SINGLE-STAGE AND MULTI-LEVEL POWER ELECTRONIC INVERTER BASED POWER SUPPLY FOR RESISTIVE LOAD

MOUNICA.T.R.[1],PRIYANGA.V[2] , MERCILIN RAAJINI.X[3]

[1] U G Student Department of Electrical & Electronics Engineering, PSVPEC, Chennai, India
[2] U G Student Department of Electrical & Electronics Engineering, PSVPEC, Chennai, India
[3] Associate Professor Department of Electrical & Electronics Engineering, PSVPEC, Chennai, India

ABSTRACT

The development and performance evaluation of a compact converter-based power supply for resistive load.The developed power supply is designed to meet weight and size requirements for applications.Single-stage and multilevel switch-mode inverters are employed to construct the power supply.The single-stage part of the power supply is constructed from multiple dc source that have their inputs fed by rechargeable batteries.The outputs of the dc source are used to feed different levels of a full bridge dc-ac inverter.The switching signals for the full bridge inverter are generated to facilitate the adjustments of the magnitude and/or frequency of the output voltage.A prototype for the single-stage multi-level power supply is constructed for performance evaluation using a load.

Keywords –*PIC Microcontroller,MATLAB,Power electronic inverter,Opto coupler,Buffer circuit.*

---

1. INTRODUCTION

Inverters are required for converting DC to AC at desired frequency. Inverters are required to control the speed of AC motors, to link renewable energy sources with grid etc. An ideal inverter will generate sinusoidal output voltage waveform at its output terminals. However it is very difficult to obtain sinusoidal voltage without sacrificing efficiency.Sinusoidal Pulse Width Modulation is a technique of control to obtainsinusoidal voltage. Recently researchers are interested in developing stepped voltage waveform at different levels resembling a staircase at the output of inverter. such inverters are called Multi Level Inverters. Level can be three, five, seven etc. One importantapplicationof multilevel converters is focused on medium and highpower conversion. Nowadays, there exist three commercial topologies of multilevel voltage source inverters : neutral point clamped (NPC), cascaded H-bridge (CHB), and flying capacitors (FCs). Among these inverter topologies,cascaded multilevel inverter reaches the higher output voltage and power levels and the higher reliability due to its modular topology.

2. OBJECTIVES

- To maximize performance of the system using Single Stage process.
- To reduce the number of stages and switches to achieve the same 11 level output of the existing method using cascaded full bridge dc-ac inverter.
- The developed power supply is designed to meet weight and size requirements for applications. The single-stage and multilevel switch-mode inverters are employed to construct the power supply.

