

Series and Parallel operation of Thyristors.

- Need for series connection of SCRs:
 - When our requirement is of high voltage operation, and the available voltage rating of SCR is not sufficient, then we connect some SCRs in series.
 - The SCRs connected in series share the voltage during the blocking state.

- Need for parallel connection of SCRs:
 - When our requirement is of high current operation and available current rating of SCR is not sufficient, then we connect SCRs in parallel.
 - The SCRs connected in parallel share the current during conduction state.

- While connecting SCRs in series or in parallel, we need to ensure that
 - ↳ Ratings of connected SCRs are fully utilized.
 - ↳ Operation of the system is satisfactory.

- String Efficiency :-

- A number of SCRs connected in series or in parallel is known as "String".
- When SCRs are connected in a string, we determine the degree of utilization of each SCR, using a term known as String efficiency.

$$\text{String Efficiency} = \frac{\text{Actual voltage rating of string}}{\text{Voltage rating of each SCR} \times \text{No. of SCR in string}}$$

For series connected SCRs.

$$\text{String Efficiency} = \frac{\text{Actual current rating of string.}}{\text{Current rating of each SCR} \times \text{No. of SCR in string}}$$

For parallel connected SCRs.

- For obtaining highest utilization of SCR rating, hence for obtaining highest possible string efficiency, the SCRs to be connected in series or parallel should have identical I-V characteristics.

- However, even the SCRs of same rating may not have identical I-V characteristics; due to differences in internal structure resulting from manufacturing process.

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so, string efficiency can never be equal to 1.

- However, unequal voltage or current sharing by the SCRs in a string can be minimized to a great extent, by using external equalizing circuits.

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(discussed in details later on).

Derating Factor (Measure of reliability of string).

- If all the SCRs connected in a string is utilizing its capacity nicely (say around 90%), then the string efficiency is good (around 90%).

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However, the string may not be very much reliable. As each SCR is working close to their maximum rated capacity, any abnormal voltage or current may damage the SCR or string.

Now, if we add one more SCR to the same string, then each SCR will utilize somewhat lower capacity due to addition of extra SCR.



The overall string efficiency will reduce, due to lower utilization & capacity.



However, the string will become more reliable. Now the SCRs are not working very close to their maximum rating, so they can withstand higher abnormal voltage and current.

So, the use of extra SCRs in the string improve the reliability of the string, though at an increased cost.

The measure of the reliability of a string is given by derating factor (DRF).

$$\text{Derating Factor} = 1 - \text{String Efficiency}$$