DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603203.

Title of Experiment	: **8. Wave shaping circuits (Half wave & Full Rectifiers, Clippers)**
Name of the candidate	: Kunal Keshan S
Register Number	: RA2011004010051
Date of Experiment	: 22nd June 2021
Date of submission	**: 29th June 2021**

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS (Rectifiers)

1 What is the necessity of rectifier?

A rectifier in the power supply helps in converting AC to DC power supply. They are used inside the power supplies of virtually all electronic equipment's.

2 What is PIV of a diode in Full Wave Rectifier (FWR) and Half Wave Rectifier (HWR)?

Peak Increase Voltage (PIV) is the maximum value of reverse voltage which occurs at the peak of the input cycle when the diode is reverse-biased. For a FWR the PIV is 2*Vi where Vi is the amplitude of the input signal. For a HWR the PIV is Vi where Vi is the amplitude of the input signal.

3 What is ripple factor? Why it is required?

Ripple factor is defined as the ratio of RMS value of an alternating current component in the rectified output to the average value of rectified output. It is essential to measure the rate of fluctuation within the resolved output.

4 Why are filters connected at the output of rectifiers?

Filters or Capacitors are used to filter the pulsating DC output after rectification so that a nearly constant DC voltage is supplied to the load. The pulsating output of the rectifiers has an average DC value and an AC portion that is called ripple voltage.

5 What are the types of filters used in rectifier? And which is better and why?
Types of filters.

a) Series Inductor Filter.
b) Shunt Capacitor Filter
c) Half Wave Rectifier with Capacitor Filter.
d) Full wave Rectifier with Shunt Capacitor Filter.
e) L – C Filters.
f) R – C Filters.
g) Choke Input L – Section Filter.
h) Π – Filter or Capacitance Input Filter

Experiment No. 8 a) **Date :**	**SINGLE PHASE HALF WAVE RECTIFIER** **29th June 2021**

Aim

To construct a half wave rectifier using diode and to draw its performance characteristics.

Apparatus Required

S. No.	Name	Range	Qty
1	Transformer	230/(6-0-6)V	1
2	R.P.S	(0-30)V	2

Components Required

S. No.	Name	Range	Qty
1	Diode	IN4007	1
2	Resistor	1K Ω	1
3	Bread Board	-	1
4	Capacitor	100µf	1
5	CRO	-	1

Formulae

With out Filter

(i) $V_{rms} = V_m / 2$

(ii) $V_{dc} = V_m / \prod$

(iii) Ripple Factor $= \sqrt{((V_{rms} / V_{dc})^2 - 1)}$

(iv) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

With Filter

(i) $V_{rms} = \sqrt{(V_{rms}^2 + V_{dc}^2)}$

(ii) $V_{rms} = V_{rpp} / (\sqrt{3} \times 2)$

(iii) $V_{dc} = V_{m -} V_{rpp} / 2$

(iv) Ripple Factor $= V_{rms} / V_{dc}$

V_{rpp} = Vmax - Vmin

Procedure

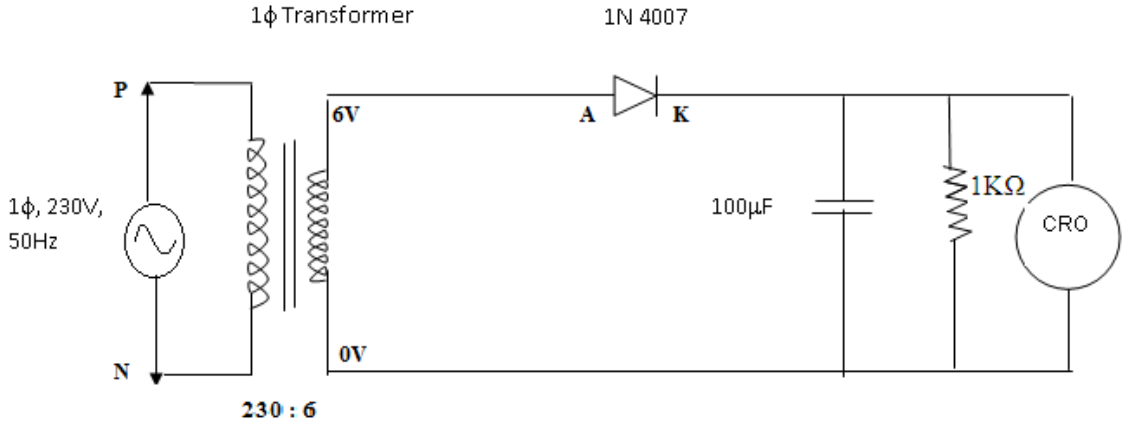
Without Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Take the rectifier output across the Load.
4. Plot its performance graph.

With Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Connect the Capacitor across the Load.
4. Take the rectifier output across the Load.
5. Plot its performance graph.

