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ijirset@gmail.com

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DC-DC Converter Topologies for Electric Vehicles, Plug-in Hybrid Electric Vehicles and Fast Charging Stations

R.Gobu¹, M.R.Mohan Raj¹, G.Syed Zabiyyullah¹, M.Loganath², K.Mohan Raj³

Assistant Professor, Department of EEE, Excel College of Engineering and Technology, Komarapalayam, Tamilnadu, India¹

PG Student, Department of EEE, Excel College of Engineering and Technology, Komarapalayam, Tamilnadu, India²

PG Student, Department of EEE, Excel College of Engineering and Technology, Komarapalayam, Tamilnadu, India³

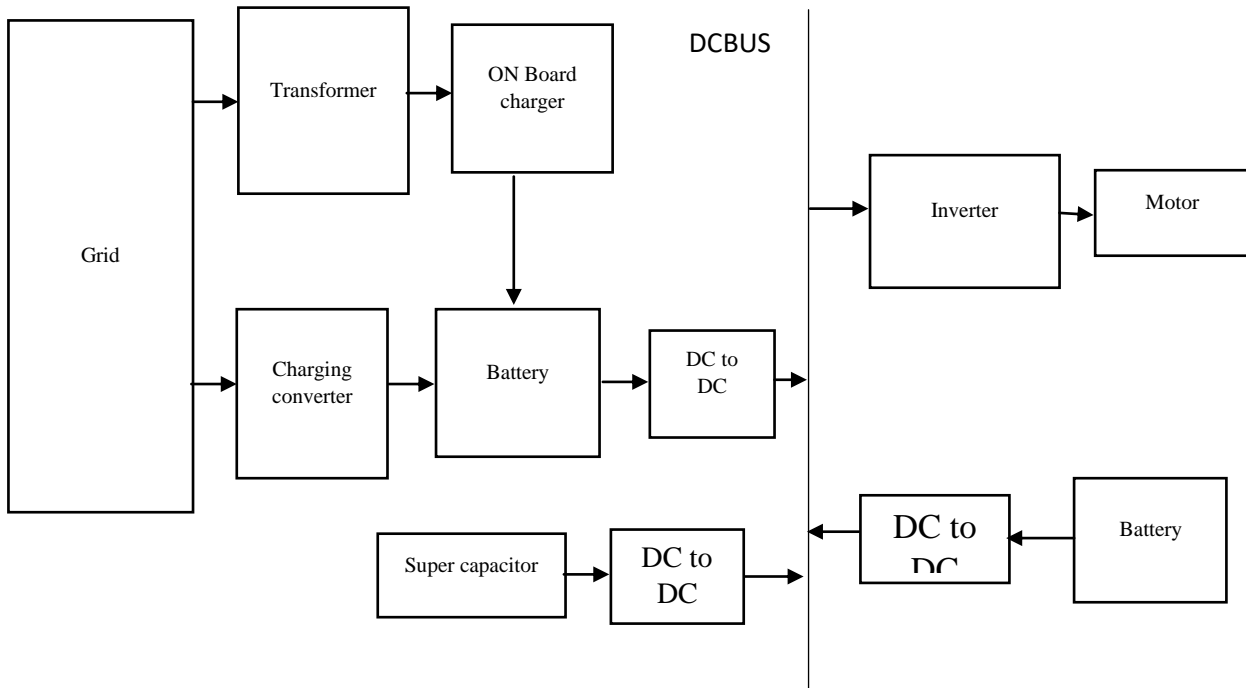
ABSTRACT: There are two types of external variations which change the operating point of a photovoltaic (PV) system: one is environmental change caused by variation in temperature and/or irradiance and the other is load change. The variation in environmental condition changes the PV array characteristic itself whereas the load variation changes the operating point within the same curve. Each type of change can be uniquely identified using history of PV voltage and current measurements. Using the above fact, this paper proposes a fast maximum power point tracking (MPPT) technique for PV array coupled with boost converter. The proposed method determines MPP in a single step by finding out temperature and irradiance at which the PV array is operating. Furthermore, based on the measured values of PV voltage and current, inductor current and load voltage are also calculated, eliminating the need for additional sensors. Supervised Power Control Technique (SPCT) is implemented to track inductor current to its desired value and find the desired duty cycle to reach MPP. The proposed method is validated by both simulation and experimental results under varying temperature, irradiance and load condition. A comparison with the existing MPPT method is also presented in order to show the efficiency of the proposed method.

