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HV Energy Dosing dc-to-dc Converter in PWM Mode

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Energy-dosing (ED) topology was shown to be effective for capacitor charging and long- flat-top pulse generation (see [1], [2] and their bibliography for examples of implementation and for the theory of operation). The inherent advantages for these applications are zero-current switching and excellent predictability following from the ED principle of operation. As the term ED implies, the output power is proportional to the switching frequency f_s . Thus, strict realization of ED is possible only when the output is frequency-regulated. At light loads, f_s might become so low as to move to the audible range, which is undesirable or even unacceptable for certain applications. Then PWM control becomes necessary.

This paper extends theory of operation of ED converters into the PWM mode. Full set of equations is derived for calculation of duty cycle corresponding to a predefined load. All possible scenarios have been covered and verified with PSpice simulations and experiments with HV converters.

Having an adequate mathematical description in PWM mode is useful for the realization of predictive control as depicted in [2].

[1] A. Pokryvailo, C. Carp, and C. Scapellati, "High Power, High Performance, Low Cost Capacitor Charger Concept and Implementation", IEEE Transactions on Plasma Science, Vol. 38, No. 10, October 2010, pp. 2734-2745.

[2] A. Pokryvailo, C. Carp, and C. Scapellati, "A 100 kW High Voltage Power Supply for Dual Energy Computer Tomography Applications", IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 22, No. 4, August 2015, pp. 1945-1953.

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