SWITCHING VOLTAGE CONVERTER WITH PWM POWER CONTROL FOR PLASMA DEVICE

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1. Introduction

Plasma produced by electric discharges in gases at atmospheric pressure has been intensively investigated for new technologies and industrial applications. To produce these discharges we need an electro-mechanic device which consists in a high voltage power supply [1] and electrodes that allow helium gas flow through them [2]. A Switching Voltage Converter has already been developed to amplify enough voltage and power to make the discharges. The goal of the present project is to implement a system improve in order to control the output voltage amplitude and, thereafter, the power of the plasma jet, enabling changes on the surface treatment.

2. Experimental Part

The device block diagram is shown on Figure 1. The PWM OSC/MOD block consists of a 555 timer integrated circuit (IC) configured as a Pulse Width Modulation (PWM) circuit. This circuit will allow the user a large range duty cycle control of a 50 kHz rectangular wave. This PWM signal is used to control the switching of a half bridge voltage converter block which works with a high DC voltage of about 450 V. The half bridge circuit uses a IR2104 integrated circuit as drive controlling two IGBT power transistor type IRG4PC40U. The system has an auxiliary bootstrap circuit made with a UF4007 fast diode and a 100 nF capacitor. The half bridge output signal goes through a low-pass filter supplying a controlled DC voltage that, finally, is connected to the Switching Voltage Converter.

3. Results and Discussions

The Figure 2 shows voltage before the low-pass filter (V_{PWM}) and after it (V_{CTRL}) for a 50% duty cycle (square wave). In this case the DC output voltage corresponds to the half level of the maximum voltage of the PWM signal. It was observed the output voltage level depends on the duty cycle of the PWM signal. The minimum duty cycle obtained was 8% of the period and maximum was 88%.

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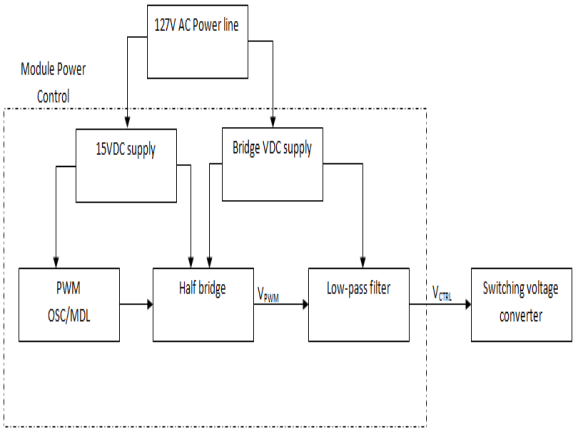

Fig. 1. *Block diagram of the power control system.*

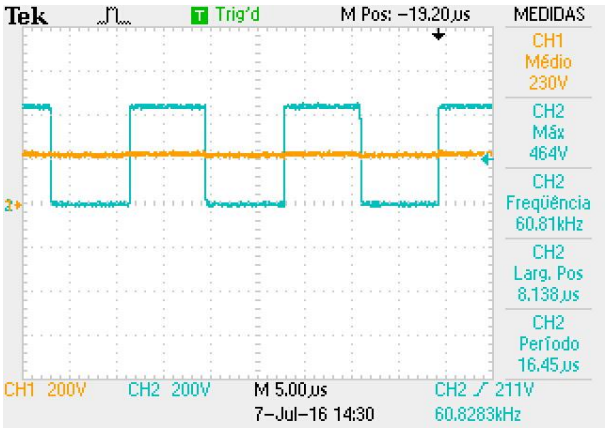

Fig. 2. *PWM voltage (V_{PWM}) and controlled output voltage (V_{CTRL}) for 50% duty cycle.*

4. References

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