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HIGH VOLTAGE HIGH EFFICIENCY DISCHARGE SUPPLY FOR A 5KW STATIONARY PLASMA THRUSTER WITH REDUCED STRESS ON COMPONENTS

Abstract

Zero voltage and zero current switching are conventionally employed for improving the efficiency of DC-DC converters. In conventional phase shifted full bridge zero voltage switching (PSFB-ZVS) converter, a large current circulates in the freewheeling interval. This circulating current is utilized to obtain zero voltage switching condition across switches in both legs of the full bridge. However, this also causes an increased current stress across the switching devices and severe parasitic voltage ringing across the rectifier. This limits the output voltage of the converter and reduces its reliability especially in long duration space missions. In order to alleviate these problems, a zero voltage zero current switching DC-DC converter topology with an energy recovery snubber (ERS) on the secondary side is presented in this study. ERS can reduce the circulating current and eliminate the parasitic ringing across rectifier by bypassing the leakage inductance energy to output. In this topology, the right leg switches goes through near zero current switching (ZCS) transition. Unlike PSFB-ZVS converter, soft switching condition can be achieved without using any external leakage inductor which results in mass reduction. This design makes the system immune to variations in the transformer parasitics. ERS also provides zero voltage switching condition in rectifier diode and freewheeling diode. In order to evaluate the experimental performance of the proposed topology two 2.5kW power converters are realized with peak efficiency of 95used in current sharing mode by employing voltage droop method to provide the dischage power to 5kW Stationary Plasma Thruster(SPT). This SPT will cater to the requirement of all electric propulsion system (AEPS) where both high thrust (300 mN for earth-orbit-raising) and throttled down operation (north-south- station-keeping) is required. Practical design consideration along with experimental results obtained from integrated test with SPT are presented in this paper.