MODELLING AND CONTROL OF BOOSTED VOLTAGE CONVERTER FOR RENEWABLE ENERGY SYSTEM

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Abstract:
Developing a high gain dc-dc converter was the goal of the project "Modelling and management of boosted voltage converter for renewable energy system." The high gain approach has been successfully used to dc/dc converter designs. But as time goes on, the output voltage will rise. The output voltage increases in a patterned advance using a high gain approach that is presented in this research. In Stevens' law, it successfully increases the voltage transfer gain. These days, the utilization of renewable energy sources is growing steadily due to its affordability and cleanliness. However, intermittent DC voltages of less than fifty are provided by renewable energy sources such as fuel cells, electrical phenomena panels, etc. Therefore, the output voltage should be improved to a higher voltage level (usually 300V to 400V) in order to connect these sources to an associated AC load or network. Due to the high voltage stress on the switch and severe duty cycle problems during operation, a typical boost converter is unable to provide such a high conversion magnitude relation. High intensity DC/DC converters are therefore required. These converters are used in a variety of applications, such as power supplies in the telecommunications industry, battery backup systems for uninterrupted power supplies (UPS), and high-intensity discharge lamps (HID) for car headlights.

Keywords: high-intensity discharge; Software packages; resonant converters; DC-DC power converters; Mathematical models.

INTRODUCTION

Electronic engineering offers with the technology, transmission, and reception of data and signals with low electricity without a whole lot problem for efficiency. Electrical work is especially concerned with the generation, transmission, distribution, and use of strength with high performance. Basically, power electronics is a subject of examine that integrates energy, electronics, and control. The operation of desk bound or rotating equipment for the transmission, generation, and distribution of electrical electricity is referred to as electricity. Power electronics is a subject of electrical engineering that offers with the application of digital concepts to enhance system performance. Therefore, power electronics have to be used to improve or beautify the overall performance of existing electric systems. Power electronics consists of the observe of modifying semiconductor gadgets and related circuits for power manipulate. Semiconductor gadgets inclusive of SCR, IGBT, MOSFET, DIAC, and TRIAC are used to govern AC or DC strength in a circuit/community.
Power electronic circuits convert one type or level of voltage or modern-day into any other, for this reason they're referred to as converters. The energy of the converters is split into six sorts. These are rectangular wave AC to DC converters or controlled converters. Switching converters are AC to DC converters. To attain a variable DC output voltage, rectangular wave converters opt to trade the voltage sharply and quickly and the AC frequency regular. They use AC thyristors for herbal or linear switching.

- AC to DC device
- DC to DC device
- AC to AC device

- DC to AC device
- Static Switches
- Diode Rectifier

Various AC to DC switching circuits Figure 1.1 shows the connection diagram of a unmarried-phase, full-wave, uncontrolled rectifier with a resistive load. It is likewise called a complete-wave rectifier bridge. In this configuration, each diodes constantly conduct present day at the identical rate, consequently supplying a closed circuit for the current glide momentarily. D1 and D2 are controlled through a fine deliver voltage. Diodes D3 and D4 control the current when the supply voltage is bad. When it's far a load resistor;

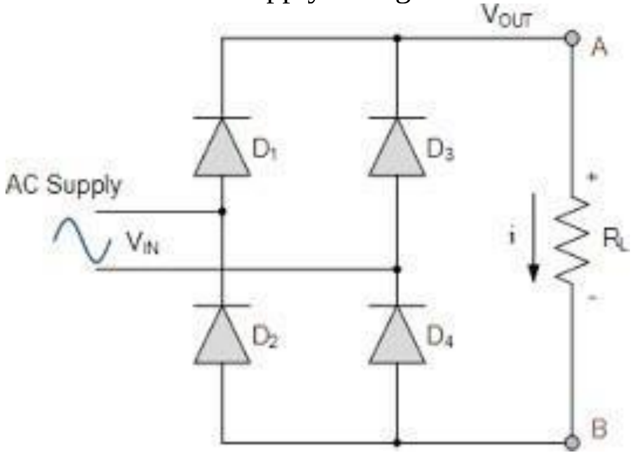


Fig 1: Single phase full wave uncontrolled Rectifier Circuit

A cycloconverter, additionally called a frequency converter, is an AC to AC converter that isn't affected by DC coupling. It converts an AC signal of a particular frequency into an AC signal of a specific frequency. This trade is finished the use of switched switches which include thyristors and their control systems.
In addition to frequency manage, the voltage output of a cycloconverter is often changed the usage of section manage strategies. These are normally used to acquire a hard and fast frequency from a variable frequency enter or to gain a variable frequency from a fixed enter.

