4.4 Six Pulse Converter

THREE PHASE FULL CONVERTER

Three phase full converter is a fully controlled bridge controlled rectifier using six thyristors connected in the form of a full wave bridge configuration. All the six thyristors are controlled switches which are turned on at a appropriate times by applying suitable gate trigger signals.

FEATURES OF 3-PHASE CONTROLLED RECTIFIERS ARE

- They provide higher dc output voltage and higher dc output power.
- Higher output voltage ripple frequency.
- Three phase controlled rectifiers are extensively used in high power variable speed industrial dc drives.

Three phase fully controlled bridge converter

The three phase fully controlled bridge converter has been probably the most widely used power electronic converter in the medium to high power applications. Three phase circuits are preferable when large power is involved. The controlled rectifier can provide controllable out put dc voltage in a single unit instead of a three phase autotransformer and a diode bridge rectifier. The controlled rectifier is obtained by replacing the diodes of the uncontrolled rectifier with thyristors. Control over the output dc voltage is obtained by controlling the conduction interval of each thyristor. This method is known as phase control and converters are also

called “phase controlled converters”. Since thyristors can block voltage in both directions it is possible to reverse the polarity of the output dc voltage and hence feed power back to the ac supply from the dc side. Under such condition the converter is said to be operating in the “inverting mode”. The thyristors in the converter circuit are commutated with the help of the supply voltage in the rectifying mode of operation and are known as “Line commutated converter”. The same circuit while operating in the inverter mode requires load side counter emf. for commutation and are referred to as the “Load commutated inverter”.

A three phase fully controlled converter is obtained by replacing all the six diodes of an uncontrolled converter by six thyristors as shown in Fig.

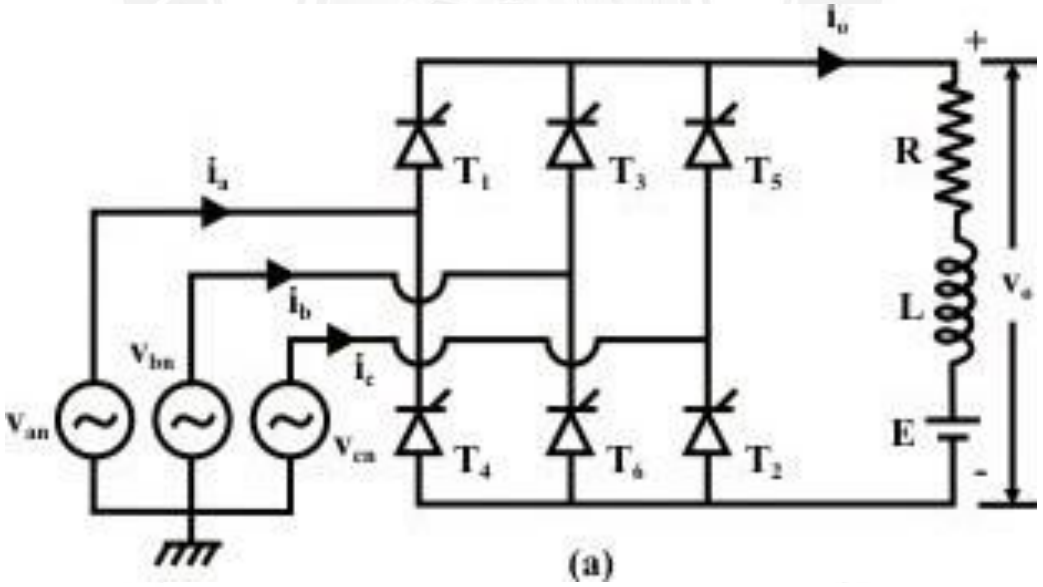

Figure 4.4.1 Six pulse converter

[Source: “Power Electronics” *by* P.S.Bimbra, Khanna Publishers *Page: 210]*

- The three thyristors (T1 ,T3 andT5) will not work together at the same time or two of them also will not work together at the same time.

- The three thyristors (T2 ,T4 andT6) will not work together at the same time or two of them also will not work together at the same time.
- (T1 and T4), (T3 and T6) or (T5 and T2) will not work together at the same time.
- Each thyristor is triggered at an interval of 2pi / 3.
- Each thyristors pair ((T6&T1), (T1&T2), (T2&T3), (T3&T4), (T4&T5), (T5&T6)) is triggered at an interval of pi / 3.
- The frequency of output ripple voltage is 6fS.

