1.7 Parallel Operation of Thyristors

It is common practice to parallel thyristors to achieve higher current ratings.

- The main design consideration for parallel thyristors operation is that all devices should share both the steady-state and transient currents.
- Any thyristors carrying more current than the other thyristors, will heat up and conducts more current leading to thermal runaway.
- An effective method of current sharing is shown in figure (1.20). In this feedback arrangement, if the current in D_1 tends to increase above that through D_2, the voltage across L_1 increases to oppose current flow through D_1. Simultaneously a negative voltage is induced across L_2 thereby increasing the current through D_2.

Note: Common heat sink should be used to avoid thermal runaway results from heating up one thyristor more than the others.

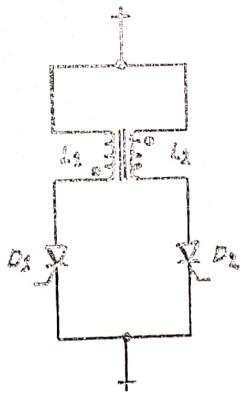


Figure (1.20) Current sharing network using cross-coupled reactors.

1.8 Cooling

Semiconductor power losses are dissipated in the form of heat, which must be transferred away. Therefore it is essential that thermal design determines accurately the maximum junction temperature from the device power dissipation.

The design of heat sink should be according to:

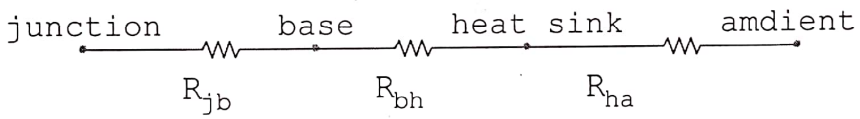
$$P = \frac{T_j - T_a}{R_{ja}} \qquad \text{.....(1.5)}$$

Where P is rate of heat transfer (i.e. the power dissipated).

T_j is junction temperature.

T_a is ambient temperature.

R_{ja} is the total thermal resistance from the junction to the ambient air.



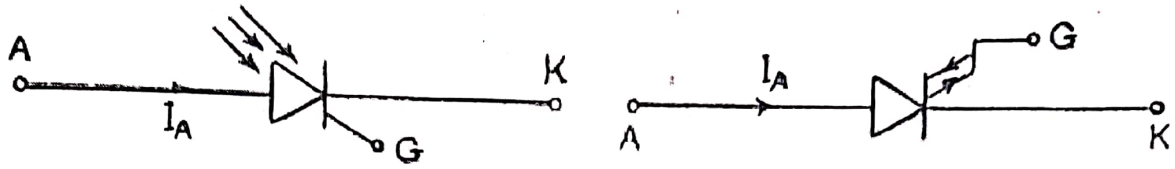
$$R_{ja} = R_{jb} + R_{bh} + R_{ha} \qquad \text{.....(1.6)}$$

1.9 LASCR

Light Activated Silicon Controlled Rectifier (LASCR) is turned-on by direct radiation on the silicon wafer. It offers complete electrical isolation between light-trigger source and the switching device. The symbol used is shown in figure (1.21a).

1.10 GTO

The Gate turn-off thyristor can be turned-on by a single pulse of positive gate current (like a thyristor), but in addition it can be turned-off by a pulse of negative gate current. Both on-state and off-state operation of the device are therefore controlled by the gate current. The symbol used for the GTO is shown in figure (1.21b).

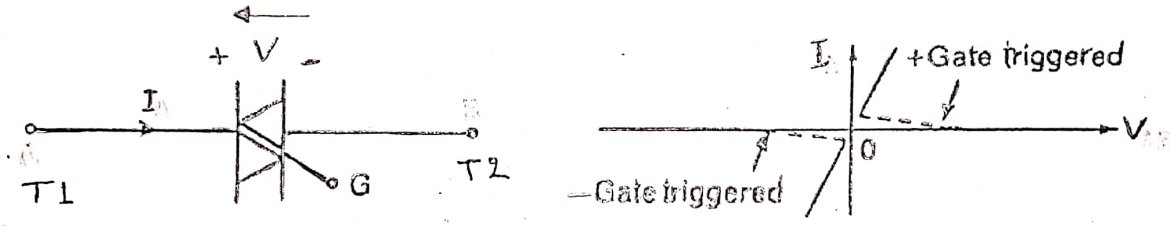


(a) (b)

Figure (1.21): (a) LASCR symbol; (b) GTO symbol.

1.11 Triac

A triac can be considered as an integration of two SCRs in inverse-parallel. The circuit symbol and volt-ampere characteristics of a triac are shown in figure (1.22). when terminal T_1 is positive with respect to terminal T_2 and the device is fired by a positive gate current ($+i_g$), it turns-on. Also, when terminal T_2 is positive with respect to terminal T_1 and the device is fired by a negative gate current ($-i_g$), the device turn-on.



(a) (b)

Figure (1.22): (a) Triac symbol; (b) Triac v-i characteristic