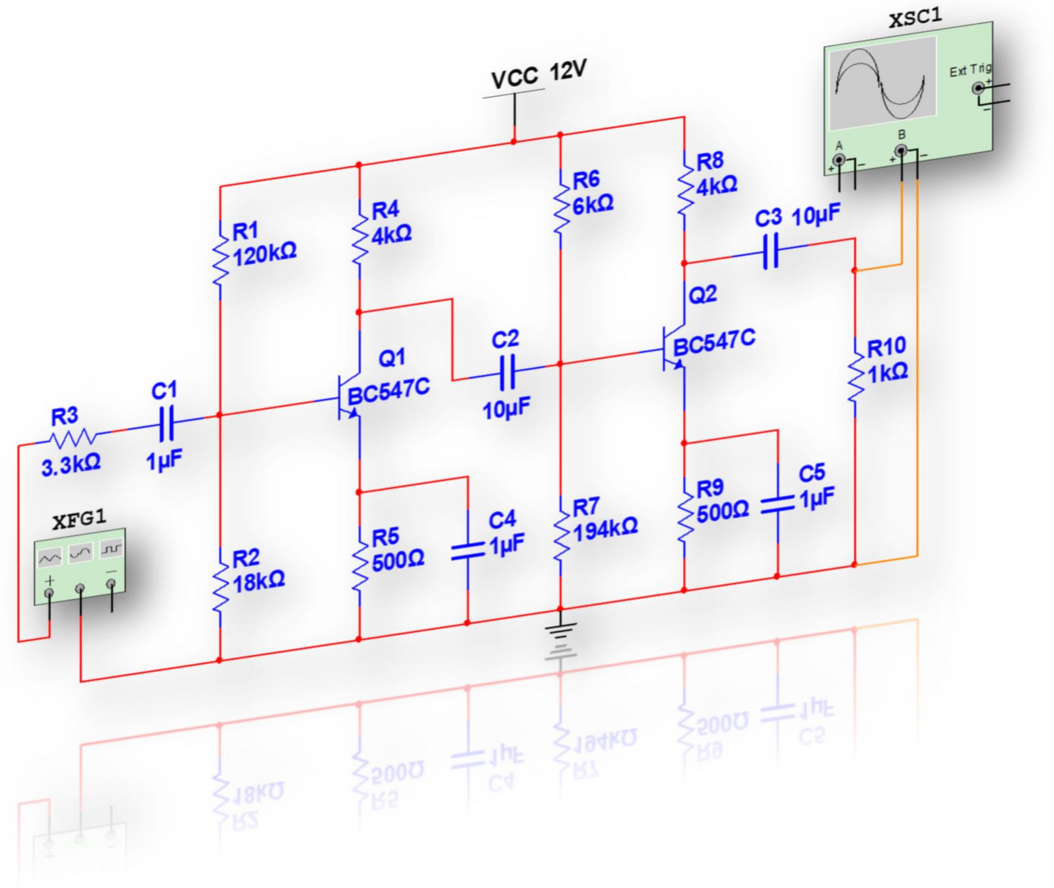
ELECTRONIC DEVICES AND CIRCUITS (EDC)
LABORATORY MANUAL

(B.E. THIRD SEMESTER - BEENE302P / BEECE302P/ BEETE302P)



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HOD
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DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

ANJUMAN COLLEGE OF ENGINEERING AND TECNHOLOGY

(AFFILIATED TO RTMNU & APPROVED BY AICTE)

VISION

WE ENDEAVOR TO IMPART QUALITY EDUCATION AND PROVIDE INTELLECT AND COMPETENT ENGINEERS, EQUIPPED TO MEET THE STANDARDS OF CHANGING INTERNATIONAL TECHNICAL SCENARIO.

MISSION

OUR MISSION IS TO PROVIDE VALUE BASED TECHNICAL EDUCATION AND TO MOULD THE CHARACTER OF THE YOUNGER GENERATION, THROUGH A SYNTHESIS OF SCIENCE & SPIRITUALITY, SO THAT THEIR EARNEST ENDEAVOR TO ACHIEVE PROSPERITY IN LIFE IS MATCHED BY AN ARDENT DESIRE TO EXTEND SELFLESS SERVICE TO THE SOCIETY, EACH COMPLEMENTING THE OTHER.

OBJECTIVE

TO LET THE STUDENTS BUILT THE ELECTRONIC CIRCUITS ON BREADBOARD AND MULTISIM OR PSPICE, INTERPRET BASIC CONCEPTS OF DIFFERENT SEMICONDUCTOR COMPONENTS, DEMONSTRATE THEIR WORKING IN THE CIRCUITS, EVALUATE PERFORMANCE PARAMETERS AND PLOT THE CHARACTERISTICS.

COURSE OUTCOME

1. The students will be able to interpret the basic concepts of different semiconductor components as a group & individual.
2. The students will be able to demonstrate the working of semiconductor devices in different electronic circuits as a group & individual.
3. The students will be able to evaluate different performance parameters of semiconductor devices and various electronics circuits like oscillators, multivibrators, amplifiers, etc.
4. The students will be able to explain the plot of characteristics of semiconductor devices and various electronics circuits like oscillators, multivibrators, amplifiers, etc. as a group & individual.
5. The students will be able to build the electronic circuit on breadboard and Multisim or Pspice, examine and show its working as a group & individual.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		-	1	-	-	-	1	-	-	-
CO2	3	-	-	-	-	-	-	-	1	1	3	-
CO3	3	-	-	3	-	-	-	-	-	-	1	1
CO4	3	3	-	-	-	-	-	-	3	1	-	-
CO5	3	-	-	-	3	-	-	-	3	-	-	-

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3:Substantial (High)

Anjuman College of Engineering and Technology
Department of Electronics and Telecommunication Engineering

ELECTRONIC DEVICES AND CIRCUITS LAB (BEETE302P)

Do's

1. Be punctual and regular in the lab.
2. Maintain Discipline all the time and obey the instructions.
3. Check the connections properly before turning ON the circuit.
4. Turn OFF the circuit immediately if you see any component heating.
5. Dismount all the components and wires before returning the kit.

Don'ts

1. Don't touch live electric wires.
2. Don't turn ON the circuit unless it is completed.
3. Avoid making loose connections.
4. Don't leave the lab without permission.

LIST OF EXPERIMENTS

1. To Plot V-I Characteristics of Si/Ge Diode [CO1,2,3,4,5,6]

AIM:

To draw the Voltage – Current (V-I) characteristics of PN junction diode under forward and reverse bias condition.

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

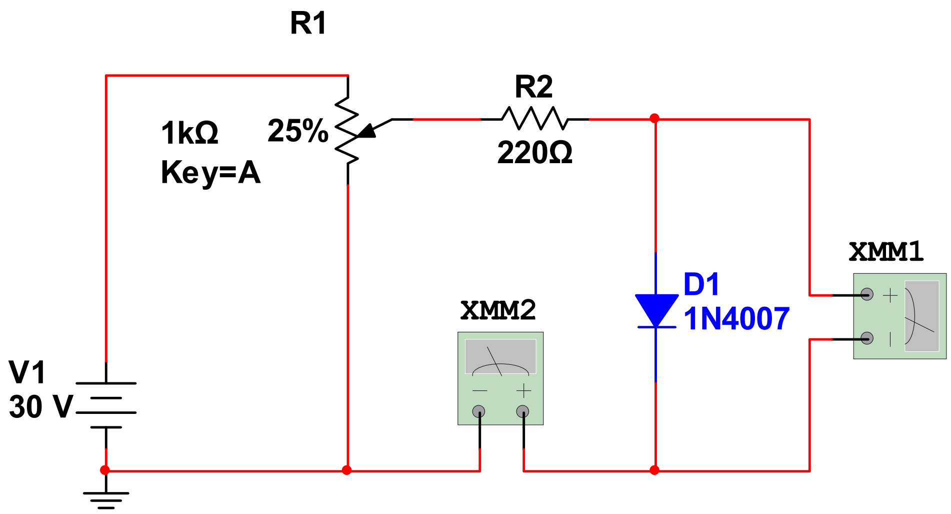


Figure 1.1: Forward Bias Circuit of PN Junction Diode

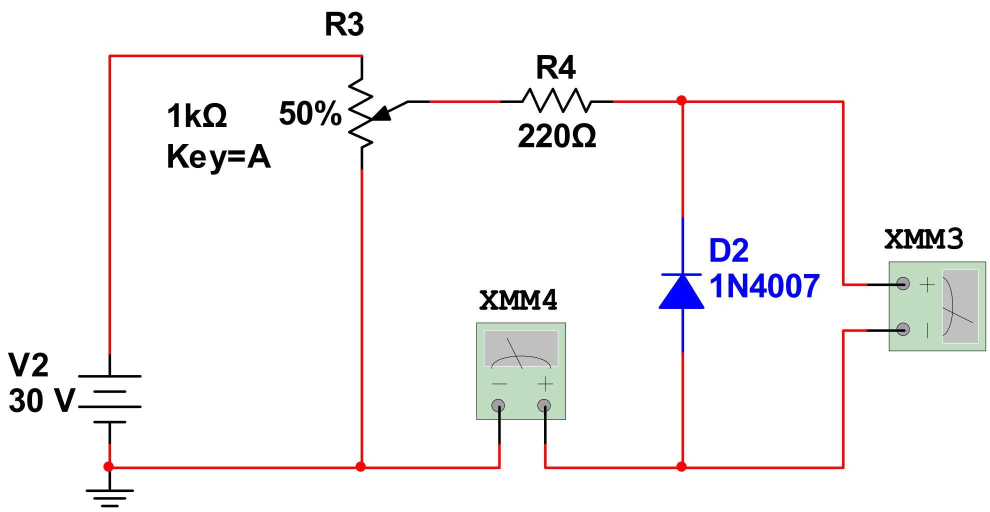


Figure 1.2: Reverse Bias Circuit of PN Junction Diode

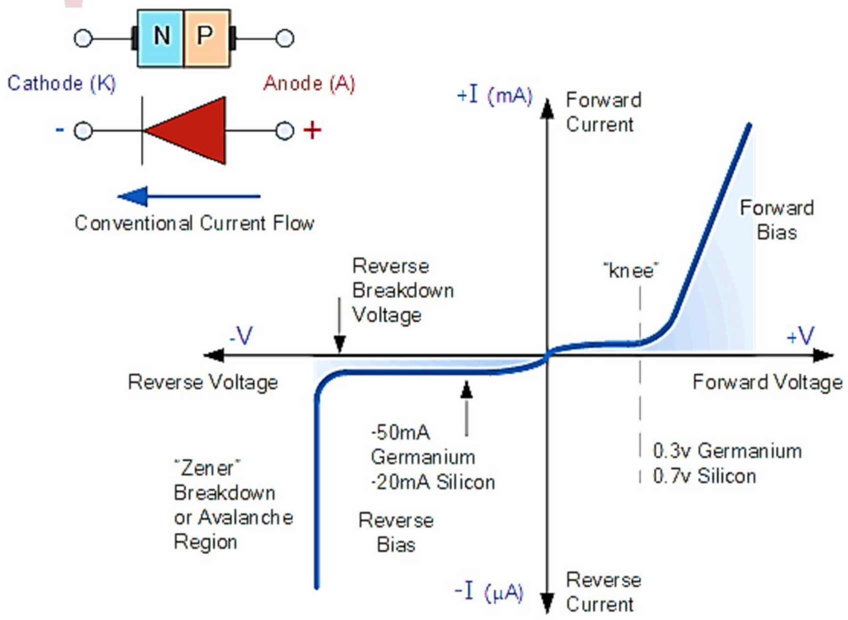


Figure 1.3: V-I Characteristics PN Junction Diode

THEORY:

A PN junction is formed by diffusing P-type material to one half side and N-type material another half side. The plane dividing the two zones is known as a junction.

FORWARD BIAS:

When the positive terminal of the external battery is connected to the P-region and negative terminal is connected to the N-region. Then it is called as forward biased PN junction.

REVERSE BIAS:

When the negative terminal of the external battery is connected to the P-region and positive terminal is connected to the N-region. Then it is called as reverse biased PN junction.

PROCEDURE:

- *For forward bias characteristic, make the connections as shown in the figure 1.1.*
- *Vary the voltage from minimum to its maximum value and note down the corresponding forward voltage V_F across the diode and the forward current I_F through the diode using voltmeter and ammeter respectively.*
- *For reverse bias characteristic, make the connections as shown in the figure 1.2.*
- *Vary the voltage from minimum to its maximum value and note down the corresponding reverse voltage V_R across the diode and the reverse current I_R through the diode using voltmeter and ammeter respectively.*
- *Plot the V-I characteristic for the forward and reverse bias of diode.*

OBSERVATION TABLE:

Sr. No.	Forward Characteristics		Reverse Characteristics	
	V_F (V)	I_F (mA)	V_R (V)	I_R (μA)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

CALCULATIONS:

- *Cut-in Voltage = Knee Voltage = _____ V*
- *Static forward Resistance,* $R_{f_S} = V_F / I_F = \quad / \quad =$ ______Ω
- *Dynamic Forward Resistance,* $R_{f_D} = \Delta V_F / \Delta I_F = \quad / \quad =$ ______Ω
- *Static Reverse Resistance,* $R_{r_s} = V_R / I_R = \quad / \quad =$ ______Ω
- *Dynamic Reverse Resistance,* $R_{r_D} = \Delta V_R / \Delta I_R = \quad / \quad =$ ______Ω

RESULT:

Voltage–Current (V-I) characteristics of PN junction diode under forward and reverse bias condition has been observed.

2. To Plot V-I Characteristics of Zener Diode [CO1,2,3,4,5,6]

AIM:

To draw the Voltage – Current (V-I) characteristics of Zener diode under forward and reverse bias condition.

