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Hybrid Energy Storage System For Nanogrid

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Abstract

Here we presents an idea of a nano grid integrated system for hybrid storage system. The nano grid means it is a single domain for voltage, reliability, and distribution and electricity sources are may or may not part of the nano grid system. Interface to other power entities in gate ways. In this project we are using sepic converter for reducing stress as compared to buck-boost converter. We are using bidirectional DC-DC converter is for charging and discharging of the battery to support the nano grid. And the voltage and current reference proposed in this paper provides the proper utilization of the solar PV in different operating conditions and UPS to the loads along with the battery storage management. A modulation scheme is implemented to operate the SEPIC for providing of AC or DC hybrid outputs from a single input. We evaluate the simulation in different modes of operation. And also we showed in hardware kit using testing lamp. And this project is used in military areas and some disaster places and weak electricity areas like ruler areas.

Keywords: sepic converter- bi-directional convertor- microcontroller.

1. Introduction

Today the world usage is for a renewable source of generation using DC/AC converters. Places where electric supply cannot reach like deserts, hurricane areas, military areas, rural areas with weak electricity grids.in this place, we are implementing this project. For this project, we have used 12v solar as input and sepic converter this converter work as a DC/DC converter this sepic converter can reduce the stress while conversion process. And we are using a 12v battery for charging and discharging and this battery is connected by using a bi-directional converter. And we have used single phase inverter to convert to dc to ac. We have connected the dc-link capacitor in between the inverter and sepic. We are showing this output in both hardware and simulation models. In the simulation model, the output will in the square waveform. Here we are MPPT for fast-tracking. And in simulation we have different modes of operation to show the accurate output. In hardware, we are using a testing lamp and solar to show the output.

2.. Existing System

The existing frame work requires two changing dc to dc convertors. The boost-converter process is used in existing system. But in conversion process the stress is high in boost converter. Since the existing system is intended for the energy move in both battery side and panel side. This converter like the non-detached bi-directional DC-DC converters works in two methods as the boost and buck.

3.. Proposed System

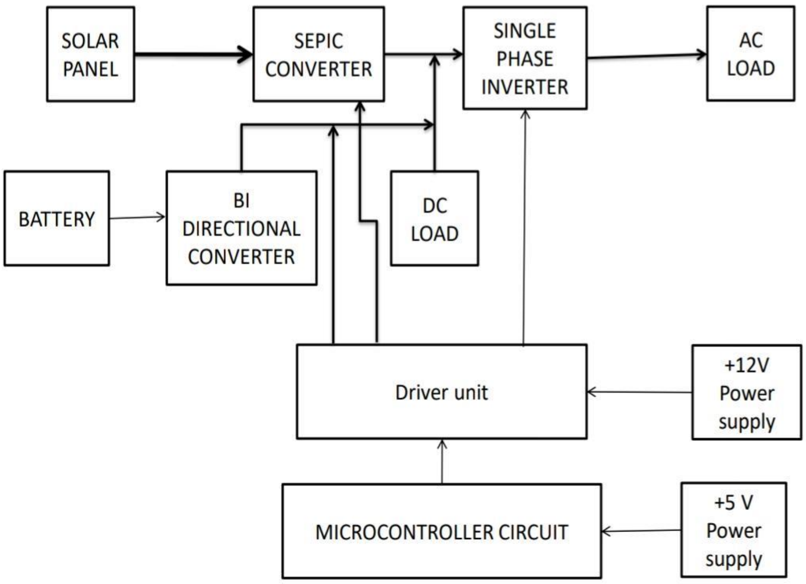
In this project we proposed sepic converter for conversion. This sepic converter is used to convert DC – DC converter. The full form of sepic converter is single-ended-primary-inductor converter. This converter gives high efficiency as compared to other convertors.

