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DC-DC Bidirectional Converter For Power Quality in EV System by Using Fuzzy

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Abstract: **For renewable energy storage applications, a bi-directional converter using a Fuzzy based simulation is discussed here. It is recommended that a three-phase, bi-directional converter be controlled by an AC/DC and DC/AC filter algorithm, also a DC-DC converter technology for recharging and discharging batteries. The goal of this study is to design and patent a bidirectional DC/DC converter (BDC) for use in hybrid electric vehicle systems so that a main energy storage (ES1) can be connected to a secondary energy storage (ES2) and a dc-bus of various voltage levels. Both step-up and step-down modes of operation are possible, using a bidirectional power flow control system (high voltage dc link energy regeneration mode). Power can flow in both directions through the converter, which is capable of both step-up and step-down operation. It can also control the flow of electricity between any two low voltage sources individually. An energy storage system nd a fuzzy controller are illustrated in simulation results of the proposed system.**

Index Terms: **AC/DC, DC/AC, renewable energy storage, electric vehicle**

I.INTRODUCTION

Due to environmental and economic concerns, numerous studies have been undertaken on electric vehicles (EVs), plug-in hybrid electric vehicles (PHEVs), and hybrid energy storage systems (HESS) (HESSs). A HESS must use the greatest features and eliminate the worst in order to perform as well as an ideal ESS. High energy/power density, low mass/volume per unit capacity, and long cycle life have been achieved by combining ultracapacitors in a HESS developed by scientists (UCs).

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Only by utilizing power converters is active hybridization of the aforementioned ESSs, in which the ESS power/current may be fully regulated, possible. On July 3rd, 2015, the manuscript was delivered to the supplied address. On October 5, it was updated and approved. Isolated and non-isolated HESS power converter topologies are the most prevalent. Galvanic isolation is achieved in isolated HEES systems by utilizing transformers. There are significant difficulties in building and controlling isolated power converters.

HESS can be built using bidirectional DC–DC converters as in, but this method does not allow the dc bus voltage to be adjusted, which is a big downside. Discrete DC-DC converters could be used for each of the three inputs. The employment of more converters in the multiple converter topology structure enhances output voltage control over the previous design. In the literature, these topologies have been proposed to reduce the cost of many converters. You may want to check out the Microphone, which is both inexpensive and easy to use. While this converter is easy to use, it doesn't allow for active power sharing between the two inputs. The dc-dc/ac boost converter has both DC storage and unidirectional ports for DC sources, hence the number of EES components is not flexible with this converter. FIGURE 1: A bidirectional MIC, the MIPEC, displays how it can manage the charge/discharge current of input sources with voltages lower than the output voltage, as exhibited (a). High-valued capacitor and a single switch are used instead of an inductor to drive both the input source energy and the stored energy in a capacitor. This study suggests a non-isolated and non-unidirectional converter with two in one output based on this information. The UC, a

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large-capacitance capacitor, is an EES element that was used to replace the expensive one.

New vehicle technologies are being pushed forward to tackle climate change and diminishing energy supply. The cutting-edge technology that will be used in future autos is now being investigated. FCV/HEVs are among the most efficient and promising options for this type of application. As a result of, in the past. We analysed the physics of the cars in order to establish the optimal electric propulsion system torque-speed profile... The operating properties of topologies were discussed for a range of vehicles, including HEVs, FCVs, and electric autos. An advanced vehicle power system includes power electronics-intensive technologies as well, in order to handle the massive vehicle load. Two suggested energy management algorithms divide the load power between a stack of fuel cells, a battery, and ultra capacitors. Fuel cell and electric vehicle energy management models have been intensively explored to determine the impact of FC performance and the benefits of hybridization on control strategies. HEV and plug-in HEV energy storage topologies have been described (PHEVs). Batteries weren't the only topic of conversation; they also discussed UC and FC. These hybrid ESSs also include several storage devices. Electric propulsion relies on a battery, electric motors, and a power electronics system.