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

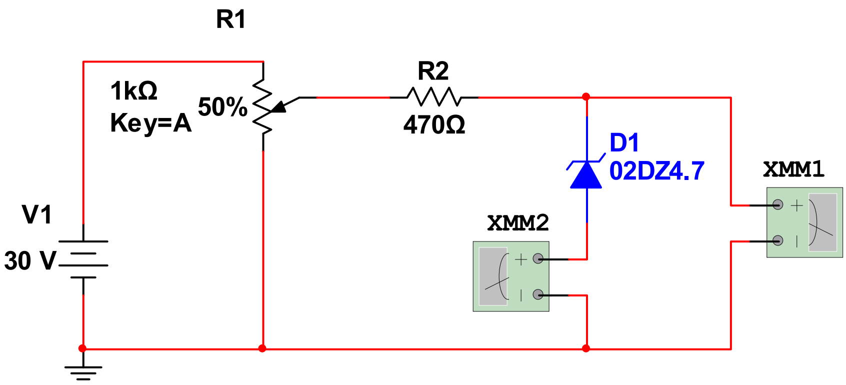


Figure 2.1: Forward Bias Circuit of Zener Diode

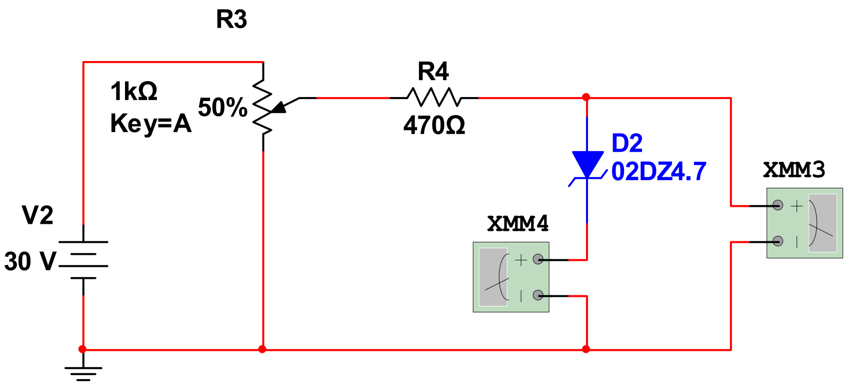


Figure 2.2: Reverse Bias Circuit of Zener Diode

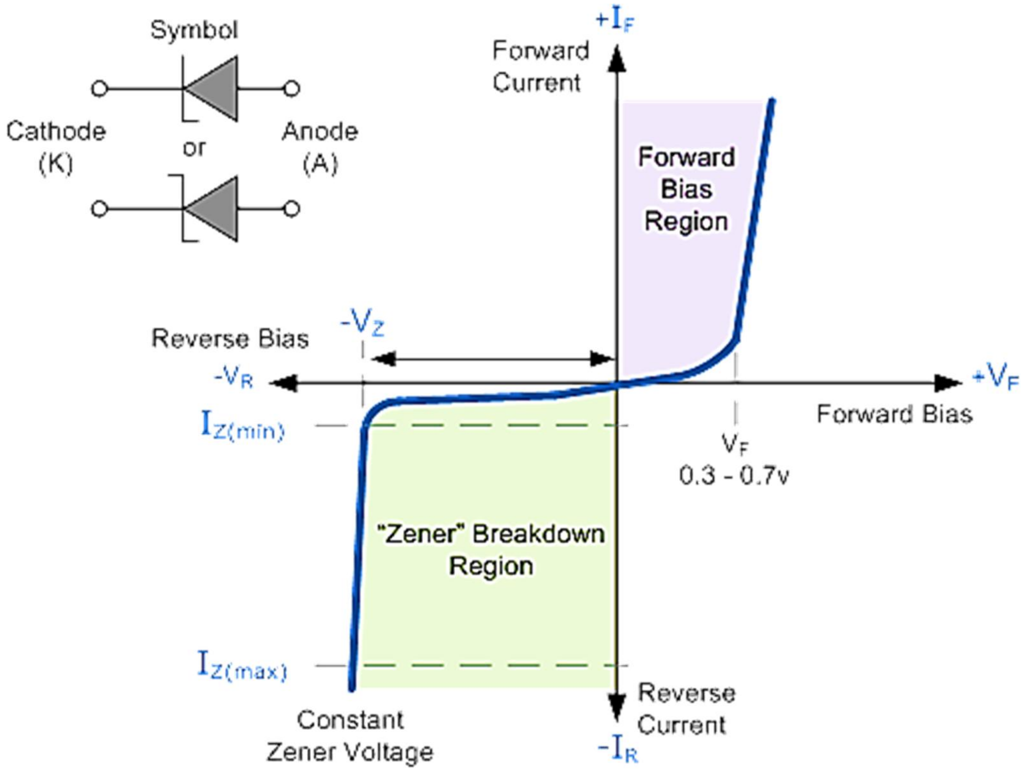


Figure 2.3: V-I Characteristics Zener Diode

THEORY:

A PN junction in Zener diode is formed by diffusing heavily doped P-type material to one half side and heavily doped N-type material other half side. The plane dividing the two zones is known as a junction.

FORWARD BIAS:

When the positive terminal of the external battery is connected to the P-region and negative terminal is connected to the N-region on Zener diode. Then it is said to be forward biased.

REVERSE BIAS:

When the negative terminal of the external battery is connected to the P-region and positive terminal is connected to the N-region of Zener diode. Then it is said to be reverse biased.

PROCEDURE:

- *For forward bias characteristic, make the connections as shown in the figure 2.1.*
- *Vary the voltage from minimum to its maximum value and note down the corresponding forward voltage V_F across the Zener diode and the forward current I_F through the Zener diode using voltmeter and ammeter respectively.*
- *For reverse bias characteristic, make the connections as shown in the figure 2.2.*
- *Vary the voltage from minimum to its maximum value and note down the corresponding reverse voltage V_R across the diode and the reverse current I_R through the diode using voltmeter and ammeter respectively.*
- *Plot the V-I characteristic for the forward and reverse bias of diode.*

OBSERVATION TABLE:

Sr. No.	Forward Characteristics		Reverse Characteristics	
	V_F (V)	I_F (mA)	V_R (V)	I_R (μA)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

CALCULATIONS:

- *Cut-in Voltage = Knee Voltage = _____ V*
- *Static forward Resistance,* $R_{f_S} = V_F / I_F = \quad / \quad =$ ______Ω
- *Dynamic Forward Resistance,* $R_{f_D} = \Delta V_F / \Delta I_F = \quad / \quad =$ ______Ω
- *Static Reverse Resistance,* $R_{r_s} = V_R / I_R = \quad / \quad =$ ______Ω
- *Dynamic Reverse Resistance,* $R_{r_D} = \Delta V_R / \Delta I_R = \quad / \quad =$ ______Ω

RESULT:

Voltage–Current (V-I) characteristics of Zener diode under forward and reverse bias condition has been observed.

3. To study HWR and FWR with C filter [CO1,2,3,4,5,6]

AIM:

To study Half Wave and Full Wave rectifier with and without Capacitor filter.

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

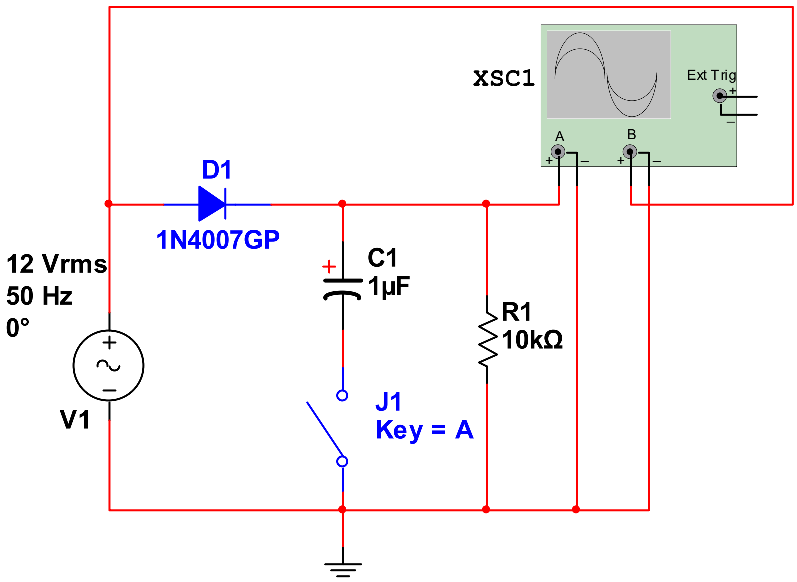


Figure 3.1: Half wave Rectifier with and without filter

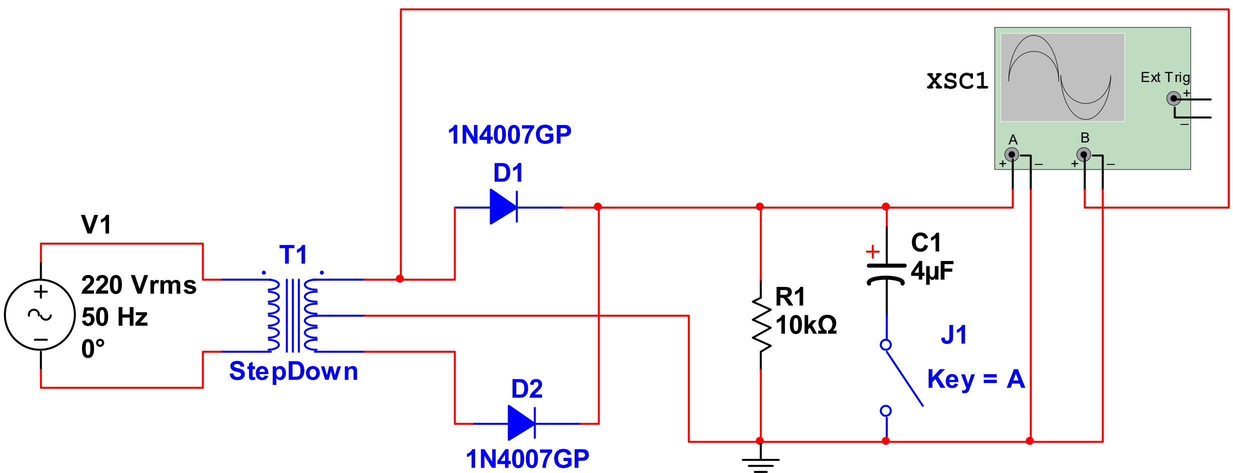


Figure 3.2: Center Tap Full Wave Rectifier with and without filter

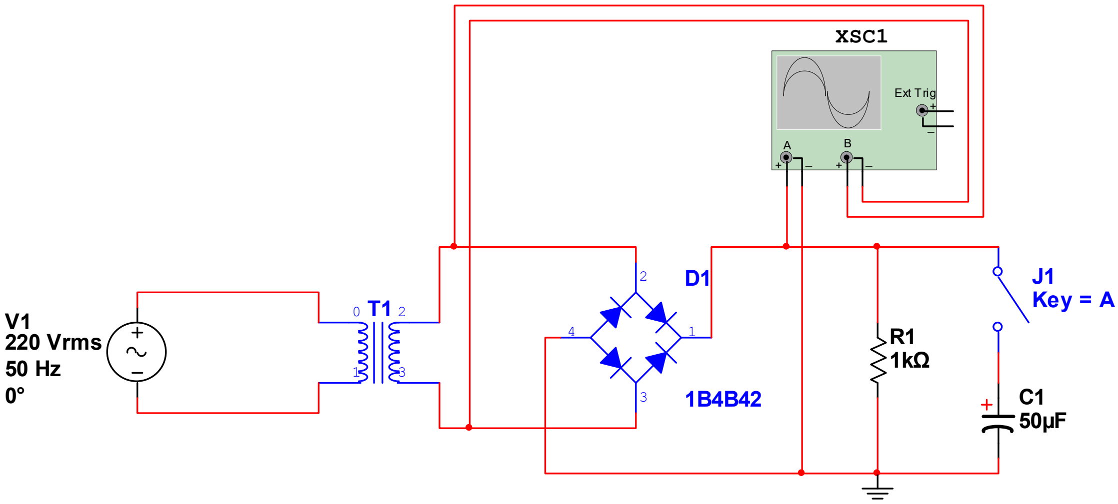


Figure 3.3: Full Wave Bridge Rectifier with and without filter

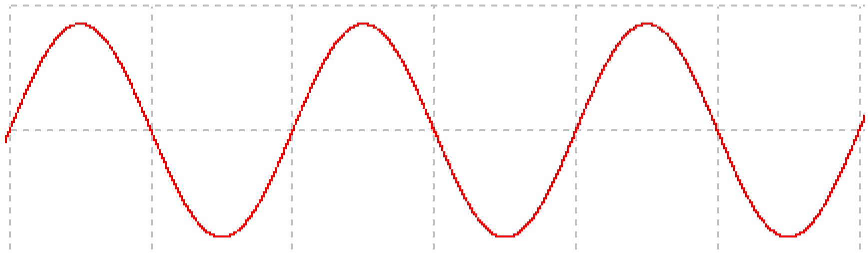


Figure 3.4: Input A.C. Signal

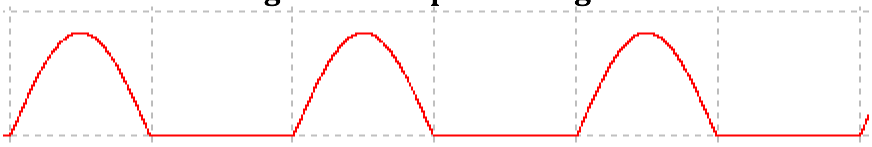


Figure 3.5: Half wave rectified Output Signal without filter

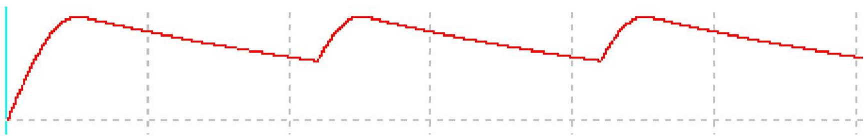


Figure 3.6: Half wave rectified Output Signal with filter

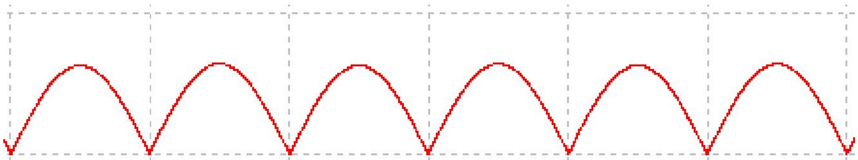


Figure 3.7: Full wave rectified Output Signal without filter

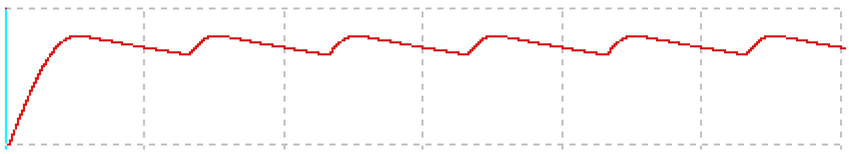


Figure 3.8: Full wave rectified Output Signal with filter

THEORY:

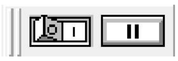
HALF WAVE RECTIFIER:

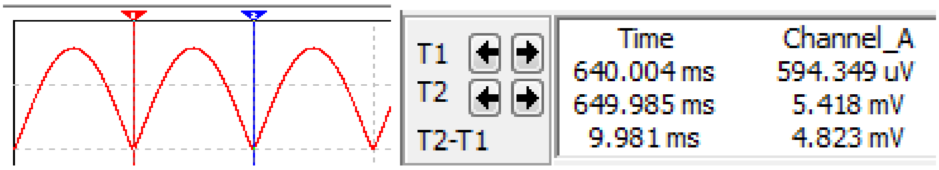
In half wave rectification, the rectifier conducts current only during the positive half cycles of input ac supply. The negative half cycles are suppressed. During positive half cycle, the diode becomes forward biased and hence half cycle appears at the output. During negative half cycle, the diode becomes reverse biased and conducts no current, hence output is zero for this period.

