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ULTRA LOW POWER HIGH VOLTAGE ENERGY STARVED FLYBACK CONVERTER FOR SPACE APPLICATIONS

Abstract

In this paper a novel Energy Starved Flyback (ESF) ultra low power converter for a capacitive load is presented. For high voltage low power dc-dc converter, Discontinuous Conduction Mode (DCM) flyback topology is an optimum choice for its least component count and complexity. In conventional DCM flyback converter, in each cycle, energy is stored in coupled inductor during the on time and transferred to the output side during the off time. For a capacitive load, this energy has to be dissipated using a bleeder resistor in order to maintain a constant output voltage which calls for power loss. This steady state power loss can be decreased by reducing the duty cycle or by increasing the inductance value. The former leads to instability at very low duty cycle and the later leads to bigger component size. In ESF converter a novel approach is used to limit the energy stored in the inductor which eliminates the need of large inductor size and reduces the steady state power loss in converter. A new approach to reduce stress on switching device is also demonstrated. Fixed turn on time operation is used to reduce the power loss for a wide range of outputs and inputs. In this paper two methods to control the output voltage are proposed. The first method is by variable frequency control and second is bang-bang control. To verify the practical feasibility a prototype converter to drive piezoelectric proportional flow control valve (PFCV) is realized using ESF topology for space applications. Both the control methods are demonstrated and evaluated based on simulation and experimental results.