Circuit Diagram



Tabular Column

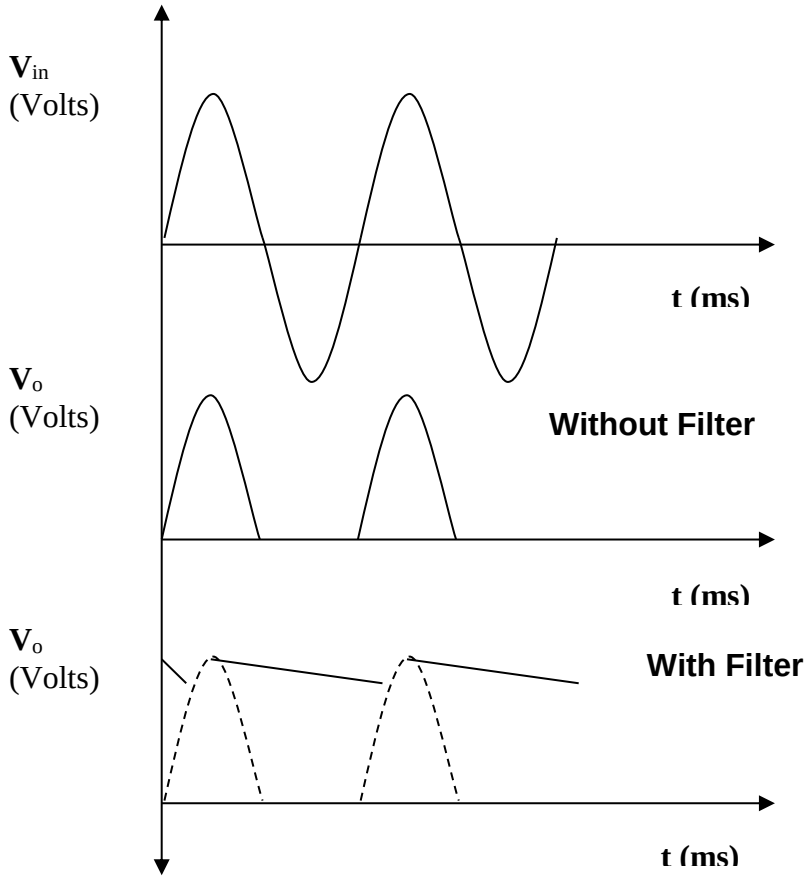
Without Filter

V_m (V)	V_{rms} (V)	V_{dc} (V)	Ripple factor	Efficiency
7.72	3.86	2.45	1.21	40%

With Filter

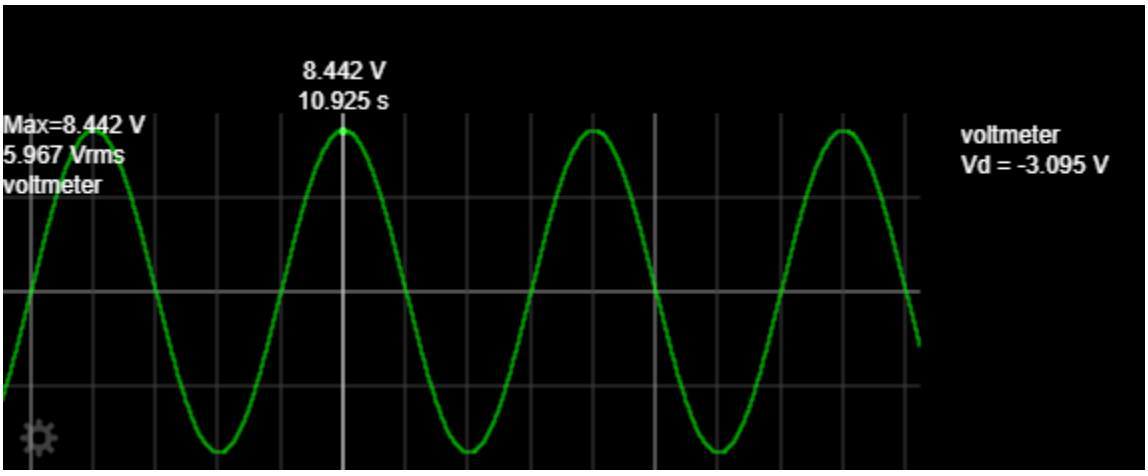
V_{rpp} (V)	V_{rms} (V)	V_{dc} (V)	Ripple factor
1.245	0.359	3.29	0.1091

Model Graph

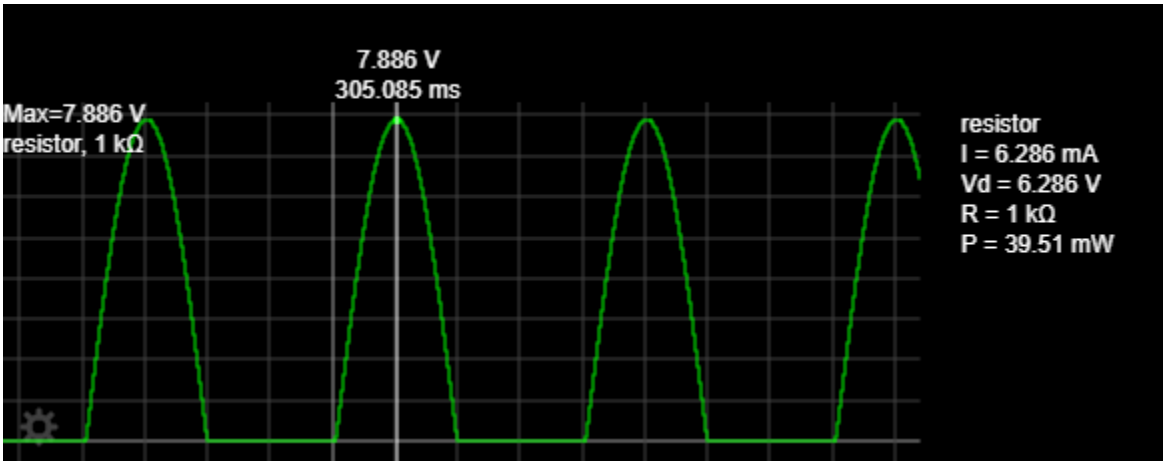


Graph:

