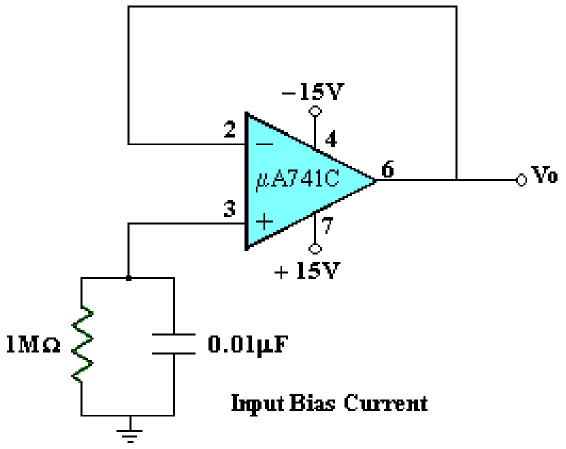
# PARAMETERS OF OPERATIONAL AMPLIFIER

## CIRCUIT DIAGRAMS:

**Input Bias Current: (Fig. 1 & Fig. 2)**

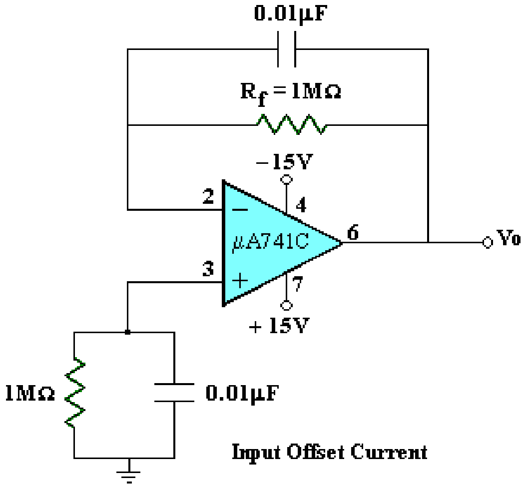



Input Bias Current



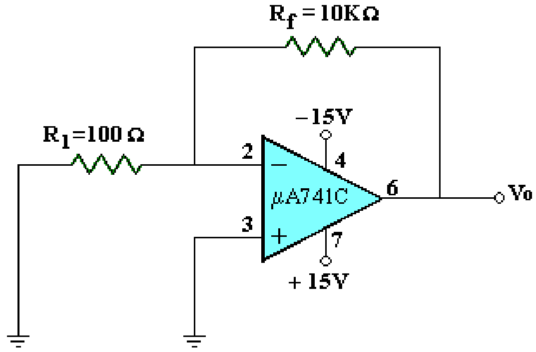

Input Bias Current

**Input Offset Current: (Fig. 3)**



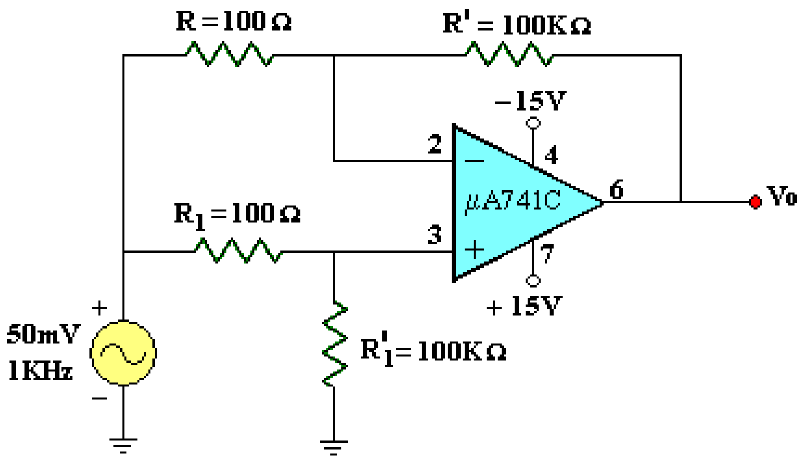

Input Offset Current

**Input Offset Voltage: (Fig. 4)**




Input Offset Voltage

**Common Mode Rejection Ratio (CMRR): (Fig. 5)**




Common Mode Rejection Ratio (CMRR)

# PARAMETERS OF OPERATIONAL AMPLIFIER

**AIM**: To determine the following parameters of OP-AMP μ A741 C.
a) Input Bias Current. b) Input Offset Current.
c) Input Offset Voltage. d) CMRR.

**APPARATUS**:

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Fixed Power supply | [- 15V – 0V – +15V] | 1 |
| 2. | Operational Amplifier | μ A 741C | 1 |
| 3. | Resistors | 1MΩ, 10KΩ, 100KΩ, 100Ω | Each 1 |
| 4. | Capacitors | 0.01μ F | 1 |
| 5. | Function generator | -- | 1 |
| 6. | Multimeter | -- | 1 |
| 7. | CRO | -- | 1 |

**PROCEDURE:**

1. Connect the circuit as shown in the figure (1).
2. The O/P voltage $V_0$ is measured from the O/P terminals.
3. $I_B^-$ is calculated by using $I_B^- = \frac{V_0}{R_f}$.
4. The circuit is connected as shown in the figure (2).
5. The O/P voltage $V_0$ is measured from the O/P terminals.
6. $I_B$+ is calculated by using $I_B^+ = \frac{V_0}{R_1}$.
7. Input bias current $I_B = \frac{I_B^+ + I_B^-}{2}$.
8. The circuit is connected as shown in the figure (3).
9. The Input offset current is measured by using the formula $I_{io} = \frac{V_0}{R_f}$.The circuit is connected as shown in the figure (4).
10. Input offset voltage
$$V_{io} = \frac{V_0}{\left(1+\frac{R_f}{R_1}\right)}$$
11. The circuit is connected as shown in the figure (5).
12. A 50 mV sinusoidal signal at a frequency of 1 KHz is applied at the I / P.
13. The O/P voltage $V_0$ is measured.
14. The CMRR is found by using,
$$CMRR = \left(1+\frac{R^1}{R}\right)\frac{V_S}{V_O}.$$
15. CMRR in decibels = 20log (CMRR).

**RESULT:**

**VIVA QUESTIONS:**

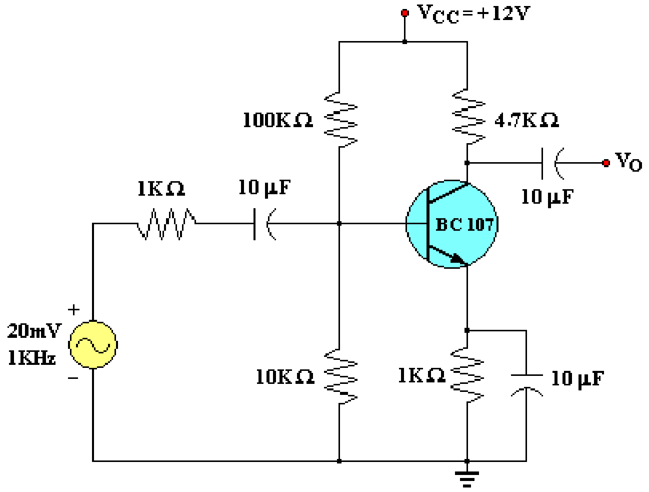
1. What are the different parameters of an OP-AMP?
2. Define input offset voltage?
3. Define Input bias current and Input offset current?
4. What is meant by slew rate?
5. Why we need to calculate the offset values?