Step-up cycloconverter:
In a step-up cycloconverter, the output frequency is better than the enter frequency. Not delayed, as used in not not on time. The frequency modulation of most processors in India and the US is 60Hz. The cycloconverter accelerator requires pressured transmission, which increases the complexity of the circuit.
In a step-down cycloconverter, the output frequency might not attain the input frequency. This is the most not unusual cycloconverter as it has many touchy applications. The cycloconverter calls for a slow herbal transition, which is simple to construct and smooth to govern. Several step-down levels are to be had for one-of-a-kind packages.

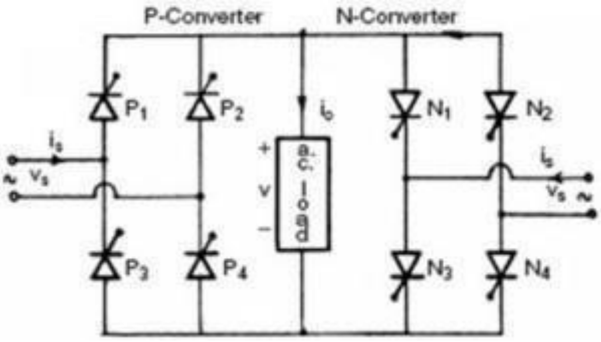


Fig 2: Single phase to single phase cyclo-converter

This form of cycloconverter converts a unit AC wave with a specific frequency and amplitude into an output AC wave of a completely unique frequency and amplitude. Three-section to one-segment cycloconverter

RELATED WORK

Neeti Dubaj et al. (2019) provided a overview at the analysis of a bidirectional DC-DC raise dollar-boost amplifier with a quadrature converter for strength garage gadgets. In this overview, it is clear from the authors' evaluation that the bidirectional DC-DC buck-raise converter makes a more suitable system with power garage [1].

M. Sheng, D. Zhai, X. Wang et al., (2016) supplied a review at the coordination of enterprise and shrewd marketplace for strength supply of hybrid inexperienced mobile community switches. In this article, they stated that the grid-geared up, intermittent and erratically dispensed energy of the industry poses critical challenges in delivering mobile visitors at a given time throughout one-of-a-kind networks. The aim is to lessen the strength consumption of cell networks by means of using renewable energy and renewable energy. We gift this hassle as a nonlinear combined-integer programming problem, which has been demonstrated to be NP-hard [2].

E. Jimenez, M. J. Carrizosa, A. Benchebe et al., (2016) offered a overview of a brand new strength generation float approach for more than one DC networks linked together. In this review, the authors evaluation the mathematical motivation for this new electricity waft algorithm from this paintings, which ensures the lifestyles of a unique answer because the voltages technique the nominal cost. The new approach became also designed to be without problems adopted in AC structures [3].

J.Y. Yong, V.K. Ramachandramurthy et al. (2015) offered a assessment of a bidirectional EV fast charging station with reactive power benefit for voltage manipulate. In this overview, the author examines the voltage rise of high-pace electric powered cars on low-voltage distribution networks under top load conditions. Simulation consequences show that rapid charging of six EVs results in emissions beyond the safe operating voltage level [4].

Vitor Farno Pires, Danier Foito, Armando Cordeiro et al., (2017) Review of a DC-DC converter with bidirectional gain and bidirectional performance for batteries. In this paper, the author considers a bidirectional quadrupole converter particular to applications requiring a financial institution of electrical strength garage devices together with batteries or supercapacitors [5].

Dason-Anjing, Chun-Soko, Guo-Guang Zhen et al., (2013) provided a assessment of a Cockcroft-Walton voltage amplifier cascade utilized in a transformer with a excessive-level DC-DC converter. In this evaluation, in destiny paintings, the writer considers the weight impact on the output voltage of the proposed converter, which desires to be managed to perform a constant-state evaluation [6].

Seyed Hossein, Resq Ghazi, Hamad-Haydari et al., (2019) offered a review of a scalable bidirectional quadrupole DC-DC converter. In this assessment, the writer examines the complexity of the desk construction. Complex small signal, high sensitivity, obligation cycle depending on the benefit [7].

