Replacement of DC to DC and DC to AC Converter by Hybrid Converter to Obtain AC and DC Outputs

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Abstract – In our paper, a method of using hybrid converter has been implemented. In the existing system, two stage approaches has been used. This two stage approach is both dc –dc converter and dc – ac Converter. This type of converters mentioned above has been used in the earlier stages, but the drawbacks that can be seen is increased cost and complexity. The proposed method mainly uses boost derived hybrid converter (BDHC) topology. This type of topology has the main advantage of high reliability and better power processing density. The proposed system is replaced by a controlled switch of single switch boost converter with a voltage source inverter bridge network. This proposed converter requires lesser number of switches which means it provides both dc and ac outputs with high reliability. This type of proposed converter will simultaneously supply both dc and ac outputs, but only using a single dc source as input. The proposed system is initially implemented with the help of simulation module. This simulation module consists of main module and the subsystem module. This main module consists of the subsystem module. This subsystem module is called as pulse width modulation (PWM) technique which is considered as the main part in the proposed system. This simulation module is implemented with the help of matrix laboratory (MATLAB) software which is used to verify the results of the boost derived hybrid converter.

Index Terms – Boost derived hybrid converter (BDHC), dc – dc converter, dc – ac converter, pulse width modulation (PWM), matrix laboratory (MATLAB)

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I. INTRODUCTION

The domain chosen for incorporating the project is the power electronics. Power electronics is the main domain which deals with the study of switching electronic circuits to control the electrical energy flow. This domain is particularly used in the research field of electrical and electronics engineering for the control and conversion of electric power. The certain areas where power electronics has applied are aerospace, commercial, industrial, residential, telecommunication, transportation. In all the above said applications, this domain plays a vital role to provide better efficiency.

a) The hybrid converter has been particularly used which replaces other types of converters used earlier. This hybrid converter can be applied to Nanogrid architectures. This Nanogrid architecture is a small type of architecture designed to interface with power system grid particularly residential electrical system [2]. There can be two types of interfacing. They are either conventional energy resources or non-conventional energy sources. This Nanogrid system can be connected to both dc loads as well as ac loads. This hybrid converter is suitable for use in compact systems where more complex circuits are avoided. For example the hybrid converter can be used to power an fan and a led lamp. As already stated above, here two loads can be used. So fan uses ac power and led lamp uses dc power. Hence we can simultaneously use both loads.
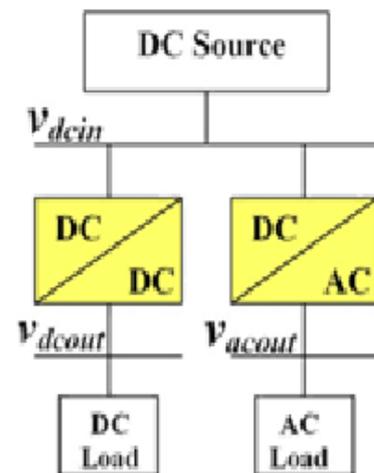

Fig 1. Power Converter based architecture

The fig.1 shows the schematic of dc – dc converter and dc – ac converter based architecture where using a input as the single dc source, the output obtained is both dc output and ac output simultaneously. Here the major drawback that can be seen is both dc – dc converter and dc – ac converter has been used.
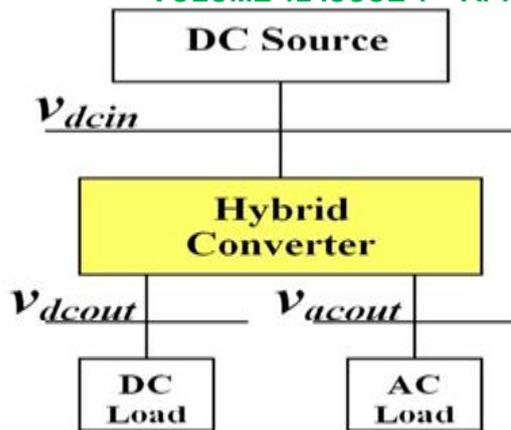
Fig 2. Hybrid Converter Architecture

The fig. 2 shows the schematic of hybrid converter based architecture where the input is a single dc source and the output obtained is both dc output and ac output simultaneously. The major advantage compared to the dc – dc converter and dc – ac converter is a single converter performs both the converters operation and hence the complexity of the entire operation is minimized. This type of hybrid converter is mainly connected to non-conventional energy sources particularly smarter residential system which provides clean energy.