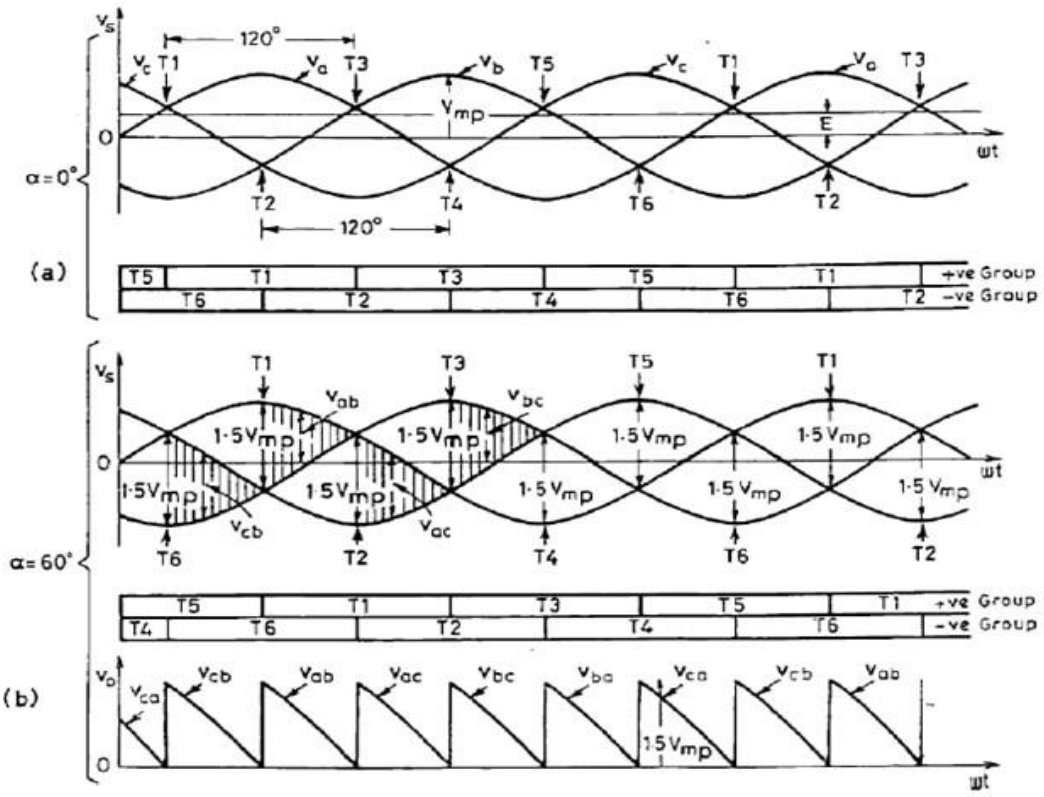

Figure 4.4.2 Six pulse converter Waveforms

[Source: "Power Electronics" *by* P.S.Bimbra, Khanna Publishers *Page: 211]*

- If T1 is triggered at (30 + α), T3 will be triggered at (30 + α+120) and T5 will be triggered at (30 +α+240). T4 will be triggered at (30 + α+180), T6 will be triggered at (30 + α+120+180) and T2 will be triggered at (30 +α +240+180).

Firing Angle	T1	T2	T3	T4	T5	T6
0˚	30˚	90˚	150˚	210˚	270˚	330˚
30˚	60˚	120˚	180˚	240˚	300˚	360˚
60˚	90˚	150˚	210˚	270˚	330˚	390˚
90˚	120˚	180˚	240˚	300˚	360˚	420˚

Three phase full converter – triggering angles of thyristor

At ωt = 30˚+α, thyristor T6 is already conducting when the thyristor T 1is turned on by applying the gating signal to the gate of T 1. During the time period to ωt =30+α to 90˚+α thyristors T 1and T 6 conduct together and the line to line supply voltage Vab appears across the load. At ωt = 90 ˚+α , the thyristor T2 is triggered and T6 is reverse biased immediately and T6 turns off due to natural commutation. During the time period ωt = 90˚+α to 150˚+α , thyristor T1 and T2 conduct together and the line to line supply voltage V ac appears across the load. The thyristors are numbered in the circuit diagram corresponding to the order in which they are triggered.