Two-phase, bidirectional DC/DC converter topology was constructed. Electric vehicles and dc-micro grid systems necessitate a higher voltage conversion ratio for the converter. In addition, Lai investigated the idea of using EV batteries paired to a DC micro grid with a BDC topology, which offers an outstanding voltage conversion ratio. FCV systems typically use the primary battery storage device to initiate the FC and power the propulsion engine. By providing peak power while the car is accelerating, the battery storage devices help enhance the FC stack's inherent low response time. High-power density super capacitors are used for peak power transients during acceleration and regeneration (SCs). SCs store braking energy and release it when the car accelerates, allowing it to generate more power. Longer battery stack and storage device life due to SCs' high power density improves FCV system efficiency.

Fig. shows a functional diagram for a power system using (FCV/HEV) technology. A low-voltage FC stack with SCs directly connected to the FCs provides power. FC stack voltage is fed into the dc/dc power converter, which then converts it into an adequate bus voltage.

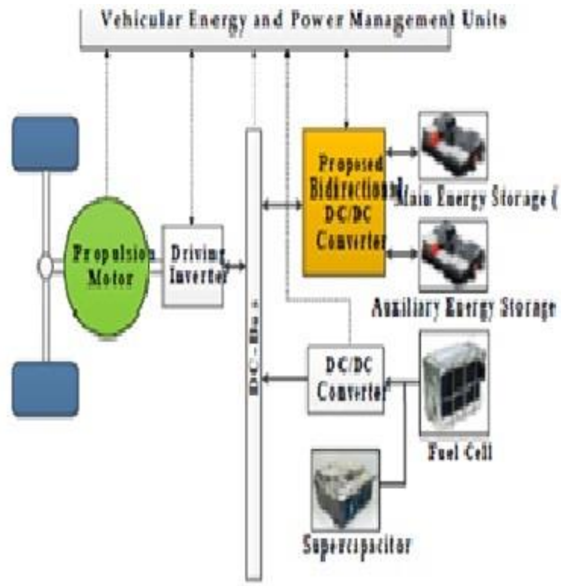


Figure 1. Typial Functional Diagram For A Fcv/Hev Power System

The propulsion motor is powered by this. Battery storage device ES2 can be utilised as an additional battery storage device to build a vehicle range extender concept. A BDC is used to connect the dc bus of the driving inverter to the energy storage of the two batteries.

Most of the time, the voltages in an FC stack and a battery storage device aren't the same for the same reasons mentioned above. BDCs have been designed to lower total costs, weights, and power consumption by delivering precise voltages to loads and controlling power flow between several sources. Bidirectional converters, which can be used with or without isolation, are included in this group.

Transformers with high frequencies provide galvanic isolation in isolated converters. Separate studies have been conducted on various circuit configurations, including flyback, half or full bridge, twin active bridges, and resonant circuits. Non-isolated BDC topologies in non-isolated multi-input converter (NIMVC) topologies outperform standard isolated ones based on data from EV systems. All three of these components can be connected at the same time using MIMO converter topologies. A single inductor and a single pole triple-throw switch are used in each of the three planned double-input converters. Non-isolated MIMO converters were shown in the year that electric vehicles (EVs) began using them. Several components, including the primary switch, inductor, filter capacitor, and rectifier diode, contribute to the voltage gain of the MIMO boost circuit. A three-port power converter with high-gain characteristics was demonstrated to overcome this limitation [27]. As a result, even though it can interface more than two power sources and operate at various voltage levels, the multiport BDC described in [25] has a short voltage range and a tiny voltage difference between the high and low sides of the BDC's output.