FULL WAVE RECTIFIER:

In full wave rectification, current flows through the load in the same direction for both half cycles of input ac voltage. This can be achieved with two diodes working alternately. For positive half cycle, one diode supplies current to the load and for the negative half cycle, the other diode does so. In this way full wave rectifier produces dc output.

PROCEDURE:

- *Connect the components as shown in figure.*
- *Run the circuit by pressing*  *button or Pressing F5 key of keyboard.*
- *Double click on Oscilloscope to get the nature of output.*
- *Adjust Scale and Y position in CRO to adjust input and output waveforms on its screen.*
- *Measure time period and frequency of output signal with and without filter by pausing the simulation by pressing the pause button* 
- *Adjust one pointer at the start of cycle and another at it's end to get the time period as shown below*



In this case time period is T2-T1=9.981 ms

OBSERVATION TABLE:

Half Wave Rectifier

Description	Amplitude (V_m)	Time Period (T)	Frequency (f)
Input Voltage			
Output Voltage without filter			
Output Voltage with filter			

Full Wave Rectifier

Description	Amplitude (V_m)	Time Period (T)	Frequency (f)
Input Voltage			
Output Voltage without filter			
Output Voltage with filter			

RESULT:

Thus, Half Wave and Full Wave rectifier with and without Capacitor filter have been studied.

4. To study I/O characteristics of CE Configuration. [CO1,2,3,4,5,6]

AIM:

To study Input-output characteristics of Common Emitter Configuration.

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

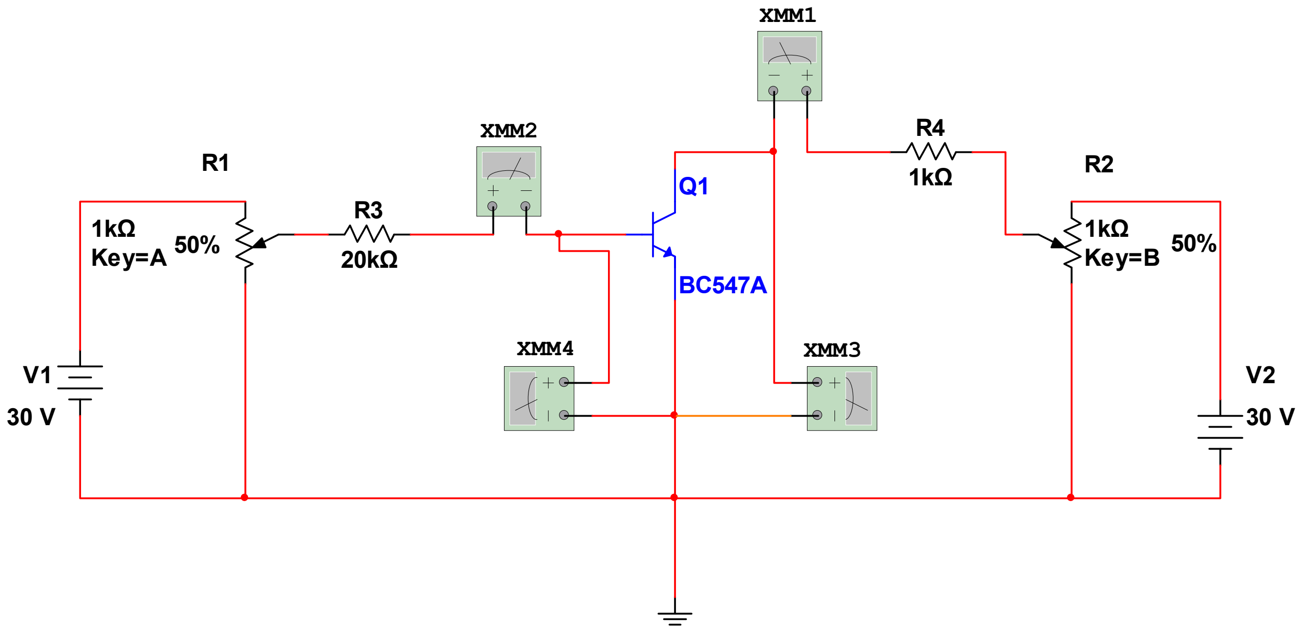


Figure 4.1: Common Emitter Amplifier circuit using npn transistor

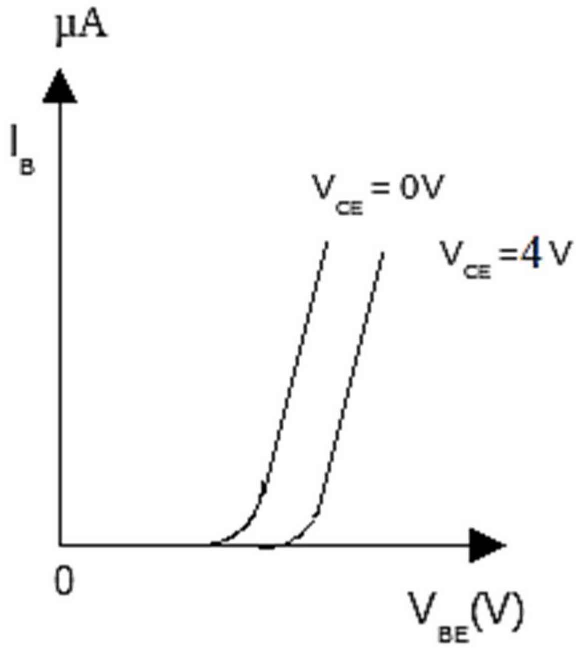


Figure 4.2: Input Characteristics

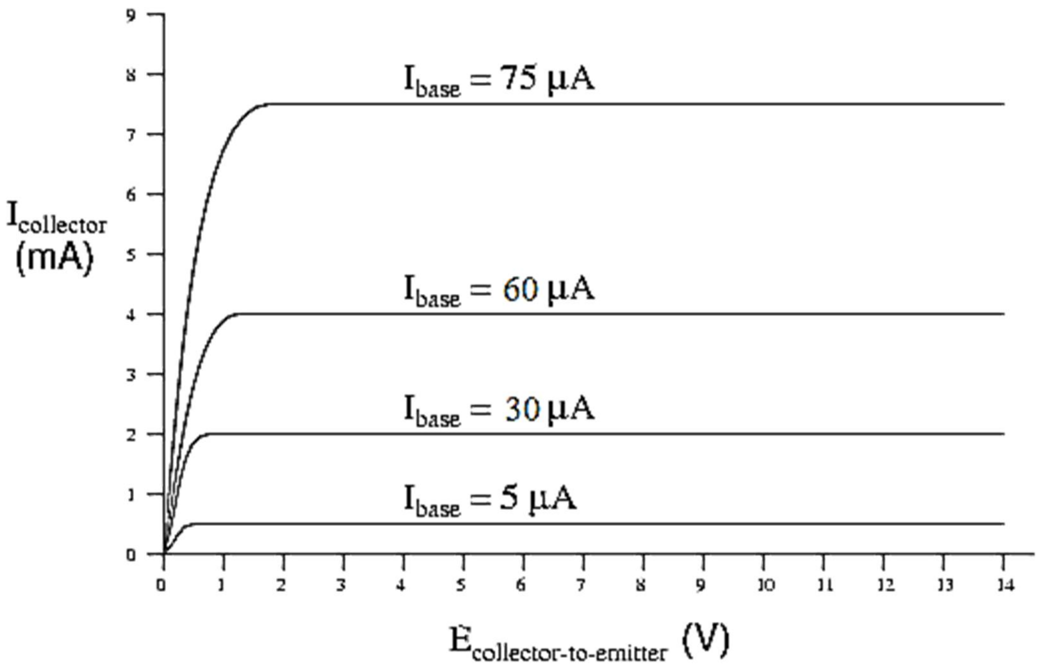


Figure 4.3: Output Characteristics

THEORY:

Bipolar junction transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of transistors namely NPN and PNP. It consists of two P-N junctions namely emitter junction and collector junction.

In Common Emitter configuration, the input is applied between base and emitter and the output is taken from collector and emitter. Here emitter is common to both input and output and hence the name common emitter configuration.

Input characteristics are obtained between the input current and input voltage taking output voltage as constant. It is plotted between VBE and IB at constant VCE in CE configuration.

Output characteristics are obtained between the output voltage and output current taking input current as constant. It is plotted between VCE and IC at constant IB in CE configuration.

INPUT CHARACTERISTICS:

It is the curve between base current I_B and base emitter voltage V_{BE} at constant collector emitter voltage.

INPUT RESISTANCE:

It is defined as the ratio of change in base-emitter voltage to the change in base current at constant V_{CE}.

PROCEDURE:

Input Characteristics

- *Connect the transistor in CE configuration as per circuit diagram*
- *Keep output voltage V_{CE} = 1V by varying V_{CC}.*
- *Varying V_{BB} gradually, note down both base current I_B and base–emitter voltage (V_{BE}).*
- *Repeat above procedure (step 3) for various values of V_{CE}.*

Output Characteristics

- *Make the connections as per circuit diagram.*
- *By varying V_{BB} keep the base current I_B = 20μA.*
- *Varying V_{CC} gradually, note down the readings of collector current (I_C) and collector-emitter voltage (V_{CE}).*
- *Repeat above procedure (step 3) for different values of I_B.*

OBSERVATION TABLE:

INPUT CHARACTERISTICS

V_{CE} = ___ V (e.g.1V)		V_{CE} = ___V (e.g.4V)	
V_{BE} (volts)	I_B (mA)or(μA)	V_{BE} (volts)	I_B (mA)or(μA)

OUTPUT CHARACTERISTICS

I_B = ________ (e.g.20μA)		I_B = ______ (e.g.60 μA)	
V_{CE} (volts)	I_C (mA)	V_{CE} (volts)	I_C (mA)

CALCULATIONS:

Input resistance: $R_i = \Delta V_{BE}/\Delta I_B =$ __________Ω (V_{CE} *constant*)

Output resistance: $R_o = \Delta V_{CE}/\Delta I_C =$ _________Ω (IB *constant*)

RESULT:

Thus, the input and output characteristics of CE configuration is plotted.

