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TRIBHUWAN UNIVERSITY

INSTITUTE OF ENGINEERING (IOE)

CENTRAL CAMPUS, PULCHOWK

A LAB REPORT ON

Basic Electronics Engineering

EXPERIMENT NO: 1

FAMILIARIZATION WITH ELECTRONIC COMPONENTS AND DEVICES

SUBMITTED TO

DEPARTMENT OF ELECTRONICS

AND COMMUNICATION ENGINEERING

SUBMITTED BY

Ashok Sapkota

073/BCE/030

DATE OF EXPERIMENT

2074-01-32

DATE OF SUBMISSION

2074-02-11

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OBJECTIVES:

1. To acquire a brief knowledge on different electronics components.
2. To become familiar with the color coding of resistor.
3. To acquire knowledge about different types of capacitors and calculate their capacitance, voltage rating and polarity.

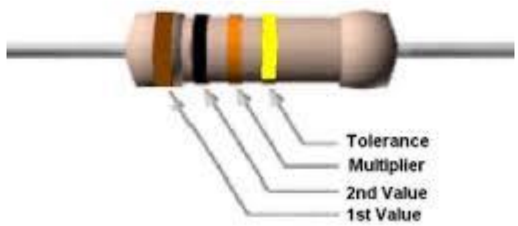
RESISTOR:

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors may be used to reduce current flow, and, at the same time, may act to lower voltage levels within circuits.

The resistance is measured in ohm (Ω). The value of resistance is either printed on the body directly or expressed by different color bands printed on the body. The different color coding system and their respective numerical value are given in the table below:

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

Using these numerical values of the color band the resistance of the resistor can be calculated.



Example:

A resistor colored yellow-violent-orange-gold would be 47kohm with a tolerance of +/-5%.

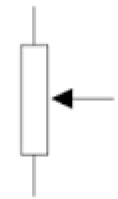
OBSERVATION TABLE FOR RESISTOR:

S.N.	Color Band	Calculated Value(Ω)	Measured Value(Ω)	Remark
1.	Brown, Black, Orange, Gold	$10\times10^3\pm5$	10000	
2.	Blue, Grey, Brown, Gold	$68\times10^1\pm5$	680.47	
3.	Brown, Black, Green, Silver	$10\times10^5\pm10$	1000000	
4.	Green,Blue,Brown, Gold	$56\times10^1\pm5$	560.2	

Variable resistor:

The resistor whose electrical resistance value can be adjusted as per requirement by adjustable component attached to it is called variable resistor.
The electrical resistance is varied by sliding a wiper contact along a resistance track. Sometimes the resistance is adjusted at present value as required at the time of circuit building by adjusting screw attached. to it and sometimes resistance can be adjusted as when required by controlling knob connected to it.

Variable resistor



variable resistor symbol

CAPACITOR:

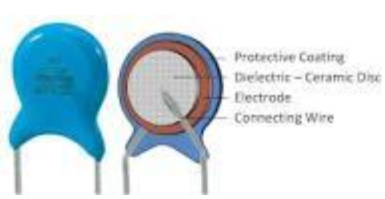
Just like the Resistor, the Capacitor, sometimes referred to as a Condenser, is a simple passive device that is used to “store electricity”. The capacitor is a component which has the ability or “capacity” to store energy in the form of an electrical charge producing a potential difference (Static Voltage) across its plates, much like a small rechargeable battery. The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V). Typical capacitance values range from about 1 pF (10^{-12} F) to about 1 mF (10^{-3} F).

There are basically two types of capacitor:

1. Ceramic capacitor
2. Electrolyte capacitor
   a. Aluminum capacitor
   b. Tantalum capacitor

Ceramic capacitor:

A ceramic capacitor is a non-polarized fixed capacitor made out of two or more alternating layers of ceramic and metal in which the ceramic material acts as the dielectric and the metal acts as the electrodes. The ceramic material is a mixture of finely ground granules of Para electric or ferroelectric materials, modified by mixed oxides that are necessary to achieve the capacitor's desired characteristics.



Electrolytic capacitor:

An aluminum **electrolytic capacitor**, usually simply called an **electrolytic capacitor** (e-cap), is a **capacitor** whose anode (+) consists of pure aluminum foil with an etched surface, covered with a uniformly very thin barrier layer of insulating aluminum oxide, which operates as a dielectric.

Electrolytic capacitor

The large capacitance of electrolytic capacitors makes them particularly suitable for passing or bypassing low-frequency signals up to some mega-hertz and storing large amounts of energy. They are widely used for decoupling or noise filtering in power supplies and DC link circuits for variable-frequency drives, for couple signals between amplifier stages, and store energy as in a flash lamp.

There are two types of capacitor coding:

1. Color coding:

Generally the code consists of 2 or 3 numbers and an optional tolerance letter code to identify the tolerance. Where a two number code is used the value of the capacitor only is given in picofarads, for example, 47 = 47 pF and 100 = 100pF etc. A three letter code consists of the two value digits and a multiplier much like the resistor colour codes in the resistors section.

For example, the digits 471 = 47*10 = 470pF. Three digit codes are often accompanied by an additional tolerance letter code as given below.

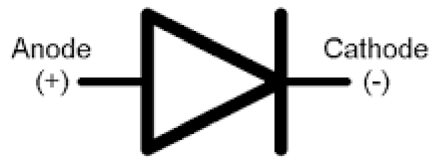
2. Number coding:

   The ceramic capacitor has color coding. The important thing to note is that the value of capacitor is generally in pico farads. The first and second digit are significant figures and the third one is a multiplier.

General Capacitance Codebreaker Information			
PicoFarad (pF)	NanoFarad (nF)	MicroFarad (mF,uF or mfd)	Capacitance Code
1000	1 or 1n	0.001	102
1500	1.5 or 1n5	0.0015	152
2200	2.2 or 2n2	0.0022	222
3300	3.3 or 3n3	0.0033	332
4700	4.7 or 4n7	0.0047	472
6800	6.8 or 6n8	0.0068	682
10000	10 or 10n	0.01	103
15000	15 or 15n	0.015	153
22000	22 or 22n	0.022	223
33000	33 or 33n	0.033	333
47000	47 or 47n	0.047	473
68000	68 or 68n	0.068	683
100000	100 or 100n	0.1	104
150000	150 or 150n	0.15	154
220000	220 or 220n	0.22	224
330000	330 or 330n	0.33	334
470000	470 or 470n	0.47	474

DIODE:

A **diode** is a specialized electronic component with two electrodes called the anode and the cathode. Most **diodes** are made with semiconductor materials such as silicon, germanium, or selenium.

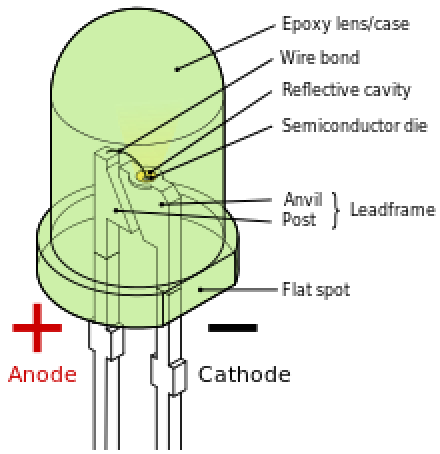


Zener diode:

A **Zener diode** allows current to flow from its anode to its cathode like a normal semiconductor **diode**, but it also permits current to flow in the reverse direction when its "**Zener** voltage" is reached. **Zener diodes** have a highly doped p-n junction.