Comparison of existing and proposed system

Existing System	Proposed System
• In boost converter the ratio will be very less.	• In sepic converter the ratio will be more so we are using sepic converter in this project.
• In boost converter the life time efficiency of solar panel is low	• In sepic converter the life time efficiency of solar panel is high

Existing System	Proposed System
• Conventional DC-DC converters, such as the boost converter and fly back converter, cannot achieve a high DC-DC conversion with high efficiency because of the resistances of elements or leakage inductance; also, the voltage stresses are large.	• So we are using SEPIC converter for intrinsic high static gain, reduced voltage stress in all semiconductors and uses only three switches.

4.. Block Diagram



5. Hardware Requirements

5.1.. Microcontroller [Pic16f877a]

The sepic converters are controlled using PIC16F877A microcontroller, as it is more viable and powerful for the application. We are using the latest Maximum Power Point Tracking algorithm, .This algorithm helps in the solar powered charging station project in an optimum way.

Special features of microcontroller:

* Power – Saving Sleep mode.

* Wide Operating Voltage Range (2.0V – 5.5v)

* Industrial and Extended Temperature Range.

* Power on Reset (POR)

* Power – up Timer (PWRT) and Oscillation Start-up Timer (OST).

5.2.. MOSFET [IRF840]

The metal oxide semiconductor field-effect transistor has three terminals they are gate, drain, and source. Here we are using IRF840 MOSFET. And the absolute rating of this MOSFET is drain-source voltage(Vds) is 500v and de rating factor is 1.0 and storage temperature is -65 to 150.maximum operating junction is 150. This is the specification of MOSFET.

5.3.. DIODE [1N477]

It converts AC into DC these are used as half wave rectifier or full wave rectifier.

Here we are using 1n4007 diode. The below three points are main while sorting diode

1. Maximum forward current capacity
2. Maximum reverse voltage capacity.
3. Maximum forward voltage capacity.

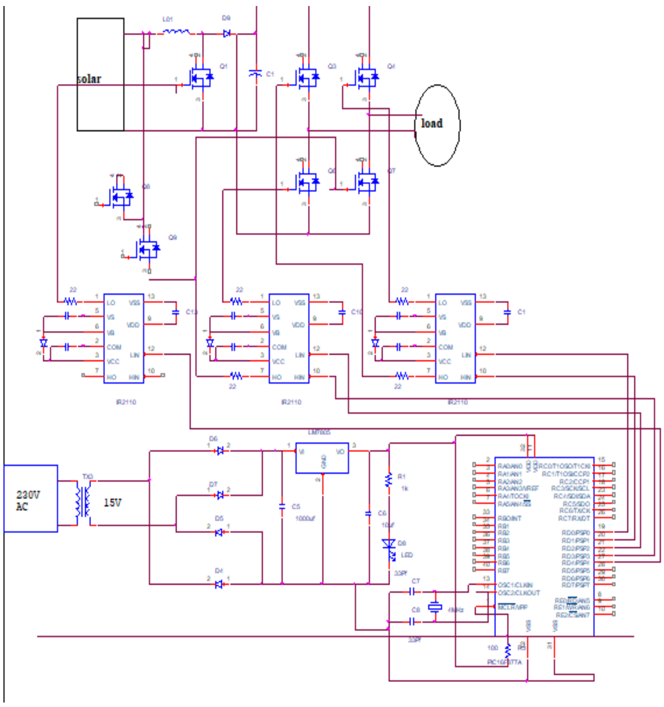
5.4.. Battery

A battery is used for charging purposes in this project we are using a 12v supply battery. In this project, the battery is connected through the bidirectional converter.Through a bi-directional converter, the battery will charge. When the load is discharged. Through the battery we can give a supply. The battery weight is 550grams. The special feature is Amptek 12v 1.3Ah.

