TWO STAGE DC AC BOOST CONVERTER USING QZSI

A Project report submitted in partial fulfilment of the requirements for the degree of B. Tech in Electrical Engineering

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CERTIFICATE

To HOD

This is to certify that the project work entitled “**Two Stage DC-AC Boost Converter using QZSI”** is the bona fide work carried out by Rachaita Dutta (11701617049), Modhurima Datta (11701617055), Raj Kumar (11701617048), Niladri Shekhar Biswas (11701618007), the students of B.Tech in the Dept. of Electrical Engineering, RCC Institute of Information Technology (RCCIIT), Canal South Road,

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CHAPTER 1

INTRODUCTION

DC-DC CONVERTER:

DC/DC conversion technology is a major subject area in the field of power engineering and drives and is widely used in industrial applications and computer hardware circuits[1] . DC/DC converters have been under rapid development since the 1940s. In addition to its high growth rate, the DC/DC converter market is undergoing dramatic changes as a result of two major trends in the electronics industry: high voltage and high-power density. The production of DC/DC converters in the world market is much higher than that of AC/DC converters.

In many technical applications, it has been required to convert a given fixed DC input to a variable output voltage and for that a specific type of converter is used called DC-DC converter. These have applications in energy storage and transferring. At present, the demand of such DC-DC converters have increased a lot and they have had a surge in their roles in hybrid vehicles [2][3].

A Boost converter is a DC-to-DC converter which a high DC output voltage from a low input supply. The magnitude of the output voltage depends on the duty cycle. It basically helps us stabilize an unstable voltage fluctuation. The main reason as to why there is a fluctuation in the voltage is that the outer power web experiences a voltage load change which is an adjustable dual voltage regulator. It is analogous to a transformer, the difference only being that it steps up AC voltage whereas a boost converter steps up DC voltage. It is a class of Switched Mode Power Supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. . To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter). A switching converter are advantageous over linear The key components of a boost regulator are an inductor; a semiconductor switch, most commonly a power MOSFET; a rectifier diode; an integrated circuit (IC) control block; and input and output capacitors.

A positive-output cascaded boost converter is the type of converter that gives a high output DC voltage of positive polarity. It has a simple structure but we get our output voltage increasing in geometric progression. In this project we have worked on the first three stages of this PO cascaded boost converter and for convenience they are called Elementary, Stage-2 and Stage-3 converters.

The Elementary converters are the fundamental converters. There are three types of fundamental DC/DC topologies that were constructed, namely: buck converter, boost converter, and buck-boost converter. They can be derived from single-quadrant operation choppers. A boost converter works in a second-quadrant operation. It can be derived from quadrant II chopper.

CHOPPER:

Choppers are the circuits that convert fixed DC voltage to variable DC voltage or pulse width-modulated AC voltage. A DC motor can run in forward running or reverse running. During the forward starting process, its armature voltage and armature current are both positive. We usually call this forward motoring operation or quadrant I operation. During the forward braking process, its armature voltage is still positive and its armature current is negative. This state is called the forward regenerating operation or quadrant II operation. Analogously, during the reverse starting process, the DC motor armature voltage and current are both negative. This reverse motoring operation is called the quadrant III operation. The two-stage boost circuit is derived from the elementary boost converter by adding the parts which are an inductor, two diodes and a capacitor and the three-stage boost circuit is derived from the two-stage boost circuit by double adding the above mentioned parts.

INVERTER:

Inverters are devices that converts a DC input to a symmetrical AC output. The output could be fixed or variable at a fixed or variable supply. A variable output is obtained by varying the input and keeping the gain constant. However, if the input is fixed and uncontrollable, a variable output can be obtained by varying the inverter gain which is done by Pulse-Width-Modulation control within the inverter.

QUASI Z-SOURCE INVERTER:

The next part that we have covered in our project is on the topic Quasi Z-source Inverter (Qszi). We know that solar energy is something that is available to us in abundance and it can be used as an environment friendly source to satisfy our energy needs. With an increase of demand in energy consumption along with the increase of population all over the world it is very important for us to turn to clean energy source, i.e., renewable sources. Acceptance of distributed power generation has been witnessed all over where renewable sources of power is spread across geographically. This however have a drawback which is production of power at different voltage and frequency for different sources. This can be overcome by using a quasi z-source. In a Quasi Z-source Inverter, we can connect the Photovoltaic (PV) arrays to an inverter which will convert DC output of PV cells to AC supply for the grid [4]. Thus, a sustainable power production can be achieved using renewable and hence eco-friendly energy source.

CHAPTER 2

Literature Review

In this paper [5] we see an alternative approach to modelling pulse width modulated (PWM) dc/dc converters out of basic converter units (BCU's) is presented in this paper. Typical PWM dc/dc converters include the well-known buck, boost, buck–boost, Cuk, Zeta, and Sepic. With proper reconfiguration, these converters can be represented in terms of either buck or boost converter and linear devices, thus, the buck and boost converters are named BCU's. The PWM converters are, consequently, categorized into buck and boost families). Using the proposed approach, not only can one find a general configuration for converters, but one can yield the same small-signal models as those derived from the direct state-space averaging method. Additionally, modelling of quasi-resonant converters and multi resonant converters can be simplified when adopting the proposed approach. The small-signal modelling of these converters operated in CCM can therefore be performed systematically and efficiently. A unique feature of the proposed approach is capable of classifying the PWM converters into families. A relationship among converter dynamics in a family may exist.

We have gone through another paper [6] that presented new ZVZCS DC-DC converter topologies for traction applications by utilizing modified resonant networks and an auxiliary cell. The proposed converter topologies have ZVS and ZCS softs witching features. ZVS and ZCS are Zero voltage and Zero Current Switching soft techniques. In addition to this the proposed converters feature in high order resonance with improved the overall voltage conversion gain. The soft-switched half bridge and full bridge topologies using medium frequency transformer for traction applications is presented in this paper. The major advantages of proposed topologies are able to increase the switching frequency with reduced switching losses. The detailed operation principles, state space analysis and simulations results are presented. The major advantage of the Half bridge and full bridge DCDC converter operates under ZVS and ZCS, which will reduce the switching losses and also improved voltage conversion gain. The major advantage of the Half bridge and full bridge DCDC converter operates under ZVS and ZCS, which will reduce the switching losses and also improved voltage conversion gain. The state space analysis also presented for the modified resonant networks. The simulation results show that performance of the proposed DC-DC converter topologies suitable for auxiliary drives in traction and high power applications.

Isolated DC-DC converters with galvanic isolation are commonly used in electric vehicle (EV) battery chargers. These converters interface between a DC voltage link, which is usually the output of a power factor correction (PFC) stage, and an energy storage unit. CLLC and Dual Active Bridge (DAB) DC-DC converters can achieve high power density, high energy efficiency, wide gain range, galvanic isolation and bidirectional power flow, and therefore, have potential applications as DC-DC converters for bidirectional EV charging systems. In this manuscript, full bridge CLLC

(FBCLLC), half-bridge CLLC (HBCLLC), full bridge DAB (FBDAB), and half-bridge DAB (HBDAB) DC-DC converters are evaluated and compared for their suitability for EV chargers. All the converters are designed with optimal soft switching features. The operating principles, design methodologies and design considerations are presented. Prototypes of the converters with power rating of 1 kW are designed and developed. The prototypes interface a 500 V DC link and a 200 – 420 V load, which is common for electric vehicle applications. The performances of the circuits are analysed and a comprehensive comparison is conducted. A new general gain expression of the HBCLLC converter is derived in this manuscript. The practicability and performance of the four DC-DC converters for bidirectional EV charging systems are discussed. The converters are designed with 1 kW power rating. All the converters can achieve high efficiency and bidirectional power flow. The topologies, operating principles and design methodologies of the converters are discussed, and the performances of the converters are compared. For bidirectional, wide load EV charging systems, the CLLC converters are slightly better than DAB converters. Considering the efficiency, size and cost, the HBCLLC converter will be the most suitable choice at 1kW. [7]

The paper [8] we next present works on a novel topology named forward–flyback bidirectional dc–dc converter (BDC), which is a hybrid of forward and flyback converters. The windings of forward and flyback transformers are connected in series on the primary side and in parallel on the secondary side. The proposed converter has no start-up problem and no high voltage spikes on the switches, which otherwise are inherent for current- and voltage-fed-type bidirectional converters. It is easy to achieve soft switching by proper control and design. The built-in flyback transformer acts as a filter inductor, so the current ripple is smaller than flyback BDCs. In this paper, the operation principles and characteristics of the proposed topology are analyzed in detail. The advantages aforementioned are verified with experimental results of a 300-W prototype. Compared with current- and voltage-fed-type BDCs, they have smaller voltage spikes on switches; moreover, they have no start-up problems and, therefore, additional flyback windings coupled with the boost chokes are no longer needed. Compared with flyback-type BDCs, the proposed BDCs have smaller current ripples on parallel-winding side, which is a valuable merit in battery charging and discharging applications. Soft switching of all switches, plus the proper design of the two transformers' turns ratios, helps to improve the conversion efficiency and power density.

In this paper, one kind of two-stage bidirectional AC/DC converter for battery formation is studied. And the post-stage DC/DC converter based on the full-bridge and push-pull structure is the focus of the study. Firstly, the small signal model is built for the bidirectional DC/DC converter. And then the control compensator is designed. The control method based on one kind of bidirectional switching control strategy with a common inner ac current-loop and an external voltage-loop double-loop design is used to realize the bidirectional operation. Also, the bidirectional switching control strategy based on digital control platform is designed. At last, a prototype of the bidirectional DC/DC converter is fabricated. The experiments results verify the correctness of the control loop and the bidirectional switching control strategy. Based on the new technology of battery formation, the two stage bi-directional AC/DC converter is suitable for battery formation which is more environmental and energy- recyclable. The analysis and the experiments of the bidirectional DC/DC converter verify the correctness of the bidirectional DC/DC control model, the loop design and the bidirectional switching control strategy. It has good engineering application values. [9]

In the next paper [10] we decide to cover, the Quasi-Z-Source Inverter (QZSI) with Energy Storage for Photovoltaic Power Generation Systems is presented. The energy storage device was integrated to QZSI topology with no need for an extra charging circuit. This upgraded topology acquires the operating characteristics from the traditional QZSI, plus the capability of operating under very low PV power conditions. Its main operating points are classified into two modes, the low PV power mode, where the battery is discharged and the high power mode, where the battery is charge up. An extended input power operating range is achieved since the lack of Photovoltaic power can be compensated by the battery. Quasi-Z-Source inverters are very suitable for Photovoltaic power generation systems and this upgrade makes them even more suitable for this type of applications. To obtain the experimental data, a prototype was built and used to demonstrate that the Quasi-Z-Source inverter is capable of managing the State of Charge of a battery and the AC output voltage in each operating mode. The proposed QZSI with energy storage is capable of performing all the traditional QZSI functions plus the new acquired ones. With the energy storage device the inverter is able to operate even in the case that the available PV power is less than the load power, since the energy storage device compensates for this lack of power in the PV system. On the other hand, it was demonstrated that in the case when the available PV power is bigger than the load power, the power not consumed by the load can be used to charge the battery. Therefore, the proposed QZSI with energy storage has a wider PV power operating range. Experiments and simulations showed a good system performance and demonstrated that the proposed operating behaviour was achieved.

This paper presents a comparative study between the single-stage quasi-Z-source inverter (QZSI) and the conventional two-stage inverter for Photovoltaic (PV) applications based on a filed programmable gate array (FPGA). The comparison is conducted in terms of the voltage stress on the inverter switches, the required active and passive components, the transient and the steady state performances, and the inverters efficiency. The modelling, the theoretical concepts, and the control design for both inverters are presented and discussed. Moreover, the passive components requirement and the inverters losses analysis are introduced. Experimental investigations are conducted to verify the proposed inverter. It is noted that the QZSI shows a lower voltage stress on the inverter switches than the conventional two-stage inverter when the inverter gain up to 2. The results also demonstrate that the transient and the steady state performances of QZSI are comparable with the ones of the two-stage inverter under the same operating conditions. However, the QZSI shows lower THD values which in turn result in a reduced output

filter size and cost. Additionally, the efficiency test is done based on calculations and real measurements for both inverters. The results point out that the QZSI shows higher efficiency than the conventional solution. Based on these observations, the QZSI proposes an attractive alternative for PV applications.It is noted that the QZSI shows a lower voltage stress on the inverter switches than the conventional two-stage inverter when the inverter gain up to 2. The results also demonstrate that the transient and the steady state performances of qZSI are comparable with the ones of the two-stage inverter under the same operating conditions. However, the qZSI shows lower THD values which in turn result in a reduced output filter size and cost. Additionally, the efficiency test is done based on calculations and real measurements for both inverters. The results point out that the qZSI shows higher efficiency than the conventional solution. Based on these observations, the qZSI proposes an attractive alternative for PV applications.

This paper [11] presents the comparative analysis of Z-source and Quasi Z-source converter for renewable energy applications. Due to the dependency of renewable energy sources on external weather conditions the output voltage, current changes accordingly which effects the performance of traditional voltage source and current source inverters connected across it. To overcome the drawbacks of VSI and CSI, Z-source and Quasi Z-source inverter (QZSI) are used, which can perform multiple tasks like ac-to-dc, dc-to-ac, ac-to-ac, dc-to-dc conversion. They can be used for both buck and boost operations, by utilizing the shoot-through zero state. The QZSI is derived from the ZSI topology, with a slight change in the impedance network and it overcomes the drawbacks of ZSI. The QZSI draws a constant current from the source when compared to ZSI. A comparative analysis is performed between Z-source and Quasi Z-source inverter, simulation is performed in MATLAB/Simulink environment and observed that Z-source has a discontinuous input current from the source whereas the quasi z-source inverter has continuous current. Moreover the quasi z-source inverter has lower component rating and reduced stress. The performance of ZSI and QZSI for photovoltaic applications is analyzed from which it is observed that the gain factor of Quasi Z-source inverter is higher and maximum power is delivered to the load when compared to Z-Source inverter. The Quasi Z-source inverter is efficient reliable and lower in cost.

This paper represents the Quasi-Z-Source inverter for photovoltaic energy conversion system. Quasi-Z-Source Inverter (QZSI) is an enhancement to Z-Source Inverter (ZSI). The QZSI inherits all the advantages of the ZSI, which can realize buck/boost, inversion and power conditioning in a single stage with improved reliability. In addition, the proposed QZSI has the unique advantages of lower component ratings and constant dc current from the source. The QZSI features a wide range of voltage gain which is suitable for applications in photovoltaic (PV) systems, due to the fact that the PV cells output varies widely with temperature and solar irradiation. MATLAB / SIMULINK model of both the circuit topology (QZSI and ZSI) with different loading conditions are presented. Maximum Boost control technique is employed here. Theoretical analysis of voltage boost, control methods and a system design guide for the QZSI in PV systems are investigated in this paper. A comparative analysis between ZSI and QZSI is given in the end. This paper presents a Quasi-Z-source inverter for Photovoltaic energy conversion system, which is derived from the traditional ZSI. The proposed QZSI inherits all the advantages of the ZSI and features its unique merits. It can realize buck/boost power conversion in a single stage with a wide range of gain that is suited well for application in PV power generation systems.