1. Input Resistance (Ri) = __________*Ω*

2. Output Resistance (Ro) = _________*Ω*

5. To determine the h-parameter of CE amplifiers. [CO1,2,3,4,5,6]

AIM:

To determine the h-parameter of CE amplifiers

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

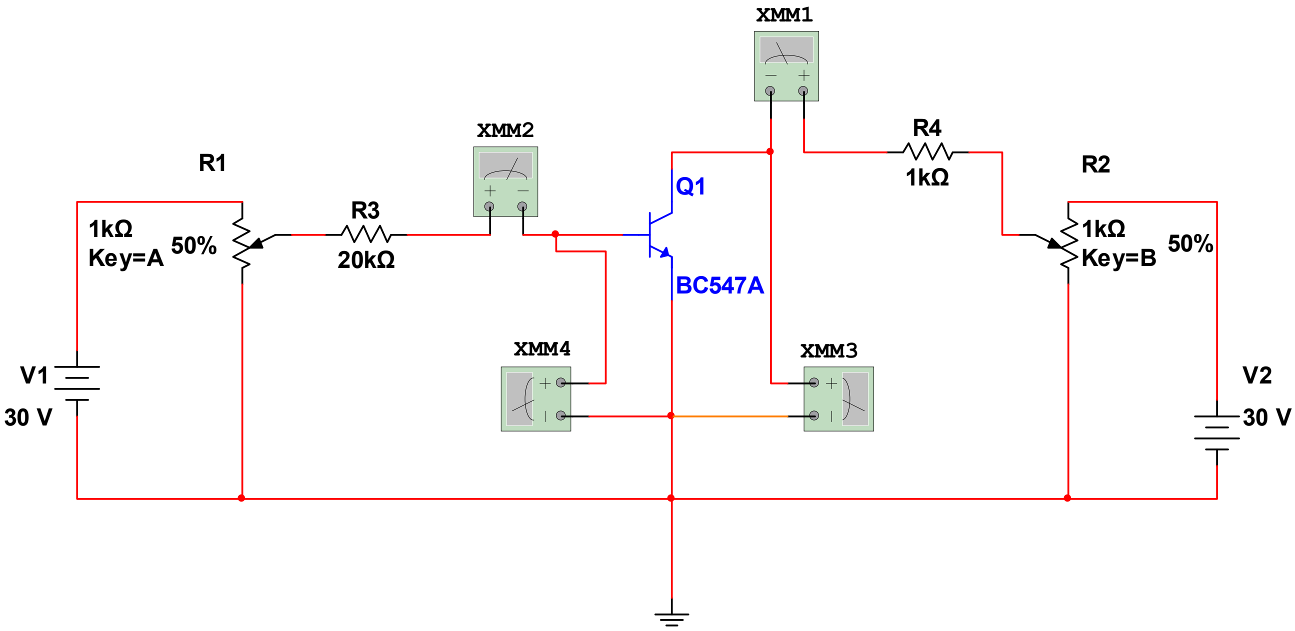


Figure 5.1: Common Emitter Amplifier circuit using npn transistor

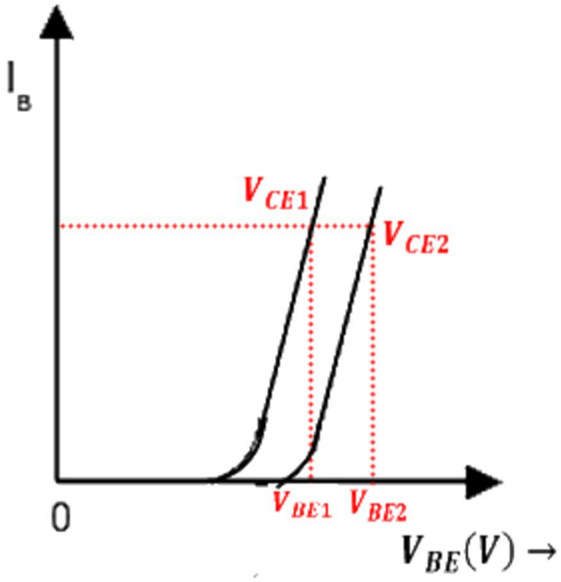


Figure 5.2: Input Characteristics to find h_{ie} & h_{re}

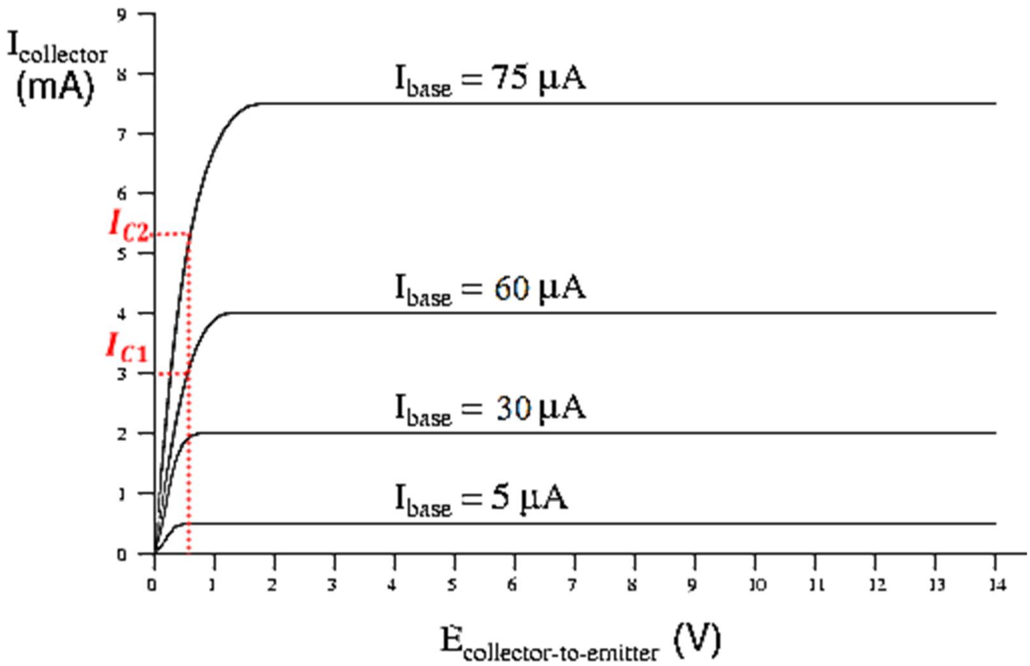


Figure 5.3: Output Characteristics to find h_{fe} & h_{oe}

THEORY:

Bipolar junction transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of transistors namely NPN and PNP. It consists of two P-N junctions namely emitter junction and collector junction.

In Common Emitter configuration, the input is applied between base and emitter and the output is taken from collector and emitter. Here emitter is common to both input and output and hence the name common emitter configuration.

Hybrid means "mixed". Since these parameters have mixed dimensions, they are called hybrid parameters. The major reason for the use of h-parameters is the relative ease with which they can be measured.

PROCEDURE:

Input Characteristics

- *Connect the transistor in CE configuration as per circuit diagram*
- *Keep output voltage V_{CE} = 1V by varying V_{CC}.*
- *Varying V_{BB} gradually, note down both base current I_B and base–emitter voltage (V_{BE}).*
- *Repeat above procedure (step 3) for various values of V_{CE}.*

Output Characteristics

- *Make the connections as per circuit diagram.*
- *By varying V_{BB} keep the base current I_B = 20µA.*
- *Varying V_{CC} gradually, note down the readings of collector current (I_C) and collector-emitter voltage (V_{CE}).*
- *Repeat above procedure (step 3) for different values of I_B.*

OBSERVATION TABLE:

INPUT CHARACTERISTICS				OUTPUT CHARACTERISTICS			
V_{CE} = ___ V		V_{CE} = ___V		I_B = 30 μA		I_B = 60 μA	
V_{BE} (volts)	I_B (mA)	V_{BE} (volts)	I_B (mA)	V_{CE} (volts)	I_C (mA)	V_{CE} (volts)	I_C (mA)

CALCULATIONS:

- $Input\ impedance\ (h_{ie}) = \frac{\Delta V_{BE}}{\Delta I_B}\ , V_{CE}\ constant.$
- $Forward\ current\ gain(h_{fe}) = \frac{\Delta I_C}{\Delta I_B}\ , V_{CE}\ constant$
- $Output\ admittance(h_{oe}) = \frac{\Delta I_C}{\Delta V_{CE}}\ , I_B\ constant$
- $Reverse\ voltage\ gain(h_{re}) = \frac{\Delta V_{BE}}{\Delta V_{CE}}\ , I_B\ constant$

RESULT:

Thus, the hybrid parameters of CE configuration are determined.

$Input\ impedance\ (h_{ie}) =$ ___________ Ω

$Forward\ current\ gain(h_{fe}) =$ _______

$Output\ admittance(h_{oe}) =$ _________ Ω^{-1}

$Reverse\ voltage\ gain(h_{re}) =$ ___________

6. To study I/O characteristics of CB Configuration. [CO1,2,3,4,5,6]

AIM:

To study Input-output characteristics of Common Base Configuration.

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

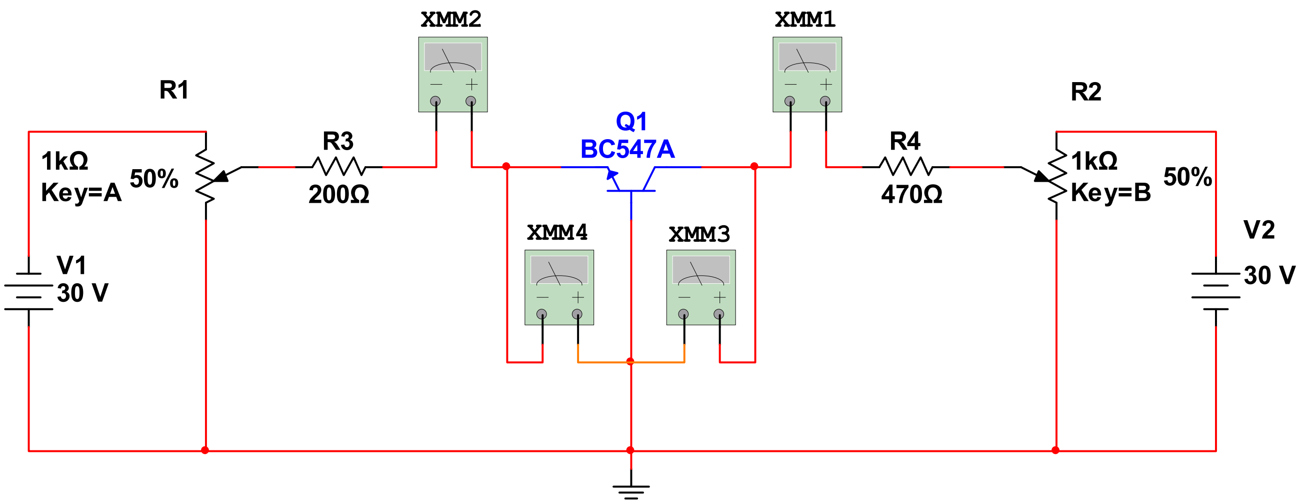


Figure 6.1: Common Base Amplifier circuit using npn transistor

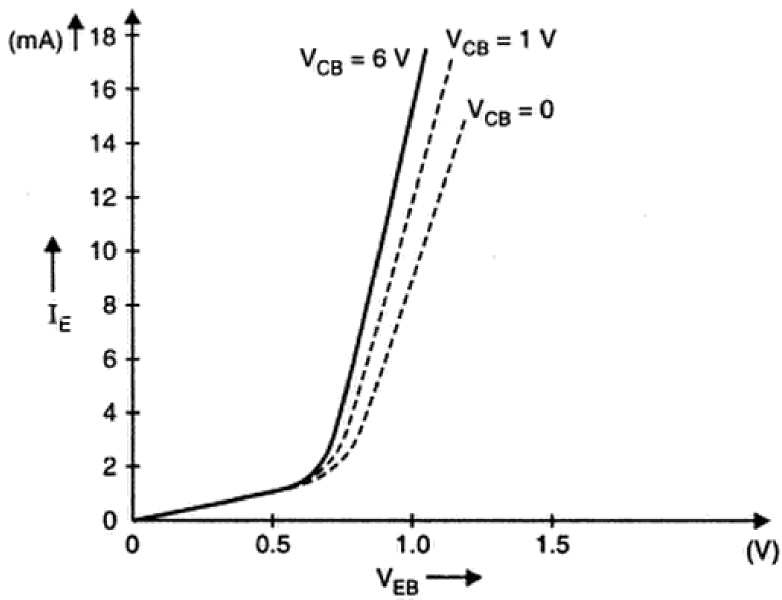


Figure 6.2: Input Characteristics

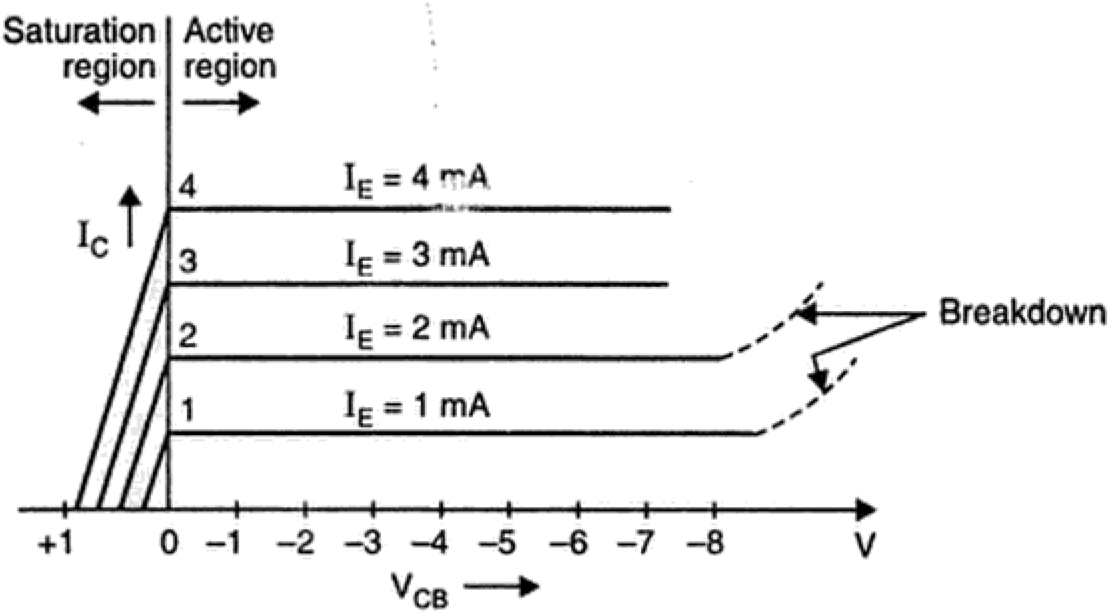


Figure 6.3: Output Characteristics

THEORY:

Bipolar junction transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of transistors namely NPN and PNP. It consists of two P-N junctions namely emitter junction and collector junction.

In Common Base configuration, the input is applied between emitter and base and the output is taken from collector and base. Here base is common to both input and output and hence the name common base configuration.

Input characteristics are obtained between the input current and input voltage taking output voltage as constant. It is plotted between V_{EB} and I_E at constant V_{CB} in CB configuration.

Output characteristics are obtained between the output voltage and output current taking input current as constant. It is plotted between V_{CB} and I_C at constant I_E in CB configuration.

INPUT CHARACTERISTICS:

It is the curve between emitter current I_E and emitter base voltage V_{EB} at constant collector base voltage.

INPUT RESISTANCE:

It is defined as the ratio of change in emitter-base voltage to the change in emitter current at constant V_{CB}.

