Proposed High-Voltage High-Current Solid State Tesla Coil Spark Gap Design

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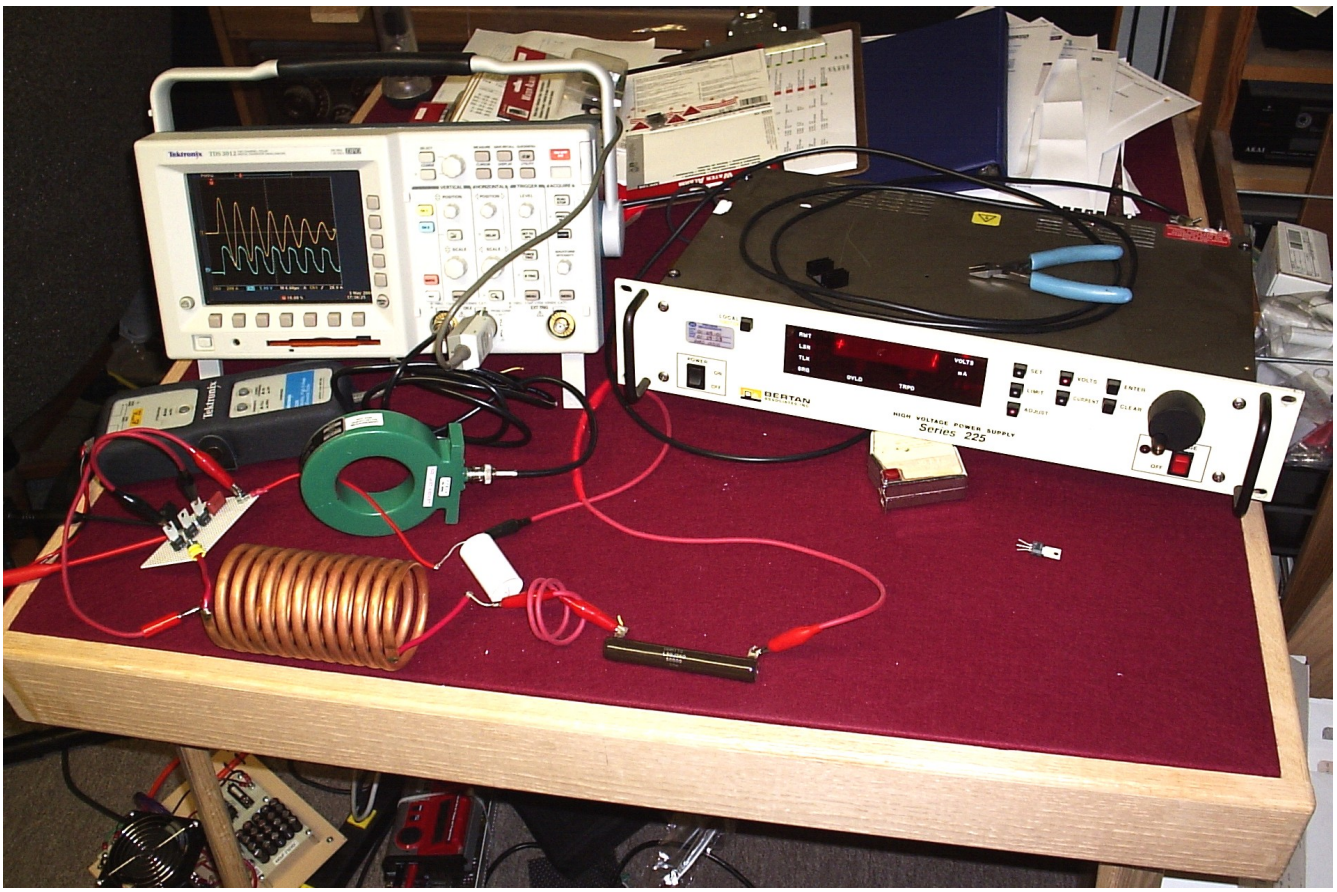
May 3, 2006
First Testing

