INDUSTRIAL ELECTRONICS

DDPE 3103

TOPIC 4

FAMILY OF THYRISTOR

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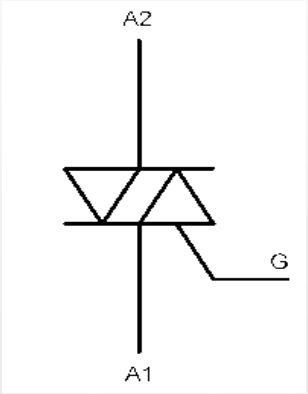
FAMILY OF THYRISTOR

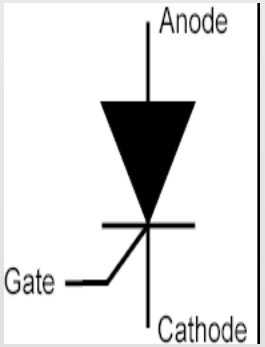
- A **thyristor** is a four layer three-terminal device.

- This device act as **an on – off** switch which is used to control output power of an electrical circuit.



- The main advantage of a thyristor over other electronics switches is that its can handle **large current** and can withstand **large voltage**.

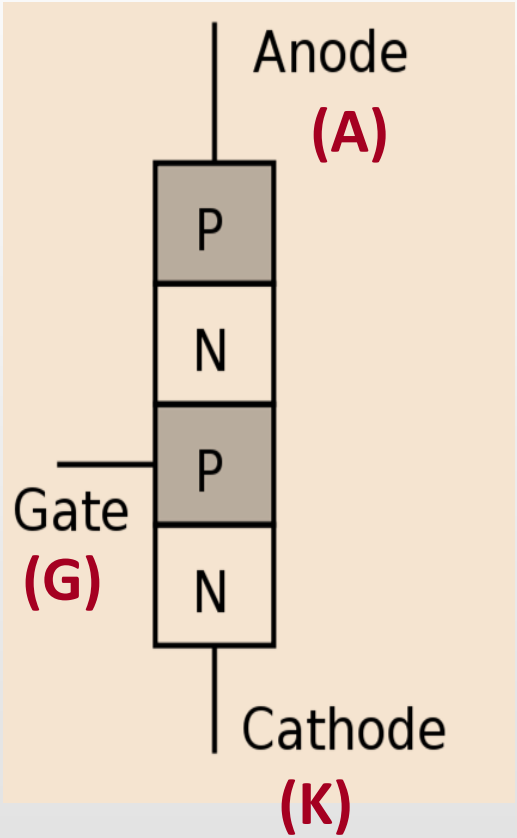
- The three main thyristor will be discussed are the **Silicon Controlled Rectifier (SCR), TRIAC** and **DIAC.**

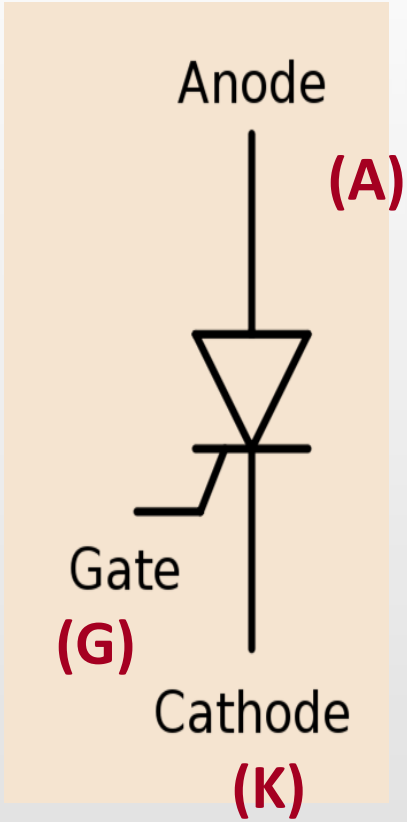


SILICON CONTROLLED RECTIFIER (SCR)

