4.5 Current Source Inverter Fed Synchronous Motor Drive:

A synchronous motor draws a stator current which is independent of stator frequency when V/f and E/f are maintained constant and armature resistance is neglected. The motor also develops constant torque. The flux also remains constant. Therefore, by controlling the stator current of a synchronous motor we can have flux control as well as torque control. As has been discussed in the case of the induction motor, current control is simple and straightforward. A synchronous motor is fed from a Current Source Inverter Fed Synchronous Motor Drive. A synchronous motor can have either separate control or self control. Due to stable operation self control is normally employed, by using either rotor position sensing or induced voltage sensing. The motor operates in CLM mode. When fed from a CSI the synchronous motor can be operated at leading power factor so that the inverter can be commutated using machine voltages. A load commutated, CSI fed self controlled synchronous motor is very well known as a converter motor. It has very good stability characteristics and dynamic behavior similar to a dc motor.

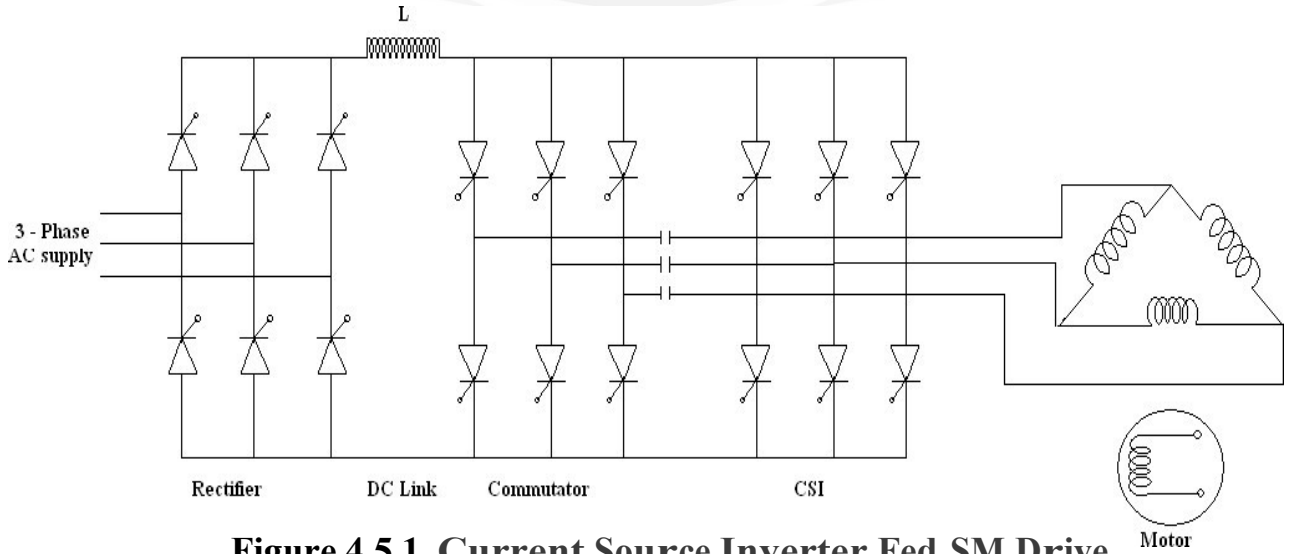

Figure 4.5.1 Current Source Inverter Fed SM Drive

(Source:"Fundamentals of Electrical Drives" by G.K.Dubey,page-211)

Due to machine commutation the working speed range starts typically above 10% of base speed and extends up to base speed. By using (assisted) forced commutation the lower speed limit can be extended to zero. During the operation in the speed range from 0 to 10% of base speed (above which load commutation is possible) the machine can be operated at UPF.

When fed from a CSI, the synchronous motor is supplied with currents of variable frequency and variable amplitude. The dc link current is allowed to flow through the phases of the motor alternately. The motor currents are quasi-square wave if the commutation is instantaneous. The motor behaviour is very much affected by the square wave currents. The harmonics present in the stator current cause additional losses and heating. They also cause torque pulsations, which are objectionable at low speeds. A Current Source Inverter Fed Synchronous Motor Drive is inherently capable of regeneration. No additional converter is required, and four quadrant operation is simple and straight forward.

Due to over excitation the machine power factor is leading. The motor is utilised less. The phase control on the line side converter for current control in the dc link causes the power factor to become poor at retarded angles of firing. The cost of the inverter is medium, due to absence of commutation circuit. The drive has moderately good efficiency and is popular as CLM in medium to high power range. Voltage spikes during commutation occur in the terminal voltage. These depend on the sub transient leakage reactance and affect the insulation of the motor also. The motor must have damper windings to limit the Voltage spikes. Application of this type of drive is in gas turbine starting, pumped hydro turbine starting, pump and blower drives, etc.