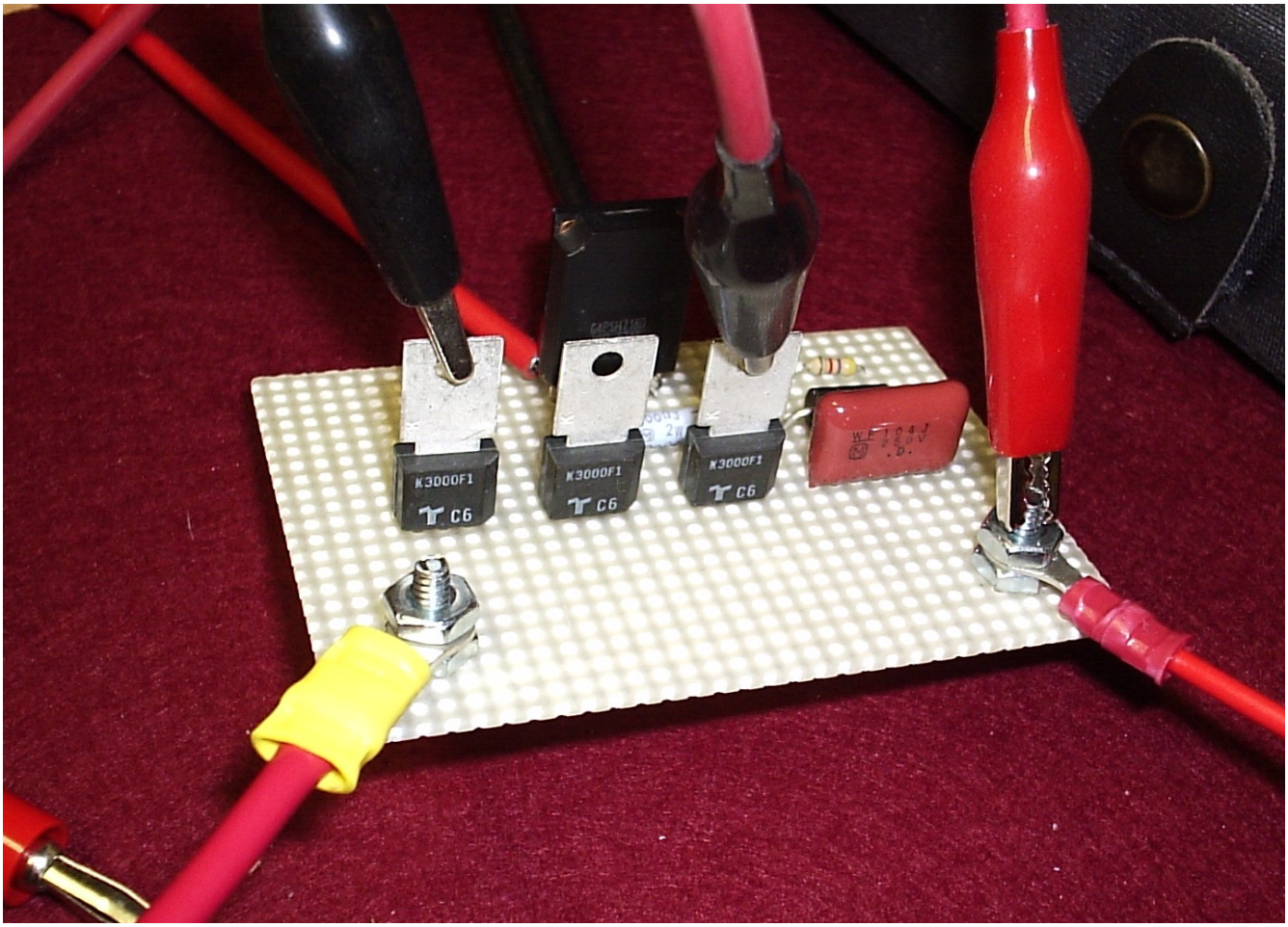
NOTE: The current probe was off by a factor of 10 in these tests. The scope's yellow current scale should be 20A/div not 200A/div.

The SIDAC circuit was set up with a 0.15uF 2000V polypropylene capacitor and a 4.5uH inductor for a resonant frequency of 195kHz. A Bertan 225-10 power supply charged the capacitor up slowly as needed. A Pearson Model 110 current probe was in the primary loop and a Tektronix P5205 probe was used to monitor the IGBT gate voltage. The scope is a Tektronix TDS3012.