Light emitting diode(LED):

A **light-emitting diode** (**LED**) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated.[4]When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.



Integrated circuit(IC):

An **integrated circuit** (**IC**), sometimes called a chip or microchip, is a semiconductor wafer on which thousands or millions of tiny resistors, capacitors, and transistors are fabricated. An **IC** can function as an amplifier, oscillator, timer, counter, computer memory, or microprocessor.

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INSTITUTE OF ENGINEERING (IOE)

CENTRAL CAMPUS, PULCHOWK

A LAB REPORT ON

Basic Electronics Engineering

EXPERIMENT NO: 2

TITLE: POWER SUPPLY CIRCUITS

SUBMITTED TO

DEPARTMENT OF ELECTRONICS

AND COMMUNICATION ENGINEERING

SUBMITTED BY

Ashok Sapkota

073/BCE/030

DATE OF EXPERIMENT

2074-01-32

DATE OF SUBMISSION

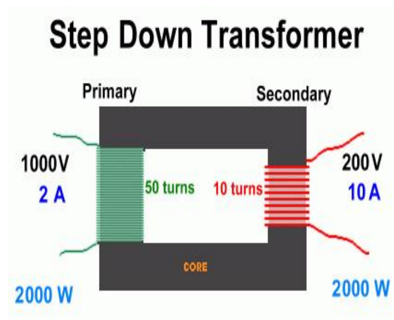
2074-02-11

Objectives:

I. To investigate the behavior of half wave and full wave rectifier.
II. To investigate the effect of filtering capacitor in half and full wave rectifier.
III. To calculate ripple factor.

Theory:

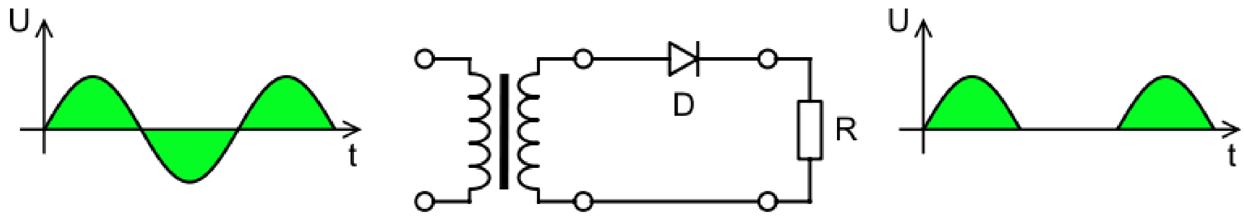
1. STEP DOWN TRANSFORMER:



A transformer is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Electromagnetic induction produces an electromotive force within a conductor which is exposed to time varying magnetic. Transformers are used to increase or decrease the alternating voltages in electric power application. In case they are used to decrease the voltage they are known a step down transformers.

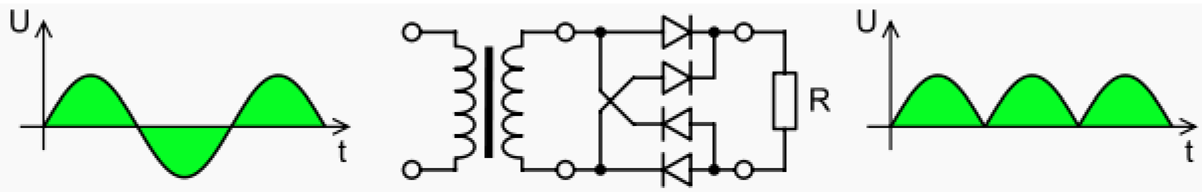
2. HALF WAVE RECTIFIER:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. In half-wave rectification of a single-phase supply, either the positive or negative half of the AC wave is passed, while the other half is blocked. Because only one half of the input waveform reaches the output, mean voltage is lower. Half-wave rectification requires a single diode in a single-phase supply, or three in a three-phase supply. Rectifiers yield a unidirectional but pulsating direct current; half-wave rectifiers produce far more ripple than full-wave rectifiers, and much more filtering is needed to eliminate harmonics of the AC frequency from the output.



3. FULL WAVE RECTIFIER:

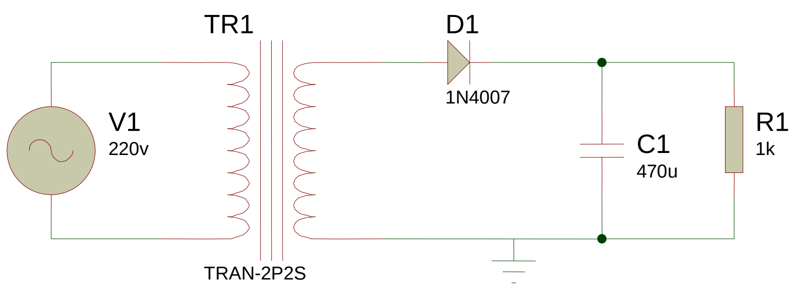
A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Full-wave rectification converts both polarities of the input waveform to pulsating DC (direct current), and yields a higher average output voltage. Two diodes and a center tapped transformer, or four diodes in a bridge configuration and any AC source (including a transformer without center tap), are needed. Single semiconductor diodes, double diodes with common cathode or common anode, and four-diode bridges, are manufactured as single components.



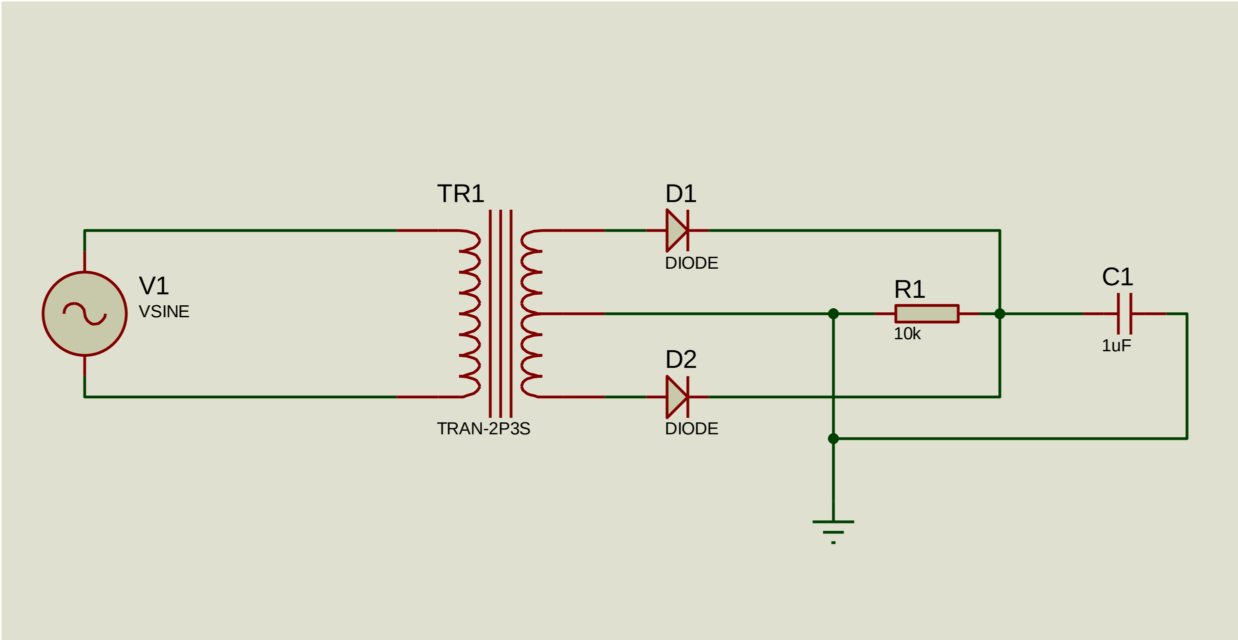
Graetz bridge rectifier: a full-wave rectifier using four diodes.