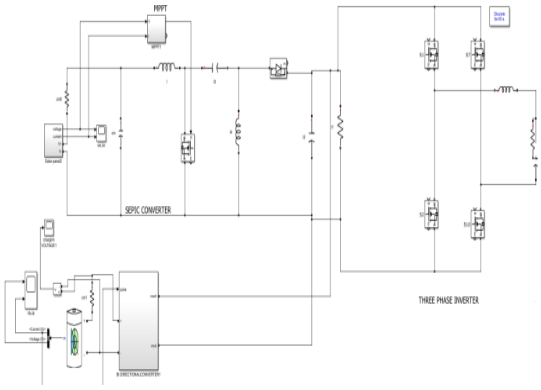
5.5.. Sepic Converter

The main concept of the sepic converter is used to reduce the stress in the conversion process. And the main definition of this sepic converter is it is a dc to dc converter. And this output of this sepic converter controlled by the duty cycle. This is the process of sepic converter.

5.6.. Circuit Diagram



6.. Simulation Diagram

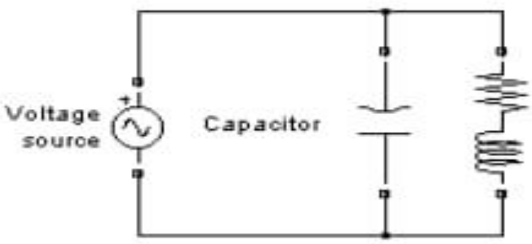


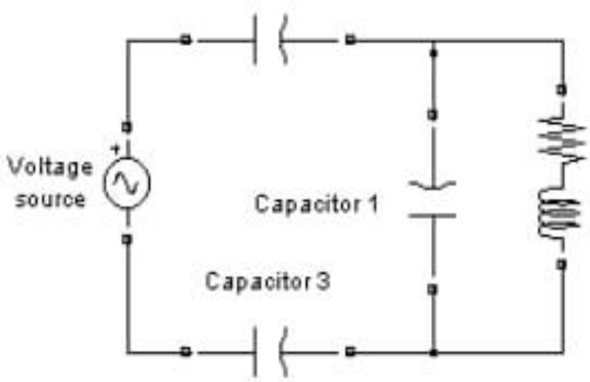
7. Working

First, we are using a 12V prototype solar panel as input. This input is connected to a sepic converter. It is a dc to dc converter. It requires a duty cycle below 50% to buck the voltage when input is low. And this supply is given to a single-phase inverter and simultaneously to a 12v battery unit with the help of a bi-directional converter. After this conversion of dc to ac through an inverter and this ac, supply is given to load

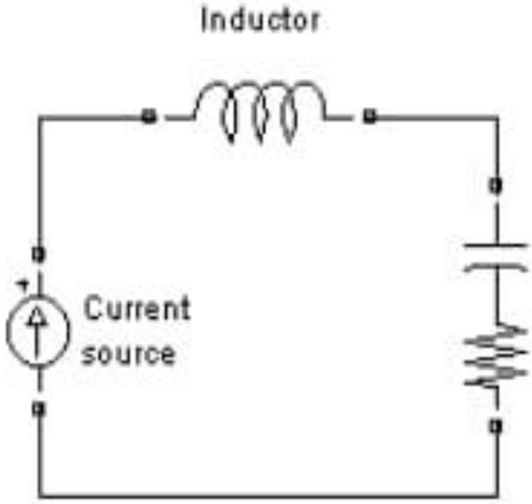
Dc link capacitor is connected in between sepic and single-phase inverter because it provides more stable dc voltage and it limits the fluctuation as the heavy inverter demand currently. Here we are showing output through simulation and hardware. In the simulation, we are showing output.

