



GE Consumer & Industrial Digital Energy

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UPS Waveform Outputs

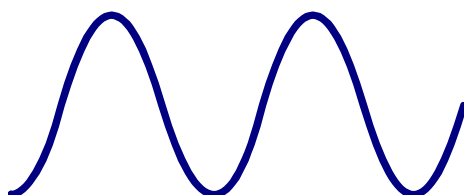
A consideration that is important in UPS applications is the *output waveform* of the UPS.

This refers to the shape of the alternating current produced by the UPS.

The quality and cost of the output inverter that is within the UPS is the primary determinant of the shape of the AC signal that is produced by most UPS's, especially ones on the lower end (Stand-by or Off-Line units).

The ideal situation is for the UPS to produce a clean output waveform that is close to what would be produced by the electrical utility, but this is not always the case.

We All Want the Perfect Wave !

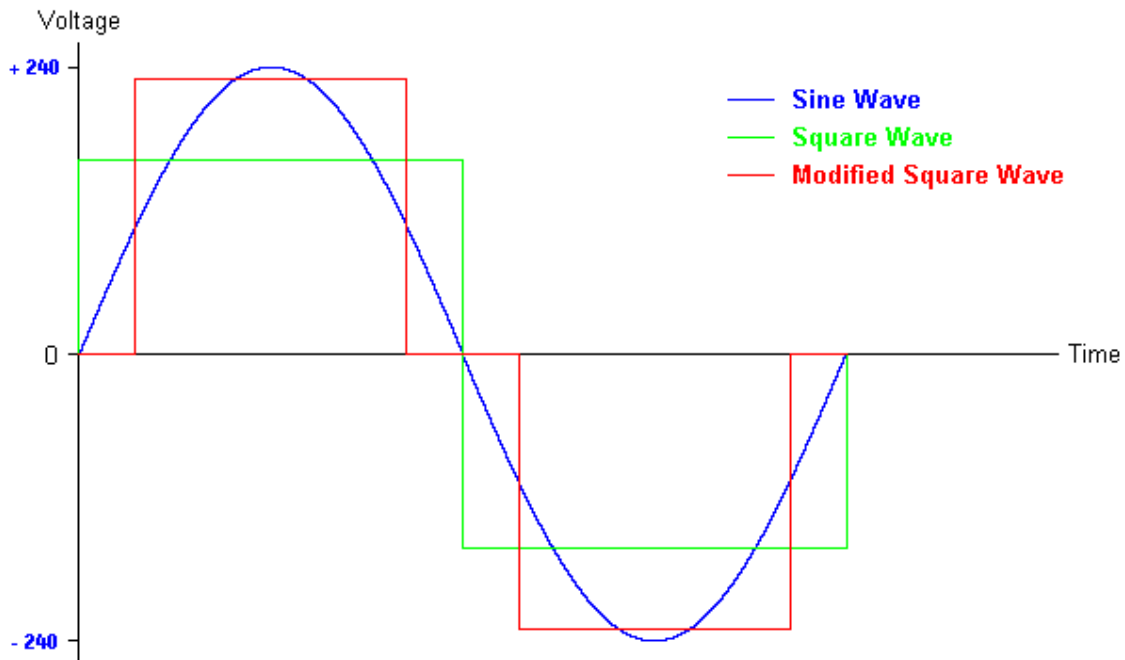


Pure Sinewave 50/60Hertz

There are three main waveform types produced by GE Digital Energy UPS's:

- **Sine Wave:** This is the best waveform, as it is the shape of an (ideal) AC electrical signal from the wall. The highest-quality UPS produce a true sine wave output, such as the Match, NetPro, LanPro, SitePro and SG Series - which require fairly expensive components in the inverter. This is especially important for online UPS's, (NetPro, LanPro, SitePro and SG Series) since their loads are always running off the inverter. True sine wave UPS's are normally found only in higher-end models.
- **Square Wave:** The least desirable output waveform type, a square wave is sort of a "flattened-out" version of a sine wave. Instead of the voltage smoothly increasing from the negative maximum to the positive maximum and back again, it shifts suddenly from negative to positive, stays there for half a cycle, and then jumps to full negative and stays there for half a cycle, then repeats. Cheaper inverters are designed produce a square wave output primarily because the components required to do this are cheap. It is not common that some electrical equipment doesn't really like running on a square wave. There are several reasons why square waves cause problems. For example, the peak voltage of a square wave is lower than the peak voltage of a sine wave, which causes issues with some types of equipment.

A sine wave has a single frequency in it--50 Hz in Australia & New Zealand--a square wave contains many higher frequencies as well, called *harmonics*, which can cause buzzing or other problems with some equipment. Square wave output is found only in the cheapest equipment and should be avoided if possible.



- **Modified Square Wave:** This waveform is a compromise between the sine wave and the square wave. The positive and negative pulses of the square wave are thinned, separated and made taller, so the peak voltage is much closer to that of a sine wave, and the overall shape of the wave more closely resembles that of a sine wave.

At the same time, the cost of the circuitry to produce a modified square wave output is much closer to the cost of a square wave's circuitry than that of a sine wave unit. (In fact, you can create a modified square wave by adding together two square waves that are shifted in phase slightly from each other.)

Many fewer pieces of equipment have problems with modified square wave power than with straight square wave. Modified square wave output is used on many lower- to middle-range UPS's such as ML and Match Series - and is also sometimes called "stepped sine wave", "pulse-width modified square wave", or even "modified sine wave".

In our terms, for a home PC UPS modified square wave output is fine (ML or Match) - It will power a PC, monitor and similar equipment without any trouble.

Selecting the level of UPS Protection

GE Digital Energy's approach to resolving the most common power problems is very simple; GE offers our customers the "next level of protection" - meaning we do not offer cheap Off-Line UPS products that only detect Power Failure, Power Sag, and Power Surge.

Our product technology and protection level starts with Line Interactive technology for the same low cost as Off-Line UPS devices.

| <i>UPS Series / Name</i> | <i>VA Range</i> | <i>Protection Against</i> | <i>UPS Topology</i> |
|---|-----------------|--|---|
| No Offer by GE. See below, GE offers "next level of protection" | N/A | Power Sag Power Fail Power Surge | Off Line / Standby |
| ML Series | 350 – 1000VA | Power Sag Power Fail Power Surge Under-voltage Over-voltage | Line Interactive - Tower |
| Match Series | 500 – 3000VA | Power Sag Power Fail Power Surge Under-voltage Over-voltage | Line Interactive - Tower or Rack |
| EP Series | 700 – 6000VA | Power Sag Power Fail Power Surge Under-voltage Over-voltage Line Noise Harmonic Distortion Frequency Variations Switching Transients | True-On-Line Double Conversion - Tower or Rack - Long Run Time |
| VH Series | 700 – 3000VA | Power Sag Power Fail Power Surge Under-voltage Over-voltage Line Noise Harmonic Distortion Frequency Variations Switching Transients | True-On-Line Double Conversion - Static Bypass - Rack / Tower - 2U High |
| LanPro Series | 3000 – 10000VA | Power Sag Power Fail Power Surge Under-voltage Over-voltage Line Noise Harmonic Distortion Frequency Variations Switching Transients | True-On-Line Double Conversion - Transformer Type |