1.5.3 Gate ratings

The gate ratings usually specified are:

1) Peak power P_{GM}.
2) Mean power P_G.
3) Peak forward gate-cathode voltage V_{GFM}.
4) Peak reverse gate-cathode voltage V_{GRM}.
5) Peak forward gate current I_{GFM}.

These ratings are illustrated in figure (1.17), where all thyristors have characteristics somewhere between high and low resistance limits.

Pulse technique is preferred as compared to continuous current because that:

1- The rise time is best achieved by pulse technique.
2- Much less power is dissipated in the gate by pulse technique.
3- The instant of firing can be accurately timed.

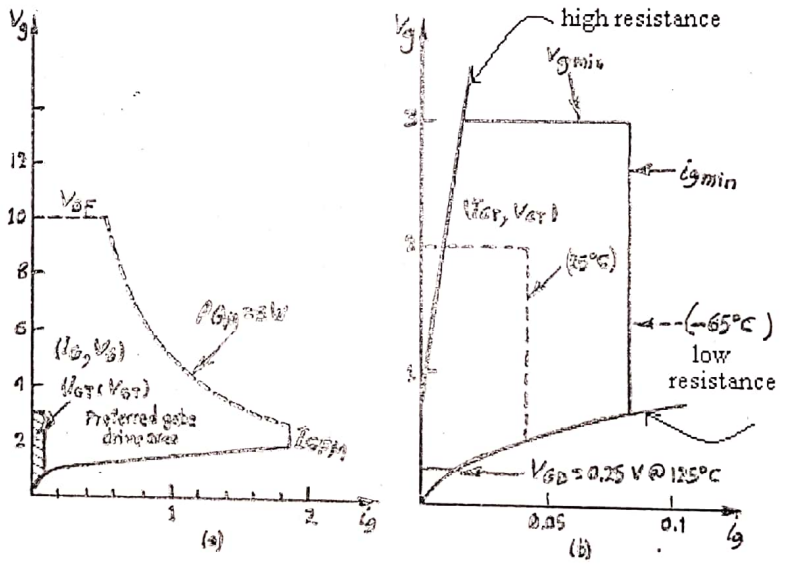


Figure (1.17) Thyristor gate ratings: (a) the preferred operating region; (b) minimum gate requirements and their temperature dependence.

(shaded area)

Gate trigger requirements:

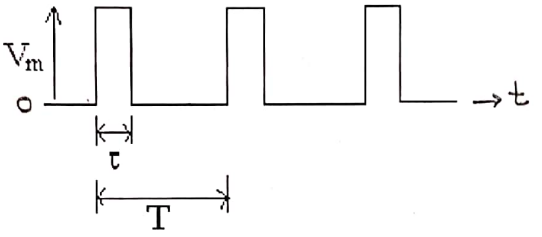
1- The operating point should be outside the uncertainty area and inside the preferred gate drive area i. e.:

$V_{gmin} < V_{GF} < V_{GFM}$ where V_{GD} is the non trigger gate voltage

$I_{gmin} < I_{GF} < I_{GFM}$, and within the rating power bounds.

2- Train of pulses is preferred than using single pulse:

- The mean power of the pulse should not exceed the rated mean power P_G:



$$\frac{V_m I_m \tau}{T} \le P_G .$$

- $\tau > t_{on}$: the width of the gate pulse should be greater than thyristor turn-on time [to ensure thyristor latching current is reached].
- The turn-on (I_G,V_G) requirements are increased as the pulse duration is decreased. For a pulse reduced from 100 μs to 1μs, the voltage to current increase above the original requirements is 2:10 respectively.

1.6 Series Operation of Thyristors

Figure (1.18) shows the forward voltage-current characteristics of a two typical power switching SCR's. Both series devices conduct the same off-state leakage current but each support different voltage. Hence one thyristor will take the most of voltage and consequently breakdown.

The solution to this problem is to connect a resistance of suitable value in parallel with each thyristor.

The other problem is that before the thyristors can reverse, reverse recovery charge must flow, but elements with least recovery charge

requirements recover first and support reverse biased. The non recovered devices recover now as a result of leakage current.

The solution to this problem is by placing capacitance across each element.

The action of the capacitor is to provide a transient current path bypassing a recovered thyristor to allow slower thyristor to recover. These solutions are shown in figure (1.19).

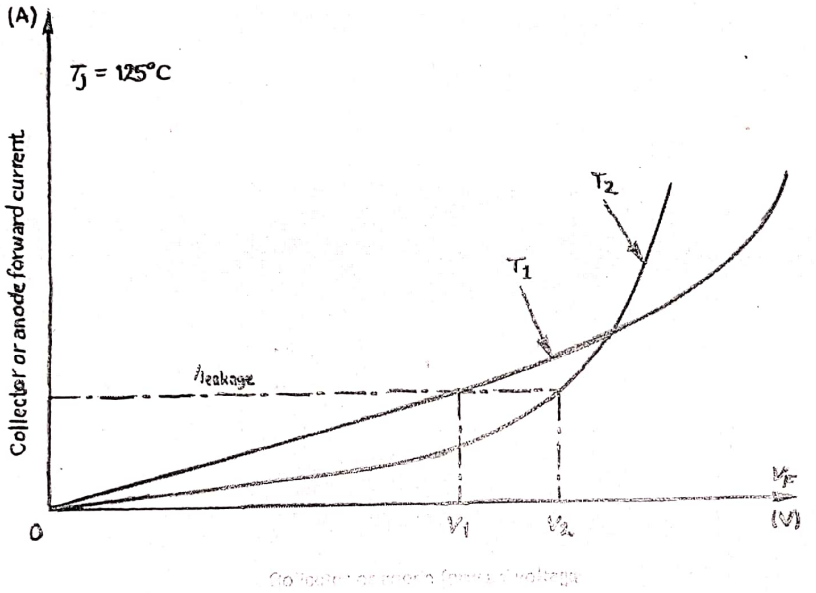


Figure (1.18) Anode forward blocking I-V characteristics showing voltage sharing imbalance for two devices in series.

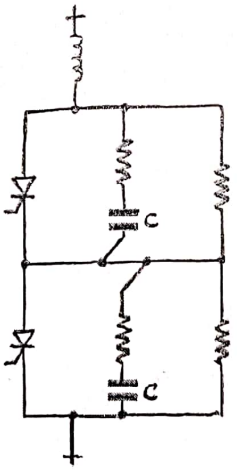


Figure (1.19) Transient and steady-state voltage sharing circuit for series connected thyristors.