COMPACT POWER CONDITIONING AND RF SYSTEMS FOR A HIGH POWER RF SOURCE

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ABSTRACT

As part of the University Consortium for High Power Microwave (HPM) Integration, compact power conditioning and RF systems were investigated with a maximum diameter of 15.24 cm. A simulator of a flux compression generator (FCG) was built as a non-destructive test stand to evaluate the power conditioning and RF systems. The FCG simulator approximated the rising current signal of an FCG with a peak between 20 kA and 60 kA. The power conditioning system consisted of a spiral-strip pulse transformer, an exploding wire fuse, and a crowbar switch. The pulse transformer enabled compact inductive energy storage, voltage step-up, and electrical isolation. The exploding wire fuse was implemented as an opening switch to transfer energy to the RF circuit, and extensive modeling of the dynamic fuse resistance was performed. The crowbar switch prevented stray circuit or generator inductance from causing fuse restrike. The RF system utilized a compact high voltage capacitor and low inductance shunt to produce high frequency RF as an alternative to HPM sources. Three geometries of the RF system were investigated with capacitances ranging from 275 pF to 730 pF. A tri-plate system was built as a proof of principle of operation of the RF system with the power conditioning components. Spiral-strip and coaxial-cylinder capacitor geometries were investigated as compact designs.

Testing of the power conditioning and RF systems was conducted with the FCG simulator and FCGs. Voltages of 180 kV or more were generated with all three geometries, resulting in greater than 130 MW of peak power. The RF frequency content peaked at 10s of MHz, and the frequency content of the tri-plate geometry extended to 250 MHz. In experiments with an antenna load, the peak voltage was greater than 700 kV. An electric field of 6 kV/m peak-to-peak was measured 5.5 m from the RF system, thus achieving the final goal of the consortium.