II PHOTOVOLTAIC TECHNOLOGY AND POWER CONVERTERS

Photovoltaic semiconductors, which are investigated in the field of photovoltaics, convert solar energy into electrical energy. Electricity is generated in a material when electromagnetic radiation strikes it, and this is known as the "photoelectric effect". In 1839, physicist Edmund Becquerel discovered that some materials can generate a little quantity of energy when exposed to light. Albert Einstein was awarded the Nobel Prize in Physics in 1905 for his explanation of light and the photoelectric effect. The first solar module was developed at Bell Laboratories in 1954. It was marketed as a solar battery, but because of its high price, it was more of a curiosity. As early as the 1960s, the space industry began making extensive use of this technology to power spacecraft. As a result of numerous space flights, technology has advanced, reliability has been proven, and costs have decreased. A global energy crisis in the 1970s pushed photovoltaics to the forefront as a viable alternative to nuclear power. Photovoltaic technology is built upon the solar cell. Solar cells are made using semiconductors, such as silicon. Impurities in the crystal lattice can significantly change semiconductor conductivity. Conductivity is improved by treating silicon, which has four valence electrons. Read on for more... about Due to the existence of cellular impurities, there is an abundance of n-donors (negative charge carriers) on the other side (n-donors). Borons (p-donors) have more electrons in their valence shells than silicon atoms because of their greater attraction for electrons (s-donor). P-type silicon is in close proximity to a higher electron concentration (n type) than n type silicon, which results in electron diffusion (p-type side). n-type silicon is a semiconductor material (p-type side). Since the p-n junction has both electrons and holes on both sides of it, they propagate across it. The electric field formed by the charge imbalance immediately on both sides of the junction prevents carrier diffusion from continuing forever. A diode is created as a result of the electric field, allowing only one path of electricity to flow. The ohmic connectors on either side of the solar cell can be used to connect the electrodes to an external load. Photons of light that fall on charge carriers in the cell provide them with energy. The charge carriers (holes) generated by light are separated from their opposing charges at the junction by an electric field (electrons). When the circuit is closed, external loads draw current from the circuit, which the load then receives.

A. Introduction To Power Converters:

For grid integration, this study suggests a hybrid photovoltaic/fuel cell grid. PV and fuel cells produce low-voltage direct-current (DC) outputs. PV/FC systems must need a power converter to meet the grid's voltage amplitude, frequency, and phase angle criteria in order to connect to the grid. Connect the entire system to the grid by employing boost dc-dc converters and inverters to convert the low voltage DC to high voltage DC. The dc-dc and dc-ac conversions in this system are referred to as two-stage conversion systems. The hybrid system's two-stage conversion necessitates the use of the following power converters.

B. Converters (Input/Output):

Converting between different voltage levels is made easier with the help of a converter that uses DC power. These devices are necessary because a transformer cannot be used to adjust the voltage of DC. In many ways, a DC-DC converter is similar to a transformer.

It's basically a transformer that produces a different voltage or current level than the source of the dc voltage or current. Electronic switching, as in typical transformers, is used to accomplish this dc transition rather than electromagnetic switching. Dc-dc converters are widely used in regulated switch mode dc power supplies as well as dc motor drive applications.

These converters don't work linearly. High-performance controls for these devices are a challenge for engineers in both control engineering and power electronics. When the dc-dc converter is appropriately managed, stability is guaranteed in any working environment. A typical control mechanism must also be able to respond well to changes in load, voltage, and even ambiguity in parameters.

Since the pioneering study of dc-dc converters, a great deal of effort has gone into modelling and controlling various dc-dc converters. The conventional linear approach to state-space averaged equations employs state averaging techniques. The model's state-space average may influence the operational point's state variables. The transfer functions of an open-loop plant can be determined with these formulae. Using the transfer function, a linear controller with the necessary transfer functions may be easily created

Converting current from one form of electrical energy to another is an essential function of many portable electronic devices, including cell phones and laptop computers. The battery or an external power source may not be able to meet the voltage requirements of all of the device's sub-circuits, which could lead to malfunction (sometimes higher or lower than the supply voltage, and possibly even negative voltage). Voltage decreases occur as the battery's stored power diminishes. In order to increase the voltage of a partially depleted battery, switching DC to DC converters are a space-saving alternative.

To efficiently convert DC electricity from one voltage level to another, we use DC-DC converters. Because linear regulators had drawbacks, we argued for switching-mode power supply instead (SMPS). Switch-mode power supply (SMPS) is a common term for power converters that use one or more switches. From now on, whenever we talk about DC-DC Converters, we'll be referring to SMPS.

For example, stepping down a motherboard's 5V DC supply to 3V, 2V, or even lower for the latest CPU processors, or stepping up 1.5V from a single cell's 1.5V to 5V to power electronic circuitry, DC-DC converters can be useful in many scenarios. All of these applications require DC energy to be transferred between voltage levels while wasting the least amount of energy possible. In other words, we're striving for the highest possible conversion rate.

The following are the several types of DC-DC converters:

Depending on the application, DC-DC converters can be found in a range of shapes and sizes. They can, however, be divided into numerous subcategories to make them more manageable. Examples of this include the ability to drop or raise a voltage, as well as the ability of some converters to do both simultaneously. In this section, we'll discuss the most common DC-DC converters.