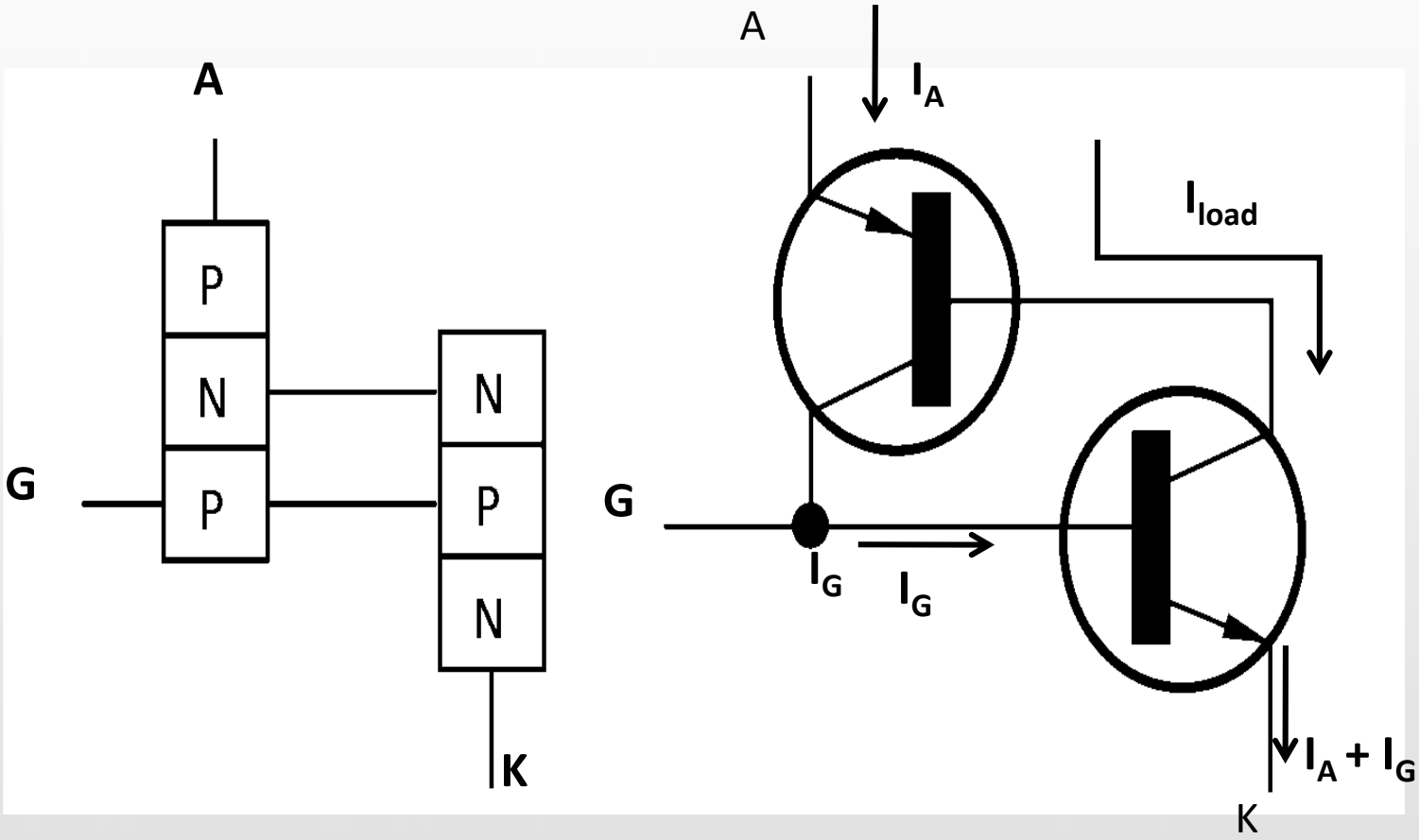
- SCR is a three **terminal four-layer pnpn device**.
- The three terminal are known as **anode (A), cathode (K),** and **gate (G).**
- In **off** state, it has a very **high resistance**.
- In **on** state, there is a very **small resistance**.
- The SCR applications include : motor controls, time-delay circuits, heater controls and phase controls circuits.

