RECTIFIER

Concept of Phase Angle Control

As we know that SCR is 3 terminal devices i.e. Anode, Cathode & Gate. To turn it 'ON' by the gate at some angle with respect to the applied voltage, this firing angle is measured with respect to the givenreference at which the firing pulses are applied to the thyristor gates. The reference point is the point at which the application of the gate pulses results in the maximum mean positive DC-terminal voltage of which the converter is capable i.e. a firing angle of 0˚ corresponds to the conditions when each thyristor in the circuit is fired at the instant its anode voltage becomes at positive in each cycle, under this condition, therefore, the converter operates in exactly the same manner as it was an uncontrolled rectifier circuit. The symbol 'α' is known as firing angle. Hence the most common method to turn ON the thyristor is achieved by varying the firing angle of the thyristor. This method of thyristor control is known as phase angle control. This method is very efficient for the controlling the average power to the load such as lamps, heaters, motors, dc transmission.

Single Phase Mid-Point Full Wave Rectifier With R Load: The circuit diagram of a single-phase full-wave converter using center-tapped transformer is shown in fig. When terminal 'P' of the transformer is positive with respect to terminal 'Q' in the positive half cycle of the supply , and if thyristor T_1 is fired at $\omega t = \alpha$, current flows from terminal 'P' through thyristor T_1, the load resistance R and back to the center-tap of the transformer. This current continues to flow up to 180˚and when the input voltage changes its polarity, the thyristor T1 goes from the ONstate to the OFF-state. In the negative half-cycle, when terminal 'Q' is positive w.r.t. Terminal 'P', if thyristor T_2 is fired at $\omega t = (\pi + \alpha)$, current flows through the thyristor T_2, the load resistance and back to the center-tap of the transformer. This current continues to flow up to 2π when the thyristor T_2 turns off. Thus, there are two current pulses of the same direction across the load in one complete cycle. Since thyristor T_1 and T_2 are forward biased during the positive and negative half cycles respectively.

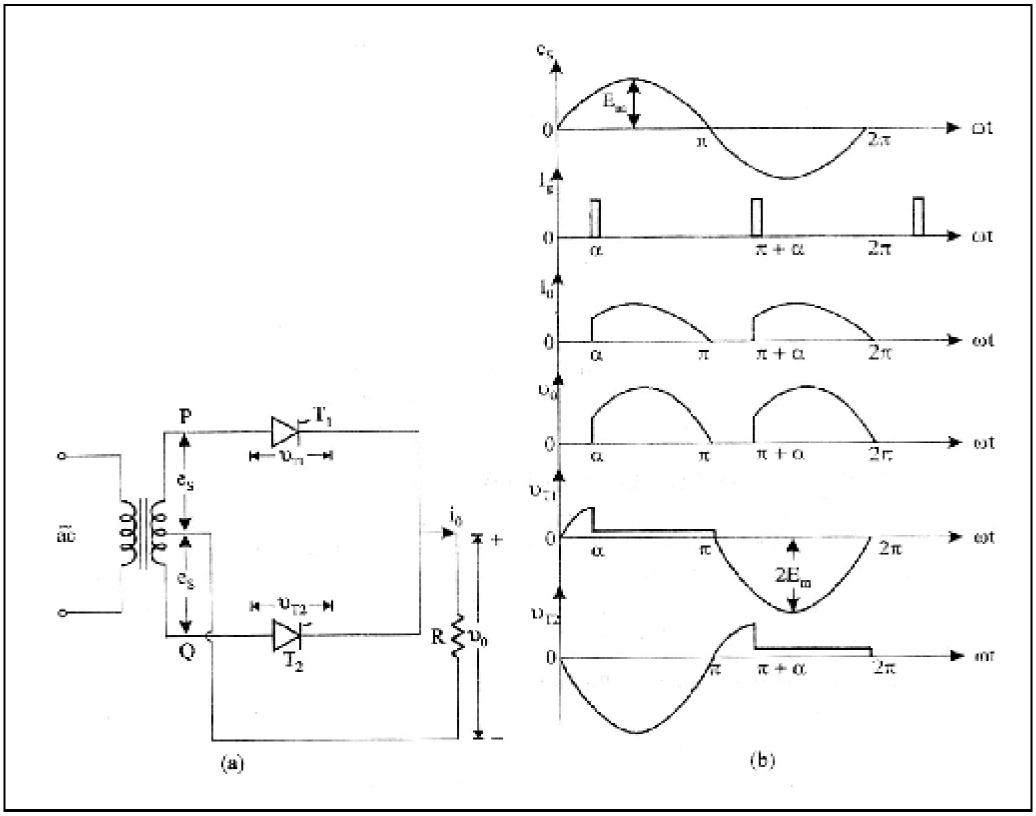


Fig. Single Phase Mid-Point Full Wave Rectifier With R Load

The average dc voltage across load is

$$V_{dc} = E_m (1+\cos \alpha) / \pi \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(4)}$$

The average load current is

$$I_{dc} = E_m (1+\cos \alpha) / \pi R \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(5)}$$

Therefore, the dc output power is

$$P_{dc} = V_{dc} \times I_{dc}$$

(2) Single Phase Mid-Point Full Wave Rectifier With RL Load:

The single phase fully controlled bridge circuit with R-L load is shown in figure.

