POWER ELECTRONICS LABAROTORY MANUAL

5TH SEMESTER B.TECH ELECTRICAL ENGINEERING

AND

ELECTRICAL &ELECTRONICS ENGINEERING

PREPARED BY:

Dr.Jayakrushna Moharana

Principal

Hi-Tech Institute of Technology

Khurda Odisha

EXPERIMENT NO-1

AIM OF THE EXPERIMENT:- To study the V-I characteristics of SCR.

APPARATUS REQUIRED:-

SL NO	NAME OF THE EQUIPMENTS / COMPONENTS	SPECIFICATIONS	QUANTITY
1	SCR (BTI51)	I_{GT} = 2 ----15mA I_L = 10 ----40mA I_H = 7 -----20mA V_{GT} = 0.6 ---- 1.5V	1
2	DC Power supply	a) 0-5Vdc/1Amp b) 0V-30Vdc/1Amp	2
3	Fixed resistor	a) 100Ω/10W b) 470Ω/0.25W c) 1KΩ/0.25W	1 1 1
4	Variable resistor (POT)	1KΩ	1
5	Digital Multimeter (Ammeter) 4 ½ digit	a) 0-20mA b) 0-200mA	1 1
6	Digital Multimeter (Voltmeter) 4 ½ digit	0-30V	1

Table.01

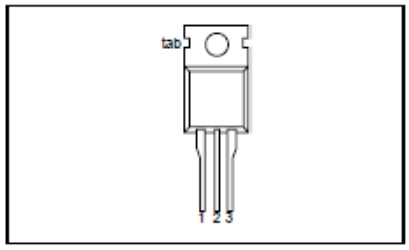
THEORY:-

SCR acts as a switch when it is forward biased. When the gate is kept open $I_G = 0$ and the operating of SCR is similar to PNPN diode. When $I_G < 0$ the break over voltage required to allow the current through SCR is large and when the $I_G > 0$ less amount of break over voltage is required to turn on the SCR. With very large positive gate currents break over voltage may occur at a very low voltage such that the characteristics of SCR is similarly to ordinary PN diode. As the voltage at which the SCR is switched ON can be controlled by varying gate current. Once the SCR is turned ON, the gate losses control and cannot be used to switch the device OFF. One way to turn the device OFF is by lowering the anode current below the holding current by reducing the supply voltage below the holding voltage, keeping the gate open. At this point even the gate signal is removed the device keep ON conducting, till the current level is maintained to a minimum level of holding current.

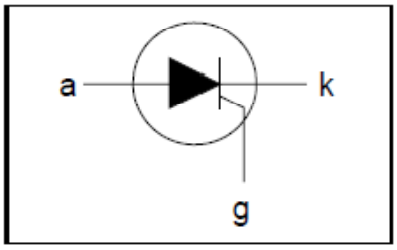
PINNING - TO220AB

PIN	DESCRIPTION
1	cathode
2	anode
3	gate
tab	anode

PIN CONFIGURATION



SYMBOL



CIRCUIT DIAGRAM:-

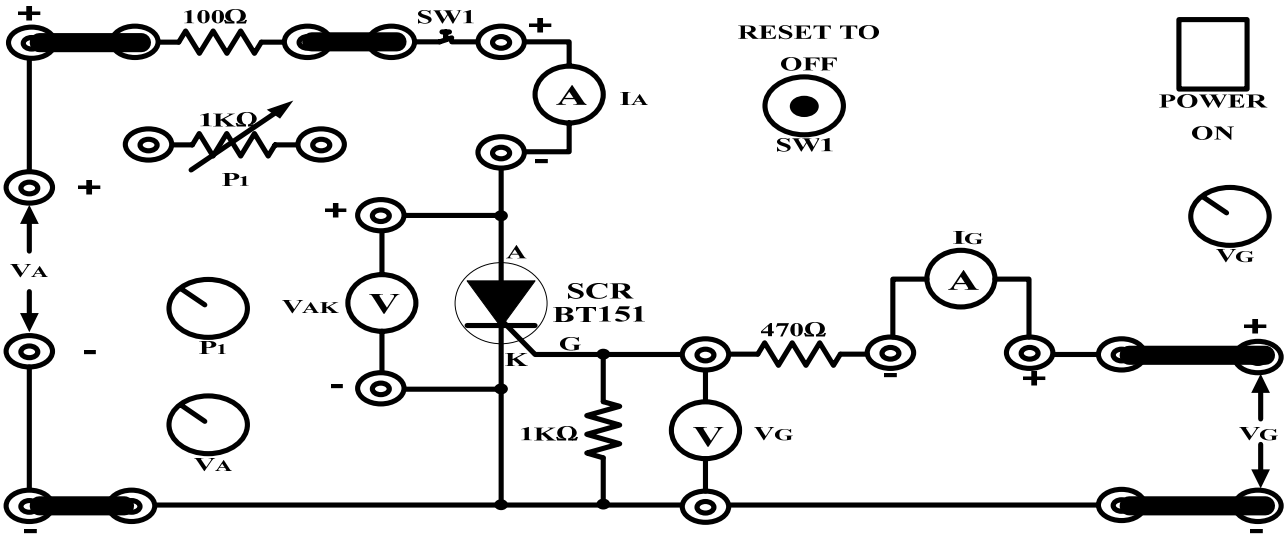


Fig.01

PROCEDURE:-

1. Connect the circuit as shown in fig.01
2. Initially some gate current is applied by varying the V_G.
3. Voltage V_A is slowly varied and different reading of ammeter (I_A) & voltmeter (V_{AK}) are taken.
4. The voltage at which the SCR is triggered and heavy current flows is noted as (V_{BO}) forward breakdown voltage.
5. Now apply the gate current more than I_G.
6. Step 3 & 4 are repeated and note down the corresponding voltage & current.
7. Draw the graph between V_{AK} & I_A at different gate current.

The ON state resistance can be calculated from the graph by using the formula

IDEAL GRAPH:-

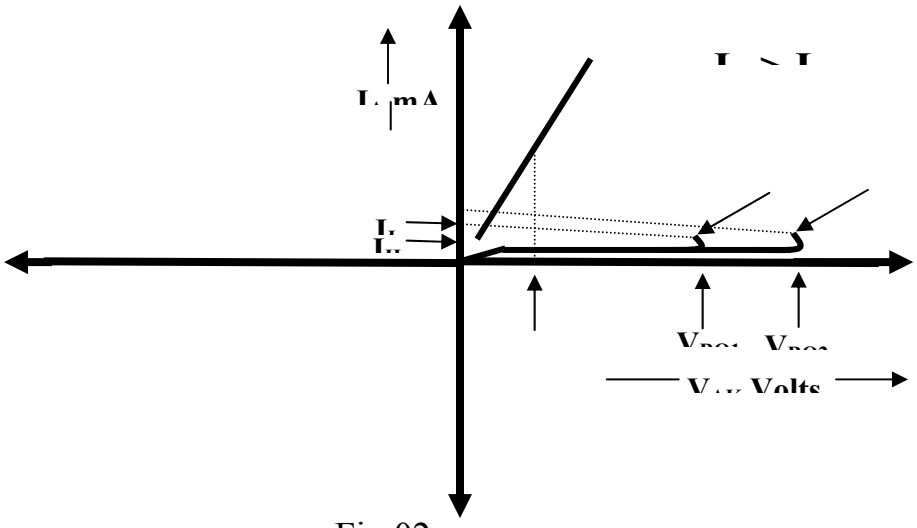


Fig.02

RESULT:

The V-I characteristics of SCR are observed and break over voltage at different gate currents is noted.

EXPERIMENT NO-2

AIM OF THE EXPERIMENT:- To study the Latching & Holding current of SCR.

APPARATUS REQUIRED:-

SL NO	NAME OF THE EQUIPMENTS / COMPONENTS	SPECIFICATIONS	QUANTITY
1	SCR (BTI51)	I_{GT} = 2 ----15mA I_L = 10 ----40mA I_H = 7 -----20mA V_{GT} = 0.6 ---- 1.5V	1
2	DC Power supply	c) 0-5Vdc/1Amp d) 0V-30Vdc/1Amp	2
3	Fixed resistor	d) 100Ω/10W e) 470Ω/0.25W f) 1KΩ/0.25W	1 1 1
4	Variable resistor (POT)	1KΩ	1
5	Digital Multimeter (Ammeter) 4 ½ digit	c) 0-20mA d) 0-200mA	1 1

6	Digital Multimeter (Voltmeter) 4 ½ digit	0-30V	1

Table.02

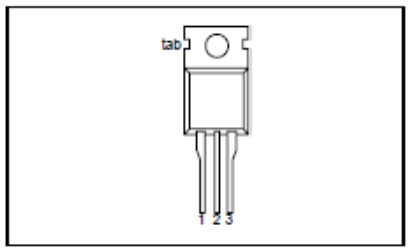
THEORY:-

SCR acts as a switch when it is forward biased. When the gate is kept open $I_G = 0$ and the operating of SCR is similar to PNPN diode. When $I_G < 0$ the break over voltage required to allow the current through SCR is large and when the $I_G > 0$ less amount of break over voltage is sufficient. With very large positive gate currents break over voltage may occur at a very low voltage such that the characteristics of SCR is similarly to ordinary PN diode. As the voltage at which the SCR is switched ON can be controlled by varying gate current. Once the SCR is turned ON, the gate losses control and cannot be used to switched the device OFF. One way to turn the device OFF is by lowering the anode current below the holding current by reducing the supply voltage below the holding voltage, keeping the gate open. At this point even the gate signal is removed the device keep ON conducting, till the current level is maintained to a minimum level of holding current.