***

# FEEDBACK AMPLIFIER

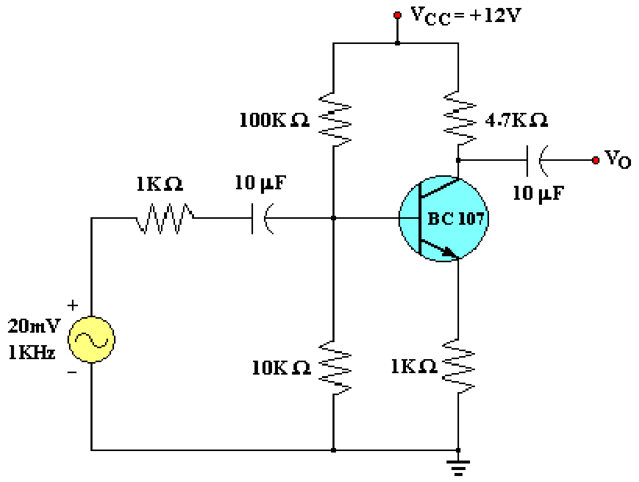
## CIRCUIT DIAGRAM:

## WITHOUT FEEDBACK:



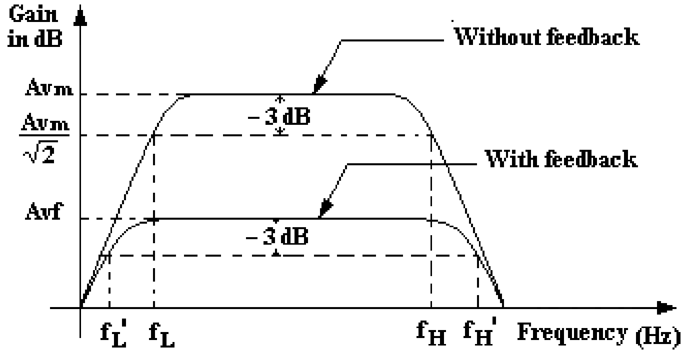

Without feedback Amplifier

## WITH FEEDBACK:




With feedback Amplifier

## MODEL GRAPH:



# FEEDBACK AMPLIFIER

**AIM:** To plot the frequency response curve of an amplifier with and without feedback.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Regulated Power Supply | (0– 30V) | 1 |
| 2. | Transistor | BC 107 | 1 |
| 3. | Resistors | 100KΩ,4.7KΩ,10KΩ | Each 1 |
| 4. | Resistors | 1KΩ | 2 |
| 5. | Capacitors | 10μF | 3 |
| 6. | Function generator | -- | 1 |
| 7. | CRO | -- | 1 |

**PROCEDURE:**

**AMPLIFIER WITHOUT FEED BACK:**

1. Connect the circuit as shown in the figure – 1.
2. Apply a 20 mV sinusoidal signal at a frequency of 100 Hz and observe the I / P signal in the C.R.O.
3. Determine the O / P voltage $V_0$ using the C.R.O.
4. Determine the gain of the amplifier $A_V = V_0 / V_I$.
5. Now vary the frequency in convenient steps upto 1MHz, keeping the I / P voltage constant and for each frequency note down the O / P voltage.
6. Tabulate the readings.
7. Draw a graph between the frequency and the gain in decibels and determine the band width.

**AMPLIFIER WITH FEEDBACK:**

1. Connect the circuit as shown in the figure – 2.
2. Apply a 20 mV sinusoidal signal at a frequency of 100 Hz and observe the I / P signal in the C.R.O.
3. Determine the O / P voltage $V_0$ using the C.R.O.
4. Determine the gain of the amplifier with feedback $A_{Vf} = V_0 / V_I$.Compare this gain with the gain of the Amplifier without feedback.
5. Now vary the frequency in convenient steps up to 1MHz ,keeping the I / P voltage constant and for each frequency note down the O / P voltage.
6. Tabulate the readings.
7. Draw a graph between the frequency and the gain in decibels and determine the band width. Compare the band width with the band width of the Amplifier without feedback.

**TABULAR FORM**:

**Vi = 20mV**

| **Frequency (Hz)** | **Without Feedback** | | | **With Feedback** | | |
|---|---|---|---|---|---|---|
| | **$V_0$ (Volts)** | **Gain $A_V=V_0/Vi$** | **Gain in db ($20logA_V$)** | **$V_0$ (Volts)** | **Gain $A_{Vf}=V_0/V_I$** | **Gain in db ($20logA_V$)** |
| 50 | | | | | | |
| 100 | | | | | | |
| 300 | | | | | | |
| 500 | | | | | | |
| 700 | | | | | | |
| 1K | | | | | | |
| 3K | | | | | | |
| 5K | | | | | | |
| 7K | | | | | | |
| 10K | | | | | | |
| 30K | | | | | | |
| 50K | | | | | | |
| 70K | | | | | | |
| 100K | | | | | | |
| 300K | | | | | | |
| 500K | | | | | | |
| 700K | | | | | | |
| 1MHz | | | | | | |

**RESULT:**

Gain of the Amplifier without feedback $A_V$ =
Gain of the Amplifier with feedback $A_{Vf}$ =
Band width of the Amplifier without feedback =
Band width of the Amplifier with feedback =

**VIVA QUESTIONS:**

1. What are the different types of feedback techniques?
2. What is the type of feedback incorporated in oscillators?
3. What are the advantages of negative feedback?
4. Why positive feedback is not used in amplifiers?
5. What is the expression for the desensitivity factor in case of negative feedback?
6. What happens to the band width of an amplifier if we incorporate negative Feedback?