I. INTRODUCTION

The electric sources of BEV and PHEV powertrains are unregulated. They have some specific problems, notably batteries and super capacitors (SCs) face voltage drops during operation. In the case of the fuel cells (FCs), the dynamic response during the transient process is relatively slow and causes a high voltage drop in a short period after the transition. Furthermore, FCs encounter many problems than batteries and SCs due to the limited supporting infrastructure, such as very few refueling stations. High initial cost due to limited production and reliability of the fuel cells. Therefore, utilizing FCs in EVs is limited and out of the scope of this method.

Moreover, SCs are suitable for capturing electricity during regenerative braking and delivering power instantaneously for acceleration due to their fast charging and discharging potential. In contrast, a battery is appropriate for providing long-term energy with a relatively high energy density, mature reliability, and compact size. Merging batteries with SCs as a hybrid energy storage system reduces stress over the batteries and ensures a fast dynamic response and a long lifespan while increasing the cost of the system. Recently, the VL technique is one of the essential techniques in designing the dc-dc converters. In this technique, using the natural features of the energy storable elements (capacitor and inductance), the output voltage gain is increased step by step.

II. BLOCK DIAGRAM



Also, by using the simple topology, the circuit characteristics are improved—the proposed dc-dc converter. The proposed converter consists of inductances and capacitors and diodes and the conventional dc-dc converter to increase transmission voltage gain. In other words, the required elements for the VL technique include these additional elements. However, the proposed structure has some drawbacks. The proposed structure uses two switches and four diodes, most of them experiencing a hard switching.

III. BLOCK DIAGRAM EXPLANATION

Energy source might require a specific dc-dc converter to be integrated into the high voltage (HV) dc link of the powertrain. For bidirectional electric sources like SCs and batteries, bidirectional dc-dc converters are essential to absorb the regenerative braking energy, which maximizes the overall efficiency of the system. However, these bidirectional sources also have different requirements for the connected DC-DC converters. For example, due to the fast charging and discharging capability of (SCs), a fast-dynamic controlled converter is required to avoid incompatible operations. A DC-DC converter with a small number of passive components is preferable when the energy source is, to lessen transition intervals between the charging mode and the discharging mode, which is generally around a few microseconds.

FAST CHARGING CONVERTER:

The charging station consists of a converter connecting grid to a DC bus where EVs get connected through battery chargers. The control of individual vehicle charging process is decentralized and a separate control is provided to deal with the power transfer from DC grid to the DC bus. An energy management strategy based on optimal power flow is also proposed by integrating a battery generation system with charging station to alleviate the impact of fast charging on the grid. The combined system along with the power output of EV fleet batteries available at the charging station reduces the net energy provided by the grid, thereby decreasing the overall load on the grid as well as minimizing the conversion.

BATTERY:

A constant voltage charger is basically a DC power supply which in its simplest form may consist of a step down transformer from the mains with a rectifier to provide the DC voltage to charge the battery. Such simple designs are often found in cheap car battery chargers. The lead-acid cells used for cars and backup power systems typically use constant voltage chargers. In addition, lithium-ion cells often use constant voltage systems, although these usually are

more complex with added circuitry to protect both the batteries and the user safety. Electric vehicles (EVs) have been alleviated by the introduction hybrids (HEVs) and plug in hybrids (PHEVs) and the development of higher energy density batteries capable of storing more energy in the same space. With the increasing popularity of electric vehicles, "range anxiety" is now being replaced by "charging anxiety". This page addresses the issues associated with providing suitable chargers and the charging infrastructure necessary to support the growing population of EVs.