3. CIRCUIT DIAGRAM OF SINGLE-STAGE AND MULTI-LEVEL POWER ELECTRONIC INVERTER BASED POWER SUPPLY FOR RESISTIVE LOAD

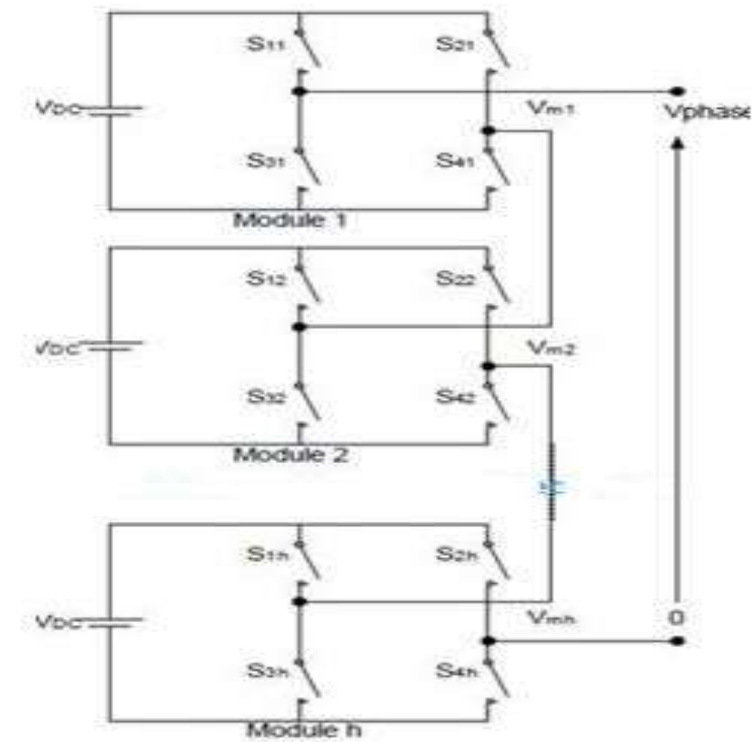

Fig-2 Circuit diagram of single-stage and multi-level power electronic inverter based power supply for resistive load

The multilevel dc-ac power electronic inverter based power supplies have demonstrated good abilities to facilitate addjusting the force,while maintaining the overall syatem stability.Mukti-level dc-ac PEI based supply for feeding resistive load without the need for high frequency transformers.Each H-bridge is constructed from 4 MOSFETs,Where each MOSFET has a voltage rating of 800v and a current rating of 4A.Each MOSFET is featured with a snubber circuit to minimize the voltage spikes and switching losses

4. WORKING PRINCIPLE

The introduction of multilevel dc–ac PEIs has provided a new avenue for designing power supplies to feed resistive load , where the output voltage can be controlled over a wide range of frequencies. The multilevel dc–ac PEI-based power supplies have demonstrated good abilities to facilitate adjusting the force, while maintaining the overall system stability. Multilevel dc–ac PEI-based power supply for feeding resistive load without the need for high-frequency transformers .The developed power supply is constructed for light weight and compact size, which are key requirements for application in aeronautical systems. The weight and size constraints are met by designing the power supply using single stage and multilevel structure, where multiple dc source PEIs are used to supply the different levels of a multilevel dc–ac PEI. The output voltage produced by the multilevel dc– ac PEI feeds the load.The switching signals for the full bridge dc-ac inverter are generated to facilitate the adjustments of the magnitude and/or frequency of the output voltage

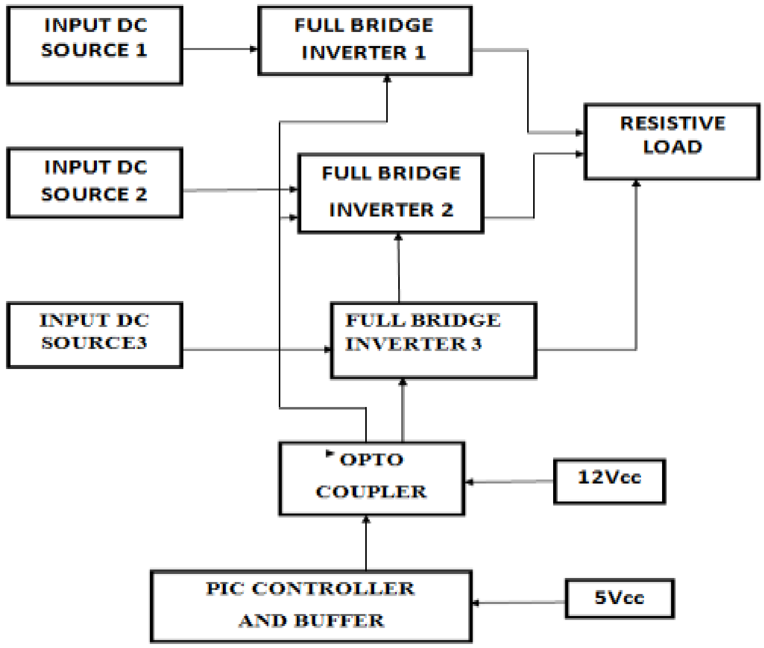

Fig-3 Block diagram of single-stage and multi-level power electronic inverter based power supply for resistive load

