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DETERMINATION OF INPUT/OUTPUT CHARACTERISTICS OF FULL-BRIDGE AC/DC/DC CONVERTER FOR ARC WELDING

Assist. prof. Dr. Eng. Stefanov G.[1], Prof. Dr. Eng. Karadzinov Lj.[2], Assos. prof. Dr. Eng. Sarac V.[3], Prof. Dr. Eng. Cingoski V.[4], Assos. prof. Dr. Eng. Gelev S.[5]
Faculty of Electrical Engineering-Radovis, University 'Goce Delcev'-Stip, Macedonia[1,3,4,5]
FEIT, University Sv. Kiril and Methodius -Skopje, Macedonia[2]

1. Introduction

In this paper, for full-bridge DC/DC converter with defined output load, are made computer simulations for estimation of switching losses of IGBT transistors. Practically AC/DC/DC converter is designed and implemented for arc welding and input/output characteristics are obtained.

2. Operating Principle on Full-Bridge DC/AC Power Converter

The conventional DC/DC converter operates with PS-PWM control at constant switching frequency. The output current is controlled by change of the phase shift between (transistors T1, T4) and lagging leg (transistors T2, T3), as given in the Fig. 1.

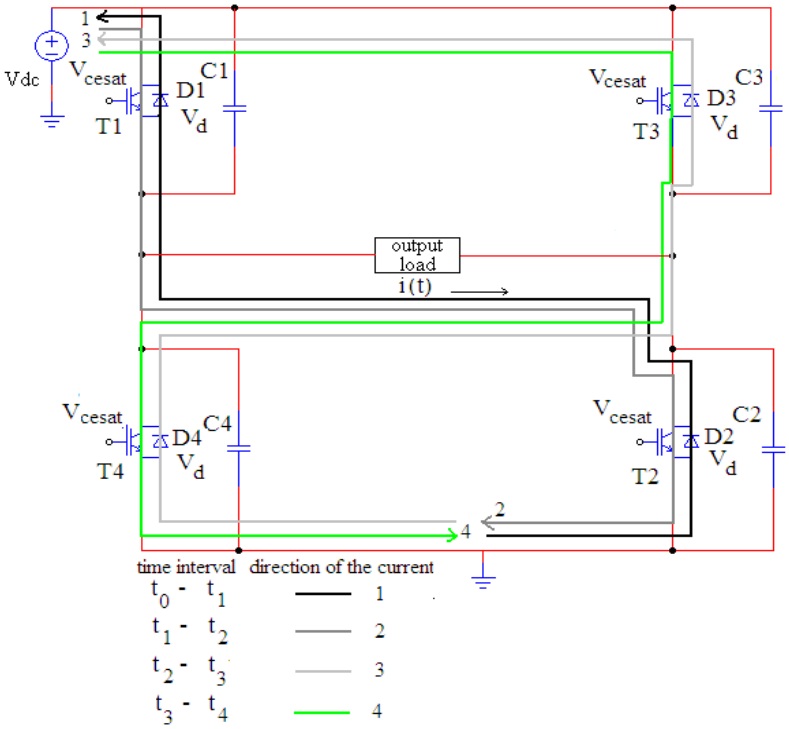


Fig. 1. Full–bridge DC/AC converter topology and the steady-state current paths in all four time intervals during one period.

The output current is lagging in respect with the output voltage. This analyze presents converter operation only in the steady-state, that is, all converter currents and voltages have the same values at the end of each period as at its beginning.

3. Design of Full-Bridge AC/DC/AC Power Converter with Computer Simulations

In this section, computer simulations in PowerSim [9] program are performed in order to estimate the switching losses of IGBT transistors in full-Bridge DC/AC converter. With the simulations the input power, harmonic distortion of voltage and current, input effective current and converter output power are determined. Also, calculation are made for efficiency of the converter for different widths on the pulse at the gates of the IGBT transistors in the bridge.

Estimate the Switching Losses of IGBT Transistors in Full-Bridge AC/DC/DC Power Converter

In the Fig. 2 is shown circuit of a full-bridge DC/DC converter used for computer simulations in PowerSim program. The parameters of the elements are shown in the Fig. 2. With this parameters and switching frequency f = 64 kHz the converter output power is Po = 3.091 kW.

