HARDWARE IMPLEMENTATION OF HIGH FREQUENCY INDUCTION HEATING

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ABSTRACT

Induction heating applications need high frequency currents which are obtained using resonant DC-AC inverter. This research presents the analysis of solid-state induction heating system. The system initially consists of LC-oscillator, MOSFET's in full bridge model and the load circuit comprises an induction heating coil. The systems active switching elements comprise power MOSFET's which gives the frequency of 33kHz.

Keyword: - *Induction heating1, High frequency2, MOSFET3, LC circuit4*

INTRODUCTION

Induction heating is a process which heat material which are electrically conductive. It is a non-contact heating process, it is one of the most efficient way to heat the material since the heat is actually generated inside the workpiece due to the combination of phenomenon namely Joules law, Electromagnetic induction, Skin effect and Heat transfer. This heating process does not consume enough man-work and it is also a pollution free process since it does not contaminate the workpiece and release any pollutants. Increasing the frequency of operation also increases switching losses which lead us to choose resonant circuit which uses the resonances of circuit capacitance and inductance to shape the waveform of current and voltage and hence no power dissipation occurs. The paper presents circuit of a DC-AC inverter for induction heating. It includes MOSFET's switching (for high frequency), Resonant circuit.

FEATURE PARAMETERS

The success of any system is based on matching the theoretical and practical values calculated and simulated respectively. So following parameters shall be tested for recognized accordingly.

A. Skin Depth and reference depth

The basic principal nature of induction heating gives rise to "skin effect" which means that the eddy current are produce of the workpiece. The depth of heating depends on the frequency of the ac field, the electrical resistivity, and the relative magnetic permeability of the work piece. The skin heating effect is defined as the depth at which approximately 86% of the heating due to resistance of the current flow occurs. The reference depths decrease with higher frequency and increase with higher temperature.

$$\partial = \sqrt{\frac{\rho}{\pi f \mu}}$$

Where,
ρ is the resistivity of the conductor in Ω.m.
f is the frequency in Hertz.
μ is the absolute magnetic permeability of the conductor.
The absolute magnetic permeability is given by (μ) = μo x μr
μo = 4π x 10-7 H/m

COMPONENTS

MOSFET (IRFP260n)	V=40V
Coil parameters (Resonant circuit)	17 gauge (25 turns)
Coil parameters (Heating coil)	10 gauge (20 turns)
Resonant circuit parameters	C=470nf
Resistor	330Ω
Diode (UF4007)	I_r =10μA, V_r =1kV, I_f =1A, V_f =1.7V
Battery	V=12V, I=7A

Where,
I_r = Reverse diode current, V_r = Reverse diode voltage, I_f = Forward diode current, V_f = Forward diode voltage

CIRCUITRY

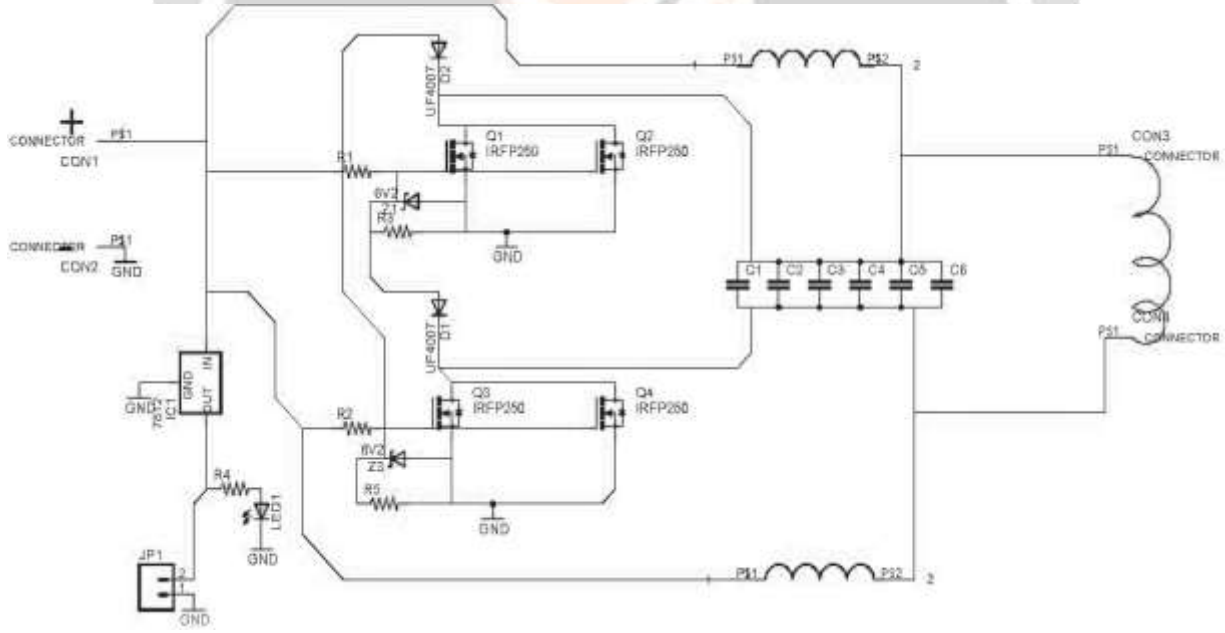

Figure 1: Proposed Circuit

The above given circuitry describes the setup of the induction heater which is tested.

Figure 2: Prototypic Induction heating model

CONCLUSIONS

From the above represented circuit and their output we verify that system which can produce high amount of heat in the work piece. The DC – AC converter circuit gives a higher frequency about 33 kHz. For a frequency range of above 30 kHz, MOSFET will be a better option as compared to IGBT due to its high switching speed, low switching and conduction losses.

FUTURE SCOPE

Induction heating is used to cure organic coating such as paints on metallic substrates, generating heat within the substrate and minimizing the tendency for formation of coating defects. A typical application is the drying of paint on sheet metal.

REFERENCES

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[3] SOFTWARE USED FOR CIRCUIT DESIGNING : "CAD Soft Eagle"