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"Design and Simulation Model of Solar Based Battery charger and Standalone mode Micro Inverter for Residential Applications"

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Abstract: **-- Solar energy utilization for many applications is growing in as good phase. As PV module converts solar energy into electrical energy and this electrical energy used for charging the battery for supplying the local load, the design of battery charger and micro inverter for residential applications, mostly in remote villages where power is not available, is much more in need. The present paper deals with the design and simulation model of solar based lead acid battery charger cum micro inverter system, which can be used in remote village locations for the supply of power for maximum of 900W. Also constant current and constant voltage based battery charging algorithms are discussed. Entire system is integrated and simulated for different conditions to validate the model and simulation results are presented.**

I. INTRODUCTION

Solar modules produce low and variable outputs due to which DC-DC boost converters are used to enhance the output also helps to get the constant output power over the variation of input power. The present paper shows the output of the converter given to battery (for charging) as well to inverter, after a certain time period battery gives power to the inverter. Based on load, the battery gets charged for certain time, so that it can supply power to the load when PV module can't supply or disconnected. Lead-acid battery is chosen based on durability and functionality. Most of the loads are AC loads, so we need to covert dc power of converter into ac power. For small power application single phase inverters are preferred. Inverters are the devices takes DC as input and gives AC output by use of some power semiconductor switches (IGBTs, thrusters etc.). These switches are considered as ideal switches and different PWM switching technique are used to get proper waveform in output that will be discussed later. The output of the inverter is given to the local load. The current paper deals with design of solar based battery charger. PV modeling is done to analyze the behavior of PV module.

2. Designing of the Proposed Model

Battery specifications considered for proposed model of design are listed in the table 1.

Battery Specifications

Specification	Value
Normal Voltage	48V
Rated Capacity	30Ah
Maximum Capacity	31.25Ah
Fully Charged Voltage	52.26V
Internal Resistance	0.016ohm

Table 1: Specifications of the Battery

2.2 Charging of the Battery with Boost Converter

2.2.1 Charging of Battery in constant current mode

In constant current charging mode, the charging current is kept constant with 10A and in constant voltage, charging mode the terminal voltage across the battery is kept constant at 520V and is controlled by PI controller.

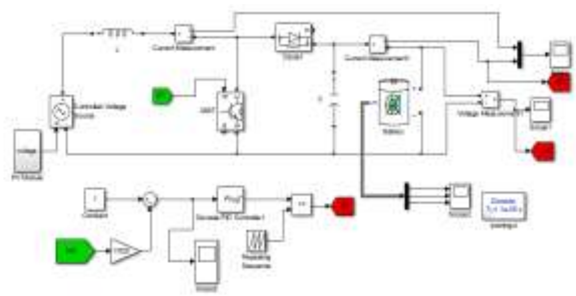

Figure 1 Block Diagram of constant current charging

For a proposed model, PI controller input as error signal for constant current has fed which is shown in Figure 3 and for constant voltage is shown in Figure 6. The battery charging current and Voltage response are shown in Figure 2 and Figure 5 respectively. The

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terminal voltage, SOC (State of Charge) of the battery during charging is shown in Figure 4.