Furthermore, the proposed QZSI has advantages of continuous input current, reduced source stress, and lower component ratings when compared to the traditional ZSI. Theoretical analysis, control method, and system design guide are presented in this paper. [12]

Current-fed quasi-Z-source inverters (qZSIs) have many advantages over traditional current source inverters and current-fed Z-source inverters. This paper analyses novel adjustable speed drive systems based on the current-fed qZSI that could provide bidirectional power flow, including their topologies, operating principle, and voltage gain. The simulation results are given to verify the rationality and feasibility of the proposed topologies. It is shown that the presented systems could provide buck-boost function, could output variable frequency voltage, especially, the thyristor front-end type and the full-controllable device front-end type topologies could flow bidirectional power flow, thus they should more suitable to the motor drive application. These novel current-fed quasi-ZSIbased adjustable speed drive systems would be widely used in the applications such as wind generation, motor drive, active power filter (APF), unified power flow controller (UPFC), etc. [13]

The paper we are concerned with here [14] deals with a new family of single-phase ac-ac converters called single-phase quasi-Z-source ac-ac converters. The proposed converter inherits all the advantages of the traditional single-phase Z-source ac-ac converter, which can realize buck-boost, reversing, or maintaining the phase angle. In addition, the proposed converter has the unique features that the input voltage and output voltage share the same ground and the operation is in the continuous current mode. The operating principles of the proposed converter are described, and a circuit analysis is provided. In order to verify the performance of the proposed converter, a laboratory prototype was constructed with a voltage of 84 V_{rms} /60 Hz. The simulation and experimental results verified that the converter has a lower input current total harmonic distortion and higher input power factor in comparison with the conventional single-phase Z-source ac-ac converter. r. The proposed converter inherits all the advantages of the traditional single-phase Z-source ac–ac converter, which can realize buck–boost as well as reversal or maintenance phase angle. In addition, the proposed single-phase quasi-Z-source ac–ac converter has unique advantages in that the input voltage and output voltages share the same ground and the operation of the input current is in CCM. Comparison of the principles of operation and the simulation results with those for the conventional single-phase Z-source ac–ac converter are presented.

CHAPTER 3

THEORY

3.1 Boost converter:

A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage while stepping down current from its input supply to its output load. It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors sometimes in combination with inductors are normally added to such a converter's output load-side filter and input (supply-side filter).

Power for the boost converter can come from any suitable DC source, such as batteries, solar panels, rectifiers, and DC generators. A process that changes one DC voltage to a different DC voltage is called DC to DC conversion. A boost converter is a DC to DC converter with an output voltage greater than the source voltage. A boost converter is sometimes called a step-up converter since it "steps up" the source voltage. Since power, the output current is lower than the source current.

3.2 Working principle of Boost converter:

The main working principle of boost converter is that the inductor in the input circuit resists sudden variations in input current. When switch is OFF the inductor stores energy in the form of magnetic energy and discharges it when switch is closed. The capacitor in the output circuit is assumed large enough that the time constant of RC circuit in the output stage is high. The large time constant compared to switching period ensures a constant output voltage V o (t) = V o (constant).
When the switch is in the ON position, the inductor output is connected to ground and the voltage Vin is placed across it. The inductor current increases at a rate equal to Vin/L.
When the switch is placed in the OFF position, the voltage across the inductor changes and is equal to Vout-Vin. Current that was flowing in the inductor decays at a rate equal to (Vout-Vin)/L.

It can be seen from the waveform diagrams that the input current to the boost converter is higher than the output current. Assuming a perfectly efficient, i.e. lossless, boost converter, the power out must equal the power in, i.e. Vin·Iin = Vout·Iout. From this it can be seen if the output voltage is higher than the input voltage, then the input current must be higher than the output current.

Switched systems such as SMPS are a challenge to design since their models depend on whether a switch is opened or closed. R. D. Middlebrook from Caltech in 1977 published the models for DC to

DC converters used today. Middlebrook averaged the circuit configurations for each switch state in a technique called state-space averaging. This simplification reduced two systems into one. The new model led to insightful design equations which helped the growth of SMPS.

3.3 Applications of Boost converter:

- Battery power systems often stack cells in series to achieve higher voltage. However, sufficient stacking of cells is not possible in many high voltage applications due to lack of space. Boost converters can increase the voltage and reduce the number of cells. Two battery-powered applications that use boost converters are used in **hybrid electric vehicles** (HEV) and lighting systems.

- The special kind of boost-converters called Voltage-Lift Type Boost Converters are used in solar photovoltaic (PV) systems. These power converters add up the passive components (diode, inductor and capacitor) of a traditional boost-converter to improve the power quality and increase the performance of complete PV system.

- They are used in regenerative braking of DC motor.
- Low power boost converters are used in portable device applications
- As switching regulator circuit in highly efficient white LED drives
- Boost converters are used in battery powered applications where there is space constraint to stack more number of batteries in series to achieve higher voltages.

3.4 Modes of operation of Boost converter:

The boost converter can be operated in two modes

a) **Continuous conduction mode** in which the current through inductor never goes to zero i.e inductor partially discharges before the start of the switching cycle.

b) **Discontinuous conduction mode** in which the current through inductor goes to zero i.e. inductoris completely discharged at the end of switch.

Circuit Analysis:

The key principle that drives the boost converter is the tendency of an inductor to resist changes in current by either increasing or decreasing the energy stored in the inductor magnetic field. In a boost converter, the output voltage is always higher than the input voltage. A schematic of a boost power stage is shown in Figure 1.

(a) When the switch is closed, current flows through the inductor in the clockwise direction and the inductor stores some energy by generating a magnetic field. Polarity of the left side of the inductor is positive.

(b) When the switch is opened, current will be reduced as the impedance is higher. The magnetic field previously created will be reduced in energy to maintain the current towards the load. Thus the polarity will be reversed (meaning the left side of the inductor will become negative). As a result, two sources will be in series causing a higher voltage to charge the capacitor through the diode *D.*

If the switch is cycled fast enough, the inductor will not discharge fully in between charging stages, and the load will always see a voltage greater than that of the input source alone when the switch is opened. Also while the switch is opened, the capacitor in parallel with the load is charged to this combined voltage. When the switch is then closed and the right hand side is shorted out from the left hand side, the capacitor is therefore able to provide the voltage and energy to the load. During this time, the blocking diode prevents the capacitor from discharging through the switch. The switch must of course be opened again fast enough to prevent the capacitor from discharging too much.

The basic principle of a Boost converter consists of 2 distinct states see figure 1 (a, b)

- in the On-state, the switch S (see figure 1) is closed, resulting in an increase in the inductor current;
- In the Off-state, the switch is open and the only path offered to inductor current is through the flyback diode *D,* the capacitor *C* and the load *R.* This results in transferring the energy accumulated during the on-state into the capacitor.
- The input current is the same as the inductor current as can be seen in figure 1(a, b). So it is not discontinuous as in the buck converter and the requirements on the input filter are relaxed compared to a buck converter.

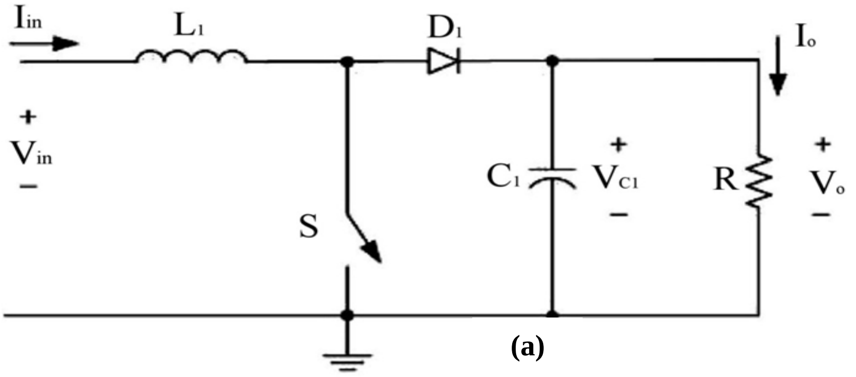
CHAPTER 4

4.1 First Stage Boost Converter

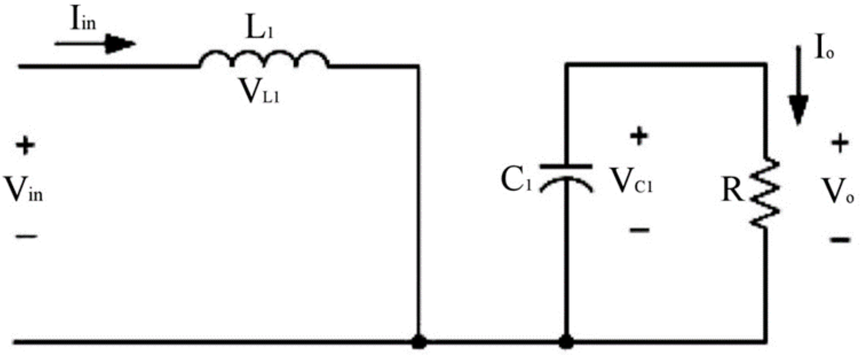
The first three stages of the main series of N/O cascaded boost converters are shown in Figures (1) For convenience, they are called elementary boost converter, two stage boost circuit, and three-stage boost circuit, respectively, and numbered as n = 1, 2, and 3.

The N/O elementary boost converter and its equivalent circuits during switch-on and switch-off are shown in figure 1.

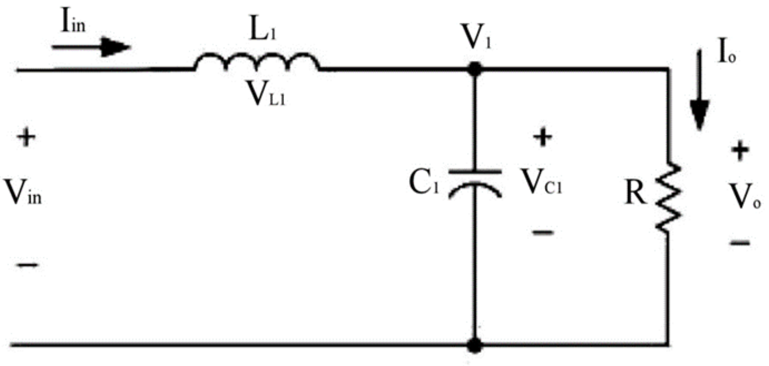
[Each circuit of this series has one switch S, n inductors, n capacitors and (2n-1) diodes.
Here, L = inductor, D = diode, I = current, C = capacitor, R = resistor/load, S = mosfet, I_0 = current output, I_{in} = current input, V_{in} = voltage input, V_0 = voltage output, f = frequency, k = voltage gain, G = voltage gain, Δi_{L1} = ripple current of inductor , ξ = variation ratio]



(a)



(b)



(c)

Figure 1(a) Circuit diagram of First stage boost converter (b) On mode off First stage boost converter (c) Off mode of First stage boost converter

The voltage across capacitor C_1 is charged to V_0. The current iL1 flowing through inductor L_1 increases with voltage *Vin* during switch-on period *kT* and decreases with voltage -(V_0 - V_{in})during switch-off period (1 − *k*)*T*. Therefore, the ripple of the inductor current i_{L1}.

$$\Delta i_{L1} = \frac{V_{in}}{L_1} kT = \frac{V_0 - V_{in}}{L_1}(1-k)T \tag{1}$$

$$V_0 = \frac{1}{1-k} V_{in} \tag{2}$$

The voltage transfer gain is

$$G = \frac{V_0}{V_{in}} = \frac{1}{1-k} \tag{3}$$

The inductor average current is

$$I_{L1} = \frac{1}{1-k}\frac{V_0}{R} \tag{4}$$

The variation ratio of current through inductor L_1 is

$$\xi_1 = \frac{\Delta i_{L1}/2}{I_{L4}} = \frac{kTV_{in}}{2L_1V_0/(1-k)R} = \frac{k(1-k)^2}{2}\frac{R}{fL_1} \tag{5}$$

Usually, ξ1 is small (much lower than unity), which means this converter works in the continuous mode.

The ripple voltage of output voltage v_0 is

$$\Delta v_0 = \frac{\Delta Q}{C_1} = kT\frac{I_0}{C_1} = \frac{k}{fC_1}\frac{V_0}{R}$$

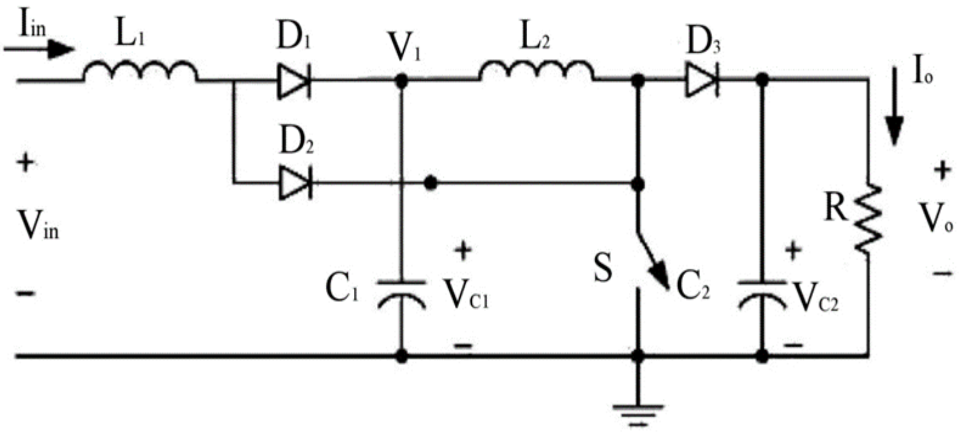
Therefore, the variation ratio of output voltage v_0 is

$$\varepsilon = \frac{\Delta v_0 / 2}{V_0} = \frac{k}{2RfC_1} \tag{6}$$

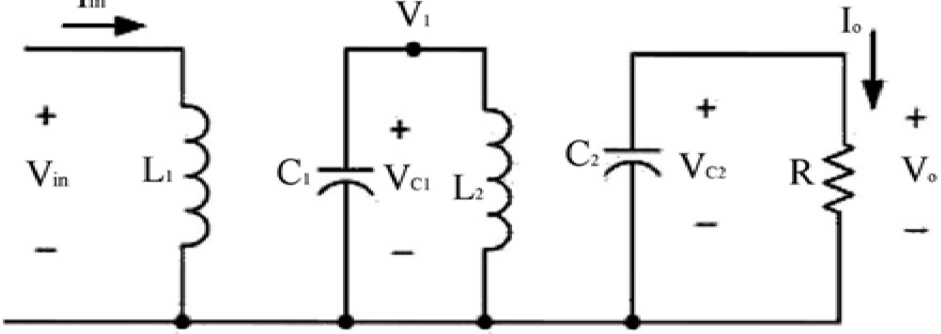
Usually, R is in kΩ, f in 10 kHz, and C_1 in μF; this ripple is smaller than 1%.

4.2 Second stage Boost converter:

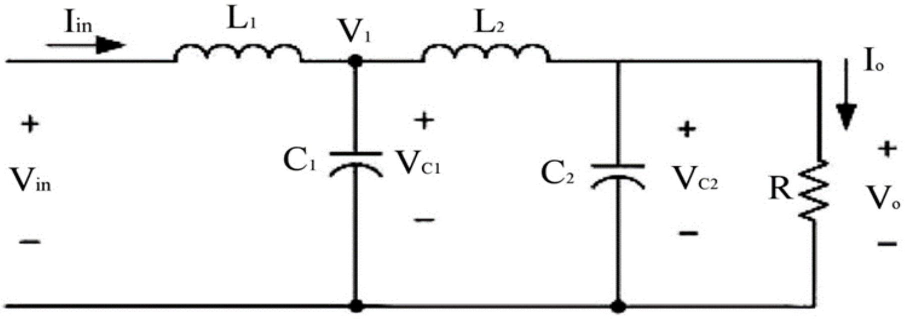
The N/O two-stage boost circuit is derived from the elementary boost converter by adding the parts ($L_2 - D_2 - D_3 - C_2$). Its circuit diagram and equivalent circuits during switch-on and switch-off are shown in



(a)



(b)



(c)

Figure 2(a) circuit diagram of two stage boost converter (b) On mode off second stage boost converter (c)Off mode of second stage boost converter

The voltage across capacitor C_1 is charged to V_1. As described in the previous section, the voltage V_1 across capacitor C_1 is $V_1 = 1/(1-k)V_{in}$.