PROCEDURE:

Input Characteristics

- ❖ *Connect the transistor in CB configuration as per circuit diagram*
- ❖ *Keep output voltage V_{CB} = ___V by varying V_{CC}.*
- ❖ *Varying V_{EE} gradually, note down both emitter current I_E and emitter-base voltage (V_{EB}).*
- ❖ *Repeat above procedure (step 3) for various values of V_{CB}.*

Output Characteristics

- ❖ *Make the connections as per circuit diagram.*
- ❖ *By varying V_{EE} keep the emitter current I_E = ___ mA.*
- ❖ *Varying V_{CC} gradually, note down the readings of collector current (I_C) and collector-base voltage (V_{CB}).*
- ❖ *Repeat above procedure (step 3) for different values of I_E.*

OBSERVATION TABLE:

INPUT CHARACTERISTICS				OUTPUT CHARACTERISTICS			
V_{CB} = ___ V		V_{CB} = ___V		I_E = ___ mA		I_E = ___ mA	
V_{EB} (volts)	I_E (mA)	V_{EB} (volts)	I_E (mA)	V_{CB} (volts)	I_C (mA)	V_{CB} (volts)	I_C (mA)

CALCULATIONS:

Input resistance: $R_i = \Delta V_{EB}/\Delta I_E \ \ (V_{CB}\ constant)$

Output resistance: $R_o = \Delta V_{CB}/\Delta I_C \ \ (I_E\ constant)$

Input Resistance (R_i) = ____________Ω Output Resistance (R_o) = ___________Ω

RESULT:

Thus, the input and output characteristics of CB configuration is plotted.

7. To determine the h-parameter of CB amplifiers. [CO1,2,3,4,5,6]

AIM:

To determine the h-parameter of CB amplifiers

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

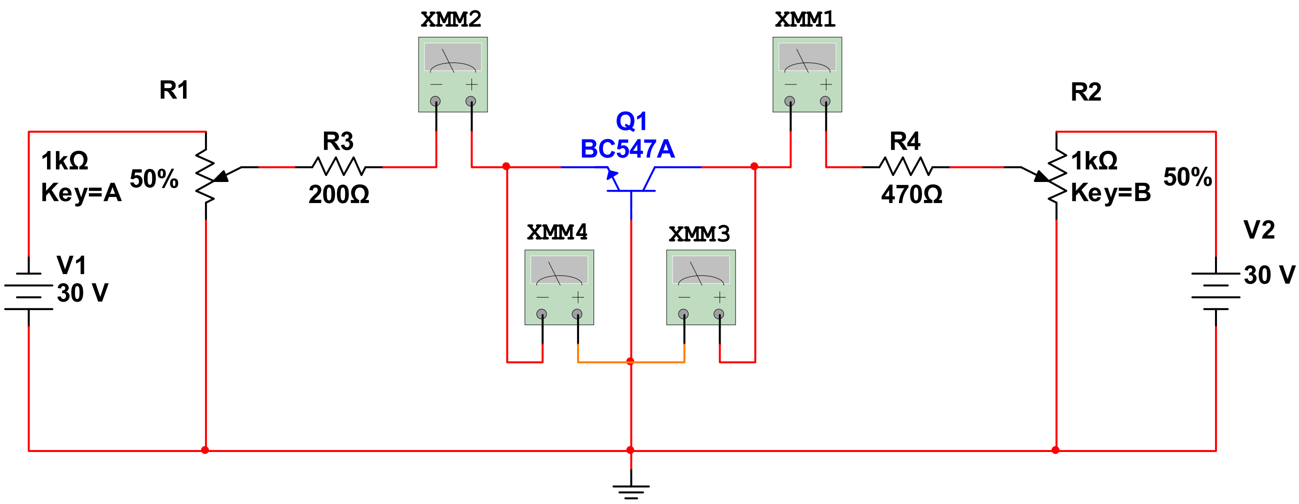


Figure 7.1: Common Base Amplifier circuit using npn transistor

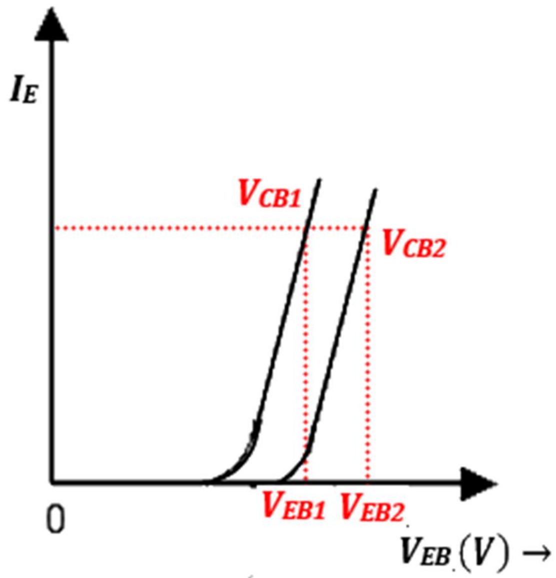


Figure 7.2: Input Characteristics to find h_{ib} & h_{rb}

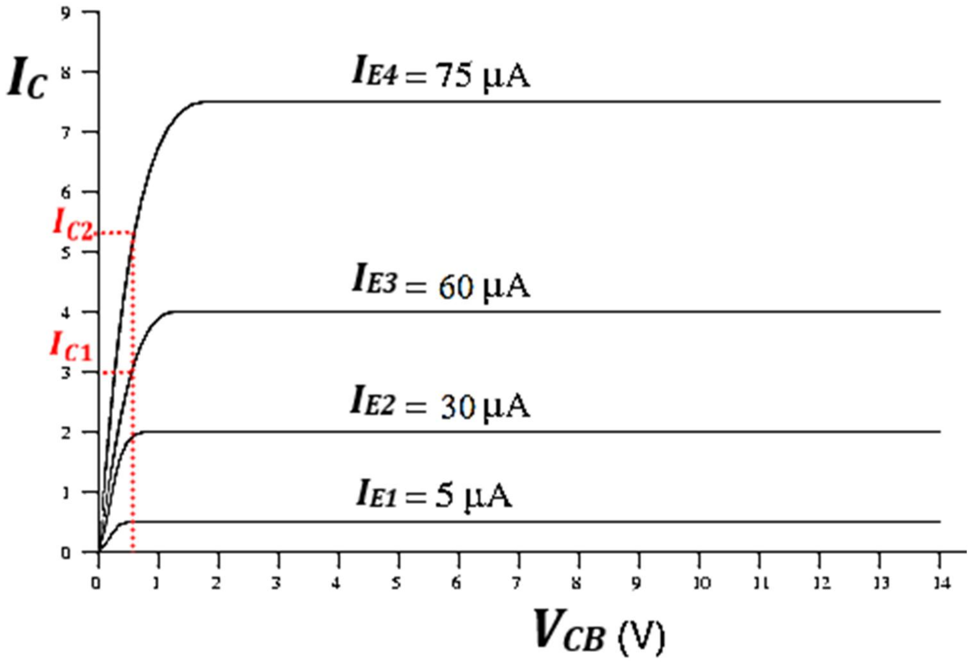


Figure 7.3: Output Characteristics to find h_{fb} & h_{ob}

THEORY:

Bipolar junction transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of transistors namely NPN and PNP. It consists of two P-N junctions namely emitter junction and collector junction.

In Common Base configuration, the input is applied between emitter and base and the output is taken from collector and base. Here base is common to both input and output and hence the name common base configuration.

Hybrid means "mixed". Since these parameters have mixed dimensions, they are called hybrid parameters. The major reason for the use of h-parameters is the relative ease with which they can be measured.

PROCEDURE:

Input Characteristics

- *Connect the transistor in CB configuration as per circuit diagram*
- *Keep output voltage V_{CB} = ___V by varying V_{CC}.*
- *Varying V_{EE} gradually, note down both emitter current I_E and emitter-base voltage (V_{EB}).*
- *Repeat above procedure (step 3) for various values of V_{CB}.*

Output Characteristics

- *Make the connections as per circuit diagram.*
- *By varying V_{EE} keep the base current I_E = ___ mA.*
- *Varying V_{CC} gradually, note down the readings of collector current (I_C) and collector-base voltage (V_{CB}).*
- *Repeat above procedure (step 3) for different values of I_E.*

OBSERVATION TABLE:

INPUT CHARACTERISTICS				OUTPUT CHARACTERISTICS			
V_{CB} = ___ V		V_{CB} = ____V		I_C = ____ μA		I_C = ____ μA	
V_{BE} (volts)	I_B (mA)	V_{BE} (volts)	I_B (mA)	V_{CB} (volts)	I_C (mA)	V_{CB} (volts)	I_C (mA)

CALCULATIONS:

- $Input\ impedance\ (h_{ib}) = \frac{\Delta V_{EB}}{\Delta I_E}\ , V_{CB}\ constant.$
- $Forward\ current\ gain(h_{fb}) = \frac{\Delta I_C}{\Delta I_E}\ , V_{CB}\ constant$
- $Output\ admittance(h_{ob}) = \frac{\Delta I_C}{\Delta V_{CB}}\ , I_E\ constant$
- $Reverse\ voltage\ gain(h_{rb}) = \frac{\Delta V_{EB}}{\Delta V_{CB}}\ , I_E\ constant$

- $Input\ impedance\ (h_{ib}) =$ __________ Ω
- $Forward\ current\ gain(h_{fb}) =$ _______
- $Output\ admittance(h_{ob}) =$ ________ Ω^{-1}
- $Reverse\ voltage\ gain(h_{rb}) =$ __________

RESULT:

Thus, the hybrid parameters of CB configuration are determined.

8. To study I/O characteristics of CC Configuration. [CO1,2,3,4,5,6]

AIM:

To study Input-output characteristics of Common Collector Configuration.

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

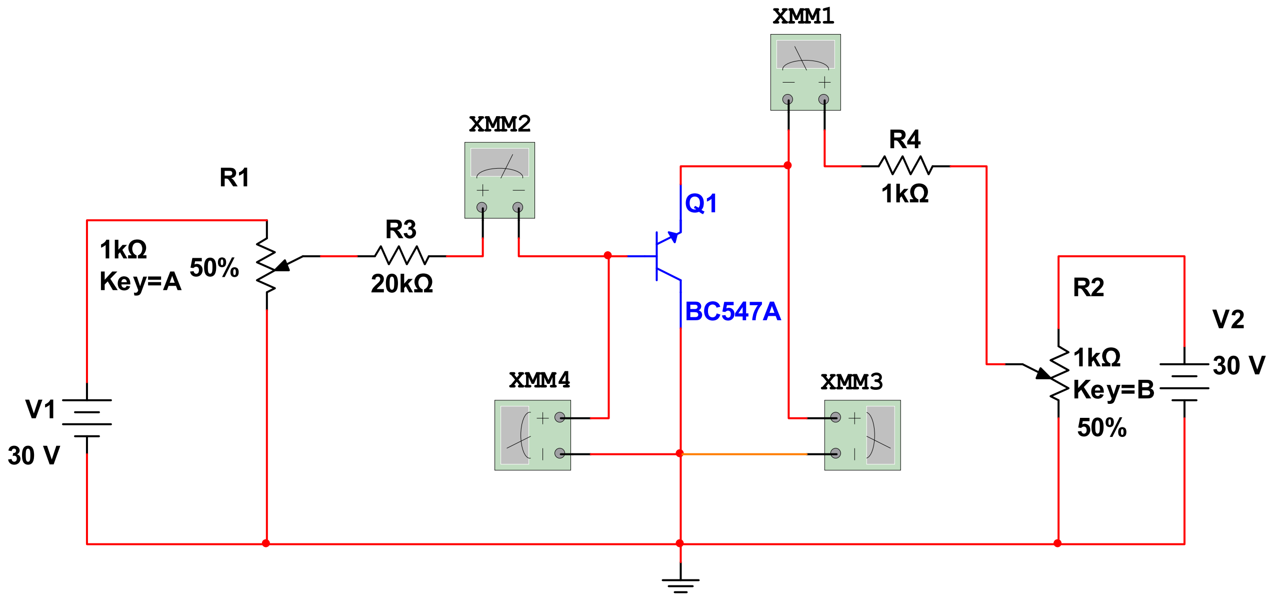


Figure 8.1: Common Collector Amplifier circuit using npn transistor

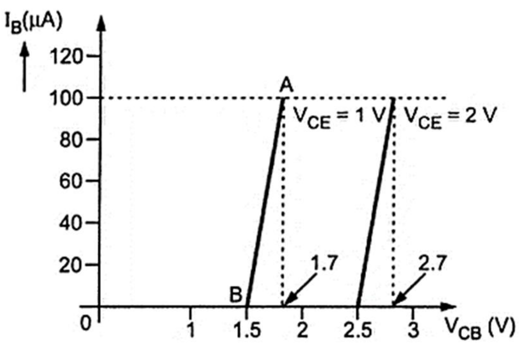


Figure 8.2: Input Characteristics

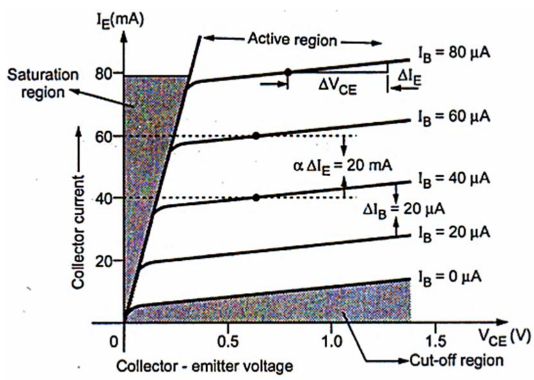


Figure 8.3: Output Characteristics

THEORY:

Bipolar junction transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of transistors namely NPN and PNP. It consists of two P-N junctions namely emitter junction and collector junction.

In Common Collector configuration, the input is applied between base and collector and the output is taken from emitter and collector. Here collector is common to both input and output and hence the name common collector configuration.

Input characteristics are obtained between the input current and input voltage taking output voltage as constant. It is plotted between V_{BC} and I_B at constant V_{EC} in CC configuration.

Output characteristics are obtained between the output voltage and output current taking input current as constant. It is plotted between V_{EC} and I_E at constant I_B in CC configuration.

