Shariatpur polytechnic Institute

INDUSTRIAL ELECTRONICS

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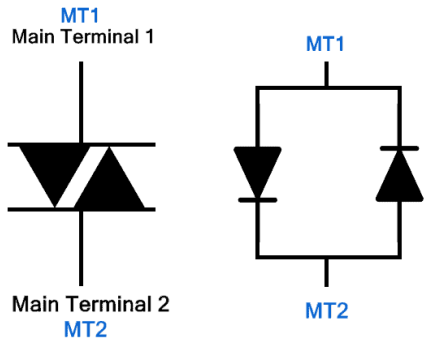
Chapter- 6
DIAC AND TRIAC

DIAC

Diac is a two terminal bidirectional semiconductor switch. 'Di' stands for two and 'ac' stands for alternating current. Thus Diac is a diode for alternating current.

It belongs to Thyristor family. It can be turned ON in both forward and negative direction. It starts conducting current when the applied voltage is above breakover voltage.



DIAC Symbol

Construction of Diac:

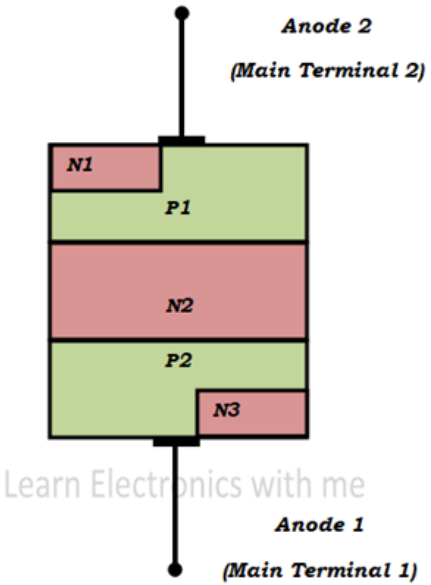


Fig.3.1 Construction of Diac

Diac is made up of five layers and two terminals. It has two P type layer and three N type layer. It has no base or gate terminal. The layers which are close to the terminals are made up of both N type and P type.

The doping concentration in all the layers is identical, whereas in transistor the doping concentration is different in each layer. Since all the layers are identical they are bidirectional and terminals can be used the either way.

Working of Diac:

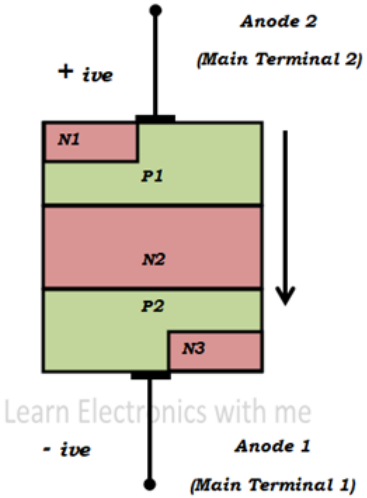


Fig.3.2 Working of Diac

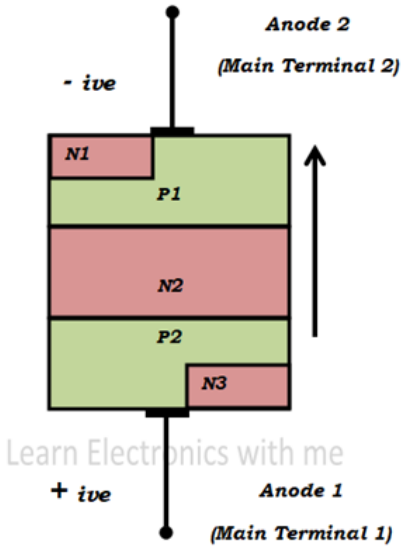
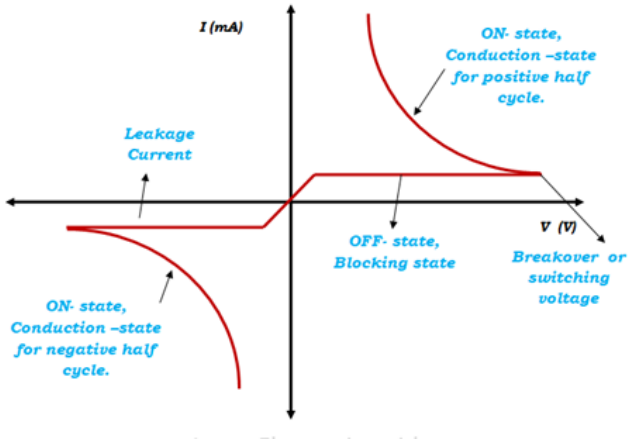


Fig. 3.3 Working of Diac

- When the terminal MT1 is positive the direction of the flow of current will be in the order P1-N2-P2-N3. The junction between P1 and N2 is forward biased, the junction between N2 and P2 is reverse biased and the junction between P2 and N3 is forward biased
- When the terminal MT2 is positive the direction of the flow of current will be in the order N1-P1-N2-P2. The junction between N1 and P1 is forward biased, the junction between P1 and N2 is reverse biased and the junction between N2 and P2 is forward biased.