The voltage across capacitor C_2 is charged to V_0. The current flowing through inductor L_2 increases with voltage V_1 during switch-on period kT and decreases with voltage $-(V_0 - V_1)$ during switch-off period $(1 - k)T$. Therefore, the ripple of the inductor current i_{L2} is

$$\Delta i_{L2} = \frac{V_1}{L_2} kT = \frac{V_0 - V_1}{L_2}(1-k)T \tag{7}$$

$$V_0 = \frac{1}{1-k} V_1 = (\frac{1}{1-k})^2 V_{in} \tag{8}$$

The voltage transfer gain is

$$G = \frac{V_0}{V_{in}} = (\frac{1}{1-k})^2 \tag{9}$$

Analogously,

$$\Delta i_{L1} = \frac{V_{in}}{L_1} kT \;\; I_{L1} = \frac{I_0}{(1-k)^2}$$

$$\Delta i_{L2} = \frac{V_1}{L_1} kT \;\; I_{L2} = \frac{I_0}{1-k}$$

Therefore, the variation ratio of current through inductor L_1 is

$$\xi_1 = \frac{\Delta i_{L1}/2}{I_{L1}} = \frac{k(1-k)^2 T V_{in}}{2L_1 I_0} = \frac{k(1-k)^4}{2}\frac{R}{fL_1} \tag{10}$$

the variation ratio of current through inductor L_2 is

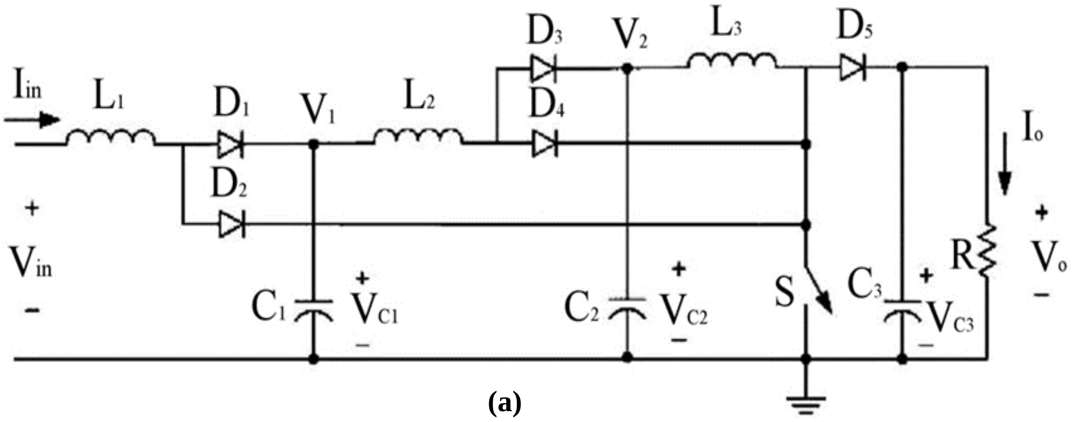
$$\xi_2 = \frac{\Delta i_{L2}/2}{I_{L2}} = \frac{k(1-k) T V_1}{2L_2 I_0} = \frac{k(1-k)^2}{2}\frac{R}{fL_2} \tag{11}$$

and the variation ratio of output voltage v_0 is

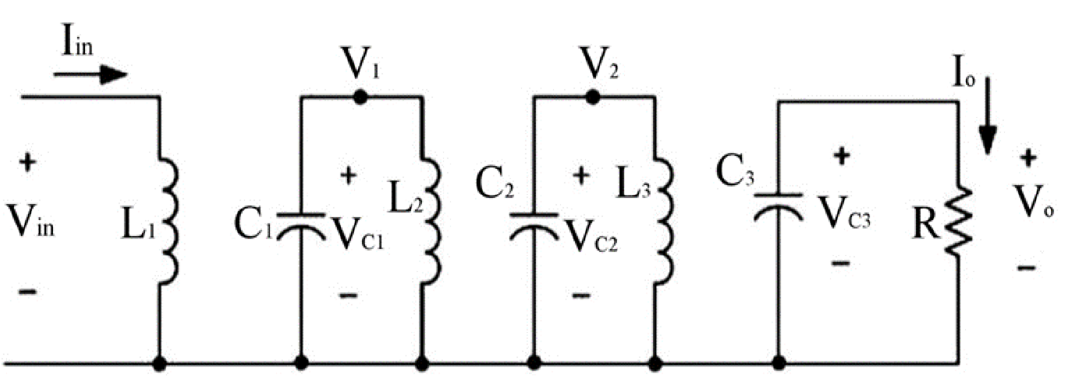
$$\varepsilon = \frac{\Delta v_0/2}{V_0} = \frac{k}{2RfC_2} \tag{12}$$

4.3 Three-Stage Boost Circuit:

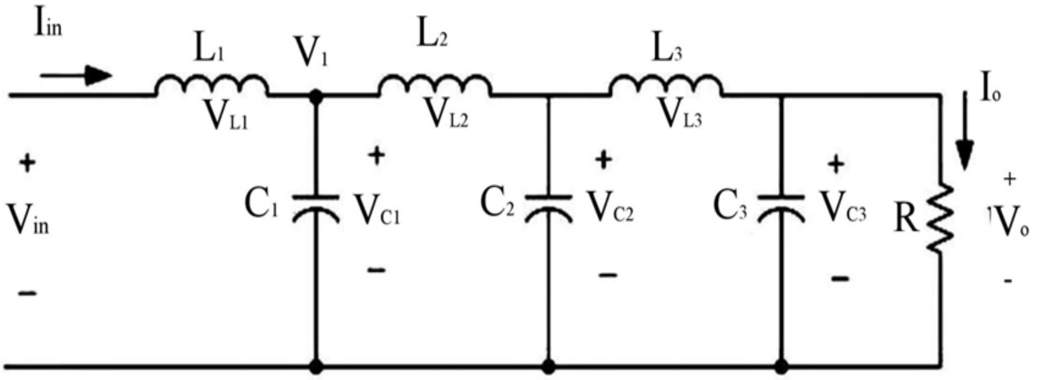
The N/O three-stage boost circuit is derived from the two-stage boost circuit by double adding the parts ($L_2 - D_2 - D_3 - C_2$). Its circuit diagram and equivalent circuits during switch-on and switch-off are shown in



(a)



(b)



(c)

Figure 3(a) ckt diagram of Third stage boost converter (b) On mode off Third stage boost converter (c) Off mode of Third stage boost converter

The voltage across capacitor is charged C_1 to V_1. As described previously, the voltage V_1 across capacitor C_1 is , and the voltage across C_1 is V_1 =1/(1-k)V_{in} capacitor C_2 is $V_3 = (\frac{1}{1-k})^2 V_{in}$

The voltage across capacitor $C3$ is charged to vo. The current flowing through inductor $L3$ increases with voltage during switch-on period $kT$and decreases with voltage-(V_0 -V_2) during switch-off period $(1 - k)T$. Therefore, the ripple of the inductor current is

$$\Delta i_{L3} = \frac{V_2}{L_3} KT = \frac{V_0 - V_2}{L_3}(1-k)T \tag{13}$$

$$V_0 = \frac{1}{1-k} V_2 = (\frac{1}{1-k})^2 V_1 = (\frac{1}{1-k})^3 V_{in} \tag{14}$$

The voltage transfer gain is

$$G = \frac{V_0}{V_{in}} = (\frac{1}{1-k})^3 \tag{15}$$

Analogously,

$$\Delta i_{L1} = \frac{V_{in}}{L_1} kT \;\; I_{L1} = \frac{I_0}{(1-k)^3}$$

$$\Delta i_{L2} = \frac{V_1}{L_2} kT \;\; I_{L2} = \frac{I_0}{(1-k)^2}$$

$$\Delta i_{L3} = \frac{V_2}{L_3} kT \;\; I_{L3} = \frac{I_0}{1-k}$$

Therefore, the variation ratio of current through i_{L1} inductor L_1 is

$$\xi_1 = \frac{\Delta i_{L1}/2}{I_{L1}} = \frac{k(1-k)^3 TV_{in}}{2L_1 I_0} = \frac{k(1-k)^6}{2}\frac{R}{fL_1} \qquad (16)$$

the variation ratio of current through i_{L2} inductor L_2 is

$$\xi_2 = \frac{\Delta i_{L2}/2}{I_{L2}} = \frac{k(1-k)^2 TV_1}{2L_2 I_0} = \frac{k(1-k)^4}{2}\frac{R}{fL_2} \qquad (17)$$

the variation ratio of current through i_{L3} inductor L_3 is

$$\xi_3 = \frac{\Delta i_{L3}/2}{I_{L3}} = \frac{k(1-k) TV_2}{2L_3 I_0} = \frac{k(1-k)^2}{2}\frac{R}{fL_3} \qquad (18)$$

and the variation ratio of output voltage v_0 is

$$\varepsilon = \frac{\Delta v_0/2}{V_0} = \frac{k}{2RfC_3} \qquad (19)$$

CHAPTER 5

5.1 Quasi Z-source Inverter:

An inverter converts DC supply to AC. The inverters can be classified into two broad types: voltage source inverter (VSI) and current source inverter (CSI). The VSI is a voltage step down/buck inverter while the CSI is a voltage boost/step up inverter. The VSI has a voltage source connected in parallel with a large capacitor while CSI has a current source as input. The CSI directly controls output AC current. Thus, the VSI is a voltage stiff inverter while the CSI is a current stiff inverter. The above inverters have certain problems and to overcome the problems another kind of inverter is used an impedance fed inverter known as Z-source inverter. A **Z-source inverter** is a type of power inverter, a circuit that converts direct current to alternating current. It functions as a buck-boost inverter without making use of DC-DC Converter Bridge due to its unique circuit topology. The advantage of the Z-source inverter over the traditional inverters is that the output ac voltage can be any value between zero and infinity regardless of the fuel-cell voltage that is, the Z-source inverter is a buck–boost inverter that has a wide range of obtainable voltage. Impedance (Z-) Source networks provide an efficient means of power conversion between source and load in a wide range of electric power conversion applications (dc–dc, dc–ac, ac–dc, ac– ac)

The below figure shows the general Z-source converter structure proposed. It employs a unique impedance network (or circuit) to couple the converter main circuit to the power source, load, or another converter, for providing unique features that cannot be observed in the traditional V- and I-source converters where a capacitor and inductor are used, respectively.

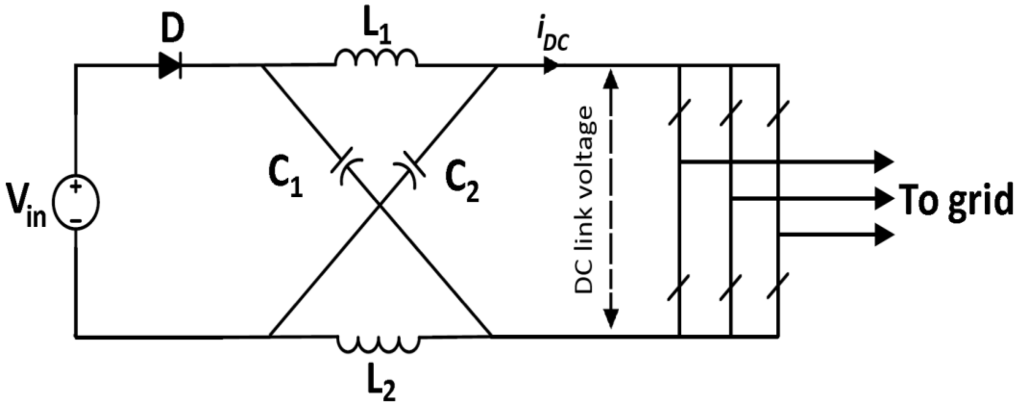
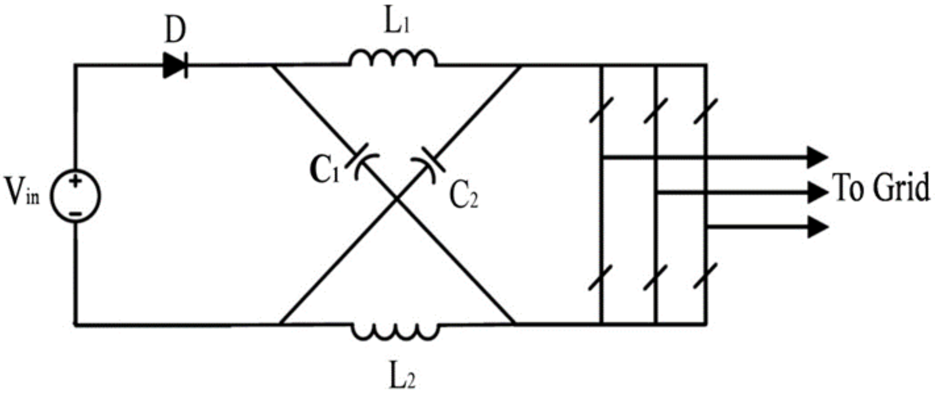
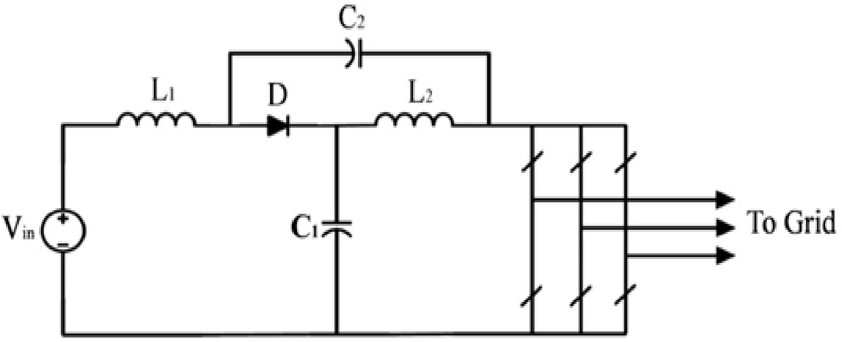


Figure 4: Schematic diagram of a Z-Source Inverter system

5.2 Circuit analysis of the Quasi-Z-Source Inverter (QZSI):



(a) Voltage fed ZSI



(b) Voltage fed QZSI

The figure 5(a) shows the traditional voltage fed ZSI and figure 5(b) shows traditional QZSI

The Quasi-Z-source/quasi-impedance source inverter (QZSI) is an upgrade of impedance source inverter (ZSI). Quasi-Z-source inverter has the ability to provide boost and DC–AC conversion of the input voltage in a single stage. The impedance network of the quasi-Z-source inverters offers unique advantages such as lower component ratings, constant DC current from source and capability to handle wide input voltage.

