

INVESTIGATION AND CHARACTERIZATION OF A HIGH ENERGY PIEZOELECTRIC PULSE GENERATOR

Caroline Susan Pinkston

Dr. Thomas G. Engel, Thesis Supervisor

ABSTRACT

This research investigates and characterizes a high energy piezoelectric pulse generator (PPG) constructed from commercially available piezoelectric materials. The high energy PPG converts mechanical energy into electrical energy, storing that energy in its internal capacitance. The energy storage of the high energy PPG developed here is more than an order of magnitude greater compared to previous investigations [1-2]. The large internal capacitance in the high energy PPG is created by stacking numerous single-element piezoelectric devices and electrically connecting them in parallel. The total internal capacitance of the PPG is around 0.15 μF . The high energy PPG is piezoelectrically charged to greater than 1 kV, thereby storing 50 mJ. The mechanical force needed to compress is derived from a steel mass. The high energy PPG uses a variable height and neoprene material to control the force. Peak forces around 18 kN are used to compress the piezoelectric material. An electromechanical model of the PPG is developed in PSpice and used to predict the performance of the high PPG under a variety of conditions. The PSpice simulations are compared to experimental test results with mechanical force rise-times ranging from sub-millisecond to several milliseconds. There is good agreement between the theoretical predictions and experimental result. The experimental research of the high energy PPG uses a variety of conditions to characterize the system of the high energy PPG.