Juqiu, Xuan, Yan Bao, Leiyiwan et al. (2014) supplied a evaluation of bidirectional converter topologies for power alternate among EVs and the grid. In this evaluation, the writer studied its operating ideas and methods to perform and resolve the energy troubles [8].

EXISTING SYSTEM

The alternative of a single-section on-board inductor (CI) converter in a car electrical panel is laid low with the big variety of elements inside the CI converter. Given the large isolation problems of isolated converters, together with the battery outcomes they motive, the layout of a non-remoted shape could be a compromise. Therefore, this paintings focuses most effective on bidirectional G2V and V2G DC-DC converters. Non-disruptive scalable bidirectional DC-DC linked to a lithium-ion battery.

BOOST CONVERTER:

An amplifying device can be a simple way to modify the device. It takes the enter voltage and will increase or decreases it. It includes an inductor, semiconductor, diode and capacitor. It can be as easy as a 555 timer or a flash SMPS IC which include the popular MC34063A IC. A lifting tool requires cohesion. It is less heavy than an AC or induction electric powered device. They have been initially advanced within the Sixties to residence herbal gasoline structures on ships. For these converts, the requirement become to be as small and cost effective as viable. Switching systems inclusive of SMPS are difficult to design because their form depends on whether the transfer is open or closed. Examples of DC/DC converters at the moment are in use. The medium-round shape is popular. Another way is to do not forget the characteristic of the electricity of the peak. We all understand that the strength saved in a given electrical device is given with the aid of x L x I2. Where L is the inductance of the coil, and that i is the most peak modern. So, we placed some energy from the input into an electrical tool and transfer the same power to the output, albeit at a higher voltage (electricity is conserved, as is obvious). This occurs hundreds of times per 2d (depending at the frequency of the generator), after which the energy is brought to each cycle to produce a measurable and beneficial quantity of power, consisting of tens of joules or 10 watts per 2d. This is due to the fact the equation teaches that the power in an electrical machine is proportional to the induction and, in general, the rectangular of the voltage. To boom the energy output, the primary concept is to growth the scale of the electric device. Of route, it's far that clean, however now not via lots, we suppose! If we strive to growth the induction, the maximum top present day will be reached, with the intention to lower over a certain time, or the time it takes for it to rise (remember the fundamental equation V/L = dI/dt), so the total electricity will now not boom a whole lot! But, for the reason that strength is proportional to the rectangular of the maximum contemporary, there could be a large growth in electricity output. So, we remember that whilst selecting an electrical machine, there may be a exchange-off between electric impulse and maximum cutting-edge. With this statistics, we can research a scientific approach for designing a lift device for any transit function using a way called role area actuation. This simplification became techniques into one. A new LED version of the cognitive fashion equation that helped to extend the SMPS.

OPERATION OF EXISTING SYSTEM:

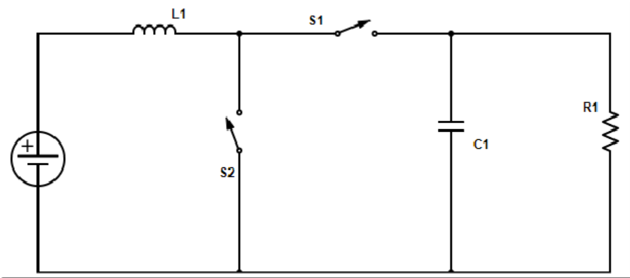


Fig 3: Equivalent circuit diagram of Existing system

Figure 3 indicates the equal circuit diagram of the existing gadget. It consists of an input voltage supply and an inductor. S1 and s2 represent switches. The MOSFET acts as a switch to keep the device on. The capacitor right here acts as a clear out. And it blocks the unnecessary additives. Finally, R1 acts as an outside load.