4. HARDWARE CIRCUIT DIAGRAM

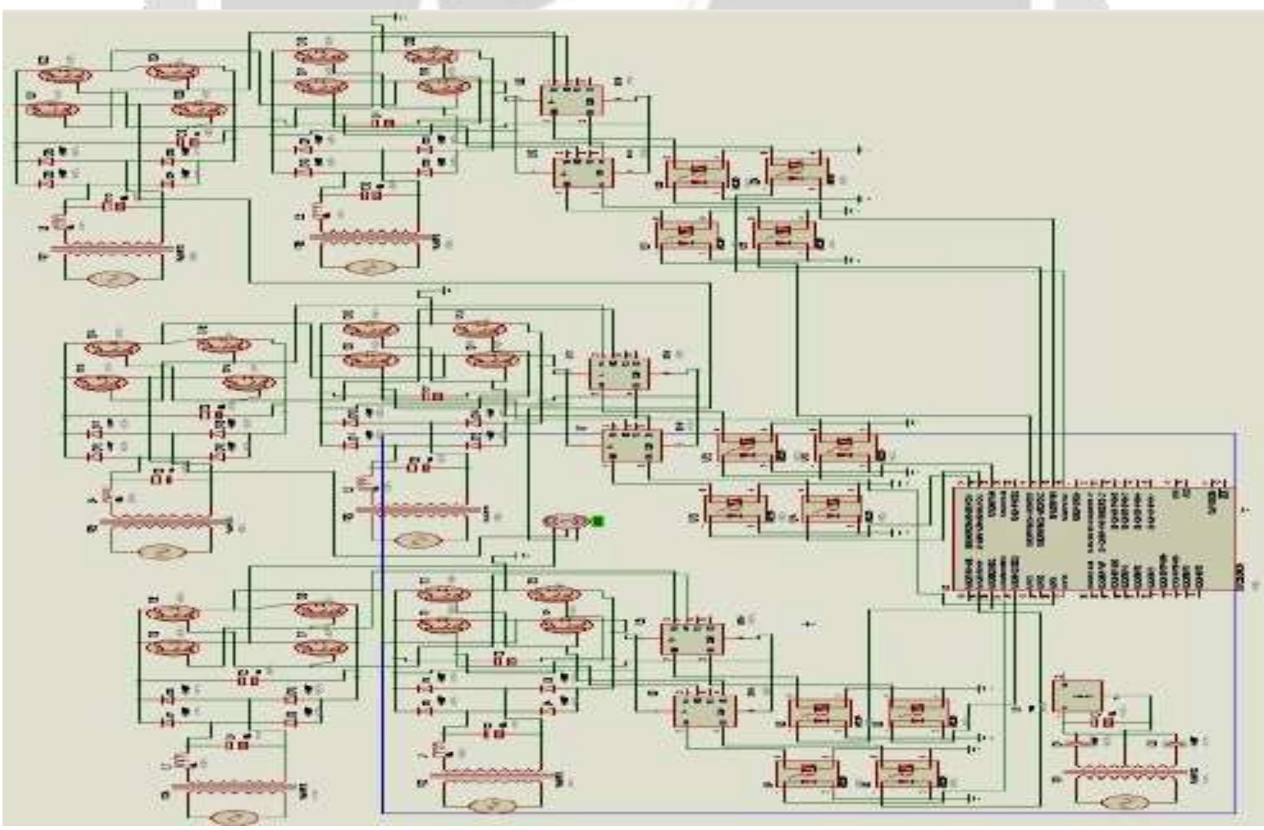

Fig-4 Hardware circuit diagram

The hardware circuit diagram of the three H-Bridge Multi-level inverter which each phase of the multilevel inverter consists of H-Bridges with four switches in each H-Bridge. The gate pulse for the switches is given using processor and the experimental setup of the proposed system. The gate drive circuit used here is the IR2110 and opto-isolator is used for the protection of the processor from the high voltage side which is the MOSFET switches. Since the switches are working in a high voltage and current the processor and the driving IC's are not able to withstand that much amount of higher voltages so we are connecting it through an opt-isolator.