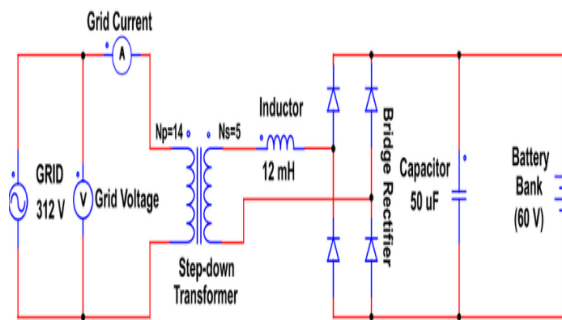


Figure: Battery Charging Circuit Diagram

DC TO DC CONVERTER:

Power semiconductor and energy efficiency technologies are continually developing and working on the best solutions for your applications. We are creating new system architectures using state-of-the-art IC and power semiconductors. As a DC-DC converter manufacturer, switch mode power supply (SMPS) has been our business for decades, including the fine regulation of direct current, also known as DC-DC (or DC to DC) conversion. In the area of DC-DC power supply we offer different DC-DC converters and solutions. Bi-directional converters using coupled inductor were introduced for soft-switching technique with hysteresis current controller. For minimizing switching losses and to improve reliability, zero-voltage-switched (ZVS) technique and zero-current-switched (ZCS) technique were introduced for Bi-directional converter. A multiphase Bi-directional converter is suitable for high power application. To achieve high voltage rating or current rating more number of converters can be connected in series or parallel with low switching frequency. A unified current controller was introduced for Bi-directional dc-dc converter which employs complementary switching between upper and lower switches.

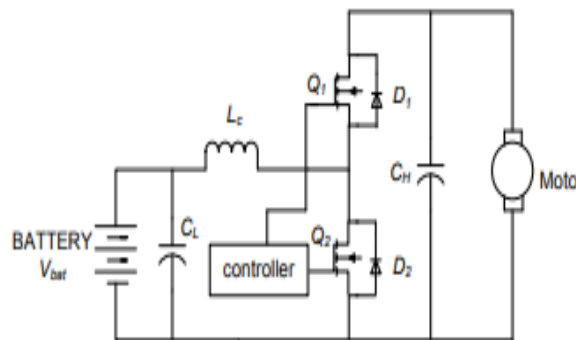


Figure: Bidirectional DC to DC Converter

SUPER CAPACITOR:

The capacitor is a two-terminal passive component, which is widely used in electronics. Almost, every circuit we find in electronics, use one or more capacitors for various usage. Capacitors are the most used electronics component after resistors. They have a special ability to store energy. There are different types of capacitors available in the market, but one which is recently getting popularity and promise a replacement or alternative of batteries in future, are supercapacitors or also known as ultra-capacitors. A supercapacitor is nothing but a high-capacity capacitor with capacitance values much higher than normal capacitors but lower voltage limits. They can store times more energy per unit volume or mass than electrolytic capacitors, can receive and deliver charge much faster than batteries, and tolerate more charging-discharging cycles than rechargeable batteries.

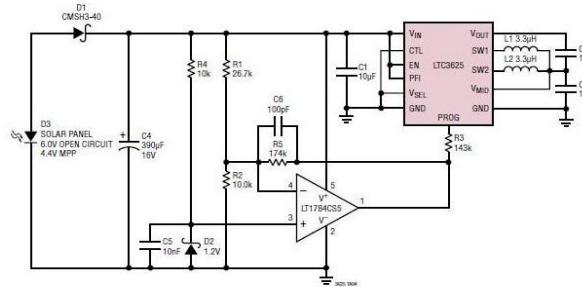


Figure: Supercapacitor Circuit Diagram

INVERTER:

DC battery and someone taps you on the shoulder and asks you to produce AC instead. How would you do it if all the current you produce flows out in one direction, what about adding a simple switch to your output lead? Switching your current on and off, very rapidly, would give pulses of direct current which would do at least half the job. To make proper AC, you'd need a switch that allowed you to reverse the current completely and do it about times every second. Visualize yourself as a human battery swapping your contacts back and forth over 3000 times a minute. In essence, an old-fashioned mechanical inverter boils down to a switching unit connected to an electricity transformer. If you've studied our article on transformers, you'll know that they're electromagnetic devices that change low-voltage AC to high-voltage AC, or vice-versa, using two coils of wire (called the primary and secondary) wound around a common iron core. In a mechanical inverter, either an electric motor or some other kind of automated switching