III. PROPOSED SYSTEM

A. Proposed Topology And Operation Modes

It is here that VH (high-voltage dc bus voltage), VES1, and VES2 are used to represent the proposed BDC design's main and secondary energy storage (Fig. 5.1). Two bidirectional power switches can be used to switch the current loops of ES1 and ES2 on or off (SES1 and SESS2 in the converter structure). Static voltage gain between the two low-voltage dual sources (VES1, VES2) and the high-voltage dc bus is improved by using a charge pump capacitor (CB) as a voltage divider (Q1, Q2, Q3, Q4) in the proposed converter (VH). Therefore, active switches are no longer stressed by high voltages and do not require high duty ratios. Active switches are no longer. S, SES1, and SES2 provide a four-quadrant switch design for managing the power flow between two low-voltage dual sources shown in Fig (VES1, VES2)

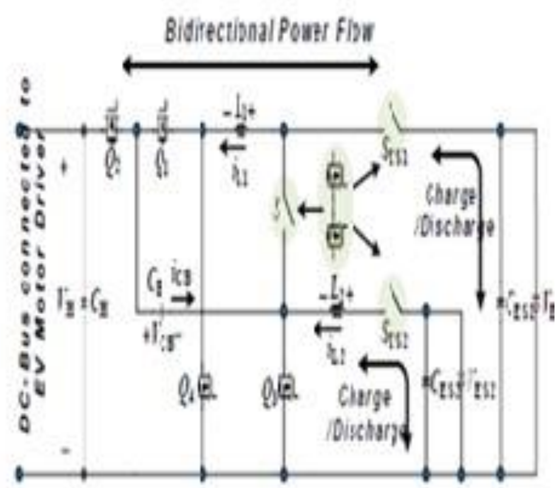


Figure 2. Proposed Bdc Topology With Dual Battery Energy Storage

Positive and negative voltage can be blocked. In order to build this bidirectional power switch, two MOSFETs connected in series and facing in opposite directions are used.

B. Low-Voltage Dual-Source-Powering Mode

a) The converter's circuit diagram and steady state waveforms are shown in Fig. 5.2(a) when it is powered by two low-voltage sources. The two low-voltage dual sources (VES1 and VES2) can now power the dc-bus and its loads because S has been deactivated and switches (SES1, SES2) have been activated. In this mode, the synchronous rectifier is provided by the high-side switches Q1 and Q2, while the low-side switches Q3 and Q4 switch with a 180° phase shift (SR).

b) When the duty ratio is greater than 50%, there are four different circuit states, as shown in Fig. 5.2(b) (Fig.5.2). According to the state of the active switches and the BDC's working principles, the operation can be summarised as follows.

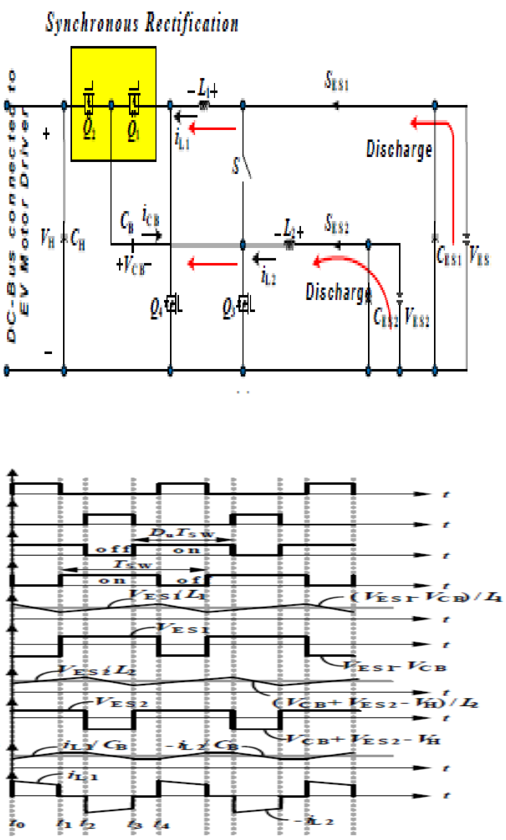


Figure 3. Low -Voltage Dual- Source –Powering Mode Of The Proposed BDC Schematic And B) Steady –State Wave Form