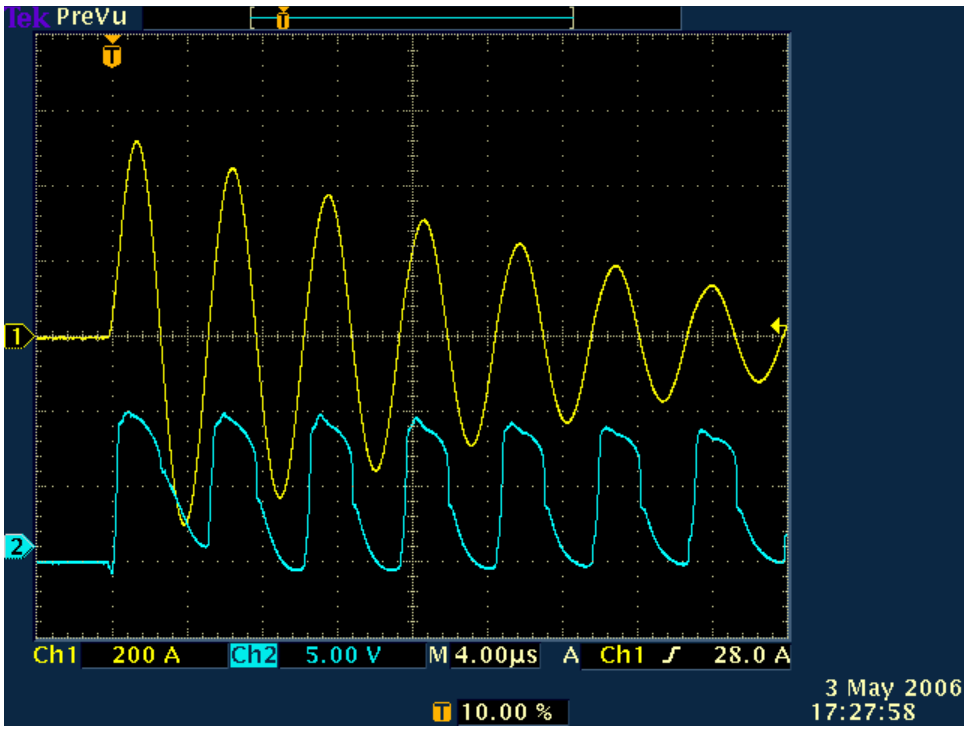
Test Setup

The SIDAC circuit had the two heatsink tabs on the outside shorted together for testing which reduced the firing voltage to 307 volts (measured). Each SIDAC has two elements so four of the six elements are out of circuit in this case.

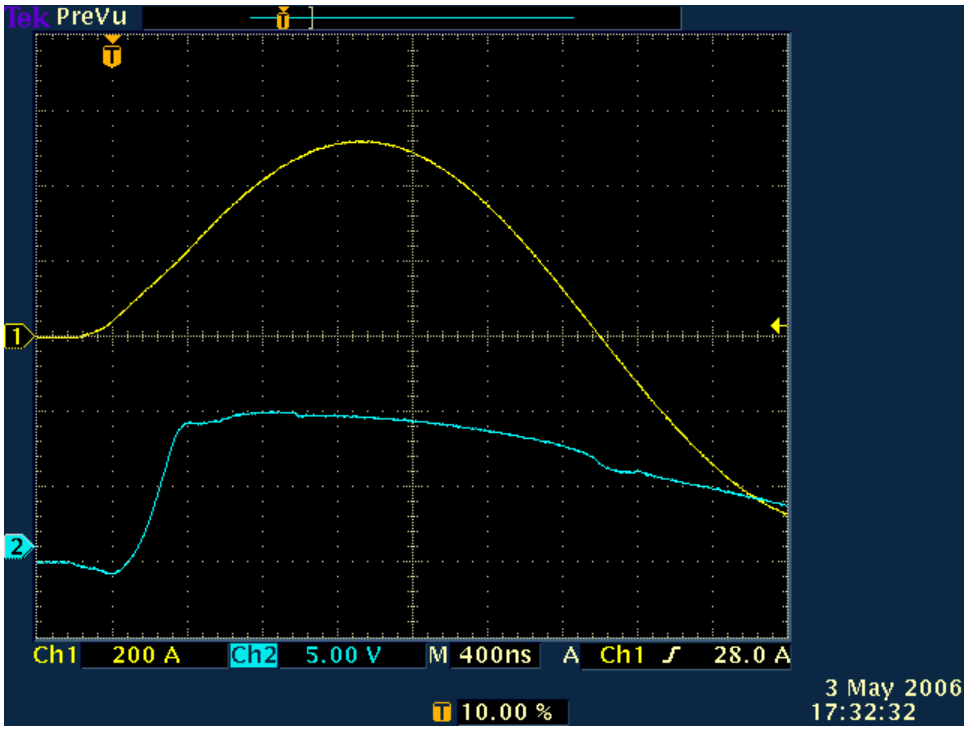


SIDAC Circuit

The circuit was fired at 307 volts with the following waveforms recorded.