SYMBOL AND CONSTRUCTION OF THE SCR



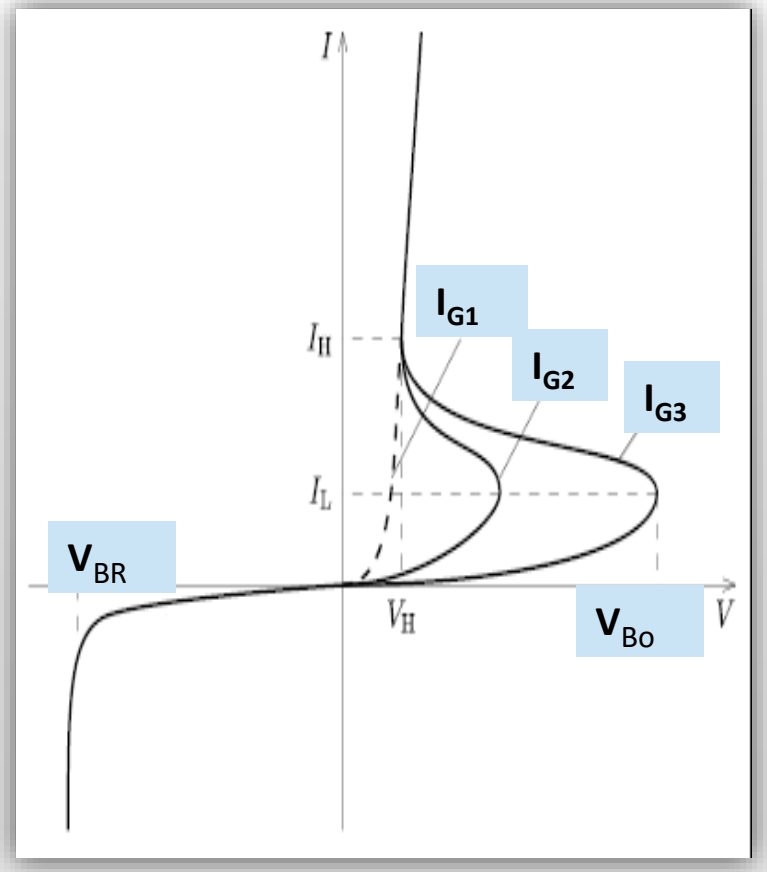


SCR Equivalent Circuit

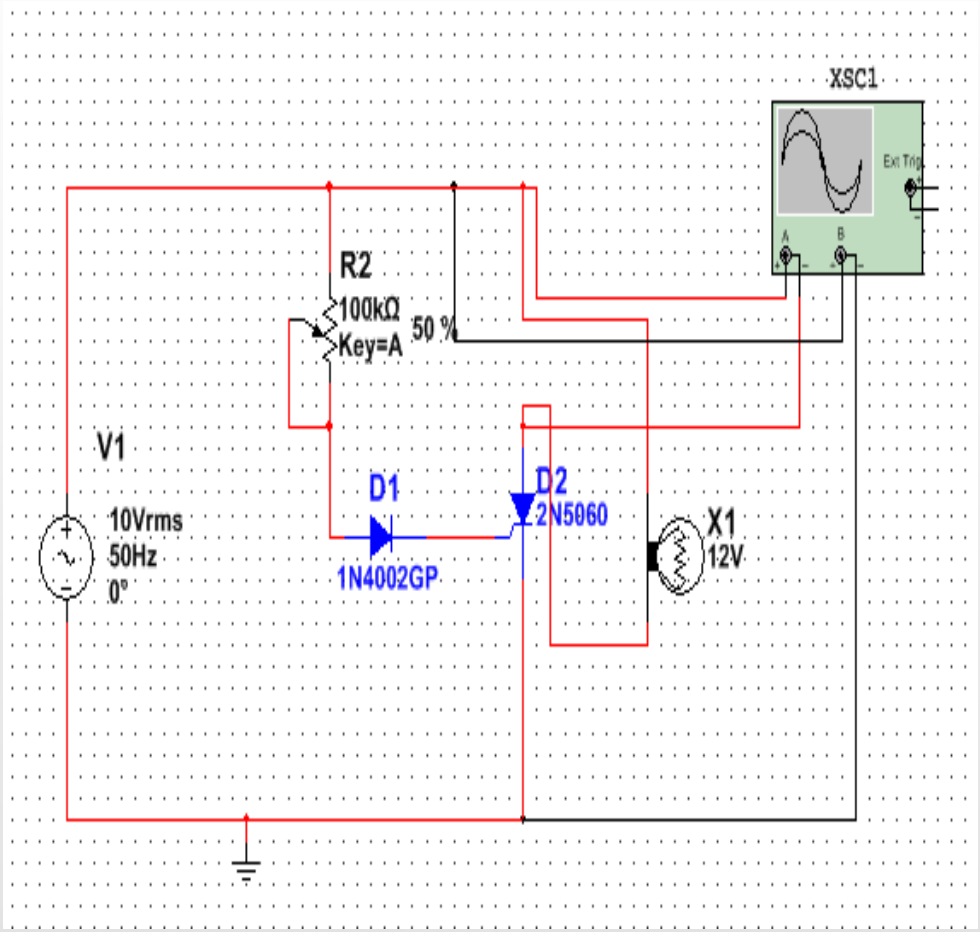


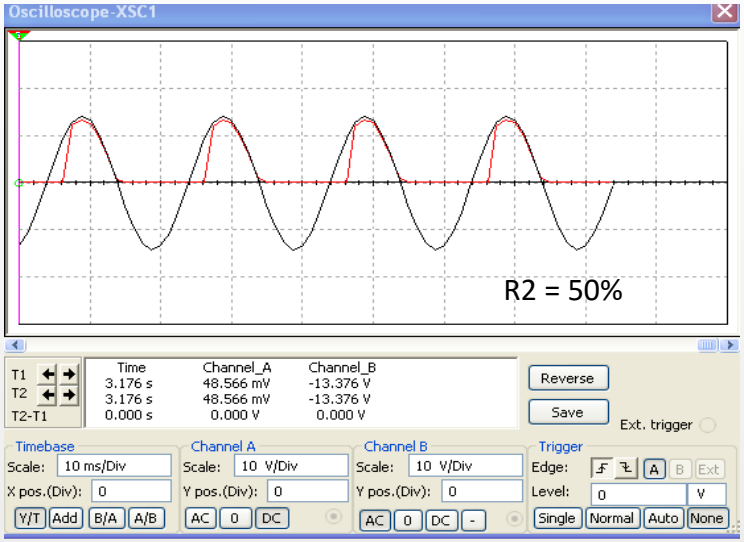
V-I CHARACTERISTICS OF SCR

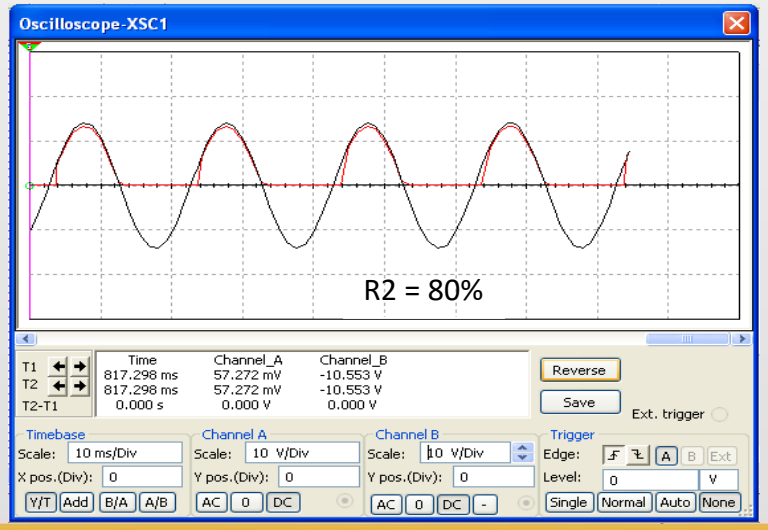
1	Breakover Voltage (V_{BO})	Minimum forward voltage supply to SCR which makes it to start conducting.
2	Peak Reverse Voltage (V_{BR})	The maximum reverse voltage apply to the SCR before breakdown.
3	Holding current (I_H)	The anode current at which SCR is turned OFF from ON condition. (if anode current less than the I_H, the SCR will turn off)
4	Forward current (I_F)	It is the maximum anode current that an SCR is capable of passing without destruction.
5	Gate Trigger Current (I_{GT})	Minimum gate current required to maintain the SCR in the on state
6	Gate Trigger Voltage (V_{GT})	Gate voltage required to produce the gate trigger current



Controlling the firing angle of the SCR by increasing and decreasing the variable resistor

