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REVIEW PAPER OF SIMULATION OF SOLAR PV BASED CHARGER EMPLOYING ZETA CONVERTER

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ABSTRACT

This study suggests a battery charger based on a Zeta converter for an electric vehicle (EV). A zeta converter is a fourth order DC-DC converter that has a non-inverted output and functions as a buck-boost converter. To charge the EV battery, the Zeta converter is managed to draw the most power possible from a photovoltaic (PV) array. The 280 watt PV modules make up the PV array. The PV array's maximum power is obtained using the Perturb and Observe (P&O) Maximum Power Point Tracking (MPPT) technique. The right duty ratio for the Zeta converter switch can also be obtained using it. The EMTDC/PSCAD software is used to model and simulate the suggested system. In order to evaluate the performance of the suggested system, simulation results are presented.

Keywords: Battery Charger, Photovoltaic, Zeta Converter.

I. INTRODUCTION

Pollution problems can be observed on Earth, and changes caused by fossil fuels are becoming a growing driving force. One action to reduce CO2 emissions is the "Kyoto Protocol," which requires states to reduce greenhouse gas emissions. The main cause of excessive carbon emissions is the combustion of fossil fuels. In addition, rapid and unpredictable oil prices have since then aroused interest in switching from fossil fuels to renewable resources. The virtual capacitor concept has been introduced in the control to reduce the DC current injection in the mains inverters. It requires the current sensor to return the signal to the virtual capacitor control circuit. The additional DC power management is used to suppress the direct current that the inverter injects into the mains. And it uses the same current sensor as the input signal from the auxiliary DC current control loop. Armstrong (Armstrong) proposed an automatic calibration converter to solve the zero operating problem of the current sensor. It needs a current sensor to detect the DC bus current. One solution is to use several photovoltaic cells connected in series to achieve the required voltage. In this solution, however, some cells may be occluded, and these occluded cells will be inversely biased, acting as loads instead of sources. In addition, discrepancies in photovoltaic modules can lead to highly localized power consumption, thereby reducing the output power. Using a high-gain dc-dc converter can be one of the effective solutions to increase the voltage of low photovoltaic cells. Use multiple switches to achieve high voltage gain and reduce AC voltage. However, compared to a single-switch DC-DC converter, the cost cost increases and the control method is more complicated. In the traditional insulated DC-DC converter, a transformer with a high speed ratio is used to achieve a large voltage increase. However, due to the large leakage inductance of the transformer, the efficiency of this method is reduced. Therefore, a non-isolated high boost amplifier is required to achieve higher efficiency. The boost converter is the most common converter used to increase the DC voltage. By using this converter, a large DC gain can theoretically be obtained. However, efficiency is reduced by actual implementation. In addition, it has a major diode reverse recovery problem. Shift converters, such as super boost converters, can be used to achieve large DC gains. However, the operating cycle of the main switch must be very large to achieve large gains. Other non-insulated inverters, such as boost inverters that use coupled inductors or cascaded boost inverters, can be used to reach higher DC voltages. However, they are unstable and inefficient at large DC voltage gains. Fuel cells and photovoltaic cells are the two main sources of energy. However, the voltage levels of these sources are too low and unpredictably unstable, varying with climatic conditions (such as solar radiation and temperature). Therefore, photovoltaic cells and fuel cell systems require high voltage amplifier converters. In theory, the classic boost converter can be used for high voltage applications. However, the efficiency and voltage amplification of the classic boost converter are limited by the large operating cycle, diode and switch loss and the corresponding series resistance of the inductor and capacitor. The stress on the main switch on the classic boost converter is very high. The high voltage of the main switch results in large line losses. DC-DC converters are used to transmit power in many applications. A stable output voltage must be obtained. In addition, high voltage conversion can be important. To provide a higher voltage conversion ratio, many modifications of the DC-DC converter have been proposed. In a switched capacitor converter, the input voltage is used to supply energy, and the switched capacitors are connected in series and supply power to the load. Therefore, the power supply voltage can be doubled.

1. ZETA CONVERTER

A schematic circuit diagram of a Cuk-Zeta DC-DC converter with 2 inputs is proposed with two different voltage sources. It includes two different input sources Vg1 or Vg2 and four diodes D1-D4 to provide recent paths in dissimilar states. This project considers the enduring construction of the input DC power supply. Therefore, if you often need to connect and disconnect each power supply from the input side of the converter, you can use active switches instead of S1 and S2. The energy receiver, converter or transmitter is located in middle of converter. This part is a two-port network consisting of shunt capacitors C1 and C2 and diodes D1 and D2 connected in an X-shape, called "transdiode capacitor network". In this state, since both sources are active, S1 and S2 are forward-facing, while S3 or D4 are inversely biased.

