

PARAMETRIC INVESTIGATION ON THRUST DEVELOPMENT
OF A PIEZOELECTRIC TRANSFORMER
PLASMA PROPULSION SYSTEM

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ABSTRACT

The PTPS-MT consists of a RF driven lithium niobate piezoelectric disc operating as a high voltage step-up transformer to ionize and accelerate plasma in a single self-contained package. Operation of the PTPS-MT is done utilizing a 400-1kV input voltage, operating at the resonance frequency of the 10mm x 2mm piezoelectric disc, to create a high voltage discharge capable of ionizing a background propellant. Acceleration is done through alternating RF fields; creating a self-neutralizing system capable of producing thrust on the order of tens of μN . Investigation and refinement of operating parameters for a piezoelectric transformer plasma propulsion system were conducted. Simulations using COMSOL Multiphysics were used to refine the electrode design of a piezoelectric crystal and establish initial operating parameters such as frequency, voltage transformation, and stress limits of the crystal. Testing was done to establish peak operational parameters to improve propellant efficiency, operational life expectancy and thruster output. Results of the thruster design, extended life cycle testing and analysis of failure modes are included.