

## INVERTERS - GENERAL INFORMATION

### **Why an inverter is needed**

The utility grid supplies you with alternating current (AC) electricity. AC is the standard form of electricity for anything that “plugs in” to the utility power. Direct current (DC) electricity flows in a single direction. Batteries provide DC electricity. AC alternates its direction many times per second. AC is used for grid service because it is more practical for long distance transmission.

An inverter converts DC to AC, and also changes the voltage. In other words, it is a power adapter. It allows a battery-based system to run conventional AC appliances directly or through conventional home wiring. There are ways to use DC directly, but for a modern lifestyle, you will need an inverter for the vast majority, if not all of your loads (**in electrical terms, “loads” are devices that use electrical energy**).

Incidentally, there is another type of inverter called grid-interactive. It is used to feed solar (or other renewable) energy into a grid-connected home and to feed excess energy back into the utility grid. This inverter is **NOT grid interactive**

### **Inverter should meet the application**

To choose an inverter; you should first define your needs. Where is the inverter to be used? Inverters are available for use in buildings (including homes), for recreational vehicles, boats, and portable applications. Will it be connected to the utility grid in some way? Electrical conventions and safety standards differ for various applications, so don't improvise.

### **Electrical Standards**

The DC input voltage must conform to that of the electrical system and battery bank. 12 volts is recommended for small, simple systems. 24 and 48 volts are the common standards for higher capacities. A higher voltage system carries less current, which makes the system wiring cheaper and easier.

The inverter's AC output must conform to the conventional power in the region in order to run locally available appliances. The standard for AC utility service in North America is 120 and 240 Volts at a frequency of 60 Hertz (cycles per second). In Europe, South America, and most other places, it is 230 volts at 50 Hertz.

### **Power capacity – “Continuous” and “Surge”**

How much load can an inverter handle? Its power output is rated in Watts. Read details under **“Characteristics of Sinusoidal AC Power” on page 7**. There are two levels of power rating -a **continuous rating** and a **surge rating**. Continuous means the amount of power the inverter can handle for an indefinite period of hours. When an inverter is rated at a certain number of Watts, that number generally refers to its continuous rating. The **“surge power”** indicates the power to handle instantaneous overload of a few seconds to provide the higher power required to start certain type of devices and appliances.

**Loads that require “surge power” to start**

Resistive types of loads (like incandescent lamps, toaster, coffee maker, electric range, iron etc) do not require extra power to start. Their starting power is the same as their running power.

Some loads like induction motors and high inertia motor driven devices will initially require a very large starting or “surge” power to start from rest. Once they have started moving and have attained their rated speed, their power requirement reduces to their normal running power. The surge may last up to 5 seconds.

TVs and microwave ovens also require surge power for starting. The manufacturers’ specification of the appliances and devices indicates only the running power required. The surge power required has to be guessed at best. See below under “Sizing of inverter for loads that require starting surge”

If an inverter cannot efficiently feed the surge power, it may simply shut down instead of starting the device. If the inverter’s surge capacity is marginal, its output voltage will dip during the surge. This can cause a dimming of the lights in the house, and will sometimes crash a computer.

Any weakness in the battery and cabling to the inverter will further limit its ability to start a motor. A battery bank that is undersized, in poor condition, or has corroded connections, can be a weak link in the power chain. The inverter cables and the battery interconnect cables must be sized properly. The spike of DC current through these cables is many hundreds of amps at the instant of motor starting.

**Sizing of inverter for loads that require starting surge**

Observe the following guideline to determine the continuous wattage of the inverter for powering loads that require starting surge. (Multiply the running watts of the device/appliance by the Surge Factor)

**\*NOTE: The surge power rating specified for this inverter is valid for duration of less than 1 second. This very short duration may not be sufficient to start motor based loads which may require up to 5 seconds to complete starting process. Hence, for purposes of sizing the inverter, use only the continuous power rating of this inverter.**

<u>Type of Device or Appliance</u>	<u>Surge Factor for Determining the Continuous *Wattage of the Inverter</u> <u>(No. of times the running power rating of the device/appliance)</u>
Refrigerator / Freezer	5
Air Compressors	4
Dishwasher	3
Automatic Washer	3
Sump pump	3
Furnace fans	3
Industrial motors	3
Portable kerosene / diesel fuel heater	2
Circular saw	3
Bench Grinder	3

**Power rating of Microwaves**

The power rating of the microwave generally refers to the cooking power. The electrical power consumed by the microwave will be approximately 2 times the cooking power. The “surge power” of the inverter should be 2 times the electrical power (i.e., 4 times the cooking power). Please note that the surge power of the microwave is not as long as the motor load and hence, the surge power of the inverter can be considered to determine adequacy of meeting the starting surge power

**Powering a water supply pump**

A water well or pressure pump often places the greatest demand on the inverter. It warrants special consideration. Most pumps draw a very high surge of current during start up. The inverter must have sufficient surge capacity to handle it while running any other loads that may be on. It is important to size an inverter sufficiently, especially to handle the starting surge (If the exact starting rating is not available, the starting surge can be taken as 3 times the normal running rating of the pump). Oversize it still further if you want it to start the pump without causing lights to dim or blink.

In North America, most pumps (especially submersibles) run on 240 VAC, while smaller appliances and lights use 120 VAC. To obtain 240 VAC from a 120 VAC inverter, use a 120 VAC to 240 VAC transformer. If you do not already have a pump installed, you can get a 120 volt pump if you don't need more than 1/2 HP.

**Idle power**

Idle power is the consumption of the inverter when it is on, but no loads are running. It is “wasted” power, so if you expect the inverter to be on for many hours during which there is very little load (as in most residential situations), you want this to be as low as possible.

**Phantom and idling loads**

Most of the modern gadgets draw some power whenever they are plugged in. Some of them use power to do nothing at all. An example is a TV with a remote control. Its electric eye system is on day and night, watching for your signal to turn the screen on. Every appliance with an external wall-plug transformer uses power even when the appliance is turned off. These little loads are called “phantom loads” because their power draw is unexpected, unseen, and easily forgotten.

A similar concern is “idling loads.” These are devices that must be on all the time in order to function when needed. These include smoke detectors, alarm systems, motion detector lights, fax machines, and answering machines. Central heating systems have a transformer in their thermostat circuit that stays on all the time. Cordless (rechargeable) appliances draw power even after their batteries reach a full charge. If in doubt, feel the device. If it's warm, that indicates wasted energy.