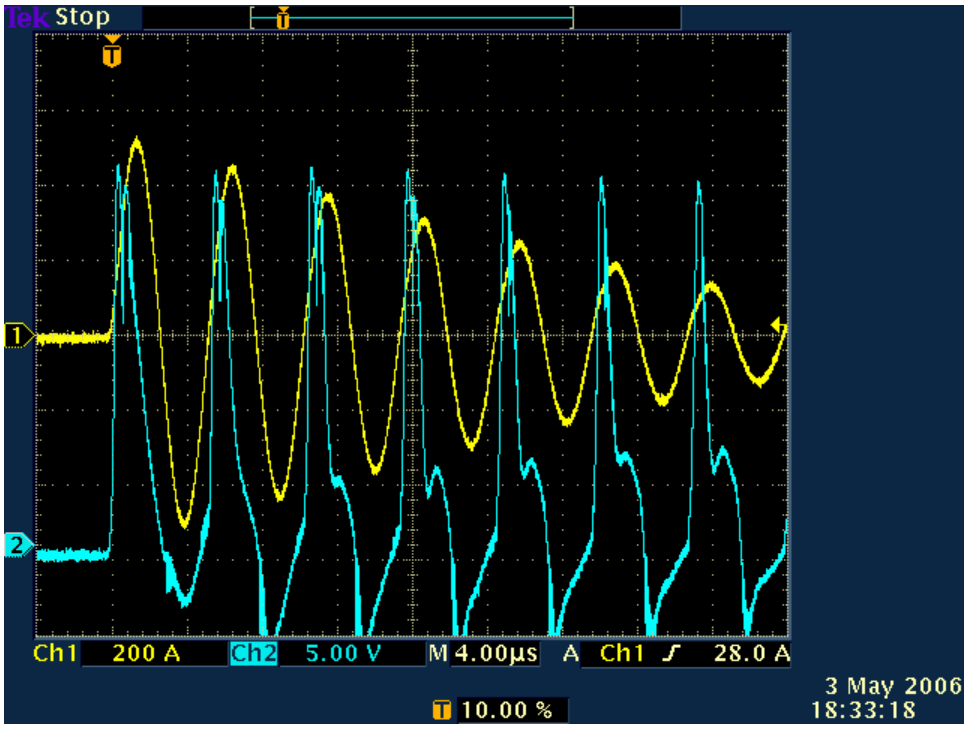
4uS/div Current (yellow) 200A/div Gate Voltage (blue) 5V/div