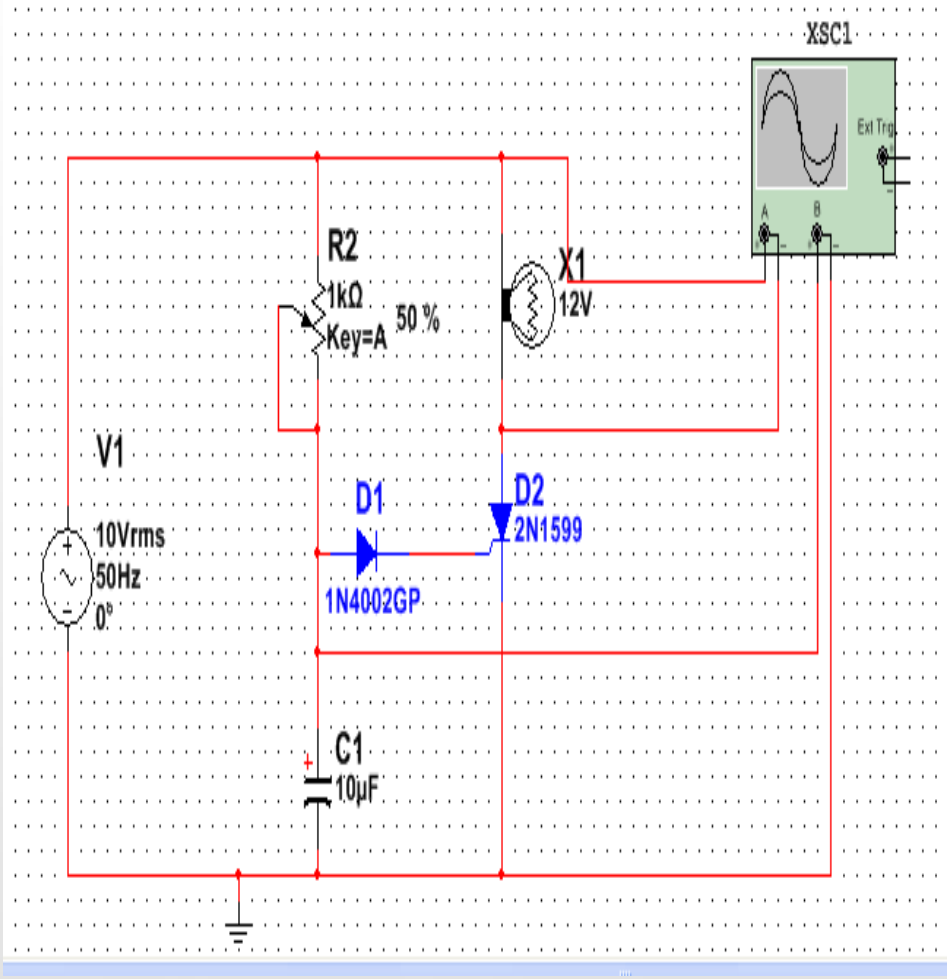


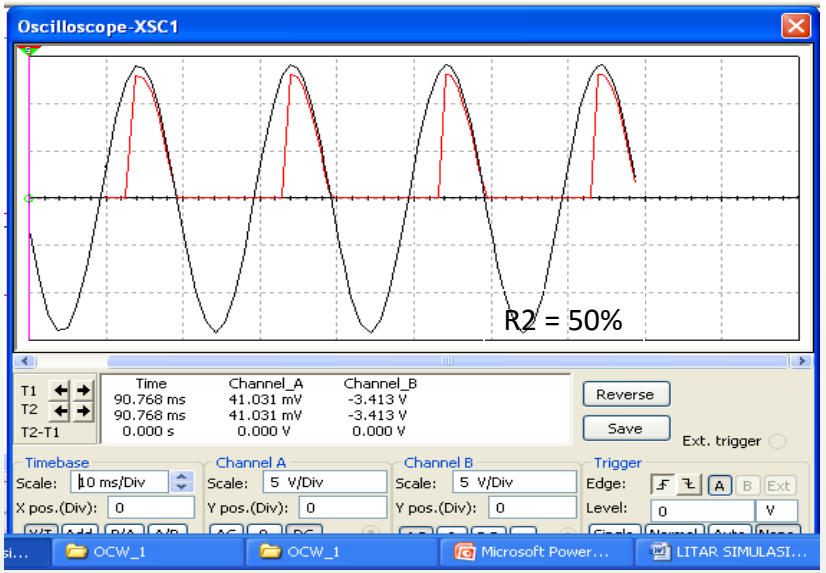


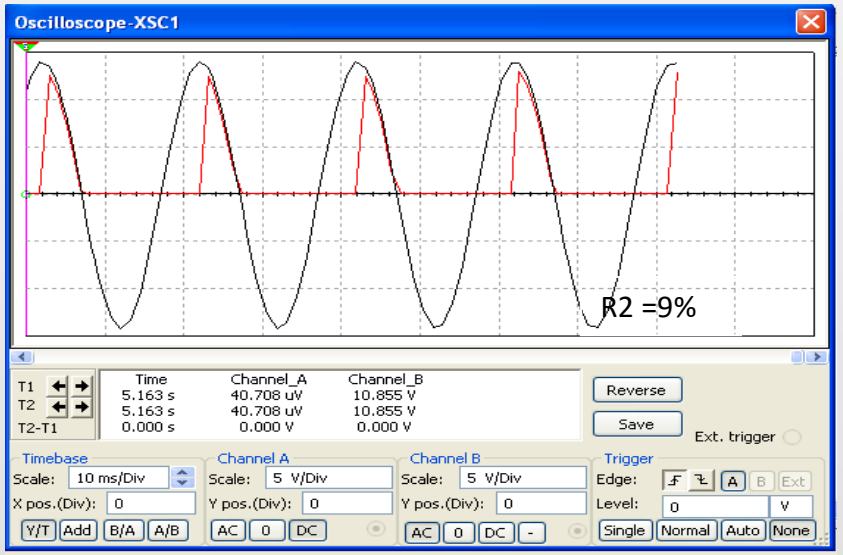


The black waveform is the input voltage , while the red waveform is the voltage across the bulb.

