

Capacitor Discharge Test System

δ^+ PolyK δ^-

PK-CPR1701

This test system was inspired by the publication of Zhang et al “A Dielectric Polymer with High Electric Energy Density and Fast Discharge Speed”. *Science* 313, 334 (2006)

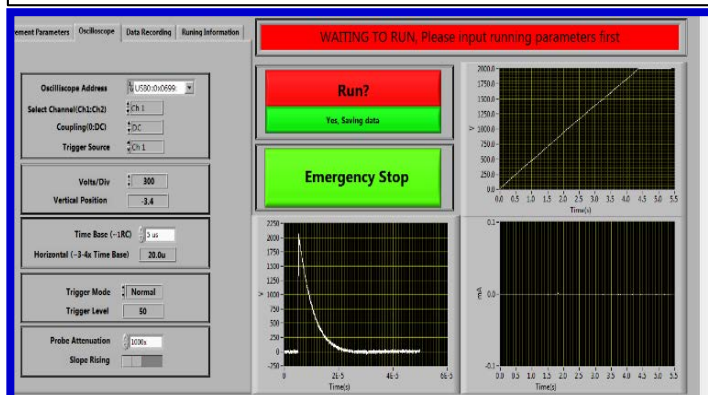
Functions

- This unique test setup can be used to evaluate the discharging performance (speed and energy density) of new dielectric materials (100 pF) or packaged capacitors (100 μ F) under high voltage.
- **PE loop test provides incorrect energy density for capacitor application:** the charges of the sample is discharged to power supply in a linear function (10-100 ms) and it significantly over estimate the energy density! In practical application, the discharging usually in nanosecond to millisecond and the discharge is exponential decay!
- It controls a high voltage power supply to charge the specimen to a pre-set voltage \rightarrow disconnect the charged sample from the power supply \rightarrow connect the charged sample to a load resistor (user selectable) with a HV MOSFET switch.
- The voltage across the load is recorded with an oscilloscope through a HV probe. Data are then transferred to the host computer, and discharged energy density is calculated automatically.
- Two Operation Modes:
 - Manual: the user control the charging relay and the discharging switch by pushing the buttons.
 - Auto: computer control everything and save test results.



Capability

1. Voltage: 10-15 kV (relay and switch)
 2. Sample capacitance: < 100 pF to > 100 μ F
 3. Discharge peak current: * < 10 A to > 5,000 A
 4. Discharging load: <1 Ω to > 100 M Ω
 5. Discharging speed: high voltage MOSFET switch, rise time < 10 ns.
 6. Accuracy of charging current, voltage, and energy is determined by the capability of the power supply & sample capacitance.
 7. Temperature of capacitor and ambient may be recorded during lifetime test [Option].
 8. Evaluate the capacitor discharge speed from 100 ns to > 1 ms.
 9. Perform automatic lifetime test and save a summary file with energy density.
 10. System components: test control system, high voltage power supply, oscilloscope, non-inductive high voltage resistors, HV probe, laptop
- * Certain models are subject to Export Control regulation.



LabView Control Program: Auto Mode

- Test controlled by the PK CapControl® LabView
- Set test voltage, charging current or voltage ramp rate, number of test cycles, data storage locations
- Control the HV amplifier, switch, and oscilloscope
- Automatically perform charge-discharge cycle lifetime test and save original charge/discharge data (voltage vs. time). A summary file is generated to save all the charge cycle, charging time, energy density, etc.

Recent Publications with this test system:

Wang et al “Sandwich-structured polymer nanocomposites with high energy density and great charge–discharge efficiency at elevated temperatures” *Proceedings of the National Academy of Sciences*, 2016; DOI: 10.1073/pnas.1603792113
<http://www.pnas.org/content/113/36/9995.abstract>

