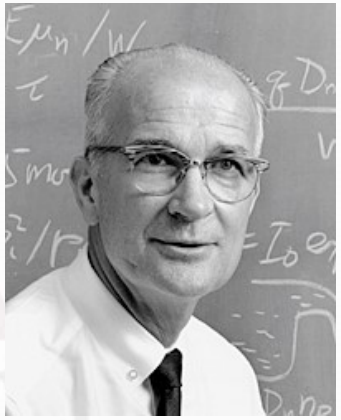
Silicon Controlled Rectifier/ Thyristor

What is a Thyristor, SCR?

Thyristors of silicon Controlled rectifiers, SCRs are semiconductor devices that can act as electronic switches sometimes controlling circuits with high voltage and current levels.

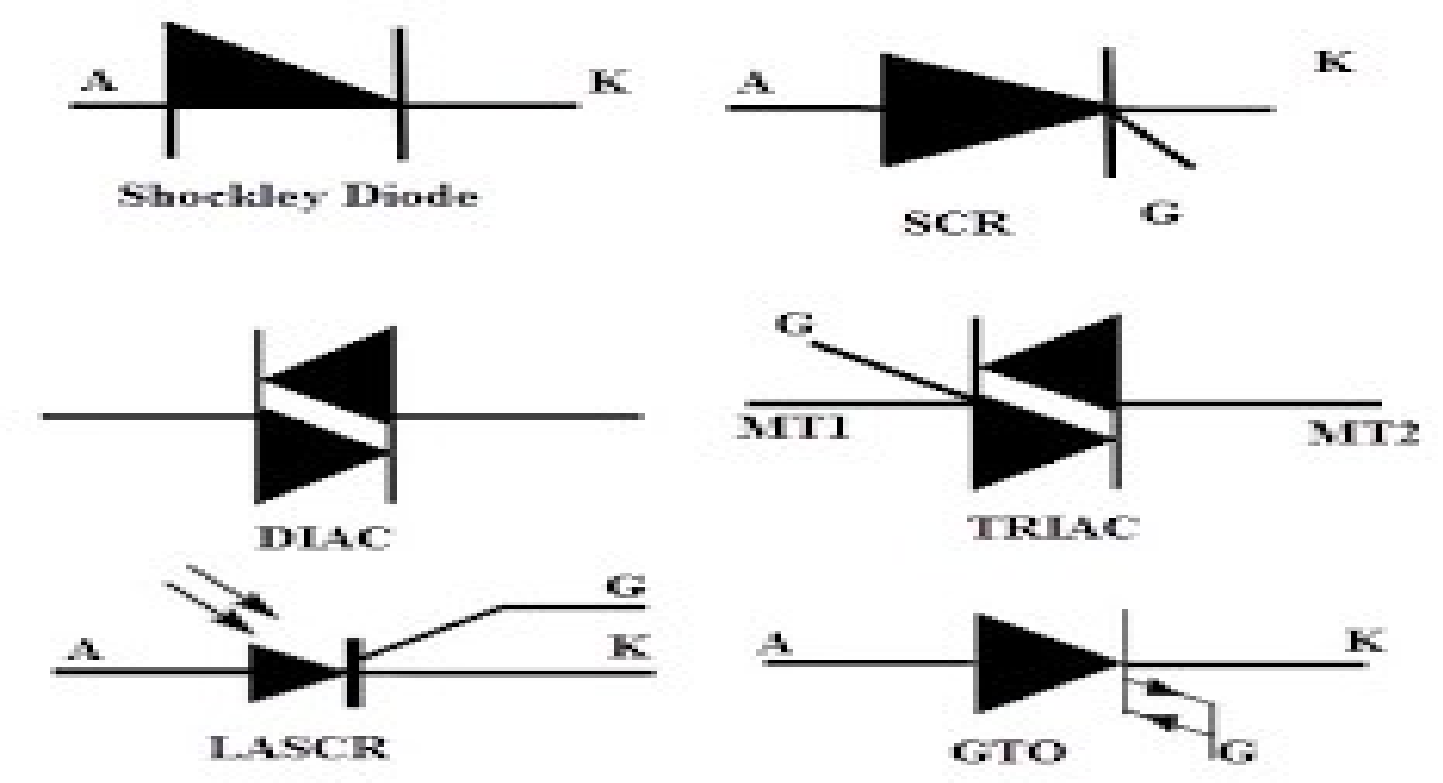
The silicon controlled rectifier (SCR) or thyristor proposed by William Shockley in 1950 and championed by Moll and others at Bell Labs was developed in 1956 by power engineers at General Electric (G.E.), led by Gordon Hall and commercialized by G.E.'s Frank W. "Bill" Gutzwiller.