The main differences between the ZSI and QZSI are:

- The current drawn by QZSI is constant DC current while the ZSI draws discontinuous current from the source leading to less harmonics.
- The applied voltage and consequently the size of capacitor C2 is greatly reduced than the regular ZSI. Because the source current drawn is constant and continuous for the qZSI, it is more suitable for application in PV and fuel cells. [qszippr]

TABLE 1 Comparison between the traditional inverters with Z-source inverter**:**

Current source inverter	Voltage source inverter	Z-source inverter
1.The CSI acts as a constant current source or current stiff since a large inductor is used in series with the voltage source	The VSI acts as a constant voltage source or voltage stiff inverter since a large capacitor is used in parallel with the voltage source.	The ZSI acts as a constant high impedance voltage source.
2. High source impedance due to large inductor connected in series with the DC source.	Low source impedance due to a capacitor connected in parallel with the DC source.	Since both inductor and capacitor are used in the DC link, it has a constant high impedance.
3. The CSI is more robust and has the capacity to bear misfiring of the switches without danger, hence less sensitive comparative to the VSI.	Misfiring of switches in a VSI is dangerous since the parallel capacitor shall the fault and hence more sensitive to switch misfiring than CSI.	The ZSI can also bear misfiring of the switches sometimes though not as much as the CSI but more than the VSI.
4. Cannot be used in both buck or boost operation of inverter at the same time.	Cannot be used in both buck or boost operation of inverter at the same time.	Can be used in both buck and boost operation of inverter at the same time.
5. The main circuits are not interchangeable. The main circuits are not interchangeable.	The main circuits are not interchangeable.	Here the main circuits are interchangeable.
6. The harmonic distortion tends to be high.	VSI also has quite high harmonic distortion.	Harmonic distortion in ZSI tends to be lower.
7. Introduction of filter causes high power loss.	Introduction of filter causes high power loss.	Compared to the VSI and CSI, lower power loss.
8. Observed that power loss decreases efficiency here.	High power loss decreases efficiency here.	Comparatively higher efficiency due to lower power loss.

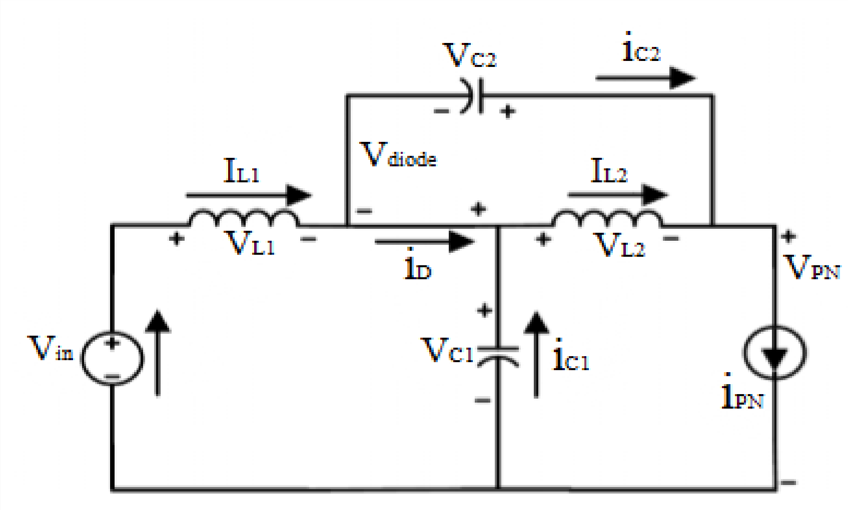
CHAPTER 6

Operation of Quasi-Z-Source Inverter (QZSI):

qSZI has two operating modes: Shoot through mode and Non-shoot through mode (Also Known As Active Mode).

- Non-shoot through mode(Active Mode):

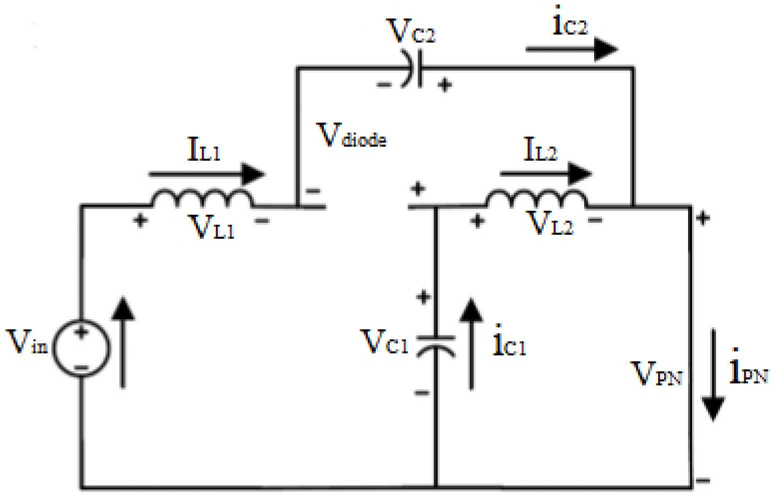
  Active mode In the non-shoot through mode or active mode, the switching pattern for the qZSI is similar to that of Voltage Source Inverter (VSI). The input dc voltage is available as DC link voltage input to the inverter, which makes the qZSI behave similar to a VSI in this mode.



(a) The Equivalent Circuit of the non-shoot through/active mode of qZSI.

- Shoot Through Mode:

  In this mode, switches of the same phase in the inverter bridge are switched on simultaneously for a very short duration. The source however isn’t short circuited when attempted to do so because of the presence of LC network (quasi), that boosts the output voltage. The DC link voltage during the shoot through states, is boosted by a boost factor, whose value depends on the shoot through duty ratio for a given modulation index.



(b)The Equivalent Circuit of the shoot through of qZSI.

Figure 6(a): The Equivalent Circuit of the non-shoot through/active mode of qzsi 6(b): The Equivalent Circuit of the shoot through of qZSI

If the shoot-through interval is T_{sh} during a switching cycle of time period T then the shoot-through duty ratio is $D = T_{sh}/T$. Similarly the non-shoot through interval is $T_{nsh} = T - T_{sh}$. The Equivalent circuit of Shoot-through mode shows a regular non shoot-through state for T_{nsh} time period, thus the inductor voltage for L_1 and L_2 shall be

$$v_{L1} = V_{in} - V_{C1} \qquad \& \qquad v_{L2} = -V_{C2} \tag{20}$$

Similarly for T_{nsh} the DC link and diode voltage V_{PN} and v_{diode} respectively are

$$V_{PN} = V_{C1} - v_{L2} = V_{C1} + V_{C2} \qquad \& \qquad v_{diode}=0 \tag{21}$$

The Equivalent circuit of Shoot-through mode Figure 6(b) reflects the current directions and voltage of the system for the shoot-through states T_{sh}, giving voltages

$$v_{L1} = V_{in} + V_{C2} \qquad \& \qquad v_{l2}=V_{c1} \tag{22}$$

Similarly for T_{ah} the DC link and diode voltage V_{PN} and v_{diode} respectively are

$$V_{PN} = 0 \quad \& \quad V_{diode} = V_{C1} + V_{C2} \tag{23}$$

Since the average of inductor voltage for a switching cycle is zero under steady state, from equation 20 and 22, we obtain

$$V_{L1} = \frac{T_{sh}(V_{in} + V_{C2}) + T_{nsh}(V_{in} - V_{C1})}{T} = 0 \tag{24}$$

$$V_{L2} = \frac{T_{sh}(V_{C1}) + T_{nsh}(-V_{C2})}{T} = 0 \tag{25}$$

Consequently,

$$V_{C1} = \frac{T_{nsh}}{T_{nsh} - T_{sh}} V_{in} \ \ \& \ \ V_{C2} = \frac{T_{sh}}{T_{nsh} - T_{sh}} V_{in} \tag{26}$$

The peak DC link voltage V_{PN} across the inverter bridge/switches can be found from the equations (21), (23) and (26) and comes out as

$$V_{PN} = V_{C1} + V_{C2} = \frac{T_{nsh}}{T_{nsh} - T_{sh}} V_{in} = \frac{1}{1 - 2(T_{sh} / T)} V_{in} = BV_{in} \tag{27}$$

Where B is the boost factor of the qZSI. If the system power rating is assumed P then we can calculate the average current across inductors L_1, L_2 as

$$I_{L1} = I_{L2} = I_{in} = P / V_{in} \tag{28}$$

Using Kirchhoff's current law and the equation (28) for capacitor and diode current, we get

$$I_{C1} = I_{C2} = I_{PN} - I_{L1} \quad \& \quad I_D = 2I_{L1} = I_{PN} \tag{29}$$

Based upon above equations and the equivalent circuit diagram, we can safely ascertain that the qZSI inherits all the advantages of ZSI. In fact, the qZSI has advantages over ZSI itself. Like ZSI, qZSI can buck-boost the input voltage and is more reliable than the traditional VSI based on the comparison drawn in Table 1.

APPLICATIONS:

Quasi Z-source inverters are most importantly used for PV power generation. However it has other applications too.

- **Photovoltaic power generation** - Quasi-Z-source inverters (qZSIs) are becoming a powerful power conversion technology in photovoltaic (PV) power systems because they allow energy power conversion in a single stage operation. However, they can cause system resonances and reduce system damping, which may lead to instabilities. These stability problems are well known in grid-connected voltage source converter systems but not in quasi-Z-source inverter (qZSI)-based PV power systems.

- **Wind power generation** - a complete quasi-Z-source inverter based for wind power generation system is modelled and analysed. The overall system is introduced in two main configurations, one is open loop and the other is closed loop. The open loop system is designed in such way to extract the maximum wind energy from the open loop configuration using the modified Space Vector Pulse Width Modulation based on the maximum constant boost of the quasi Z source inverter.

- **Fuel cell stack systems** - Utility interactive inverters converting dc power sources such as fuel cells to ac grid systems are increasingly becoming popular as the energy crisis and environmental concern become the driving force for alternative energy. In general, the inverters employed in the small distributed generation are required to have the following characteristics:
  - Allowable for wide output voltage variation of distributed energy sources;
  - Assured output power quality with low THD and voltage/current flickering as well as frequency deviation and
  - Available for isolated operation and line parallel operation.

- **Speed control of induction motors** - In the proposed PV power generation system, in order to lower the voltage stress on the inverter bridge and keep a high voltage gain, the maximum constant boost control with third harmonic injection was chosen as the control method.

- **Use in electric vehicles** – qZSI are used in electric vehicles. The qZSI with continuous input current and its wide range boosting ability is suitable for this application where a three phase induction motor should be supplied from a lower battery voltage.

CHAPTER 7

SAMPLE OUTPUT:

First stage dc boost converter:

We simulate the first stage dc boost converter in Matlab software.

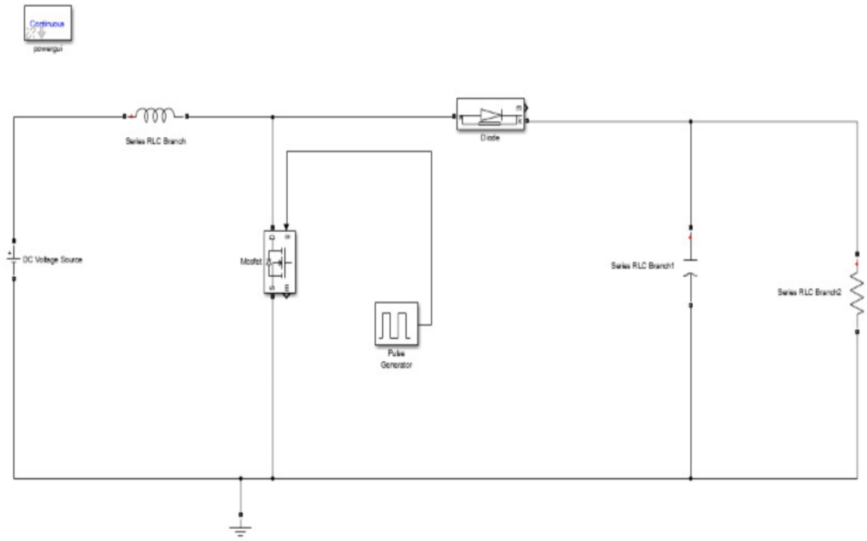


figure 7: simulation circuit of First stage dc boost converter

Here we use the mosfet ad a switch. As it is a SMPS Switch. We use a inductor and capacitor as a storage element. All the values of the elements are shown below-

Table-2

Elements	value
input voltage	24volt
inductance	100uH
capacitance	330uH
load	100ohm

We simulate the circuit at 50% duty cycle,75% duty cycle .and 25% duty cycle.

THE OUTPUT GRAPH FOR 50%DUTY CYCLE

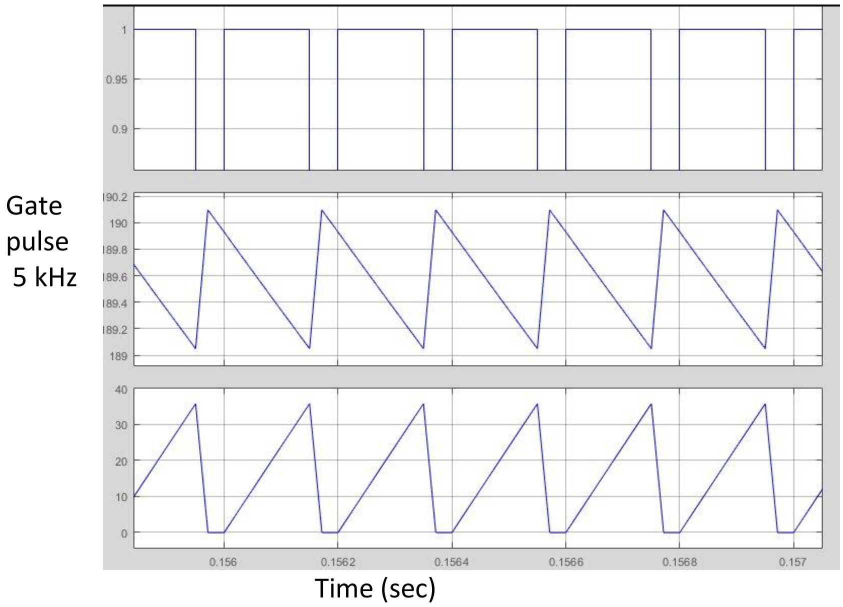


Figure 8 (1) Gate-pulse 0f 50% duty cycle (2) output voltage 3) output current

The Figure (1) represents the output graph and voltage and current measurements. We got 124volt as output voltage and got 25amp current at 50% duty cycle. From the euation-3 we got the value of voltage transfer gain 5.34. And side by side we also achieve the load current and calculate the load power that is 2976watt.

The output graph for 75%duty cycle:

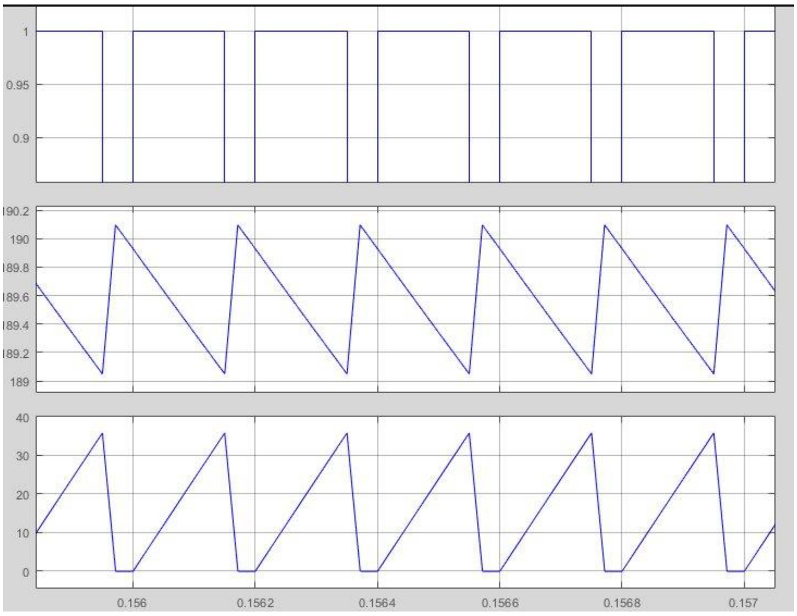
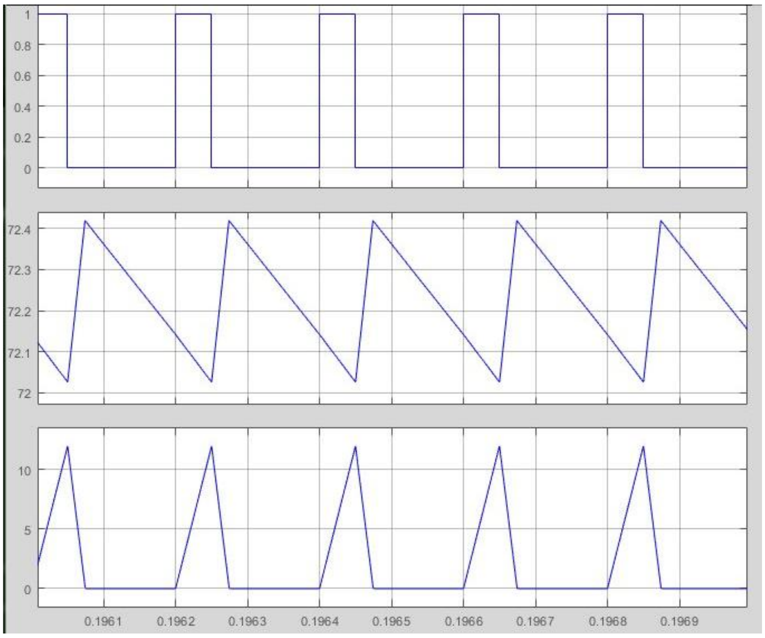


Figure 9 (1) Gate-pulse 0f 75% duty cycle (2) output voltage 3) output current

The Figure 8represents the output graph and voltage and current measurements. We got volt as output voltage 182volt and got 32-amp current at 75% duty cycle. From the euation-3 we got the value of voltage transfer gain 7.5. And side by side we also achieve the load current and calculate the load power that is 5824watt.