II.   REVIEW OF LITERATURE
A.   Maximum Boost Control of the Z- Source Inverter

In 2005, F.Z. Peng, M. Shen and Z. Qian had proposed different boost control methods. The main aim is to achieve maximum boost voltage using maximum boost control method and also we have to reduce the voltage stress under the condition of desired voltage gain [5]. This voltage stress can be minimized by boost factor and by maximizing the modulation index. Miaosen et al also had proposed two constant boost control methods to obtain maximum voltage gain and this voltage gain is free from low frequency ripple and here also the voltage stress is reduced simultaneously. The main advantage of these types of method includes the voltage stress is completely minimzed especially in low frequency operations.

B.   Extended Boost Z – Source Inverter

In 2010, C.J. Gajanayake, F.L. Luo, H.B. Gooi, P.L. So and L.K. Siow had proposed a different method known as extended boost Z- Source Inverter in which the original Z-Source inverter and the boosting capability is very less so that it is not suitable for applications which requires very high boost demand. Thus the extended boost Z-Source inverter [3] , is mainly considered to overcome the limitations of classical Z – Source inverter. The main comparison is here between the diode assisted topology and capacitor assisted topology. But rather than these two topology a new topology has been

proposed called as hybrid system topology. So here a suitable modulation method is selected by distributing the shoot through current to the inverter bridge to reduce the current stress.

C.   Derivation and Characteristics of Switched Boost Inverter

In 2011, S. Upadhyay, R. Adda, S. Mishra and A. Joshi had proposed an alternative implementation of Z-Source inverter. This type of system uses a LC impedance network which is connected between the dc source and voltage source inverter [7]. The converter size increases due to the use of impedance which consists of two inductor and capacitor. Here the stable operation is achieved because the impedance network is symmetrical. Here the active components are present in a large amount. The main drawback is that topology cannot be used to supply ac and dc loads simultaneously.

D.   Inverse Watkins – Johnson Topology

In 2012, S. Mishra, R. Adda and A. Joshi had proposed an inverter circuit based on the Inverse Watkins – Johnson (IWJ) topology that can achieve similar advantages as that of a ZSI [4]. This inverse Watkins – Johnson topology also called switched boost inverter (SBI) is proposed for the improvement of basic inverter topology. This type of proposed converter requires two switches and one pair of LC filter along with the voltage source inverter. This load is connected across the capacitor or a switching terminal to form a switched boost inverter. The implementation of switched boost inverter needs more active components and less passive components.

E.   Synchronous Reference Frame Based Control of Switched Boost Inverter for Standalone DC Nanogrid Applications

In 2013, R. Adda, O. Ray, S. Mishra and A. Joshi had proposed a switched boost inverter which is suitable for standalone dc Nanogrid applications. Switched boost inverter is a single stage power converter which can supply simultaneous ac and dc loads from a single dc input. These topologies also possess electromagnetic interference noise immunity which is achieved by allowing shoot through of the inverter leg switches. A power electronic interface called a switched boost inverter is used for dc Nanogrid applications.

III.   OBJECTIVE AND OVERVIEW OF HYBRID CONVERTER

A.   Objective
1.   The main objective is to use hybrid converter to simultaneously obtain DC and AC outputs.
2.   To consider different parameters through simulation and also different values.
3.   To determine the results of the simulation through MATLAB.
4.   To extend the proposed philosophy to higher order boost converters in order to achieve a higher conversion ratio.