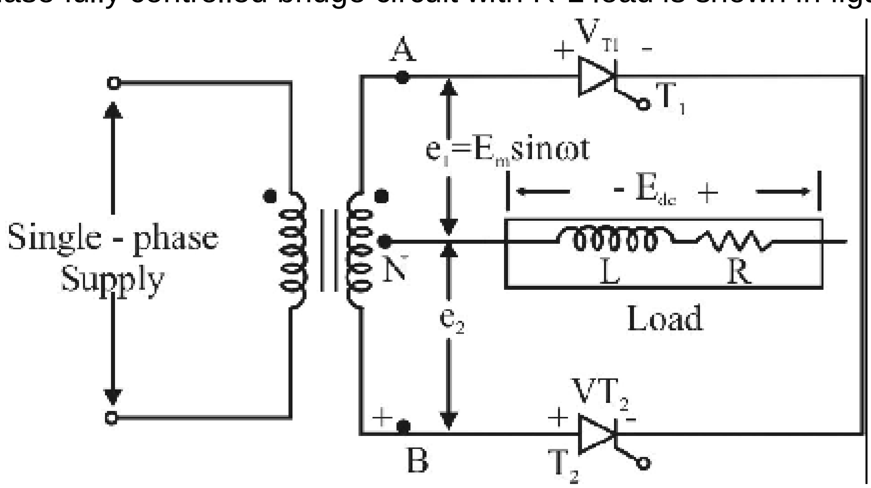
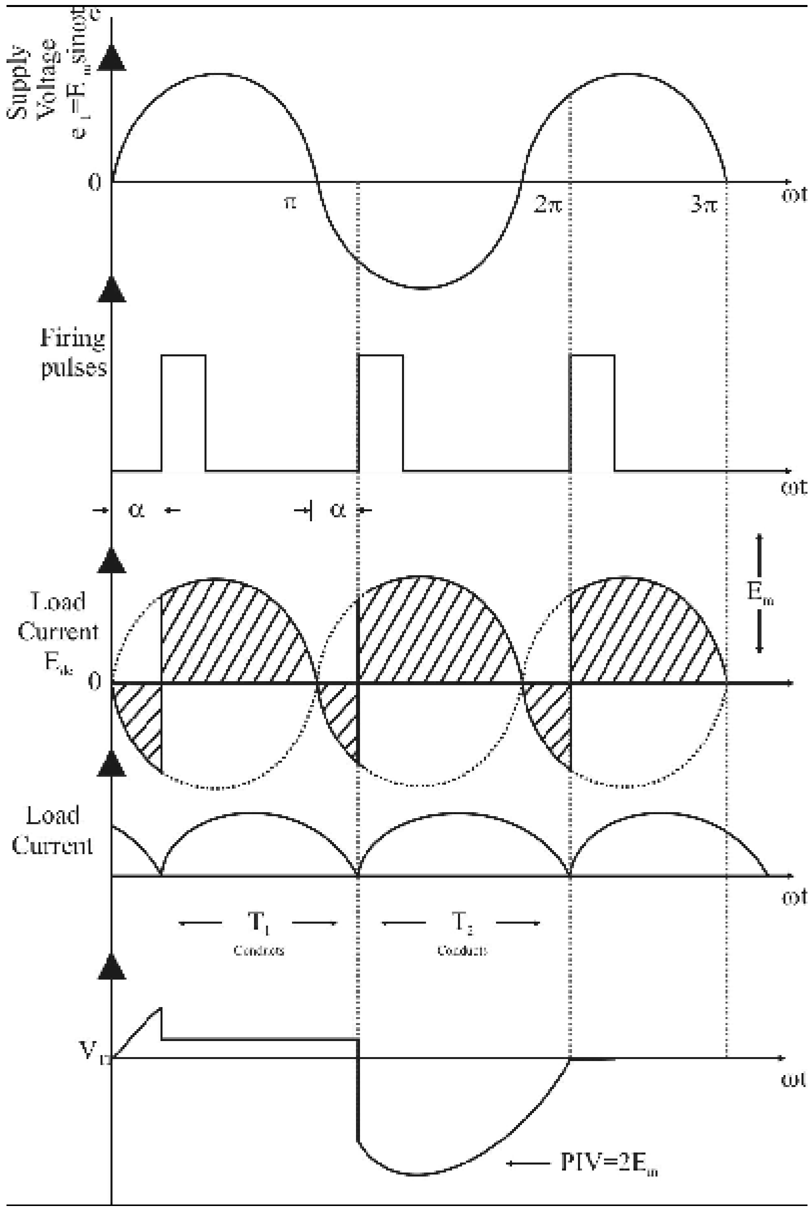


Fig. Single Phase Mid-Point Full Wave Rectifier With RL Load



Waveform

Conduction does not take place until the thyristors are fired in order to current to flow, thyristor T1 and T2 must be fired together as must thyristor T3 and T4 in the next half cycle. To ensuring simultaneous firing both thyristors T1 and T2 are fired from the same firing circuit. Inductance L is used in the circuit to reduce the ripple .A large value of L will result in a continuous steady current in the load .A small value of L will produce a discontinuous load current for large firing angles.

The voltage waveform at the d.c. Terminal comprises a steady d.c. Component on to which is superimposed an a.c. ripple component , having a fundamental frequency equal to twice that of a.c. supply .The input line current has a square waveform of amplitude Id and fundamental component of this waveform is in phase with the input voltage.