Speed Control of DC & AC Motor by Chopper

Speed Control of Slip Ring Induction Motor

- The speed control of the slip ring induction motor by chopper is shown in the figure A.
- The ON and OFF time of chopper is adjusted in order to get desirable speed of the motor.
- The three phase rectifier converts AC into DC.
- The copper losses are very high due to high content of harmonics at the output of the rectifier.

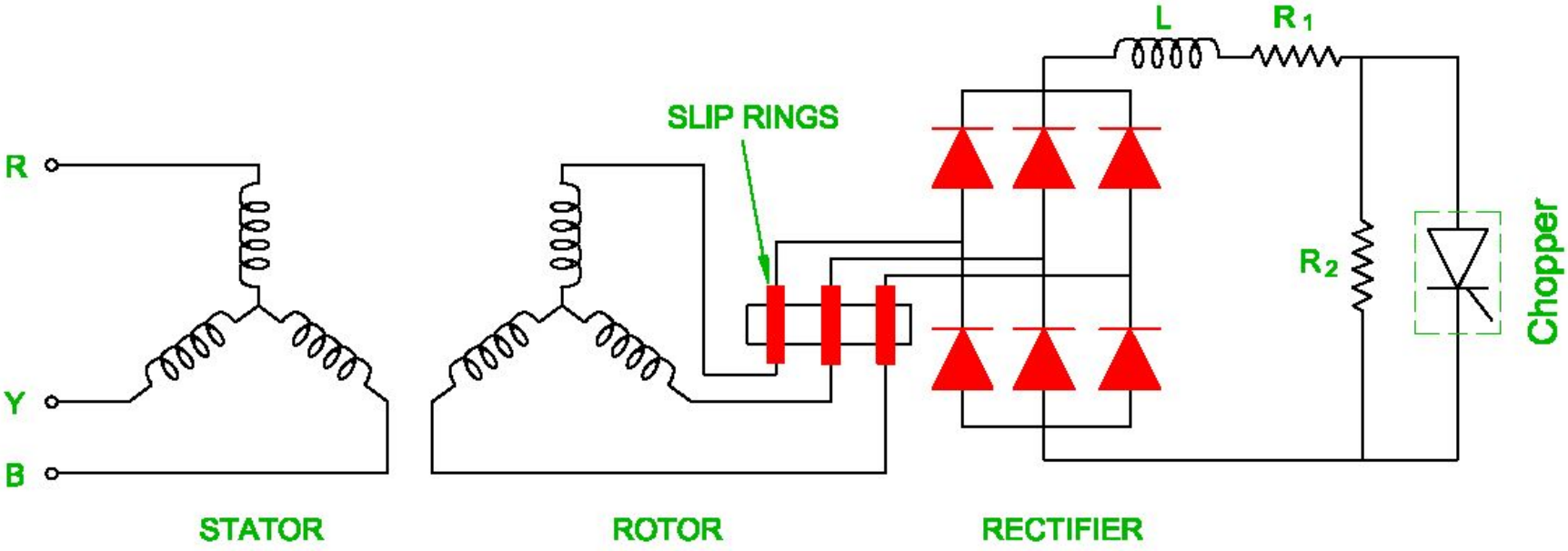

FIG A : SPEED CONTROL OF THE SLIP RING INDUCTION MOTOR BY CHOPPER

- The function of the inductor is to reduce ripple at the output of the rectifier.
- When chopper CH is ON, the resistance R_2 is short circuited.
- Similarly when the chopper CH is OFF, the external resistance is equal to $R_1 + R_2$.
- The average external resistance can vary by switching chopper.

Effective external resistance =

$$R_1 (T_{ON}) + (R_1 + R_2)(T_{ON} + T_{OFF}) / (T_{ON} + T_{OFF})$$

- The speed of the slip ring induction motor depends upon rotor resistance.
- The high speed operation of motor is obtained by low rotor resistance and vice versa.
- The speed of the motor can be changed by ON – OFF control of chopper.
- The transistor is used as switching device for low power, GTO for medium power and SCR for high power requirement in the chopper circuit.

Speed Control of DC Motor by DC Chopper

- The speed control of DC series motor by using chopper is shown in the figure A.
- This speed control is achieved through constant frequency control or variable frequency control.
- When chopper CH is switched on, the DC motor gets input supply voltage V_{dc}.
- The DC motor does not get any voltage when chopper CH is switched off.

- The load current completes its path through freewheeling diode or we can say that stored energy of inductor dissipates in the freewheeling diode during chopper turn off time.
- The average output voltage across load is

$$V_O = [\, T_{ON} / (T_{ON} + T_{OFF}) \,] V_{dc}$$

$$= (T_{ON} / T) V_{dc}$$

$$V_O = K V_{dc}$$

- The voltage across load can be adjusted to any value by switching chopper with suitable time interval.