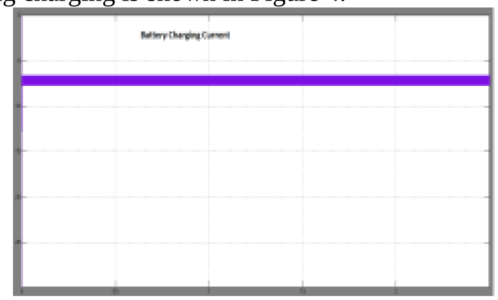

Figure 2 charging current for constant current

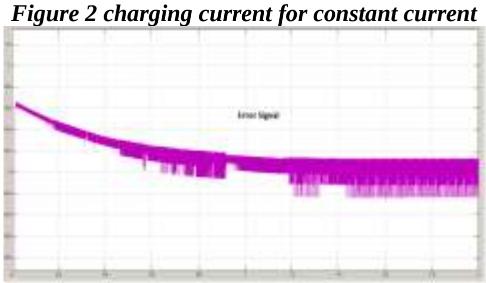

Figure 3 Error Signal to PI controller for constant current Charging

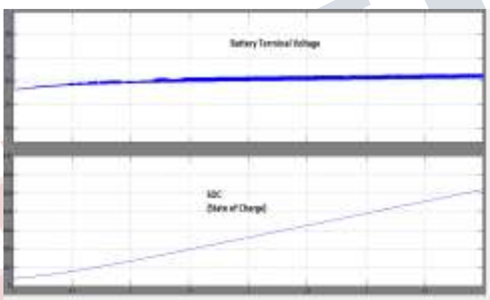

Figure 4 Terminal Voltage and SOC (state of charge) of the battery for constant current Charging

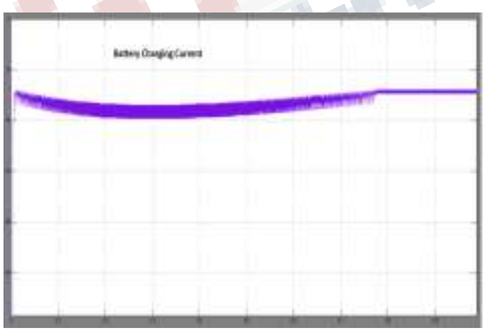

Figure 5 charging current for constant Voltage

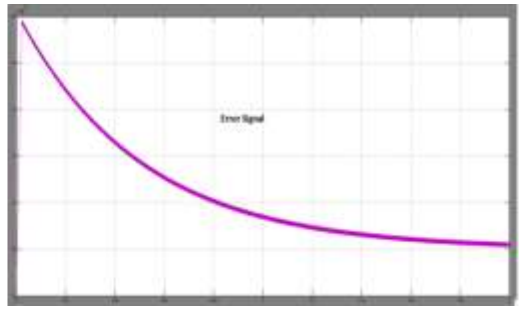

Figure 6 Error Signal to PI controller for constant Voltage

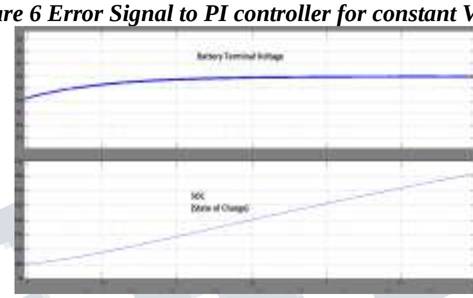

Figure 7 Terminal Voltage and SOC (state of charge) of the battery for constant Voltage Charging

III.SIMULTANEOUS CHARGING/DISCHARGING OF THE BATTERY WITH LOAD (INVERTER)

The present design of a system in which PV module supplies power to both battery and inverter and for a particular period of time the battery is charged as well as inverter gets dc input from the PV module while in the next period of time the PV module is disconnected and dc power is supplied to the inverter through the battery (which discharge the battery).

3.1 System used for Constant Voltage and Current

Two subsystems one for DC to DC converter (Boost) with and other for the inverter (single phase hybrid switching) has been considered.

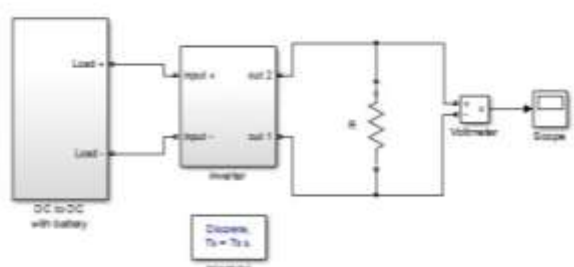

Figure 8 Simulation block diagram for constant voltage charging and discharging

3.1.1 Simulation for Constant Voltage charging

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Figure 9 DC to DC subsystem for Constant Voltage Charging