The output graph for 25%duty cycle:



Gate
pulse
5 KHz

Figure 10 (1) Gate-pulse 0f 25% duty cycle (2) output voltage 3) output current

The Figure represents the output graph and voltage and current measurements. We got volt as output voltage 73volt and got 15 amp current at 25% duty cycle. From the euation-3 we got the value of voltage transfer gain 3.05. And side by side we also achieve the load current and calculate the load power that is 1095watt.

Table-3

Slno.	Output voltage (volt)	Gain	Duty cycle (%)
1.	**75**	**3.2**	**25**
2.	**128**	**5.3**	**50**
3.	182	7.5	75

Third stage dc boost converter:

We simulate the third stage dc boost converter in MATLAB software.

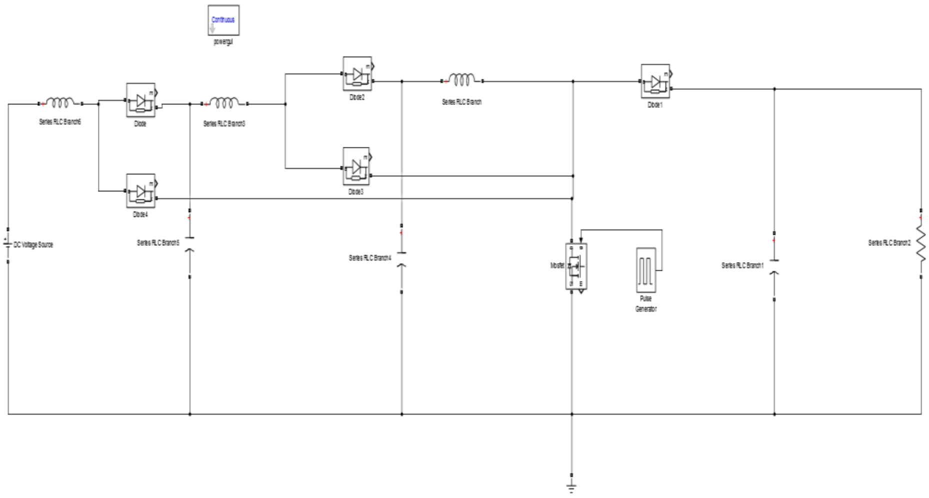


Figure 11: simulation of three stage boost converter

Here we use the mosfet ad a switch. As it is a SMPS Switch. We use a inductor and capacitor as a storage element. All the values of the elements are shown below-

Table-4

Components	value
Input voltage	24volt
Capacitance value C1	110uH
C2	120uH
C3	130uH
L1	1mH
L2	2mH
L3	3mH

We simulate the circuit at 28% duty cycle,50% duty cycle .and 75% duty cycle.

The output graph for 28%duty cycle

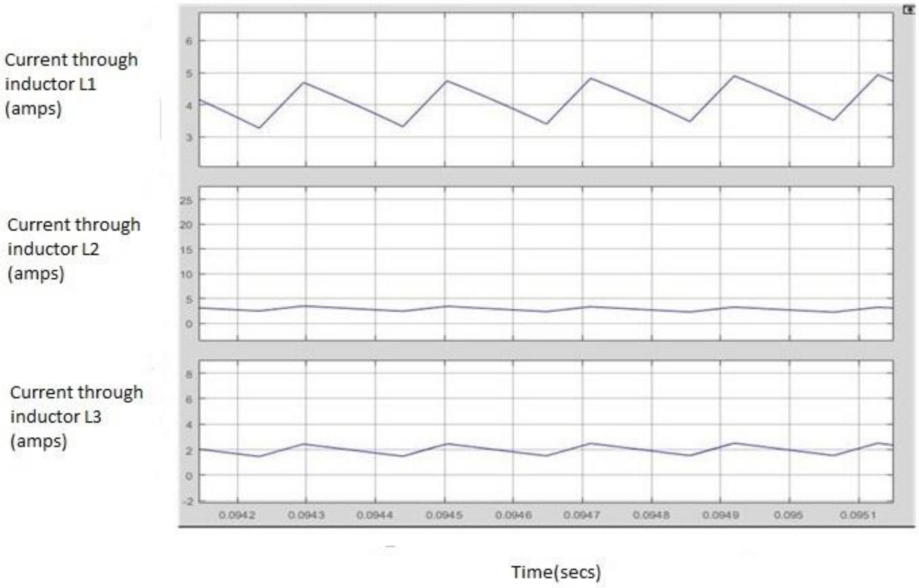


Figure 12 (1) current through L1 (2) current through L2 3) current through L3

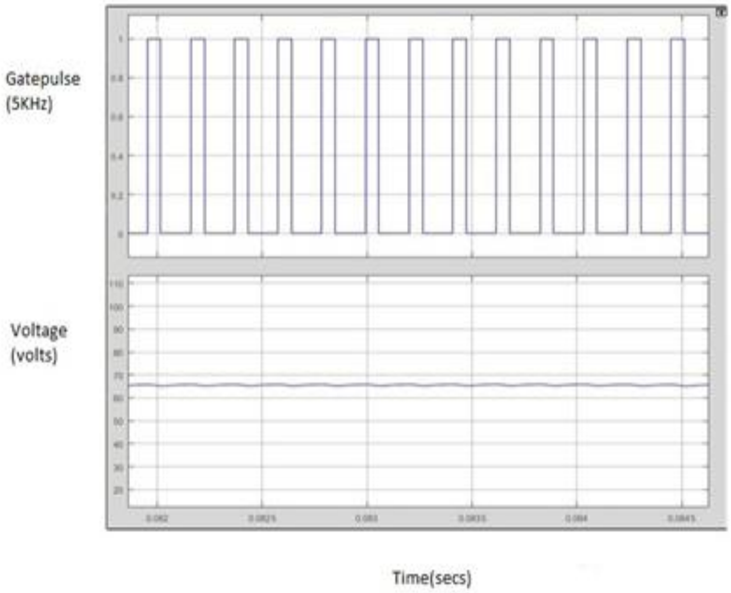


Figure 13(1) Gate-pulse 0f 28% duty cycle (2) output voltage

The Figure represents the output graph and voltage and current measurements. We got volt as output voltage 200volt and got 5 amp current at 28% duty cycle. From the euation-3 we got the value of voltage transfer gain 8.2. And side by side we also achieve the load current and calculate the load power that is 1000watt.

The output graph for 50%duty cycle:

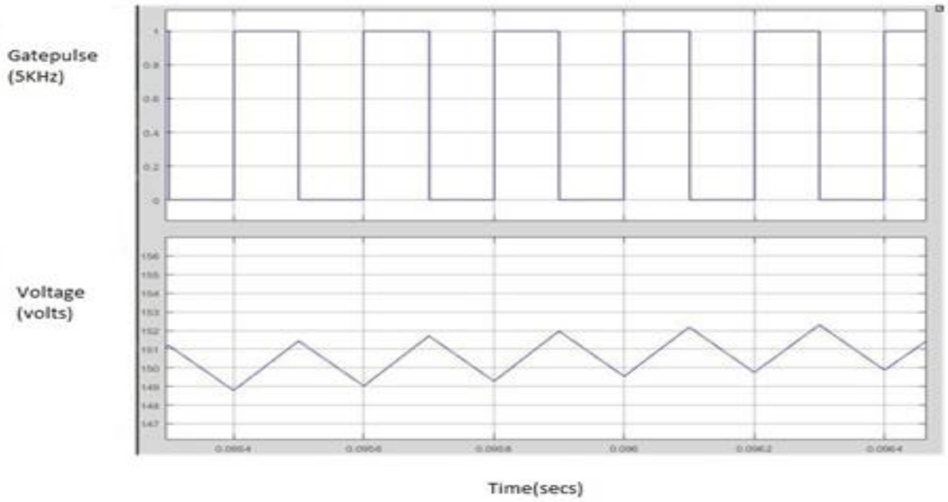


Figure 14(1) Gate-pulse 0f 50% duty cycle (2) output voltage

The Figure represents the output graph and voltage and current measurements. We got 160volt as output voltage and got 25amp current at 50% duty cycle. From the euation-3 we got the value of voltage transfer gain 6.7. And side by side we also achieve the load current and calculate the load power that is 2976watt.

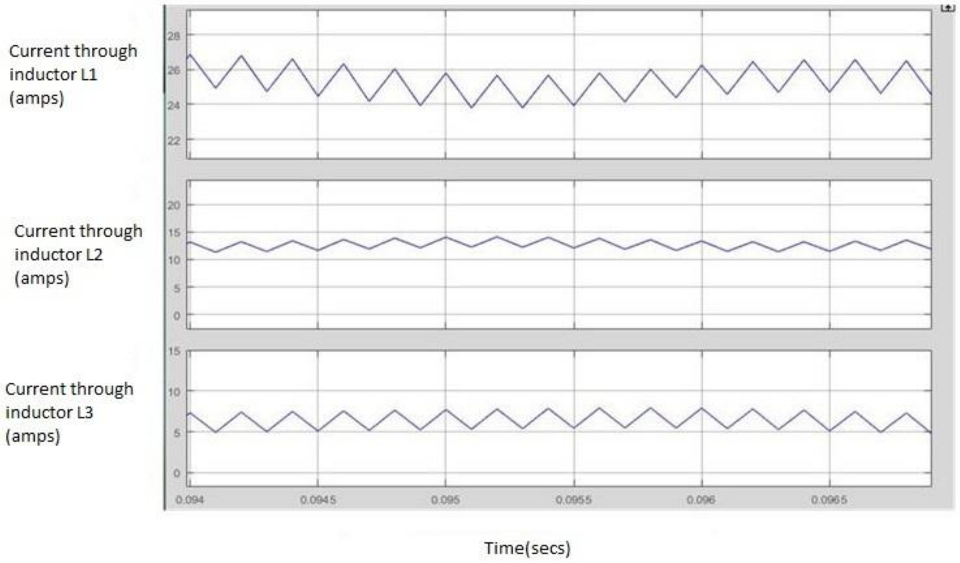
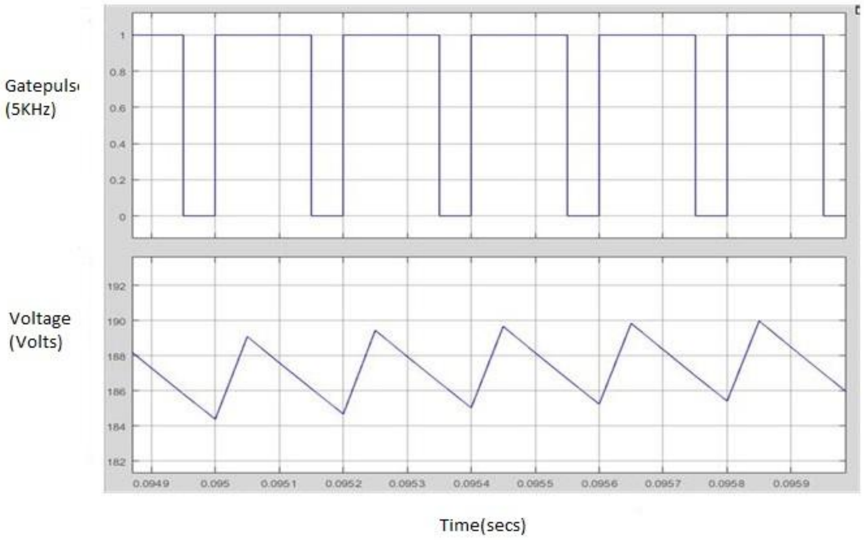


Figure 15(1) current through L1 (2) current through L2 3) current through L3

The Figure represents the output graph and voltage and current measurements. We got 160volt as output voltage and got 15amp current at 50% duty cycle. From the euation-3 we got the value of voltage transfer gain 6.7. And side by side we also achieve the load current and calculate the load power that is 2400watt.

The output graph for 75%duty cycle:



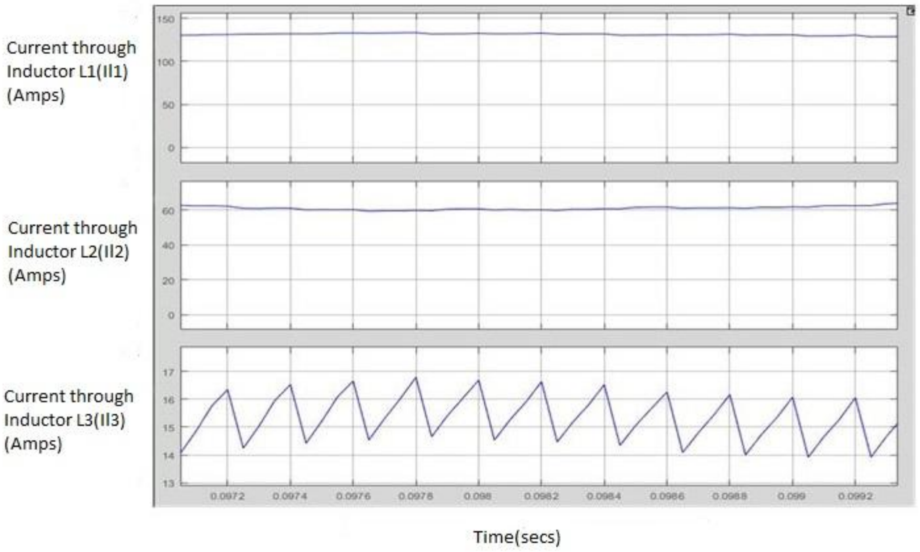


Figure 14(1) current through L1 (2) current through L2 (3) current through L3

The Figure represents the output graph and voltage and current measurements. We got 130volt as output voltage and got 30amp current at 75% duty cycle. From the euation-3 we got the value of voltage transfer gain 5.4. And side by side we also achieve the load current and calculate the load power that is 3900watt.

Table-5

SL. NO.	VOLTAGE	GAIN	DUTY CYCLE (%)
1.	200	8.3	28
2.	160	6.7	50
3.	130	5.4	75

Sample output of Quasi-zsi Inverter:

We use the MATLAB software to simulate the quasi-z Source inverter.

