

Full Bridge Inverter Topology For Domestic Induction Heating Applications

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Abstract: Domestic induction heating (IH) is currently the choice in modern domestic application due to its advantages regarding fast heating time, efficiency and improved control. Induction heating applications require high frequency currents which are obtained using resonant converters. In this paper a novel DC-AC single phase inverter is proposed and simulated using MATLAB. When the switches are turned on and off, a conventional inverter generates switching loss because of the hard-switching. Thus the inverter loss is increased. Proposed system contains auxiliary circuit. The converter stage switches perform soft-switching because of the auxiliary circuit. Therefore all switches perform soft-switching when the switches are turned on and off. Thus the proposed system reduces switching loss and voltage stress.

Keywords: Induction heating, resonant converter, hard switching, soft switching.

I. INTRODUCTION

An easy way to comply with the conference paper formatting requirements is to use this document as a template and Induction heating is a non-contact heating process. Since the material is non-contact the process of heating does not contaminate it being heated and inside the work-piece the heat is actually generated. This can be contrasted with other heating methods where heat is generated in a heating element or flame, which is then applied to the work-piece. Hence in the cooking market, domestic induction heating is becoming a standard option due to its benefits such as higher efficiency, cleanness and the reduced heating times. In order to implement this type of appliances, a converter of wide bandwidth (typically 20 to 100 kHz) and high power output (up to 5 kW [1]–[2]) is required. The development of high frequency AC/AC converters for kitchen equipments is need of the hour [1]. A high frequency induction boiler, cooker and super heated steamer compared with the conventional gas cooking equipment are much more attractive for home and business uses. Increasing the frequency of power converters is desirable, as it allows the size of circuit to be reduced, leading to more compact and cheaper circuits. However, increasing the frequency of operation, the single phase boost chopper converter produces the harmonic distortion and high input peak current. So the switching losses are high and hence reduce system efficiency.

One solution to this problem is to replace the conventional "chopper" switch with a "resonant" switch. The resonances of circuit inductances and capacitances will shape the current or the voltage waveform across the switching element, such that when switching takes place, there is no current through or voltage across it, and hence no power dissipation. Inverter topologies commonly used for IH are the full-bridge and half bridge ([3]-[4]). The modulation strategies commonly applied to control output power are based on modifying either switching frequency or duty cycle to achieve the desired output power. The half-bridge series resonant inverter is used to design converters with up to 3.5-kW output power. The full-bridge ([5]-[6]) topology can offer the higher output power (up to 5 kW). The Open loop circuit requires the manual change of frequency of the switching elements. In this paper a direct DC -AC closed loop full bridge inverter topology is introduced. The load voltage is given as the pulse to the switching elements. In the feedback loop PI controller is used to generate a pulse signal.

II. FULL BRIDGE INVERTER TOPOLOGY

A DC supply of 30V is given to the full bridge inverter. The dc voltage is converter to ac voltage. This ac voltage is stored in the capacitor C_1 when it is charged. An isolation transformer is placed to separate the input and output circuits. The capacitor C_2 smoothen the ac current which flows to the load. An equivalent resistive load is chosen in the place of induction heating.

A feedback system is introduced to switch the switching elements. The output voltage and the reference signals are compared and an error signal is produced. This error signal is passed through the PI controller to amplify the signal. The output subsystem will generate a pulse signal for the switching elements based on the remainder value and this subsystem works on if-else condition.

III. SIMULATION RESULTS

The simulation input parameters are given below as per the calculation.

Input voltage	30V dc
L	0.065H
C ₁	2.3uF
C ₂	4.5uF
R ₃	1280 ohm

The SIMULINK model of the proposed circuit is given in the below figure1.