INPUT CHARACTERISTICS:

It is the curve between base current I_B and base collector voltage V_{BC} at constant emitter collector voltage.

INPUT RESISTANCE:

It is defined as the ratio of change in base-collector voltage to the change in base current at constant V_{EC}.

PROCEDURE:

Input Characteristics

- *Connect the transistor in CC configuration as per circuit diagram*
- *Keep output voltage V_{EC} = ___V by varying V_{EE}.*
- *Varying V_{BB} gradually, note down both base current I_B and base-collector voltage (V_{BC}).*
- *Repeat above procedure (step 3) for various values of V_{EC}.*

Output Characteristics

- *Make the connections as per circuit diagram.*
- *By varying V_{BB} keep the base current I_B = ____ μA.*
- *Varying V_{EE} gradually, note down the readings of emitter current (I_E) and emitter collector voltage (V_{EC}).*
- *Repeat above procedure (step 3) for different values of I_B.*

OBSERVATION TABLE:

INPUT CHARACTERISTICS				OUTPUT CHARACTERISTICS			
V_{EC} = ___ V		V_{EC} = ____V		I_B = ___ μA		I_B = ___ μA	
V_{BC} (volts)	I_B (μA)	V_{BC} (volts)	I_B (μA)	V_{EC} (volts)	I_E (mA)	V_{EC} (volts)	I_E (mA)

CALCULATIONS:

Input resistance: $R_i = \Delta V_{BC}/\Delta I_B \ \ (V_{EC}\ constant)$

Output resistance: $R_o = \Delta V_{EC}/\Delta I_E \ \ (I_B\ constant)$

1. Input Resistance (R_i) = ____________Ω

2. Output Resistance (R_o) = ___________Ω

RESULT:

Thus, the input and output characteristics of CC configuration is plotted.

9. To determine the h-parameter of CC amplifiers [CO1,2,3,4,5,6]

AIM:

To determine the h-parameter of CC amplifiers

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires/PC with Multisim Software.

CIRCUIT DIAGRAM:

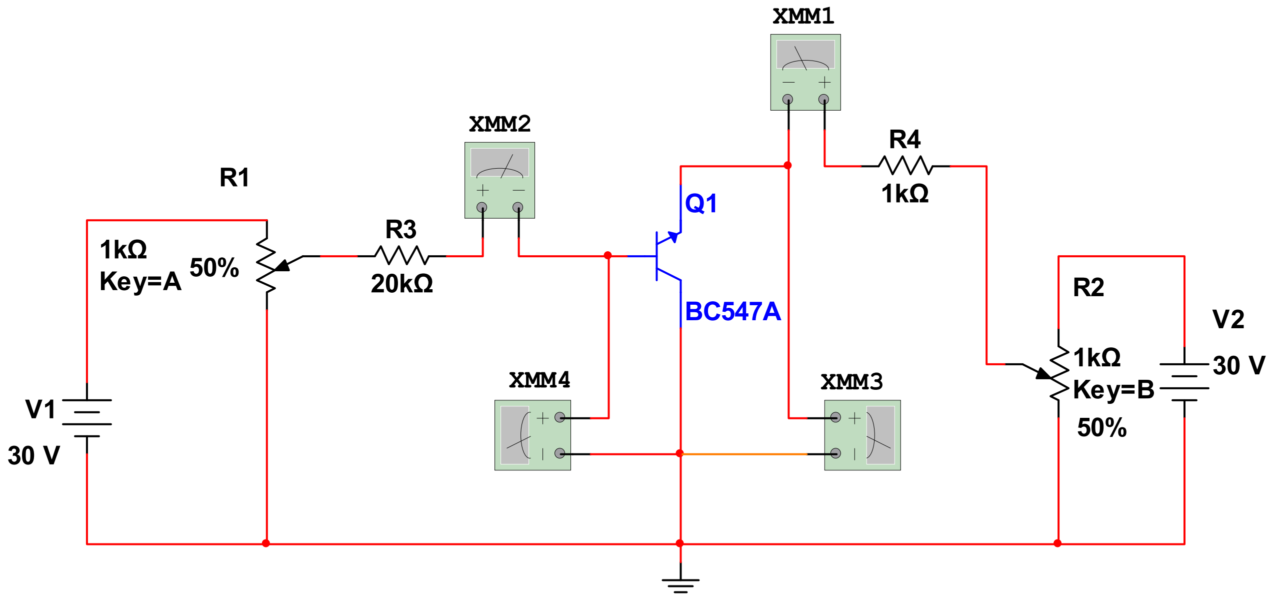


Figure 9.1: Common Collector Amplifier circuit using npn transistor

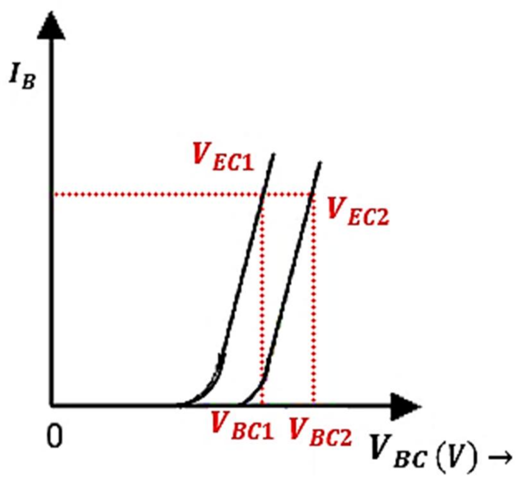


Figure 9.2: Input Characteristics to find h_{ic} & h_{rc}

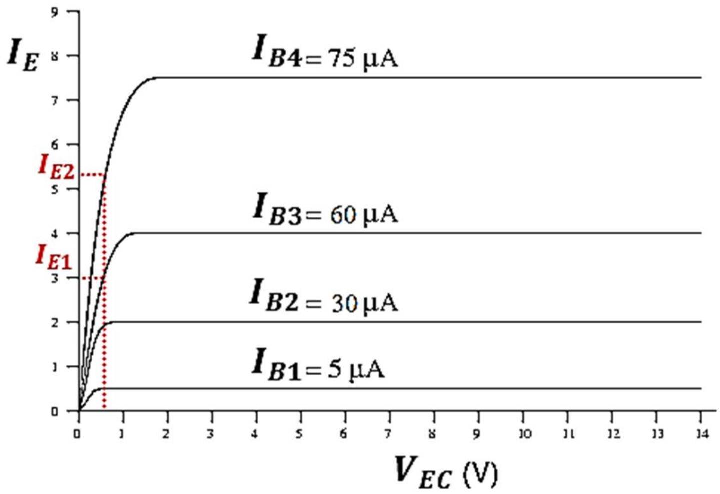


Figure 9.3: Output Characteristics to find h_{fc} & h_{oc}

THEORY:

Bipolar junction transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of transistors namely NPN and PNP. It consists of two P-N junctions namely emitter junction and collector junction.

In Common Collector configuration, the input is applied between base and collector and the output is taken from emitter and collector. Here collector is common to both input and output and hence the name common collector configuration.

Hybrid means "mixed". Since these parameters have mixed dimensions, they are called hybrid parameters. The major reason for the use of h-parameters is the relative ease with which they can be measured.

PROCEDURE:

Input Characteristics

- *Connect the transistor in CC configuration as per circuit diagram*
- *Keep output voltage V_{EC} = ___V by varying V_{EE}.*
- *Varying V_{BB} gradually, note down both base current I_B and base-collector voltage (V_{BC}).*
- *Repeat above procedure (step 3) for various values of V_{EC}.*

Output Characteristics

- *Make the connections as per circuit diagram.*

- *By varying V_{BB} keep the base current I_B = ____ μA.*
- *Varying V_{EE} gradually, note down the readings of emitter current (I_E) and emitter collector voltage (V_{EC}).*
- *Repeat above procedure (step 3) for different values of I_B.*

OBSERVATION TABLE:

INPUT CHARACTERISTICS				OUTPUT CHARACTERISTICS			
V_{EC} = ___ V		V_{EC} = ____V		I_B = ___ μA		I_B = ___ μA	
V_{BC} (volts)	I_B (μA)	V_{BC} (volts)	I_B (μA)	V_{EC} (volts)	I_E (mA)	V_{EC} (volts)	I_E (mA)

CALCULATIONS:

- $Input\ impedance\ (h_{ic}) = \frac{\Delta V_{BC}}{\Delta I_B}\ , V_{EC}\ constant.$
- $Forward\ current\ gain(h_{fc}) = \frac{\Delta I_E}{\Delta I_B}\ , V_{EC}\ constant$
- $Output\ admittance(h_{oc}) = \frac{\Delta I_E}{\Delta V_{EC}}\ , I_B\ constant$
- $Reverse\ voltage\ gain(h_{rc}) = \frac{\Delta V_{BC}}{\Delta V_{EC}}\ , I_B\ constant$

RESULT:

Thus the hybrid parameters of CC configuration are determined.

$Input\ impedance\ (h_{ic}) =$ ___________Ω

$Forward\ current\ gain(h_{fc}) =$ _______

$Output\ admittance(h_{oc}) =$ _________Ω^{-1}

$Reverse\ voltage\ gain(h_{rc}) =$ ___________

10. To find Bandwidth of RC coupled Amplifier. [CO1,2,3,4,5,6]

AIM:

To find Bandwidth of RC coupled Amplifier

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires function generator, CRO/PC with Multisim Software.

CIRCUIT DIAGRAM:

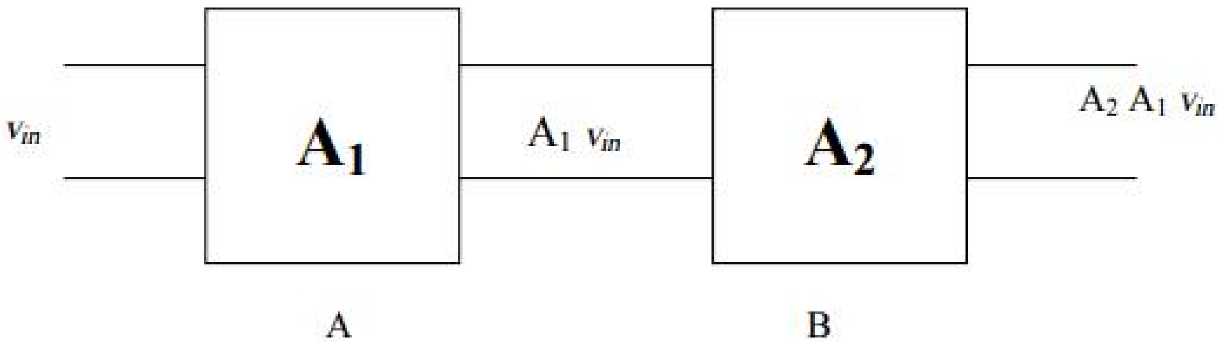


Figure 10.1: Cascade Amplifier with two stages

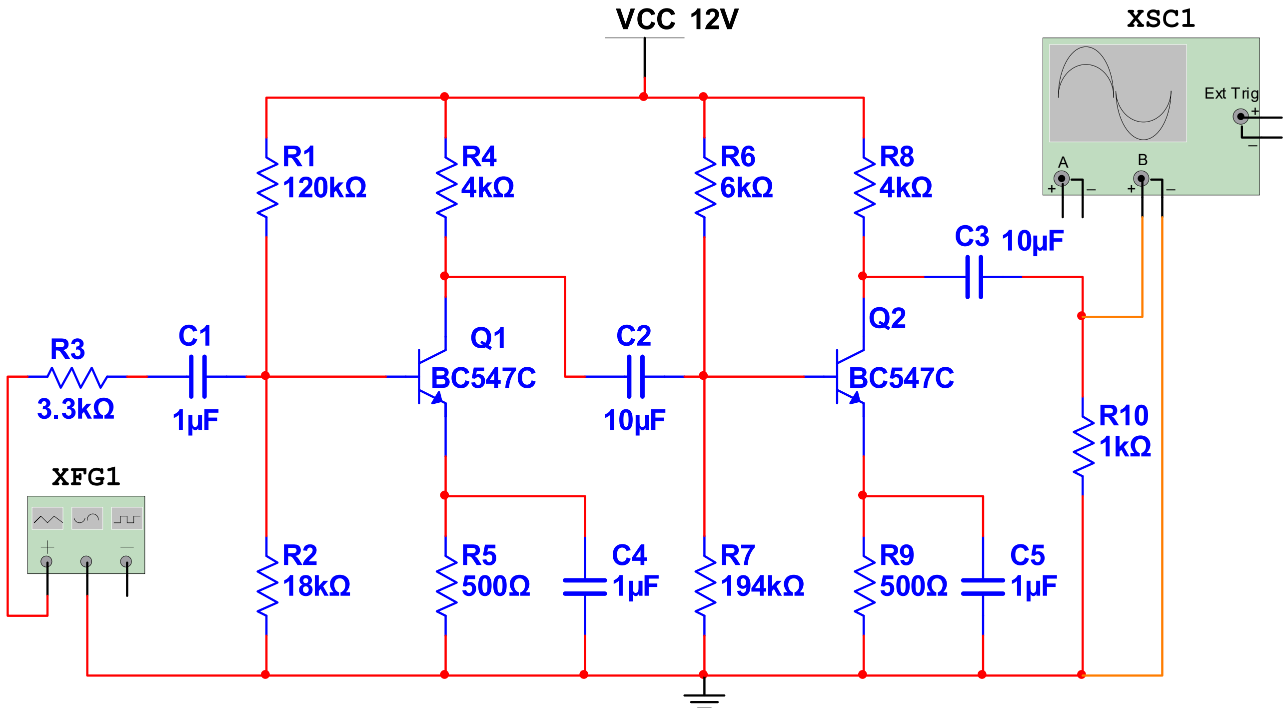


Figure 10.2: Circuit Diagram of two stage RC Coupled Amplifier

OUTPUT WAVEFORM:

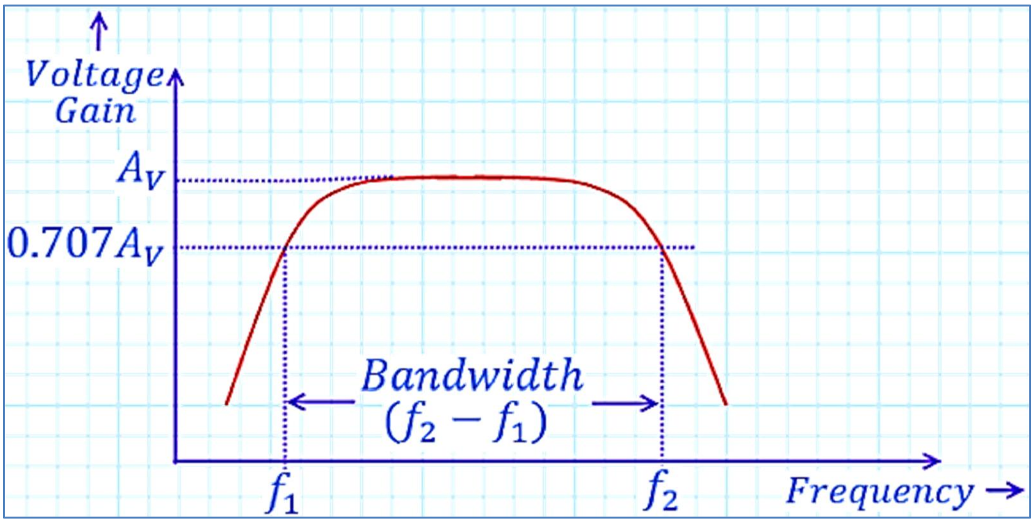


Figure 10.3: Frequency Response showing Bandwidth of Single stage Amplifier

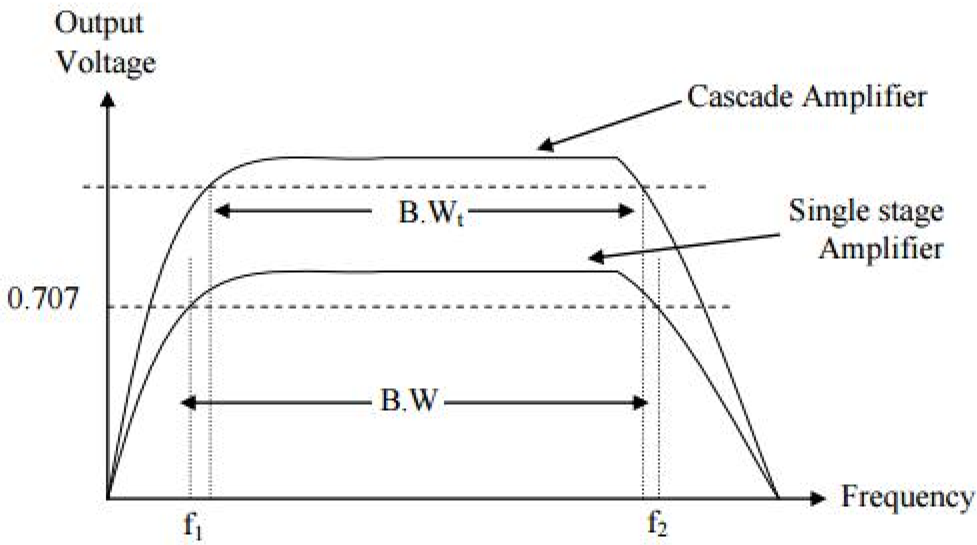


Figure 10.4: Frequency Response showing comparison of bandwidths offered by single stage and multistage Amplifiers

THEORY:

It is often impossible to get the required gain from a single stage amplifier. For example, a gain of 10000 is required to produce 10 V output from 1mV input, which is not possible with a single stage. Therefore, multistage amplifier is required.

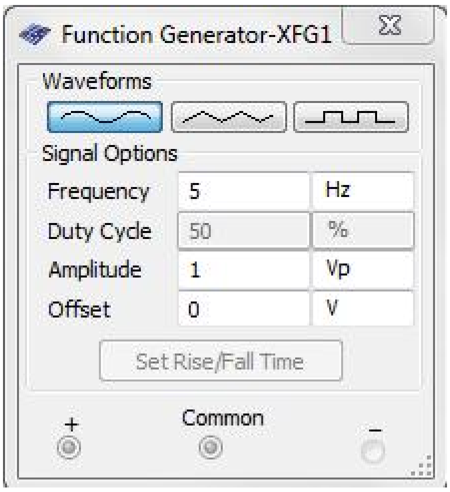
Consider a two-stage amplifier having stage A of gain A_1 and stage B of gain A_2 as shown in Figure 10.1. If an input signal V_{in} (volts) is applied to the stage A, the output of stage A will be a product of gain and input i.e. $A_1 \times V_{in}$ (volts), which is further applied to the stage B, then the overall *output will become* $A_1 \times A_2 \times V_{in}$ *(volts). In general, overall gain of multistage amplifier is* A_{total}*, then it can be expressed in terms of single stage gains as* $A_{total} = A_1 \times A_2$.

Now these two stages must be connected in cascade (series) to get their gains multiplied. The most popular type of coupling two stages is capacitor coupling, as it provides excellent audio fidelity. A coupling capacitor is used to connect output of first stage to input of second stage. Resistances R_1, R_2, R_5 *and* R_6, R_7, R_9 *provides stabilized biasing of two stages. Emitter by-pass capacitor* C_4 *&* C_5 *offers low reactance paths to signal. Coupling Capacitor transmits ac signal from a stage to the next, blocks DC as shown in Figure 10.2.*

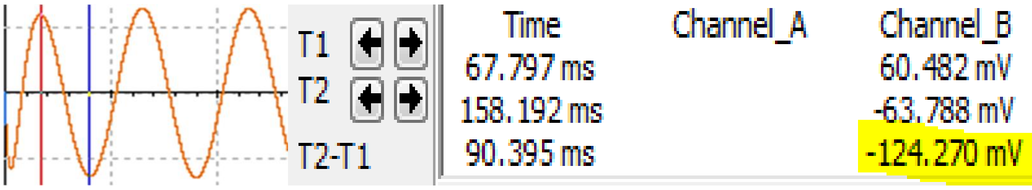
When ac signal is applied to the base of the transistor Q_1*, its amplified output appears across the collector resistor* R_4*. It is given to the second stage for further amplification and the signal appears with more strength at the output of stage 2 i.e. transistor* Q_2*. Frequency response curve is obtained by plotting a graph between frequency and gain in dB. The gain is constant in mid frequency range and gain decreases on both sides of the mid frequency range as shown in Figure 10.3 & Figure 10.4.*

PROCEDURE:

- *Connect the components as shown in Figure 10.2.*
- *Apply the lowest frequency with amplitude of 1 Volt as shown in following figure*



- *Now measure the amplitude of output signal from oscilloscope as shown in following figure*



- *So, for the input with 1V & 5 Hz the output in 124.27 mV, this is shown as first reading in following observation table.*
- *Get the readings up to few MHz and tabulate them, then draw the plot in semilog graph paper.*
- *We can connect the oscilloscope to the output of first stage of amplifier and draw the frequency response on the same semilog graph to compare two-stage bandwidth with single stage bandwidth.*
- *Now draw a horizontal line at a point* $0.707 \times Amplitude$*, this line will intersect the bandwidth at two points. Draw the perpendicular lines from both points of intersections. The first line will show lower cut-off frequency* f_1 *while the second point will show upper cut-off frequency* f_2.
- *The bandwidth will be difference of* $f_2 - f_1$

OBSERVATION TABLE:

Frequency (Hz)	I/P Voltage (V_i)	O/P Voltage (V_o)	Voltage Gain $A_v = 20\,log(V_o/V_i)$ Volts

RESULT:

Thus, the Bandwidth of two stage RC coupled Amplifier is found to be________Hz.

11. To evaluate frequency of RC Oscillators. [CO1,2,3,4,5,6]

AIM:

To evaluate frequency of RC Oscillators.

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires, CRO/PC with Multisim Software.

CIRCUIT DIAGRAM:

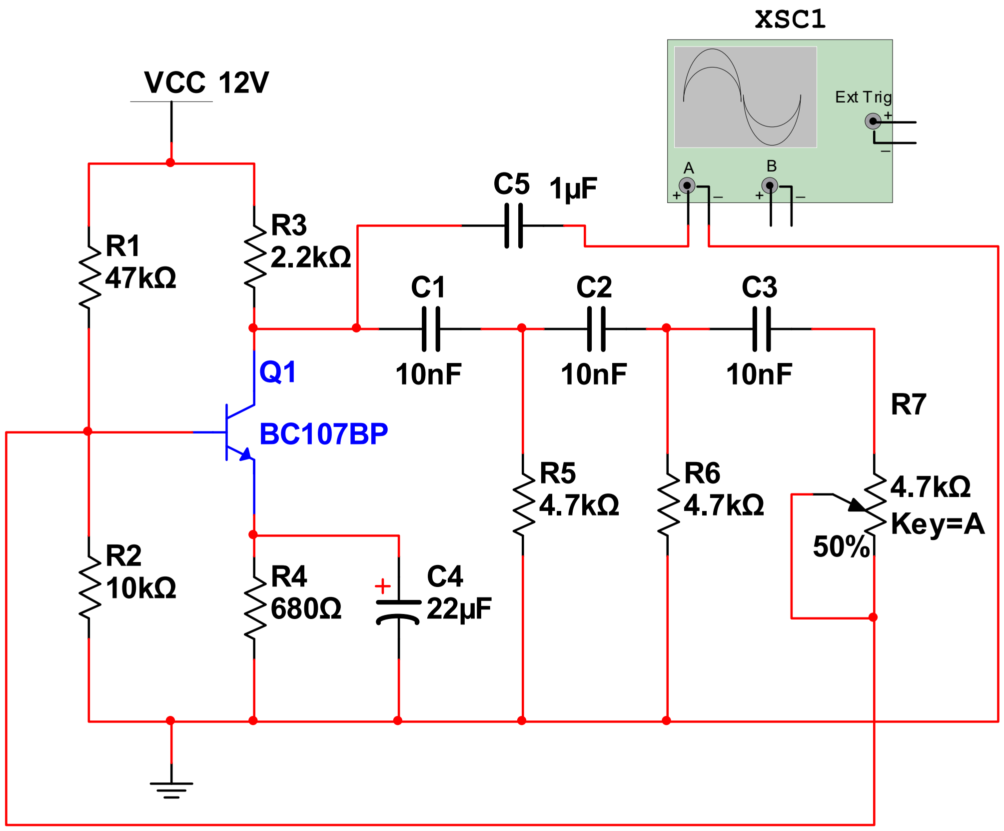


Figure 11.1: RC Phase Shift Oscillator

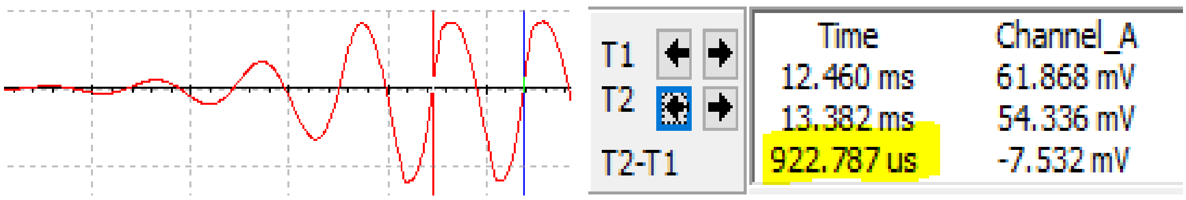


Figure 11.2: Output waveform of RC Phase Shift Oscillator and Time Period Calculated as T = 922.787 µs

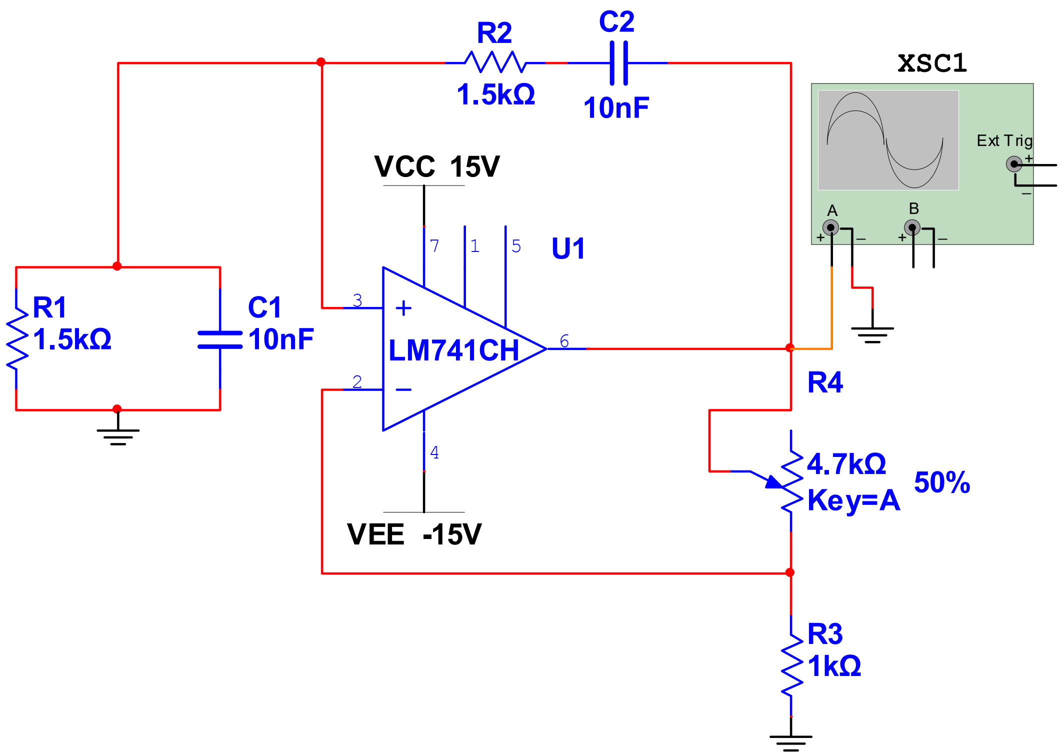


Figure 11.3: Wein Bridge Oscillator

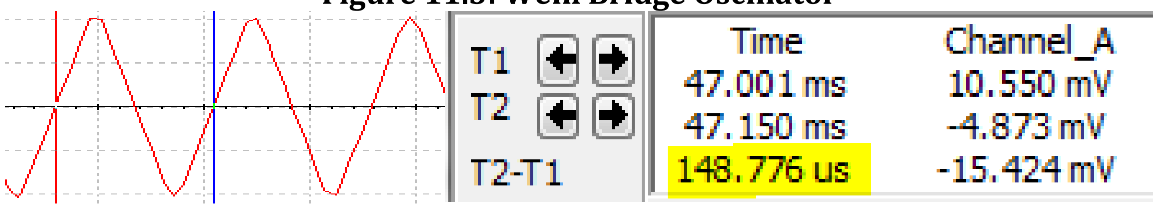


Figure 11.4: Output waveform of Wein-Bridge Oscillator and Time Period Calculated as T = 148.776 µs

THEORY:

RC-Phase Shift Oscillator: It has a CE amplifier followed by three sections of RC phase shift feedback networks. The output of the last stage is fed back to the input of the amplifier. The values of R and C are chosen such that the phase shift of each RC section is 60°. Thus, the RC ladder network containing three RC sections produces a total phase shift of 180° between its input and output voltage for the given frequencies.