COMPONENTS OF EXISTING SYSTEM

Input voltage	42-48V
Capacitors (c1-c6)	470uf
Inductor	1.5mH
Switching frequency (fsc)	1KHZ
Switching frequency (fsm)	60KHZ
Switching Devices	IGBTs
Diodes	PN-junction
Output Power	200W
Output Voltage	450V
Output Current	0.45A

RESULTS OF EXISTING SYSTEM

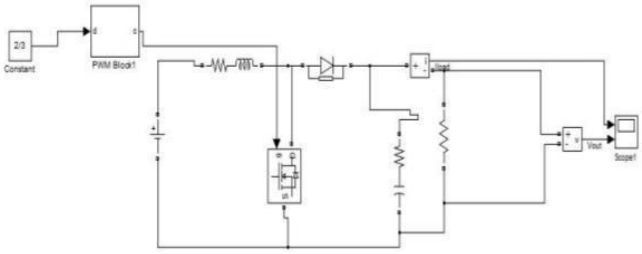


Fig 4: Block diagram of Existing simulation Result

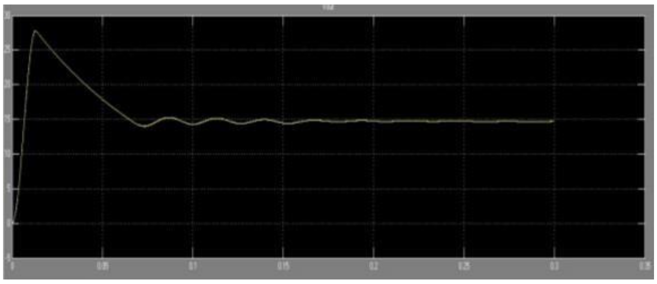


Fig 5: Output voltage of existing system

50 kHz is the operating frequency. The simulation yielded an output voltage of 15 V. The duty cycle is kept above 50%. Fig. 3.3 displays the simulation's output current, which is o.4 A.

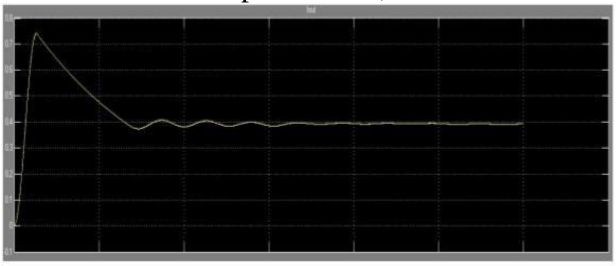


Fig 6: Output current waveforms

RESULTS OF PROPOSED SYSTEM

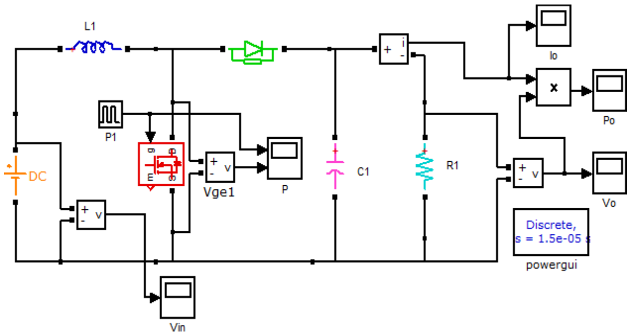


Fig 7: Circuit diagram of conventional boost converter.

Figure 7 displays the circuit diagram for a traditional boost converter. Figure 8 shows the input voltage, which is 24V. Fig 9 shows the switching pulse for the boost converter M1 & Vds. The gate voltage is 1V, and the voltage across the drain to the source is 80V.

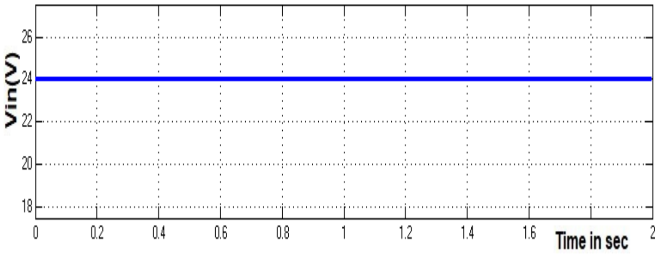


Fig 8: Input Voltage

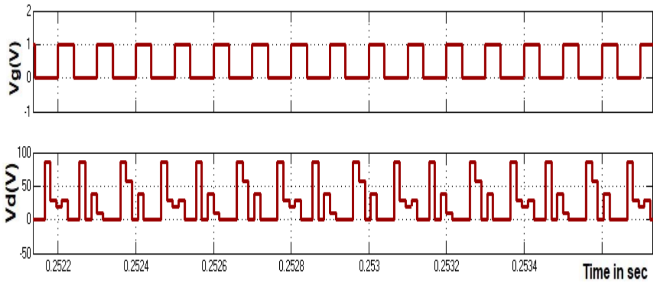


Fig 9: Switching pulse of boost converter M1 & Vds

Figure 9 shows the voltage across the R-load, which is 85V. Figure 10 shows the ripple voltage across the R-load, which is 88V. Figure 11 shows the current flowing via the R-load, which is 0.9A. Figure 12 displays the output power, which is 74W.