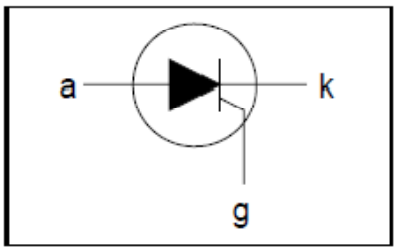
PINNING - TO220AB

PIN	DESCRIPTION
1	cathode
2	anode
3	gate
tab	anode

PIN CONFIGURATION



SYMBOL



CIRCUIT DIAGRAM:-

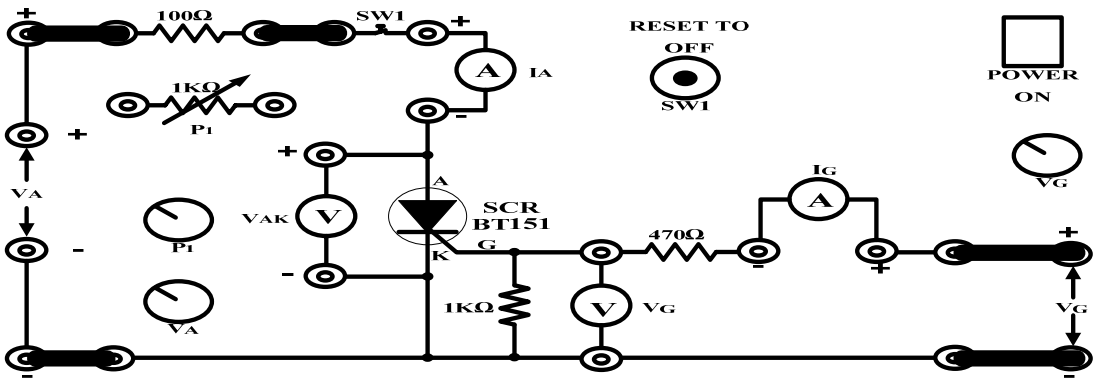


Fig.03

PROCEDURE:-

Holding Current:

1. Connect the circuit as shown in fig.1
2. Set V_A at 10Vdc constant with the help of POT V_A.
3. Now apply the gate voltage gradually until the SCR fires then note down the value of I_G (e.g. 2.8mA) and also the value of I_A & V_{AK}.
4. Then keep the Gate voltage to zero or open the Gate voltage.
5. Observe the ammeter (I_A) reading by reducing the anode-cathode supply voltage V_A. The point at which the ammeter (I_A) reading suddenly goes to zero gives the value of Holding current I_H.

Latching Current:

1. Connect the circuit as shown in fig.1
2. Set V_A at particular value, observe I_A, by opening the gate voltage V_G. If it goes to zero after opening the switch indicates $I_A < I_L$.
3. Repeat step-2 such that the current I_A should not go to zero after opening of the gate voltage V_G. Then I_A gives the value of I_L.

CONCLUSION:- The Latching & holding current of SCR are observed.

EXPERIMENT NO-3

AIM OF THE EXPERIMENT:- To study the V-I characteristics of TRIAC.

APPARATUS REQUIRED:-

SL. NO.	APPARATUS REQUIRED	QUANTITIES
1	TRIAC trainer kit	01
2	Patch cord	As per required
2	Multimeter	03

Table.03

THEORY:-

The Triac is a member of the thyristor family. But unlike a thyristor which conducts only in one direction (from anode to cathode) a triac can conduct in both directions. Thus a triac is similar to

two back to back (anti parallel) connected thyristors but with only three terminals. As in the case of a thyristor, the conduction of a triac is initiated by injecting a current pulse into the gate terminal. The gate looses control over conduction once the triac is turned on. The triac turns off only when the current through the main terminals become zero. Therefore, a triac can be categorized as a minority carrier, a bidirectional semi-controlled device. They are extensively used in residential lamp dimmers, heater control and for speed control of small single phase series and induction motors.

CIRCUIT DIAGRAM:-

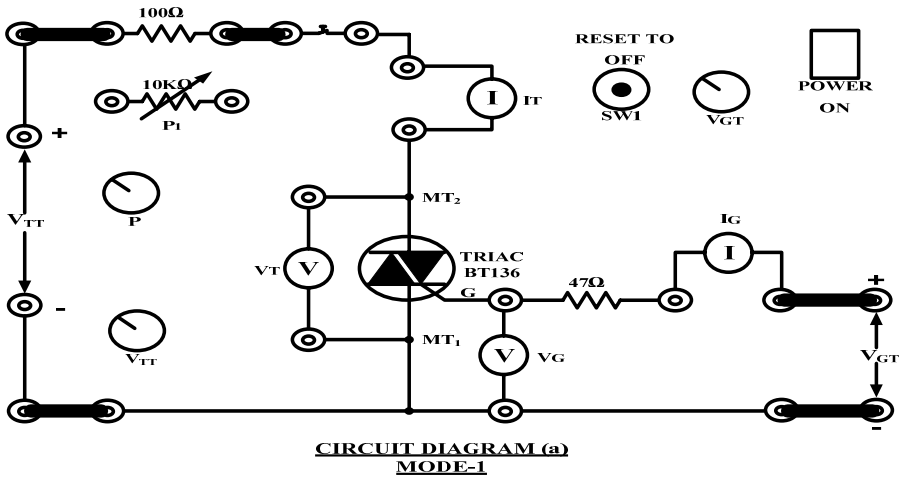


Fig.04

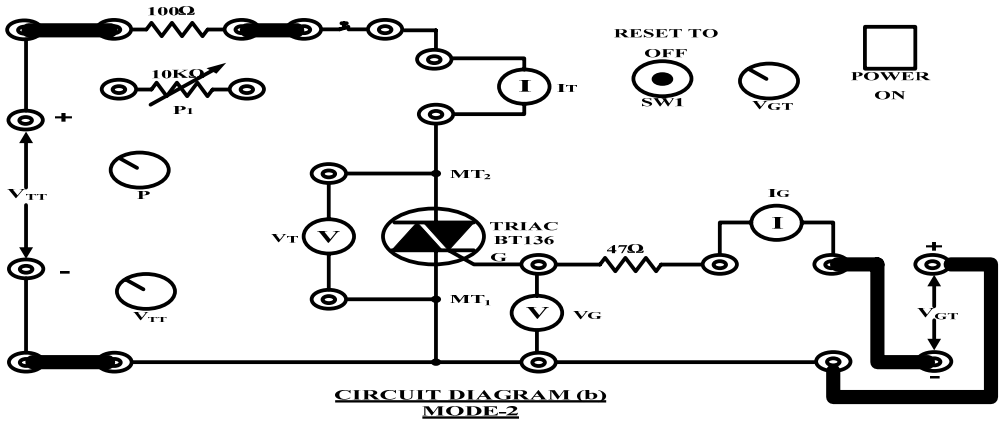


Fig.05

PROCEDURE:-

FOR MODE-1

1. Connections are made as shown in the circuit diagram (a).

2. The value of gate current I_G is set to a convenient value by adjusting V_{GT}.
3. By varying the supply voltage V_{TT} gradually step-by-step, note down the corresponding value of V_T & I_T. Note down the value of V_T & I_T at the instant of firing of TRIAC and after firing (by reducing the voltmeter range and increasing the ammeter ranges) then increase the supply voltage V_T & I_T.
4. The point at which the TRIAC fires gives the value of break-over voltage V_{BO1}.
5. A graph of V_T & I_T is to be plotted.

FOR MODE-2

1. Connections are made as shown in the circuit diagram (b).
2. The gate current is set as same value as in mode-1.
3. Repeat the step no 3,4 & 5 of mode-1.

CONCLUSION:-

EXPERIMENT NO-4

AIM OF THE EXPERIMENT:- To study the V-I characteristics of MOSFET.