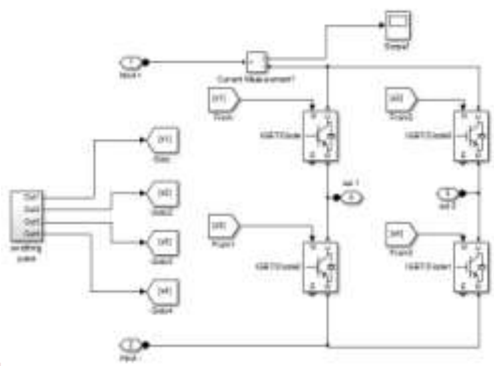

Figure 10 Inverter subsystem for Constant Voltage Charging

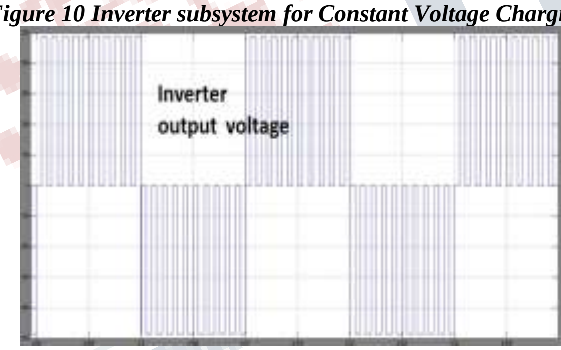

Figure 11 Inverter output Voltage for Constant Voltage Charging

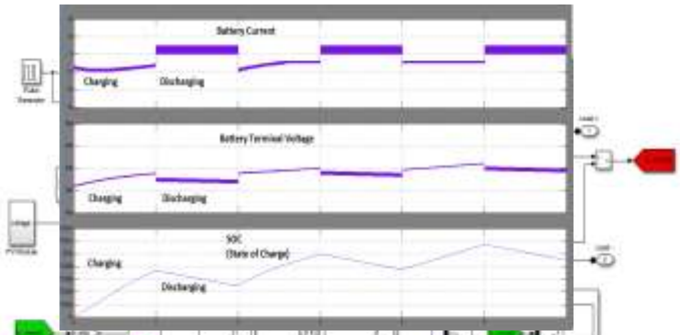

Figure 12 Battery current, voltage and SOC during charging and discharging for constant Voltage

3.1.2 Simulation for Constant Voltage charging

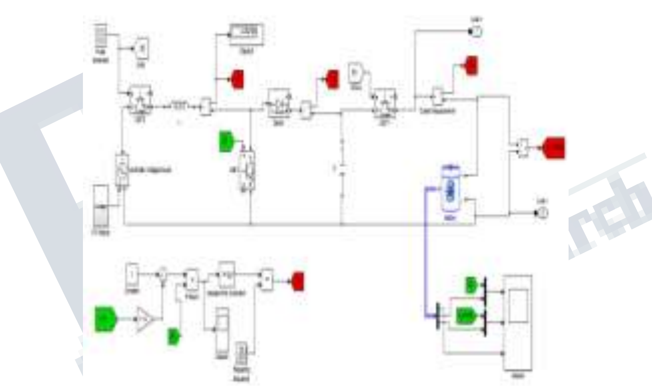

Figure 9 DC to DC subsystem for Constant Current Charging

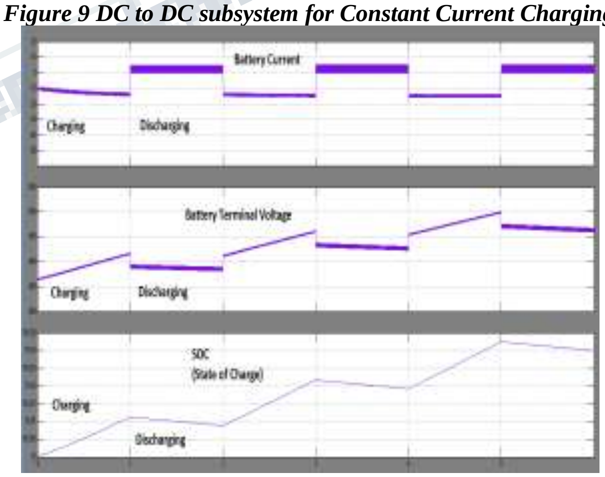

Figure 14 Battery current, voltage and SOC during charging and discharging for constant current

IV CONCLUSION

Step by step development of solar based battery charger cum micro inverter system is implemented in present paper. Battery current, Battery Terminal voltage and state of charge for both constant Voltage and Current charging are plotted in MATLAB Simulink.

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