Controlling the firing angle of the SCR with an RC circuit



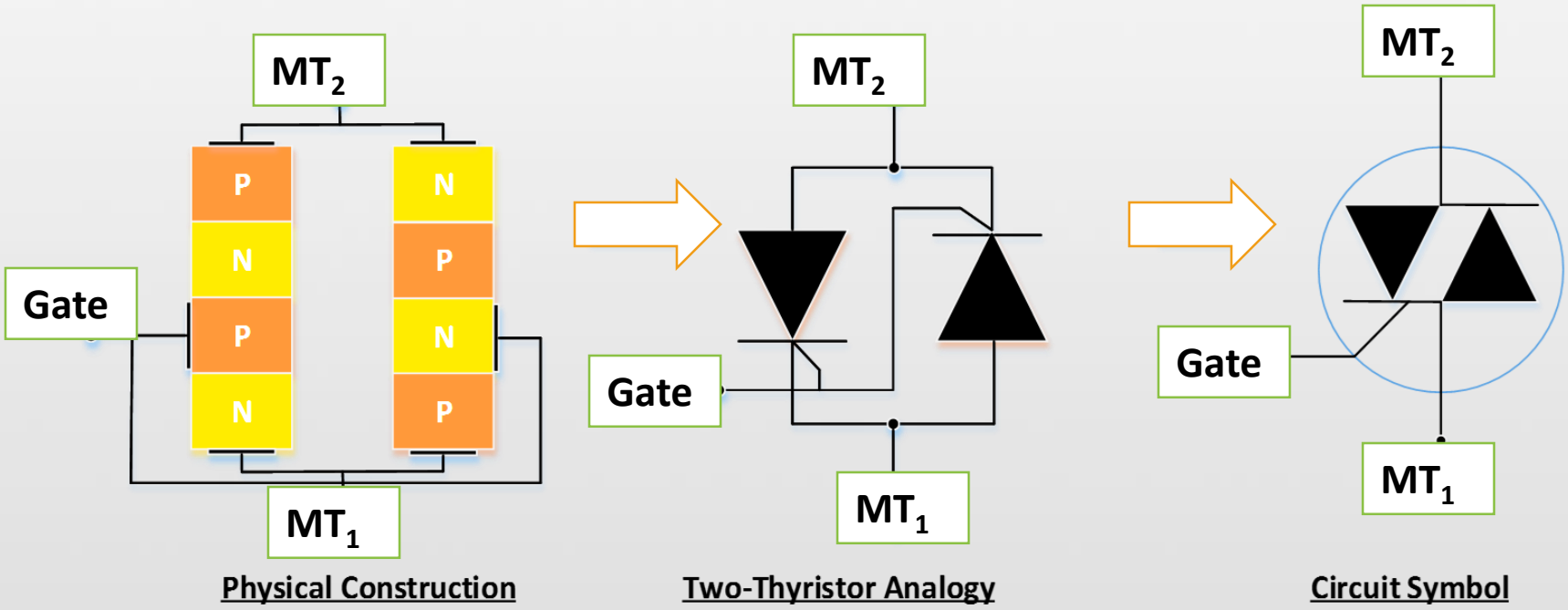




The black waveform is the input voltage , while the red waveform is the voltage across the bulb.

TRIAC

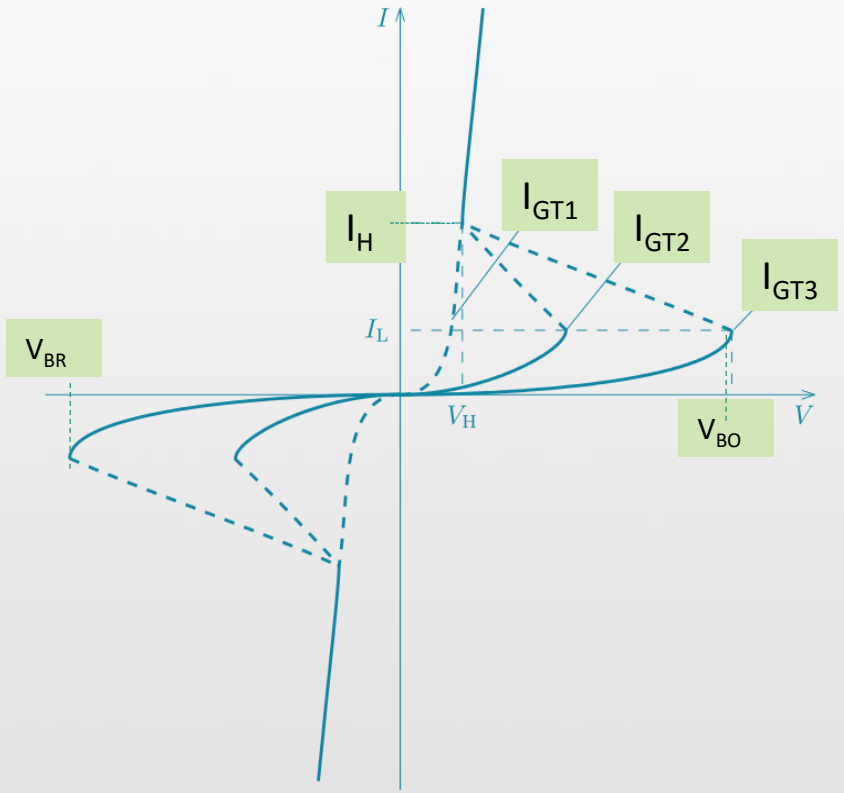
- Triac is a three terminal semiconductor device for controlling current.
- Some applications of Triac are domestic light dimmers, electric fan speed control and small motor control