5. HARDWARE SNAPSHOT OF SINGLE-STAGE AND MULTI-LEVEL POWER ELECTRONIC INVERTER BASED POWER SUPPLY FOR RESISTIVE LOAD

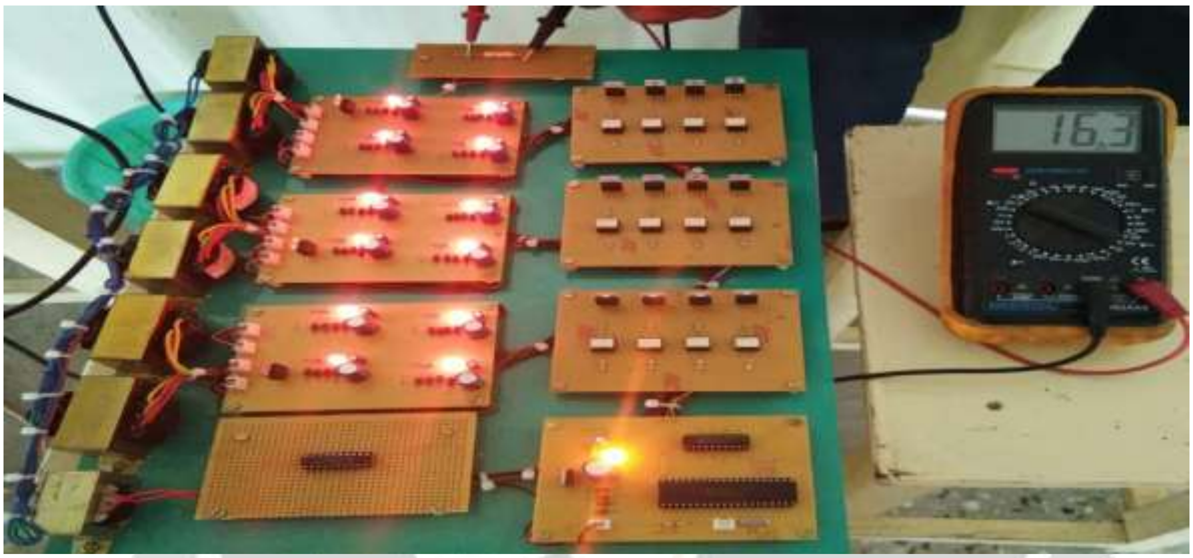

Fig-5 Hardware Snapshot of output voltage

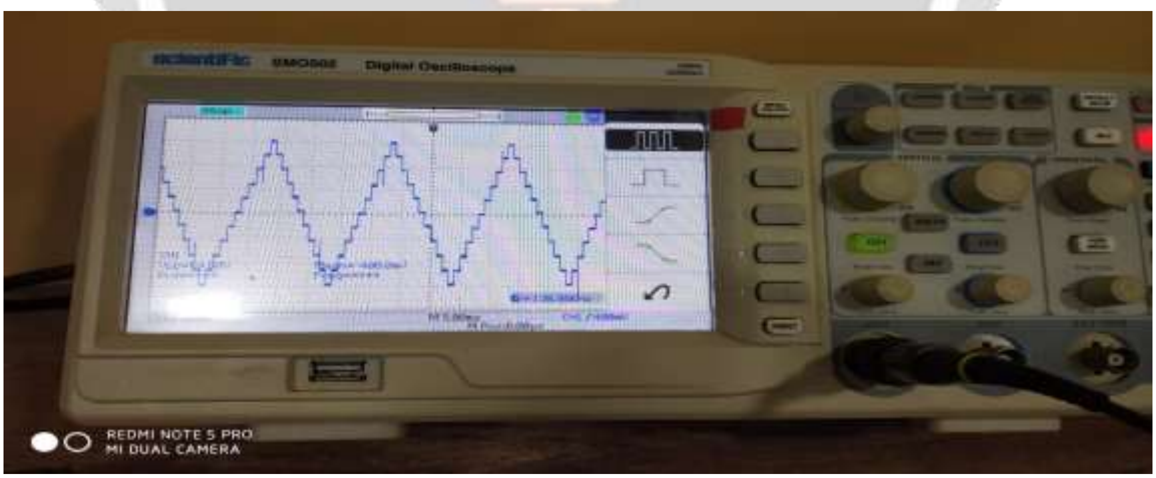

Fig-6 hardware snapshot of single-stage and multi-level power electronic inverter based power supply for resistive load

The Single stage and multilevel power electronic inverter based power supply for resistive load is proposed. The circuit consists of three set of inverters, each inverter having four MOSFET switches so totally twelve switches used, PIC16F877A microcontroller block and power supplies for the inverter circuit is used. The current gain for microcontroller is less so we used buffer circuit to amplify the current gain. The circuit consists of two set of buffers because each buffer operates only eight MOSFETs but here we used twelve switches so we require one more buffer. IRF840 MOSFET is used here,optocouplers are provided the isolation of MOSFETs. And the power supplies with the MOSFET act as a input source to the inverter. The ratio of three inverter is 1:2:2 i.e 6:12:12. Resistive load are connected across switches to verify the output.

6. HARDWARE REQUIREMENTS

- RAM - 2GB
- Hard Disk - 20 GB
- Switches - Four MOSFET switches
- Gate driver circuit
- Buffer circuit
- Current Transformer
- LED
- PIC Microcontroller
- Load (200W and 100W Bulb)

SOFTWARE REQUIREMENTS

- Tool - MATLAB R2015a
- Operating system - Windows 7,8

7. CONCLUSION