V-I characteristics of Diac :



V-I Characteristics of Diac

When the external voltage is applied at the terminals, Diac does not conduct immediately. Only a small leakage current flows. When the applied voltage is further increased and when it crosses the breakover voltage the junction which is reverse biased breaks and they start conducting.

Till the breakover voltage is reached they remain in forward and reverse blocking state. After the applied voltage is increased above the breakover voltage avalanche breakdown takes place and the current increases. It happens for both the polarity of voltages. To turn OFF the device the applied voltage is decreased below the breakover voltage.

Advantages of Diac:

1. It is of low cost
2.It is used for low power applications
3.Smooth control of power
4.Diac can be switched ON or OFF just by lowering the voltages.

Disadvantages of Diac:

1.Trigger voltage is 30v. So the incoming voltage to trigger the diac
2.should be minimum of 30v.

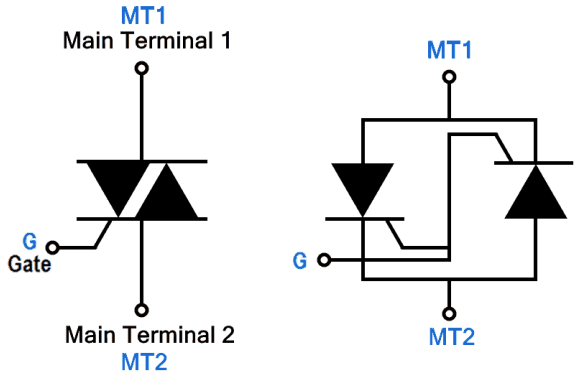
Application of Diac:

- Used in TRAIC triggering circuit
- Used in Lamp dimmer circuit
- Used in heat control circuit
- Used in speed control of a universal motor.

TRIAC

✓ A TRIAC is a semiconductor device with three terminals that allow and control the flow of current, thus the name Triac. Instead of SCR, TRIAC is a bi-directional switch while SCR is uni-directional.

✓ Triac is the equivalent of two SCRs connected in a reverse-parallel connection with gates connected to each other. A TRIAC is triggered into conduction in both directions by a gate signal like an SCR. Below is the Symbol of TRIAC is shown



TRIAC Symbol

Construction of TRIAC

TRIAC is nothing but Two SCRs are connected in inverse parallel with a common gate terminal. The gate terminal is connected to both the N and P regions due to which gate signal may be applied, irrespective of the polarity of the signal. In Triac, we do not have anode and cathode because it works for both the polarities which means that the device is bidirectional. It consists of three terminals namely,
main terminal 1(MT1),
main terminal 2(MT2),
and gate terminal G.
The figure shown below shows the construction of a triac. There are two main terminals namely MT1 and MT2 and the remaining terminal is gate terminal.

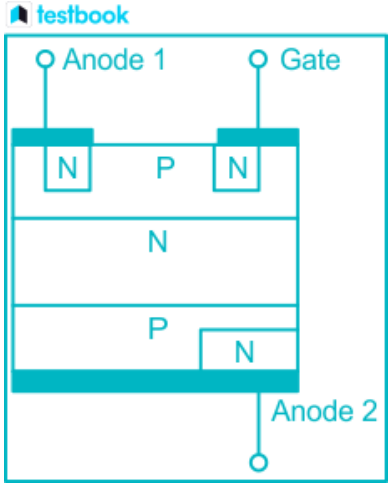


Fig.3.4- TRIAC Construction Diagram

TRIAC Working

The working of Triac is based on the Thyristor, The triac can be turned on by providing the gate voltage higher than the break over voltage. So, it can be turned on by applying the gate pulse of about 35 micro seconds to turn it on without making the voltage high. When the voltage applied is less than the breakover voltage, we use the gate triggering method to turn it on.