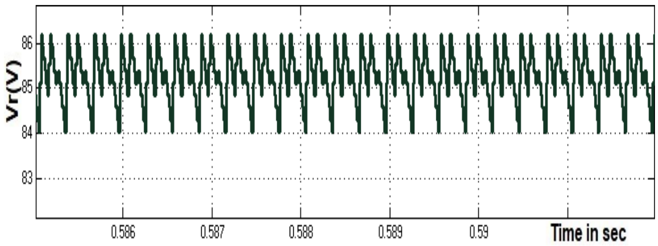


Fig 10: Voltage Ripple across R-load

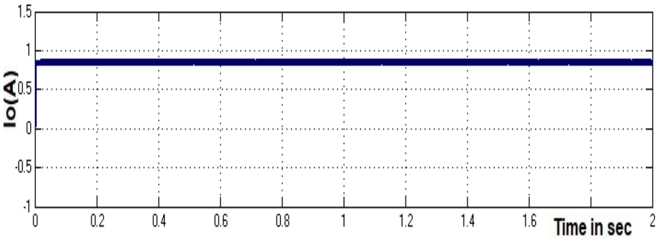


Fig 11: Current through R load

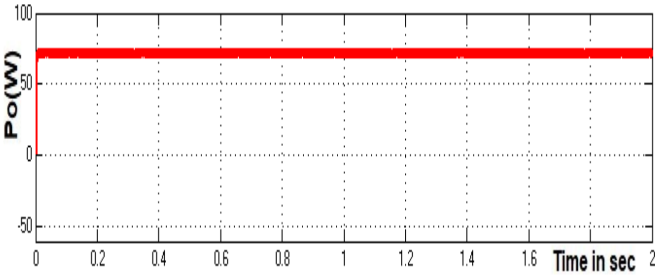


Fig 12: Output power

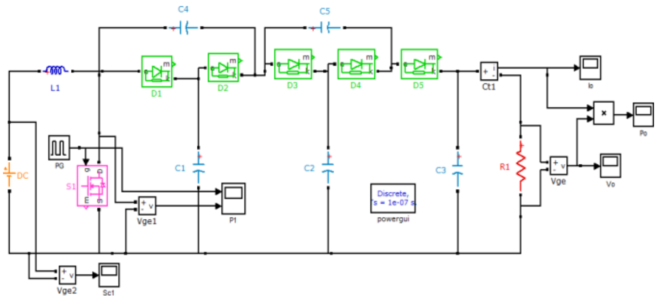


Fig 13: Circuit diagram of proportional bi-directional DC-DC converter

Figure 13 displays the circuit diagram for a proportional bi-directional DC-DC converter.

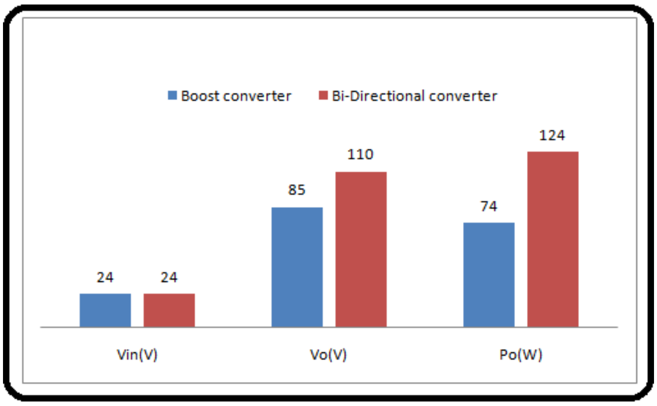


Fig 14: Bar chart of Output Voltage, Ripple Voltage & Output Power

Table compares the output power, output voltage, and ripple voltage of a boost converter and a bi-directional DC-DC converter. Figure 14 shows a bar chart diagram of a boost converter and a bi-directional converter with input voltage, output voltage, and power.

