

2.6 SILICON CONTROLLED RECTIFIER (SCR)

The SCR stand for Silicon Control Rectifier, it is used in industries because it can handle high values of current and voltage.

Three terminals

- Anode - P-layer
- Cathode - N-layer (opposite end)
- Gate - P-layer near the cathode

Three junctions - four layers

Connect power such that the anode is positive with respect to the cathode - no current will flow

A silicon controlled rectifier is a semiconductor device that acts as a true electronic switch. It can change alternating current and at the same time can control the amount of power fed to the load. SCR combines the features of a rectifier and a transistor.

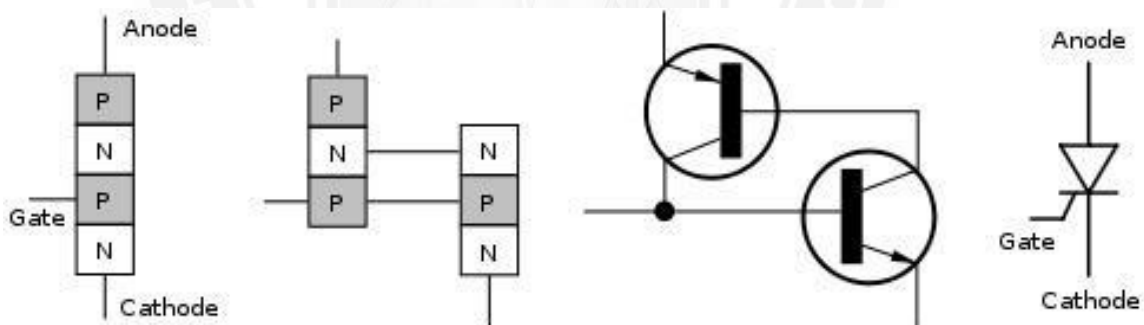


Figure 2.6.1 Basic Structure, equivalent transistor model and symbol of SCR

[Source: "Electronic devices and circuits" by "Balbir Kumar, Shail.B.Jain, and Page: 110"]

When a p n junction is added to a junction transistor the resulting three p n junction device is called a SCR. ordinary rectifier (p n) and a junction transistor (n p n) combined in one unit to form p n p n device.

Three terminals are taken: one from the outer p- type material called anode a second from the outer n- type material called cathode K and the third from the base of transistor called Gate. GSCR is a solid state equivalent of thyatron. The gate anode and cathode of SCR correspond to the grid plate and cathode of thyatron SCR is called thyristor.

Working Principle

Load is connected in series with anode the anode is always kept at positive potential w.r.t cathode.

SCR Operation / Working

The Silicon Control Rectifier SCR start conduction when it is forward biased. For this purpose the cathode is kept at negative and anode at positive. When positive clock pulse is applied at the gate the SCR turns ON.

When forward bias voltage is applied to the Silicon Control Rectifier SCR, the junction J1 and J3 become forward bias while the junction J2 become reverse bias.

When we apply a clock pulse at the gate terminal, the junction J2 become forward bias and the Silicon Control Rectifier SCR start conduction. The Silicon Control Rectifier SCR turn ON and OFF very quickly, At the OFF state the Silicon Control Rectifier SCR provide infinity resistance and in ON state, it offers very low resistance, which is in the range of 0.01Ω to 1Ω .

SCR Firing & Triggering

The Silicon Control Rectifier SCR is normally operated below the forward break over voltage (VBO). To turn ON the Silicon Control Rectifier SCR we apply clock pulse at the gate terminal which called triggering of Silicon Control Rectifier, but when the Silicon Control Rectifier SCR turned ON, now if we remove the triggering voltage, the Silicon Control Rectifier SCR will remain in ON state. This voltage is called Firing voltage

Break over Voltage

It is the minimum forward voltage gate being open at which SCR starts conducting heavily i.e turned on.

Peak Reverse Voltage (PRV)

It is the maximum reverse voltage applied to an SCR without conducting in the reverse direction

Holding Current

It is the maximum anode current gate being open at which SCR is turned off from on conditions.

V-I Characteristics of SCR

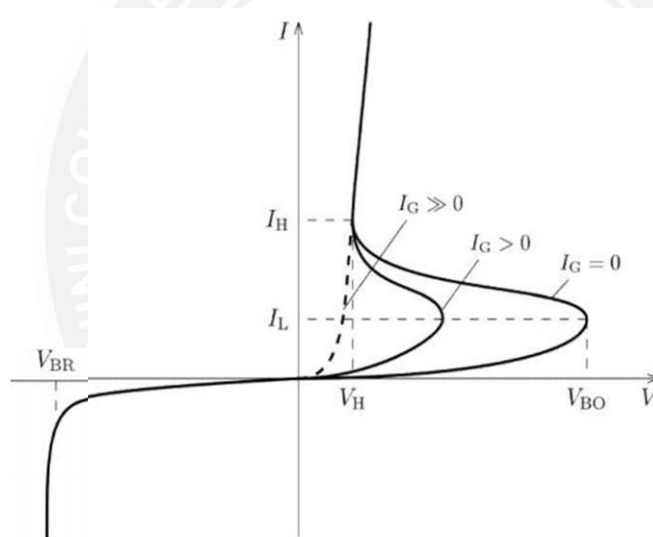


Figure 2.6.2 V-I Characteristics of SCR

[Source: "Electronic devices and circuits" by "Balbir Kumar, Shail.B.Jain, and Page: 110]

Forward Characteristics

When anode is +ve w.r.t cathode the curve between V & I is called Forward characteristics. OABC is the forward characteristics of the SCR at $I_G = 0$. If the supplied voltage is increased from zero point A is reached. SCR starts conducting voltage across SCR suddenly drops (dotted curve AB) most of supply voltage appears across RL

Reverse Characteristics

When anode is -ve w.r.t cathode the curve b/w V & I is known as reverse characteristics reverse voltage come across SCR when it is operated with ac supply

reverse voltage is increased anode current remains small avalanche breakdown occurs and SCR starts conducting heavily is known as reverse breakdown voltage.

Application

- ✓ SCR as a switch
- ✓ SCR Half and Full wave rectifier
- ✓ SCR as a static contactor
- ✓ SCR for power control
- ✓ SCR for speed control of d.c. shunt motor
- ✓ Over light detector

