THYRISTOR GATE CHARACTERISTICS

Fig. 3.6 shows the gate trigger characteristics.

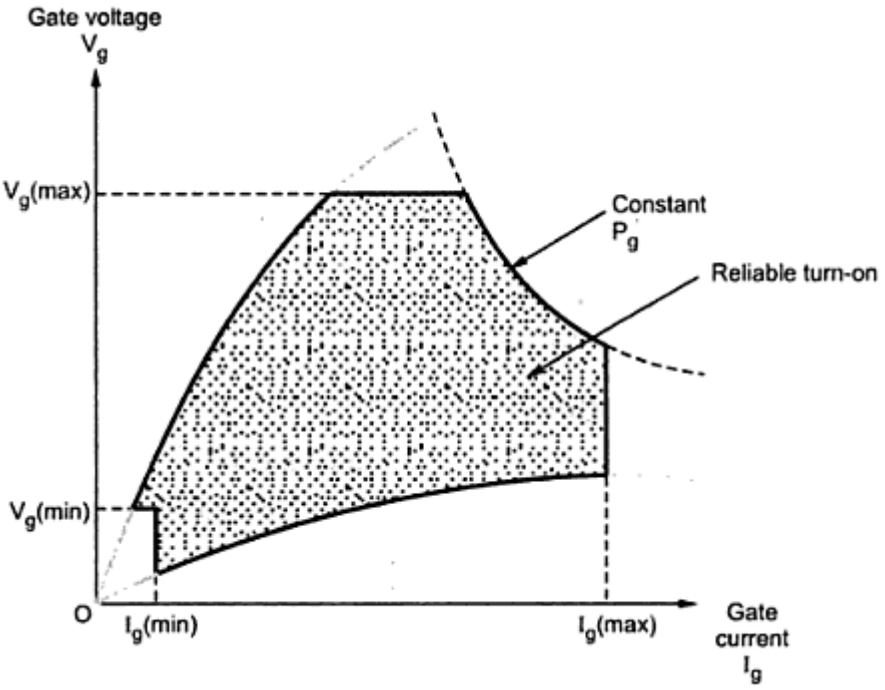


Fig 3.6 Gate Characteristics

The gate voltage is plotted with respect to gate current in the above characteristics. $I_{g(max)}$ is the maximum gate current that can flow through the thyristor without damaging it Similarly $V_{g(max)}$ is the maximum gate voltage to be applied. Similarly $V_{g\ (min)}$ and $I_{g(min)}$ are minimum gate voltage and current, below which thyristor will not be turned-on. Hence to turn-on the thyristor successfully the gate current and voltage should be

$$I_{g(min)} < I_g < I_{g(max)}$$

$$V_{g\ (min)} < V_g < V_{g\ (max)}$$

The characteristic of Fig. 3.6 also shows the curve for constant gate power (P_g). Thus for reliable turn-on, the (V_g, I_g) point must lie in the shaded area in Fig. 3.6. It turns-on thyristor successfully. Note that any spurious voltage/current spikes at the gate must be less than $V_{g\ (min)}$ and $I_{g(min)}$ to avoid false triggering of the thyristor. The gate characteristics shown in Fig. 3.6 are for DC values of gate voltage and current.

Pulsed Gate Drive

Instead of applying a continuous (DC) gate drive, the pulsed gate drive is used. The gate voltage and current are applied in the form of high frequency pulses. The frequency of these pulses is upto l0 kHz. Hence the width of the pulse can be upto 100 micro seconds. The pulsed gate drive is applied for following reasons (advantages):

i) The thyristor has small turn-on time i.e. upto 5 microseconds. Hence a pulse of gate drive is sufficient to turn-on the thyristor.

ii) Once thyristor turns-on, there is no need of gate drive. Hence gate drive in the form of pulses is suitable.

iii) The DC gate voltage and current increases losses in the thyristor. Pulsed gate drive has reduced losses.

iv) The pulsed gate drive can be easily passed through isolation transformers to isolate thyristor and trigger circuit.

Requirement of Gate Drive

The gate drive has to satisfy the following requirements:

i) The maximum gate power should not be exceeded by gate drive, otherwise thyristor will be damaged.

ii) The gate voltage and current should be within the limits specified by gate characteristics (Fig. 3.6) for successful turn-on.

iii) The gate drive should be preferably pulsed. In case of pulsed drive the following relation must be satisfied: (Maximum gate power x pulse width) x (Pulse frequency) ≤ Allowable average gate power

iv) The width of the pulse should be sufficient to turn-on the thyristor successfully.

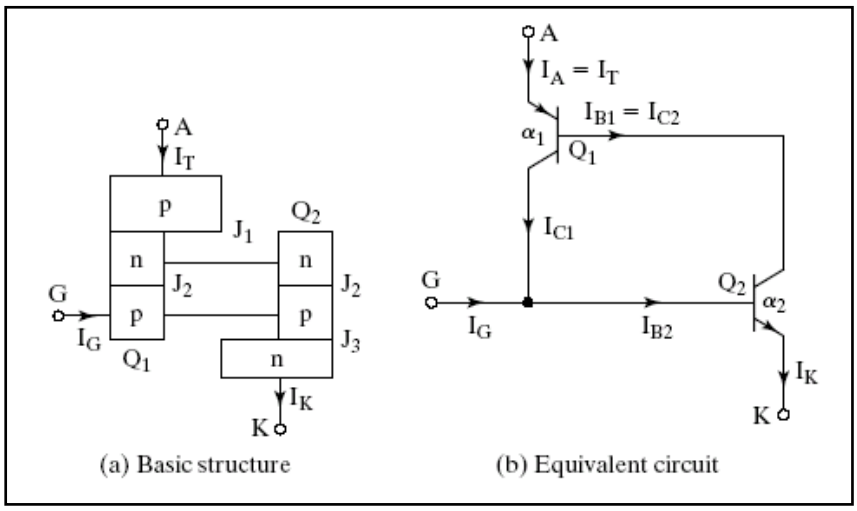
v) The gate drive should be isolated electrically from the thyristor. This avoids any damage to the trigger circuit if in case thyristor is damaged.

vi) The gate drive should not exceed permissible negative gate to cathode voltage, otherwise the thyristor is damaged.

vii) The gate drive circuit should not sink current out of the thyristor after turn-on.

Quantitative Analysis

Two Transistor Model



(a) Basic structure (b) Equivalent circuit