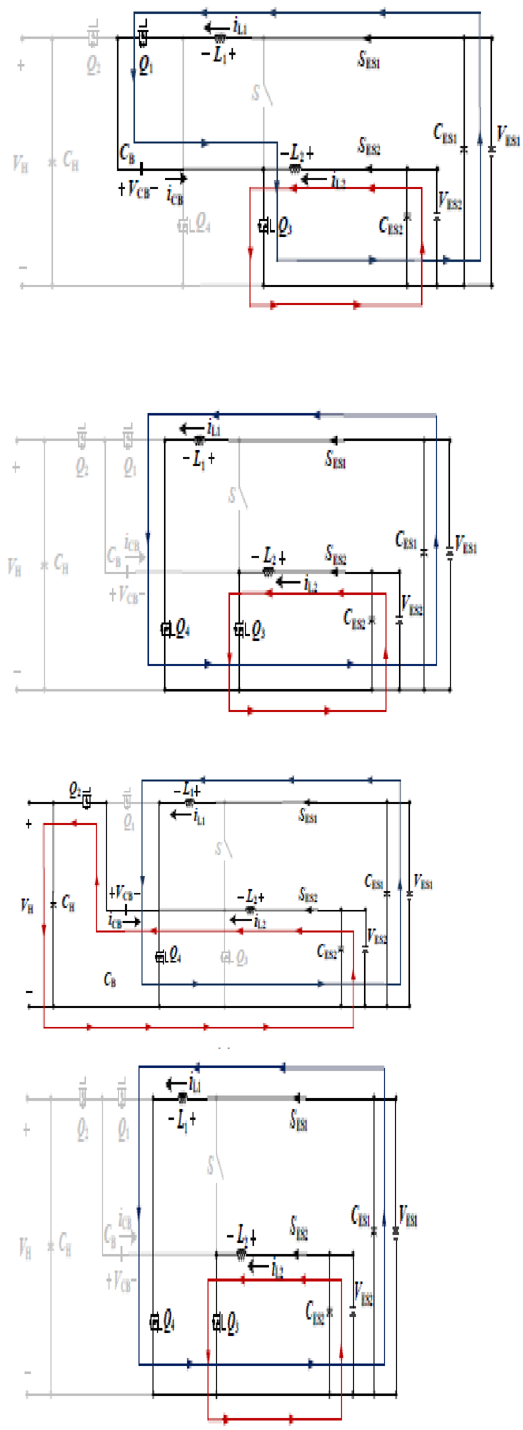


Figure 4. Circuit States Of The Proposed BDC For The Low-Voltage Dual-Source Powering Mode a) State1 b) State 2 c) State 3

IV CONTROLLER IN ELECTRICAL ENGINEERING

A. *Introduction:*

Control theory, a branch of engineering and mathematics that cuts across many fields, focuses on the behaviour of dynamical systems. System output is referred to as "reference" in this context. One or more output variables must follow a reference across time in order for the system's output to be controlled by a controller.

To achieve system stability, the goal of control theory is to find corrective actions from the controller that keep the system from oscillating about the set point.

B. *Contrast Between Open-Loop And Closed-Loop Control.*

A closed-loop action is depicted by the symbol

Negative feedback can be counteracted byIf the controlled variable does not disappear, but instead increases in value (theoretically) to infinity, the system can become unstable.

In order to combat the disruptions for which it was developed, is only able to erase those disturbances.

Controlled objects can't become unstable as long as they're steady.

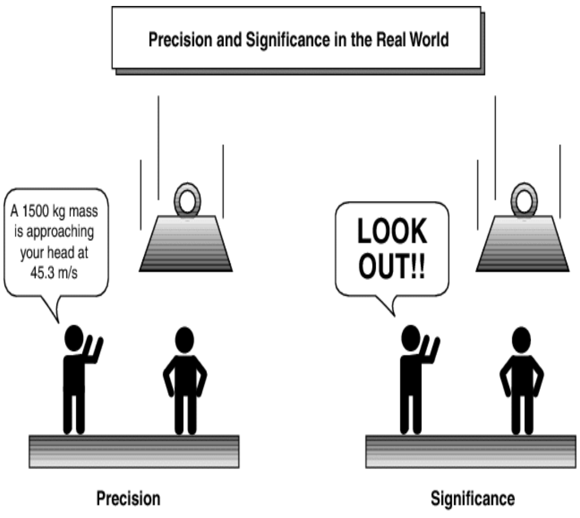


Figure 5. FIG Fuzzy Description

V SIMULATION RESULTS

A. *Existing Results*

Fig shows the MATLAB/SIMULINK circuit design of the proposed bidirectional DC/DC converter.