Characteristic of a Triac

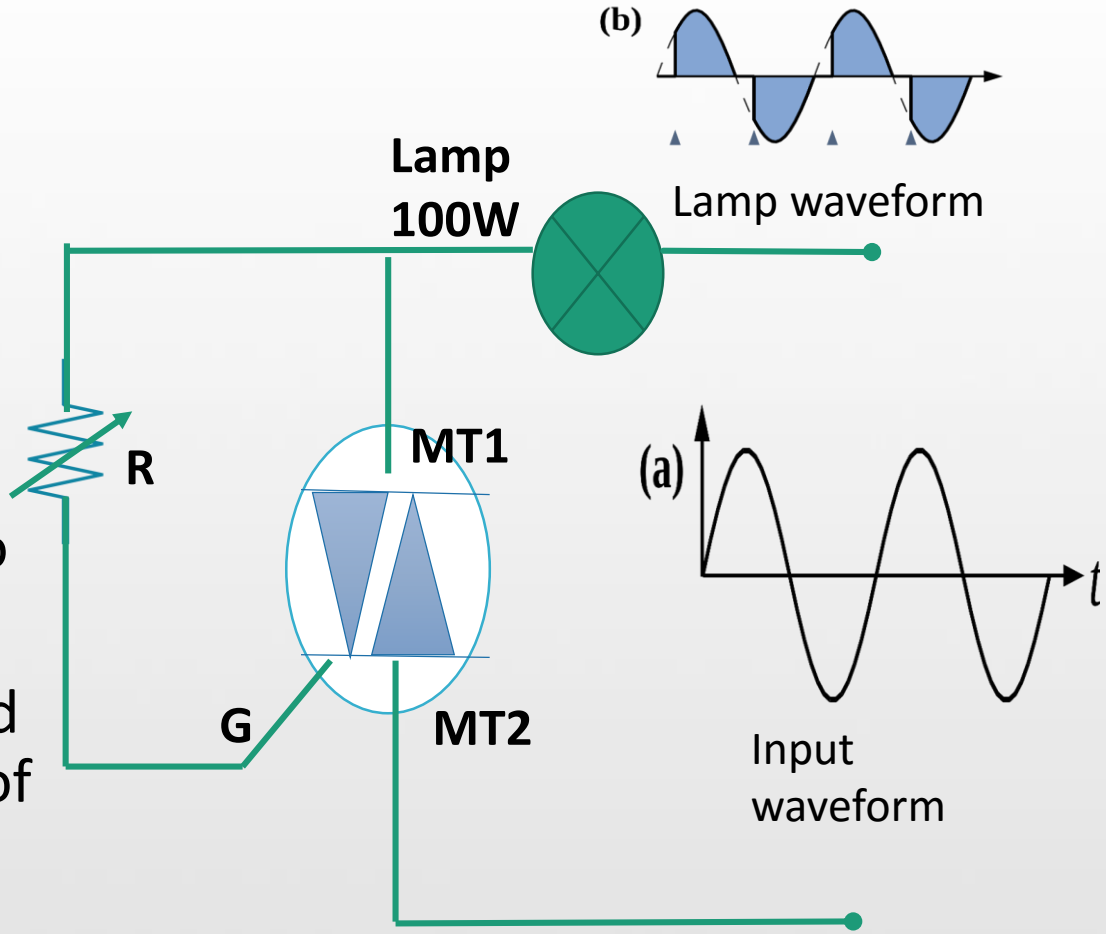
The voltage and current to be considered are:

- Forward breakover voltage
- Reverse breakover voltage.
- Holding current
- Gate voltage trigger
- Gate current trigger requirements.



An application of a Triac

- At input zero the Triac is cut off and the lamp will not light up.
- As the input voltage increases, a small gate current (a few mA) flowing through the gate (G) and the Triac starts to activate.
- The lamp will light up and give total output power of 100 watts.
- The brightness of the lamp can be controlled by varying the resistor R.