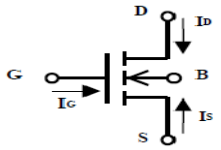
APPARATUS REQUIRED:-

SL. NO.	APPARATUS REQUIRED	QUANTITIES
1	MOSFET trainer kit	01
2	Patch cord	As per required
2	Multimeter	03

Table.04

THEORY:-

A metal-oxide-semiconductor field-effect transistor (MOSFET) is a three-terminal device that can be used as a switch (e.g. in digital circuits) or as an amplifier (e.g. in analog circuits). The three terminals are referred to as the **Source**, **Gate**, and **Drain** terminals. The MOSFET also has a **Body** terminal, which is usually tied to the source terminal (so that $V_{BS} = 0$ Volts) in discrete transistors. **Current flow between the source and drain terminals is controlled by the voltage V_{GS} applied between the gate and source terminals:** If the gate-to-source voltage is below a threshold voltage value V_T (e.g. ~2 Volts, for the transistors which you will be using in this lab), no current can flow between the source and the drain – i.e. the transistor is OFF; if the gate-to-source voltage is higher than V_T, then current can flow between the source and the drain – i.e. the transistor is ON. The circuit symbol for an n-channel enhancement-mode ($V_T > 0$ Volts) MOSFET is shown in Figure 1, along with the terminal current reference directions.



CIRCUIT DIAGRAM:-

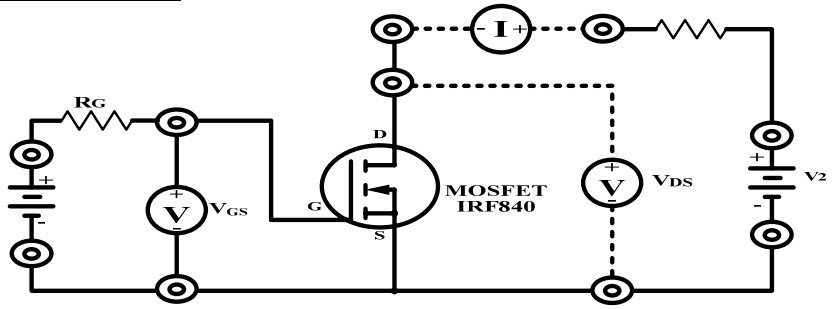


Fig.06

PROCEDURE:-

Drain Characteristics:

1. Connections are made as shown in the Experimental circuit diagram.
2. Adjust the value of V_{GS} slightly more than the threshold voltage Vth.
3. Slowly vary V2 and note down the value of I_D & V_{DS}.
4. For a particular value of V_{GS} there is pinch off voltage (Vp) between collector & emitter.
5. Repeat the experiment for a different value of V_{GS} and note down I_D & V_{DS}.
6. Draw the graph of I_D v/s V_{DS} for different value of V_{GS}.

Ideal Graph:

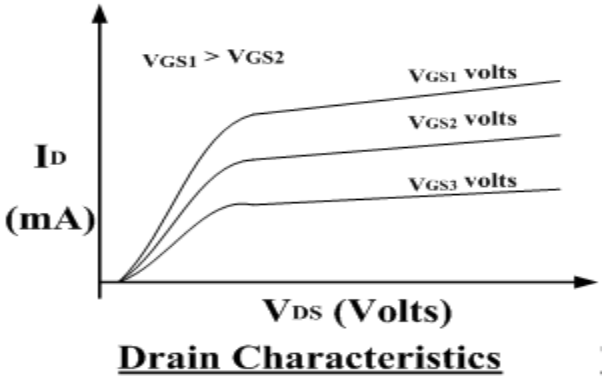


Fig.07

TABULATION:-

V_{GS} =		V_{GS} =		V_{GS} =	
V_{DS} (V)	I_D (mA)	V_{DS} (V)	I_D (mA)	V_{DS} (V)	I_D (mA)

Table.05

CONCLUSION:-

EXPERIMENT NO-5

AIM OF THE EXPERIMENT:- To study the V-I characteristics of UJT.

APPARATUS REQUIRED:-

SL. NO.	APPARATUS REQUIRED	QUANTITIES
1	UJT trainer kit	01
2	Patch cord	As per required
2	Multimeter	02

Table.06

THEORY:-

Unijunction transistor (UJT) is a single junction three-terminal special semiconductor device used in pulse and switching circuits. It exhibits special characteristics; a negative resistance region in the characteristics curve. It consists of a N-type silicon bar along one side of which, about 70% distance from the bottom a p-type island is doped. The region where the p island meets with N bar is the uni-pn-junction. The P material is called the Emitter and the top of the bar close to the emitter is called Base-2 (B2), the bottom of the bar is called the Base-1 (B1). Figure-1 shows the structure of UJT.

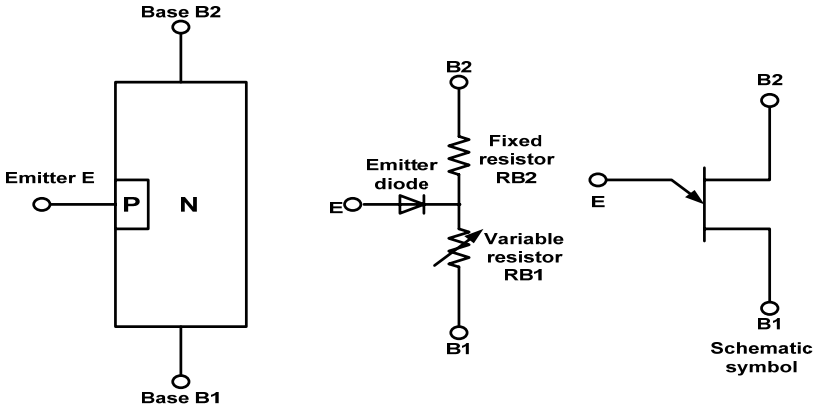


Fig.08

The emitter E is heavily doped having many holes. The N – type bar is lightly doped such that the bar resistance is 5KΩ to 10KΩ with emitter open. The emitter forms a pn junction equivalent to a diode as shown in the equivalent circuit. The N terminal of the diode is connected to voltage divider formed by the bar. The resistance R_{B2} of base-2 is of lower value and resistance of the base-1 R_{B1} is of higher value because of the positioning of the pn doping. Further, by applying a positive voltage to base-2 with respect to base-1, the emitter ejects holes travels down toward the base-1. This makes variation in base resistance R_{B1}. Hence, base-1 resistance is a variable resistance and base-2 resistance is a fixed resistance as shown in figure-1. The resistance R_{B1} varies from 50Ω to 5KΩ.

CIRCUIT DIAGRAM:-

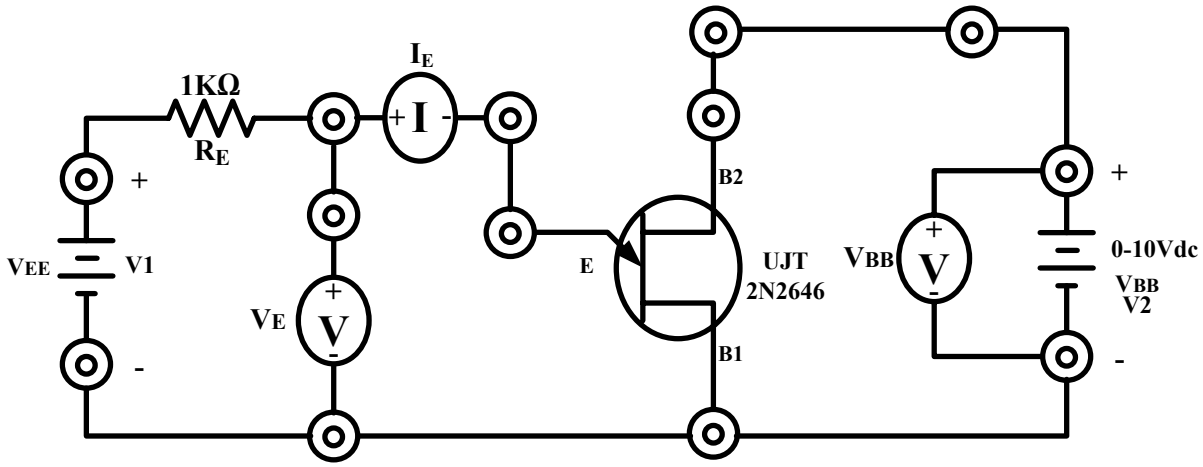


Fig.09

PROCEDURE:-

1. Complete the circuit connections are made as shown in figure. V_{BB} is set to 8V by adjusting V_{BB} power supply. While monitoring voltmeter emitter voltage V_E is varied slowly. When V_E reaches peak voltage point suddenly, voltage starts dropping. This is the indication of current flow in the UJT. The peak voltage at which conduction starts is noted in table. This procedure is repeated for 2-3 times to confirm the exact peak voltage.
2. Further increase in the V_E value increases the current. The current & voltage are noted in table.
3. Trial is repeated by varying V_{BB} to 10V & 4V. In each case peak-point, voltage is determined and the variations in emitter current with emitter voltage are recorded in table.
4. Draw the graph between V_E & I_E.

