One-shot Design of Radial Mode Piezoelectric Transformer for Magneticless Power Conversion

Piezoelectric Transformer based resonant power converters are an attractive alternative to magnetic power converters in applications requiring a power level currently less than 100W. Among the benefits are a power density up to 40W/cm3, a low profile, reduced radiated EMI and high system efficiency due to zero voltage switching commutation. The main criteria to take advantage of these benefits are, despite the fact that a PT is a piezoelectric capacitor, is optimization the transformer to behave inductively as a means to avoid excessive hard switching losses. With this objective, the inverse mathematical problem has been solved, that directly links wanted electrical specifications to the mechanical dimensions of a radial mode piezoelectric transformer. The novel outcome of this study is that the soft switching ability is directly linked to the ratio between the active volume of the primary and secondary sections and independent on all other parameters. Eight different radial mode PTs has been constructed that verifies this result in practice. Based on one of these designs the efficiency for a half-bridge resonant converter operating in zero-voltage- switching mode has been measured to in-between 93% and 97% depending on the output power.