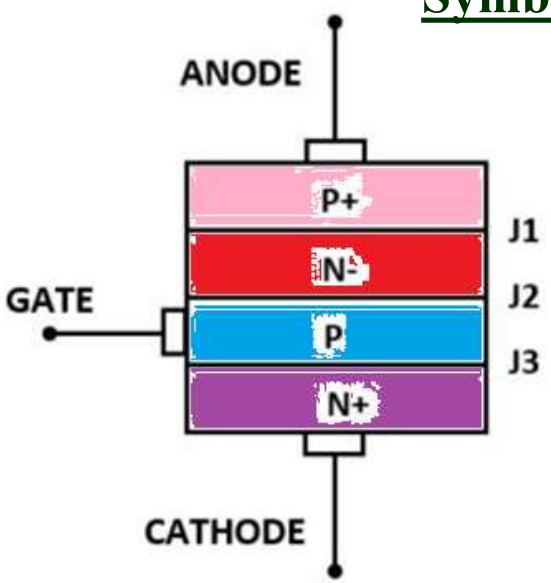
Introduction:

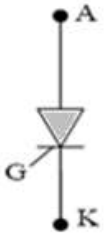
- Thyristor is a three terminal device with four layers of alternating P and N type material (three P-N junctions). The three terminals are Anode, Cathode and Gate.
- The Thyristor is mentioned as Silicon Controlled Rectifier (SCR) as it is made up of silicon and working as controlled rectifier.
- The thyristor is inherently a slow switching device compared to BJTs or MOSFETs because of the long carrier lifetimes used for low on-state losses and because of the large amount of stored charge.
- It is therefore normally used at lower switching frequencies.
- It has large reverse-recovery currents.

