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PV Integrated Smart Charging of PHEVs Based on DC Link Voltage Sensing

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ABSTRACT: The aim of this project is to Design and Performance of a Bidirectional Non Isolated DC–DC Converter for a battery Energy Storage System.A unique control strategy based on DC link voltage sensing, which describes the direction of power flow is presented and the various modes of operation have been described. The practical feasibility and effectiveness of the proposed control strategy has been validated by experimental results. The proposed control method based on the change in DC link voltage level due to the change in simple and unique. The battery which contain low charge gets charged by other battery according to smart charging PHEVs.By using this method the charge level of any one battery is maintained through life time.

KEYWORDS: buck and boost converter,battery.

I.INTRODUCTION

THE ongoing research in the field of plug-in hybrid electric vehicles (PHEV) and the growing global awareness for a pollution free environment; will lead to an increase in the number of PHEV in the near future. The proliferation of these PHEV will add stress to the already overloaded U.S grid creating new challenges for the distribution network. Though it is always advantageous to charge the EV during night time there will be considerable PHEV load during the day and even during the hours of peak demand. Transmission and distribution systems can be upgraded to meet the peak demand but this may result in capacity surplus during normal operating conditions. There is also a potential risk of night-charging challenge as the TOU (time-of-use) pricing is designed to discourage charging during the daytime.

This would overload the distribution transformers which are otherwise designed to cool overnight. Though installing transformers with higher power rating would solve the problem, it is a rather expensive option. Hence, it's time to develop charging station infrastructure coupled with smart charging strategies which can reduce the stress imposed on the grid. One way is to use renewable energy resources to charge the PHEV. Photovoltaic systems would be the best choice among the available options because of the following reasons:

PV technology is expected to be practical and cost — effective at the kW scale and as a result it is a good candidate for grid-connected photovoltaic charging stations

are indispensable to charging and discharging of energy storage devices. A PLUG-IN hybrid electric vehicle (PHEV) is a hybrid electric vehicle with rechargeable batteries that can be restored to full charge by connecting the vehicle plug to an external electric power source. Battery chargers are another key components required for the emergence and acceptance of PHEV's. For PHEV applications, most commonly on-board chargers are used.

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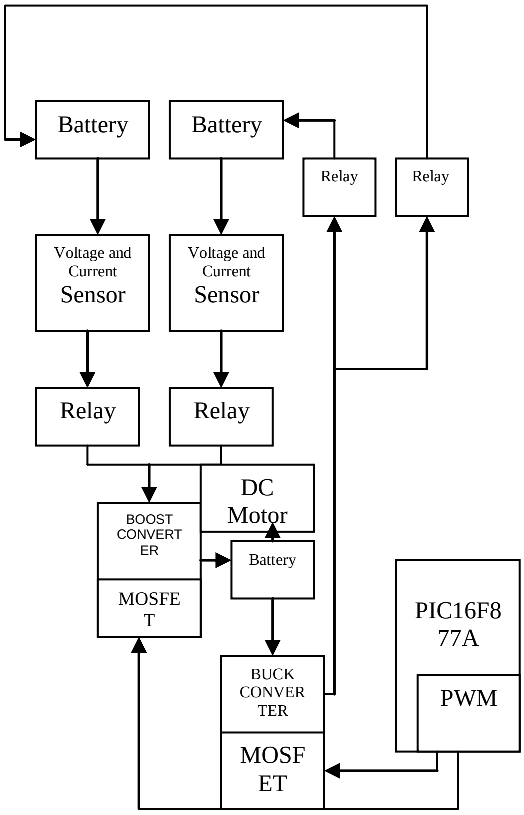
II. SYSTEM DESCRIPTION

The Block Diagram of system hardware is shown in the fig 1



III. INTRODUCTION ABOUT PIC MICRO CONTROLLER

Micro controllers are used for more specific applications. In the micro controller family PIC16F877A is more widely used device in the recent times. The reasons for its wide usage are it has large memory capacity, it has adequate input /output ports etc. The following are the details about the PIC micro controller.

PIC 16F877A Micro Controller

PIC16F874A/877A devices are available in 40-pin and 44-pin packages. All devices in the PIC16F87XA family share common

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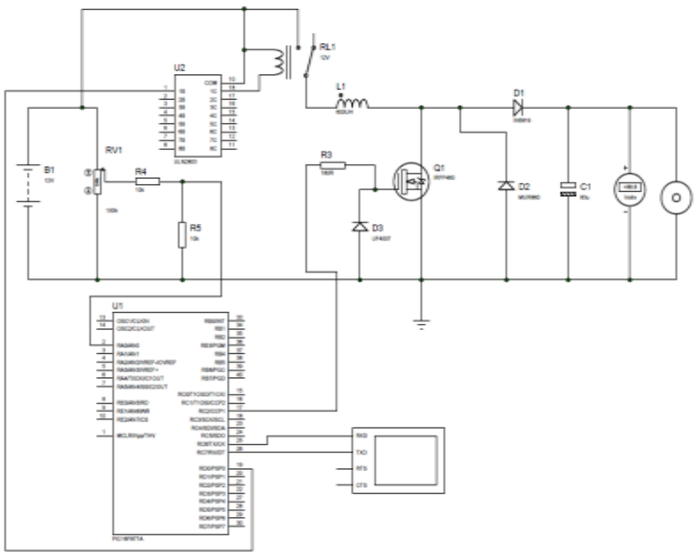
IV. SIGNIFICANCE OF THE PROPOSED CHARGING STATION