TABULATION:-

V_{BB} = 8V	V_{BB} = 8V	V_{BB} = 8V

V_E (V)	I_E (mA)	V_E (V)	I_E (mA)	V_E (V)	I_E (mA)

Table.07

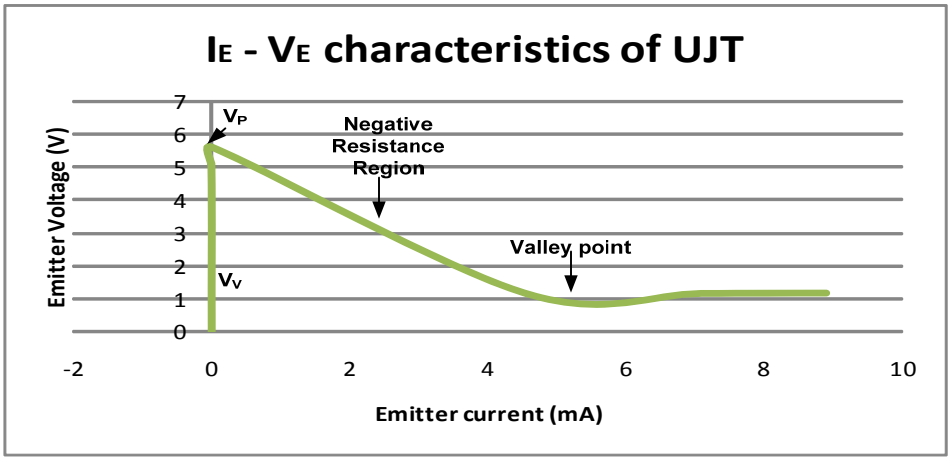


Fig.10, IE – VE characteristics of 2N2646 UJT

CONCLUSION:-

EXPERIMENT NO-6

AIM OF THE EXPERIMENT:- To study the cosine triggering.

APPARATUS REQUIRED:-

SL. NO.	APPARATUS REQUIRED	QUANTITIES
1	Cosine triggering trainer kit	01
2	Patch cord	As per required
3	CRO	01
4	CRO probe	02

Table.07

THEORY:-

The cosine firing scheme for thyristors in single-phase converters is shown in Fig - 01. The synchronizing transformer steps down the supply voltage to an appropriate level. The input to this transformer is taken from the same source from which converter circuit is energized. The output voltage *vl* of synchronizing transformer is integrated to get cosine-wave *V2*. The de control voltage *Ec* varies from maximum positive *Ecm* to maximum negative *Ecm* -so that firing angle can be varied from zero to 180°. The cosine wave *V2* is compared in comparators 1 and 2 with *Ec* and - *Ec'* When *Ec* is high as compared to *V2'* output voltage *V3* is available from

comparator 1. Same is true for comparator 2. So the comparators 1 and 2 give output pulses *u3* and *u4* respectively as shown in Fig - 02. It is seen from this figure.

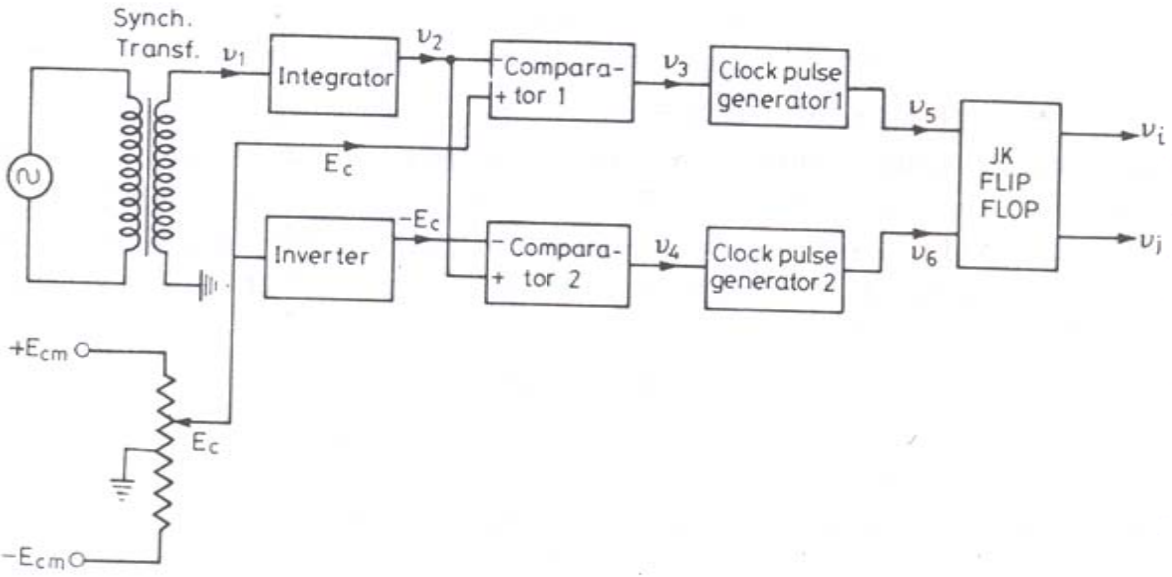


Fig.11

That firing angle is governed by the intersection of *v2* and *Ec'* When *Ec* is maximum, firing angle is zero. Thus, , firing angle a in terms of *V2m* and *Ec* can be expressed as

$$V_{2m} \cos \alpha = E_c$$

$$\alpha = \cos^{-1} \frac{E_c}{E_c} \qquad \ldots \text{Eq 01}$$

Where V_{2m} = maximum value of cosine signal V_2.

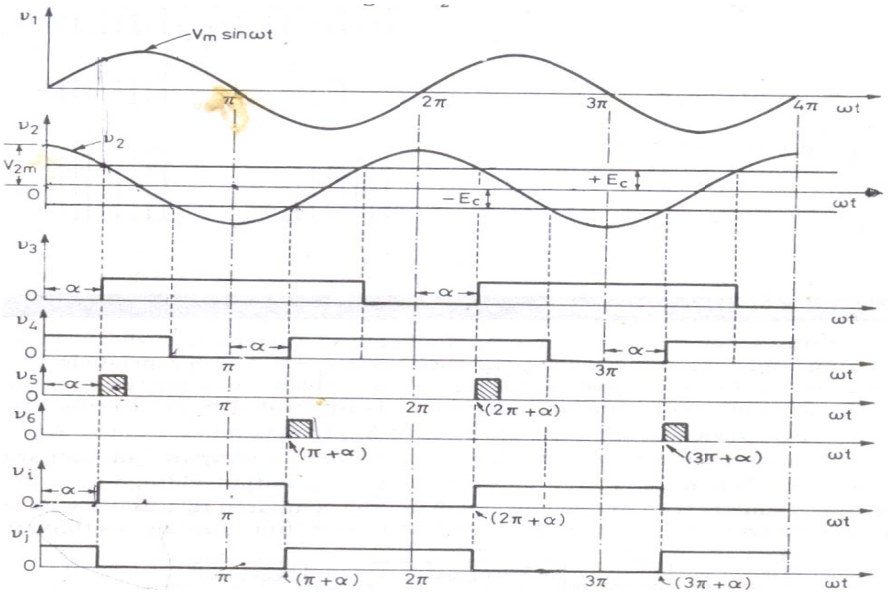


Fig.12

The signals v_3, v_4 obtained from comparators are fed to clock-pulse generators 1, 2 to get clock pulses v_5, v_6 as shown in Fig - 02. These signals v_5, v_6 energise a JK flip flop to generate output signals v_i and v_j. The signal v_i is amplified through the circuit of above Fig. and is then employed to turn on the SCRs in the positive half cycle. Signal v_j, after amplification, is used to trigger SCRs in the negative half cycle.