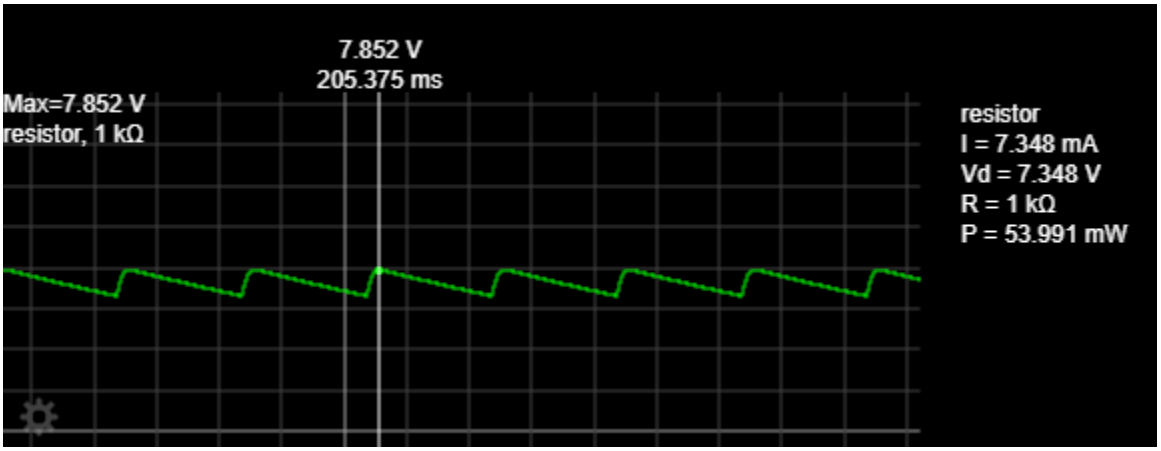
V_{in}



V_o Without Filter

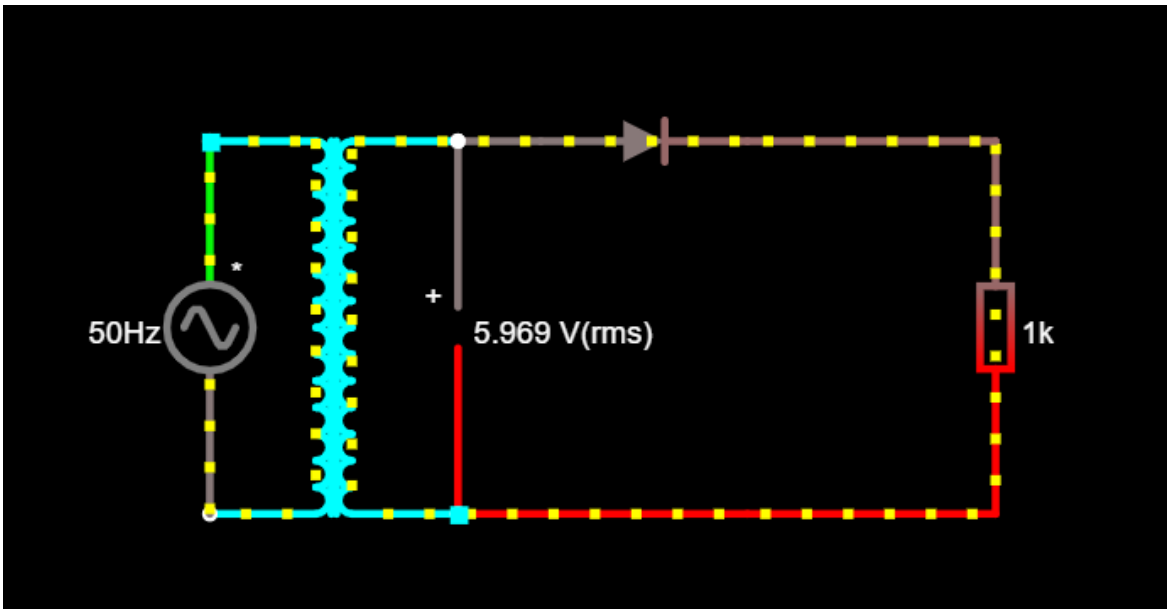


V_o With Filter

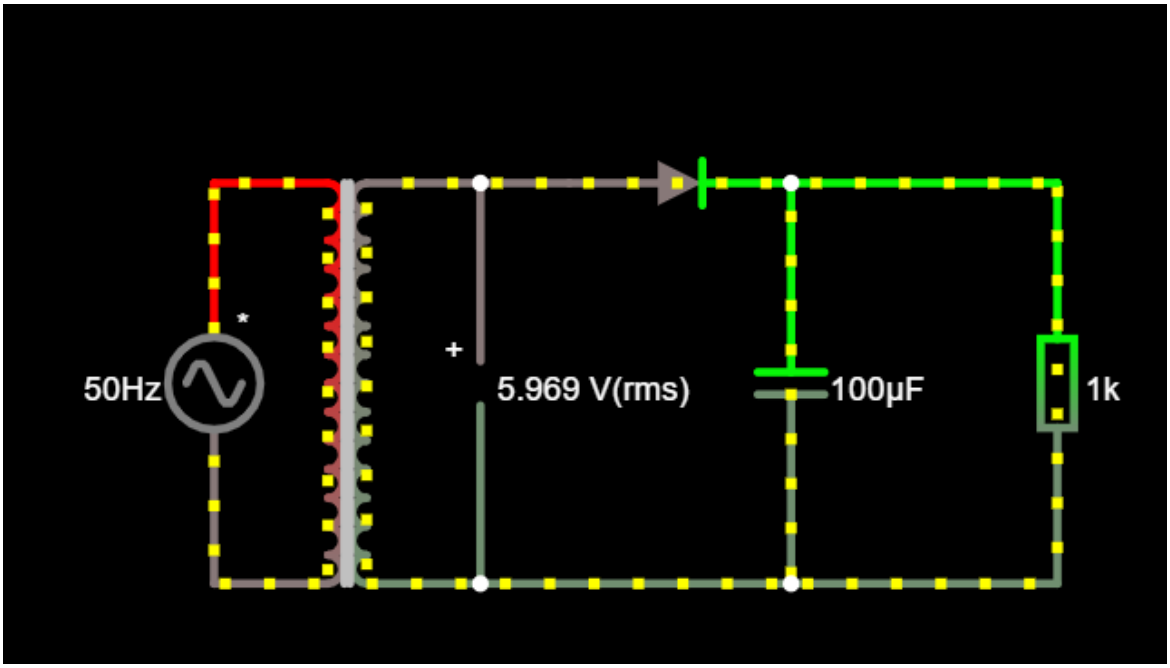


Result:

Without Filter:



With Filter:



Experiment No. 8 b) **Date :**	**SINGLE PHASE FULL WAVE RECTIFIER** **22nd June 2021**

Aim

To construct a single phase full-wave rectifier using diode and to draw its performance characteristics.

Apparatus Required

S. No.	Name	Range	Qty
1	Transformer	230/(6-0-6)V	1
2	R.P.S	(0-30)V	2

Components Required

S. No.	Name	Range	Qty
1	Diode	IN4007	2
2	Resistor	1K Ω	1
3	Bread Board	-	1
4	Capacitor	100µf	1
5	CRO	1Hz-20MHz	1
6	Connecting wires	-	Req

Formulae

Without Filter

(i) $V_{rms} = V_m / \sqrt{2}$

(ii) $V_{dc} = 2V_m / \Pi$

(iii) Ripple Factor = $\sqrt{((V_{rms} / V_{dc})^2 - 1)}$

(iv) Efficiency = $(V_{dc} / V_{rms})^2 \times 100$

With Filter

(i) $V_{rms} = V_{rpp} /(2*\sqrt{3})$

(ii) $V_{dc} = V_m - V_{rpp}$

(iv) Ripple Factor = $V_{rms'} / V_{dc}$

Procedure

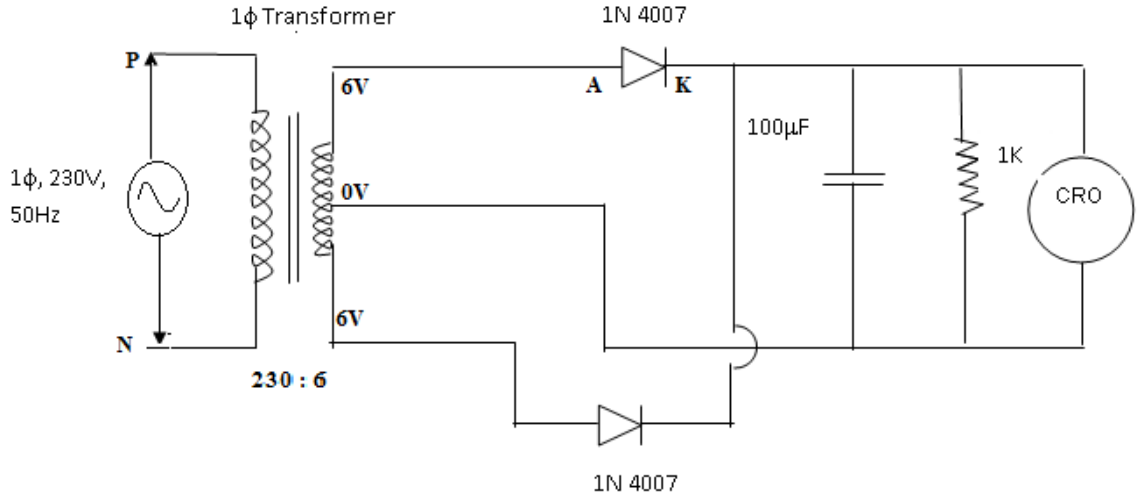
Without Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Take the rectifier output across the Load.
4. Plot its performance graph.

With Filter

1. Give the connections as per the circuit diagram.
2. Give 230v, 50HZ I/P to the step down TFR where secondary connected to the Rectifier I/P.
3. Connect the Capacitor across the Load.
4. Take the rectifier output across the Load.
5. Plot its performance graph.