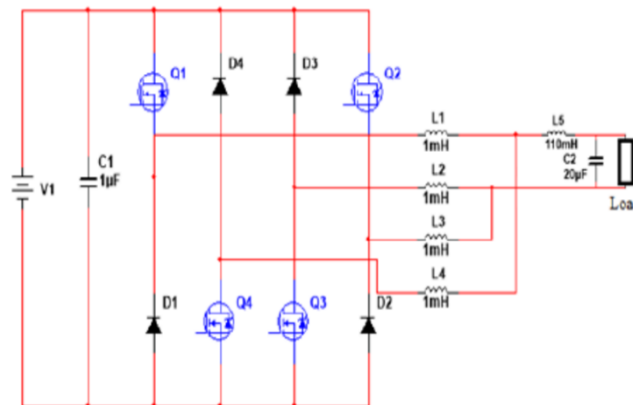
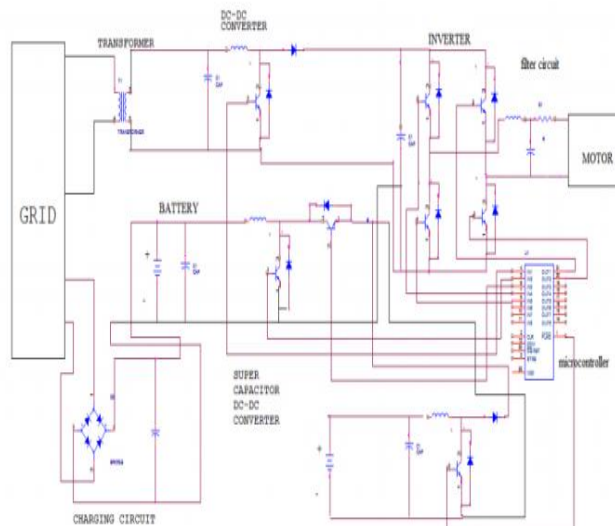
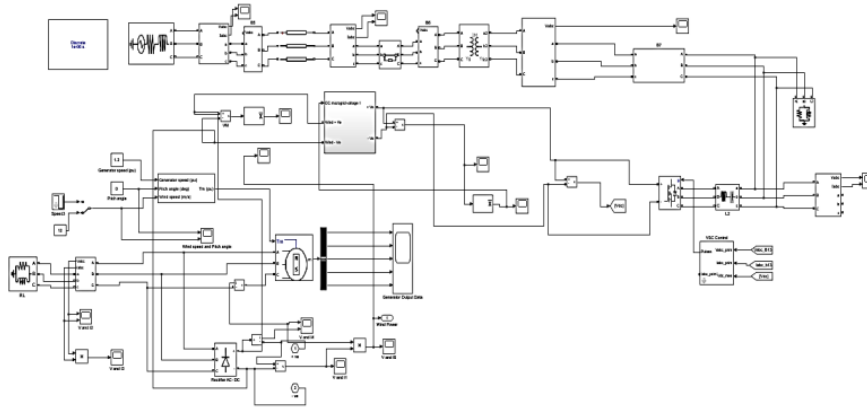


