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Pulsed Power Capacitors
and their Applications

Novacap offers a line of Pulsed Power capacitors that have exceptional reliability afforded by ceramic multilayer fabrication. They are available in many sizes including standard 1210, 1825, 3040, 3640 and 7565. Custom design sizes and assemblies are also available.

The capacitors will function and have been shock tested at 10KG's at 0.5mS, 12KG's at 0.4mS, and 60KG's at 50uS. They are extremely radiation hard displaying less than 5% voltage/charge loss at 10 kRad and less than 10% voltage/charge loss at 100 kRad.

These Pulsed Power capacitors operate most efficiently with a high internal voltage stress and deliver maximum energy at these elevated voltages. They are polarized parts and polarity markers must be observed during application. Typical voltage ratings for these components are between 500 Vdc and 2800 Vdc, depending on the application. Individual chip capacitors can also be assembled into parallel, series or series parallel arrangements for higher voltage and energy requirements. The capacitors can be integrated with other components to make efficient firing circuits.

Applications

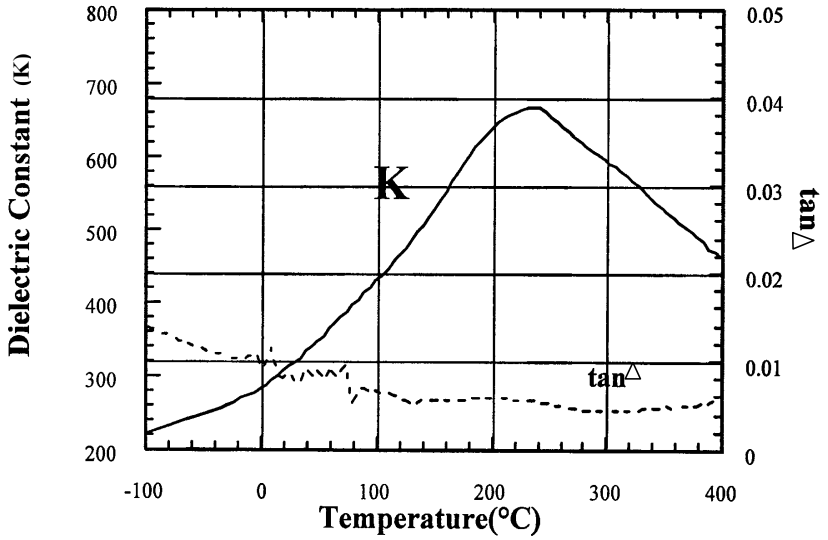
Applications include but are not limited to the following:

- Detonation Circuitry
- Oil Exploration
- Seismic Evaluation
- Ignitors
- Lasers
- Power Storage Modules
- Pulsed Lighting
- Temperature Sensing
- Photoflash
- Strobe Lighting
- Power Interruption
- Ballast Capacitors
- Snubbers

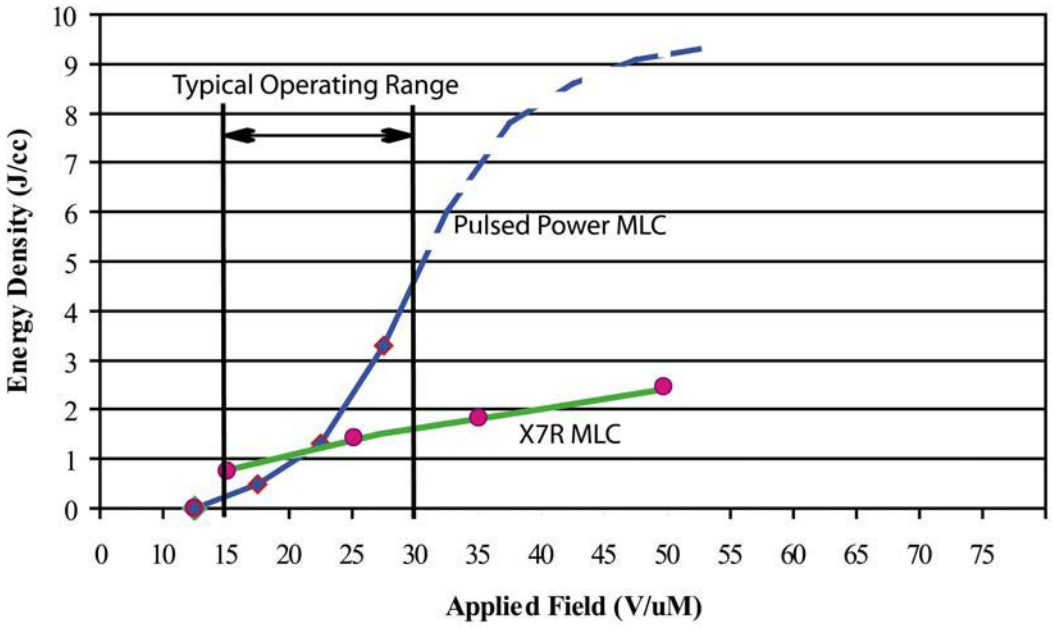
They are manufactured using a dielectric formulation that has a positive voltage coefficient, positive temperature coefficient, and a high dielectric constant. These properties can provide up to 7 joules/cc of discharge energy depending on part size, capacitance value and voltage applied, thus far surpassing energy density of conventional electrolytic capacitors, X7R or temperature compensating dielectrics, and permitting discharge solutions in greatly reduced component footprint and volume.