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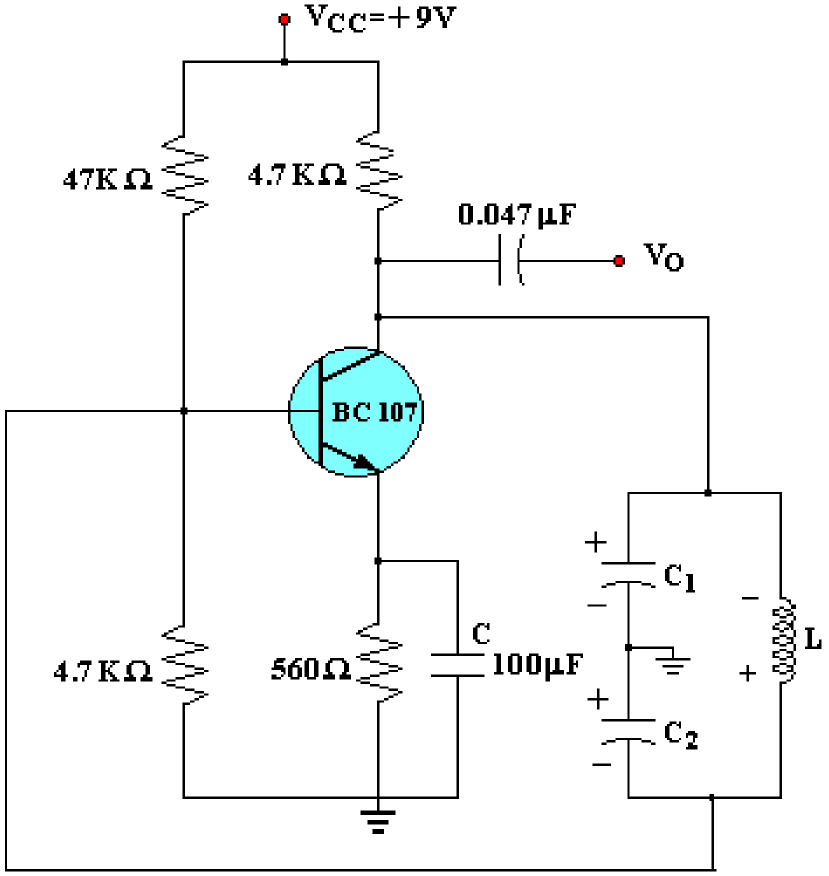
# COLPITTS OSCILLATOR

## CIRCUIT DIAGRAM:




**Colpitts Oscillator**

## TABULAR FORM:

<table>
<tr><th rowspan="2">S.NO.</th><th rowspan="2">L (mH)</th><th colspan="2">C ( µF)</th><th rowspan="2">Practical frequency (Hz)</th><th rowspan="2">Theoretical Frequency (Hz)</th></tr>
<tr><th>$C_1$</th><th>$C_2$</th></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

# COLPITTS OSCILLATOR

**AIM:** To determine the frequency of oscillations of a given Colpitts Oscillator.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | DC Regulated Power Supply | (0-30V) | 1 |
| 2. | Resistors | 560Ω, 47 KΩ | Each 1 |
| 4. | Resistors | 4.7 KΩ | 2 |
| 5. | Capacitors | 100µF, 0.047µF | Each 1 |
| 6. | Decade Inductance Box | -- | 1 |
| 7. | Decade Capacitance Box | -- | 2 |
| 8. | CRO | -- | 1 |

**PROCEDURE:**

1. Connect the circuit diagram as shown in the figure.
2. Switch on the power supply.
3. Connect the out put terminals to CRO.
4. Adjust the capacitances until a sinusoidal wave form is observed on the CRO.
5. Measure the time period of the sinusoidal wave form (T) and determine the Frequency (1/T).
6. Repeat the above steps for different values of L, $C_1$ & $C_2$.
7. Tabulate the readings and compare with theoretical values

**CALCULATIONS:**

$f_0$ (practical) =1/T Hz.

$f_0$ (theoretical) $f_0 = \dfrac{1}{2\pi\sqrt{LC_{eq}}}$. [Where $C_{eq} = \dfrac{C_1C_2}{C_1 + C_2}$ ]

**RESULT:**

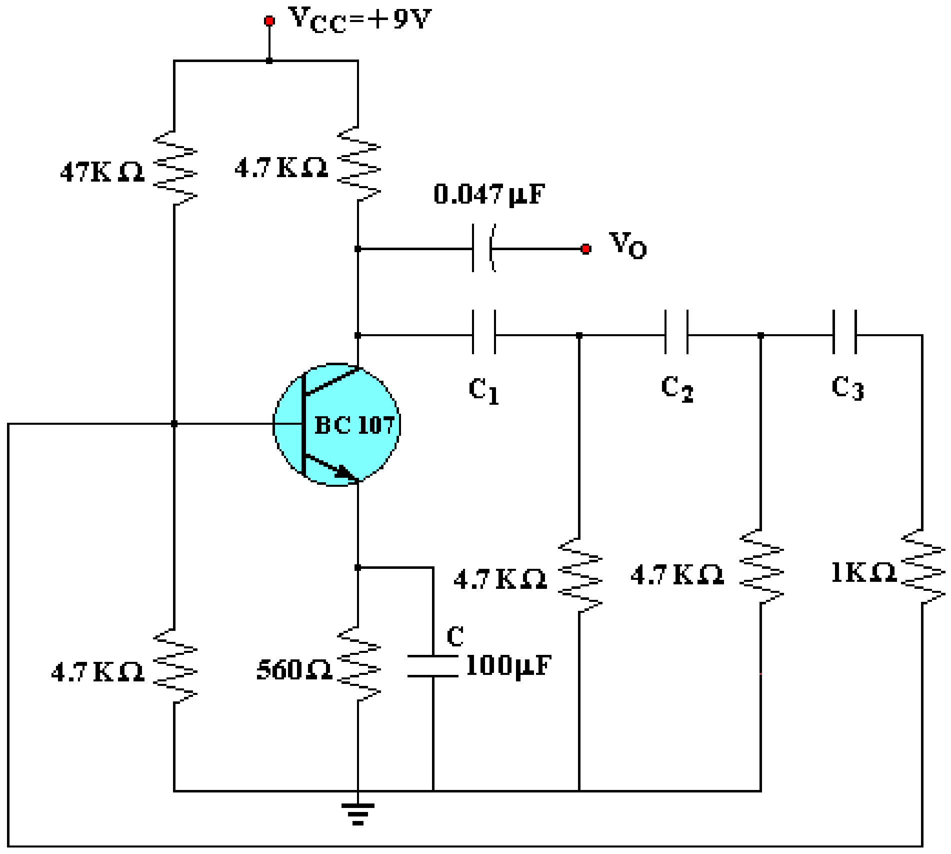
**VIVA QUESTIONS:**

1. Why RC network oscillator cannot be used at Radio frequencies?
2. Why LC network oscillators are preferred at high frequencies?
3. Why a buffer amplifier is required in between an oscillator and a load?
4. What is meant by ringing in an amplifier?
5. Why the crystal oscillator is highly stable?
6. Draw the electrical equivalent circuit of a crystal oscillator?