Circuit Diagram



Tabular Column

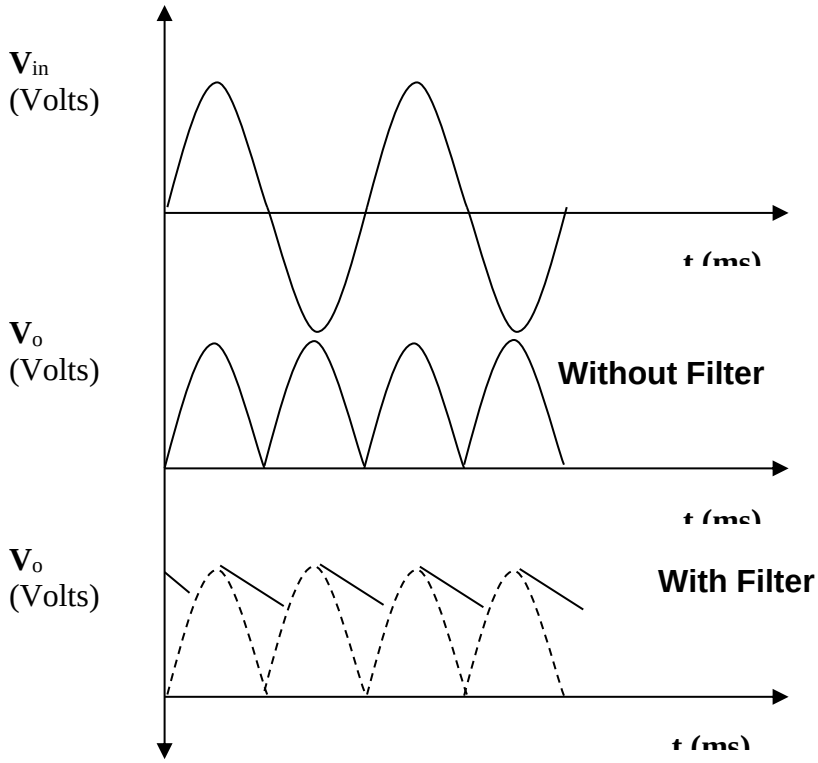
Without Filter

V_m	V_{rms}	V_{dc}	Ripple factor	Efficiency
5.40	3.81	3.44	0.48	81%

With Filter

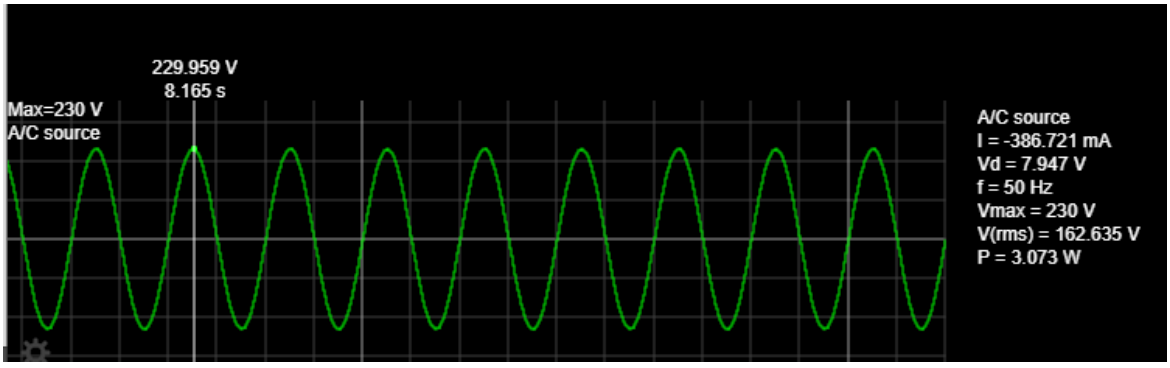
V_{rms}	V_{rpp}	V_{dc}	Ripple factor
4.10	14.2	8.4	0.48

Model Graph

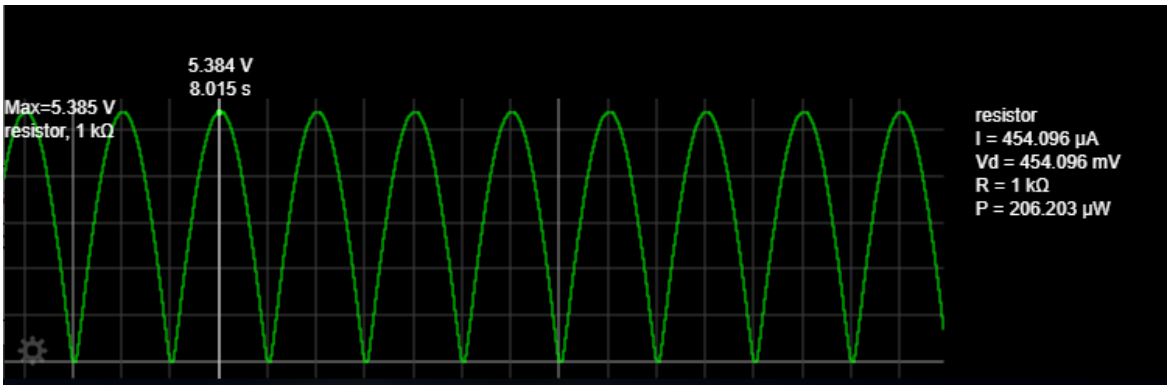


Graph:

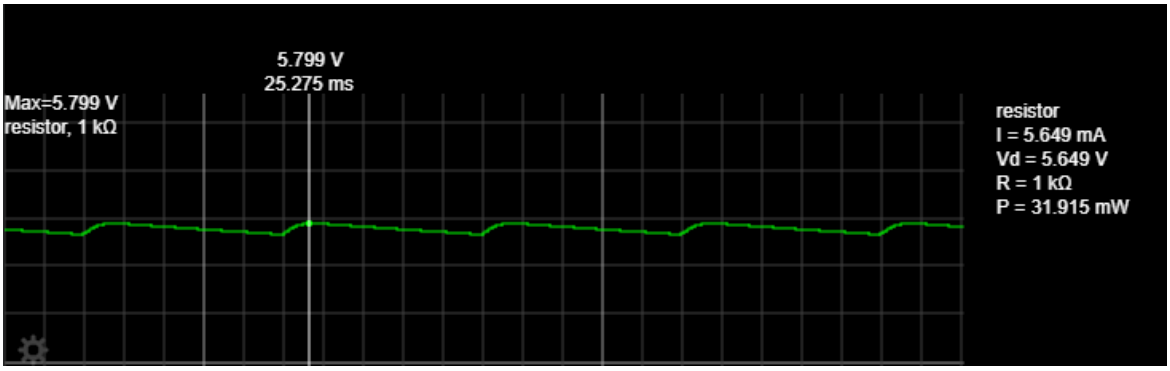
Vin,



Vo, Without Filter:

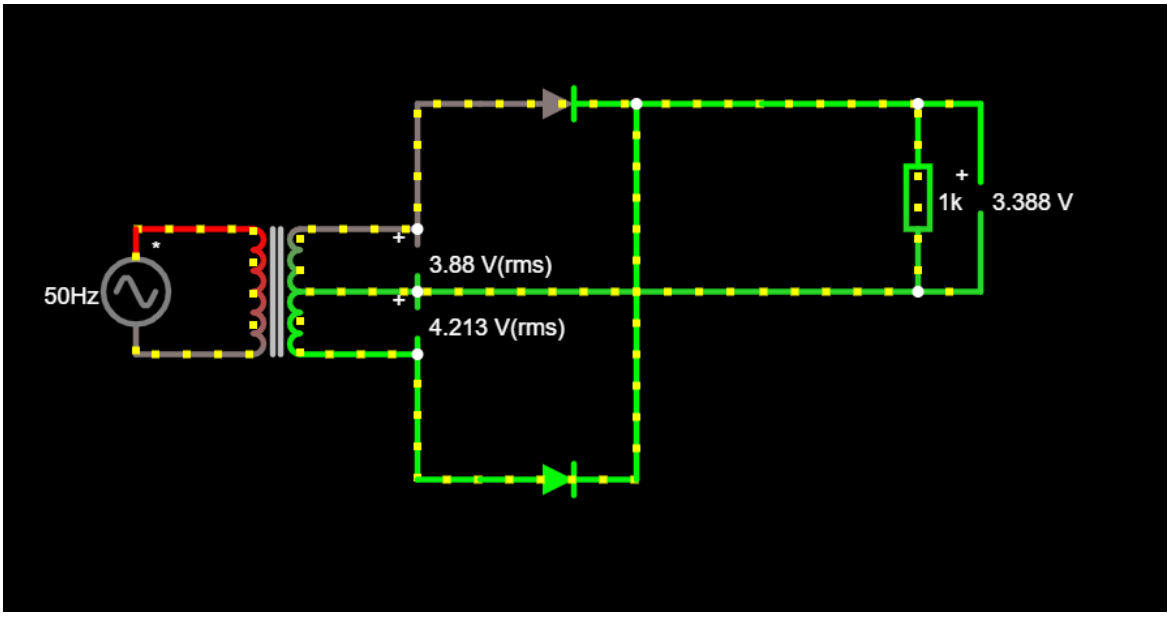


Vo, With Filter:

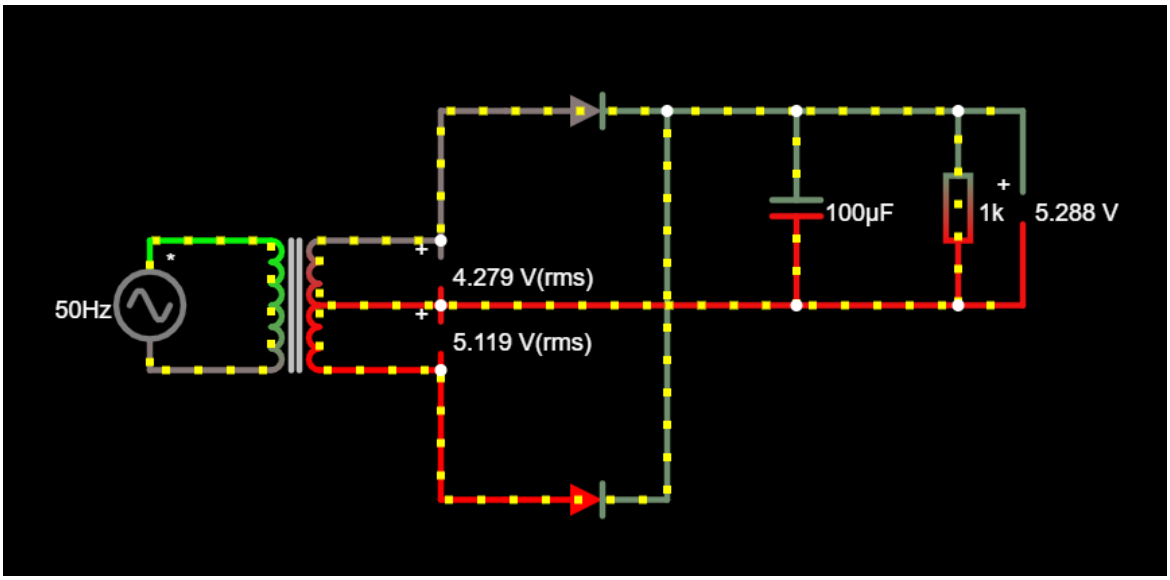


Result:

Without Filter:



With Filter:



POST LAB QUESTIONS

1. What is Transformer Utilization Factor (TUF)?

Transformer Utilization Factor (TUF) is defined as the ratio of DC power output of a rectifier to the effective Transformer VA rating used in the same rectifier.

2. Mention the value of ripple factor for HWR, FWR & rectifier with center tapped transformer.

Ripple factor of a full wave rectifier is 0.48 and the ripple factor for a half wave rectifier is 1.21.

3. What is the difference between uncontrolled rectifier and controlled rectifier? Which is advantageous and why?

The rectifier circuit using diodes only are called uncontrolled rectifiers. When SCRs (Silicon Controlled Rectifier) are used to convert AC to DC, they are called controlled rectifiers. Advantages of Controlled rectifiers over uncontrolled rectifiers, they compensate the DC line voltage variations caused by voltage variations the medium voltage power network and keep voltage constant even in

case of load variation. Advantages of Uncontrolled rectifiers over controlled rectifiers, in full wave rectifiers we can obtain output voltage during the positive and negative half cycles

4. State the average and peak value of output voltage and current for full wave rectifier and half wave rectifier.

For Full Wave Rectifier:
Average value of output voltage = 2Vm/π;
RMS voltage = Vm/(2)^1/2

For Half Wave Rectifier:
Average value of Output voltage = Vm/π;
RMS voltage = Vm/2
Where Vm is the input voltage.

5. What is PIV of a diode in half wave and full wave rectifier?

Peak Increase Voltage (PIV) is the maximum value of reverse voltage which occurs at the peak of the input cycle when the diode is reverse-biased. For a FWR the PIV is 2*Vi where Vi is the amplitude of the input signal. For a HWR the PIV is Vi where Vi is the amplitude of the input signal.

Clippers
PRE LAB QUESTIONS

1. What are the differences between linear and nonlinear wave shaping circuit?

The process by which the form of a non-sinusoidal signal is altered by transmission through a linear network is called linear wave shaping and the circuit is used is called linear wave shaping circuit.
The process of production non-sinusoidal output wave forms from sinusoidal input, using non-linear elements is called as nonlinear wave shipping.

2. What are the applications of wave shaping circuit?

It is used to hold the waveform at a particular DC level, to limit the voltage level of the waveform of some presenting value and suppressing all other voltage levels in excess of the present level.

3. What is wave shaping?

Wave shaping is used to create or modify specified time-varying electrical voltage or current waveforms using combinations of active electronic devices, such as transistors or analog or digital integrated circuits, and resistors, capacitors, and inductors.

4. What is the necessity of wave shaping?

To cut off the positive and negative portions of the input waveform. It is often needed to alter the shape of waveform like cutting off positive or negative portion of wave, generation of one wave from other, holding wave at some DC level.

5. Mention the application of clipper and clamper.

They are frequently used for the separation of synchronizing signals from the composite signals. Used to protect the electronic circuits by applying the AC input signals to the described voltage range. Without any alteration, the shape of the applied signal in any electronic circuit, the DC level can be shifted as desired by the clamper circuits.

Experiment No. 8c) Date :	CLIPPERS 29th June 2021

Aim

To study the clipping circuits for different reference voltages and to verify the responses.

Apparatus Required

S.No.	Name	Range	Qty
1	CRO	1Hz-20MHz	1
2	RPS	(0–30) V	1
3	Bread Board	-	1
4	Connecting Wires	-	Req
5	Function Generator	1Hz-1MHz	1

Components Required

S.No.	Name	Range	Qty
1	Resistor	10KΩ	1
2	Diode	IN4007	1

Theory

The non-linear semiconductor diode in combination with resistor can function as clipper circuit. Energy storage circuit components are not required in the basic process of clipping. These circuits will select part of an arbitrary waveform which lies above or below some particular reference voltage level and that selected part of the waveform is used for transmission. So they are referred as voltage limiters, current limiters, amplitude selectors or slicers. There are three different types of clipping circuits.