Figure5.8 Inverter Circuit Diagram

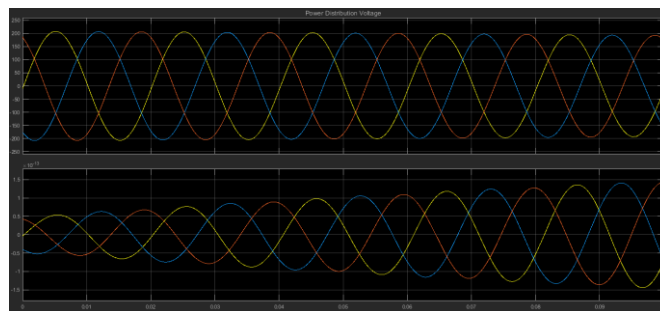
CIRCUIT DIAGRAM



IV. MATLAB SIMULATION OUTPUT

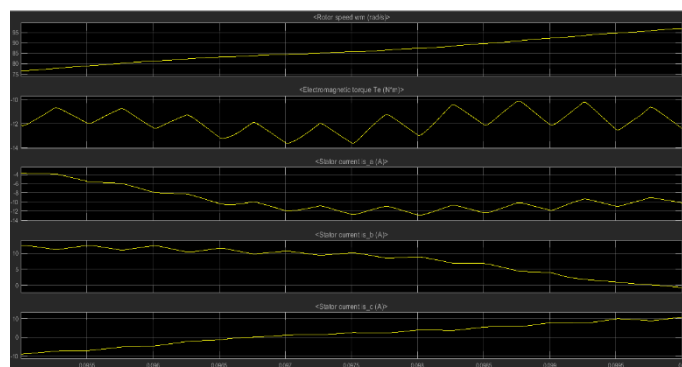


Load waveform



- ❖ Represent the load side voltage and current for the wind energy generation. The synchronous grid voltage is with respect to time.

MOTOR WAVEFORM



V. CONCLUSION

very first time, this method presents the state of art reviews of the design and evaluation of DC-DC converter topologies for BEV and PHEV powertrains and converter topologies for FCHARs, including future trends of research. This review has given a focus on multiple performance features, such as output power, component count, switching frequency, electromagnetic interference (EMI), losses activeness, cost and reliability which directly influence the selection of a particular DC-DC converter for respective BEV and PHEV powertrains. This method will also guide automotive engineers and PE converter designers to select passive components precisely based on powertrains demand. DC-DC boost converters face switching loss problems. To overcome that, soft switching DC-DC converter



topologies are utilized. In general, boost converter losses occur due to hard switching, but in soft switching configuration, switching losses are eliminated by forcing voltage or current to zero during the switching transition.

REFERENCES

- 1 Srija, D. K., Keerthi, T. S., Anusha, R., Chandana, B. H., & Peddapati, S. (2019) "Performance analysis of non-isolated high step-up dc-dc converter topologies used in photovoltaic grid connected electric vehicle charging stations", Fifth International Conference on Electrical Energy Systems (ICEES).
- 2 Farhani, S., & Bacha, F. (2018) "Modeling and control of a dc-dc resonant converter interfacing fuel cell in electric vehicle" the International Renewable Energy Congress (IREC).
- 3 Singh, S. K., Kumar, D., Prakash, M., Kumar, A., & Sadhu, P. K. (2018) "Analysis and Control Implementation for Instantaneous Mode Switching Bi-Directional Dc-Dc Converter for Plug-In Electric Vehicle", International Conference on Power, Energy and Environment: Towards Smart Technology (ICEPE).
- 4 Shin, C.-H., Kim, D.-Y., Ko, A.-Y., Won, I.-K., Kim, Y.-R., & Won, C.-Y. (2015) "The configuration of electric vehicle system using isolated DC-DC converter for a low-voltage and high-current type battery", International Conference on Power Electronics and ECCE Asia (ICPE-ECCE Asia).
- 5 Nick, R., & Shahalami, S. H. (2016) "Quad quadrant bidirectional DC/DC converter for electric vehicles with high gain voltage", Iranian Conference on Electrical Engineering (ICEE).
- 6 Arazi, M., Payman, A., Camara, M. B., & Dakyo, B. (2018) "Study of different topologies of DC-DC resonant converters for renewable energy applications", International Conference on Ecological Vehicles and Renewable Energies.
- 7 Sun, Z., & Bae, S. (2018) "Multiple-Input Soft-Switching Step-up/down Converter for Renewable Energy Systems", International Conference on Renewable Energy Research and Applications (ICRERA).
- 8 Zhi Qu, Dayal, V., Jiawei Dong, Sangha, R., Shafiei, N., Arefifar, S. A., ... Botting, C. (2016) "Comprehensive power MOSFET model for LLC resonant converter in renewable energy applications", International Symposium on Power Electronics for Distributed Generation Systems (PEDG)
- 9 ARAZI, M., PAYMAN, A., CAMARA, M. B., & DAKYO, B. (2018) "Control of isolated DC/DC resonant converters for energy sharing between battery and supercapacitors", 2018 7th International Conference on Renewable Energy Research and Applications (ICRERA).
- 10 Shen, Y., Wang, H., Al Durra, A., Qin, Z., & Blaabjerg, F. (2018) "A Structure-Reconfigurable Series Resonant DC-DC Converter with Wide-Input and Configurable-Output Voltages", IEEE Transactions on Industry Applications,



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