B.   Overview of Hybrid Converter

1. The foremost thing is to obtain simultaneously dc and ac outputs using a single dc input source.
2. To efficiently obtain the output, we go for hybrid converter rather than dc to dc and dc to ac converter.
3. We obtain both types of output and hence this type of converter provides high power processing density.

IV. EXISTING SYSTEM (DC – DC AND DC – AC CONVERTER)
A. Existing System Block Diagram

The main architecture which has been continuously used is Nanogrid architecture. This architecture is efficiently interfaced with different kinds of energy resources conventional or non – conventional sources. This type of architecture uses separate power converters for each conversion type. The residential system which had to be made smart are connected to conventional or non – conventional energy source to provide cleaner energy. Due to the constraints of space, this types of energies are localized and have a low terminal voltage and power ratings. The main problem that we have to face is noise. Due to electromagnetic interference and other problems, the generation of noise is faced in residential systems. Thus the voltage source network in such type of applications needs to be highly reliable. The Z – Source inverter proposed already can cause the problems of shoot through due to the electromagnetic interference. The main drawback is Z- Source cannot supply dc and ac loads simultaneously. This is mainly because of two capacitors which have to be matched with equal loads across them. Unmatched loads on the capacitors might lead to dynamic stability.

V. PROPOSED SYSTEM (HYBRID CONVERTER)
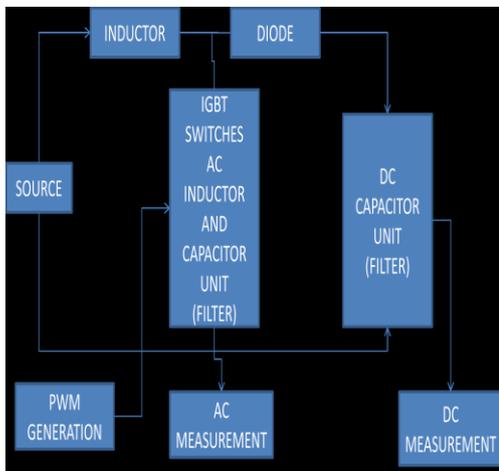### A. Proposed System Block Diagram

Fig 3. Proposed System Module

The proposed system block diagram block diagram is also called as overall module of simulation. The proposed converter is derived from switched boost inverter which is called as Boost Derived Hybrid Converter. This switched boost inverter is similar to Z – Source inverter but can achieve the advantage of lesser number of passive components and simultaneously supplying dc and ac loads. The blocks considered in the proposed modules are Source, Input Inductor, PWM Generation, DC Capacitor unit, IGBT Switches, AC Inductor and Capacitor unit and Diode.

B. Source

The source here considered is a dc source. The dc source can be solar panel, battery and fuel cell.

C. Input Inductor

An inductor is a passive device that stores energy in its magnetic field and returns energy to the circuit whenever required. When inductor is connected to a circuit with dc source, two process called storing and decaying is said to happen.

D. PWM Generation

In the simulation module IGBT (Insulated Gate Bipolar Transistor) switching system is considered. IGBT on and off switching is determined by PWM (Pulse Width Modulation) generation. So, switching speed should be high and hence PWM generation is opted to increase the switching speed.

E. DC Capacitor Unit

Here mainly dc capacitor is considered in the module which is connected in parallel to the source. When dc capacitor is connected in parallel, then with the help of this unit dc will be allowed and ac will be locked. Hence we can measure the dc value directly through this unit.

VI. SIMULATION DETAILS
A. MATLAB

MATLAB (matrix laboratory) which works on numerical computing platform and mainly it is a fourth generation programming language. Simulink is an additional package which provides a graphical simulation system. MATLAB is mainly used in academic, industry and research side mainly focusing on the design and development. MATLAB is particularly used in Power Electronics because of the factor called efficiency. Mainly it is easy to design power electronics system in matlab because it is an easy way of approach. Designing is very simple and it does not require any complexity. The main advantage of Matlab is the graphical output can be easily optimized for interaction. Matlab is not only a programming language but also a programming environment. We can create several number of programs and functions that can perform continuous tasks which is repetitive.