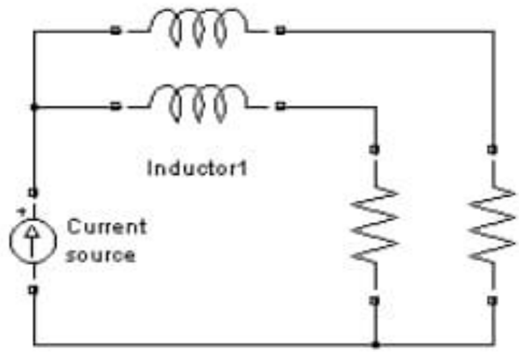
8.Simulation Working:





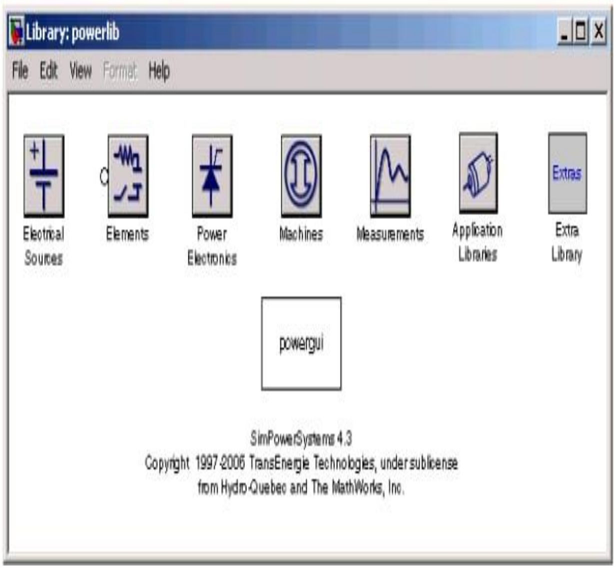
We connected a voltage source in parallel with a capacitor, or a series of capacitor elements in series.





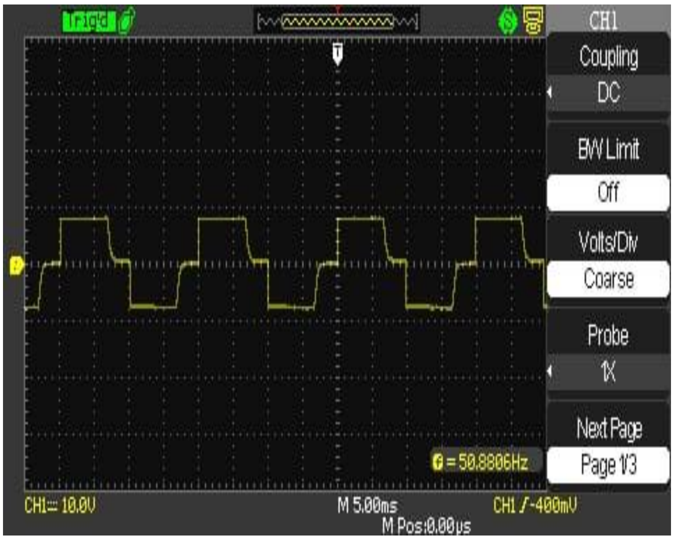
To fix the problem we can add a small resistance in series between voltage source and the capacitors. And we connected a current source in series with an inductor, or a series inductors connected in parallel, and we can add a large resistance in parallel with the inductor and the capacitors.

Electrical circuit with power lib libraries:-



While opening this libaries to produce the windows containing the blocks to copied into the circuits. And the voltage measurement blocks acts as a interface between the sim power system. And the current measurement blocks from the measurement library of powerlib can be used to convert any measred current into a simulink signal.

8. Result



9. Application

It can be used in deserts, military campaigns,

It will use in natural disasters/hurricane prone areas.

10..Conclusion

The proposed system is successfully designed through hardware and simulation. Finally we have got the stable output through the simulation and hardware. And we used different mode of operation in this project to get accurate output. A power reference algorithm is proposed and implemented through the sepic DC-DC converter for energy conversion from solar PV efficiently in different operating conditions. The battery storage system is controlled by bi-directional converter. A prototype of the system has been developed to verify the proposed system using CRO for simulation for hardware testing lamp. Finally we proposed a new conversion process to reduce the stress and we improved efficient conversion process.

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