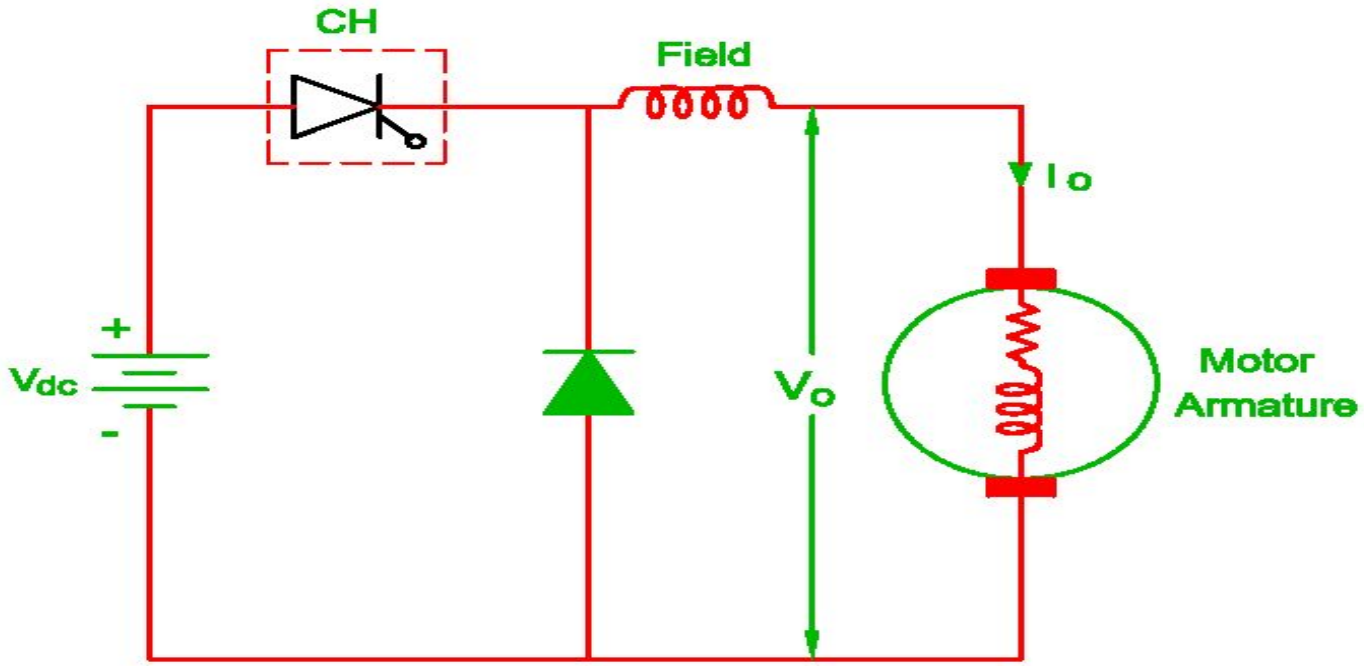

FIG A : SPEED CONTROL OF THE DC SERIES MOTOR

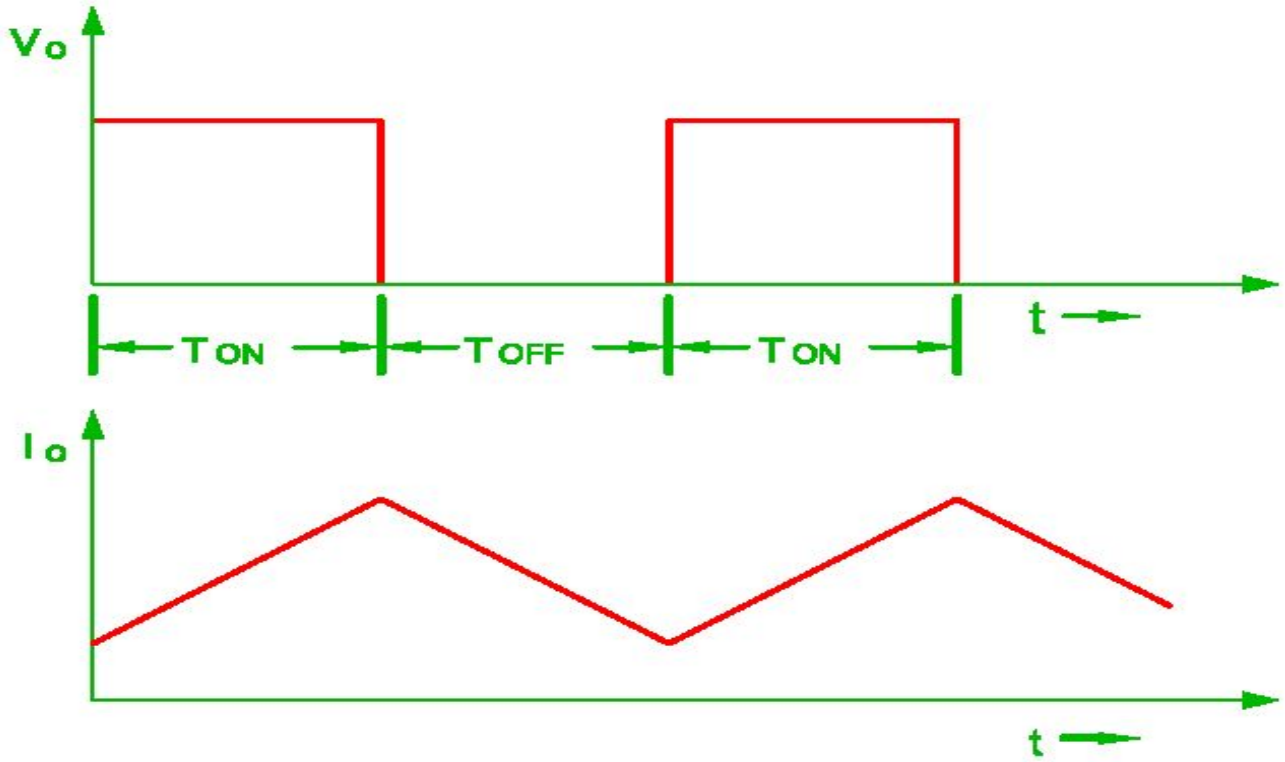

FIG B : VOLTAGE AND CURRENT WAVEFORMS

Salient Features of Chopper Speed Control

- Smooth speed control
- Fast response
- Wide range of control
- High power at lower speed range