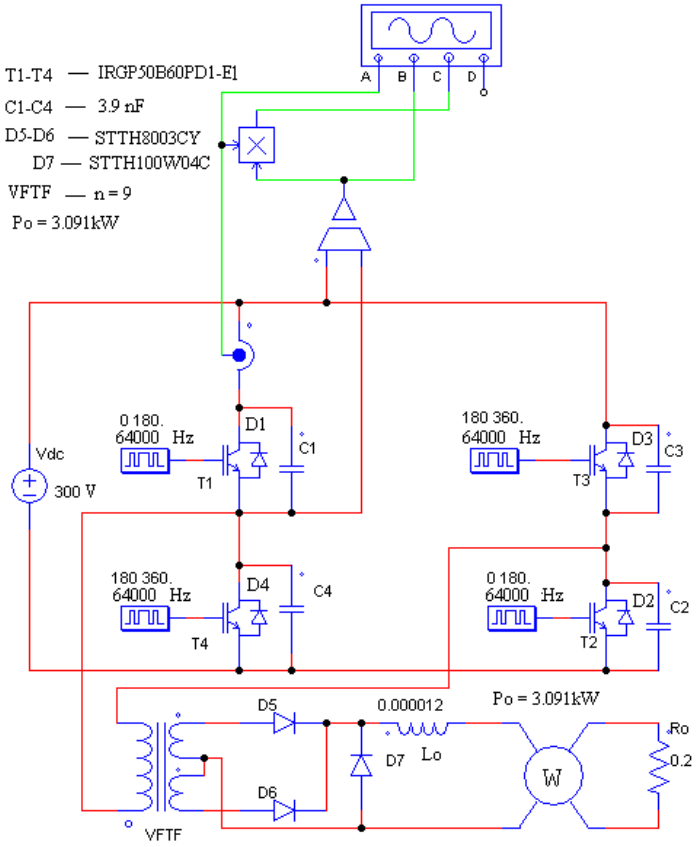


Fig. 2. Circuit of full-bridge DC/DC power converter used for computer simulations in the PowerSim program.

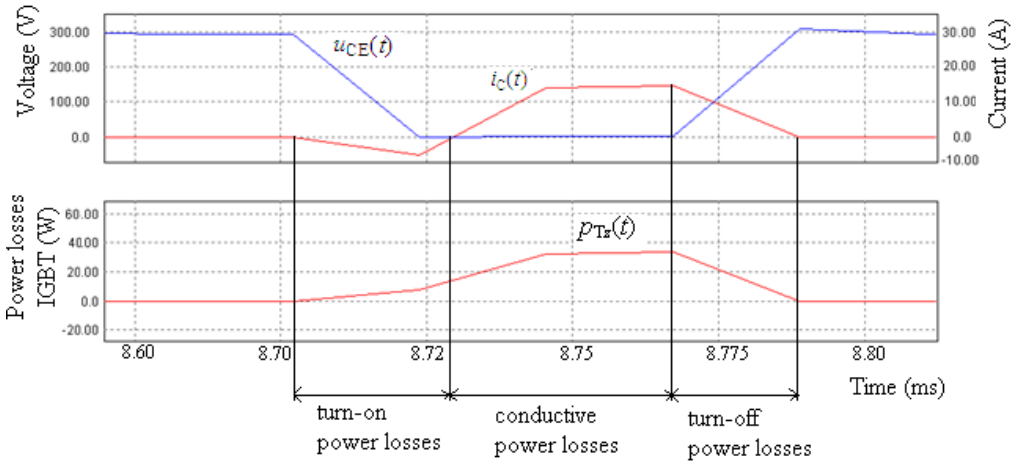


Fig. 3. Waveforms of iC(t), vCE(t) and pTz(t) of one IGBT transistors module in bridge.

In the Fig. 6 is shown diagram for converter efficiency obtained from values given in Table III. From Table III and Fig. 6 can be concluded that maximum converter output power is 3.091 kW and maximum converter efficiency is 0.94 when the output power of the converter is maximum.

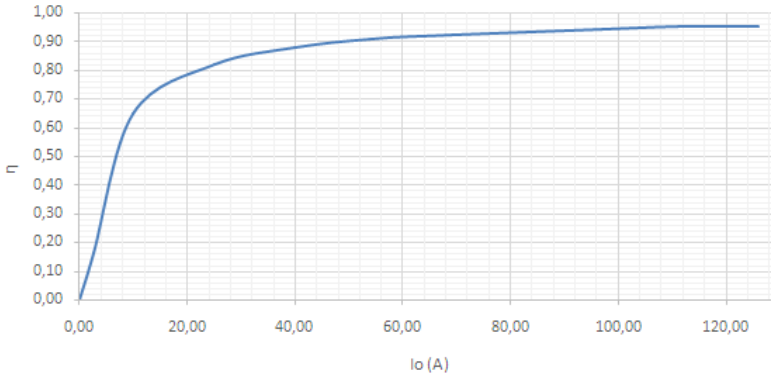
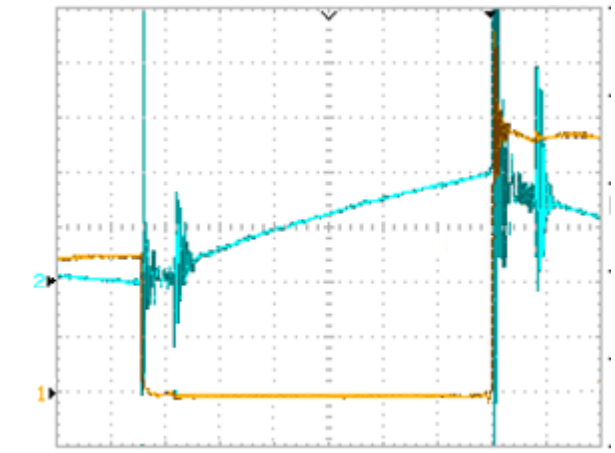