1) Positive Clipping circuit.

2) Negative Clipping.

3) Positive and Negative Clipping (slicer).

In positive clipping circuit positive cycle of Sinusoidal signal is clipped and negative portion of sinusoidal signal is obtained in the output of reference voltage is added, instead of complete positive cycle that portion of the positive cycle which is above the reference voltage

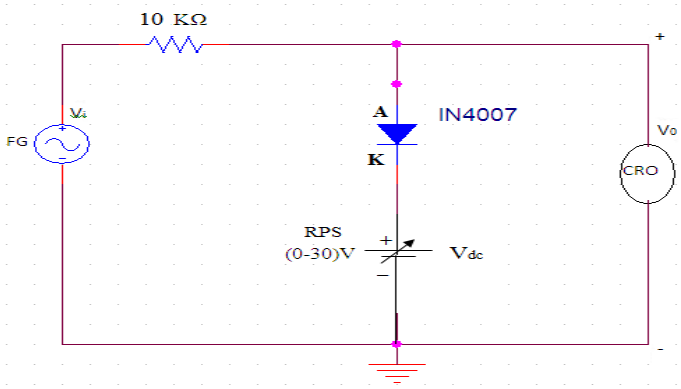
value is clipped. In negative clipping circuit instead of positive portion of sinusoidal signal, negative portion is clipped. In slicer both positive and negative portions of the sinusoidal signal are clipped.

Procedure

1. Connect the circuit as shown in the circuit diagram.
2. Connect the function generator at the input terminals and CRO at the output terminals of the circuit.
3. Apply a sine wave signal of frequency 1 KHz, Amplitude greater than the reference voltage at the input and observe the output waveforms of the circuits.

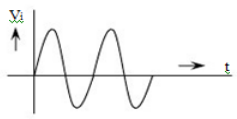
Circuit Diagram

Positive Clipper

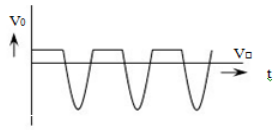


Model Graph:

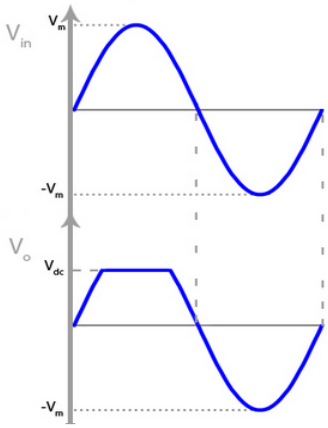
Input waveform



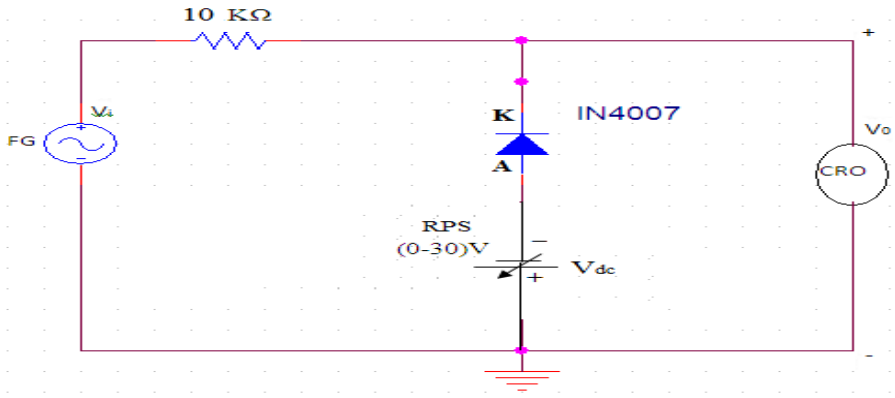
Unbiased Clipper Output Waveform

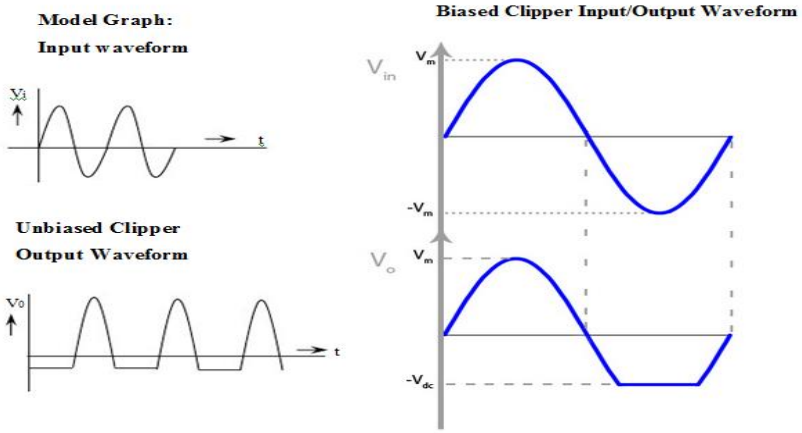


Biased Clipper Input Output Waveform



Negative Clipper





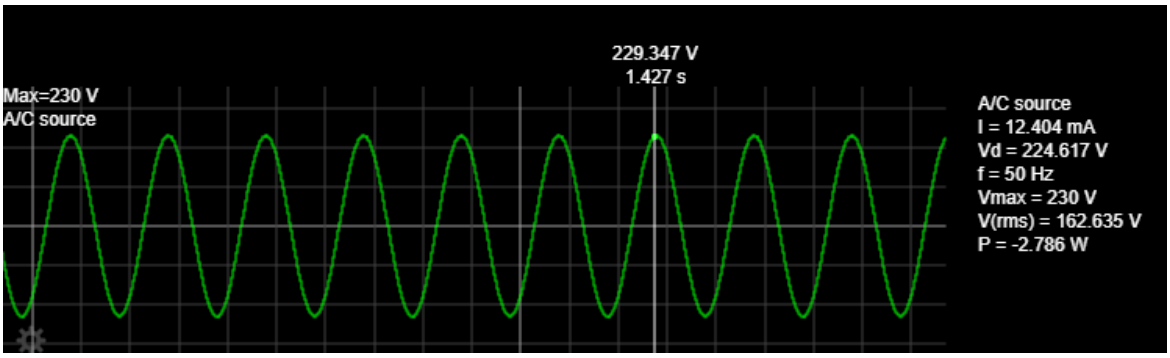
Tabulation:

Positive Clipper **Negative Clipper**

Unbiased Clipper			
V_{ref} = 0V		**V_{ref} = 0V**	
Output voltage (V)	**Time Period (ms)**	**Output voltage (V)**	**Time Period (ms)**
115	270	131	200
Biased Clipper			
V_{ref} = 2V		**V_{ref} = 2 V**	
Output voltage (V)	**Time Period (ms)**	**Output voltage (V)**	**Time Period (ms)**
132	290	137	230