The development and performance evaluation of a compact and lightweight power supply for load deployed. The developed power supply is designed as a modular, single-stage and 11-level PEIs, which are switch mode PEIs. The modular design together with the simple operation and control can offer possible expansion for other applications that may require output voltages with different magnitudes and/or frequencies. The use of the multi-level dc-ac PEI can be advantageous in accommodating reduced switching frequencies, while producing output voltages with a low harmonic content. Performance results have shown the ability of the developed power supply to produce stable high voltage at different high frequencies, which are required for operating load. Finally, test results have shown that changing the switching frequency of the multi-level dc-ac PEI.

8. REFERENCES

[1] B. Zheng, Y. Liu, C. Gao, and Y. Li, “Design and Application of Multichannel Peristaltic Acceleration Pulsed Plasma Power Supply,” *IEEE Trans. on Plasma Science*, Vol. 42, No. 7, pp. 1902–1908, 2014.

[2] G. Neretti, A. Cristofolini, C. A. Borghi, A. Gurioli, and R. Pertile, “Experimental Results in DBD Plasma Actuators for Air Flow Control,” *IEEE Trans. on Plasma Science*, Vol. 40, No. 6, pp. 1678–1687, 2012.

[3] M. Amjad and Z. Salam, “Analysis, Design, and Implementation of Multiple Parallel Ozone Chambers for High Flow Rate,” *IEEE Trans.on Industrial Electronics*, Vol. 61, No. 2, pp. 753–765, 2014.

[4] S. A. Saleh, B. Allen, R. Meng, T. Lavigne, and B. G. Colpitts, “On the Employment of 1φ, Voltage-Source, Switch-Mode PWM, DC-AC Converters for Supplying Dielectric Barrier Discharge Devices,” *in Proc.of the 50th IEEE Industry Application Society (IAS) Annual Meeting*, Dallas, TX, October, 2015.