***

# RC-PHASE SHIFT OSCILLATOR

**CIRCUIT DIAGRAM:**




RC-Phase shift Oscillator

**TABULAR FORM:**

| S.No | Resistance (KΩ) | Capacitance (μF) | Practical Frequency (Hz) | Theoretical Frequency (Hz) |
|---|---|---|---|---|
| 1 | 4.7 | 0.1 | | |
| 2 | 4.7 | 0.01 | | |
| 3 | 4.7 | 0.001 | | |

# RC-PHASE SHIFT OSCILLATOR

**AIM** : To determine the frequency of oscillations of a given RC phase shift Oscillator.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | DC Regulated power supply | (0 – 30V) | 1 |
| 2. | Transistor | BC 107 | 1 |
| 3. | Resistors | 1KΩ, 47KΩ, 560Ω | Each 1 |
| 4. | Resistors | 4.7KΩ | 4 |
| 5. | Capacitors | 0.1μF, 0.01μF, 0.001μF | Each 3 |
| 6. | Capacitors | 0.047μ F | 1 |
| 7. | Capacitors | $\frac{100\,\mu F}{20V}$ | 1 |

**PROCEDURE:**

1. Connect the circuit diagram as shown in the figure.
2. Switch on the power supply.
3. Connect the O/P terminals to C.R.O.
4. Observe the sinusoidal wave form on C.R.O.
5. Determine the time period (T) of the wave form and frequency (1/T).
6. Repeat the above procedure for different sets of Capacitors.
7. Tabulate the readings and compare with theoretical values.

**CALCULATIONS:**

f (practical) = 1/T Hz.

$$f_o = \frac{1}{2\pi RC\sqrt{6+4K}} \quad \text{(Theoretical)} \qquad \text{Where } K = R_C / R = 1.$$

$R_1 = R_2 = R_3 = R.$
$C_1 = C_2 = C_3 = C.$

**RESULT:**

**VIVA QUESTIONS:**

1. Which type of feedback is incorporated in RC phase shift oscillator ?
2. Can we built up an RC phase shift oscillator using two stages of RC network of each $90^0$ phase shift ?
3. State Barkhausen criterion?
4. What is the condition imposed on A and β to get sustained oscillations ?

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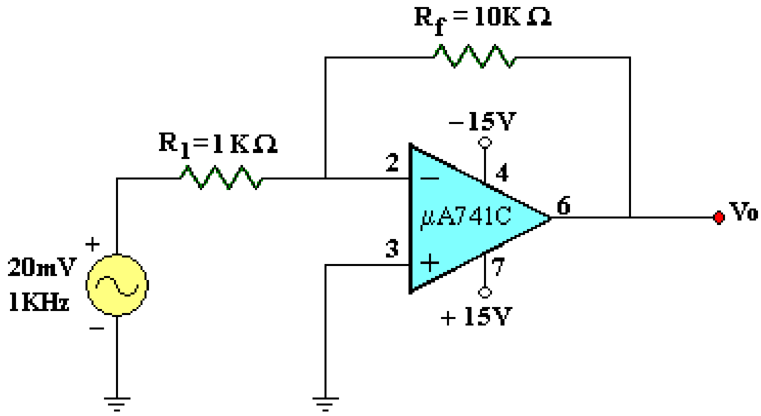
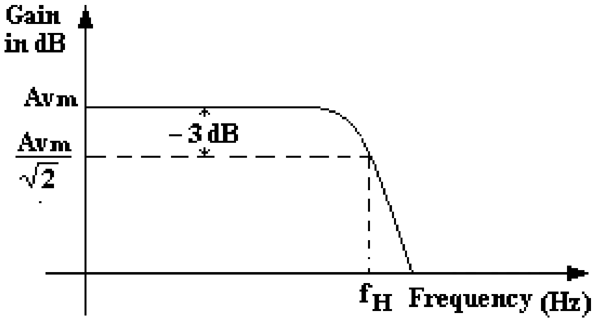
# FREQUENCY RESPONSE OF OP-AMP

## CIRCUIT DIAGRAM:




Frequency Response of Op-Amp

## MODEL GRAPH:




## TABULAR FORM:

Vi = 20mV

| S.No. | Frequency (KHz) | $V_0$ (mV) | Gain $A_V = V_0 / V_i$ | Gain in db (20 log $A_V$) |
|---|---|---|---|---|
| 1 | 50 | | | |
| 2 | 100 | | | |
| 3 | 300 | | | |
| 4 | 500 | | | |
| 5 | 700 | | | |
| 6 | 1K | | | |
| 7 | 3K | | | |
| 8 | 5K | | | |
| 9 | 7K | | | |
| 10 | 10K | | | |
| 11 | 30K | | | |
| 12 | 50K | | | |
| 13 | 70K | | | |
| 14 | 100K | | | |
| 15 | 300K | | | |
| 16 | 500K | | | |
| 17 | 700K | | | |
| 18 | 1MHz | | | |

# FREQUENCY RESPONSE OF OP-AMP

**AIM:** To plot the frequency response characteristics of OP-AMP µ A 741 C and to obtain the band width.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Fixed power supply | [- 15V – 0V – +15V] | 1 |
| 2. | OP-AMP | µ A 741 C | 1 |
| 3. | Resistors | 10KΩ, 1KΩ | Each 1 |
| 4. | Function generator | -- | 1 |
| 5. | CRO | -- | 1 |

**PROCEDURE:**

1. Connect the circuit as shown in the figure.
2. Switch on the power supply and the function generator.
3. Apply a 20 mV sinusoidal signal at the I/P.
4. Vary the frequency in convenient steps and note down the amplitude of the O/P Wave form.
5. Tabulate the readings.
6. Plot a graph between gain and frequency.
7. Determine the band width.