SIMULATION RESULTS:

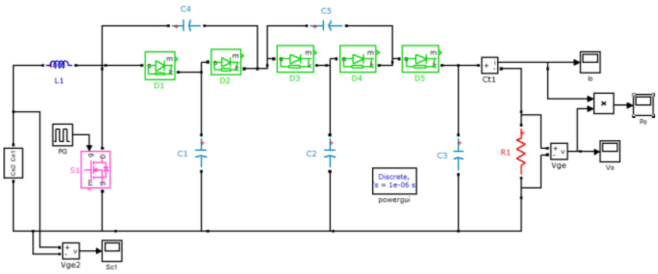


Fig 15: Circuit diagram of proposed bi-directional DC-DC converter with source disturbance.

Figure 15 displays the circuit diagram for the suggested bi-directional DC-DC converter with source disturbance. The input voltage, which is 30V, is displayed in Fig 16 Figure 17 shows the voltage across the R-load, which is 165V. Figure 18 shows the current flowing via the R-load, which is 1.7A. The output power, which is 280W, is displayed in Figure 19.

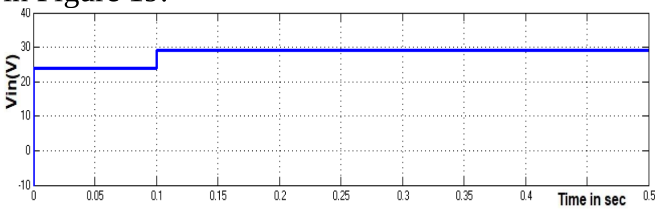


Fig 16: Input voltage

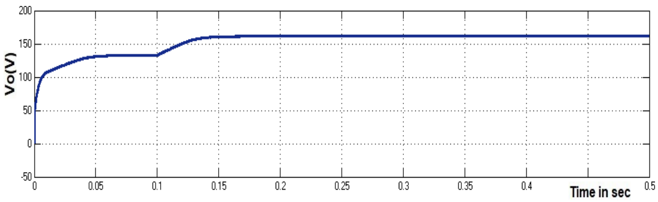


Fig 17: Voltage across R-load

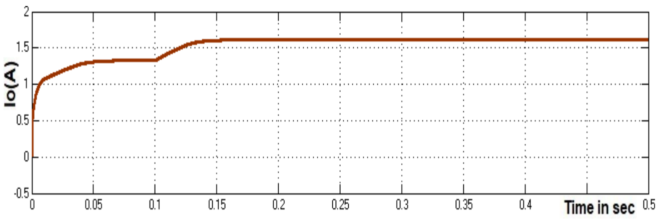


Fig 18: Current through R-load

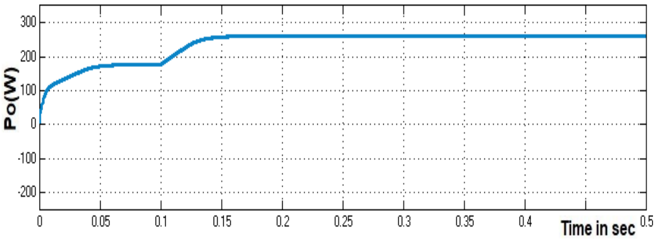


Fig 19: Output power

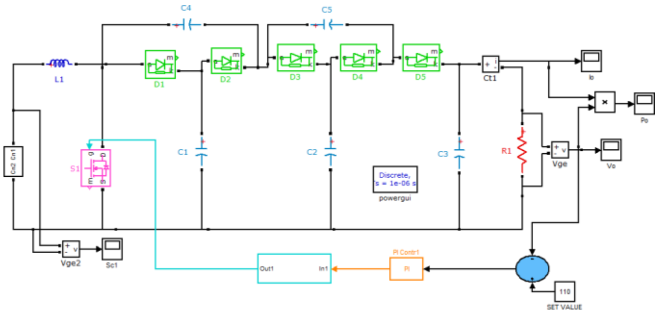


Fig 20: Circuit diagram of proposed bi-directional DC-DC converter with closed loop PI controller.