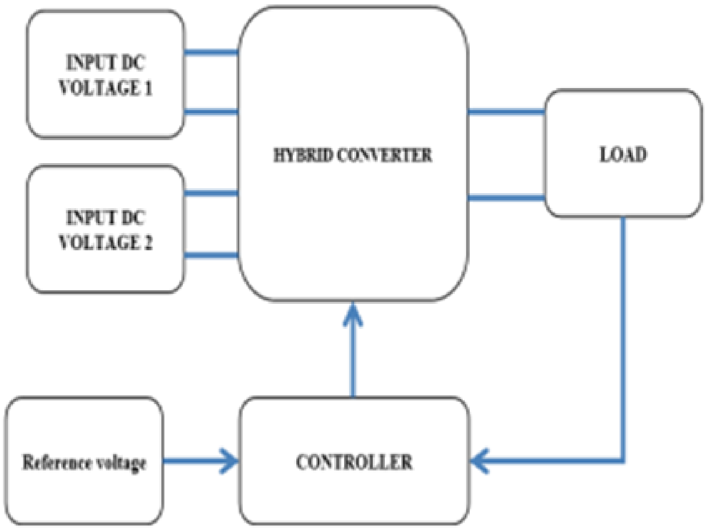

Fig 1: Proposed block diagram.

DC-DC converters are power electronic circuits that convert a DC voltage from one level to another to provide a regulated output. In this work, Zeta converter is selected compared to other conventional DC-DC converters due to the advantages of soft starting, continuous output current, boundless region for MPPT, low ripple input, and output currents [11].Zeta converter is configured based on buck converter and it can either step-up or down the output voltage depending on the duty cycle of the switch used in the circuit Zeta converter is similar to the Cuk and Sepic converter where it can produce an output voltage that is either greater or less than the input voltage with no polarity reverse. The significant lower output voltage ripple is the one that distinguishes zeta converter from the other two mentioned converters. The output voltage ripple is described as an undesired power loss. Moreover, the output voltage ripple is related to the switching frequency and the capacitor capacitance, where larger capacitance is required in the design to reduce the output voltage ripple Figure 1 shows the equivalent circuit of zeta converter. Zeta converter consists of two inductors and a series capacitor. The input capacitor exists to filter the input voltage and the output capacitor filters the output voltage. In order to design the zeta converter, some assumptions need to be made before proceeding with the analysis The circuit is operating in a steady state.• The inductor current is operating in contentious• mode (always positive) (CCM). The switching period is T; the switch is closed for• time DT and open for time (1-D) *T where D is the duty cycle. The passive components are assumed to be ideal.• The two coupled inductors are

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identical.• Figure 2 shows the equivalent circuit of the zeta converter when the switch Q1 is closed (on). When Q1 is on, the energy flowing from the input source will be stored in L1a, L1b and Cc . L1b also will provide the output current of the circuit

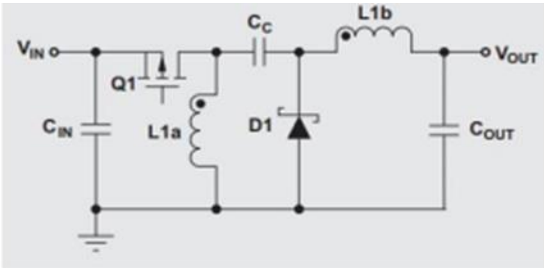

Fig 2: Zeta converter equivalent circuit

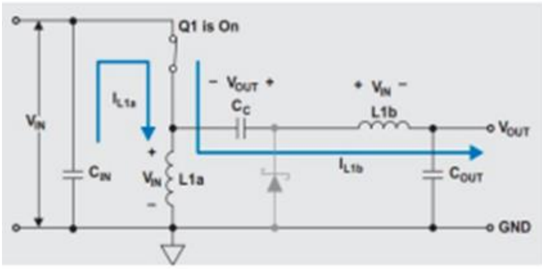

Fig 3: Equivalent circuit of zeta converter when Q1 is on

II. LITERATURE REVIEW

1) An overview of power electronics in electric vehicles By C.C. Chan; K.T. Chau In response to concerns about energy cost, energy dependence, and environmental damage, a rekindling of interest in electric vehicles (EVs) has been obvious. The market for EVs will be large due to the "California standards" on zero emission vehicles in the United States, as well as similar stricter air pollution regulations throughout Europe, Asia, and much of the rest of the world. To meet market demands, power electronics technology development for EVs will proceed at a faster rate. The current state of interdisciplinary technologies in EVs is examined in this research. Power electronics technology has a number of difficulties in terms of EV propulsion, battery charging, and power accessories.