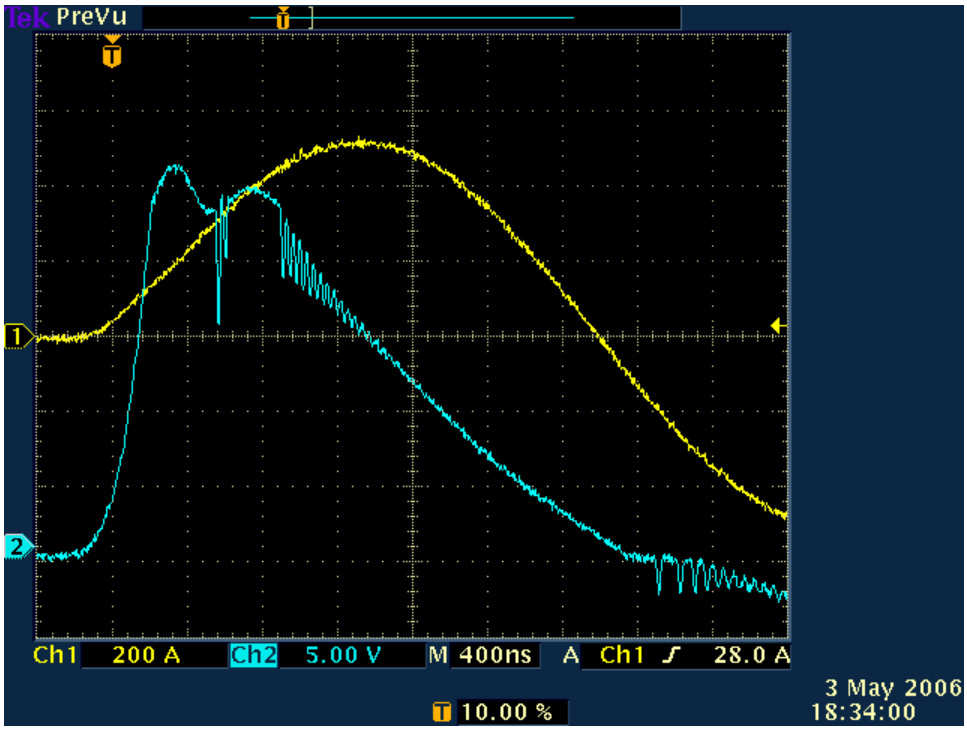


400nS/div Current (yellow) 200A/div Gate Voltage (blue) 5V/div

The gate voltage is not reaching the expected 24V. It appears to reach about 10 volts where the IGBT is expected to be turned on and able to pass about 150 amps. From the second scope capture, it appears the IGBT is turning on and removing charge voltage from the gate circuit so it can no longer continue charging to the proper voltage.

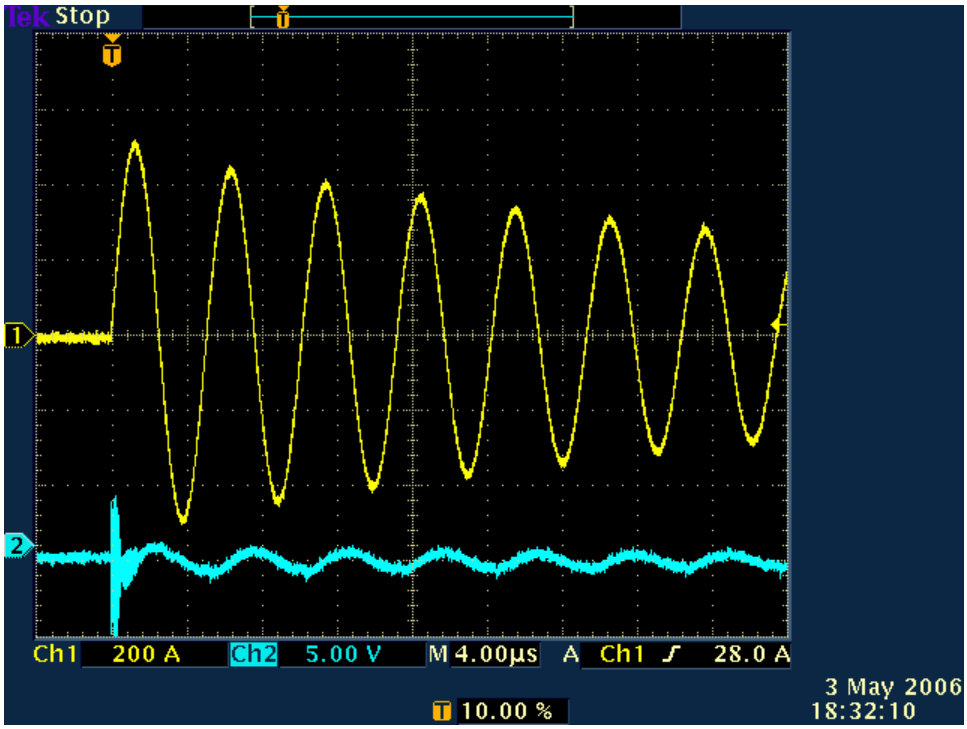
The voltage across the transorb and 100nF capacitor was measured.