CIRCUIT DIAGRAMS:

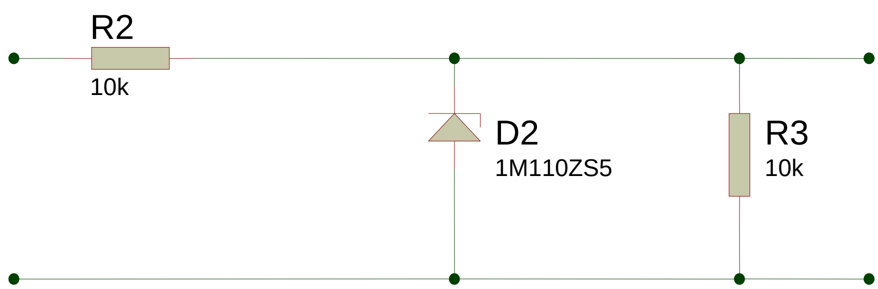
- **CIRCUIT DIAGRAM FOR HALF WAVE RECTIFIER:**



- **CIRCUIT DIAGRAM FOR FULL WAVE RECTIFIER:**

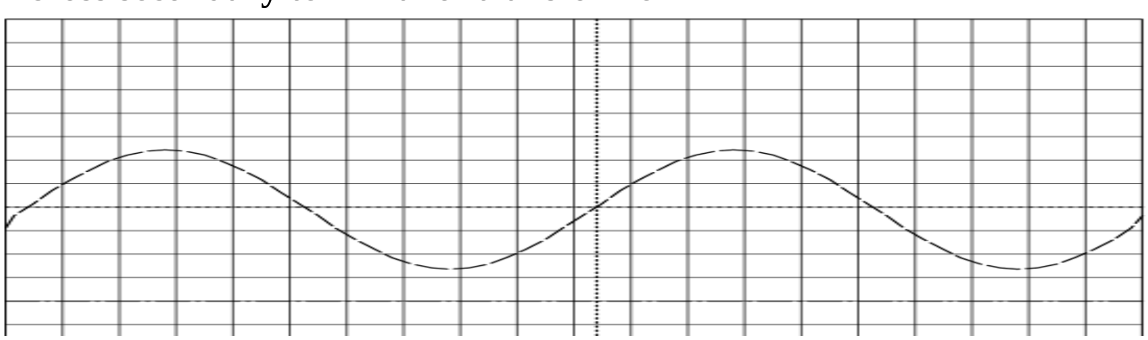


- **CIRCUIT DIAGRAM FOR ZENER DIODE REGULATOR:**

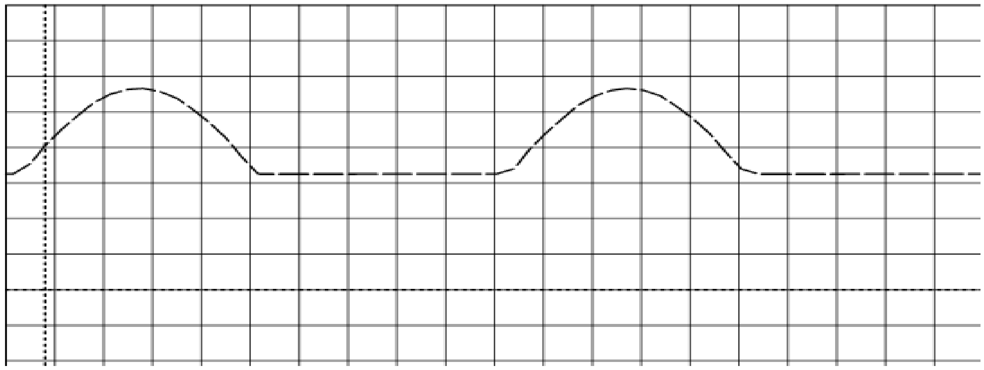


Oscillograms

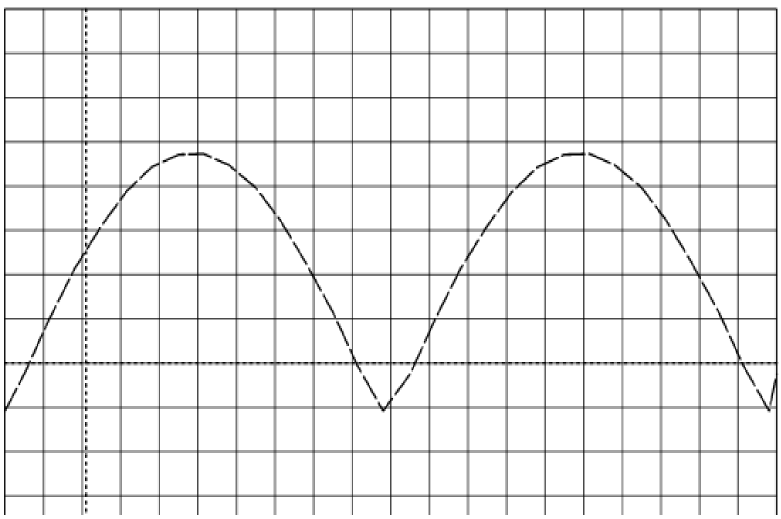
- ➢ **Across secondary terminal of transformer**



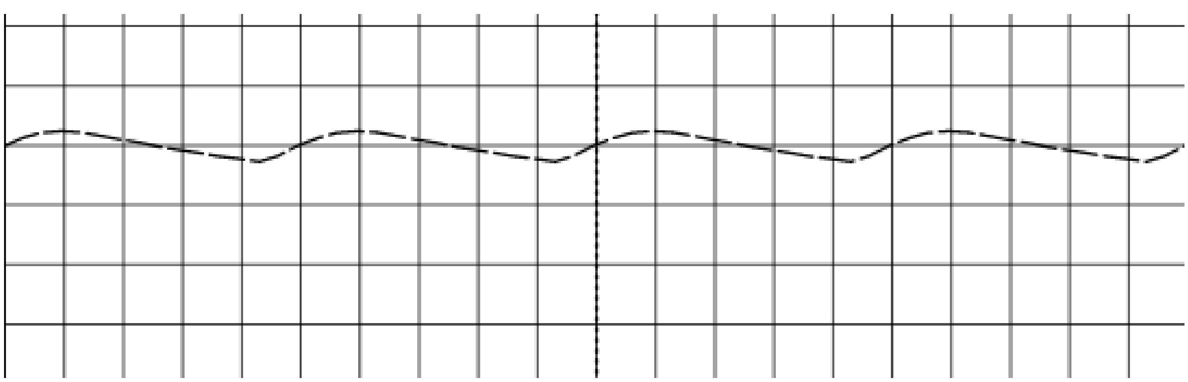
- ➢ **Pulsating DC**



- **Fluctuating DC**



- **Output waveform**



OBSERVATIONS

- **OBSERVATION FOR RECTIFIER CIRCUIT:**

	Pulsating DC Output	
Observation	Half wave Rectifier	Full-wave Rectifier
Input Peak Voltage V_{in}/V		
Input rms Voltage V_{rms}/V		
Output Peak Voltage V_o/V		
Average output voltage V_{avg}/V		
Input frequency(f_{in})/Hz		
Output frequency(f_{out})/Hz		