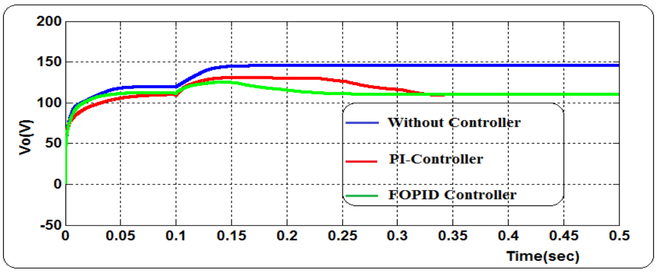


Fig 21: Output voltage with PI and FOPID controller.

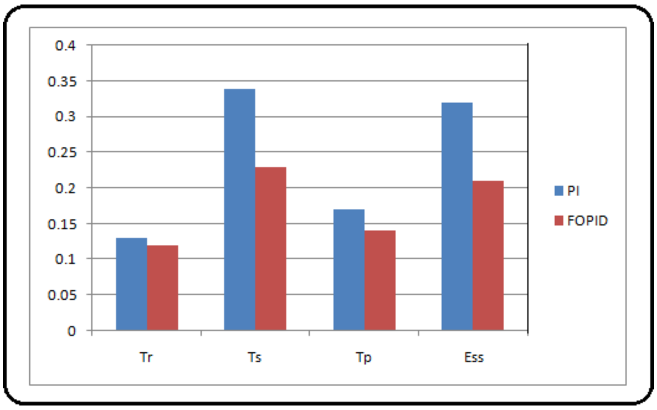


Fig 22: Bar chart of PI and FOPID controller

HARDWARE RESULTS
POWER SUPPY CIRCUIT:

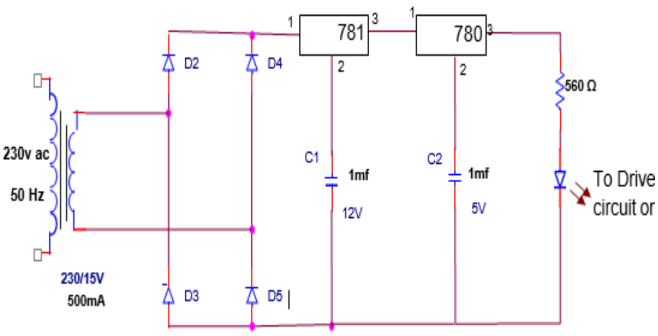


Fig 23: Power circuit.

PIC CONTROLLER

The hardware used in this project is a Pic-microcontroller, specifically the "Pic 16F84A." One advantage of the Pic-microcontroller is that it has a smaller instruction set than the conventional microcontroller. In contrast to conventional processors, which are usually sophisticated, Pic microcontrollers might be architectural processors.

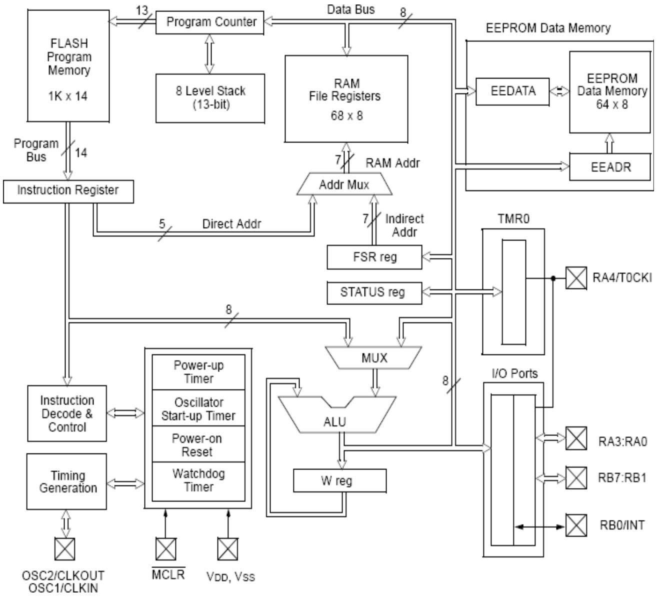


Fig 24: Block Diagram of "PIC16F84A"

EXPERIMENTAL RESULTS:

Using a power MOSFET IRF840 and a microcontroller PIC 16F84A with a switching frequency, the modified high gain converter prototype is created in the lab to confirm its functionality and performance. The hardware includes a control circuit, a rectifier circuit, an MBC-board, and a load. Figu.5.7 displays the MBC hardware snapshot.