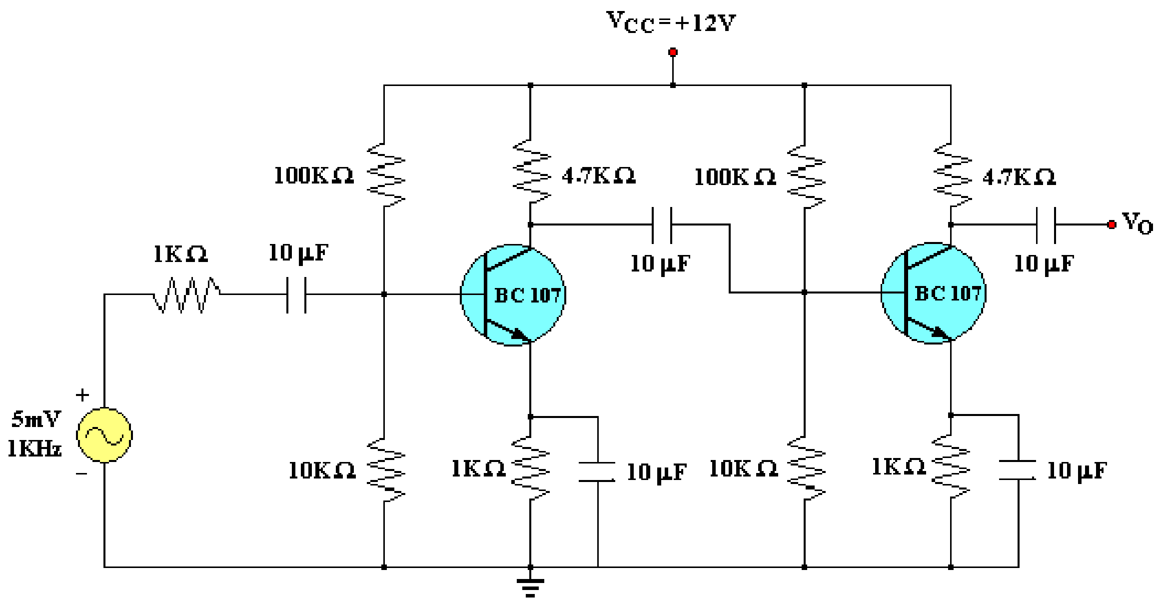
**RESULT:**

Upper cut-off frequency = KHz.
Lower cut-off frequency = Hz.
Band Width = KHz

***

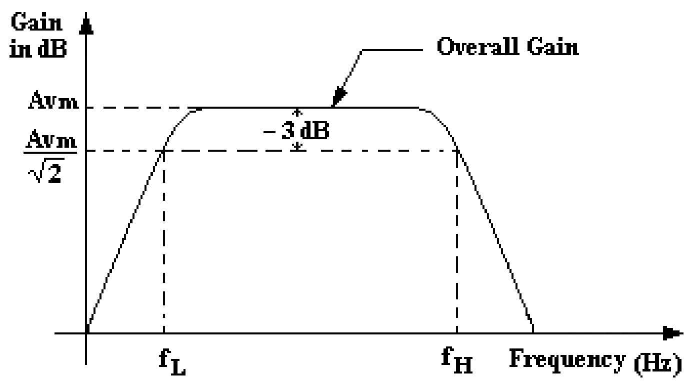
# TWO STAGE RC-COUPLED AMPLIFIER

## CIRCUIT DIAGRAM:




Two Stage RC-Coupled Amplifier

## MODEL GRAPH:



# TWO STAGE RC-COUPLED AMPLIFIER

**AIM:** To plot the frequency response of Two stage RC – Coupled Amplifier and to obtain its band width.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | D.C Regulated power supply | (0 – 30V) | 1 |
| 2. | Transistors | BC 107 | 2 |
| 3. | Resistors | 10KΩ, 100KΩ, 4.7KΩ | Each 2 |
| 4. | Resistors | 1KΩ | 3 |
| 5. | Capacitors | 10µF | 5 |
| 6. | Function Generator | -- | 1 |
| 7. | CRO | -- | 1 |

**PROCEDURE:**

1. Connect the circuit as shown in the figure.
2. Switch on the power supply and the Function generator.
3. Apply a 5mV sinusoidal signal at the I/P.
4. Vary the frequency in convenient steps and note down the O/P voltage.
5. Tabulate the readings and calculate the gain in dB.
6. Plot a graph between gain and frequency.
7. Determine the band width.

**RESULT:**

Upper cut-off frequency = KHz.
Lower cut-off frequency = Hz.
Bandwidth = KHz.

**VIVA QUESTIONS**:

1. What is the need for Two stage Amplifier?
2. Differentiate between interacting and non- interacting stages?
3. Give the expression for the overall upper cut-off frequency of a multistage amplifier?
4. What is the effect of multistage amplifier on band width?
5. What is the choice of transistor configuration in multistage amplifier?
6. What is cascade amplifier?
7. What is the advantage of cascade amplifier?

***

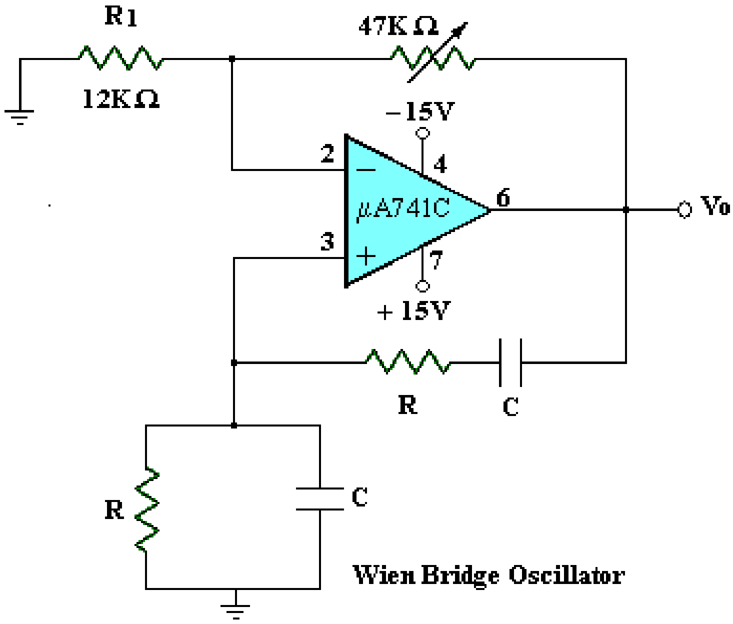
**TABULAR FORM:**

**Vi = 20mV**

| S.No | Frequency (Hz) | Vo (mV) | Voltage Gain Av=(Vo/Vi) | Gain in dB (20logAv) |
|---|---|---|---|---|
| 1 | 50 | | | |
| 2 | 100 | | | |
| 3 | 300 | | | |
| 4 | 500 | | | |
| 5 | 700 | | | |
| 6 | 1K | | | |
| 7 | 3K | | | |
| 8 | 5K | | | |
| 9 | 7K | | | |
| 10 | 10K | | | |
| 11 | 30K | | | |
| 12 | 50K | | | |
| 13 | 70K | | | |
| 14 | 100K | | | |
| 15 | 300K | | | |
| 16 | 500K | | | |
| 17 | 700K | | | |
| 18 | 1MHz | | | |

# WEIN BRIDGE OSCILLATOR

CIRCUIT DIAGRAM:




TABULAR FORM:

| S.No | Capacitance C ( µ F ) | Resistance R (Ω) | Theoretical Frequency = 1/2π RC (Hz) | Practical Frequency=1/T (Hz) |
|---|---|---|---|---|
| 1 | 0.047 | 3.3K | | |
| 2 | 0.33 | 220 | | |

# WEIN BRIDGE OSCILLATOR

**AIM**: To determine the frequency of oscillations of a given Wein Bridge oscillator and compare it with the theoretical value.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Fixed Power Supply | [- 15V – 0V – +15V] | 1 |
| 2. | OP-AMP | μ A741C | 1 |
| 3. | Potentiometer | 47 K Ω | 1 |
| 4. | Resistors | 3.3 K Ω, 220Ω | Each 2 |
| 5. | Resistors | 12 KΩ | 1 |
| 6. | Capacitors | 0.047μ F, 0.33μ F | Each 2 |
| 7. | CRO. | -- | 1 |

**PROCEDURE:**

1. Connect the circuit as shown in the figure.
2. Connect 0.047 μ F, and 3.3 K Ω in place of C and R.
3. Connect the O/P to the C.R.O and observe the sinusoidal signal and measure its frequency.
4. Connect 0.33 μ F, and 220 Ω in places of C and R.
5. Observe the sinusoidal signal and measure its frequency.
6. Tabulate the readings and Compare it with theoretical values

**FORMULAS:**

Practical Frequency $f_o = \frac{1}{T}$

Theoretical Frequency $f_o = \frac{1}{2\pi RC}$

**RESULT:**

Theoretical frequency = KHz.

