

OutBack FX



Xantrex SW Plus



Samlex PST

# Off-Grid Inverter Efficiency

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Exeltech XP



SMA America  
Sunny Island

An inverter converts the DC electricity produced by a renewable energy (RE) system into 120- or 240-volt AC electricity for use by your home's appliances. It is the essential link between RE resources and actual electricity use, so its overall operating efficiency is of the highest importance. Efficiency characteristics such as peak efficiency, average or typical efficiency, and idle consumption are all variables that contribute to an inverter's overall operating efficiency.

Inverters used in off-grid systems differ from those used in batteryless grid-tie applications. Off-grid inverters are designed to convert stored battery energy to AC. Batteryless inverters are designed to convert DC electricity from solar-electric modules (PVs) directly into grid-synchronous AC. While some inverters are designed for both battery-based off-grid systems and grid-tied solar-electric systems with battery backup, most battery-based inverters are designed for off-grid use only.

## Peak Efficiency

Every inverter has a point of maximum efficiency, a "sweet spot" where it is the most efficient at converting DC into AC. This peak efficiency point is usually between 20 and 30

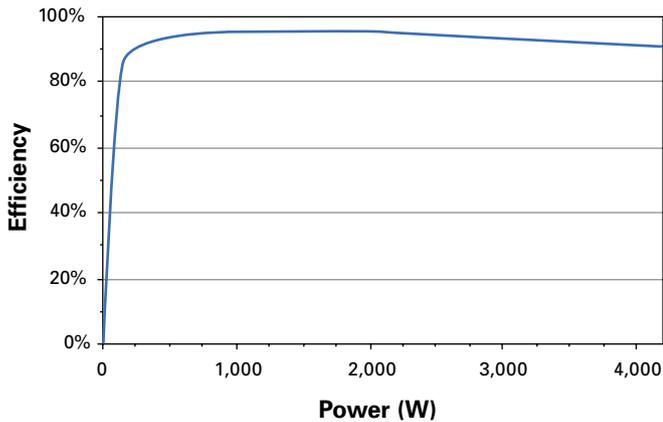
percent of the inverter's maximum rating. For example, an inverter with a 4,000-watt rating will be most efficient when operating between 800 and 1,200 watts.

Typical peak efficiencies vary from about 92 to 96 percent. The power versus efficiency curve (opposite page) shows that a given inverter will have a relatively low conversion efficiency at low power. Conversion efficiency increases as the inverter reaches its peak efficiency point. As power levels rise beyond the inverter's point of peak efficiency, conversion efficiency will remain relatively linear, dropping only a few percent up to its rated power output.

## Average Efficiency

The average or typical efficiency of an off-grid inverter depends on how the system's users operate it. If the inverter is to be the most efficient, most of its operating time should be at or above its sweet spot. In an off-grid system, an inverter operates at a variety of power levels. Sometimes, there is lots of appliance use and the inverter is heavily loaded. At other times, such as at night, only low levels of power are demanded from the inverter.

## Typical Inverter Efficiency Curve



### Idle Consumption

Even during the night with no electricity usage at all, an inverter still consumes some energy. This is called “idle” or “standby” consumption and is generally between 10 and 25 watts. Keeping the inverter idling allows low power appliances, like AC clocks, to run uninterrupted, but can add a significant daily electrical load to small RE systems. An inverter’s idle consumption should be included in your appliance energy use list when sizing your renewable energy system.

### Sleep Mode

In the early days of RE, we used the inverter only when necessary, and inverters had a low power “sleep” mode (typically between 2 and 6 watts) for when no appliances were in use. When the user turned on a load, the inverter would wake up. Sleep mode was only active when there was no demand on the inverter.

These days, there seems to be some appliance using electricity all the time—devices like telephones, fax machines, and answering machines. Thus, the sleep mode is seldom used in modern systems, and the inverter is usually active 24/7.

### Efficiency is Sweet

When buying an off-grid inverter, you need to consider its maximum power and surge ratings, which you will need to power your largest appliance or collection of appliances. But don’t forget to also pay attention to the power point where the inverter will spend most of its operating time. If the bulk of your electricity use is close to or above the inverter’s sweet spot, it will be operating at high efficiency, and you’ll save valuable renewable energy.

### Access

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