For a single-phase full converter, average output voltage is given by

$$V_o = \frac{2V_m}{\pi} \cos \alpha \qquad \ldots \text{eq 02}$$

Substituting the value of α from Eq-01 and 02, we get

$$V_o = \frac{2V_m}{\pi} \text{ Cos } [\text{Cos}^{-1} \frac{E_c}{V_{2m}}] = [\frac{2V_m}{\pi} \text{ x } \frac{1}{2V_m}] \text{ x } E_c$$

$$V_0 = k\, E_c \qquad \ldots (0)$$

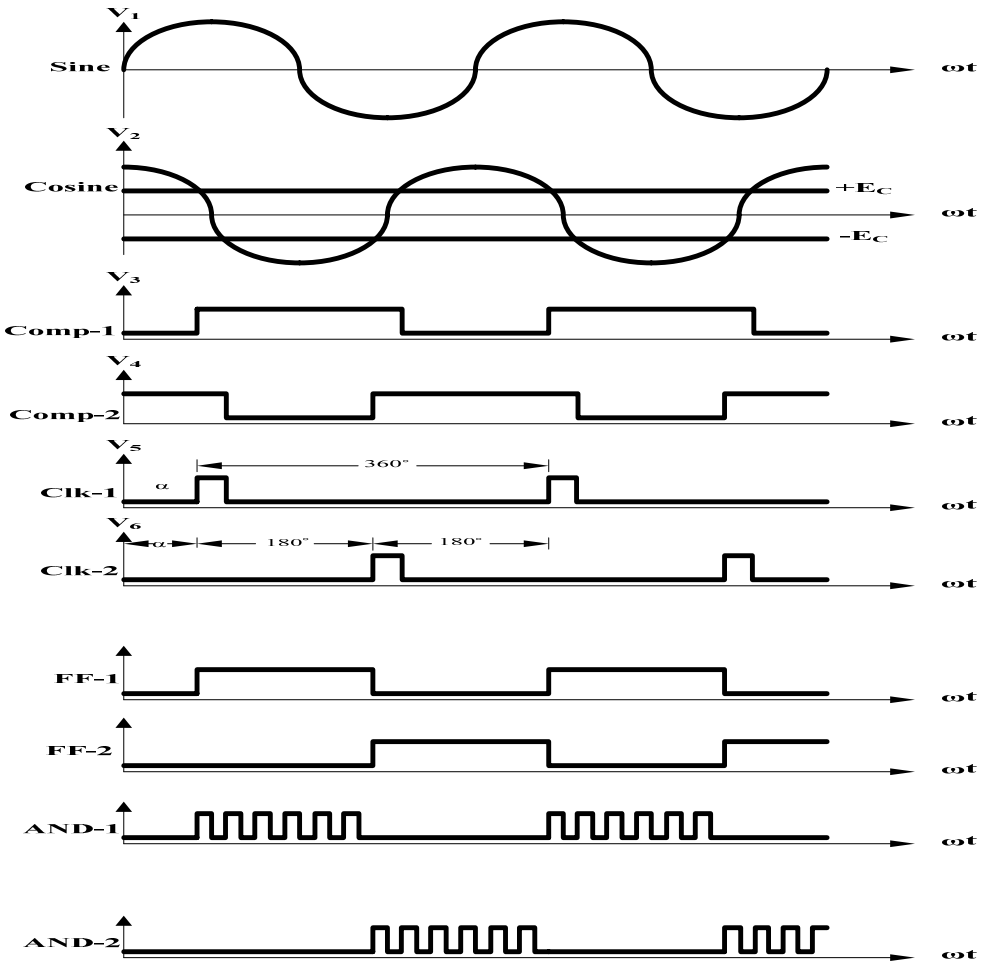
This shows that cosine firing scheme provides a linear transfer characteristic between the average output voltage V_o and the control voltage *Ec.* This scheme, on account of its linear transfer characteristic, improves the closed-loop response of the converter system. This feature has made the cosine firing scheme quite popular in industrial applications.

PROCEDURE:-

1. Switch on the power of the Experimental Trainer kit.
2. Study the different block of each stage.
3. As shown in the experimental diagram, connect the output of the sine wave V_1 (transformer) to the CH1 of the CRO with respect to GND and adjust the time division of the CRO properly to observe the waveform clearly.
4. Then connect the output of the cosine wave V_2 (Integrator) to the CH2 of the CRO with respect to GND and adjust the time division of the CRO properly to observe the waveform clearly.
5. Then put V_2 to CH1 and V_3 to CH3 of the CRO with respect to GND.
6. Then vary the firing control POT ($+E_C$) and observe the output change of the square wave (comparator-1) V_3, its width changes as change in the firing control POT $+E_C$.
7. Repeat the above procedure 4, 5 & 6 for square wave out put (comparator-2) V_4.

8. Observe the output of the clock pulse generator 1 V_5 to CH1 of CRO & clock pulse generator 2 V_6 to CH2 of CRO by varying the firing control POT also.
9. Finally observe the output of the JK flip-flop with respect to gnd and also observe the output of the JK FF by varying the firing control pot.
10. Connect the output of the gate triggering pulse (Vi & Vj) to the SCR firing module (Externally which is not provided on the trainer) to the gate & cathode and along with load resistor as shown in the figure below:
11. Observe the output waveform on CRO.
12. The firing angle is varied with the help of a cosine controlled trainer kit Firing control POT which is provided in the firing module and output wave form is seen on a CRO.
13. Plot the input and output waveforms on the same graph paper.
14. The firing angle is varied and DC output voltage and current through the load is noted.

EXPECTED WAVEFORM:



CONCLUSION:-

EXPERIMENT NO-7

AIM OF THE EXPERIMENT:- To study the UJT triggering.

APPARATUS REQUIRED:-

SL. NO.	APPARATUS REQUIRED	QUANTITIES
1	UJT triggering trainer kit	01
2	Patch cord	As per required
3	CRO	01
4	CRO probe	01

Table.08

THEORY:-

The Unijunction transistor (UJT) is commonly used for generating triggering signals for SCRs. A UJT has three terminals, called the emitter E, base-one B1 and base-two B2. Between B1 and B2 the unijunction has the characteristics of an ordinary resistance. This resistance is the inner base resistance R_{BB} and has value in the range 4.7 to 9.1KΩ. The basic construction of the UJT, its circuit symbol and characteristics are shown in fig.1 (a), 1(b) and 1(c) respectively.

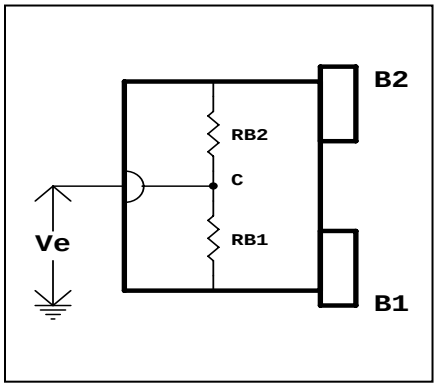


Fig. 1 (a) Basic

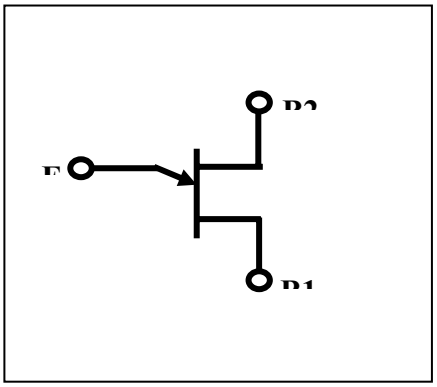


Fig. 1 (b) Circuit

Fig.13

When a dc voltage is applied between B1 and B2 potential of point C, refer to fig.1(a) is ηVs the parameter n = RB1 / (RB1 + RB2) is called the intrinsic stand-off ratio. The value of η lies between 0.51 and 0.82. as long as the emitter voltage V_E is less than ηVs, the Emitter –Base-1, PN junction is reversed biased and the UJT is in off-state. When the emitter voltage V_E exceeds ηVs +V_D the UJT starts conducting and this voltage is known as peak point voltage. The voltage V_D is the equivalent emitter diode voltage. The charge carrier injected into the base-1 region, increase the conductivity and reduce the resistance RB1. The potential of the point'C' therefore

decreases, increasing the forward bias of the P-N junction. The emitter current increases with a decrease in emitter voltage. The UJT therefore exhibits a negative resistance characteristics. At valley point the carriers in emitter current requires an increase in the emitter voltage, beyond the valley point.

The circuit of Fig.2 (a) shows the UJT relaxation oscillator. When the dc supply voltage V_S is applied, the capacitor C is charged through resistor R since the emitter circuit of the UJT is in the open state. The tome constant of the charging circuit is T = RC. When the emitter voltage V_E, which is same as the capacitor voltage V_C reaches the peak point voltage V_P, the UJT turns ON and capacitor C will discharge through RB1 at a rate determined by the time constant T_2 = RB1C. T2 is much smaller than T1. when the emitter voltage V_E decays to the valley point V_V, the emitter ceases to conduct and the UJT turns OFF, and the charging cycle is repeated. The waveform of the emitter voltage and the output pulses across RB1 are shown in figure 2(b).

The period of oscillation, T is independent of the dc supply voltage V_S and is given by

$$T \cong 1 / f \cong RC \ln * 1/ 1- n$$

The output pulses are current pulses due to the discharge current of the capacitor. The current pulses will be of sufficient amplitude to trigger the SCR, since the emitter base-1 resistance is very small, when the UJT starts conducting. These properties of the UJT, make it useful in gate trigger circuit for SCR.