Practical frequency = KHz.

**VIVA QUESTIONS:**

1. What are the different techniques for the stabilization of an oscillator?
2. What is the principle of operation of Wein Bridge oscillator?
3. What is the condition imposed on $R_f$ and $R_1$ to get oscillations in case of Wien Bridge oscillator?
4. State barkhausen criterion?
5. What is the condition imposed on A and β to get sustained oscillations?

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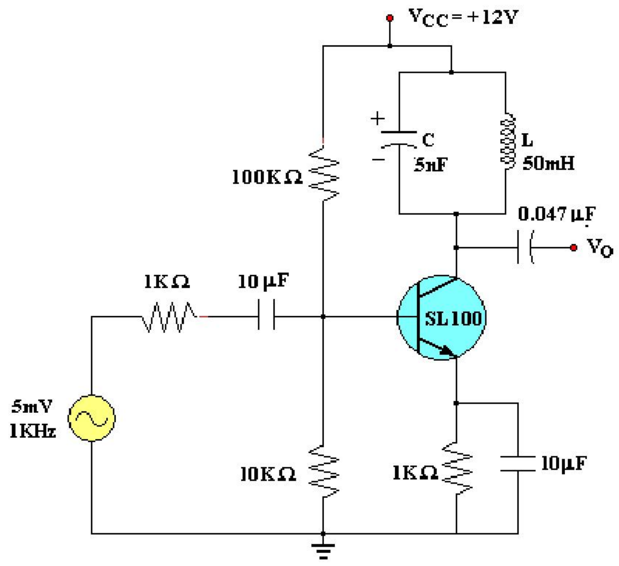
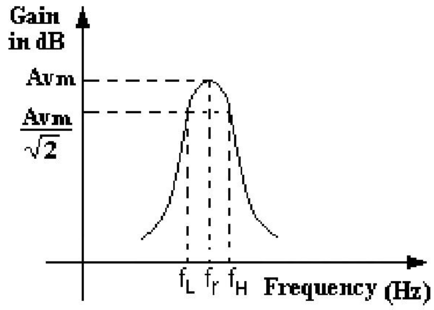
# TUNED VOLTAGE AMPLIFIER

**CIRCUIT DIAGRAM:** **MODEL GRAPH:**




Tuned Voltage Amplifier




**TABULAR FORM:**

**Vi = 5mV**

| S.No | Frequency (Hz) | Output Voltage ( $V_0$) (mV) | Gain in dB = 20 log ( $V_0$ / $V_i$ ) |
|---|---|---|---|
| 1 | 50 | | |
| 2 | 100 | | |
| 3 | 300 | | |
| 4 | 500 | | |
| 5 | 700 | | |
| 6 | 1K | | |
| 7 | 3K | | |
| 8 | 5K | | |
| 9 | 7K | | |
| 10 | 10K | | |
| 11 | 30K | | |
| 12 | 50K | | |
| 13 | 70K | | |
| 14 | 100K | | |
| 15 | 300K | | |
| 16 | 500K | | |
| 17 | 700K | | |
| 18 | 1MHz | | |

# TUNED VOLTAGE AMPLIFIER

**AIM:** To obtain the frequency response of a tuned voltage amplifier.
and to obtain the band width.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Transistor | SL100 | 1 |
| 2. | Resistors | 1KΩ , 22 KΩ , 1.8KΩ, 470 Ω | Each 1 |
| 3. | Capacitors | 10F, 33F | Each 1 |
| 4. | IF Transformer | -- | 1 |

**PROCEDURE:**

1. Connect the circuit as shown in the figure.
2. Apply a 4 mV sinusoidal signal at a frequency of 1 KHz and note down the O/P.
3. Now vary the frequency of the input signal upto 1MHz in suitable steps by keeping the input voltage constant.
4. Note down the O/P voltage $V_0$.
5. Tabulate the readings.
6. Draw gain Vs frequency graph on semi log sheet and determine the band width.

**RESULT:**

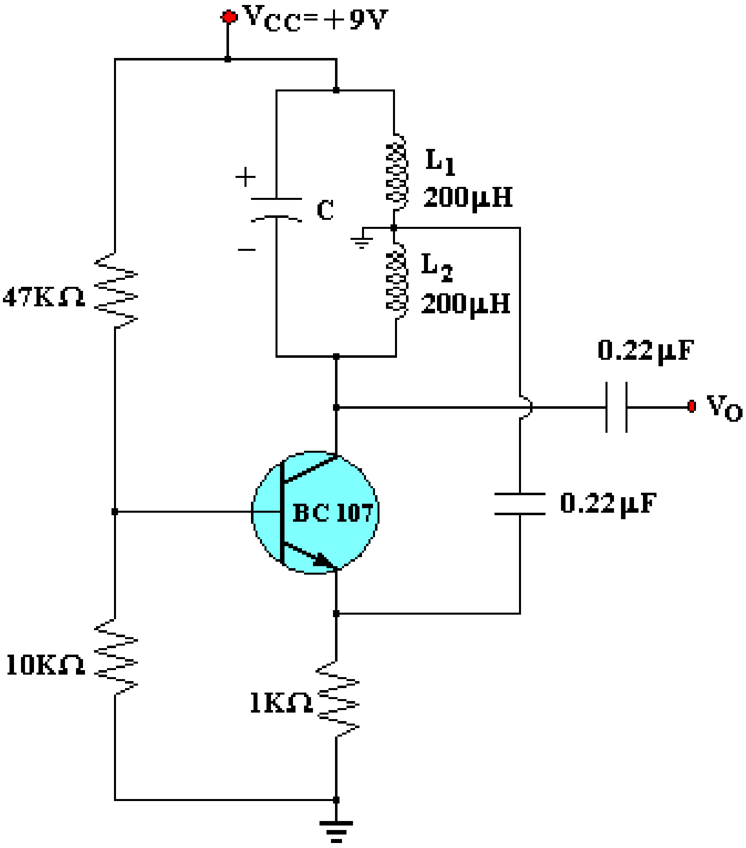
**VIVA QUESTIONS:**

1. What is a tuned amplifier?
2. Distinguish between a single tuned and a double tuned amplifier?
3. What is meant by stagger tuned amplifier?
4. Is the tuned amplifier a narrow band or a wide band amplifier?
5. Define selectivity?
6. What parameters shall be selected for a highly tuned amplifier?
7. Where the tuned amplifiers are used?
8. What type of tuning is used in the IF stage of a Radio receiver ?
9. What is the relation between the band width of a double tuned and a stagger tuned amplifier?
10. How to improve the band width of a tuned amplifier?
11. What is meant by critical tuning?