- **OBSERVATION FOR RECTIFIER CIRCUIT WITH FILTER CAPACITOR:**

	With Filter Capacitor	
Output dc voltage (V_{DC}), V		

Ripple voltage ($V_{r(p-p)}$),V		
Ripple rms voltage ($V_{r(rms)}$),V		

- **OBSERVATION FOR ZENER DIODE REGULATOR:**

	$V_{in(V)}$	**6**	**7**	**8**	**9**	**10**	**12**	**14**	**16**	**18**
R_L=330 Ω	**$V_{out(V)}$**									
R_L=556 Ω	**$V_{out(V)}$**									

DISCUSSION AND CONCLUSION:

Hence half wave and full wave rectified circuits were first simulated and then connected using various hardware components. Similarly, simulations were also carried out for zener diode to study zener diode regulator. Observations were done and noted down. Various results were then calculated and respective analyses were done.

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A LAB REPORT ON

Basic Electronics Engineering

EXPERIMENT NO: 3

TITLE: BIPOLAR JUNCTION TRANSISTOR

SUBMITTED TO

DEPARTMENT OF ELECTRONICS

AND COMMUNICATION ENGINEERING

SUBMITTED BY

Ashok Sapkota

073/BCE/030

DATE OF EXPERIMENT

2074-02-11

DATE OF SUBMISSION

2074-02-26

https://civinnovate.com/civil-engineering-notes/

OBJECTIVE :

(i) To understand and investigate a transistor as switch.
(ii) To understand and investigate the behavior of common emitter BJT amplifier, including
  (a) Measurement of voltage gain
  (b) Use of emitter by pass capacitor
  (c) Phase relationship between input and output
(iii) To check and identify the BJT with ohmmeter.

THEORY:

Transistor: A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits.

BJT Transistors and configuration: A bipolar junction transistor (BJT or bipolar transistor) is a type of transistor that relies on the contact of two types of semiconductor for its operation. BJTs can be used as amplifiers, switches, or in oscillators. BJTs can be found either as individual discrete components, or in large numbers as parts of integrated circuits. There are two types of BJT. They are (i) PNP and (ii) NPN.

As the Bipolar Transistor is a three terminal device, there are basically three possible ways to connect it within an electronic circuit with one terminal being common to both the input and output. Each method of connection responding differently to its input signal within a circuit as the static characteristics of the transistor vary with each circuit arrangement.

- Common Base Configuration – has Voltage Gain but no Current Gain.
- Common Emitter Configuration – has both Current and Voltage Gain.
- Common Collector Configuration – has Current Gain but no Voltage Gain.

Transistor Biasing: Transistor Biasing is the process of setting a transistors DC operating voltage or current conditions to the correct level so that any AC input signal can be amplified correctly by the transistor. A transistors steady state of operation depends a great deal on its base current, collector voltage, and collector current and therefore, if a transistor is to operate as a linear amplifier, it must be properly biased to have a suitable operating point. The purpose of biasing is to ensure that the BJT remains in the active state at all times. The major issue faced in biasing is that the location of the bias point can be very sensitive to transistor parameters which may change due to temperature, manufacturing, etc. As such, we need to develop circuits that “force” the bias point to be mostly independent of the transistor parameters.

EQUATIONS:

$I_e = I_b + I_c$

$\beta = I_c / I_b$

$I_b = (V_{BC} – V_{BE}) / R_B$

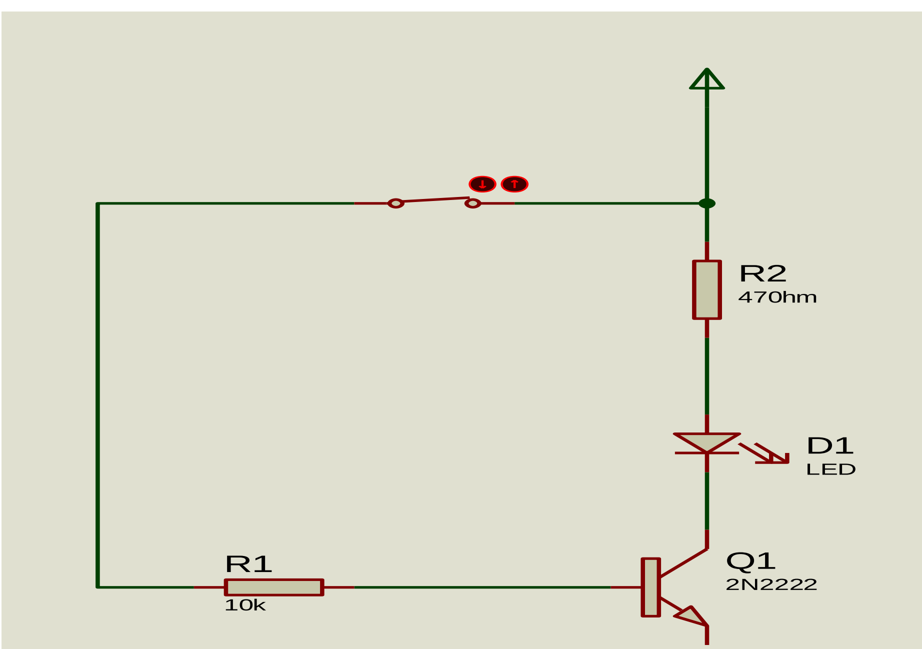
$I_{C(Bias)} = V_{CE} / R_C$

$A_v = \Delta V_o / \Delta V_{in}$

$A_c = \Delta I_o / \Delta I_{in}$

V_C or $V_{CE} = V_{CC} – I_cR_c$

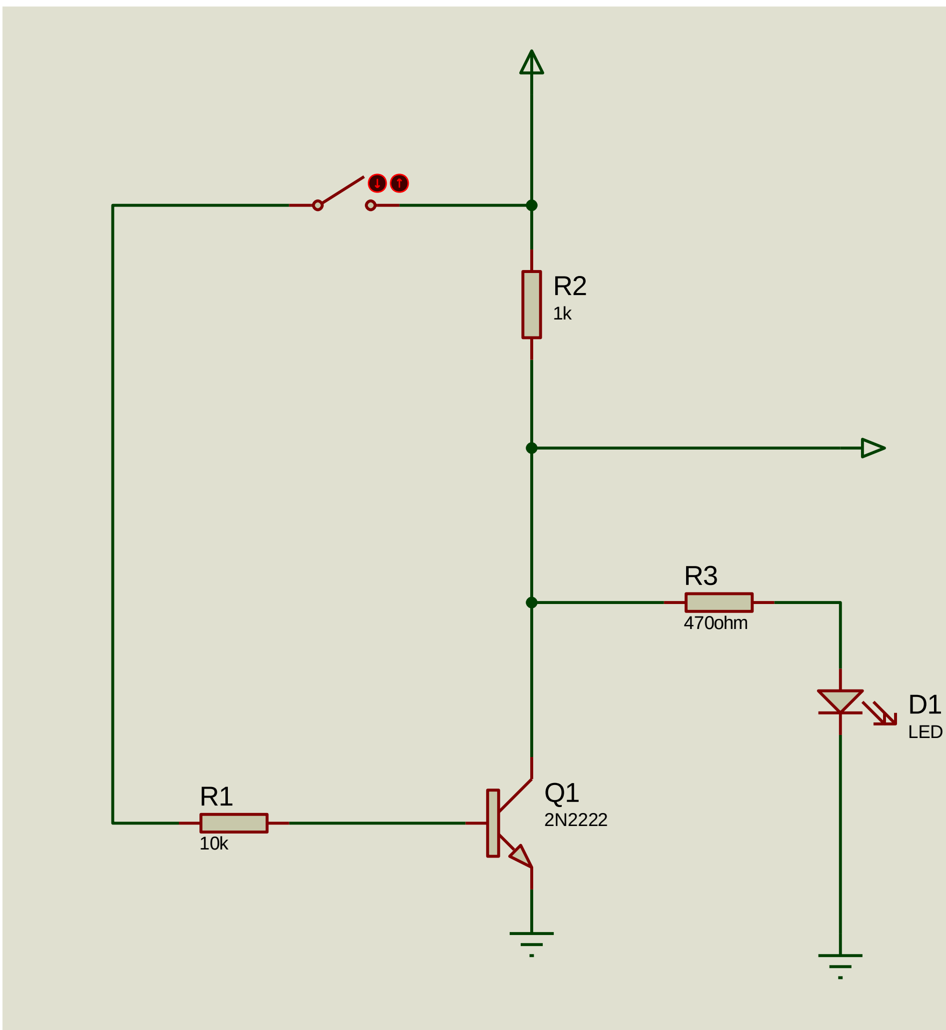
TRANSISTOR AS A SWITCH:



OBSERVATIONS:

S.N	Switch	LED	Transistor Mode
1.	ON	ON	Saturation mode
2.	OFF	OFF	Cutoff mode

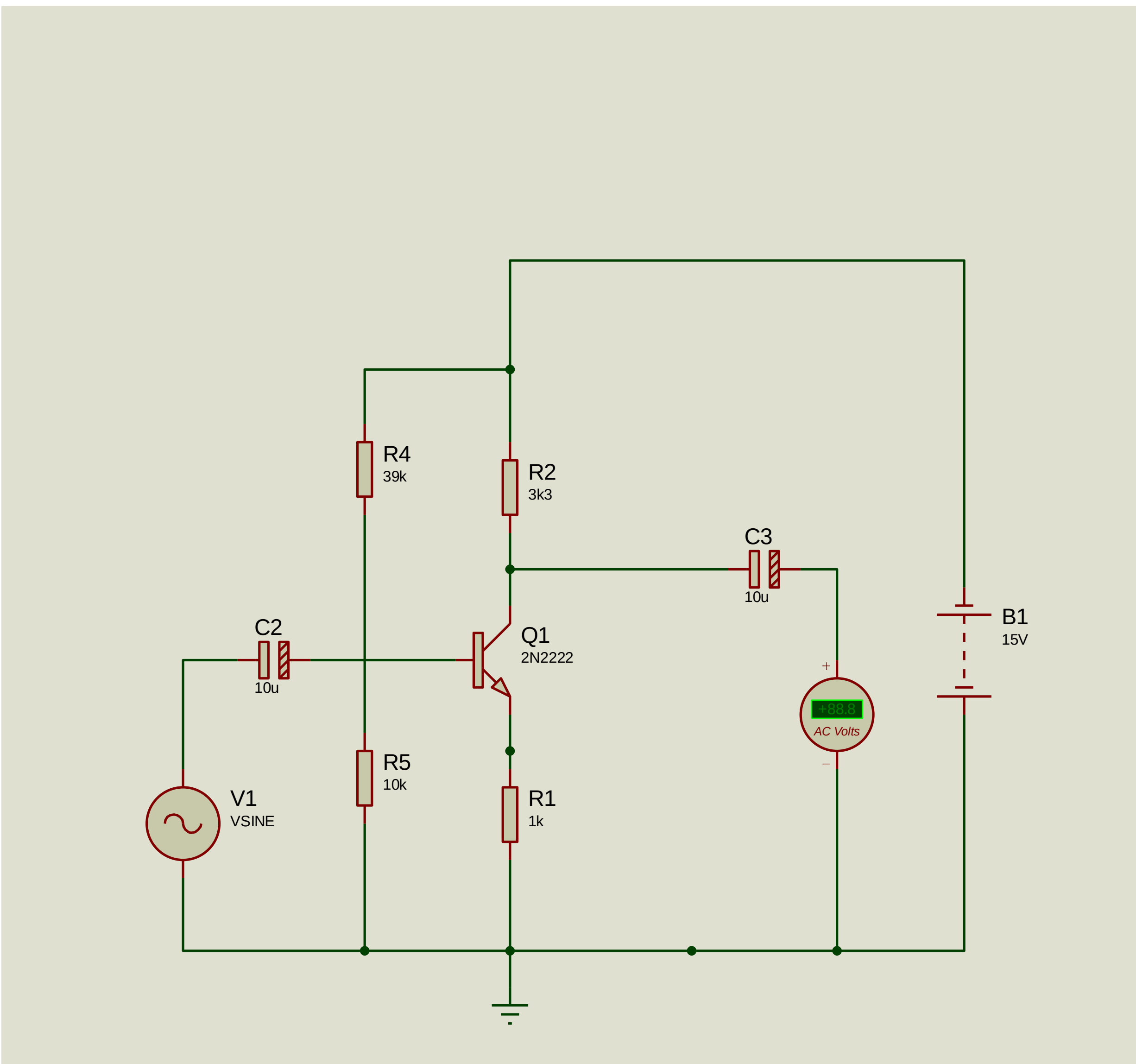
TRANSISTOR AS LOGIC INVERTER:



OBSERVATIONS:

S.N	Switch	Vout	Transistor Mode
1.	ON		Saturation mode
2.	OFF		Cutoff mode

TRANSISTOR AS A AMPLIFIER:

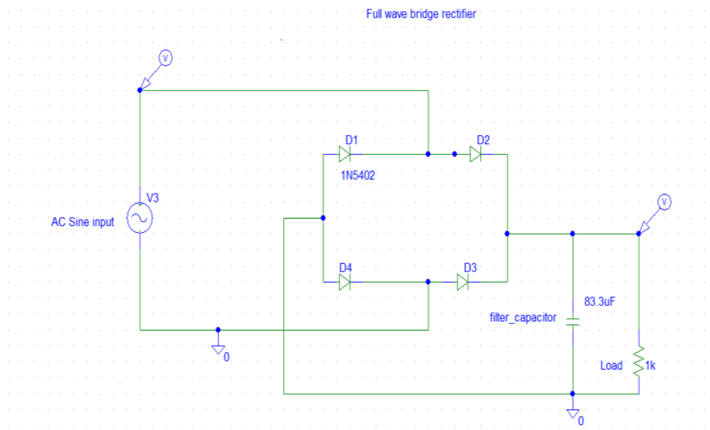


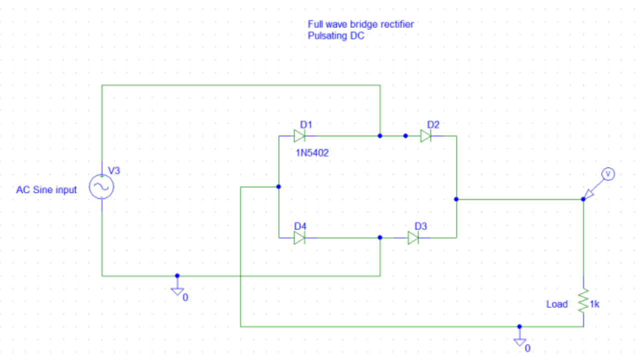
OBSERVATIONS:

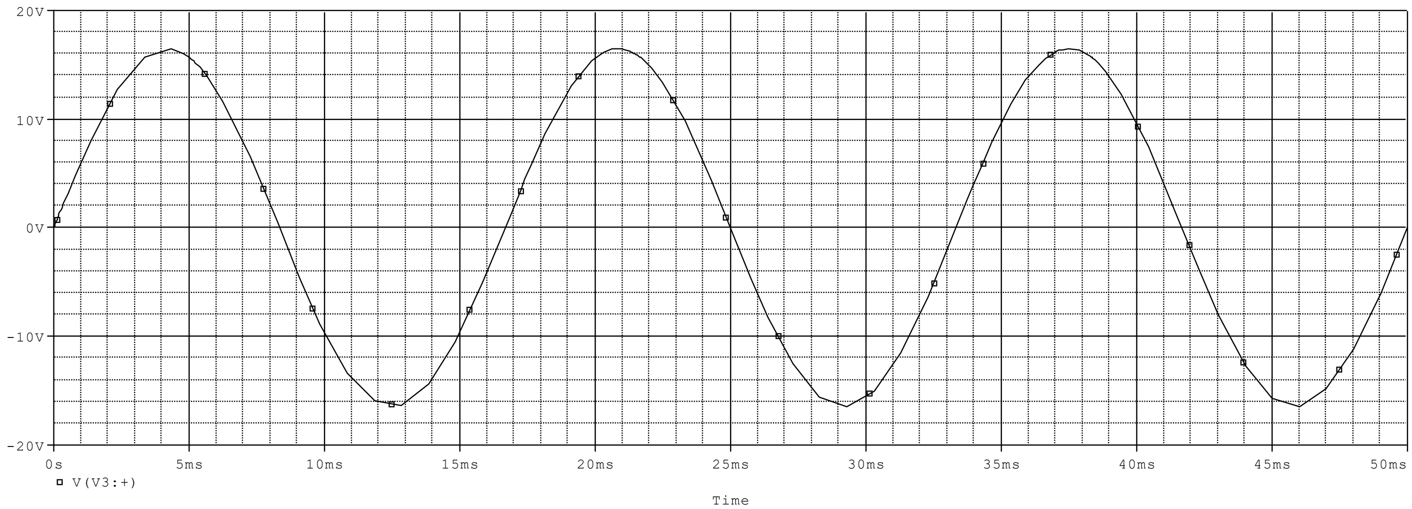
	Without capacitor	With capacitor
Vin(p-p)	1V	1V
Vo(p-p)	2.6V	56V
C ,Av	2.6	56
Phase angle, ϕ	189.2	180

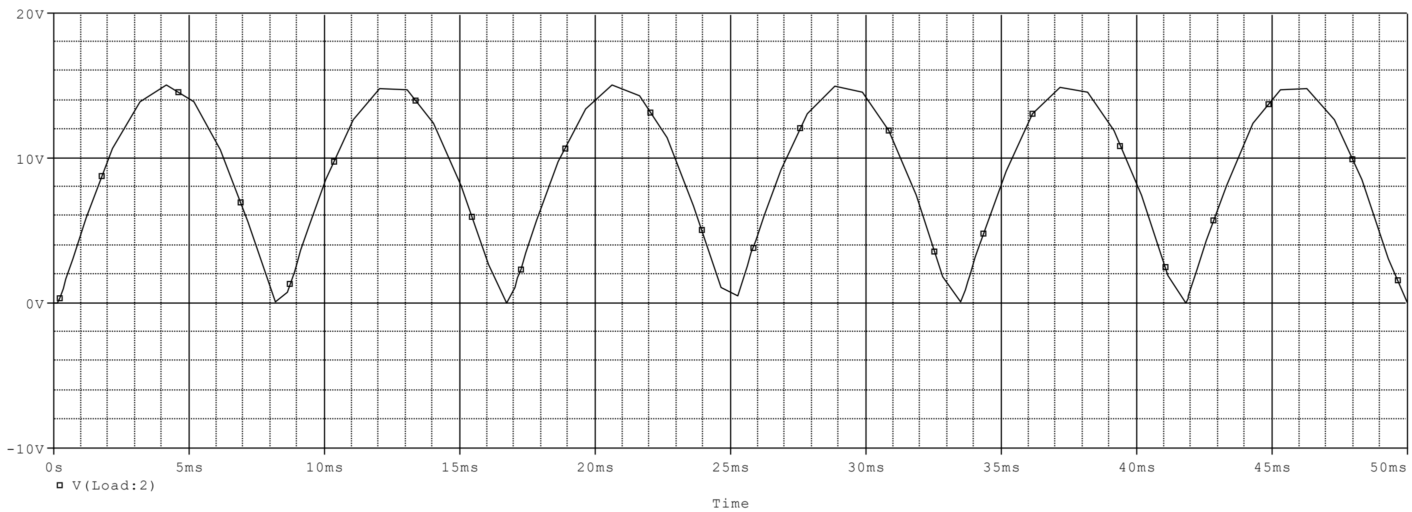
CONCLUSION:

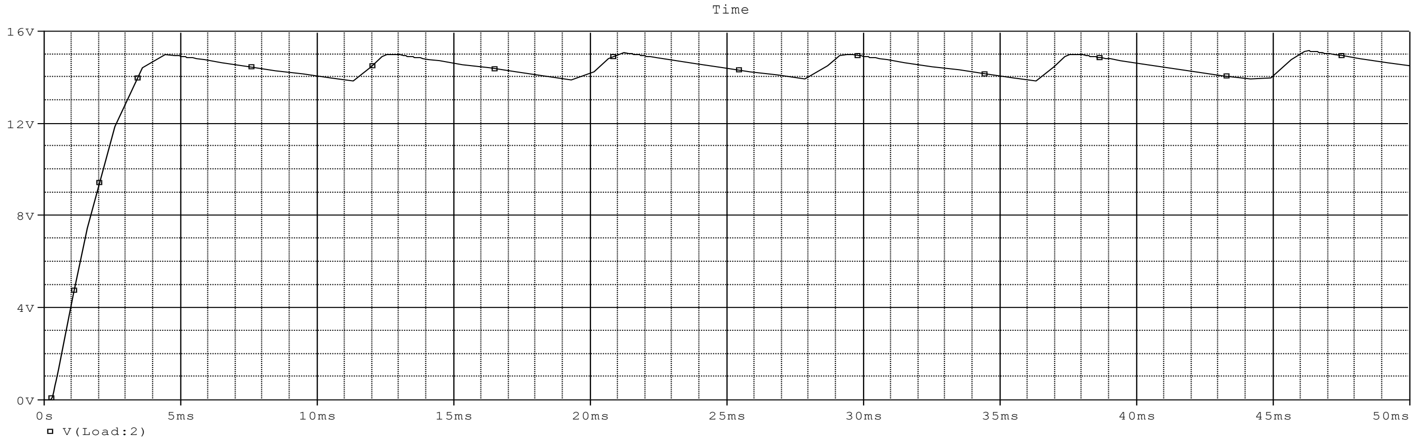
In this way the characteristics of the transistor of the transistor as a switch and logical inverter was observed and finally we used transistor circuit to amplify the voltage making an amplifier circuit.

