Hybrid Inverter with Solar Battery Charging

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Abstract

Inverters are widely used in the domestic as well as industrial environments to serve as second line of source in case of power cut form the electricity utility grids. However, due to low capacity of the battery the inverter dies out with the use of heavy load appliances. This project is designed in such a way that it overcomes this limitation using solar energy. Hybrid Inverter with Solar Battery Charging System consists of an inverter powered by a 12V Battery. This inverter generates up to 110V AC with the help of driver circuitry and a heavy load transformer. This battery gets charged from two sources, first being the mains power supply itself. If the mains power supply is available, the relay switches to the connection using mains power supply to supply to the load. This power supply also charges the battery for using it as back up the next time there is power outage. The use of solar panel to charge the battery gives an additional advantage of surplus power in case the power outage of mains is prolonging. Thus, this inverter can last for longer duration's and provide uninterrupted power supply to the user.

Keyword- Hybrid Inverter, Solar Charger, Battery

I. INTRODUCTION

Using vast experience of designing of such power electronic products embedded with technological excellence from Australia, STATCON offers state-of-art single phase Hybrid Solar Inverter-Cum- charger system. It consists of MPPT PWM Solar Charge Controller with Hybrid Inverter. As per the requirement, the same inverter can supply full DC power for charging of battery through 230V AC mains (wherever available). The Inverter can thus both charge the battery and supply the AC to connected Loads through Grid synchronization. Provision for command to start / stop of DG set also available, in case battery gets discharged beyond certain level. The different control & monitoring options available are: Via the front panel LCD display and membrane key-pad. A structured, software menu-driven system is available for monitoring and setting up the inverter. Via a RS-232 / RS-485 and RJ-45 TCP/IP connection. These connections can be utilized to connect a PC to monitor and configured the inverter locally. The inverter can be connected to a SCADA system through the TCP/IP communication port available.

II. PRINCIPLE

A solar inverter's main job is to convert DC power generated from the array into usable AC power. Hybrid inverters go a step further and work with batteries to store excess power as well. This type of system solves issues renewable energy variability and unreliable grid structures. Inverters for grid-tied applications can only provide power based on what the array can immediately generate from the sun," explained Bryan Whitton, product manager at Darfon. "Hybrid inverters can store power in batteries and then drawn upon it as needed for energy stabilization. Hybrid inverters can vary in size, performance and features. But Mara White, product manager for Out Back Power, said most models usually operate bi-directionally, meaning they can convert DC power from modules to usable AC power and then convert stored AC from the batteries to power loads when needed. "Hybrids can also remain grid-connected and use a mix of renewable and non-renewable energy to charge batteries and offset loads," White added.

Some contractors have used hybrid inverters in the residential, remote home applications for the past decade or two. But Allan Gregg, VP of applications engineering at GreatWall - which manufactures Satcon inverters - said the range of applications has expanded over the past few years to include large capacity microgrids as well as grid-connected systems.

Historically, hybrid inverters have been used more frequently in developing countries that do not have access to a reliable power grid.

In North America and Europe, hybrid inverter-based systems are usually elective, White explained. Users choose to use them for storing energy for self-consumption or provide back-up power during emergencies. But in the developing world, hybrids are more of a necessity to compensate for weak or intermittent grids or a lack of grid electricity all together. Microgrids in places such as India, Asia and Africa are also driving hybrid inverter adaptation.

Fig. 1: A hybrid inverter system in a residential installation. Hybrid inverters work with batteries to store power

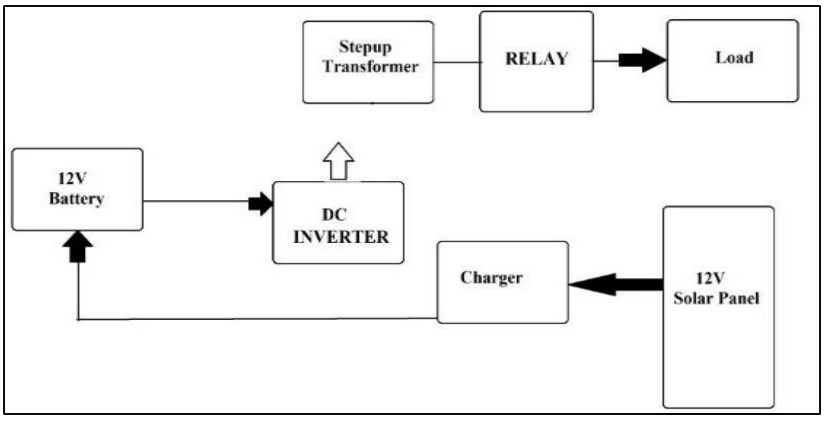

Fig. 2: Hybrid Solar Inverter

Still, Whitton said hybrid models are beginning to be used on a more daily basis in areas of the U.S. where the grid is unpredictable, such as Hawaii, or in states where net-metering has been widely supported. Applications with less than ideal solar characteristic are also good for hybrid-based systems because they can store power and redistribute it during peak times, improving payback. Basically, if the site has the potential for losing the grid frequently, you should consider a hybrid for off-grid operation. Having the flexibility of a hybrid system can add initial cost to a project, though experts say this can be offset by the ability to self-consume all of one's available PV electricity.