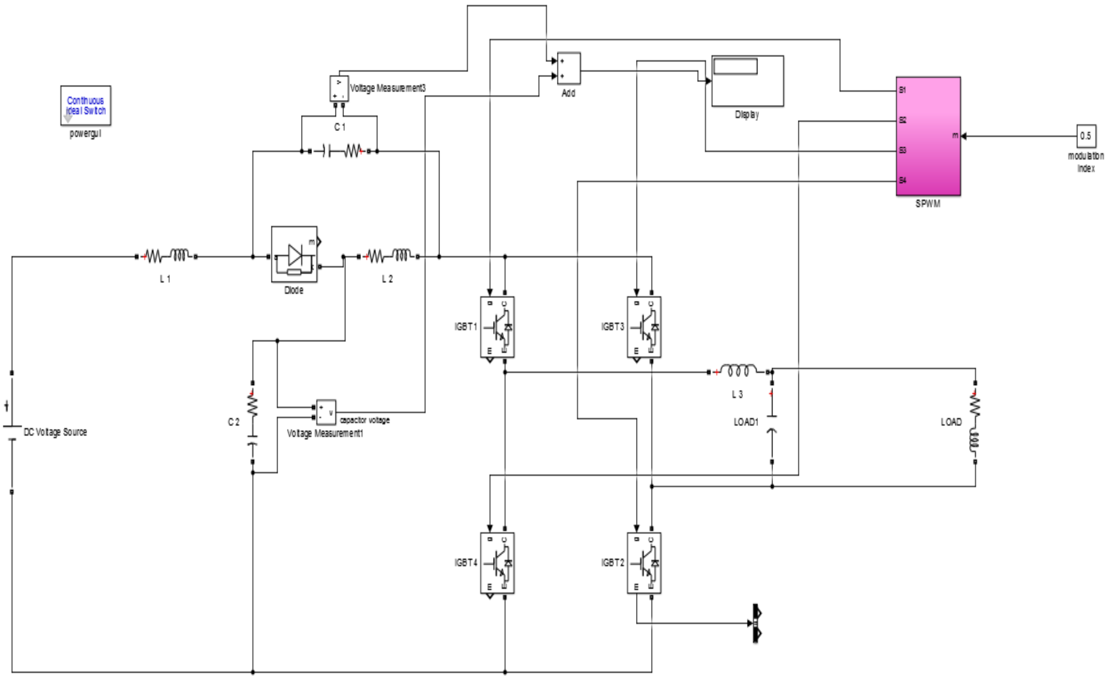


Figure 15: Simulated circuit of Quasi Z source inverter

All the information's of the parameters are given below: -

Table-6

Input voltage	24volt
Capacitance value C1	110uH

C2	120uH
C3	130uH
L1	1mH
L2	2mH
L3	3mH

The output graph of Quasi-zsi:

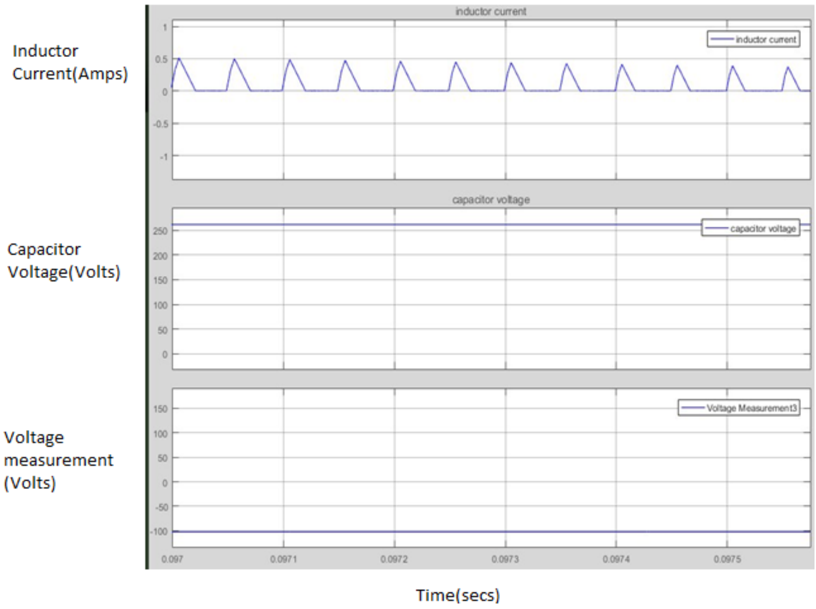


Figure 16 (1) Inductor Current (2) Capacitor Voltage (3) Voltage Measurement

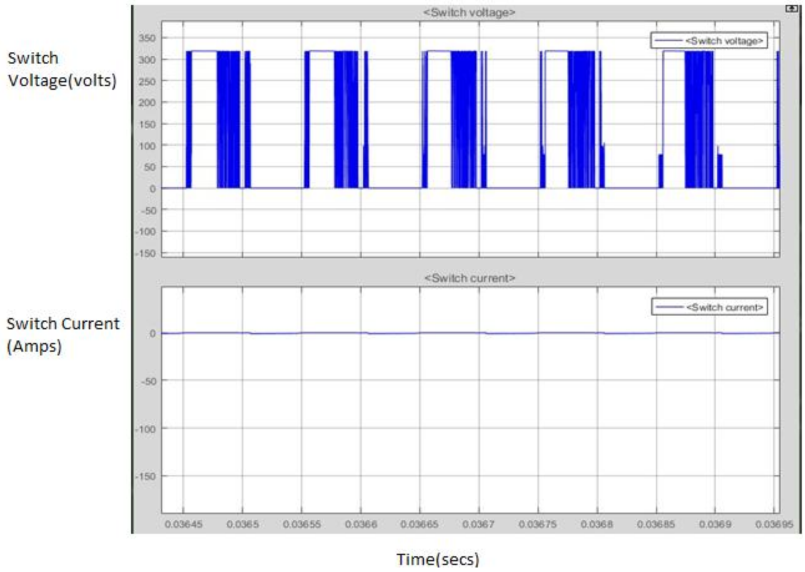


Figure 17 (1) Switch Voltage (2) Switch Current

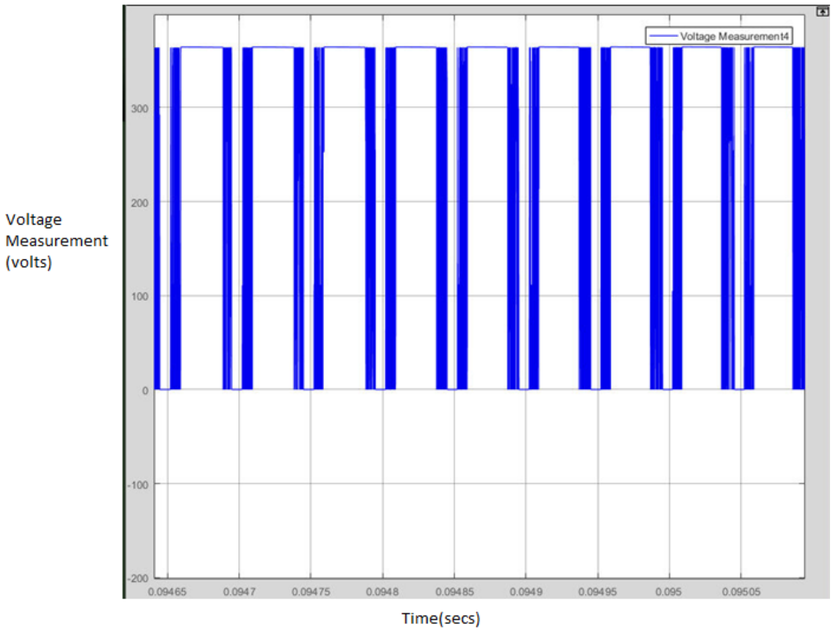


Figure 18 Voltage Measurement

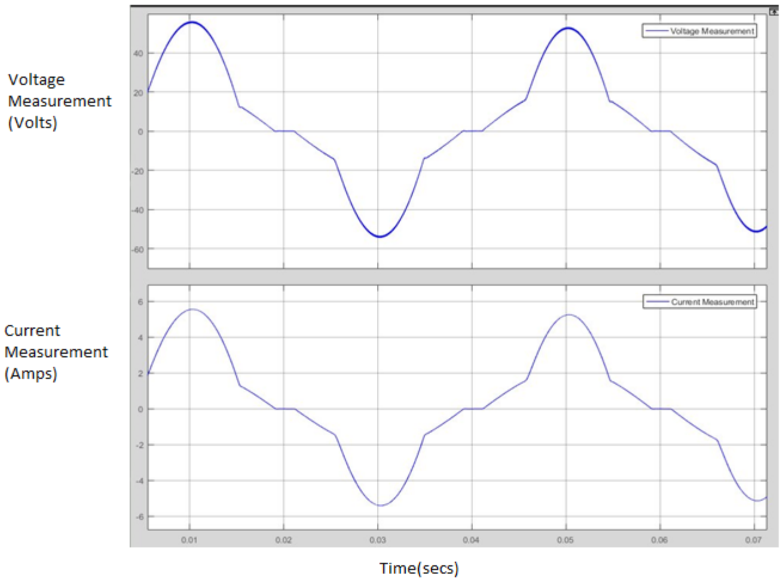


Figure 19 (1) Voltage Measurement (2) Current Measurement

From the graph we got the output voltage graph and current graph. From the corresponding figure we observed the output voltage is 50volt and the current is 5.5ampere. Using the formula, we got the load power that is 275 watt and from the first curve we got the inductor current, capacitor voltage and switch voltage characteristics. We got the inductor current 0.5amp and the capacitor voltage is 252volt.

DC BOOST CONVERTER WITH QUASI ZSOURCE INVERTER:

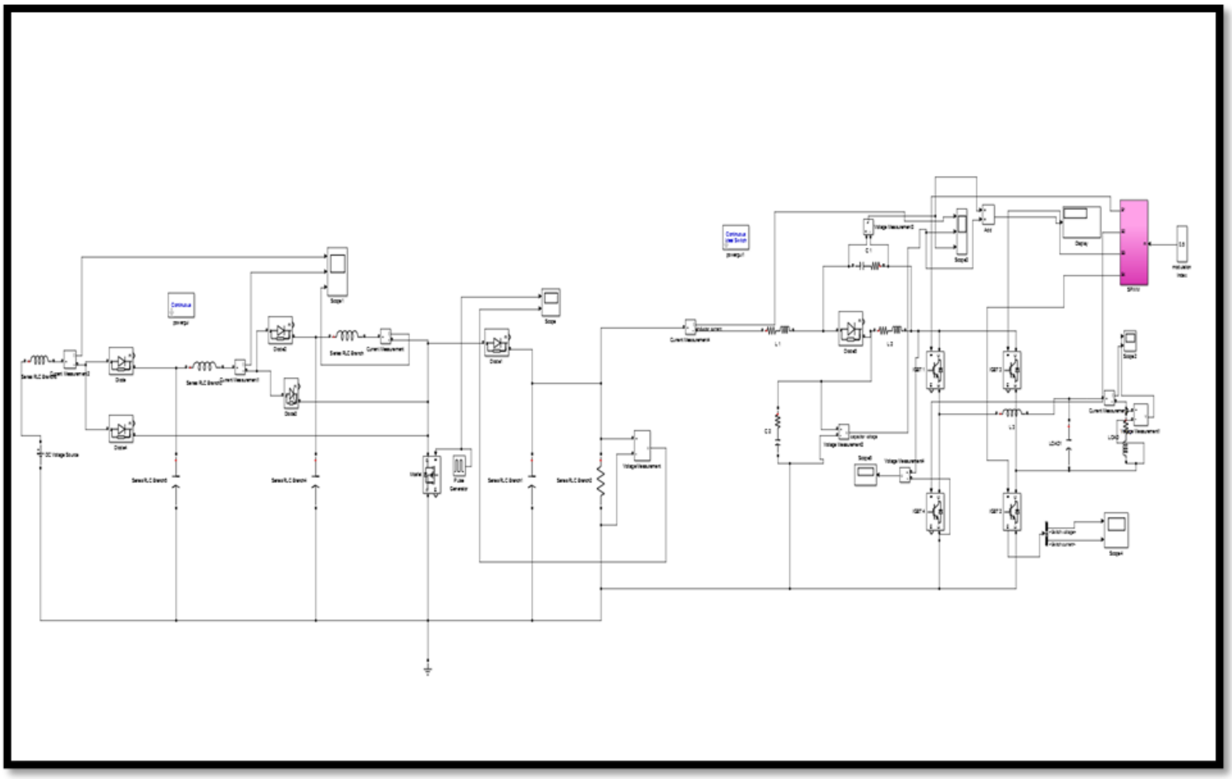


Figure 20: Simulation of dc boost converter with quasi-z source inverter

Sample output for 30% duty cycle:

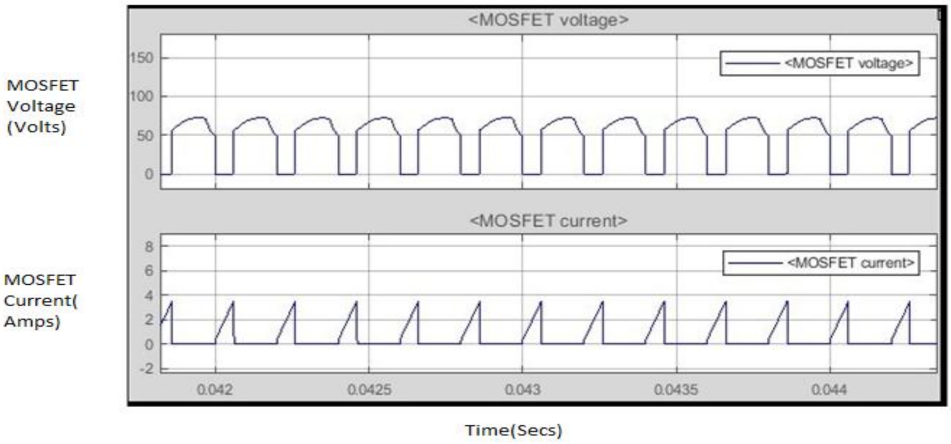


Figure 21: (1) MOSFET Voltage (2) MOSFET Current

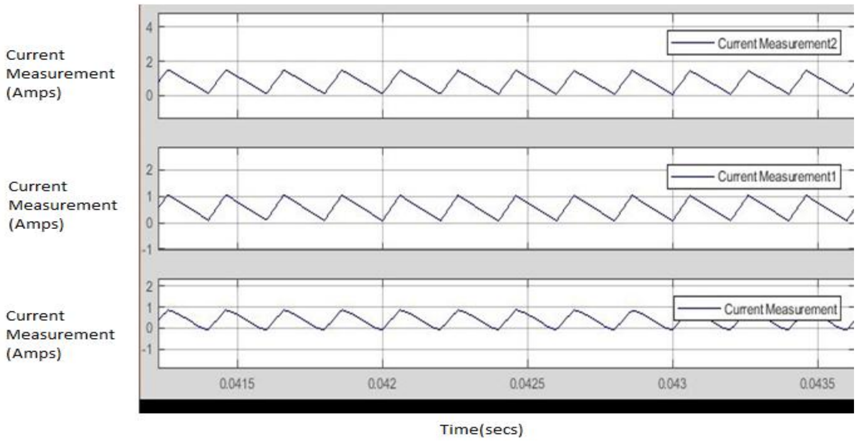


Figure 22: (1) Current Measurement (2) Current measurement (3) Current measurement