CIRCUIT DIAGRAM:-

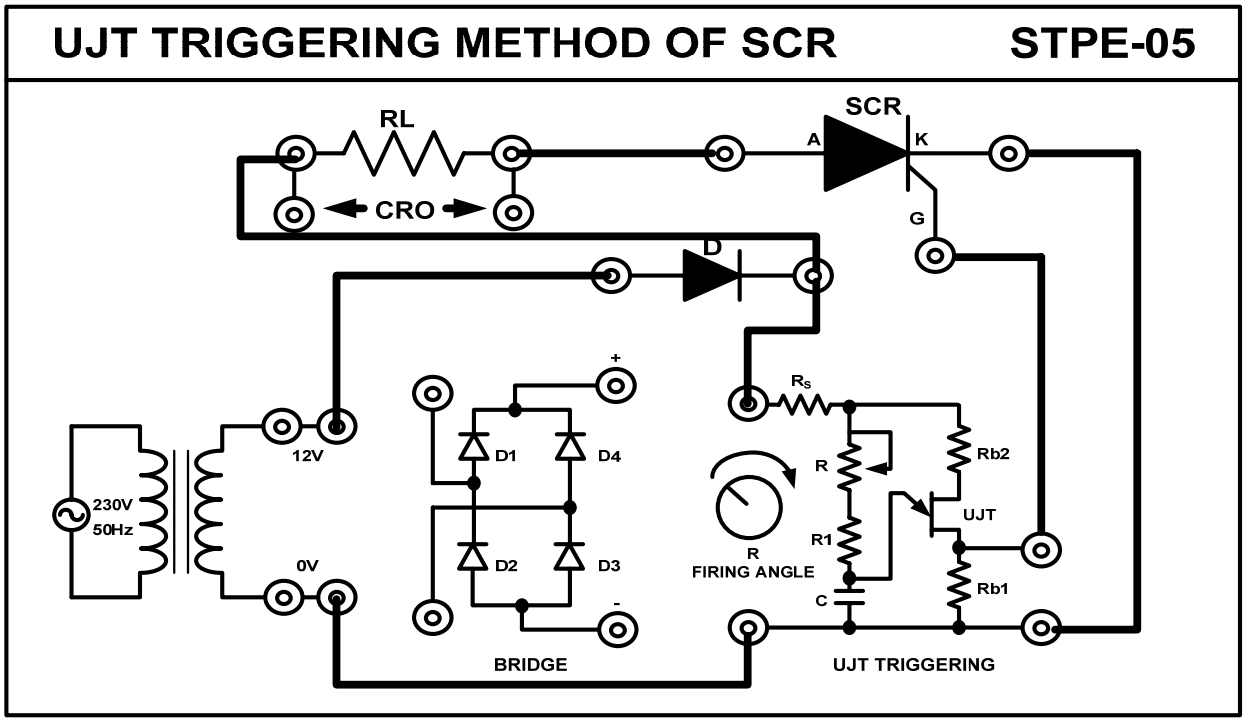


Fig.13

PROCEDURE:-

1. The connections are made as shown in the circuit diagram.
2. By varying a resistance R gradually in step by step, note down the corresponding value of V_n & V_m from CRO and V_{ODC} from DC voltmeter.
3. If the firing angle ranges from 0˚ to 90˚, then the firing angle can be calculated from,

   $$\alpha = \text{Sin}^{-1} (V_n / V_m) \text{ in degrees}$$

4. If the firing angle ranges from 90˚ to 180˚, then the firing angle can be calculated from,

   $$\alpha = 180^\circ - \text{Sin}^{-1} (V_n / V_m) \text{ in degrees}$$

5. The conduction angle β can be calculated by using a formula,

   $$\beta = 180^\circ - \alpha$$

6. The current & power is calculated by,

   $$I_{dc} = (V_{dc} / R) \text{ in Amp}$$
   $$P_{dc} = (V^2_{dc} / R) \text{ in Watt}$$

7. A graph of V_{dc} v/s α, V_{dc} v/s β, I_{dc} v/s α, I_{dc} v/s β, Pdc v/s α, P_{dc} v/s β are to be plotted on a graph sheet.
8. For a given frequency, the value of R can be calculated using the formula,

   $$T = 2.303.RC. \text{Log}_{10}(1/1-\eta)$$
   $$R = T / 2.303.C. \text{Log}_{10}(1/1-\eta)\Omega$$

   Where C = 0.1μF & η = intrinsic stand off ratio=0.67
9. This value of R is set in the circuit. Step no 3, 4, 5 & 6 are repeated and waveform are observed at different points as shown.
10. Compare V_{oth} with $V_{opractical}$. Where $V_{oth} = Vm / \pi (1+ \cos\alpha)$
11. Do the experiments for HWR & FWR separately.

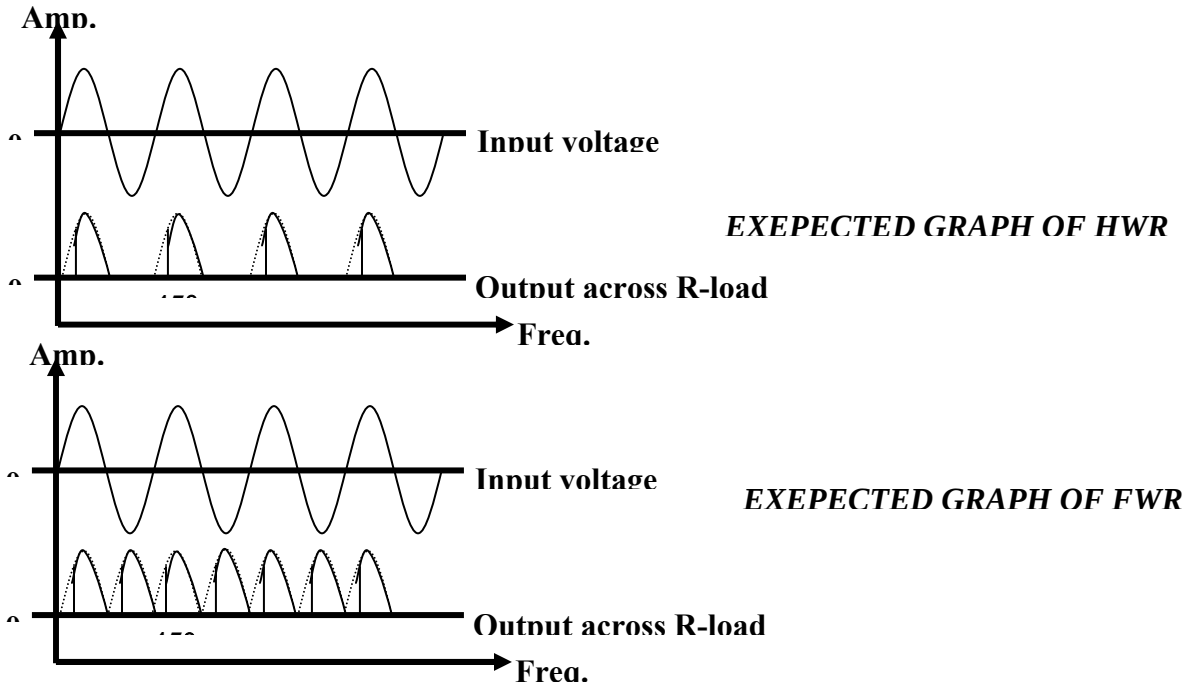


Fig.14

IDEAL WAVEFORMS:

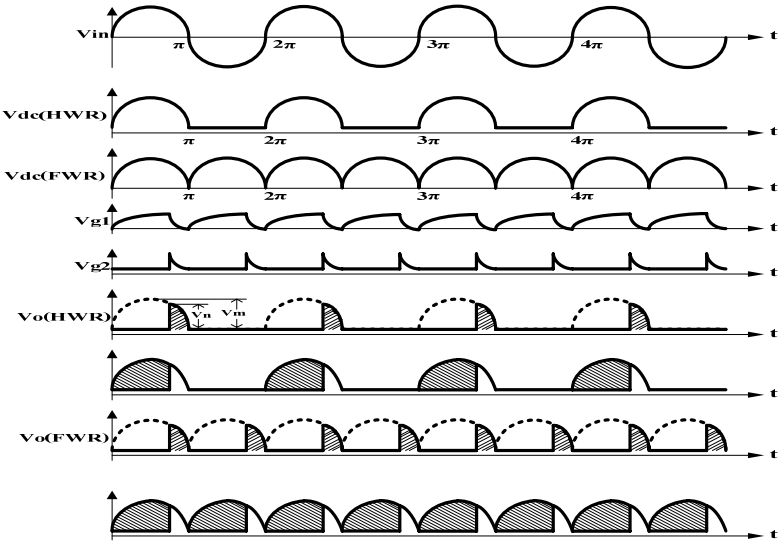


Fig.15

TABULAR COULMN:-

SL NO	FROM C.R.O								V_{dc} (V_{load}) in volt	I_{dc} (V_{dc} / R) in A	P_{dc} (V^2_{dc} / R) in Watt	V_{oth}
	0˚ to 90˚				90˚ to 180˚							
	V_n in volt	V_m in volt	$\alpha = \sin^{-1}(V_n/V_m)$	$\beta = 180^\circ - \alpha$	V_n in volt	V_m in volt	$\alpha = \sin^{-1}(V_n/V_m)$	$\beta = 180^\circ - \alpha$				

Table.09

CONCLUSION:-

EXPERIMENT NO-8

AIM OF THE EXPERIMENT:- To study of single phase half wave controlled rectifier circuit with R & R-L load.