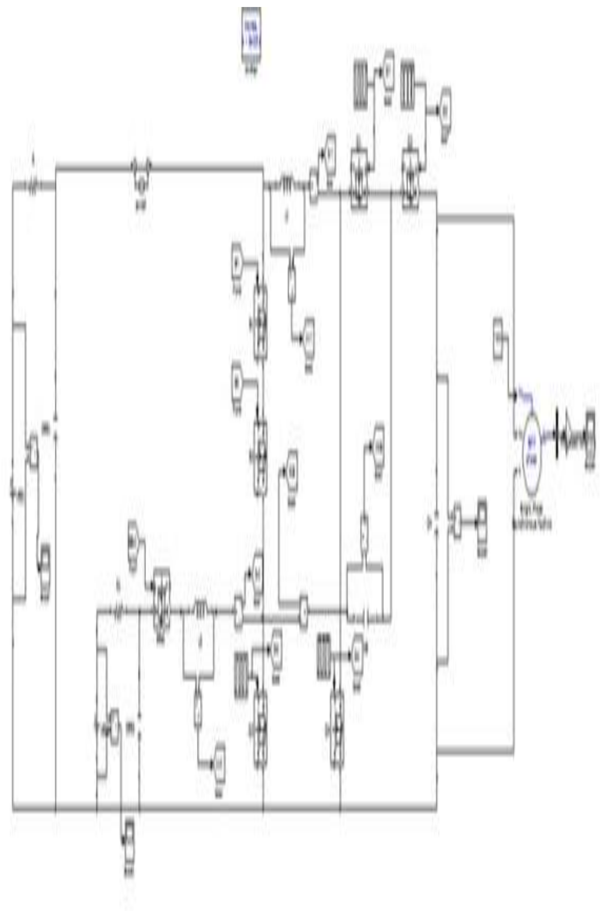
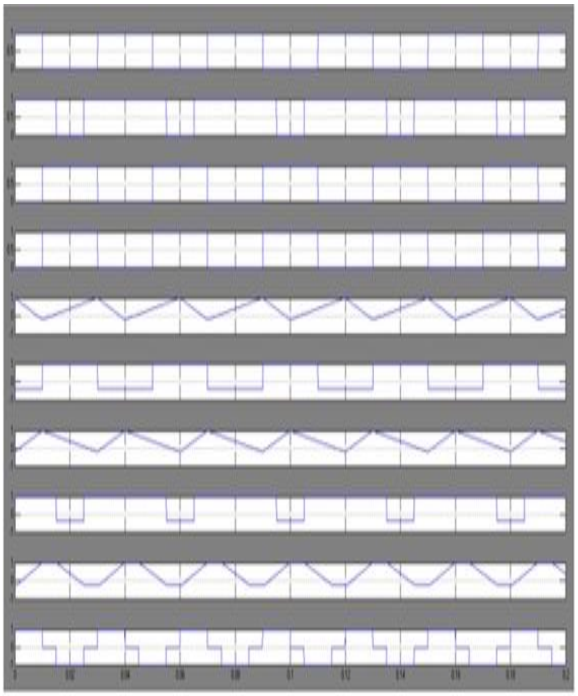


Figure 6. Matlab/Simulink Circuit Diagram Of Proposed Bidirectional Dc/Dc Converter

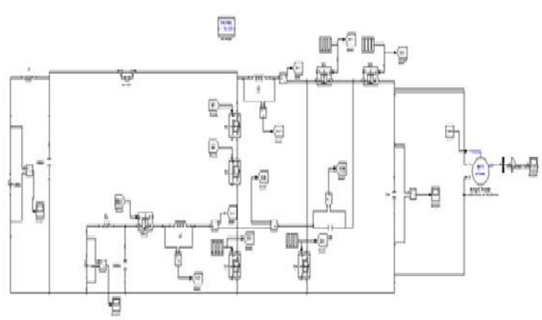
B. *Case 1: Low-Voltage Dual-Source-Powering Mode*

Low voltage dual source powering mode. S has been disabled and switches (SES1, SES2) have been activated, allowing the two low-voltage dual sources (VES1 and VES2) to provide the dc-bus and its loads with energy. In this mode, the high-side switches Q1 and Q2 serve as the synchronous rectifier, while the low-side switches Q3 and Q4 actively switch with a 180° phase shift (SR).