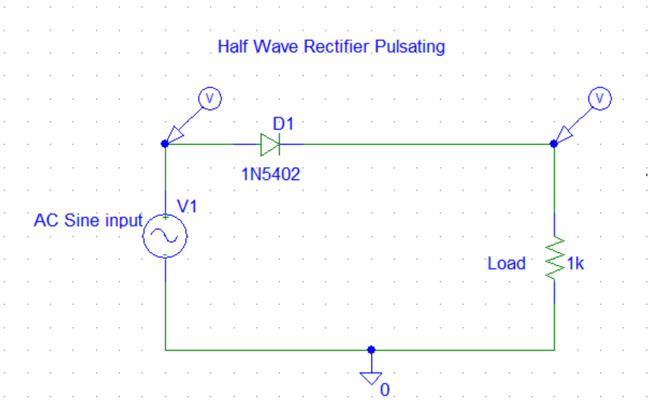

Full wave bridge rectifier
V3
AC Sine input
D1
1N5402
D2
D4
D3
83.3uF
filter_capacitor
Load
1k
0

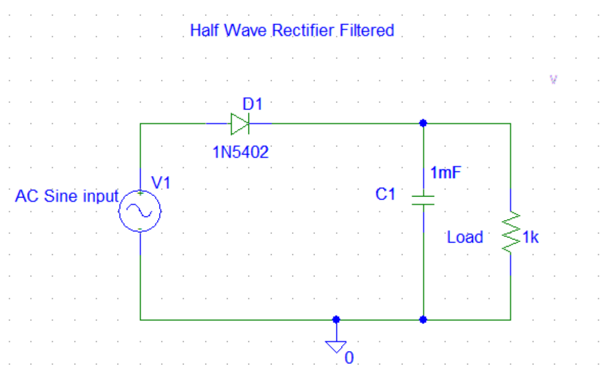

Full wave bridge rectifier
Pulsating DC
V3
AC Sine input
D1
1N5402
D2
D4
D3
Load
1k
0

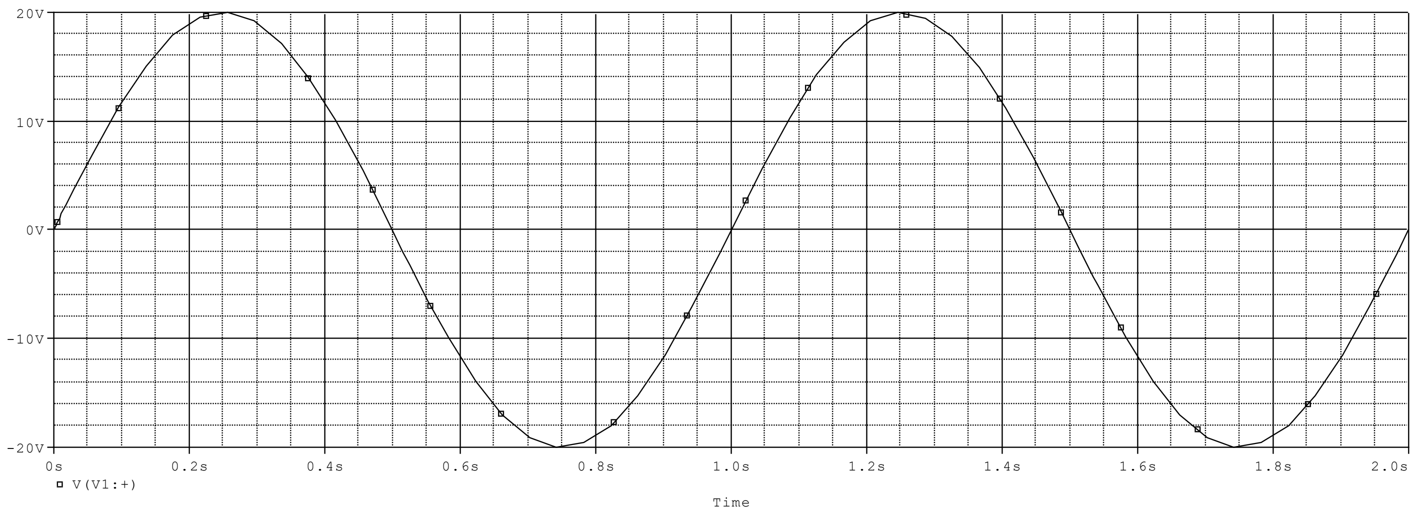

20V
10V
0V
-10V
-20V
0s 5ms 10ms 15ms 20ms 25ms 30ms 35ms 40ms 45ms 50ms
V(V3:+)
Time

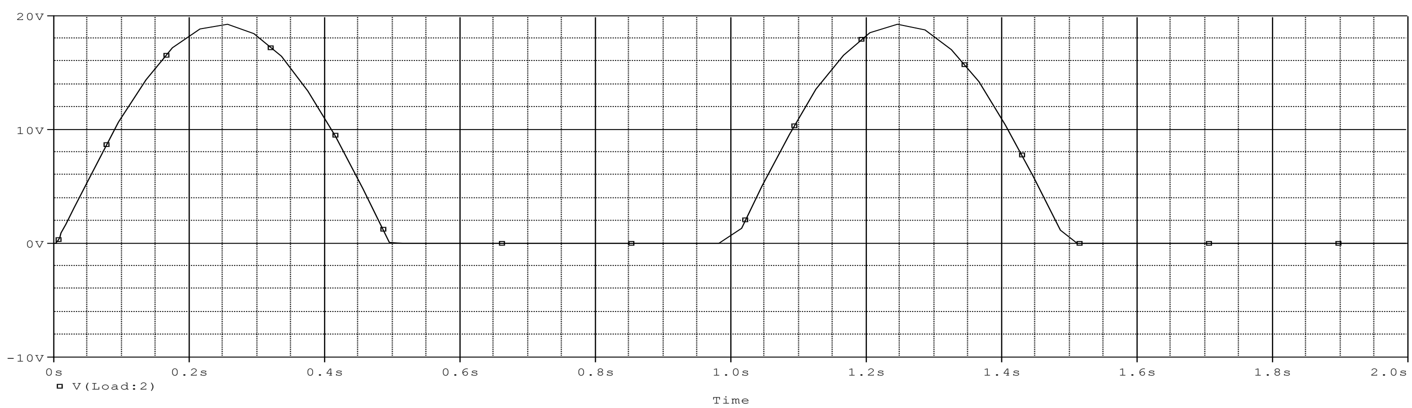

20V
10V
0V
-10V
0s 5ms 10ms 15ms 20ms 25ms 30ms 35ms 40ms 45ms 50ms
V(Load:2)
Time