Contact Information

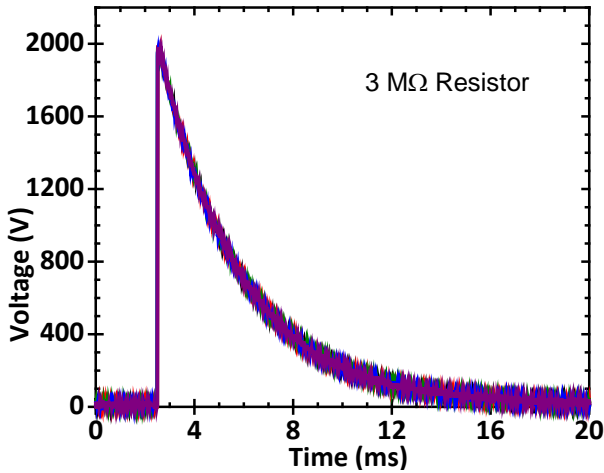
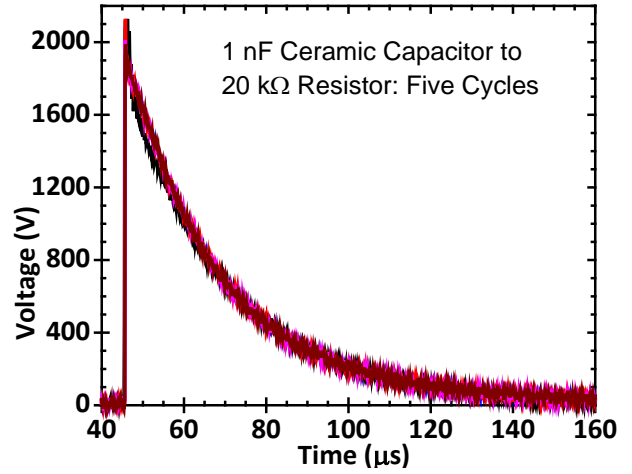
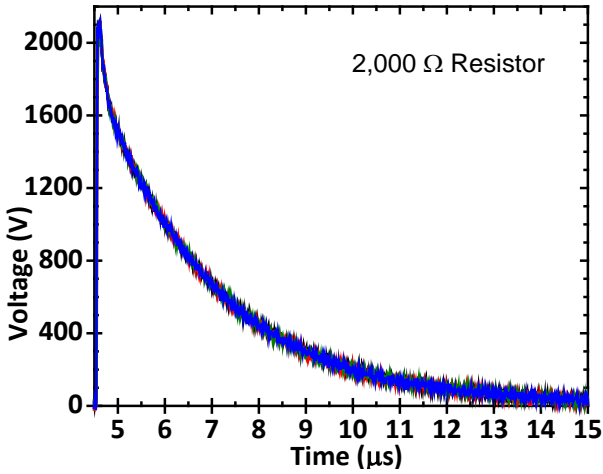
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Example Test Results

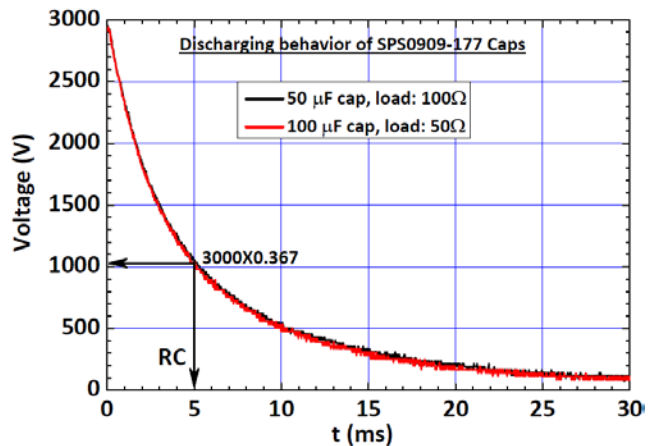
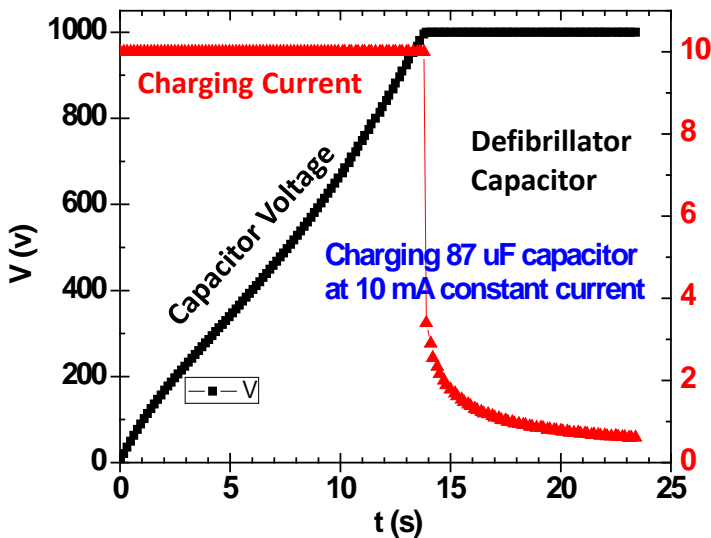
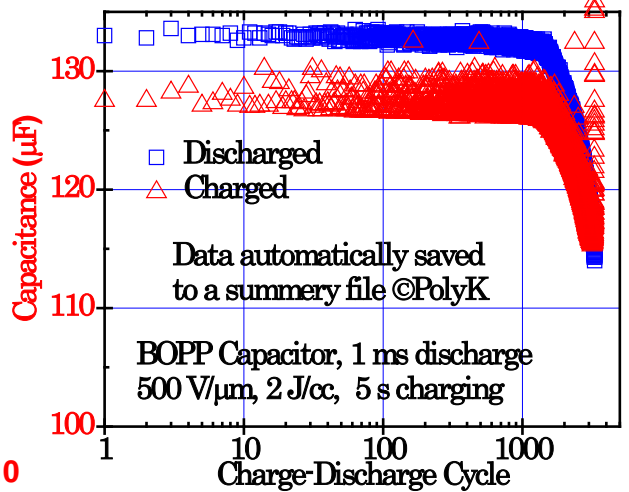
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Discharge Speed Test: 1 nF Ceramic Capacitor



Lifetime Test of BOPP Capacitors



Contact Information

The capability to record charging current and voltage and the stability of the current are determined by the HV power supply or amplifier.

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