***

# HARTLEY OSCILLATOR

**CIRCUIT DIAGRAM:**




Hartley Oscillator

**TABULAR FORM:**

| Capacitance C ( µ F ) | Inductance ( m H ) | | Practical Frequency (Hz) | Theoretical Frequency (Hz) |
|---|---|---|---|---|
| | $L_1$ | $L_2$ | | |
| | | | | |
| | | | | |

# HARTLEY OSCILLATOR

**AIM:** To Determine the frequency of oscillations of a Hartley Oscillator and compare it with the theoretical values.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | D.C Regulated Power Supply | (0 – 30V) | 1 |
| 2. | Resistors | 1KΩ, 10kΩ, 47KΩ | Each 1 |
| 3. | Capacitors | 0.22μF | 2 |
| 4. | Decade Capacitance Box | -- | 1 |
| 5. | Decade Inductance Box | -- | 2 |
| 6. | CRO | -- | 1 |

**PROCEDURE:**

1. Connect the circuit as shown in the figure.
2. Connect the O / P of the oscillator to the C.R.O.
3. Adjust the Capacitance and Inductance Boxes until a sinusoidal signal is observed in the CRO.
4. Determine the frequency of the wave form.
5. Determine the frequency by varying the capacitance in convenient steps.
6. Tabulate the readings and compare the readings with the theoretical values.

**FORMULAS:**

Theoretical Frequency $f_0 = \dfrac{1}{2\pi\sqrt{L_{eq}C}}$

Practical Frequency F: $\dfrac{1}{T}$

**CALCULATIONS:**

**RESULT:**

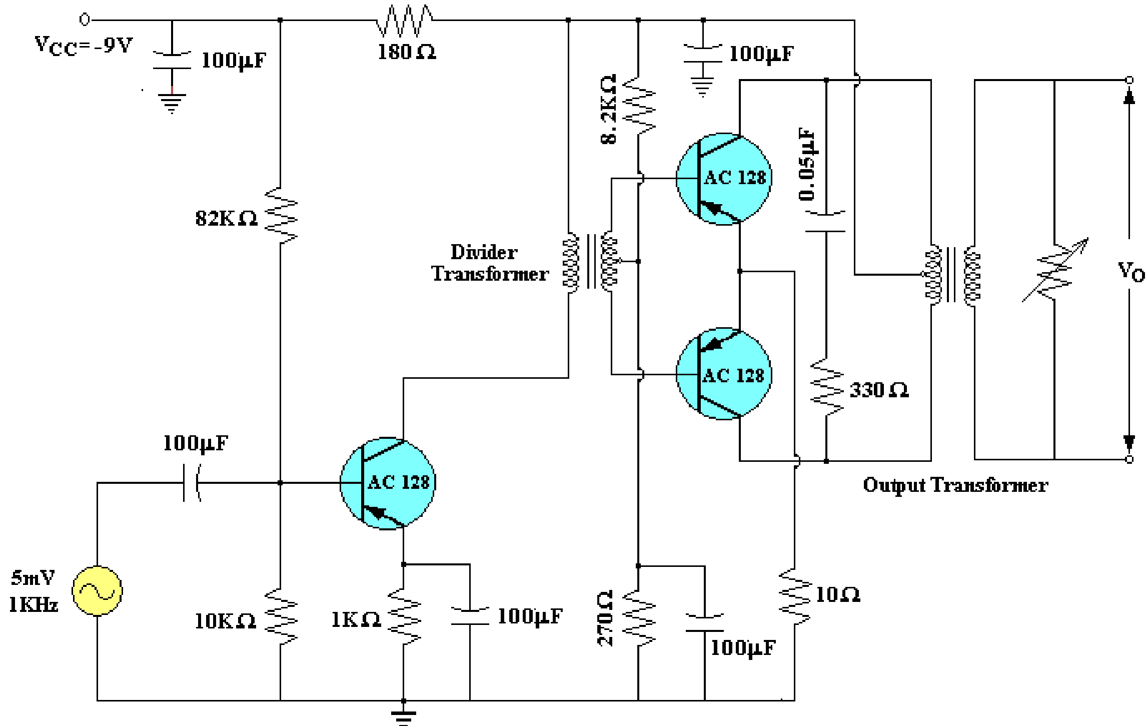
**VIVA QUESTIONS:**

1. Why RC network oscillator cannot be used at Radio frequencies?
2. Why LC network oscillators are preferred at high frequencies?
3. Why a buffer amplifier is required in between an oscillator and a load?
4. What is meant by ringing in an amplifier?
5. Why the crystal oscillator is highly stable?
6. Draw the electrical equivalent circuit of a crystal oscillator?

***

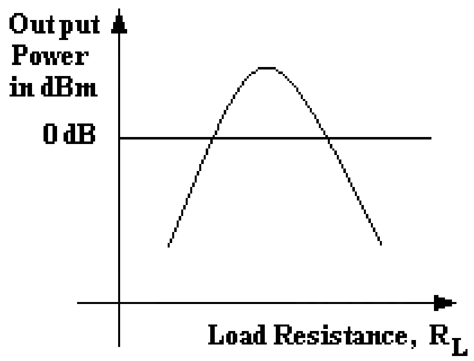
# CLASS-B PUSH PULL AMPLIFIER

## CIRCUIT DIAGRAM:




Class-B Push Pull Amplifier

## MODEL GRAPH:




## TABULAR FORM:

| S.No | $R_L$ (Ω) | Output Power $P_o$ (mW) | Power in db (10 log $P_0$) |
|---|---|---|---|
| | | | |
| | | | |

# CLASS-B PUSH PULL AMPLIFIER

**AIM**: To Plot the Graph between Load and Power of a Class B Push pull Power Amplifier.

**APPARATUS:**

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Push pull power amplifier module | -- | 1 |
| 2. | D.C Regulated Power supply | (0-30V). | 1 |
| 3. | Function generator | -- | 1 |
| 4. | CRO | -- | 1 |

**PROCEDURE:**

1. Connect the circuit diagram as shown in the figure.
2. Determine the maximum signal handling capacity of the push pull amplifier.
3. Apply sinusoidal signal of 4mV peak to peak voltage at a frequency of 1 KHz.
4. Connect Power meter at the O/P terminals.
5. By changing the load at the O/P terminals measure the power in the Power meter.
6. Tabulate the readings.
7. plot the graph between Power vs load