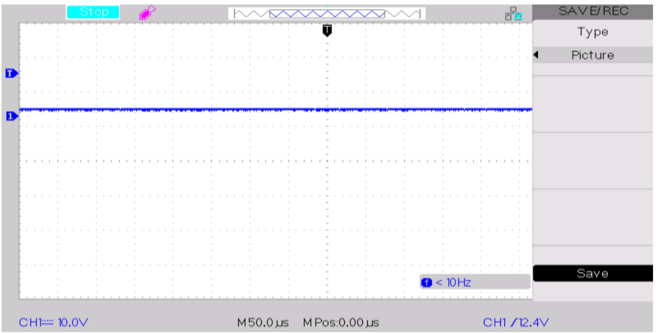


Fig 25: Input voltage

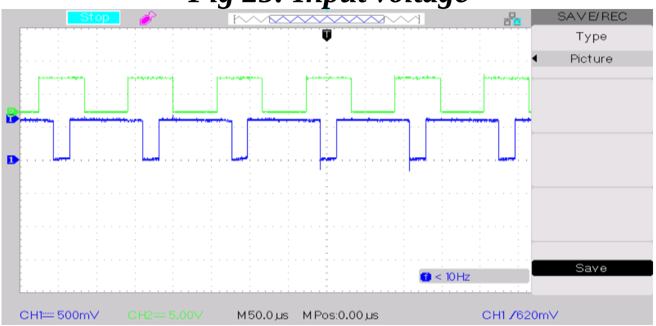


Fig 26: Switching pulse of M1&Vds

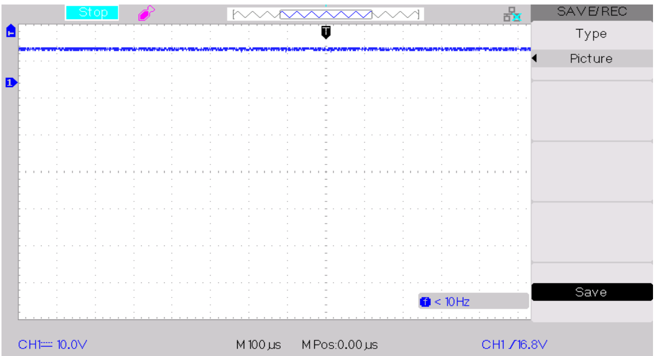
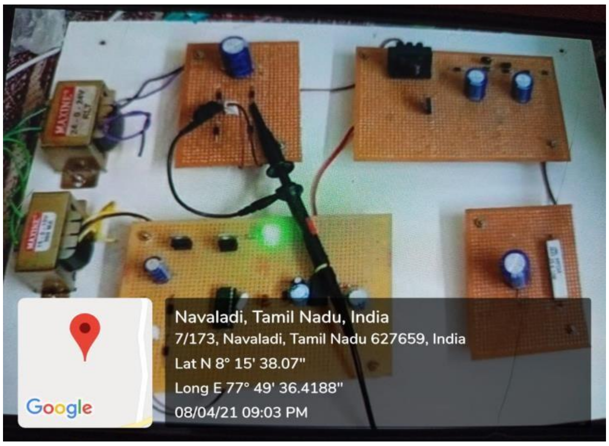


Fig 27: Output voltage across R load

CONCLUSION

A simulation of the boost DC-DC converter system's current circuit diagram is made. A high gain bidirectional DC-DC converter with an open loop is modeled using the suggested circuit schematic. It simulates a bidirectional DC-DC converter with high gain and a closed-loop PI controller. It simulates a high-gain bidirectional DC-DC converter with a closed-loop FOPID controller. The output voltage is raised to 110V from 85V. The ripple in voltage is decreased from 2.0V to 0.15V. The output power is raised to 124W from 74W. The rise time is shortened from 0.13 to 0.12 seconds. Peak time is shortened to 0.14 seconds from 0.17 seconds. The settling time has been shortened from 0.34 to 0.23 seconds. The steady state error voltage drops to 0.21V from 0.32V.

The IRF-840 offers value effectiveness, low on-resistance, ruggedized device form, and quick changing. For all commercial-industrial applications, the TO-220 package is widely preferred at power dissipation levels up to about fifty watts. The TO-220 is widely accepted in the industry due in part to its low package cost and low heat resistance.



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