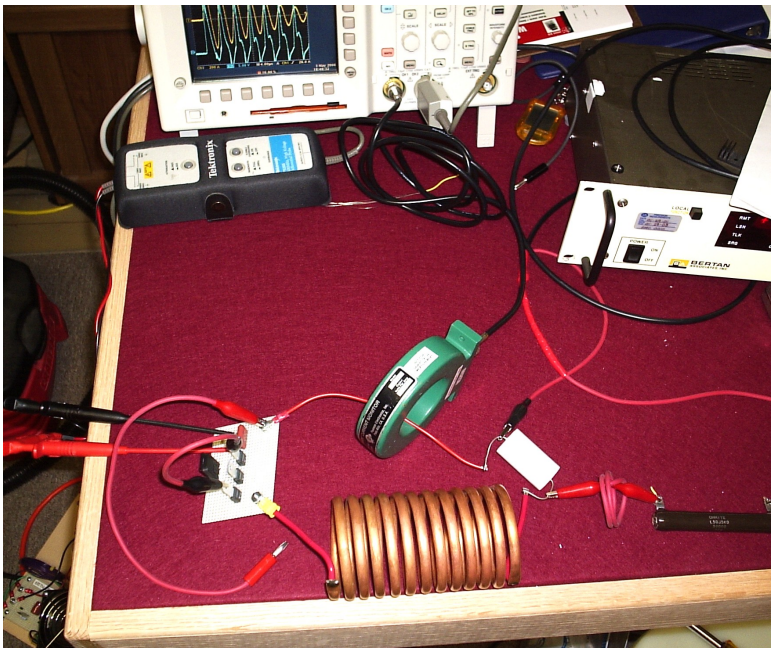


The transorb and capacitor voltage are hitting the 24 volt limit much as expected. there would appear to be sufficient voltage to continue charging the IGBT gate. However, the capacitor voltage is also being driven down instead of remaining steady near the 24 volt level.

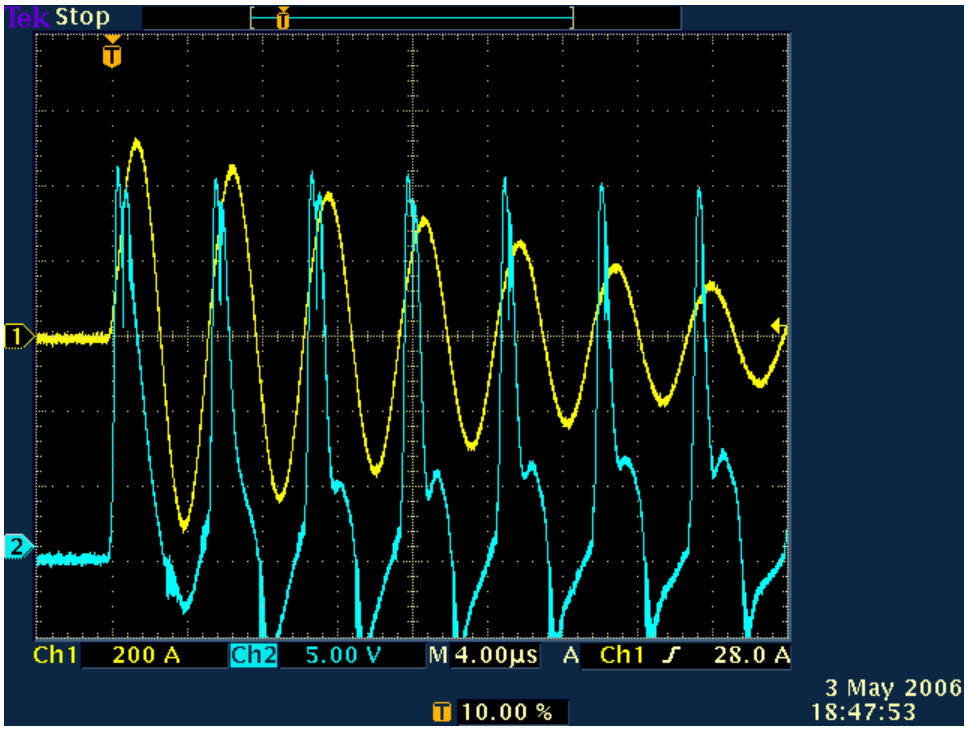
As a comparison, the gap was directly shorted with a heavy wire at 300V.



The loss is somewhat less as seen by the longer ring down time but that is expected at low power. There may be noise being picked up on the voltage probe that might have some effect on the readings. The scope and voltage probe electronics were moved further back.



Moving the test equipment further back seem to have no effect on the readings.



It's all probably real...