There are also important design considerations when using hybrid inverters. For example, Gregg warned that the battery bank voltage should be compatible with the DC input requirements of the inverter, and there should be enough solar capacity to supply the load as well as charge the batteries.

Wiring can also be more complex when using hybrid inverters, especially when panels are dedicated for critical backed-up loads. And as with any device that does several jobs at once, a hybrid inverter is usually slightly less efficient, although, improvements in other balance-of-system components can compensate for that slight loss easily.

There are also specific electrical safety issues with any type of energy storage, so White recommended getting specialized training in energy storage techniques and design. Most available training is focused on simple grid-tied systems because they have been most U.S. solar installations until now. But with incentives changing and the surge in energy storage interest and applications, it's important to get ahead of the curve and get advanced training quickly.

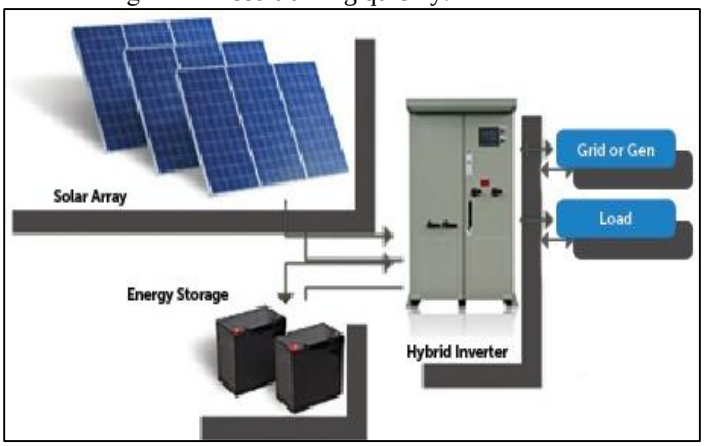

Fig. 3: An example of power flow in a hybrid inverter system

The inverter can direct power to a load or the grid if needed or store it in batteries if not. It can also use power from the grid if needed.

III. SPECIAL FEATURES

- Adaptive algorithm for high efficiency
- MPPT Solar Charger High efficiency
- DC-DC power conversion
- Low current distortion and high PF during charging mode
- Available from 3KVA to 15KVA in wide voltage range
- Multi stage battery charging including temperature compensation
- Fast changeover time
- High inrush current
- Current sharing between Solar & AC when present
- Auto DG start-stop as per requirement
- Digital display with keypad control
- RS-485 with extended touch screen display
- Data logging with storage and GPRS monitoring S

IV. APPLICATIONS

- Data Center Site
- Office Farm Houses
- Telecom Shelters
- Petrol Pumps
- Pipe Lines
- Railway Signaling etc.
- Hospitals / Apartments

V. CONCLUSION

The traditional off-grid solar system uses a simple battery inverter that converters DC power from a battery bank to AC power to supply your home or appliances, these systems need separate battery chargers and regulators. There are more advanced versions of these battery inverters with built in chargers known as inverter/chargers. In recent years very advanced inverters have become available which are inverter/chargers with in-built generator control systems, advanced monitoring capabilities and other features, these are known as interactive or multi-mode inverters. They are typically used in conjunction with a solar inverter to create what is known as an AC coupled system. A new type of solar and battery inverter is now also available, known as an all-in-one hybrid inverter. It combines a solar inverter and inverter/charger into one simple unit. These inverters are a very economical way to enable what is known as 'self-use' or 'load shifting' of energy. Allowing you to store solar or off-peak energy to be used during peak times. Although it is important to know that some all-in-one inverters cannot function during a power outage such as when there is a blackout. They can also have limited functionality and monitoring capabilities. Multi-mode inverters also known as grid-interactive inverters can function in both hybrid and off-grid modes. These inverters are very powerful and can work with multiple energy sources such as wind, solar and back-up generators, but of course this comes at an extra cost. An interactive inverter would normally be required if you wished to add batteries to your existing on-grid solar system.

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