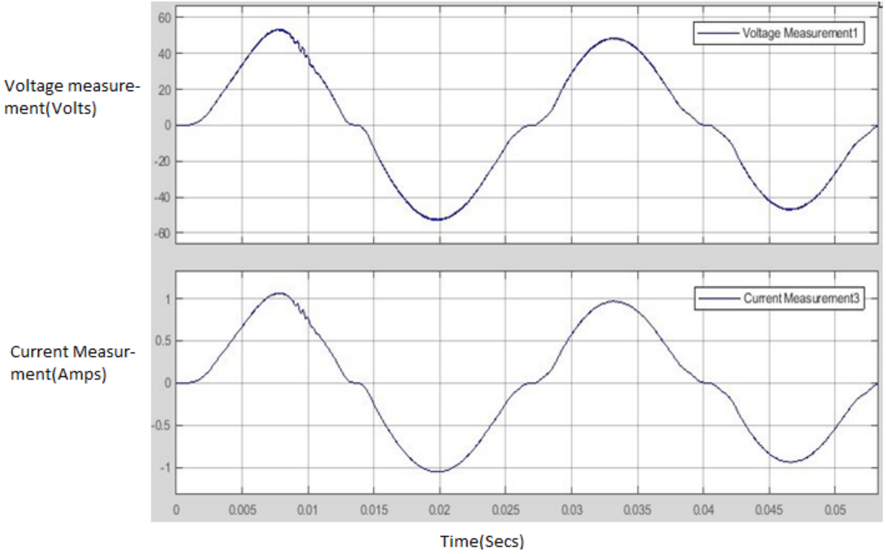


Figure 23: (1) Voltage Measurement (2) Current Measurement

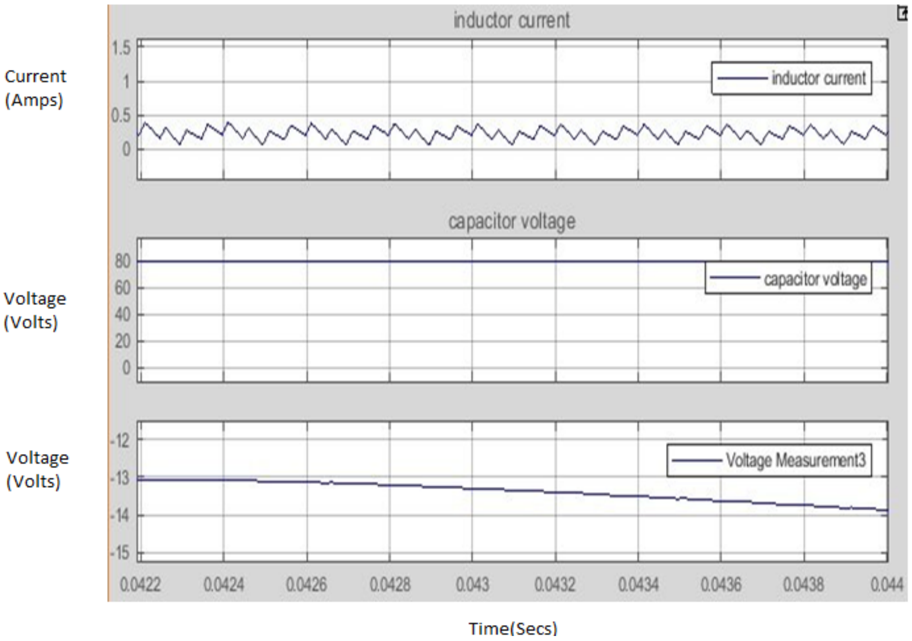


Figure 24: (1) Current (2) Voltage (3) Voltage

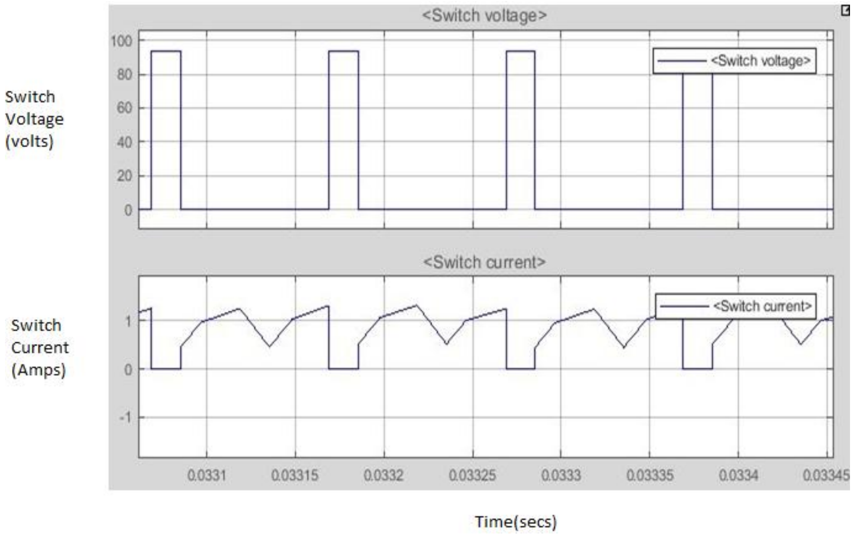


Figure 25: (1) Switch Voltage (2) Switch Current

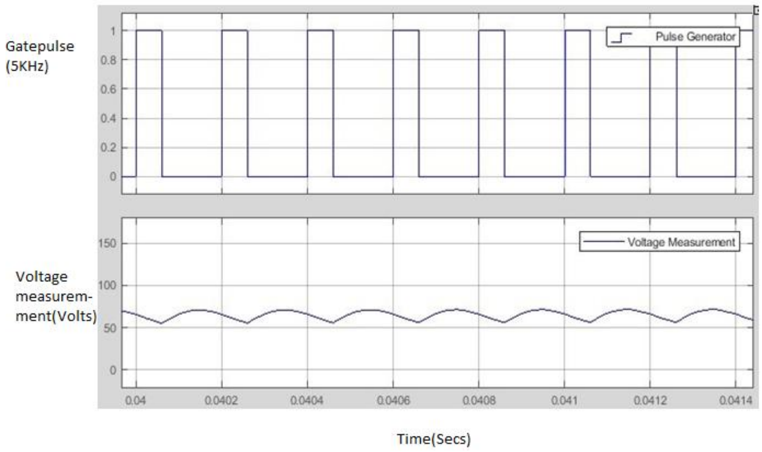


Figure 26: (1) Gatepulse (2) Voltage Measurement

The Figure represents the output graph and voltage and current measurements. We got 190volt as output voltage and got 15amp current at 30% duty cycle. From the euation-3 we got the value of voltage transfer gain 8.2. And side by side we also achieve the load current and calculate the load power that is 2400watt. Here we also got the Mosfet voltage 170volt and Mosfet current 18amps. And from the fourth curve we got the inductor current, capacitor voltage and switch voltage characteristics. We got the inductor current 1.5amp and the capacitor voltage is 200volt.We also measured the switch voltage as 220volt and switch current 3amps.

THE OUTPUT GRAPH FOR 50%DUTY CYCLE:

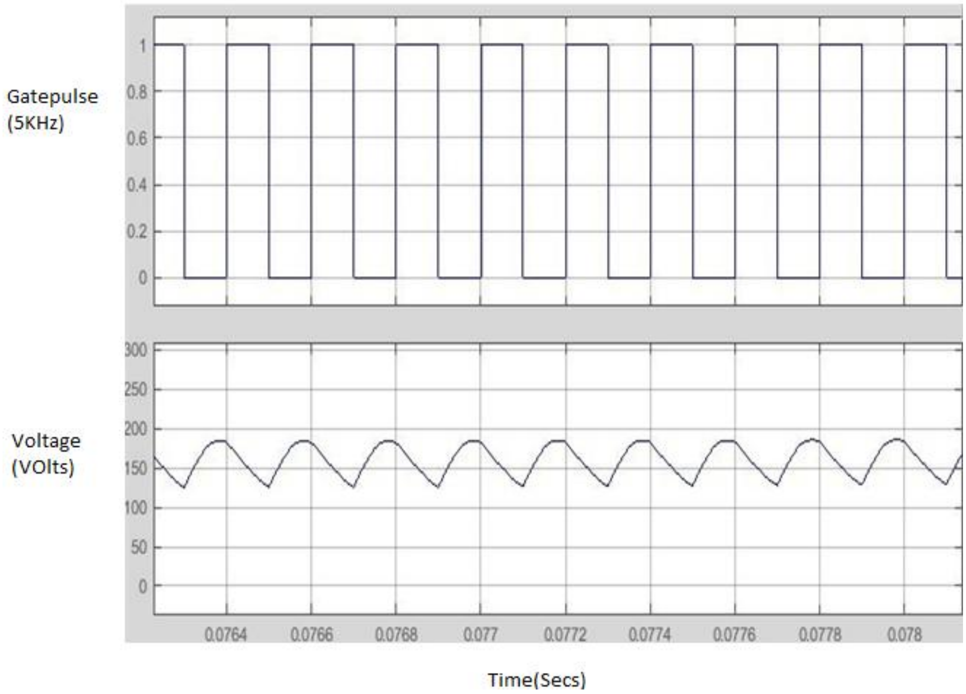


Figure 27: (1) Gatepulse (2) Voltage

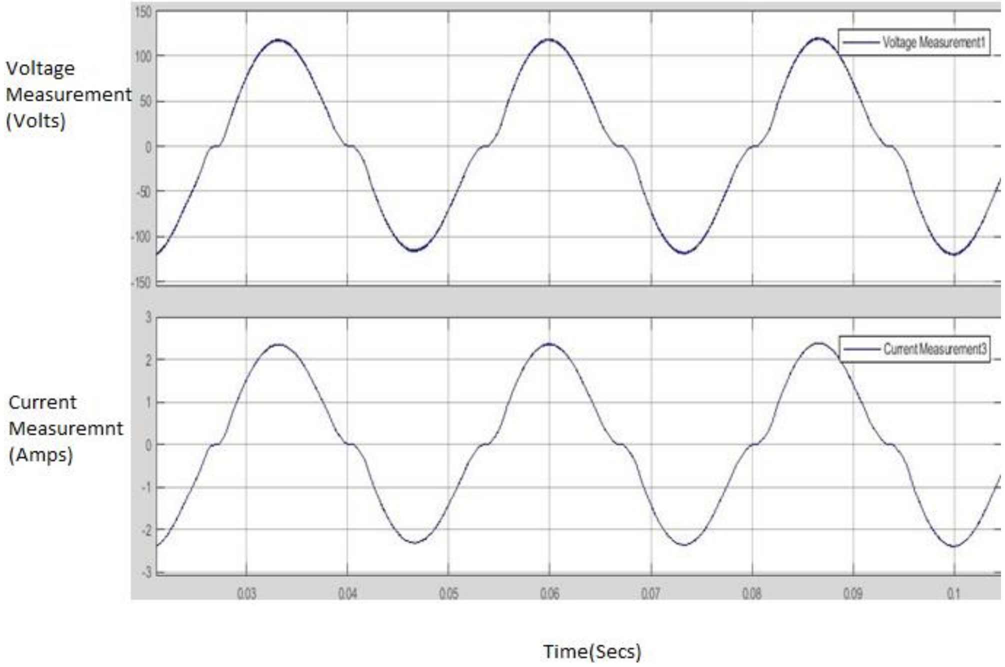


Figure 28: (1) Voltage Measurement (2) Current measurement

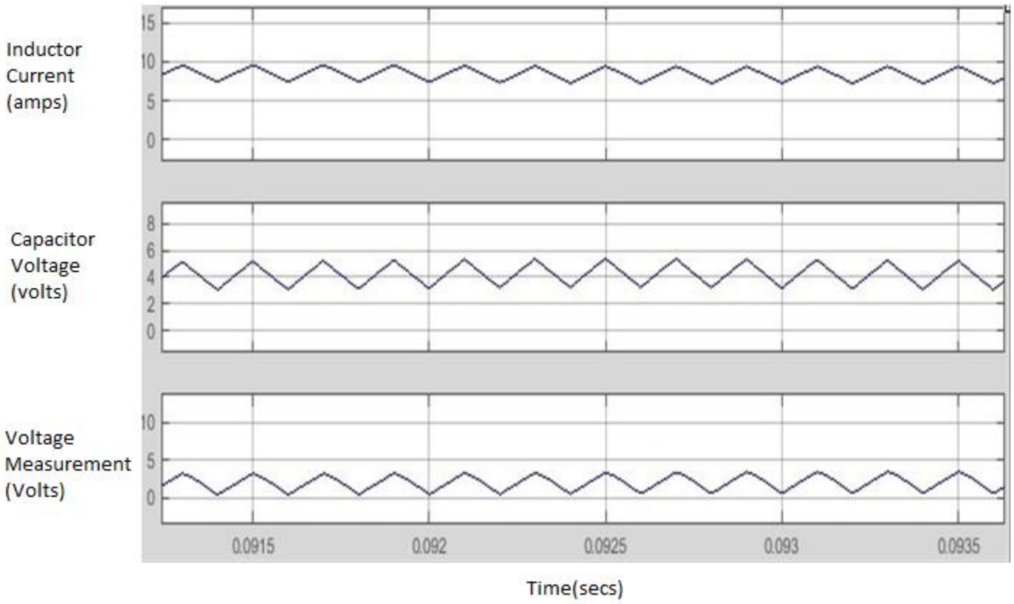


Figure 29: (1) Inductor Current (2) Capacitor Voltage (3) Voltage measurement

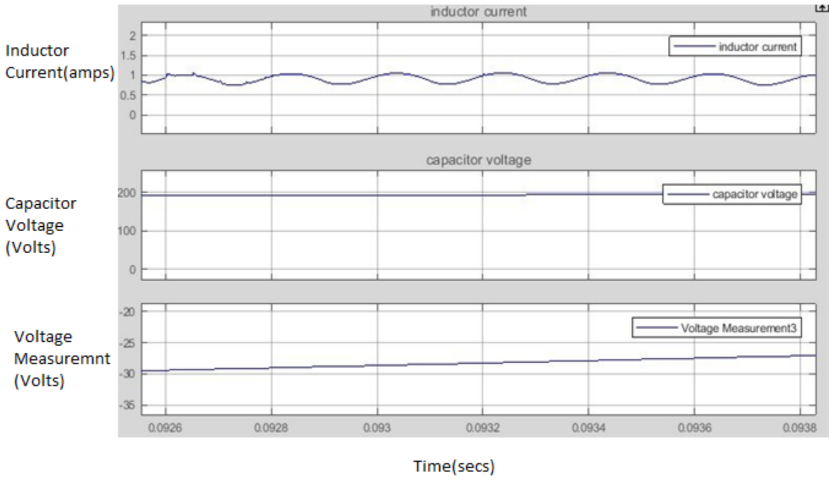


Figure 30: (1) Inductor Current (2) Capacitor Vootage (3) Voltage Measurement

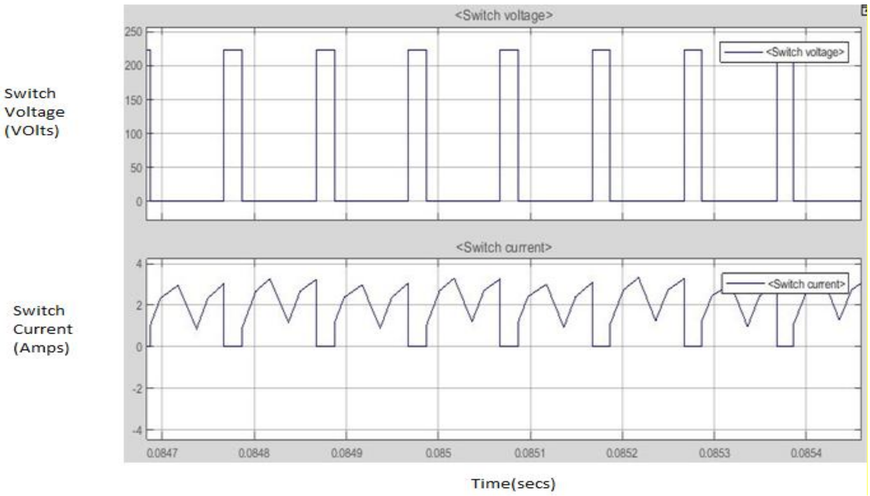


Figure 31: (1) Switch Voltage (2) Switch Current

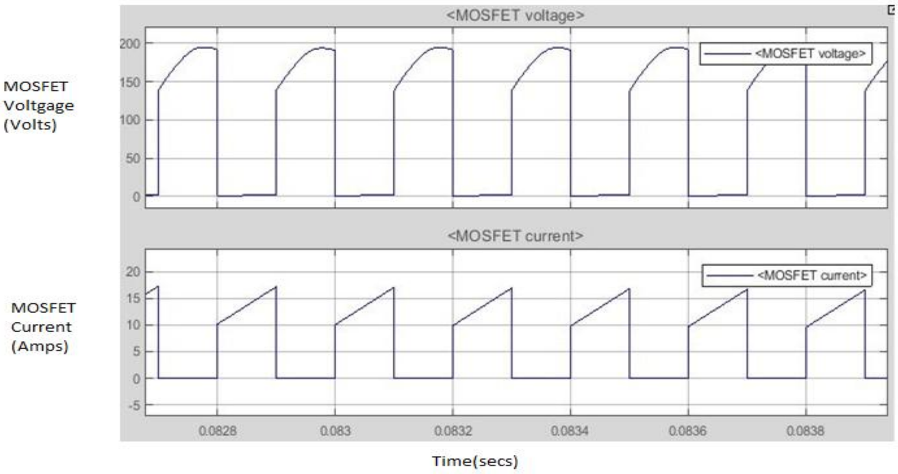


Figure 32: (1) MOSFET Voltage (2) MOSFET Current

The Figure represents the output graph and voltage and current measurements. We got 160volt as output voltage and got 15amp current at 50% duty cycle. From the euation-3 we got the value of voltage transfer gain 6.7. And side by side we also achieve the load current and calculate the load power that is 2400watt. Here we also got the Mosfet voltage 165volt and Mosfet current 16amps. And from the fourth curve we got the inductor current, capacitor voltage and switch voltage characteristics. We got the inductor current 1.1amp and the capacitor voltage is 180volt.We also measured the switch voltage as 220volt and switch current 2.5amps.

THE OUTPUT GRAPH FOR 75%DUTY CYCLE:

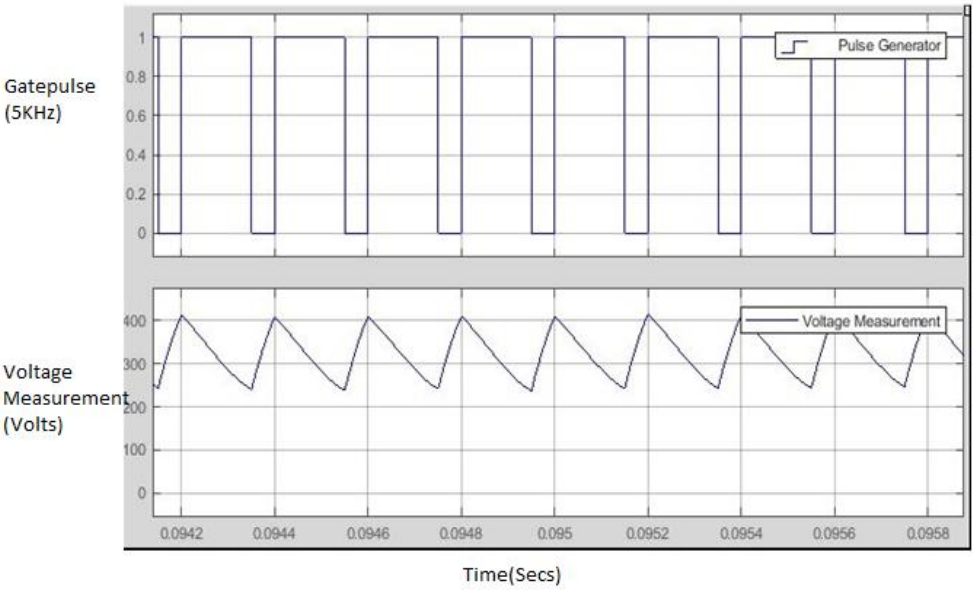


Figure 33: (1) Gate pulse (2) Voltage Measurement

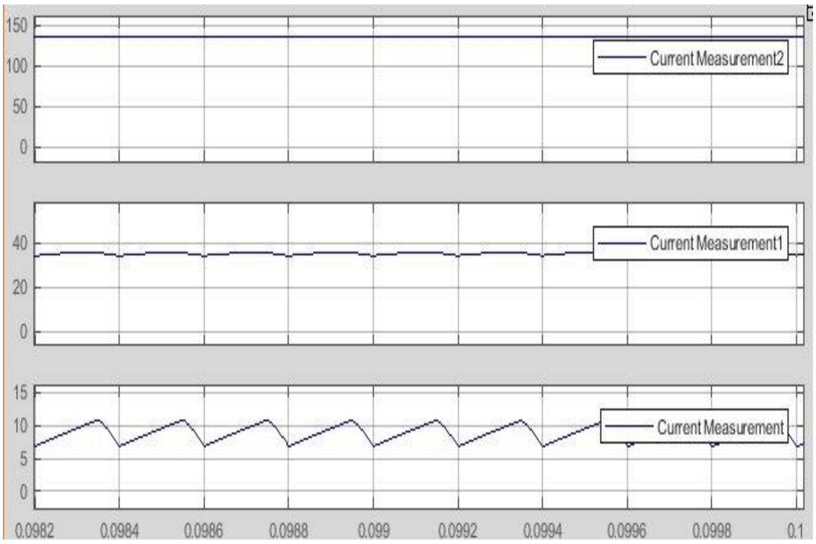


Figure 34: (1) Current through L1 (2) Current through L2 (3) Current through L3

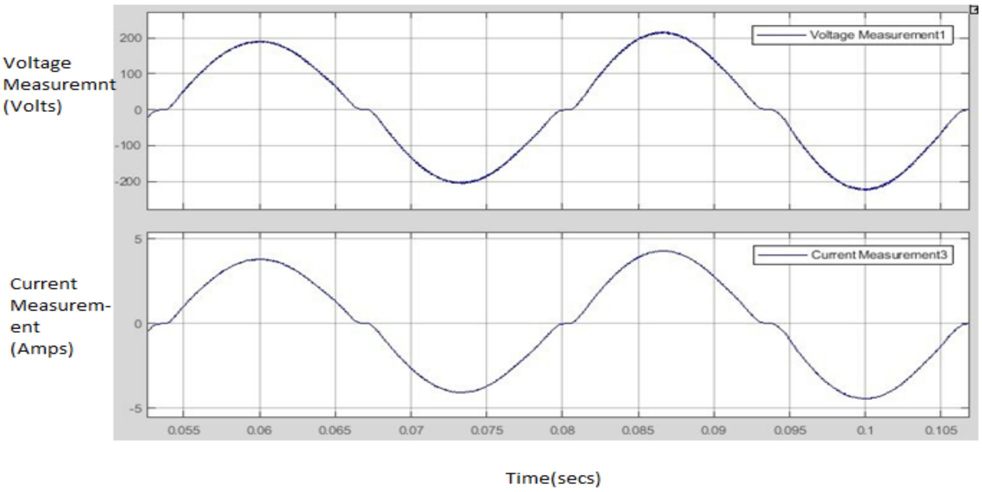


Figure 35: (1) Voltage Measurement (2) Current Measurement

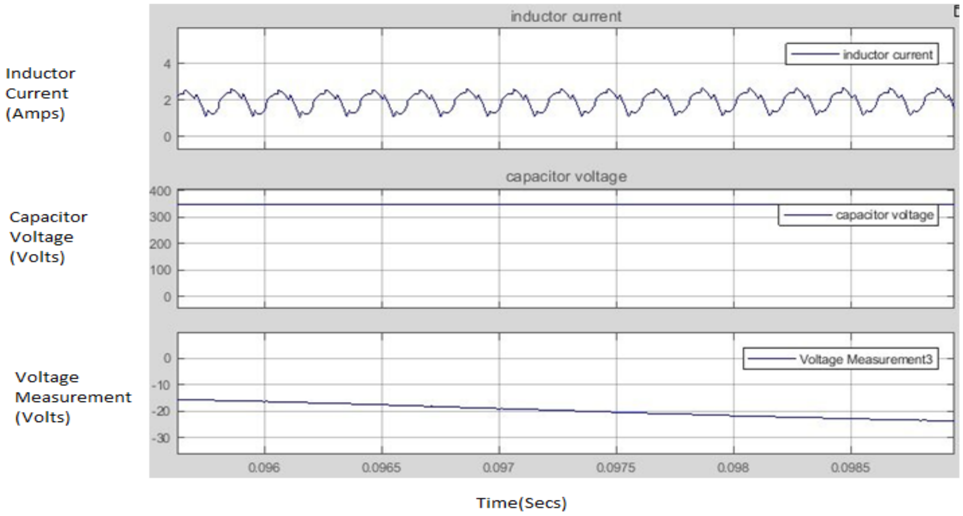


Figure 36: (1) Inductor Current (2) Capacitor Voltage (3) Voltage Measurement

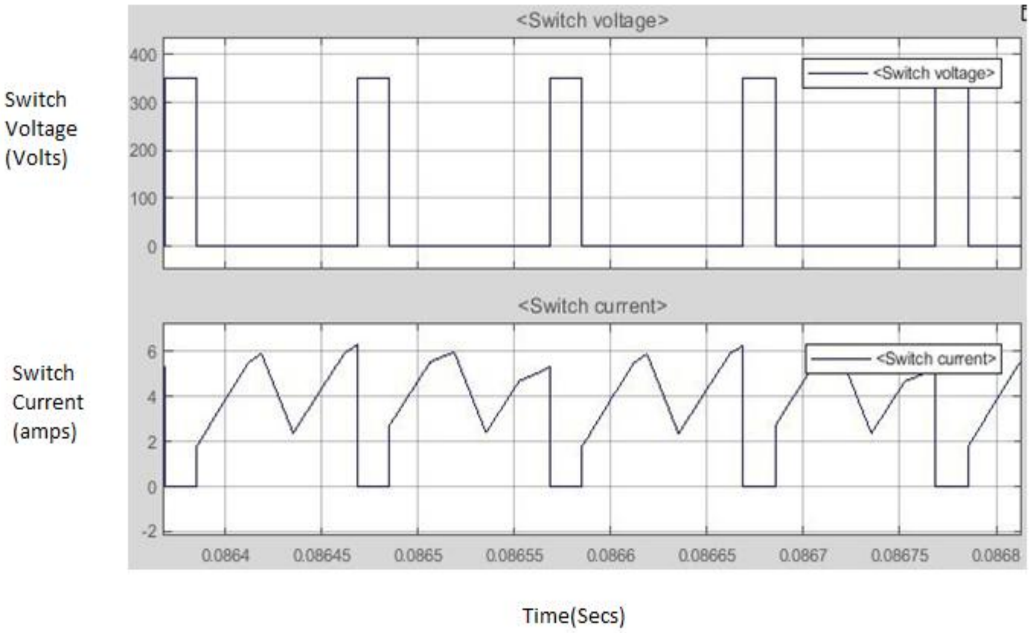


Figure 37: (1) Switch Voltage (2) Switch Current

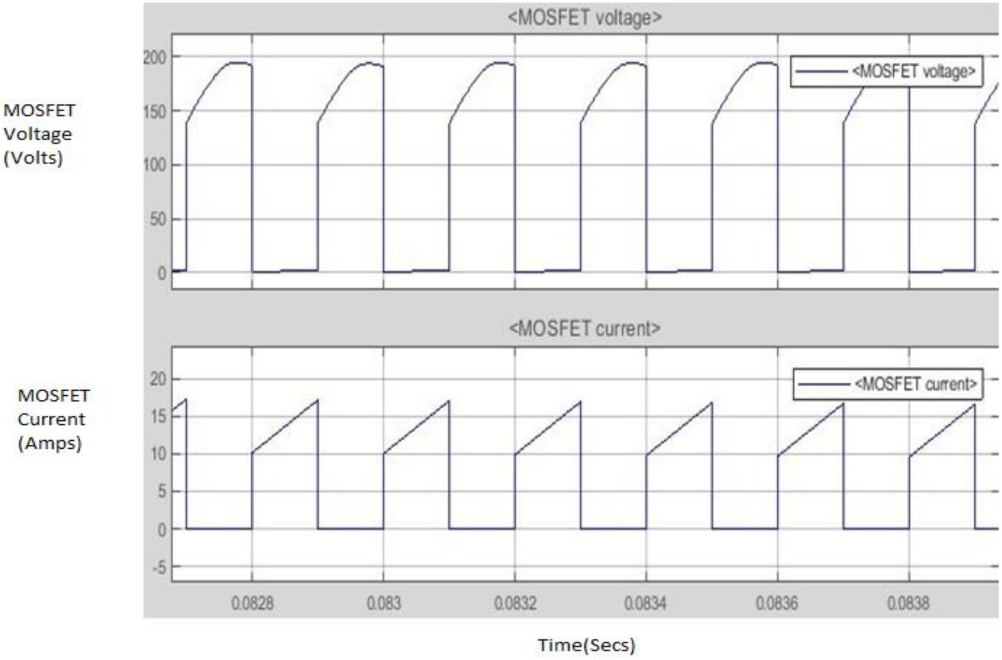


Figure 38: (1) Mosfet Voltage (2) Mosfet Current

The Figure represents the output graph and voltage and current measurements. We got 220volt as output voltage and got 7.5amp current at 75% duty cycle. From the euation-3 we got the value of voltage transfer gain 5.4. And side by side we also achieve the load current and calculate the load power that is 3000watt. Here we also got the Mosfet voltage 390volt and Mosfet current 180amps. And from the fourth curve we got the inductor current, capacitor voltage and switch voltage characteristics. We got the inductor current 2.5amp and the capacitor voltage is 350volt.We also measured the switch voltage as 340volt and switch current 4.5amps.

CHAPTER 8

CONCLUSION:

A boost converter can be compared to an AC transformer with continuously variable turn ratio. Boost converter is used in the SMPS topologies, used to boost up the voltage from lower level to the higher level without change in the power level. Boost converters are used in the solar inverters and many step – up dc voltage as a source input. Fair amount of reduction of cells is found in a model of Toyota Prius which uses a dc-dc boost converter.A DC-DC boost converter has much higher switching power converter efficiency than that of a linear converter. A DC-DC Boost converter is known as “Joule Thief”, based on the blocking oscillator concept.

An inverter is a device that converts a given uncontrolled DC supply into a controlled AC output. A basic Z-source inverter is an impedance fed inverter different from a traditional current or voltage fed inverter made into use to get rid of the problems of the latter. It is basically a two-port network (L1 and L2) and capacitors (C1 and C2) and connected in X shape (as shown in the equivalent circuit previously employed to provide and impedance source (Z-source) coupling the inverter to the DC source and AC load. However, a Z-source inverter have certain drawbacks and overcome those a Quasi-Z source inverter has been derived and put into use.

FUTURE Scope:

There are certain drawbacks of the DC-DC boost converter and the project tends to get on with a future scope and aims at suggesting a few solutions whose implementations might be focused on in near future.

- Try to in boosting the output voltage.
- Try to control the topology.
- Fault-protection and current limiting.
- Efforts to integrate the inverter function with the Power factor corrector function.
- Refinement of the characterization of induced system noise.

CHAPTER 9

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