B. Parameters in simulation

Table1. Parameters

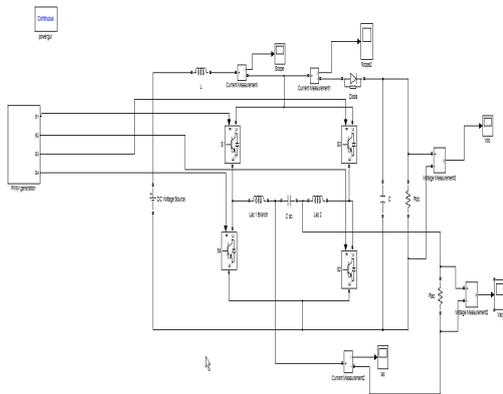| COMPONENTS	RATINGS
DC Voltage Source	48V
Input Inductor	5mH
AC Filter Inductor (1 & 2)	500µH
AC Filter Capacitor	1µF
DC Capacitor	100mF
DC Load	5KΩ
AC Load	100KΩ

C. Simulation Diagram

Fig 4. Proposed simulation diagram

The simulation diagram of proposed system is shown above and here the circuit involves two types of modules. The modules are main module and the subsystem module. The subsystem module is known as PWM Generation module. Through the subsystem module we are providing gate pulse to the IGBT switches.

D. AC Voltage Output

Fig 5. AC Voltage output

The above figure is the observed ac voltage output in the simulation for the proposed system. The axes considered are x axis is time and y axis is amplitude. So as per the specifications used in the simulation diagram, the output of the ac voltage should be around 30V rms. The above simulation clearly depicts that the ac voltage around is 45V. Finally we come to know that the maximum value is 45V and the expected output value is maximum value $/\sqrt{2}$. So hence the value attained is around 28V rms.
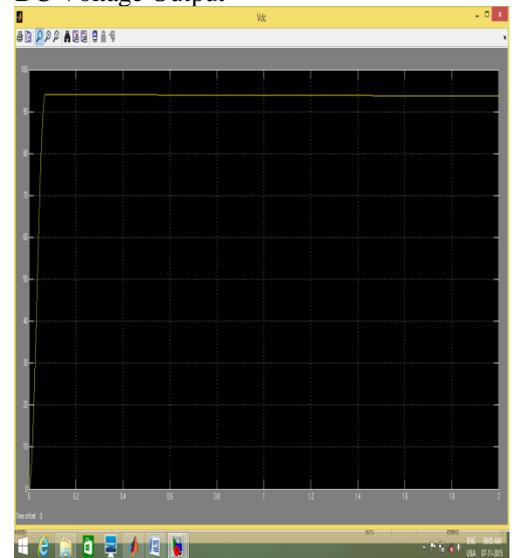
E. DC Voltage Output

Fig 6.DC Voltage output

The above figure is the observed dc voltage output in the simulation for the proposed system. The axes considered are x axis is time and y axis is amplitude. So as per the specifications used in the simulation diagram, the output of the dc voltage should be around 100V. The above simulation clearly depicts that the dc voltage is around 95V.

VII. CONCLUSION

This method of topology uses hybrid converter which has been used to increase the efficiency by simplifying the circuit design. This method uses only four switches which will reduce the switching losses. This method has been designed using MATLAB software and the observed output says that the expected output says that the expected output has been achieved using this method.

VIII. FUTURE ENHANCEMENT

In the future, proposed scheme will be implemented in hardware system. Through the hardware system, we will observe the results of the hybrid converter system by simplifying the circuit components and it will meet the expected output through hardware.

ACKNOWLEDGEMENT

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