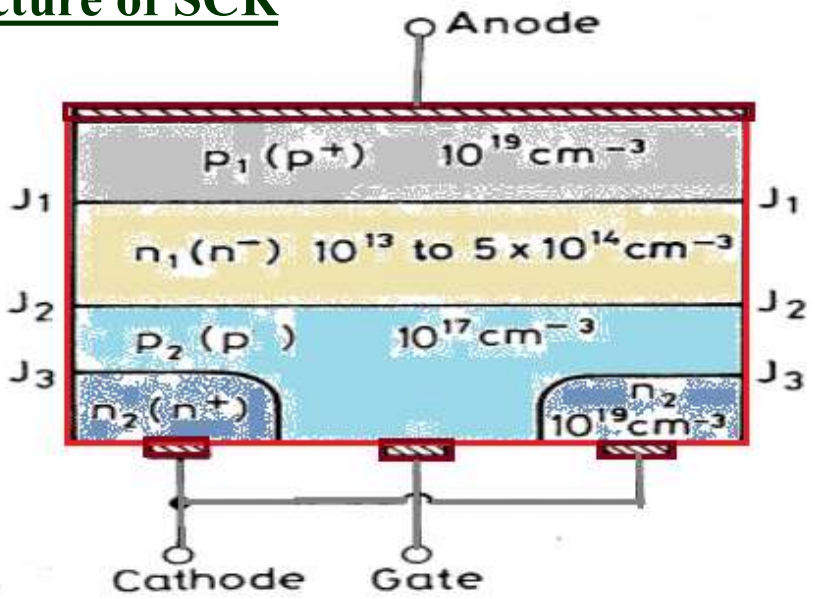
Thyristor Family and Similar device



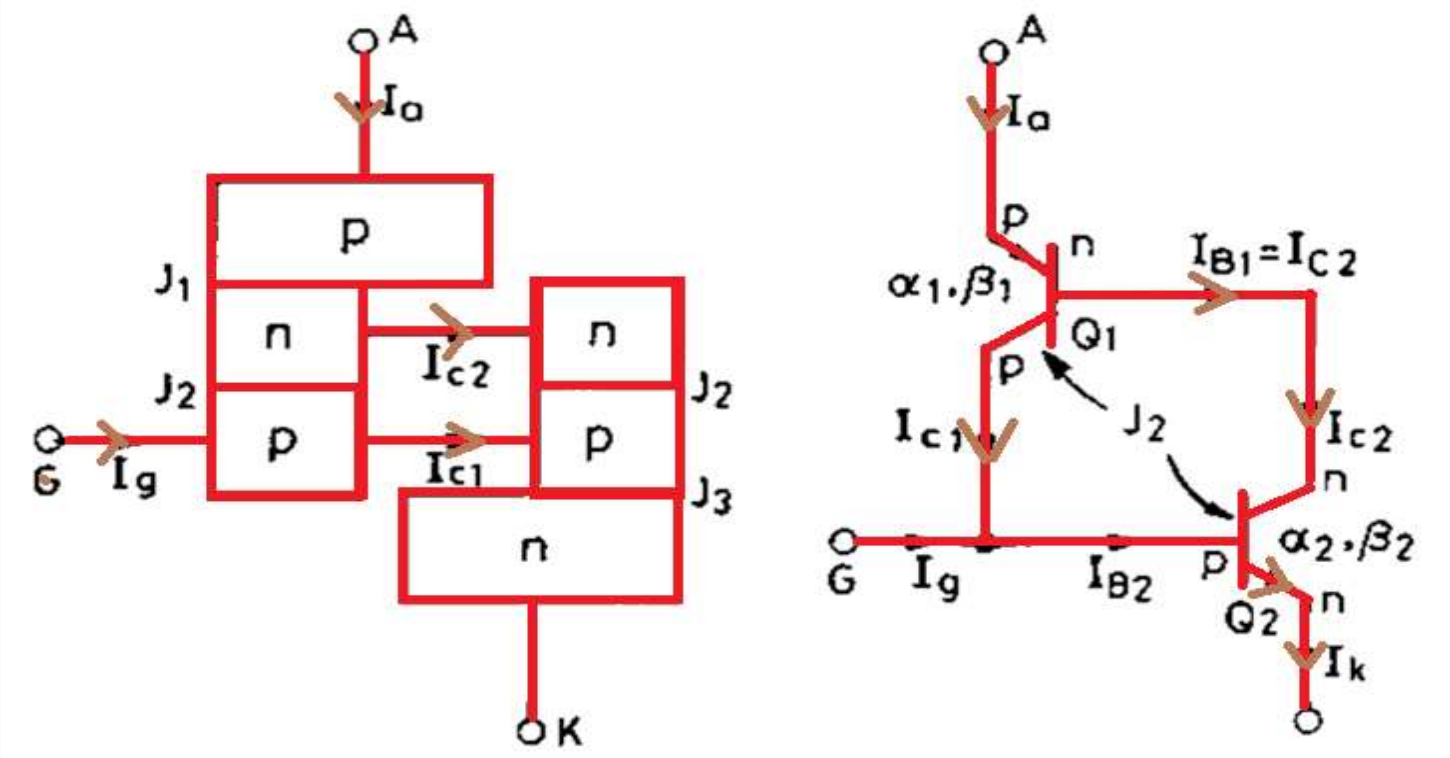
Symbol and Structure of SCR



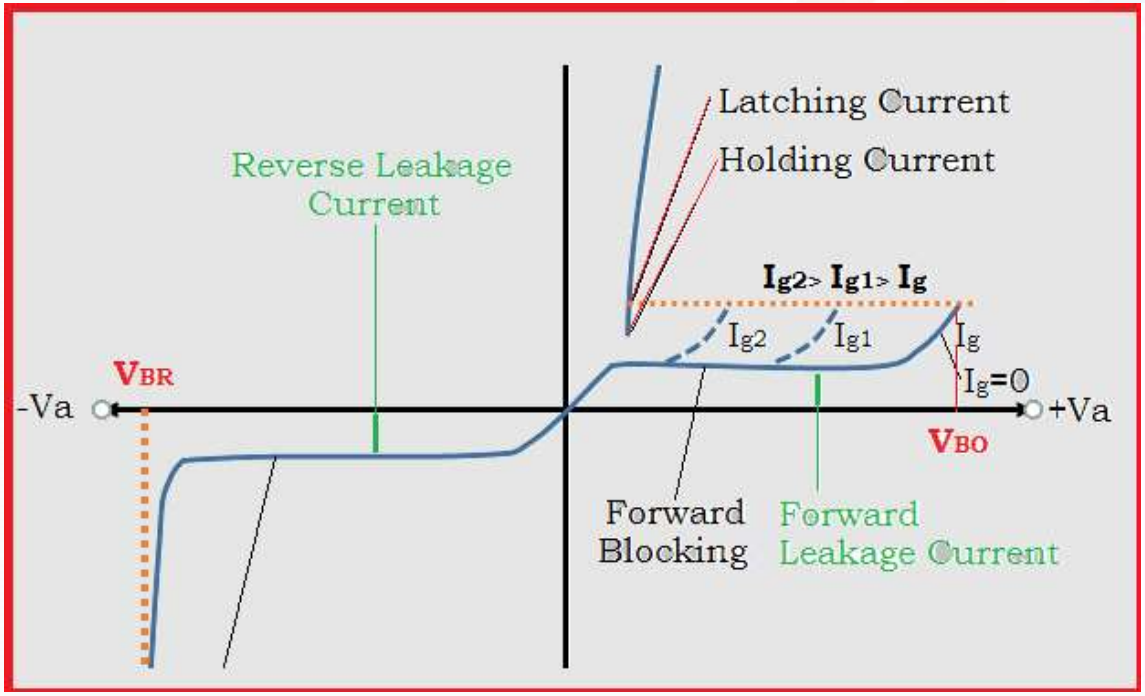


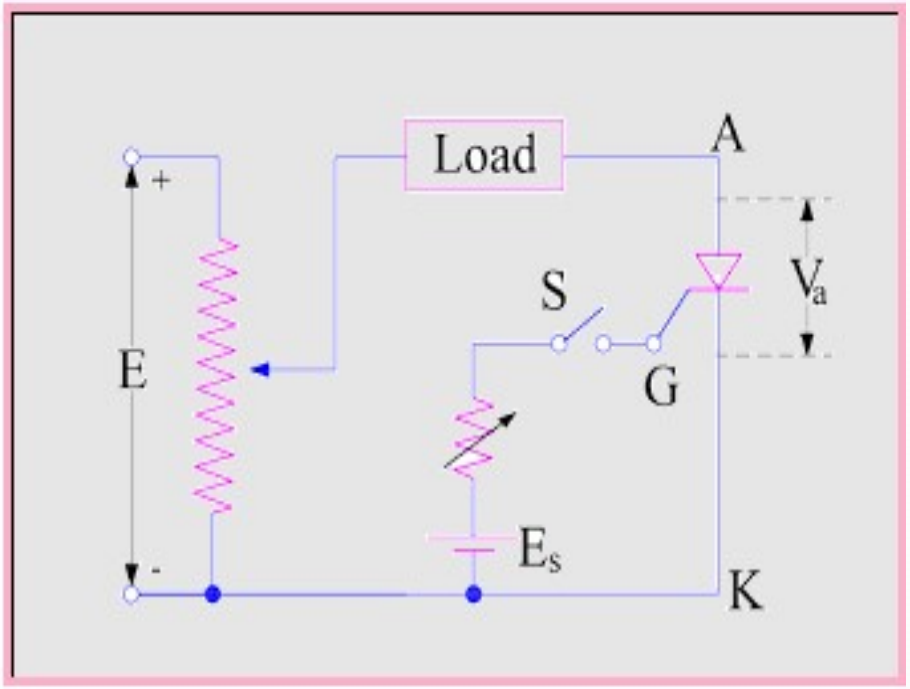


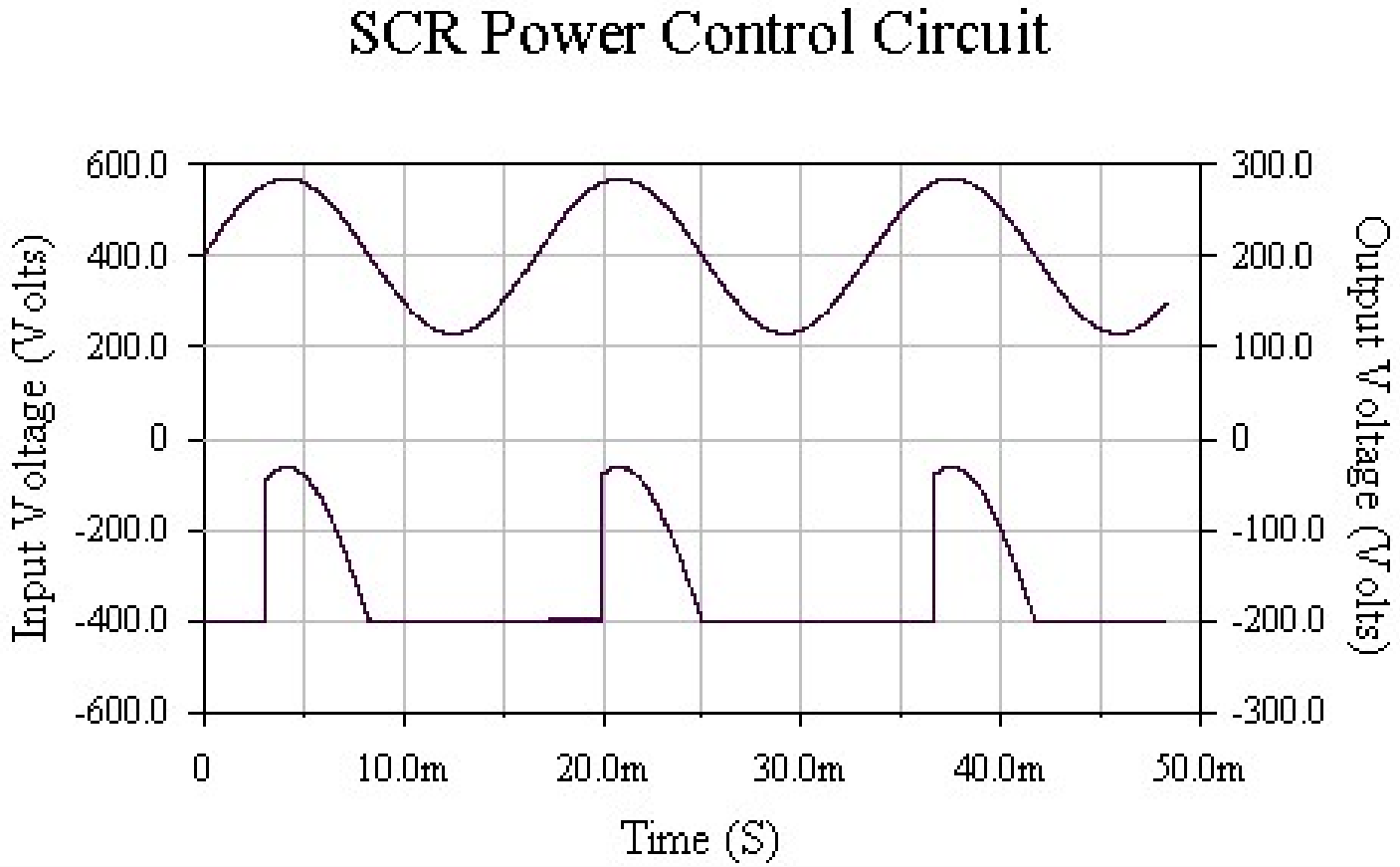
Two Transistor Model



VI Characteristics of SCR






SCR Power Control Circuit
600.0
400.0
200.0
0
-200.0
-400.0
-600.0
Input Voltage (Volts)
300.0
200.0
100.0
0
-100.0
-200.0
-300.0
Output Voltage (Volts)
0
10.0m
20.0m
30.0m
40.0m
50.0m
Time (S)

• Parameters of Thyristors:

- Latching Current(I_L):
  It is the minimum anode current required to switch(latch) the SCR from OFF state t ON state.
- Holding Current(I_H):
  It is the minimum anode current required to hold the SCR in ON state.
  Peak Reverse Voltage:
  It is the maximum voltage that can be applied across the SCR in reverse biased condition.
- Peak Inverse Voltage:
  It is the maximum voltage which the device can safely withstand in its OFF state.
- ON State Voltage:
  The voltage which appears across the device during it's ON state is known as it's ON state Voltage.
- Rate of rise of voltage dv/dt:
  The rate at which the voltage across the device rises without triggering the device is known as its rate of rise of voltage.
- Current Rating:
  The current carrying capacity of the device is known as its current rating.

Switching Characteristics of SCR