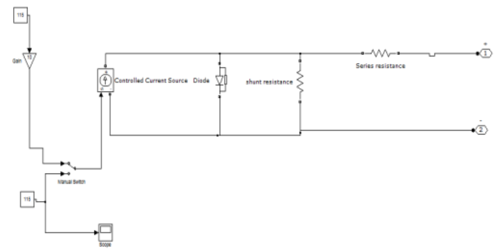


C. FIG: A Stedy Stete Wave Form Of Low - Voltage Dual- Source –Powering Mode Of The Proposed Bdc

D. Extension Results With Pv



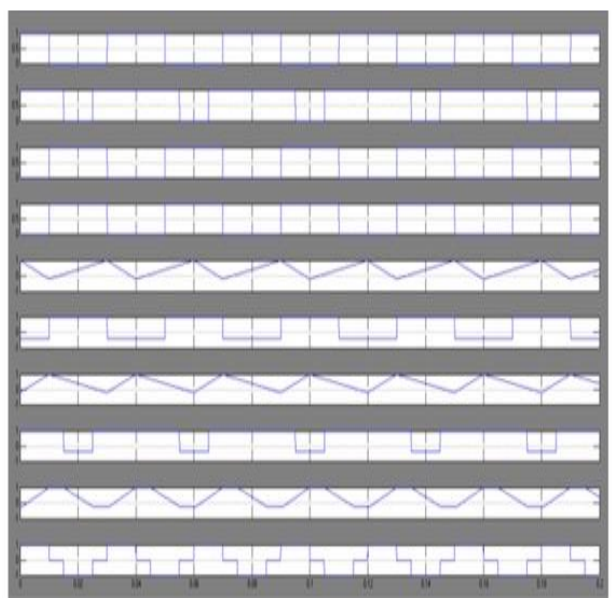
E. Matlab/Simulink Circuit Diagram Of Proposed Bidirectional Dc/Dc Converter With PV



F. PV SUB SYSTEM

G. Case 1: Low-Voltage Dual-Source-Powering Mode

It is possible to use a low-voltage dual-source power option. The two low-voltage dual sources (VES1 and VES2) can now power the dc-bus and its loads because S has been deactivated and switches (SES1, SES2) have been activated. In this mode, a PV system takes the role of the VES to produce ripple-free dc voltage. A phase-shift angle of 180° is applied to low-side switches Q3 and Qt4 while high-side switches Q1 and 2 function as the synchronous rectifier (SR). Figure 7.13 shows common waveforms that can serve as a guide.



H. FIG: A Stedy Stete Wave Form Of Low - Voltage Dual- Source –Powering Mode Of The Proposed Bdc

CONCLUSION

Batteries in the solar car store the power generated by the solar cells. In order for the batteries and motor to make use of the solar array's energy, it must first be converted to the proper system voltage using power trackers. The stored energy can then be used by the motor and motor controller to propel the vehicle. We'll use two batteries in this vehicle: one to power the engine with electricity from the panel, and the other as a backup power source for various electrical devices. A PV-based BDC design was proposed to connect dual battery energy sources to high-voltage dc buses with varying voltage levels... Various power transfer modes were considered when analysing the proposed BDC's circuit design, principles of operation, and static voltage gains. An energy storage device is modelled in the Simulink environment with the grid/RES system using a fuzzy-based bi-directional converter in MATLAB. Both the rectifier and the DCDC converter side filters have been developed to fulfil the demands of the battery and the grid in concert with each other. The highest conversion efficiencies were found in the high-voltage dc-bus energy-regenerative buck mode, the low-voltage dual-source powering mode, the low-voltage dual-source boost mode (ES2 to ES1), and the low-voltage dual-source buck mode (ES1 to ES2). The results show that the proposed BDC works well in FC/HEV systems to construct a hybrid power architecture.

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