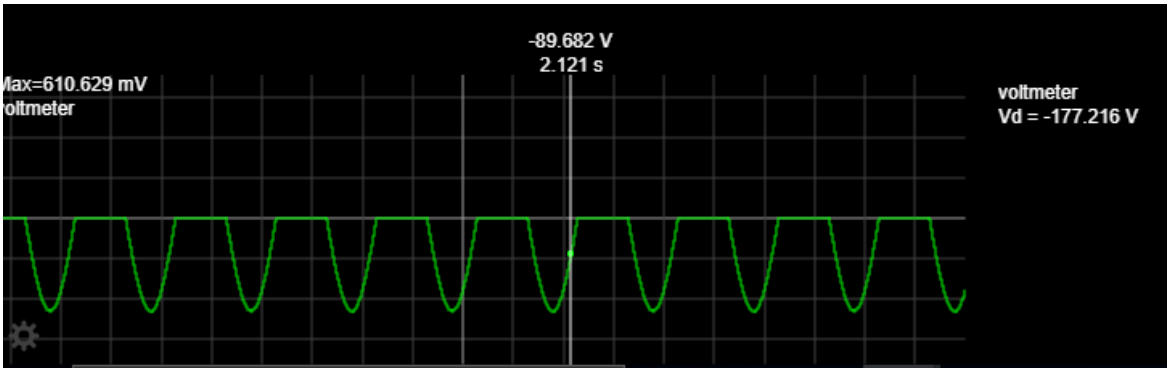
Graph:

Vin,

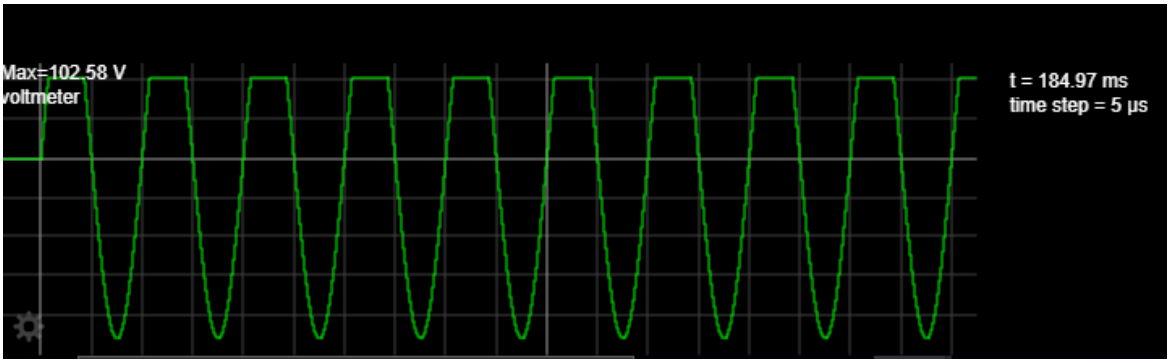


sVo, Positive Clipper.

Unbiased:

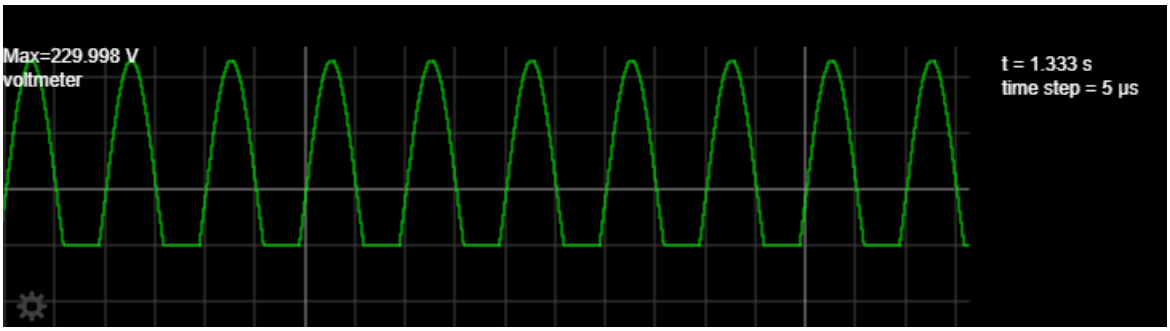


Biased:

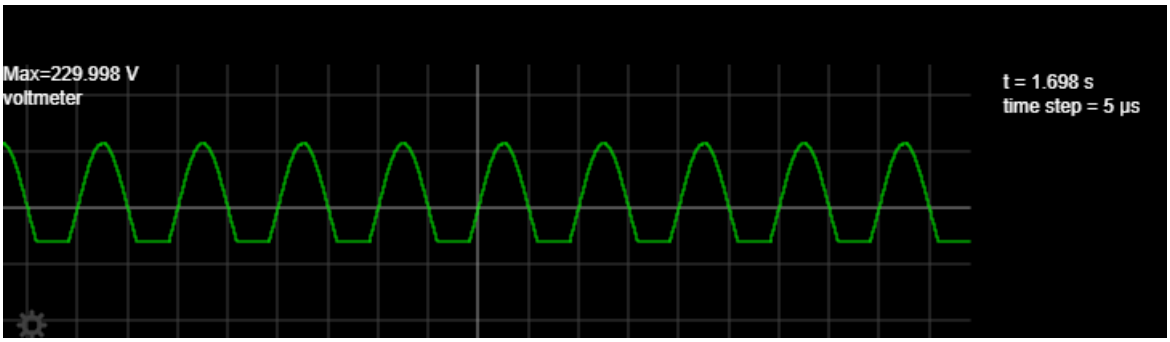


Vo, Negative Clipper.

Unbiased:

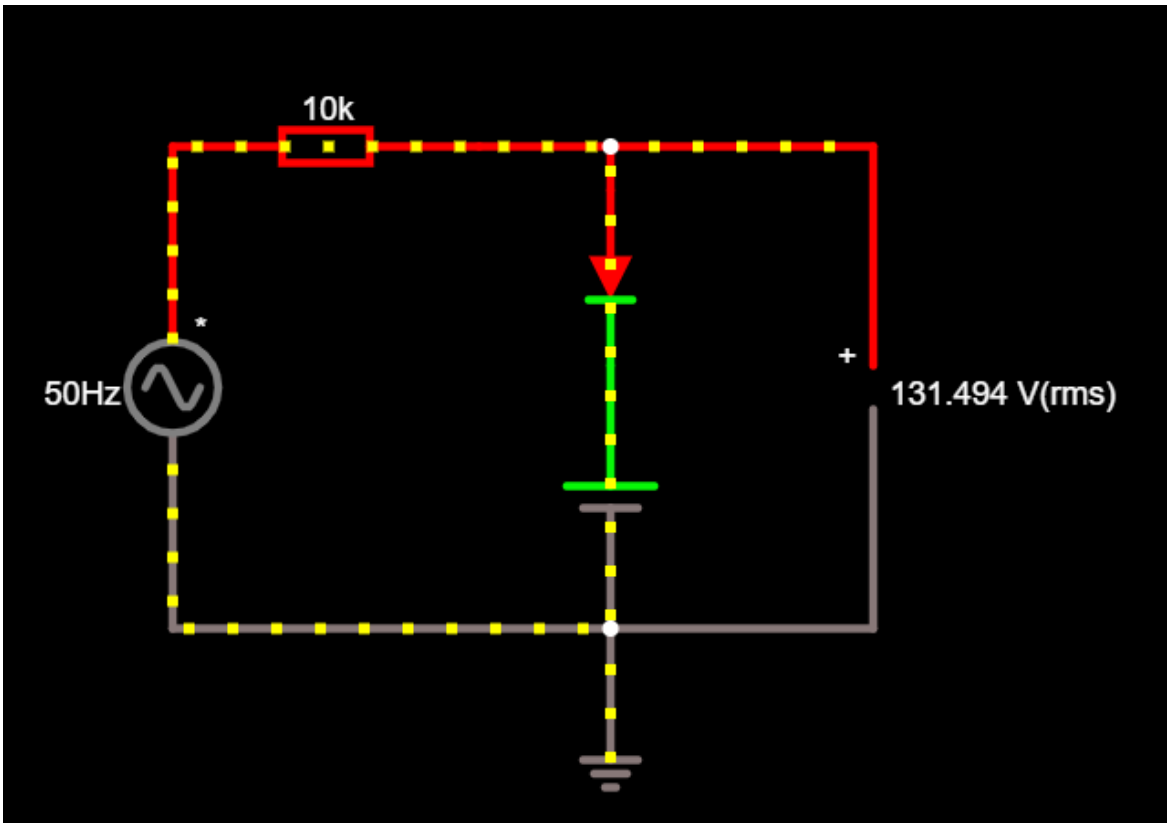


Biased:

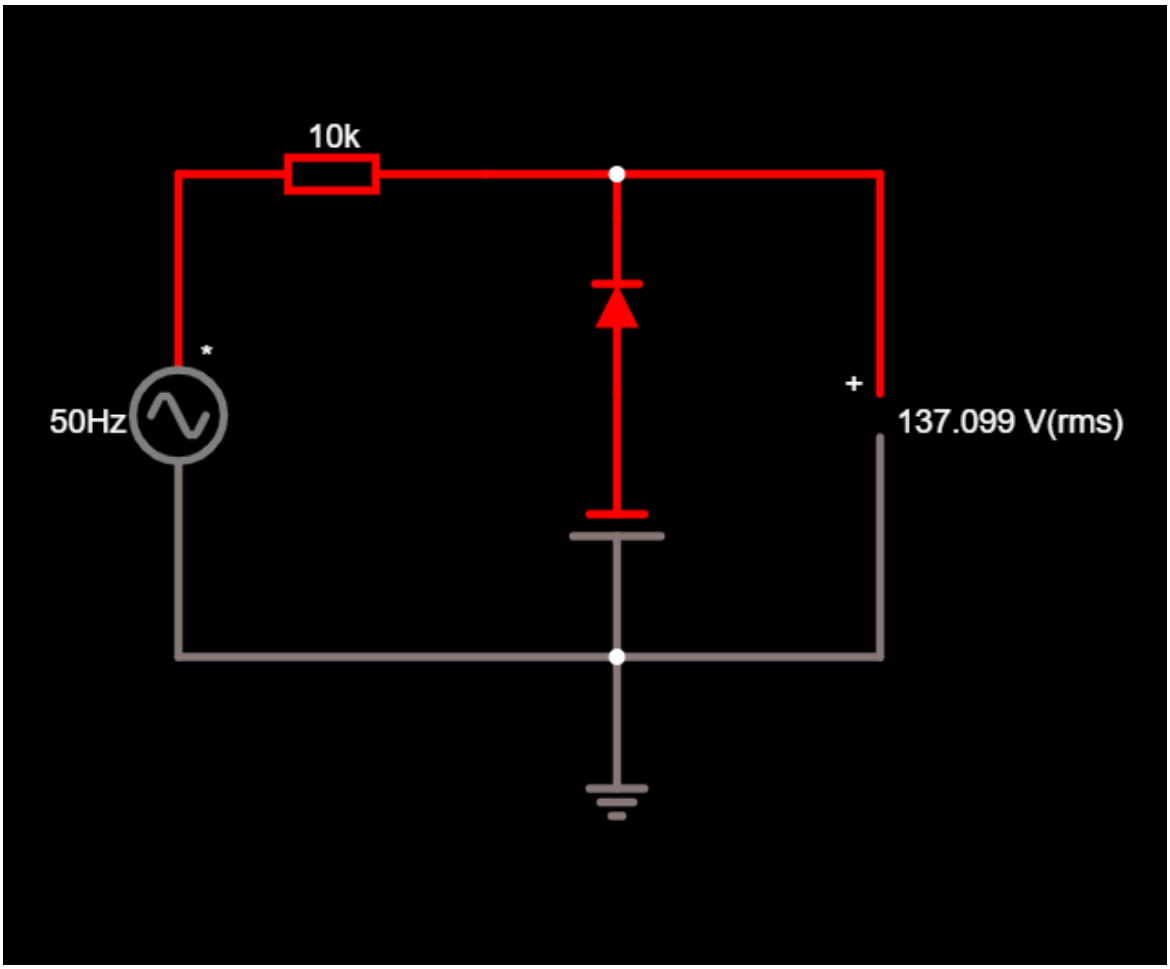


Result:

Positive Clipper:



Negative Clipper:



POST LAB QUESTIONS

1. Differentiate +ve and -ve Clippers.

A clipper circuit in which the diode is connected in series to the input signal and that attenuates the positive portions of the waveform, is termed as positive clippers.
The negative clippers are almost the same as the positive clipper, with only one difference. If the diode has its polarity reversed, the circuits, will become a negative clipper circuit.

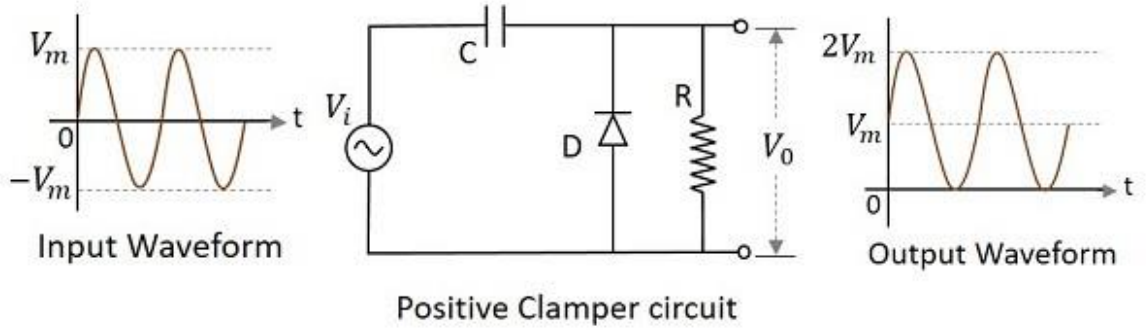
2. What is the function of Clampers?

A clamper is an electronic circuit that fixed either the positive or the negative peak excursions of a signal to a defined value by shifting its DC value.

3. Write the classifications of clippers and clampers.

The clipper circuits are generally classified into three types: Series clippers, Shut clippers and Dual (combination) clippers. Clampers can be broadly classified into two types: Positive Clampers and Negative Clampers.

4. Draw the output for the given input to the clamper circuit



Positive Clamper circuit

5. What is the need of wave shaping circuit?

In electronics application, it is often needed to alter the shape of waveform like cutting off positive or negative portion of wave, generation of one wave from other, holding wave at some dc level etc. To do this wave shaping circuits are needed.