**RESULT:**

**VIVA QUESTIONS:**

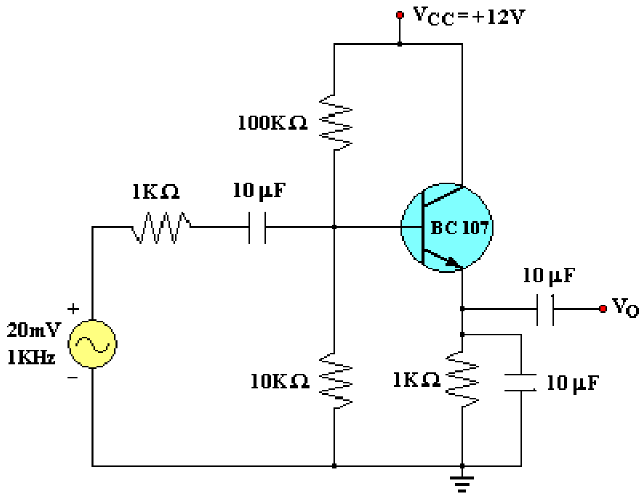
1. What is meant by conversion efficiency? Which type of power amplifier has the maximum conversion efficiency? Why?
2. To which class does the push-pull amplifier belongs and what are the advantages of it?
3. What is meant by crossover distortion? In which power amplifier it is maximum?
4. Why class-A amplifier is used in transmitter modulators?
5. What is the maximum theoretical efficiency of a class-A amplifier?
6. Which harmonics are eliminated in the class –B push-pull amplifier?
7. What is meant by complementary symmetry push-pull amplifier? State its advantages.
8. Why the load is to be coupled through a transformer in a class-A amplifier?
9. Discuss the stability techniques of power amplifier?
10. Draw the thermal equivalent circuit of a power amplifier?

***

# VOLTAGE SERIES FEED BACK AMPLIFIER

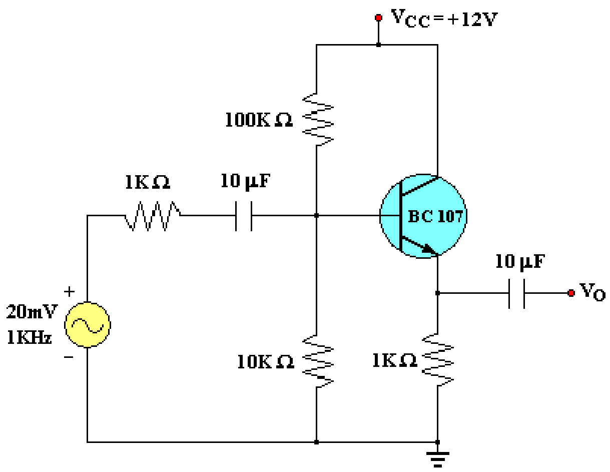
## CIRCUIT DIAGRAM:

## WITHOUT FEEDBACK:



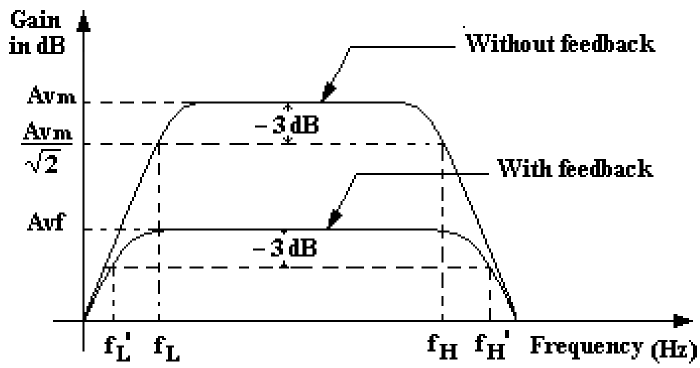

Voltage-Series W/O F/B Amplifier

## WITH FEEDBACK:




Voltage-Series with F/B Amplifier

## MODEL GRAPH:



# VOLTAGE SERIES FEED BACK AMPLIFIER

**AIM**: To Plot the frequency response curve of an amplifier with and without feedback.

**APPARATUS**:

| S.No | Name | Range / Value | Quantity |
|---|---|---|---|
| 1. | Regulated Power Supply | (0– 30V) | 1 |
| 2. | Transistor | BC 107 | 1 |
| 3. | Resistors | 100KΩ, 10KΩ | Each 1 |
| 4. | Resistors | 1KΩ | 2 |
| 5. | Capacitors | 10μF | 3 |
| 6. | Function generator | -- | 1 |
| 7. | CRO | -- | 1 |

**PROCEDURE**:

**AMPLIFIER WITHOUT FEEDBACK**:

1. Connect the circuit as shown in figure – 1.
2. Apply a 20mV sinusoidal signal at a frequency of 100Hz and observe the I/P waveform in the CRO.
3. Determine the O/P Voltage Vo using the CRO.
4. Determine the gain of the amplifier Av = Vo/Vi.
5. Now vary the frequency in convenient steps up to 1MHz keeping the I/P constant and for each frequency note down the O/P voltage.
6. Tabulate the readings.
7. Draw the graph between the frequency and the gain in decibels and determine the band width.

**AMPLIFIER WITH FEEDBACK**:

1. Connect the circuit as shown in figure – 2.
2. Apply a 20mV sinusoidal signal at a frequency of 100Hz and observe the I/P waveform in the CRO.
3. Determine the O/P Voltage Vo using the CRO.
4. Determine the gain of the amplifier Avf = Vo/Vi. Compare this gain with the gain of the Amplifier without feedback.
5. Now vary the frequency in convenient steps up to 1MHz keeping the I/P constant and for each frequency note down the O/P voltage.
6. Tabulate the readings.
7. Draw the graph between the frequency and the gain in decibels and determine the band width. Compare the band width with the band width of the Amplifier without feedback.

**TABULAR FORM:**

**Vi = 20mV**

| Frequency (Hz) | Without Feedback | | | With Feedback | | |
|---|---|---|---|---|---|---|
| | $V_0$ (Volts) | Gain $A_V=V_0/Vi$ | Gain in db ($20logA_V$) | O/P $V_0$ (Volts) | Gain $A_{Vf}=V_0/V_I$ | Gain in db ($20logA_V$) |
| 50 | | | | | | |
| 100 | | | | | | |
| 300 | | | | | | |
| 500 | | | | | | |
| 700 | | | | | | |
| 1K | | | | | | |
| 3K | | | | | | |
| 5K | | | | | | |
| 7K | | | | | | |
| 10K | | | | | | |
| 30K | | | | | | |
| 50K | | | | | | |
| 70K | | | | | | |
| 100K | | | | | | |
| 300K | | | | | | |
| 500K | | | | | | |
| 700K | | | | | | |
| 1MHz | | | | | | |

**RESULT:**

Gain of the Amplifier without feed back at Av =
Gain of the Amplifier with feedback at Avf =
Band width of the Amplifier without feed back =
Band width of the Amplifier with feed back =

**VIVA QUESTIONS:**

1. What are the different types of feedback topologies?
2. Which type of feed back incorporated in oscillators?
3. What are the advantages of negative feedback?
4. Why positive feedback is not used in Amplifiers?
5. What is the expression for the desensitivity factor in case of negative feed back?
6. What is the effect of negative feed back on band width of an Amplifier?

***