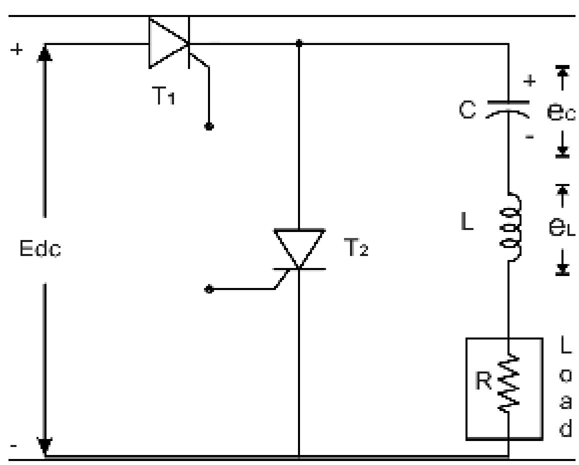
INVERTER

The DC to AC power converters are known as Inverters. An inverter is a circuit, which converts a dc power into an ac power at desired output voltage and frequency. The ac output voltage could be fixed or variable frequency. This conversion can be achieved either by controlled turn on and turn off devices (e.g. BJT's, MOSFETs, IGBTs, MCTs, SITs, GTOs, and SITHs) or by forced commutated thyristors, depending on applications. The output voltage waveforms of ideal inverter should be sinusoidal. The voltage waveforms of practical inverters are, however, nonsinusoidal and contain certain harmonics. Square wave or quasi-square wave voltages are acceptable for low and medium power applications, and for high power applications low, distorted, sinusoidal waveforms are required. The output frequency of the inverter is determined by the rate at which the semiconductor devices are switched on and off by the inverter control circuitry and consequently, an adjustable frequency ac output is readily provided.

Series Inverter: In this type of inverters, the commutating elements, viz. L and C are connected in series with the load. This constitutes a series R-L-C resonant circuit. If the load is purely resistive, it only has resistance in the circuit. In case of load being inductive or capacitive in nature, its inductance or capacitance part is added to the commutating elements (being in series). This type of thyristorised inverter produces an approximately sinusoidal waveform at a high output frequency, ranging from 200Hz to 100 kHz, and is commonly used in relatively fixed output applications such as ultrasonic generators, induction heating etc., Due to the high switching frequency the size of commutating components is small. The circuit diagram of basic series inverter is shown in Fig.1. Two thyristors T1 and T2 are used to



Basic Series Inverter

produce the two halves (positive and negative respectively) in the output. The commutating elements are connected in series with the load R to form the series R-L-C circuit. The values of L and C are chosen such that they form an under damped circuit.

This is necessary to produce the required oscillations. This condition is fulfilled by selecting L and c such that

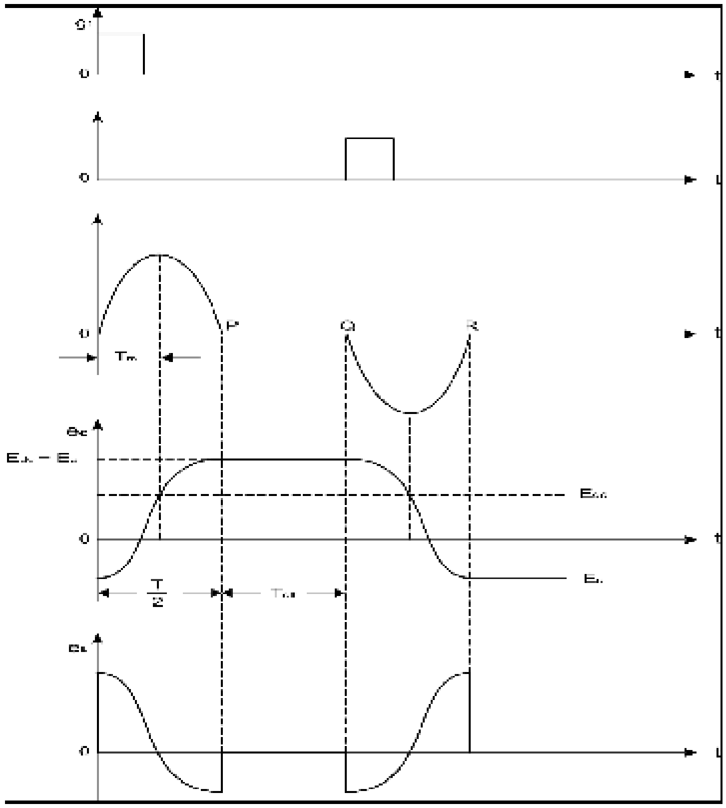
$$R_2 < 4L / C$$

The operation of a basic series inverter circuit can be divided into three operating modes.

Mode 1: This mode begins when a dc voltage is applied to the circuit and thyristor T1 is triggered by giving external pulse to its gate. As soon as SCR T1 is triggered, it starts conducting and resulting in some current to flow through the R-L-C series circuit. Capacitor C gets charged up to the voltage, Ec, with positive polarity on its left plate and negative polarity on its right plate. The load current is of alternating in nature. This is due to the under damped circuit formed by the commutating elements. It starts building up in the positive half and goes gradually to its peak value, then starts returning and again becomes zero as shown in Fig.2. When the current reaches its peak-value the voltage across the capacitor is approximately the supply voltage Edc. After this the current starts decreasing but the capacitor voltage still increases and finally the current becomes zero and but the capacitor retains the highest voltage i.e ($E_{dc} + E_c$), where E_c is the initial voltage across the capacitor at the instant SCR T1 was turned-on. At P, SCR T1 is automatically turned off because the current flowing through it becomes zero.

Mode 2: During this mode, the load current remains at zero for a sufficient time (T_{off}).therefore both the thyristors T1 and T2 are off. During this period PQ capacitance voltage will be held constant.

Mode 3: Since the positive polarity of the capacitor C appears on the anode of SCR T2, it is in conducting mode and hence triggers immediately. At Q, SCR T2 is triggered. When SCR T2 starts conducting, capacitor C gets discharged through it. Thus, the current through the load flows in the opposite direction forming the negative alteration. This current builds up to the negative maximum and then decreases to zero at the point R.SCR T2 will then be turned off. Now the capacitor voltage reverses to some value depending upon the values of R, L and C. Again after some time delay (T_{off}), SCR T1 is triggered and in the same fashion other cycles are produced. This is a chain of process giving rise to alternating output almost sinusoidal in nature and the dc source is intermittent in nature. Positive alteration of the ac output is drawn from the dc input source, whereas for the negative alteration the current is drawn from the capacitor.



Voltage and current waveforms

SCR is triggered. If this is not done, both the SCRs will start conducting simultaneously resulting in a short circuit of the dc input source. This time delay (T_{off}) must be more than the turn off time of the SCRs. The output frequency is given by

F= 1/((T/2)+ T_{off}) Hz

Where T is the time period of oscillations and is given by

$$T \quad \frac{\pi}{2} = \sqrt{\left(\frac{1}{LC} - \frac{R^2}{4L^2}\right)}$$

and T_{off} is the time-delay between turn-off of one SCR and turn-on of the other SCR. Thus, by changing the value of T_{off}, frequency can be changed without changing the commutating elements.