2.8 TRIAC

The TRIAC is a three terminal semiconductor device for controlling current. It gains its name from the term diode for Alternating Current.

It is effectively a development of the SCR or thyristor, but unlike the thyristor which is only able to conduct in one direction, the TRIAC is a bidirectional device.

TRIAC symbol

The circuit symbol recognizes the way in which the TRIAC operates. Seen from the outside it may be viewed as two back to back thyristors and this is what the circuit symbol indicates.
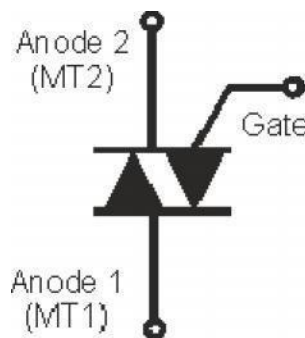

Figure 2.8.1 TRIAC symbol for circuit diagrams

[Source: "Electronic devices and circuits" by "Balbir Kumar, Shail.B.Jain, and Page: 115]

On the TRIAC symbol there are three terminals. These are the Gate and two other terminals are often referred to as an "Anode" or "Main Terminal". As the TRIAC has two of these they are labelled either Anode 1 and Anode 2 or Main Terminal, MT1 and MT2.

TRIAC basics

The TRIAC is a component that is effectively based on the thyristor. It provides AC switching for electrical systems. Like the thyristor, the TRIACs are used in many electrical switching applications. They find particular use for circuits in light dimmers, etc., where they enable both halves of the AC cycle to be used.

This makes them more efficient in terms of the usage of the power available. While it is possible to use two thyristors back to back, this is not always cost effective for low cost and relatively low power applications. It is possible to view the operation of a TRIAC in terms of two thyristors placed back to back
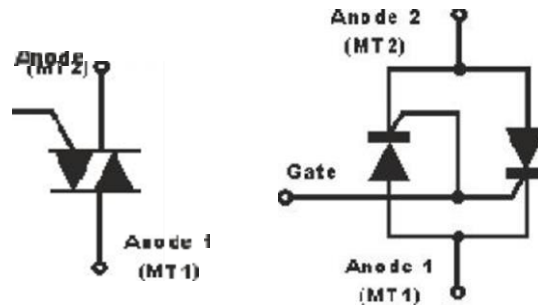
Figure 2.8.2 TRIAC

[Source: "Electronic devices and circuits" by "Balbir Kumar, Shail.B.Jain, and Page: 115]

One of the drawbacks of the TRIAC is that it does not switch symmetrically. It will often have an offset, switching at different gate voltages for each half of the cycle. This creates additional harmonics which is not good for EMC performance and also provides an imbalance inthe system

In order to improve the switching of the current waveform and ensure it is more symmetrical is to use a device external to the TRIAC to time the triggering pulse. A DIAC placedin series with the gate is the normal method of achieving this.
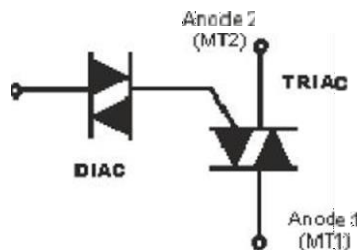

Figure 2.8.3 DIAC and TRIAC connected together

[Source: "Electronic devices and circuits" by "Balbir Kumar, Shail.B.Jain, and Page: 116]

With switch S open, there will be no gate current and the triac is cut off. Even with no current the triac can be turned on provided the supply voltage becomes equal to the break over voltage.

When switch S is closed, the gate current starts flowing in the gate circuit. Break over voltage of triac can be varied by making proper current flow. Triac starts to conduct wheather MT2 is positive or negative w.r.t MT1.
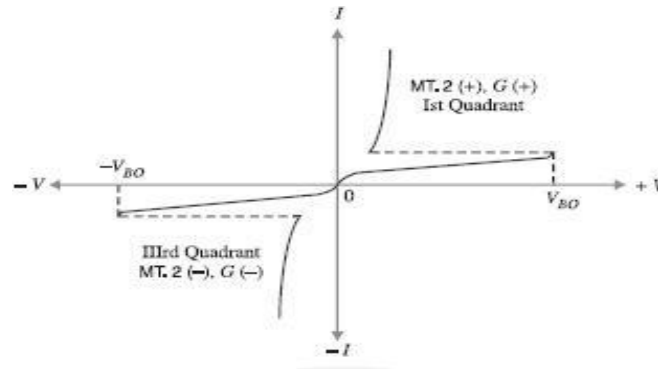
Characteristics

Figure 2.8.4 The V-I Characteristics curve for TRIAC

The V-I curve for triac in the Ist and IIIrd quadrants are essentially identical to SCR in the Ist quadrant. The triac can be operated with either positive or negative gate control voltage but in normal operation usually the gate voltage is positive in quadrant I and negative in quadrant III. The supply voltage at which the triac is ON depends upon gate current. The greater gate current and smaller supply voltage at which triac is turned on. This permits to use triac to control a,c. power in a load from zero to full power in a smooth and continuous manner with no loss in the controlling device.

Advantages

- Can switch both halves of an AC waveform

- Single component can be used for full AC switching

Disadvantages

- A TRIAC does not fire symmetrically on both sides of the waveform
- Switching gives rise to high level of harmonics due to non-symmetrical switching
- More susceptible to EMI problems as a result of the non-symmetrical switching
- Care must be taken to ensure the TRIAC turns off fully when used with inductive loads.

Applications

- ✓ Domestic light dimmers

- ✓ Electric fan speed controls

- ✓ Small motor controls

- ✓ Control of small AC powered domestic appliances