2) Electric, hybrid electric, and plug-in hybrid electric vehicle power electronics and motor drives by Kaushik Rajashekara, Young Joo Lee, and Ali Emadi Automobile manufacturers are creating electric, hybrid electric, and plug-in hybrid electric vehicles in response to regulations requiring emissions reduction and increased fuel efficiency. Power electronics is a technology that makes it possible to create these more ecologically friendly cars and to integrate cutting-edge electrical structures to handle rising electric load requirements. This study provides a brief overview of current trends, potential vehicle strategies, and the role of power electronic subsystems. For the successful development of these vehicles, the requirements of power electronic parts and electric motor drives are also addressed.

3) By Ankit Kumar Singh and Mukesh Kumar Pathak, an enhanced two-stage non-isolated converter for onboard plug-in hybrid EV battery charging This study describes a single-phase, two-stage, non-isolated converter for an on-board battery charger for plug-in hybrid electric vehicles[]. In contrast to typical SEPIC, Cuk, Zeta, and inverting buck-boost converters, the second stage of this battery interface is a bi-directional dc-dc converter with a wide range of output voltage and minimal component stress in both directions. The second stage bi-directional dc-dc converter also performs more efficiently in both the buck mode from one direction and the boost mode from the other than the two switches non-inverting buck-boost converter. Results from simulations are provided to show how well the suggested system works.

4) Evaluation and Efficiency Comparison of Front End AC-DC Plug-in Hybrid Charger Topologies by Fariborz Musavi; Murray Edington; Wilson Eberle; William G. Dunford As a key component of a plug-in hybrid electric vehicle (PHEV) charger system, the front-end ac-dc converter must achieve high efficiency and power density. The topologies for use in front end ac-dc converters for PHEV battery chargers are evaluated in this paper's

topology survey. Several boost power factor adjusted converters that offer high efficiency, high power factor, high density, and cheap cost are the subject of the topology survey. Five prototype converters that change the 400 V dc input voltage from universal ac to it are given with their experimental results and interpretations. In North America, where the average supply is restricted to 120 V and 1.44 kVA or 1.92 kVA, the results show that the phase shifted semi bridgeless PFC boost converter is perfectly suitable for automotive level I home charging applications. The bridgeless interleaved PFC boost converter is an ideal topology contender for typical supplies of 240 V, with power levels of 3.3 kW, 5 kW, and 6.6 kW, for automotive level II residential charging applications in North America and Europe.

5) Design of a Soft-Switched 6-kW Battery Charger for Traction Applications by Brendan Peter McGrath; Donald Grahame Holmes; Patrick John McGoldrick; Andrew Douglas McIver Auxiliary power converters for traction rolling stock applications have to operate under difficult conditions, including high-input voltages which are subject to wide fluctuations, high temperatures, and harsh environmental constraints. Additionally there is often a need for silent operation, which implies switching frequencies above 20 kHz. High-frequency DC-DC converters, which have the advantages of being smaller and lighter, are being employed more frequently for these applications. However, a standard hard-switched converter based on IGBTs finds it difficult to handle large input voltages and switch at high frequencies, making soft-switching topologies an appealing option. This paper outlines the design approach for an IGBT-based 6-kW ZVS battery charger that switches at a 20 kHz frequency. This study demonstrates the design trade-off between managing the hard-switch turn-on losses at low load, reducing the duty cycle loss brought on by soft-switching delays, and reducing the effects of tail current-switching losses. The choice of the ZVS capacitors, the series inductance value, the transformer turns ratio, and the choice of the IGBTs all depend on these trade-offs. This study presents the design details, theoretical forecasts, and experimental findings for the designed conversion system.

6] M. Savaghebi, A. Jalilian, In recent times, people have been paying more attention to the use of dispersed generals (DGs) not only to inject energy into boxes, but also to improve quality. There is a long-term monitoring method for compensating for the lack of oil in the microgrid islands. This method is based on accurate control of the DGs interface converter. The DG is bound to compensate for the shortcomings of the bill, as long as it shares compensatory work and strong and reactive forces. The DG control system focuses on powerful and robust controls, virtual reality channels, current voltage and current controllers, and unbalanced printers. The method of design of the control system is discussed in detail, and simulations and presentation experiments are provided. The results prove the effectiveness of this method in the processing of food insufficiency. Under unbalanced conditions, the power system will suffer significant losses and become unstable. Similarly, volatility inefficiencies can have a negative impact on devices such as induction motors, electronic power converters and high-speed imaging (ASD). In these operations, the wave of fuel generated by the unbalanced load is released by the balance in the current line. But, in the case of heavy load inequalities, the current rise of the engine is that the level of active filtering exceeds the weight of the filter. On the other hand, it is known that the distributed compiler (DG) producer is often confused with the prime return, which is connected to the power distribution system through an interface converter (e.g., a printer with variable variables). dc / ac conversion). The power generation system can be a public box or a local DG board called a DG. The function of the DG center is to adjust the angle of development and the strength of the production line to control the active and reactive power injection, but this compensation will be considered as an inconvenience to disassemble the pipeline. In other words, there is an agreement between the effectiveness of unreasonable compensation and the ability to correct mining. To solve this problem, the proposal of this paper proposes a direct modification of the bill of lading to compensate for the shortage of oil in the microphone. In this way, the indication of compensation is treated as an order followed by the monitoring of the bill. It should be noted that according to the theory of symmetric elements, a group with a large number of unbalanced processes (e.g. or present) can be formed into three groups: balanced elements, i.e., healthy, structural elements The well-adjusted phase consists of three phasors of the same size and ± 120 ° phase shift. The negatively charged component consists of similar phasors, however, the path of rotation is the opposite of the positive phasor series. The zero transmission element is three phasors equal in amplitude and zero phase shift. As mentioned earlier, no significant micro grid elements were studied

