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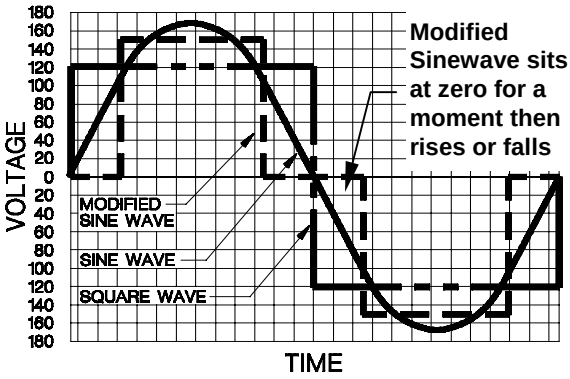
Modified Sinewave and Sinewave Waveforms

Unfortunately, in the world of alternating current electricity, not all waveforms are created equal. When we talk about waveforms, what we are interested in is the shape of the wave that an AC signal traces with relation to time.

The three most common outputs for inverters are square wave, modified sinewave (sometimes called a quasi sinewave), and sinewave outputs. In this paper, we will look at these waveforms, and how different types of loads behave when operating from them.

In the figure below is a graph representing the three different types of waveforms.



Notice that as time progresses from left to right, the three different waveforms rise at different rates. For example, the sinewave smoothly increases to its peak and smoothly decreases. Modified sinewave and square waves shoot straight up, level off at peak voltage, and then drop straight down. The modified sinewave also sits at zero for a short period. This is the main difference between it and the square wave.

Most devices with variable speeds such as electric drills, or devices with chargers such as cordless drills or screwdrivers, can behave irrationally when operating with modified sine or square wave inverters.

These types of units use one of two types of solid state “switches” in them, SCR’s (Silicon Controlled Rectifiers) or Triac’s.

The basic theory is that a timing circuit looks at the point where the waveform crosses zero volts and uses this point as a reference to start its clock. On a drill for example, depending on how much the trigger has been moved, a certain amount of electricity will be allowed through based on this time. Think of it as a water wheel that has been mounted under a faucet that you control. If the water always comes out in smooth rising and falling surges, you could count when the surge hit zero pressure and then by delaying how much of each surge gets to the wheel you can control its speed. If you let the entire surge from zero up to peak pressure and back to zero pressure through the faucet, the wheel will spin the fastest. If you only let the portion of the surge from zero pressure through peak pressure through the faucet, the wheel will run about half speed.

If there was no way to time this process it would be impossible to know exactly when to turn the faucet on and off to achieve a desired speed.

Since a sinewave has a sloped “zero crossing” (the point where the voltage passes through zero volts), the timing circuit will work. It knows when to turn the switch on or off. However, if the wave passes through zero too fast or sits at zero for a period of time, the timer gets confused. It doesn’t know where zero is. The reason is that it looks for the rate of change or the slope of the zero crossing point. A modified sine or square wave has no slope. Therefore, the timing circuit can’t figure out when to let power through and when not to. Since the timer never starts, no power passes through to the device at all. When the trigger on the drill is pulled all the way to high speed, the whole SCR and timer circuit is bypassed and the drill runs at full speed. This explains why all or none is available in some drills. Others will run erratically and won’t be variable.

Battery chargers experience the same problems. The Triacs (Switches) don’t know when to let electricity through since they can’t find the zero crossing. Therefore, inadequate (if any) charging will take place. Some chargers will react

opposite and allow full power through, possibly overheating them.

Small wall based chargers (called wall warts) will often have overheating problems with modified sine or square wave inputs.

Some computers and stereo equipment use switching power supplies that utilize SCR's and Triacs as well. These pieces of equipment may experience the same troubles as in the examples given previously.

Unfortunately, it is hard to predict what exact models of equipment will have problems with modified sinewave and square waveforms. The only way to know for sure is to try it. If it doesn't work, take it back and try another!