APPARATUS REQUIRED:-

SL. NO.	APPARATUS REQUIRED	QUANTITIES
1	Half wave trainer kit	01
2	Patch cord	As per required
3	CRO	01
4	CRO probe	01
5	Multimeter	01

Table.10

THEORY:-

As shown in Fig.(1), the single-phase half-wave rectifier uses a single thyristor to control the load voltage. The thyristor will conduct, ON state, when the voltage v_T is positive and a firing current pulse i_G is applied to the gate terminal. The firing pulse by an angle α does the control of the load voltage. The firing angle α is measured from the position where a diode would naturally conduct. In Fig.(1), the angle α is measured from the zero crossing point of the supply voltage v_s . The load in Fig. (1) is resistive and therefore current i_d has the same waveform as the load voltage. The thyristor goes to the non-conducting condition, OFF state, when the load voltage and, consequently, the current try to reach a negative value.

The load average voltage is given by:

$$V_{dc} = \frac{1}{2\pi}\int_{\alpha}^{\pi} V_{max} \sin \omega t d(\omega t) = \frac{V_{max}}{2\pi}(1+\cos\alpha)$$

Where Vmax is the supply peak voltage.

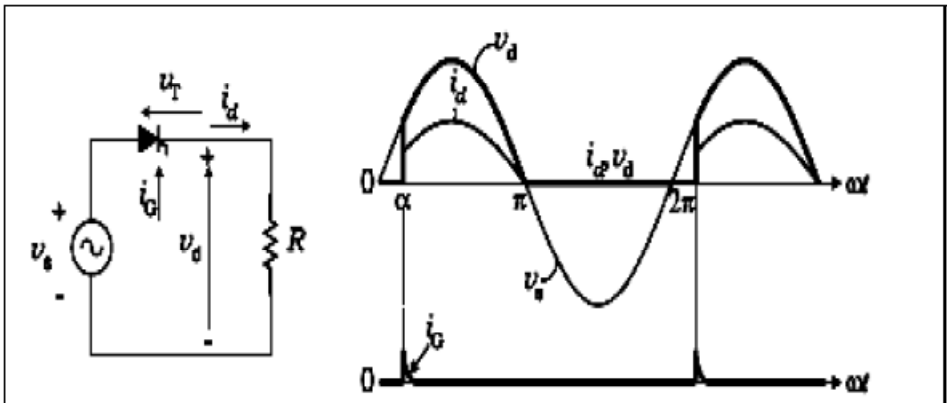


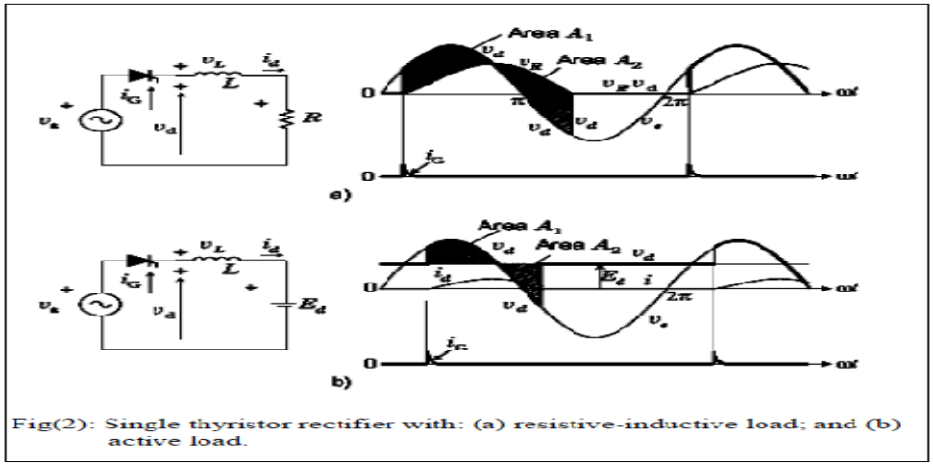
Fig.(1):Single thyristor rectifier with resistive load.

Fig.16

Fig.(2-a) shows the rectifier waveforms for an R ÿ L load. When the thyristor is turned ON, the voltage across the inductance is

$$v_L = v_S - v_R = L\frac{di_d}{dt}$$

The voltage in the resistance R is $v_R = R \times i_d$. While $v_S - v_R > 0$. On the other hand, id decreases its value when $v_S - v_R < 0$. The load current is given by:



Fig(2): Single thyristor rectifier with: (a) resistive-inductive load; and (b) active load.

Fig.17

CIRCUIT DIAGRAM:-

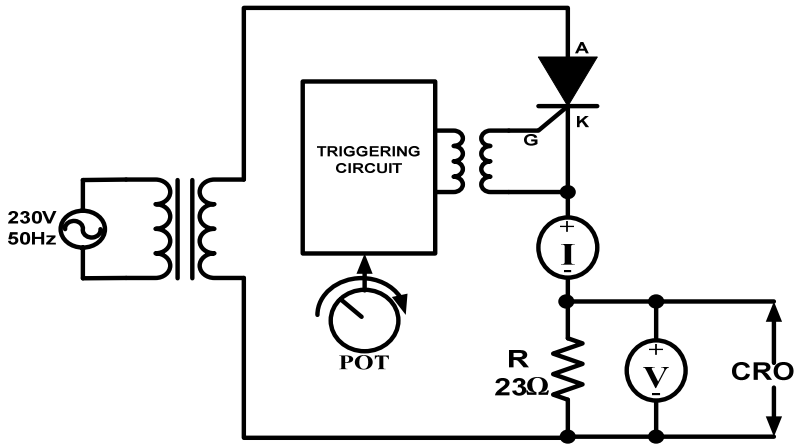


Fig.18: Diagram-01->half-wave controlled rectifier with r-load

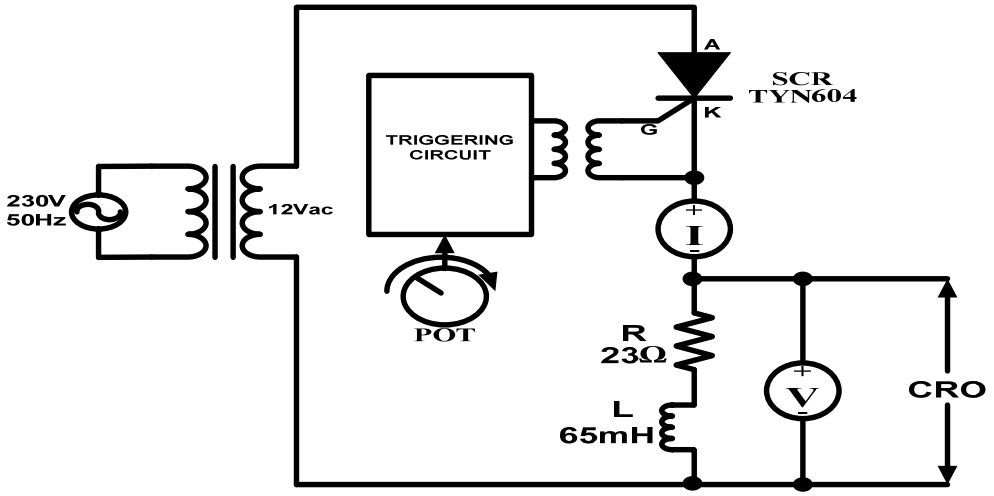


Fig.19: Diagram-02->half-wave controlled rectifier with rl-load

PROCEDURE:-

1) Procedure for R loads:

1. The connections are made as shown in the experimental diagram - 01 of half controlled rectifier with R - load using isolation transformer which is provided externally.
2. Connect 12Vac & 0Vac to the triggering circuit module.
3. The gate cathode terminals of the SCR are connected to the respective points on the firing module.
4. Check all the connections and confirm connections made are correct before switching on the equipments.
5. Switch ON the trainer unit.
6. The firing angle is varied with the help of a POT which is provided in the firing module and output wave form is seen on a CRO.
7. Plot the input and output waveforms on the same graph paper.
8. The firing angle is varied and DC output voltage and current through the load is noted.
9. Tabulate the practical values on the observation table.

1) Procedure for R L – loads:

1. The connections are made as shown in the experimental diagram - 02 of half controlled rectifier with R L - load using isolation transformer which is provided externally.
2. The gate cathode terminals of the SCR are connected to the respective points on the firing module.
3. Check all the connections and confirm connections made are correct before switching on the equipments.
4. Switch ON the trainer unit.
5. The firing angle is varied with the help of an INC and DEC POT which is provided in the firing module and output wave form is seen on a CRO.
6. Plot the input and output waveforms on the same graph paper.
7. The firing angle is varied and DC output voltage and current through the load is noted.