7] in this paper. Alia M. Khatab et.al (2018)This paper proposes an electric vehicle (EV) battery charger based on Zeta converter. The Zeta converter is a fourth-order DCDC converter used as a buck-boost converter with non-inverting output. The Zeta converter is controlled to extract the maximum power from the photovoltaic (PV) setup to charge the EV battery. The photovoltaic array consists of 280 watt photovoltaic modules. Perturbation and observation (P&O) technology for maximum power point tracking (MPPT) is used to obtain maximum power from the PV array. It can also be used to obtain the correct operating cycle of the Zeta switch. The proposed system is modeled and simulated using EMTDC / PSCAD software. Simulation results are presented to evaluate the performance of the proposed system.

8] Surbhi Shringi et.al (2019) :Comparison of Zeta, Buck-Boost, and Cuk converters used in solar-based systems using P&O technology to track the maximum power point. The converter and its advantages and disadvantages are described and simulated to compare the output power. Simulation results show that between Buck-Boost, Cuk and Zeta converters. Zeta converter can track the maximum power without any secondary fluctuations, so it's the best match for the solar system

9] Kuldeep Singh Rathode et.al (2019)This work introduces the method of realizing incremental conductivity (INC) MPPT by voltage perturbation by tracking the maximum power point (MPP) of solar cell (SPV) arrays using Zeta converters. INC MPPT caused by voltage interference requires a PI controller (INC-PI MPPT). INC-PI MPPT eliminates the step size collection faced by INC MPPT in direct duty cycle management, and tracks MPP at high speed or reduces oscillations around MPP without affecting accuracy. The Zeta converter operates in incessant wire mode and provides an unlimited range for MPPT. The suggested system can be intended and modeled to achieve good exactness or stability under high dynamic situations. The suggested system was simulated and MATLAB / Simulink was used to compare the INC-PI MPPT and INC MPPT for shortest operating cycle controller to verify the proposed system's performance under actual operating conditions.

10] Paulson Samuel et.al (2019) : This paper proposes a multi-phase technology in-phase buck-boost converter, called multi-device multiphase interleaved buck-boost converter (MDMPIBBC). This study shows how the use of multi device and multi-phase technology in converters can reduce the size of filter components, reduce the current ripple, and increase bandwidth. The state space model of the proposed converter is used to evaluate the stability of MDMPIBC. When evaluating the converter performance, the internal resistance of the passive components is considered. For FC power supplies with a full load voltage of 55 V and a nonload voltage of 90 V, the stability state of the MDMPIBBC is analyzed, which is in accordance with the ratings of Ballard's "FCgen 1020ACS" model. With the recommended converter, the observed FC ripple is 4% (less than the allowed FC current shrinkage, ie 5%).

11] Md Saidul Hasan et al (2018) This work proposes a DC-DC buck boost converter that mainly provides a down-shot output voltage lower than input energy. It consists of the same components comparable to conventional DC-DC buck converters, such as MOSFET switches, paired inductors, and coupled capacitors. PSIM simulations have been performed to compare and contrast the efficiency of proposed DCDC buck-boo.st converter and conventional DC-DC buck converter. The results show that the efficiency of the proposed DC-DC buck boost converter is higher than that of the conventional DC-DC buck converter in terms of switching frequency and load variation

III. CONCLUSION

In this proposed system a new transformer-free step-down boost converter based on ZETA converter. Only one chief switch is used in this converter, which reduces losses or recovers efficiency. The voltage boost of the converter is developed than traditional boost, buck boost, ZETA, CUK and. The structure of suggested converter is very simple or therefore converter control is very simple. This thesis presents a new dual-input Cuk-zeta dc-dc converter. Explain in detail its working principle and stable condition. Analysis and simulation results show that the input DC power supply can supply power to load because disaster of each input power supply does not interfere with the operation of other equipment. The 2 contribution bases may have different properties and voltages. The ability of the proposed converter to work in buck and boost modes is an beneficial feature. The converter's boost properties make it suitable for new energy applications. The converter can be studied further for dynamic examination. The closed loop control strategy is also realized for suggested converter

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