Self-Excited DC Series Generator

In **self-excited generator** field coils are energized by the current produced by the generator, the field winding is also connected to the armature winding in varying ways to achieve a wide range of performance characteristics.

In series type of generators, the field windings are connected in series with armature conductors.

The field (excitation) current in a series-wound generator is the same as the current the generator delivers to the load as they are both in series.

These types of generators are restricted for the use of power supply because of their increasing terminal voltage characteristic with the increase in load current from no load to full load. We can clearly see this characteristic from the characteristic curve later in this article. However, they give constant current in the dropping portion of the characteristic curve. For this property they can be used as constant current source and employed for various applications.

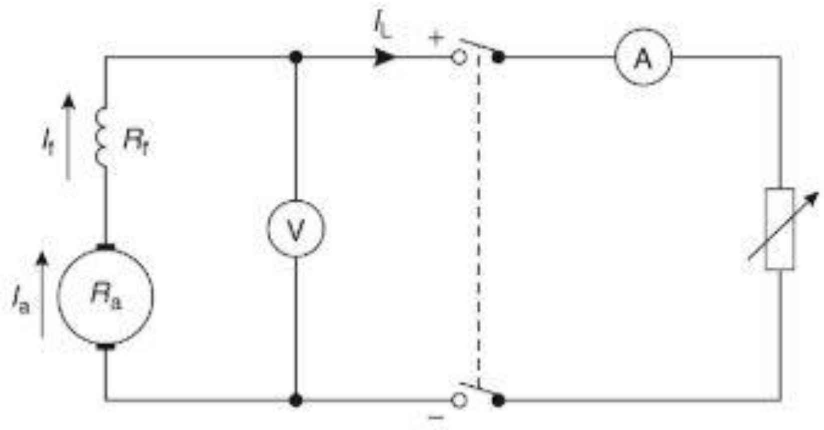
Another advantage of a series wound generator is that it has less to no windings as compared to that of the shunt wound type, resulting in low electrical resistance.

However, the machine has the following disadvantages:

1. It cannot self-excite until the load circuit is completed and its resistance value is less than the critical resistance
2. The voltage to which it self-excites depends on the load current and very little control is possible
3. The load characteristic is a rising one and is unsuitable, in fact it is dangerous, and may result in load ‘burn-out’

A series generator is never used for normal generating purposes, but only certain applications. Machines of this type are usually specialist marine electrical systems only such as specific electric propulsion and winch controls.

They are also used as boosters to compensate the voltage drop in the feeder in various types of distribution systems such as railway service.



Equations for self-excited series-wound DC generator:

$$I_a = I_f \text{ (series field current)} = I_L = I.$$

So, the emf generated:

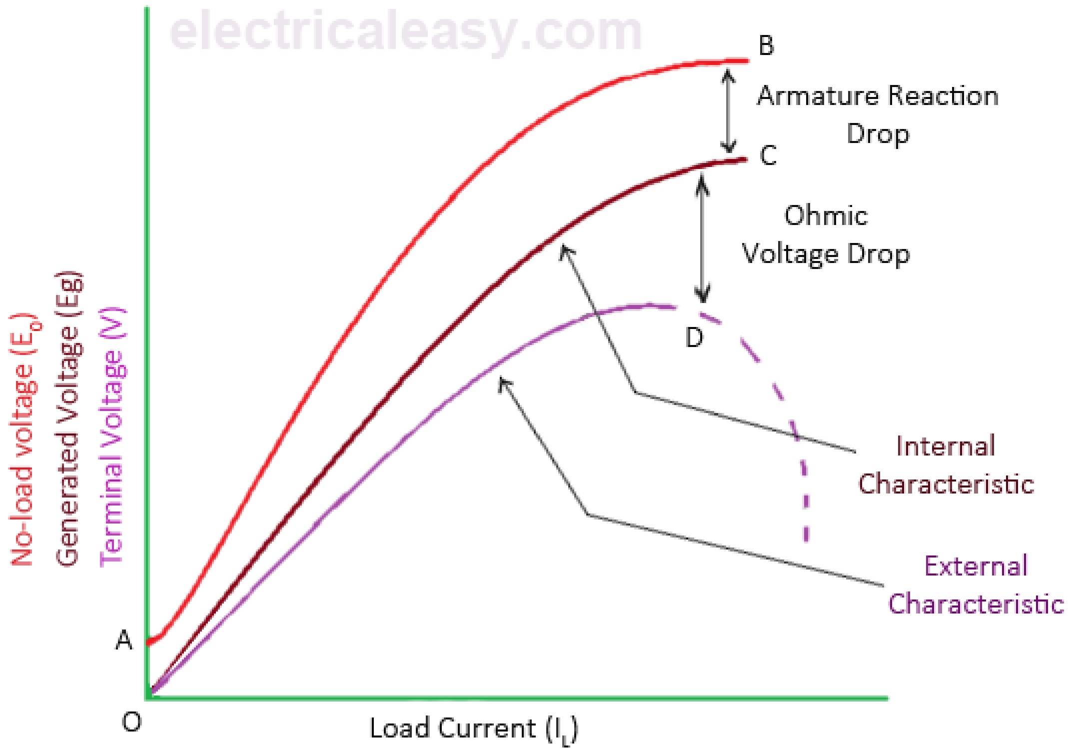
$$E_g = V + I_f R_f + I_a R_a = V + I(R_f + R_a).$$

The generated power:

$$P_g = E_g * I$$

Finally, the load delivered power:

$$P_L = V * I.$$



Characteristics of DC series generator

The curve AB in above figure identical to open circuit characteristic (O.C.C.) curve. This is because in DC series generators field winding is connected in series with armature and load. Hence, the load current is similar to field current (i.e. $I_L=I_f$). The curve OC and OD represent internal and external characteristic respectively. In a DC series generator, terminal voltage increases with the load current. This is because, as the load current increases, field current also increases. However, beyond a certain limit, terminal voltage starts decreasing with increase in load. This is due to excessive demagnetizing effects of the armature reaction.