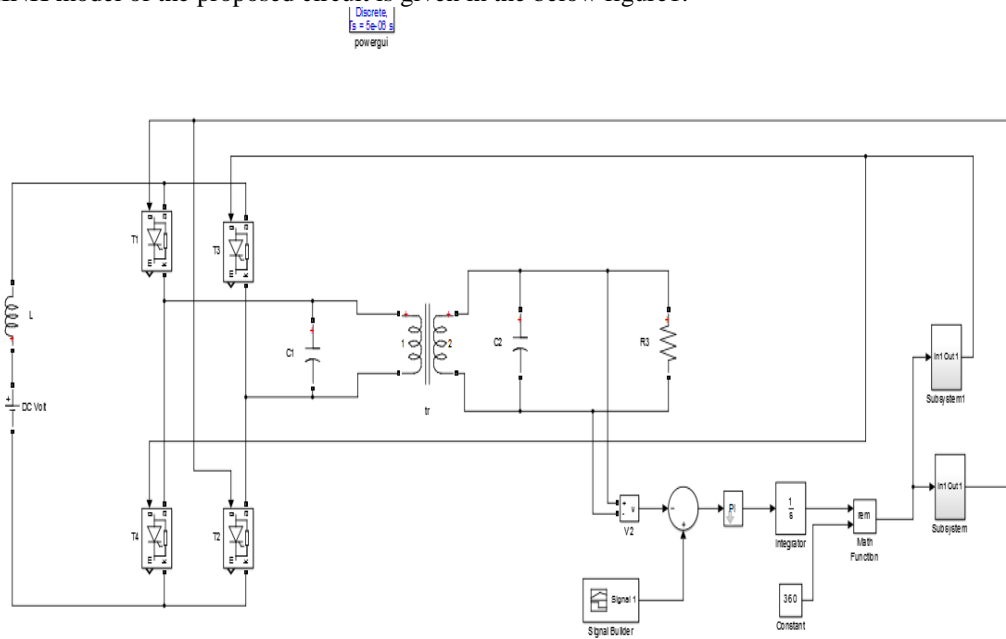


Fig.1. SIMULINK model of the proposed circuit

The simulation results are given in the below figure2. The output current, switching sequence and output voltages are given in the waveform.

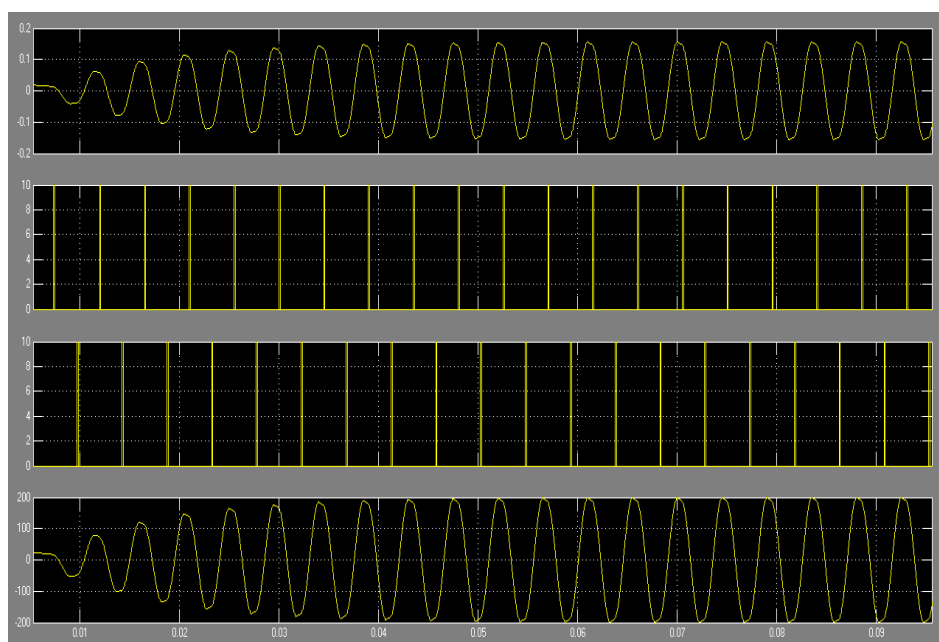


Fig.2. SIMULATAION waveforms

- a. Load current, b. T1&T2 pulse, c. T3&T4 pulse, d. Load voltage

IV. CONCLUSION

In this paper, a direct dc–ac boost resonant converter applied to domestic IH application was proposed with closed loop condition and simulated using MATLAB. The topology is simple. The switch operates in a soft commutation mode. The converter provides a wide range power control. Manually supplying of frequency is avoided with feedback circuit. This converter has merits like reduced stresses, reduced components and high power density.

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