INVERTERS - CHARACTERISTICS OF SINUSOIDAL AC POWER

Voltage, current, power factor, types of loads

The voltage waveform of 120 VAC, 60 Hz mains / utility power is like a sine wave. In a voltage with a sine wave-form, the instantaneous value and polarity of the voltage varies with respect to time and the wave-form is like a sine wave. In one cycle, it slowly rises in the positive direction from 0 V to a peak positive value **+ Vpeak** = 170 V, slowly drops to 0 V, changes the polarity to negative direction and slowly increases in the negative direction to a peak negative value **- Vpeak** =170 V and then slowly drops back to 0 V. There are 60 such cycles in 1 sec. Cycles per second is called the "**frequency**" and is also termed "**Hertz (Hz.)**. If a linear load is connected to this type of voltage, the load will draw current which will also have the same sine wave-form. However, the peak value of the current will depend upon the impedance of the load. Also, the phase of the sine wave-form of the current drawn by the linear load may be the same or lead / lag the phase of sine wave-form of the voltage. This phase difference determines the "**Power Factor** (mathematically = the cosine of the phase difference)" of the load. In a **resistive type of load** (like incandescent lamps, heaters etc) the sine wave-form of the current drawn by the load has 0 phase difference with the sine wave-form of the voltage of the AC power source. The Power Factor of a resistive load is unity (1). **The rated output power (in Watts) of the inverters is normally specified for resistive type of loads that have unity (1) Power Factor.** In a **reactive type of load** (like electric motor driven loads, fluorescent lights, computers, audio / video equipment etc), the phase of the sine wave-form of the current drawn by the load may lead or lag the sine wave-form of the AC voltage source. In this case, the power factor of reactive loads is lower than unity (1) – generally between 0.8 and 0.6. **A reactive load reduces the effective wattage that can be delivered by an AC power source**

RMS and peak values

As explained above, in a sine wave, the instantaneous values of AC voltage **(Volt, V)** and current **(Ampere, A)** vary with time. Two values are commonly used – Root Mean Square **(RMS)** value and peak value. For simplicity, RMS value can be considered as an average value. **Mathematically, Peak Value = 1.414 x RMS value.** For example, the 120 VAC, 60 Hz. mains / utility power is the RMS value. The peak value corresponding to this is = 1.414 x 120 = 170V.

The values of the rated output voltage and current of an AC power source are their RMS values

AC power – Watts / VA

The power rating of an AC power source is designated in Volt Amperes (VA) or in Watts (W)

Power in Volt Amperes (VA) = RMS Volts (V) x RMS Amps (A)

Power in Watts = RMS Volts (V) x RMS Amps (A) x Power Factor

NOTE : The rated power of the inverter in Watts (W) is normally designated for a linear, resistive type of load that draws linear current at unity (1) power factor. If the load is linear and reactive type, the rated power of the inverter in watts will be limited to its normal rated power in watts (W) x Power Factor. For example, an inverter rated for 1000 W (at unity power factor) will be able to deliver only 600 watts to a reactive type of load with a power factor of 0.6