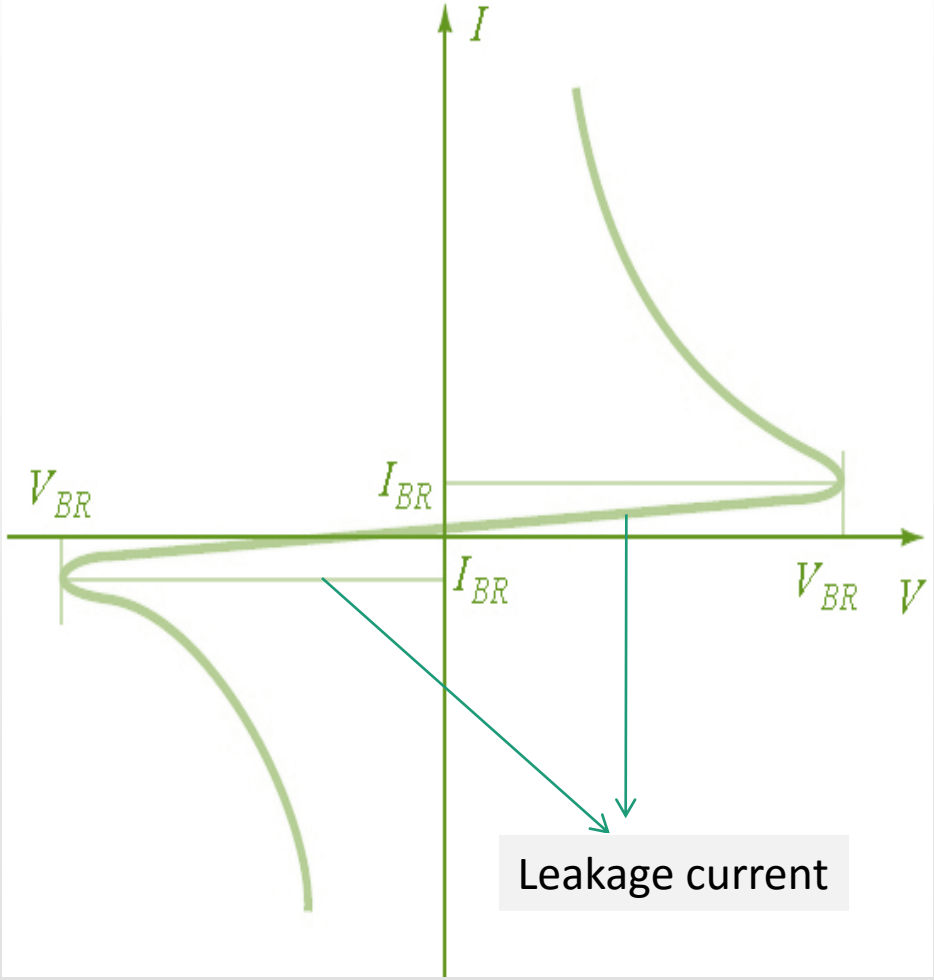


DIAC

- A Diac is a bi-directional semiconductor switch that can conduct in both forward and reverse polarities once, the breakover voltage is reached.
- The name Diac comes from the words **Di**ode **AC** switch.
- The Diac is widely used to assist the triggering of a Triac when used in AC switches.
- Application include in light dimmers such as those used in domestic lighting and are also widely used in starter circuits for fluorescent lamps.

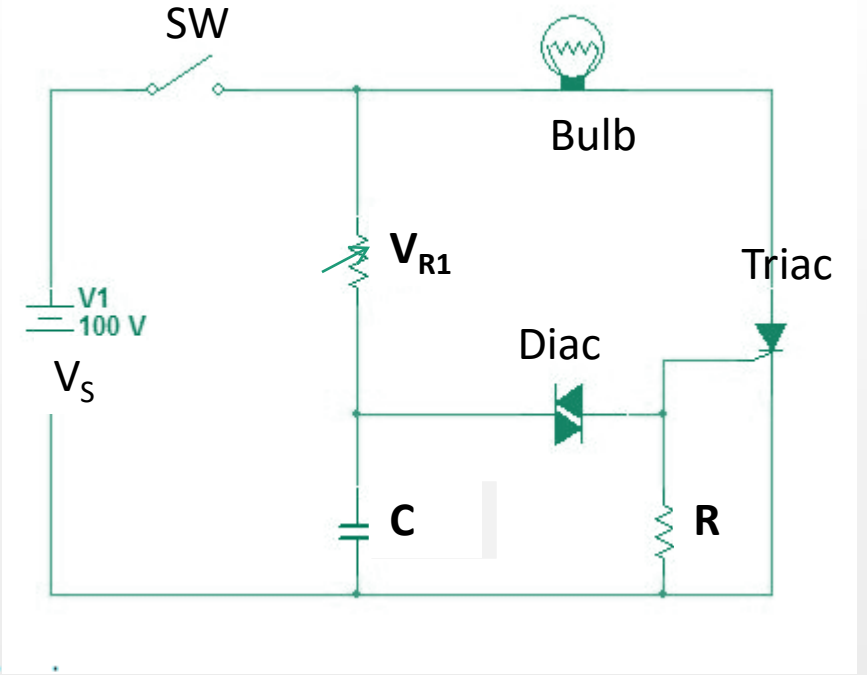
Characteristic of a Diac

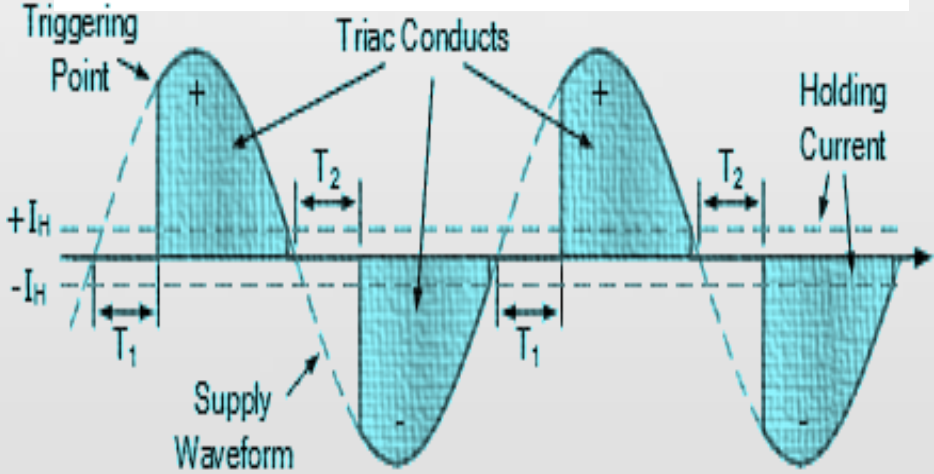
- As the voltage is increased from zero in either direction, a small amount of leakage current occurs, as shown in characteristic curve.
- When V_{BR} is reached in either direction, the Diac, starts to conduct and current will flow that produces very small internal resistance.



Application Circuit of Triac and Diac

- When the switch SW is closed, the capacitor charging voltage reaches the breakover voltage of the Diac (about 30 V), the Diac starts conducting and trigger the Triac.
- The phase angle at which the Triac is triggered can be varied using V_{R1}, which controls the charging rate of the capacitor.
- The bulb will light up depends on the voltage supplied to it.





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