It is predicted that there will be one million plug-in hybridelectric vehicles on the road by the year 2015 . This will add extra load to the already overloaded U.S grid. Extensive research on design and implementation of a smarter grid is going to play an important role in the integration of PHEVs to the existing electric power system . Smart grid technologies may be a solution to manage the charging rates and time scheduling of the PHEVs which have a significant impact on the system load curve. A PHEV with smart or controlled mid-day charging may provide overall improved vehicle performance, increasing the drive time travelled using low cost electricity and potentially reducing the size of the battery . The proposed charging station will charge the PHEVs from the photovoltaic system, thus reducing the stress on the grid. When the grid is at peak demand and solar power is insufficient to charge the PHEVs then the charging station would enable vehicle charging to be delayed or temporarily interrupted. The charging station also includes an energy storage unit (ESU) which consists of a battery bank to store energy during off peak hours. The control of the charging station is based on the change in DC link voltage level due to the change in irradiation of the sun. The proposed control method is simple and unique.

The goal of the proposed architecture is: to charge the PHEVs using minimum energy from the utility with a kind of demand side management to improve the energy efficiency. Smart charging techniques like the one proposed in this paper will be required to avoid major expense to upgrade the transformers and other substation equipment . Also, according to the data gathered by National Household Travel Survey, 60% of vehicles are parked at the workplace for more than 4 hrs. In view of this, the proposed charging station will be appropriate for parking facilities at a workplace.



V. ARCHITECTURE OF THE CHARGING STATION

The main components of the charging station are the PCU, photovoltaic array, energy storage unit and the controller. The PCU consists of a DC/DC boost converter which also performs the function of maximum power point tracking (MPPT), a DC/DC buck converter with battery management system embedded in the controller, an energy storage unit (ESU) and a DC/AC bi-directional grid tied converter. The ESU will support the charging of PHEV when there is no power available either from the grid or the PV system. The battery pack in the ESU can be charged from the grid during off peak hours.

The block diagram in Fig. 1 and the following control description is based on charging requirements of a single PHEV. Multiple PHEVs can be charged by increasing the corresponding ratings of the charging station components like the PV

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panels and the associated power converters. Each PHEV must have a separate buck converter installed for each charge point.

The controller monitors and controls the power flow in the system. As shown in Fig. 1 the controller operation is based on eight inputs. , SOC and are used to determine the direction of power flow. and are used to implement MPPT by means of incremental conductance algorithm is the magnitude of the voltage at the DC link, is the detected battery voltage of the PHEV which is the measure of state-of-charge (SOC). is the loading condition of the distribution transformer, is the current flowing through the boost switch, is the current fed into the grid by the DC/AC converter, is the voltage across the PV array and is the current flowing from the PV array. Based on the control signals the controller performs the following tasks:

• Controls the DC/DC boost converter to extract the maximum power from the PV emulator by implementing the incremental conductance algorithm.

• Manages the charging of the PHEV by monitoring its state of charge (SOC). The controller disconnects the buck converter from the PHEV based on the loading of distribution transformer and the state of charge (SOC) of the battery.

• Generates PWM signals at 20 kHz to facilitate the switching of the inverter switches. PWM signals at high switching frequency ensures a sinusoidal voltage at the inverter output.
• The controller changes the modes of operation based on the DC-link voltage. Based on the change in DC-link voltage the converters are controlled to manage the direction of power flow in each mode.

VI. PROPOSED SYSTEM

The Proposed DC to DC converter is Boost Converter and Buck Converter. In Our Proposed system, we have used three batteries to operate the bidirectional DC to DC Converter. The two batteries are connected in input side of the boost converter and another one battery is connected in Boost converter output side. The Proposed system needs to check the power levels of the Boost converter input side two batteries. If the two batteries power are full, the microcontroller will give the priority to anyone battery to distribute the input power to the Boost converter. Suppose a battery power is full and another one battery power is low means the low power battery is charged by the Buck converter and the charge full battery is distribute the input power to the boost converter. The Boost Converter is stepped up the input voltage and the boost converter output is given to the Boost converter output side to the battery, vehicle and the Buck Converter input. The Buck converter is stepped down the input voltage and this converter output is directly connected to the Low power battery for charging purpose.

VII. CONCLUSION

A unique control strategy based on DC link voltage sensing, which decides the direction of power flow is presented and the various modes of operation have been described. The practical feasibility and effectiveness of the proposed control strategy has been validated by experimental results from a laboratory prototype. The proposed control method based on the change in DC link voltage level due to the change in irradiation of the sun, is simple and unique. The charging algorithm facilitates charging of the PHEVs using minimum energy from the utility with a kind of demand management to improve the energy efficiency. Smart charging techniques like the one proposed in this paper will help avoid major expense to upgrade distribution transformers and other substation equipment with the increase in PHEV loads on the distribution system .The battery which contain low charge gets charged by other battery according to smart charging PHEVs .By using this method the charge level of the anyone battery is maintain through lifetime.

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