

Solar photovoltaic inverter

Solar inverters use maximum power point tracking (MPPT) to get the maximum possible power from the PV array. Solar cells have a complex relationship between solar irradiation, temperature and total resistance that produces a non-linear output efficiency known as the I-V curve. It is the purpose of the MPPT system to sample the output of the cells and determine a resistance (load) to obtain maximum power for any given environmental conditions;

The fill factor, more commonly known by its abbreviation FF, is a parameter which, in conjunction with the open circuit voltage (Voc) and short circuit current (Isc) of the panel, determines the maximum power from a solar cell. Fill factor is defined as the ratio of the maximum power from the solar cell to the product of Voc and Isc;

There are three main types of MPPT algorithms: perturb-and-observe, incremental conductance and constant voltage. The first two methods are often referred to as hill climbing methods; they rely on the curve of power plotted against voltage rising to the left of the maximum power point, and falling on the right;

The key role of the grid-interactive or synchronous inverters or simply the grid-tie inverter (GTI) is to synchronize the phase, voltage, and frequency of the power line with that of the grid. Solar grid-tie inverters are designed to quickly disconnect from the grid if the utility grid goes down. This is an NEC requirement that ensures that in the event of a blackout, the grid tie inverter will shut down to prevent the energy it produces from harming any line workers who are sent to fix the power grid.

Grid-tie inverters that are available on the market today use a number of different technologies. The inverters may use the newer high-frequency transformers, conventional low-frequency transformers, or no transformer. Instead of converting direct current directly to 120 or 240 volts AC, high-frequency transformers employ a computerized multi-step process that involves converting the power to high-frequency AC and then back to DC and then to the final AC output voltage;

Many solar inverters are designed to be connected to a utility grid, and will not operate when they do not detect the presence of the grid. They contain special circuitry to precisely match the voltage, frequency and phase of the grid. When a grid is not detected, grid-tie inverters will not produce power to avoid islanding which can cause safety issues.

Advanced solar pumping inverters convert DC voltage from the solar array into AC voltage to drive submersible pumps directly without the need for batteries or other energy storage devices. By utilizing MPPT (maximum power point tracking), solar pumping inverters regulate output frequency to control the speed of the pumps in order to save the pump motor from damage;

Solar pumping inverters usually have multiple ports to allow the input of DC current generated by PV arrays, one port to allow the output of AC voltage, and a further port for input from a water-level sensor.

Conventional alternating current power is a sinusoidal voltage pattern that repeats over a defined period. That means that during a single cycle, the voltage passes through zero two times. In European systems the voltage at the plug has a maximum of 230V and cycles 50 times a second, meaning that there are 100 times a second where the voltage is zero, while North American derived systems are 120V 60Hz, or 120 zero voltages a second.

To address this, solar inverters use some form of energy storage to buffer the panel's power during those zero-crossing periods. When the voltage of the AC goes above the voltage in the storage, it is dumped into the output along with any energy being developed by the panel at that instant. In this way, the energy produced by the panel through the entire cycle is eventually sent into the output.

The problem with this approach is that the amount of energy storage needed when connected to a typical modern solar panel can only economically be provided through the use of electrolytic capacitors. These are relatively inexpensive but have well-known degradation modes that mean they have lifetime expectancy on the order of a decade. This has led to a great debate in the industry over whether or not microinverters are a good idea, because when these capacitors start to fail at the end of their expected life, replacing them will require the panels to be removed, often on the roof.

In comparison to normal household current on two wires, current on the delivery side of the power grid uses three wires and phases. At any given instant, the sum of those three is always positive (or negative). So while any given wire in a three-phase system undergoes zero-crossing events in exactly the same fashion as household current, the system as a whole does not, it simply fluctuates between the maximum and a slightly lower value.

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