Since CE Amplifier produces 180° phases shift the total phase shift from the base of the transistor around the circuit and back to the base will be exactly 360° or 0°. This satisfies the Barkhausen condition for sustaining oscillations and total loop gain of this circuit is greater than or equal to 1, this condition is used to generate the sinusoidal oscillations. The theoretical frequency of oscillations of RC-Phase Shift Oscillator is

$$f = \frac{1}{2\pi RC\sqrt{6}}$$

Wein Bridge Oscillator: It is one of the most popular type of oscillators used in audio and sub-audio frequency ranges (20 – 20 kHz). This type of oscillator is simple in design, compact in size, and remarkably stable in its frequency output. Furthermore, its output is relatively free from distortion and its frequency can be varied easily. However, the maximum frequency output of a typical Wien bridge oscillator is only about 1 MHz. This is also, in fact, a phase-shift oscillator. It employs either an amplifier with two transistors, each producing a phase shift of 180°, and thus producing a total phase-shift of 360° or 0° or an operational amplifier which gives of phase shift of 0°. In this experiment, Wein Bridge Oscillator is designed with Op-Amp LM741 as shown in Figure 11.3 and its output waveform is shown in Figure 11.4.

PROCEDURE:

- *Connect the components as shown in Figure 11.1*
- *Measure the time period of output signal on oscilloscope and calculate its frequency, this will be practical frequency of RC Phase Shift Oscillator.*
- *Connect the components as shown in Figure 11.3*
- *Measure the time period of output signal on oscilloscope and calculate its frequency, this will be practical frequency of Wein Bridge Oscillator.*

CALCULATIONS:

RC-Phase Shift Oscillator:

Value of Resistance & Capacitance used: R=_______Ω & C=_______F

Evaluating theoretical frequency from $f = \frac{1}{2\pi RC\sqrt{6}}$ =_______*Hz*

Evaluating experimental time period T_d = _____*Sec & frequency from output waveform* $f = \frac{1}{T_d}$ =________*Hz.*

Wein-Bridge Oscillator:

Value of Resistance & Capacitance used: R=_______Ω & C=_______F

Evaluating theoretical frequency from $f = \frac{1}{2\pi\sqrt{R_1C_1R_2C_2}}$ =_______*Hz*

Evaluating experimental time period T_d = _____*Sec & frequency from output waveform* $f = \frac{1}{T_d}$ =________*Hz*

RESULT:

The RC phase shift oscillator & Wein-Bridge oscillator has been studied and the frequency of oscillation has been evaluated.

12. To evaluate frequency of LC Oscillators. [CO1,2,3,4,5,6]

AIM:

To evaluate frequency of LC Oscillators (Colpitt's and Hartley Oscillator).

APPARATUS:

Trainer Kit, Connecting Wires/Breadboard, components, wires, CRO/PC with Multisim Software.

CIRCUIT DIAGRAM:

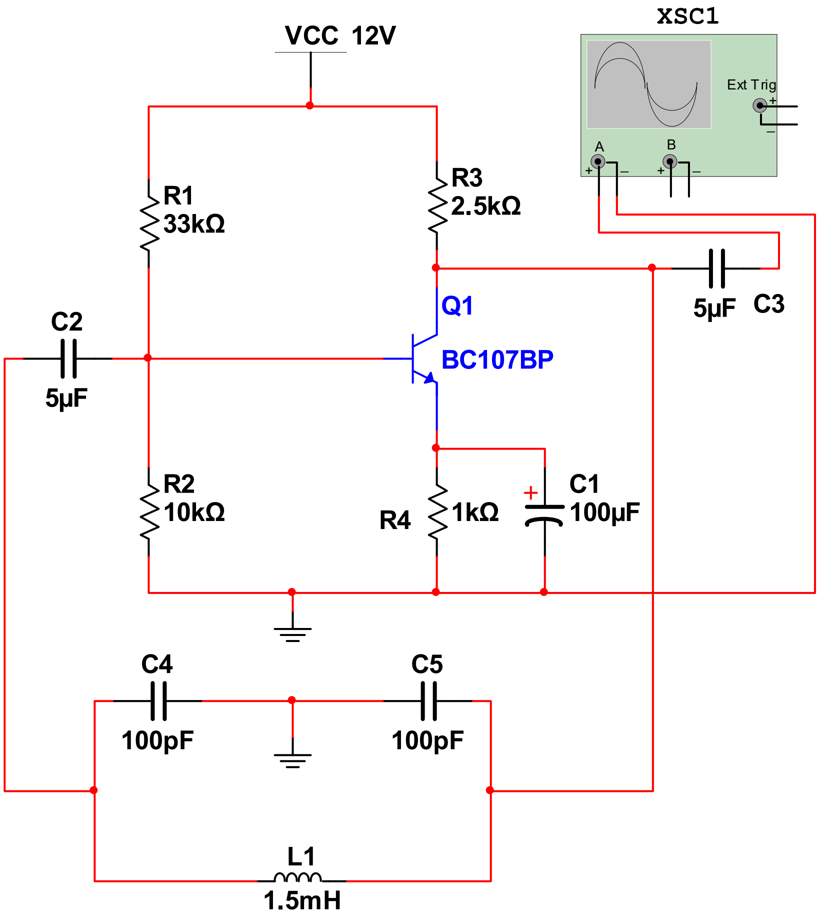


Figure 12.1: Colpitt's Oscillator

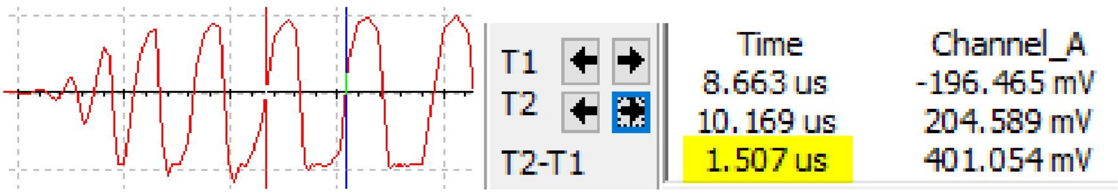


Figure 12.2: Output waveform of Colpitt's Oscillator and Time Period Calculated as T = 1.507 µs

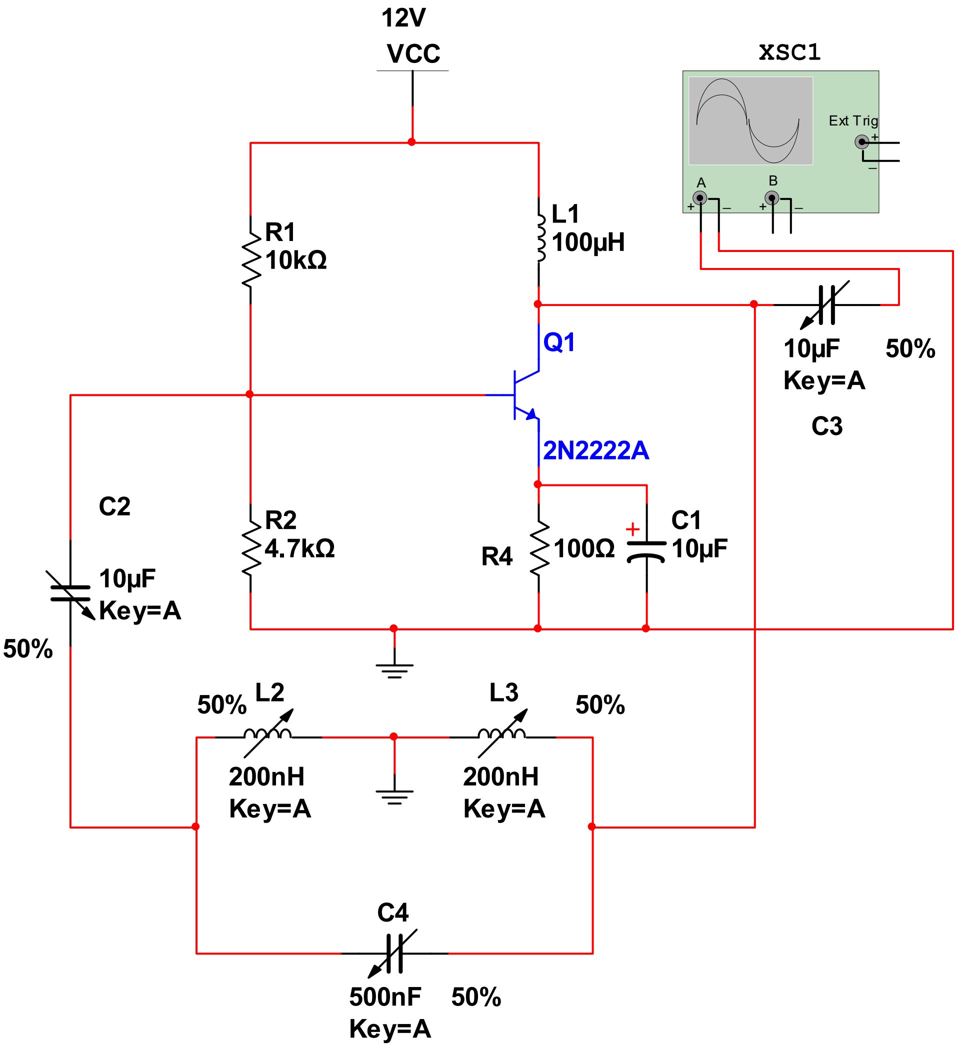


Figure 12.3: Hartley Oscillator

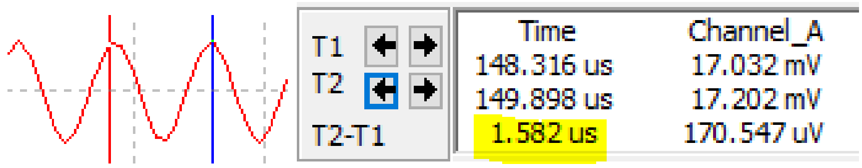


Figure 12.4: Output waveform of Hartley Oscillator and Time Period Calculated as T = 1.582 µs

THEORY:

Colpitt's Oscillator:

Colpitt's oscillator is a radio frequency oscillator which generates a frequency of the range of (30 KHz to 30MHz). The collector supply voltage V_{CC} is applied to the collector transistor R_C parallel combination of $R_E = C_E$

with resistor $R_1 = R_2$ provides the stabilized self-bias. The tuned circuit consists of C_1, C_2 & L are extending from collector act to the base act determines basically the transistor of oscillator. The feedback is through the tank circuit itself.

$$f_o = \frac{1}{2\pi\sqrt{L\left[\frac{C_1C_2}{C_1 + C_2}\right]}}$$

Hartley Oscillator:

The tank circuit shown in the circuit consist of two coils L_1 & L_2. The coil L_1 is inductively coupled to the coil L_2 and the combination work as an auto transformer. The feedback between the o/p & i/p circuits are accomplished through auto transformer action which also introduced a phase shift of 180°. The phase reversed between the o/p & i/p voltages occur because they are taken from the opposite ends of the coils (L_1 & L=) with respect to the tap which is grounded. The frequency of oscillator is grounded by

$$f_o = \frac{1}{2\pi\sqrt{C[L_1 + L_2 + 2M]}}$$

PROCEDURE:

- *Connect the components as shown in Figure 12.1*
- *Measure the time period of output signal on oscilloscope and calculate its frequency, this will be practical frequency of Colpitt's Oscillator.*
- *Connect the components as shown in Figure 12.3*
- *Measure the time period of output signal on oscilloscope and calculate its frequency, this will be practical frequency of Hartley Oscillator.*

CALCULATIONS:

Colpitt's Oscillator:

Value of Inductance & Capacitances used are:

L=________H; C_1=________F & C_2=_______F

Evaluating theoretical frequency from $f = \frac{1}{2\pi\sqrt{L\left[\frac{C_1C_2}{C_1+C_2}\right]}}$ =________*Hz*

Evaluating experimental time period Td = _____Sec & frequency from output waveform $f = \frac{1}{T_d}$ =_________*Hz.*

Hartley Oscillator:

Value of Inductance & Capacitance used are:

L_1=________H; L_2=______H & C=________F (M=0)

Evaluating theoretical frequency from $f = \frac{1}{2\pi\sqrt{C[L_1+L_2+2M]}}$ =________*Hz*

Evaluating experimental time period Td = _____Sec & frequency from output waveform $f = \frac{1}{T_d}$ =_________*Hz*

RESULT:

The Colpitt's & Hartley oscillators have been studied and the frequency of oscillation has been evaluated.