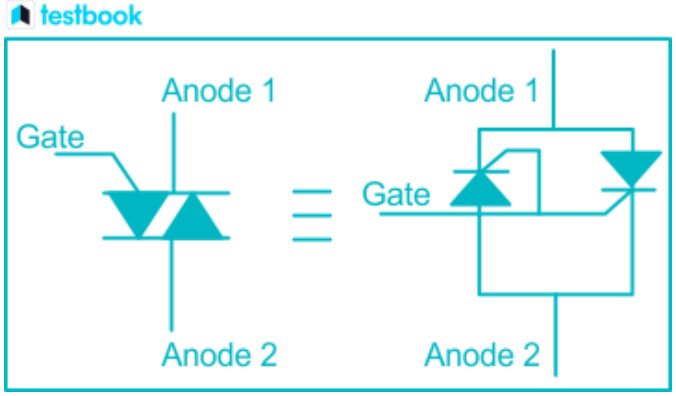


Fig-Working Diagram of TRIAC

TRIAC has Four Mode of operation

- **When MT2 and Gate are Positive with Respect to MT1**

Current flows through the path P1-N1-P2-N2, When this happens. Here, P1-N1 and P2-N2 are forward-biased and N1-P2 is reverse-biased. The triac will operate in a positively biased region. Positive gate with respect to MT1 forward biases P2-N2 and breakdown will happen.

- **When MT2 is Positive with a Negative Gate with Respect to MT1**

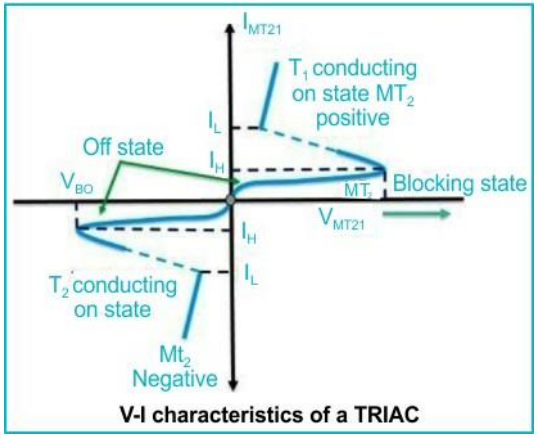
The current flows through the path P1-N1-P2-N2. But P2-N3 is forward biased and current carriers injected into P2 on the triac.

- When MT2 and Gate are Negative with Respect to MT1 Current flows through the path P2-N1-P1-N4. Two junctions P2-N1 and P1-N4 are forward biased and the junction N1-P1 is reverse biased. The triac is said to be in the negatively biased region.

- When MT2 is Negative with a Positive Gate with Respect to MT1 P2-N2 is forward-biased at that condition. The current will flow, so the triac turns on. The sensitivity of triggering in mode 2 and 3 is high and if marginal triggering capability is required, negative gate pulses should be used. Triggering in mode 1 is more sensitive than in mode 2 and mode 3.

VI Characteristics Of Triac

The Characteristics Curve of TRIAC is basically works in Four Mode -
Mode 1: In the first quadrant operation, VMT21 and VG1 both are positive.
Mode 2: In the second quadrant operation, VMT21 is positive and VG1 is negative.
Mode 3: In the third quadrant operation, VMT21 and VG1 both are negative.
Mode 4: In the fourth quadrant operation, VMT21 is negative and VG1 is positive.
So, VMT21 represents the voltage of terminal MT2 with respect to terminal MT1 and VG1 represents gate voltage with respect to terminal MT1.



V-I characteristics of a TRIAC

A high value of current flows through the device when it starts conduction. However, such a high current can damage the device. So, an external resistance is inserted in order to limit the excess current. Here, the control terminal is the gate and properly applied gate potential controls the firing angle of the device.

Advantages And Disadvantages Of TRIAC

TRIAC has good advantages and a few disadvantages according to their applications or uses.

Advantages of Triac:

✓ Triac can be triggered with positive or negative polarity of gate pulses.
✓ It requires only a single heat sink of a slightly larger size, whereas, for SCR, two heat sinks should be required of a smaller size.
✓It requires a single fuse for protection.
✓A safe breakdown in either direction is possible but for SCR protection should be given with a parallel diode.

Disadvantages of Triac:

✓ Compared to SCR, TRIAC is not very reliable.
✓ It has lower (dv/dt) rating then than SCR.
✓ Lower ratings are available compared to SCR
✓ It can be triggered in both directions, So we need to be careful about the triggering circuit.

Triac Application

- ✓ They are used in control circuits.
- ✓ It is used in High-power lamp switching.
- ✓ It is used in AC power control.
- ✓ It is used in residential light dimmers and small electric fans to control speed.


Any
Questions


THANK YOU
FOR YOUR
ATTENTION