Fig. 6. Converter efficiency at the full-bridge AC/DC/DC power converter obtained by simulations.

4. Experimental Results

Based on the results obtained above practical prototype of the full-bridge AC/DC/DC power converter for arc welding is realized. The operation of the prototype is experimental tested and results are given here. The experiments are made for input mains voltage Vin = 220 V. The output no-load voltage is about 60 V, which is enough for arc burning at normal operating conditions. The maximum output power of the converter is 3.09 kW at switching frequency of 64 kHz.



m v_{ceT1} = 50V/div
m i_{cT1} = 10A/div
m_t = 1µs/div
0 v_{ceT1} = -3div

Fig. 8. v_{ceT1} and icT1 of transistor T1.-detail.

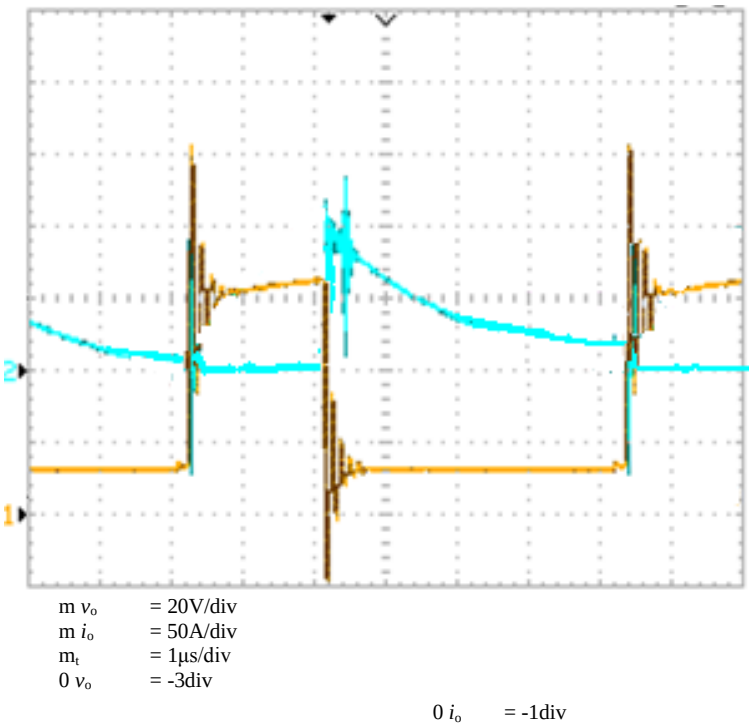


Fig.9. vo and io of the converter at short circuit, arc welding and no-load conditions.

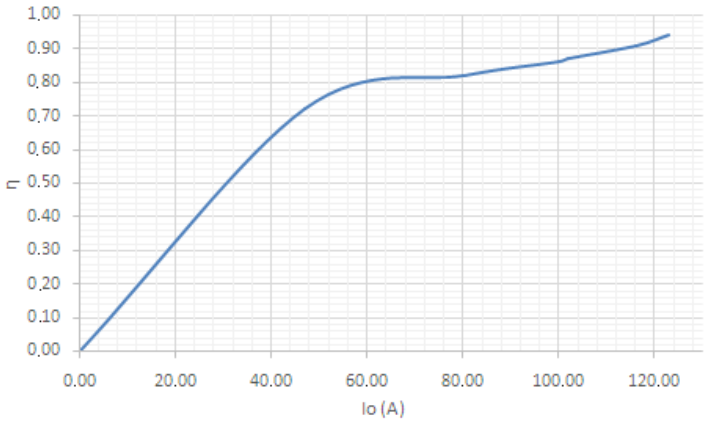


Fig. 10.Experimental obtained efficiency of the prototype of full-bridge DC/DC power converter at arc welding.

5. Conclusion

AC/DC/DC converters by Phase-Shifted PWM control is design and practical realize. Effect the tail current problem at turn-off the IGBT and their impact on the power losses is estimated with computer simulations.

The realized prototype is tested and obtained its input/output characteristics. The harmonics in input current and power factor, as and efficiency of the converter are determined.