8. Tabulate the practical values on the observation table.

OBSERVATION TABLE:-

FOR R-LOAD

Sl No.	Firing Angle α in degree	Load Voltage in Volts	Load Current in Amp
01			
02			
03			

Table.11

FOR RL- LOAD

Sl No.	Firing Angle α in degree	Load Voltage in Volts	Load Current in Amp
01			
02			
03			

Table.12

CONCLUSION:-

EXPERIMENT NO-9

AIM OF THE EXPERIMENT:- To study of single phase full wave controlled bridge rectifier circuit with R & R-L load.

APPARATUS REQUIRED:-

SL. NO.	APPARATUS REQUIRED	QUANTITIES
1	Full wave trainer kit	01
2	Patch cord	As per required
3	CRO	01
4	CRO probe	01
5	Multimeter	01

Table.13

THEORY:-

A fully controlled converter or full converter uses thyristors only and there is a wider control over the level of dc output voltage. With pure resistive load, it is single quadrant converter. Here, both the output voltage and output current are positive. With RL- load it becomes a two-quadrant converter. Here, output voltage is either positive or negative but output current is always

positive. Figure shows the quadrant operation of fully controlled bridge rectifier with R-load. Fig shows single phase fully controlled rectifier with resistive load. This type of full wave rectifier circuit consists of four SCRs. During the positive half cycle, SCRs T1 and T2 are forward biased. At ωt = α, SCRs T1 and T3 are triggered, then the current flows through the L – T1- R load – T3 – N. At ωt = π, supply voltage falls to zero and the current also goes to zero. Hence SCRs T1 and T3 turned off. During negative half cycle (π to 2π). SCRs T3 and T4 forward biased. At ωt = π + α, SCRs T2 and T4 are triggered, then current flows through the path N – T2 – R load- T4 – L. At ωt = 2π, supply voltage and current goes to zero, SCRs T2 and T4 are turned off. The Fig-3, shows the current and voltage waveforms for this circuit. For large power dc loads, 3-phase ac to dc converters are commonly used. The various types of three-phase phase-controlled converters are 3 phase half-wave converter, 3-phase semi converter, 3-phase full controlled and 3-phase dual converter. Three-phase half-wave converter is rarely used in industry because it introduces dc component in the supply current. Semi converters and full converters are quite common in industrial applications. A dual is used only when reversible dc drives with power ratings of several MW are required. The advantages of three phase converters over single-phase converters are as under: In 3-phase converters, the ripple frequency of the converter output voltage is higher than in single-phase converter. Consequently, the filtering requirements for smoothing out the load current are less. The load current is mostly continuous in 3-phase converters. The load performance, when 3- phase converters are used, is therefore superior as compared to when single-phase converters are used.

Vout=(2Vs)(Cosα)/π **Iavg=Vavg/R**

CIRCUIT DIAGRAM:-

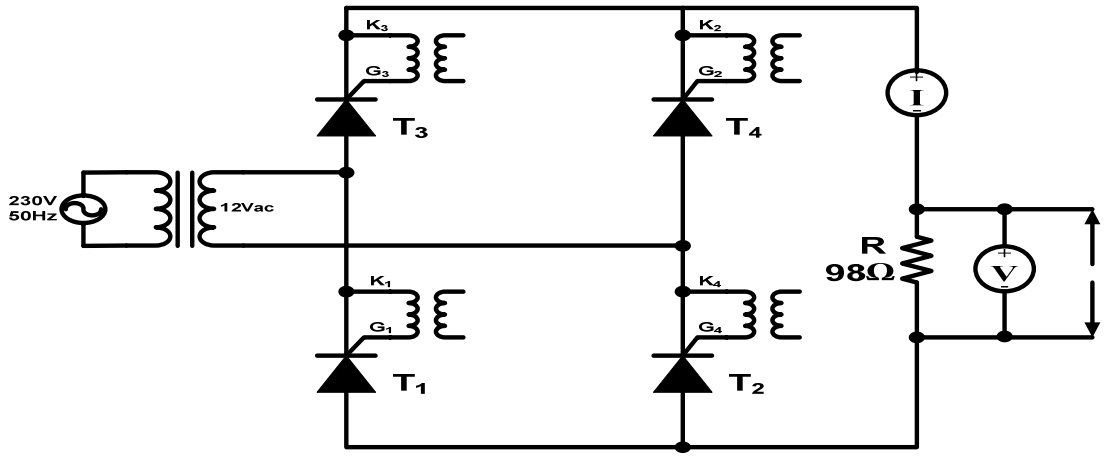


Fig.20: Diagram-01->full-wave controlled bridge rectifier with r-load

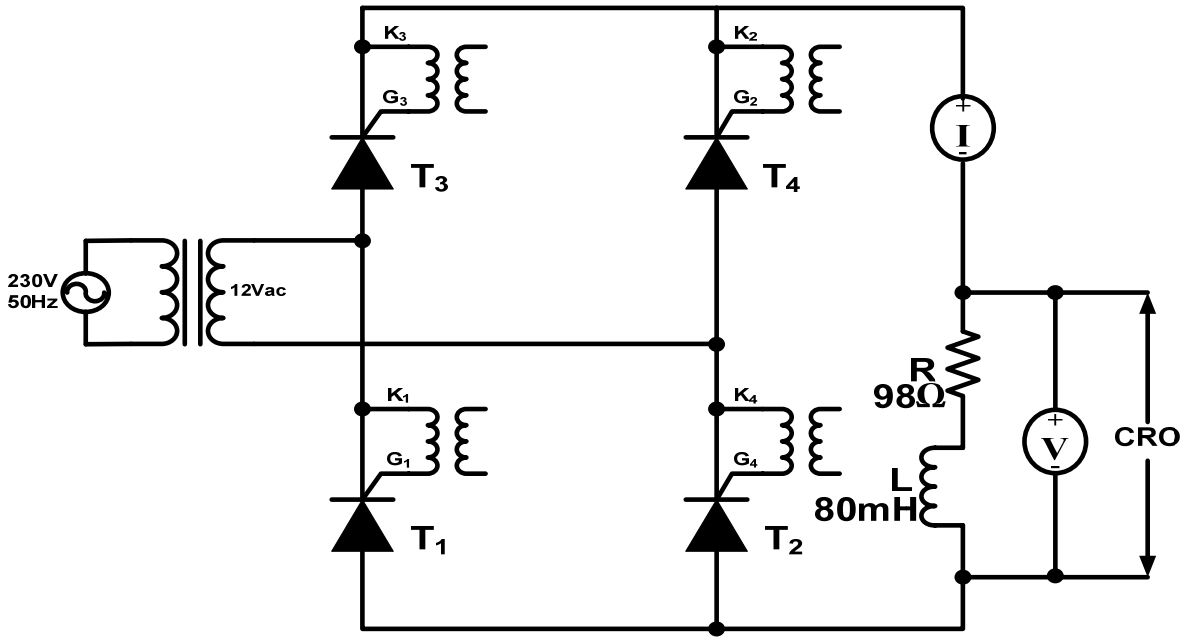


Fig.21:Diagram-02->full-wave controlled bridge rectifier with rl-load

PROCEDURE:-

FOR R-LOAD

1. The connections are made as shown in the experimental diagram - 01 of Full controlled Bridge Rectifier with R - load using isolation transformer which is provided externally.
2. Connect 12Vac & 0Vac to the triggering circuit module.
3. The gate cathode terminals of the SCR are connected to the respective points on the firing module.
4. Check all the connections and confirm connections made are correct before switching on the equipments.
5. Switch ON the trainer unit.
6. The firing angle is varied with the help of an INC and DEC POT which is provided in the firing module and output wave form is seen on a CRO.
7. Plot the input and output waveforms on the same graph paper.
8. The firing angle is varied and DC output voltage and current through the load is noted.
9. Tabulate the practical values on the observation table.

FOR RL – LOAD

1. The connections are made as shown in the experimental diagram - 02 of Full controlled Bridge Rectifier with R L - load using isolation transformer which is provided externally.

2. The gate cathode terminals of the SCR are connected to the respective points on the firing module.
3. Check all the connections and confirm connections made are correct before switching on the equipments.
4. Switch ON the trainer unit.
5. The firing angle is varied with the help of an INC and DEC POT which is provided in the firing module and output wave form is seen on a CRO.
6. Plot the input and output waveforms on the same graph paper.
7. The firing angle is varied and DC output voltage and current through the load is noted.
8. Tabulate the practical values on the observation table.

OBSERVATION TABLE:-

FOR R-LOAD

Sl No.	Firing angle α in degree	Load voltage in volts	Load current in Amp
01			
02			
03			

Table.14

FOR RL-LOAD

Sl No.	Firing angle α in degree	Load voltage in volts	Load current in Amp
01			
02			
03			

Table.15

CONCLUSION:-