CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
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Project Number
S0708

Project Title
DRSSTC: A Double Resonant Solid-State Tesla Coil

Abstract

Objectives/Goals
Tesla Coils have been used for over 100 years to study high voltage, high frequency discharge (1,000,000+ volts!), but over half of the input power is lost in the simple spark gap switch. Recently, high power semiconductor switches and microcontrollers have made possible solid-state Tesla coils but these cannot match the (>Megawatt) peak power of a spark gap so they are limited to brush type CW discharge.

My objective is to demonstrate a new topology which will create long streamers by greatly increasing the power factor as seen by the IGBT switches (average watts transferred per peak volt amp).

Methods/Materials
My innovation is to drive a primary LC resonator for exactly half the beat period (a dozen cycles or so) while the loosely coupled secondary mode extracts all of the energy and then discharges, producing long arcs more efficiently than either "spark gap" or existing solid state tesla coils.

Results
I've cycled over 1000 amps through an IGBT rated for 160 amps peak by overdriving the gate to maintain saturation. This was a critical test which demonstrated the peak power capability. The dual H-bridge drive has soft switched up to 400 amps at 280 volts and 57 Khz, which would generate a 5-joule burst and 500 kilovolts in the presence of the secondary.

Conclusions/Discussion
Though successful, my DRSSTC implementation is under continual revision. During a test last week, EMI caused a catastrophic shoot-through. I've designed a fix and ordered replacement parts and expect to have it running at again at even higher levels before the State Fair.

Summary Statement
I designed and built a uniquely efficient solid-state multi-resonant pulse transformer circuit for Tesla Coils

Help Received
My parents helped with the typing, and family, friends and Tesla Coil Mailing List peers have listened to my "transfunctionator jibberish" all winter