Analysis of voltage Multiplier Bridge fed with current for high voltage applications

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Abstract:

The power density of high voltage DC power supplies can be significantly enhanced through the application of diode-capacitor voltage multipliers. Further optimization can be achieved by powering these multipliers with high-frequency series resonant converters. Ideally, the series resonance should be formed by the transformer's leakage inductance and the capacitors within the multiplier, effectively supplying the multiplier with an AC current. The steady-state performance of a current-fed voltage multiplier bridge topology, encompassing an arbitrary number of stages and capacitors, has been analyzed in terms of voltage and current stress. Additionally, an equivalent circuit for the current-fed voltage multiplier has been identified. This equivalent circuit can be represented as a standard full bridge rectifier in series with a resistor and a capacitor. The properties of this equivalent circuit, including the maximum stress values, can be calculated using straightforward formulas presented in this report. The theoretical findings align with the results of detailed MATLAB simulations and have been experimentally validated.

Keywords:

High Voltage DC Power Supplies, Diode-Capacitor Voltage Multipliers, Power Density Optimization , High Frequency Series Resonant Converters, Leakage Inductance, Steady State Analysis