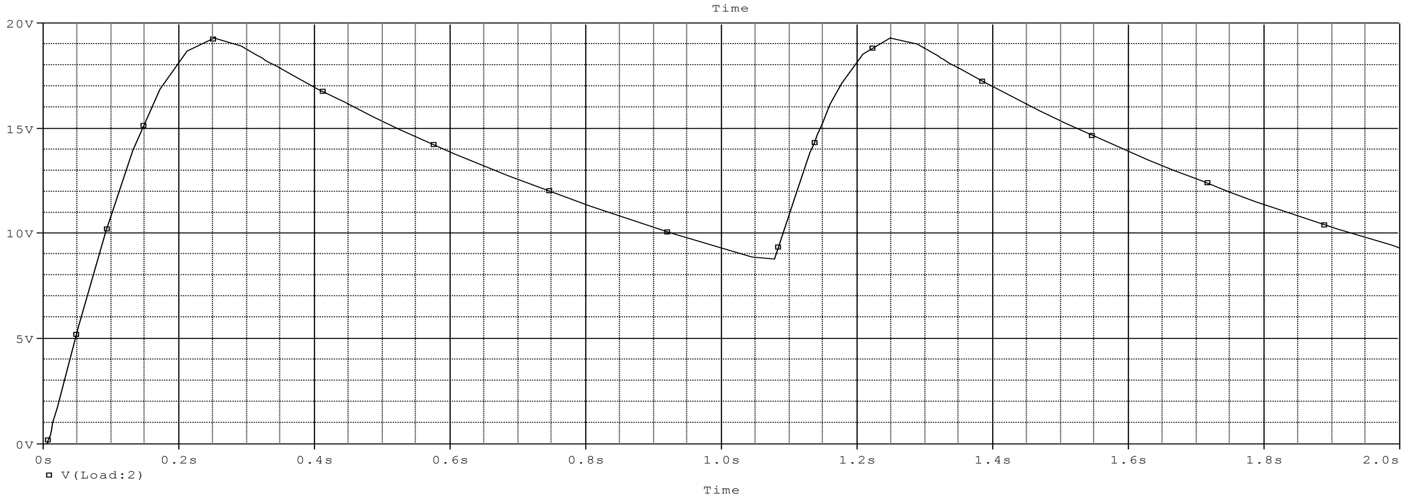

16V
12V
8V
4V
0V
0s 5ms 10ms 15ms 20ms 25ms 30ms 35ms 40ms 45ms 50ms
V(Load:2)
Time


Half Wave Rectifier Pulsating
D1
1N5402
V1
AC Sine input
Load
1k
0

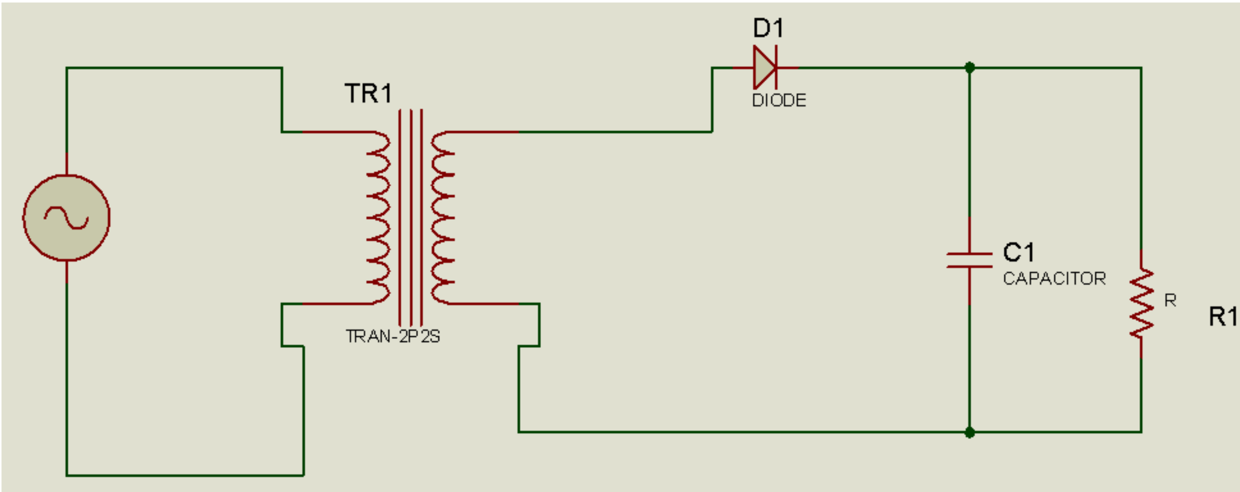

Half Wave Rectifier Filtered
D1
1N5402
V1
AC Sine input
1mF
C1
Load
1k
0


20V
10V
0V
-10V
-20V
0s 0.2s 0.4s 0.6s 0.8s 1.0s 1.2s 1.4s 1.6s 1.8s 2.0s
V(V1:+)
Time

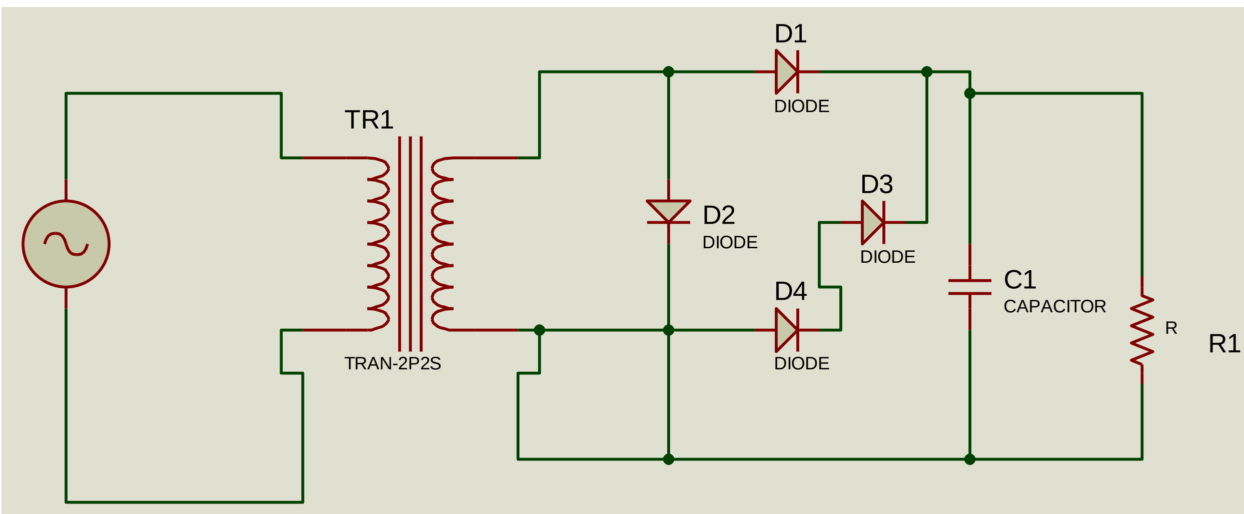

20V
10V
0V
-10V
0s 0.2s 0.4s 0.6s 0.8s 1.0s 1.2s 1.4s 1.6s 1.8s 2.0s
V(Load:2)
Time


20V
15V
10V
5V
0V
0s 0.2s 0.4s 0.6s 0.8s 1.0s 1.2s 1.4s 1.6s 1.8s 2.0s
V(Load:2)
Time

Half Wave rectifier Circuit



Bridge Full- Wave rectifier Circuit



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