X7R capacitors only have a slight positive linear increase in energy because the dielectric constant is decreasing as the voltage potential increases. Pulsed Power capacitors increase in deliverable energy much faster than conventional dielectrics under voltage because the electric field induces a phase transition that gives a positive voltage coefficient. Graph 1 shows the temperature coefficient of pulsed power capacitors.

Graph 1



Active Energy Density Performance of
Pulsed Power Capacitor vs. X7R MLC

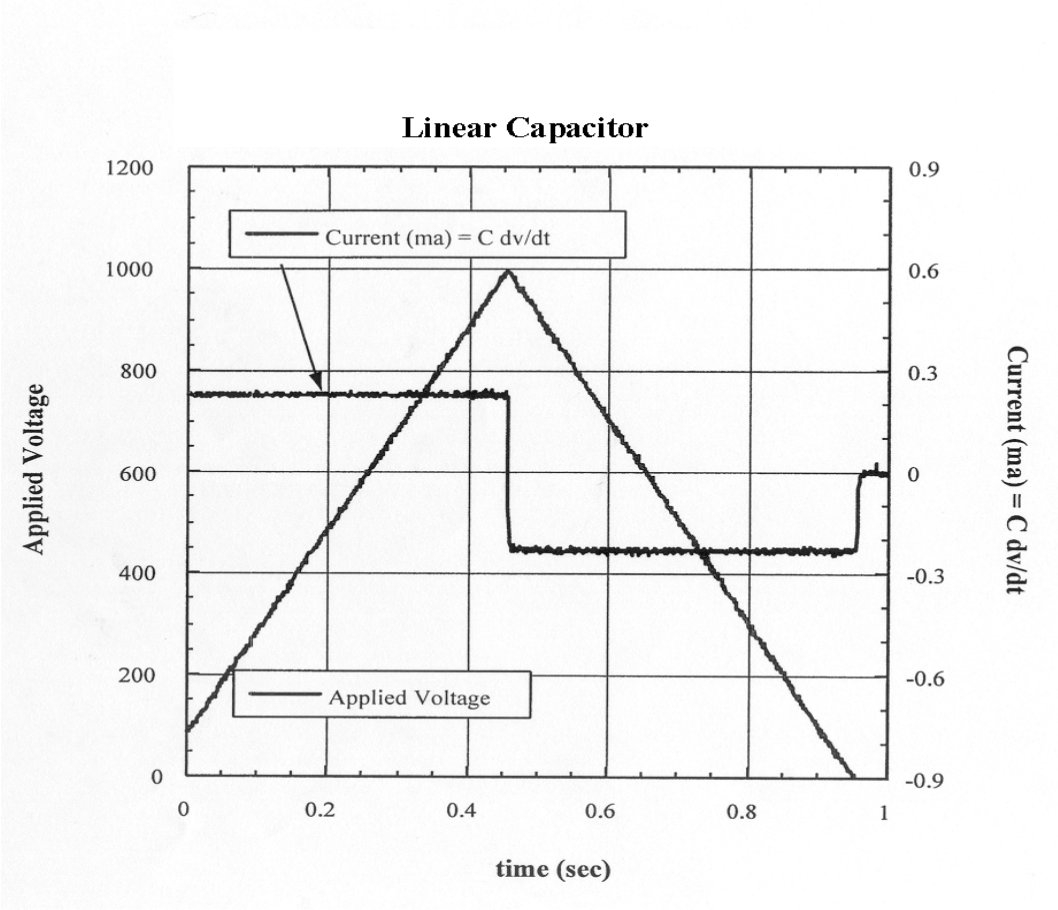


Graph 2

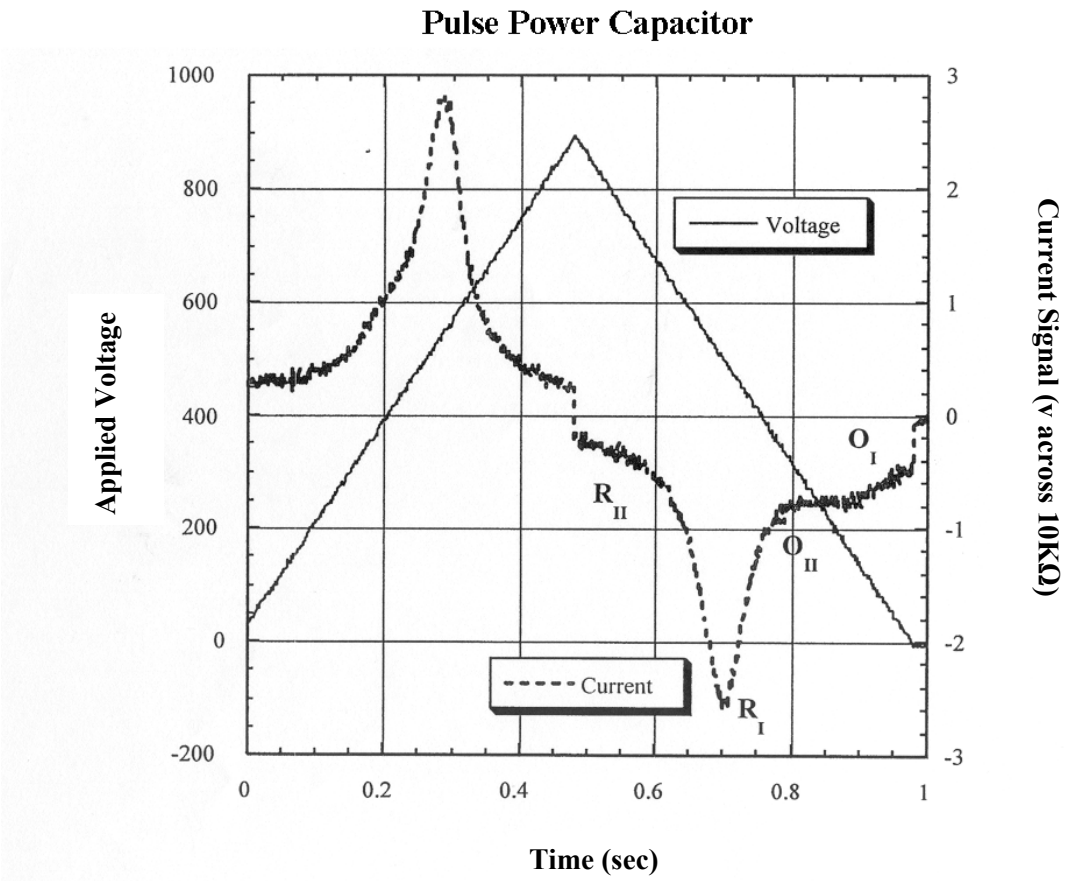
Graph 2 shows the active energy density vs. the applied field for Pulsed Power capacitors and X7R dielectric material. The unique dielectric material and chip construction provides for minimal internal losses allowing maximum energy delivery with pulses that are exceedingly fast.

The storage of electrical energy is different than in conventional capacitors. The charged state from the induced field causes a phase transition. The energy is stored in this phase transition, not in the displacement of charges that we see in linear dielectrics. Most of the electrical energy is stored at high field levels allowing the Pulsed Power capacitors to deliver more energy at the voltage needed.

The phase transition can be distinguished by triangular wave testing. The current through a capacitor is the capacitance multiplied by the rate of voltage change. The triangle wave test is a good method of measuring the electrical properties of nonlinear capacitors because the rate of voltage change is a constant. An ideal linear capacitor driven by a triangle wave has a square wave for the current as shown in graph 3. The Pulsed Power capacitor will have a current waveform as shown in graph 4.

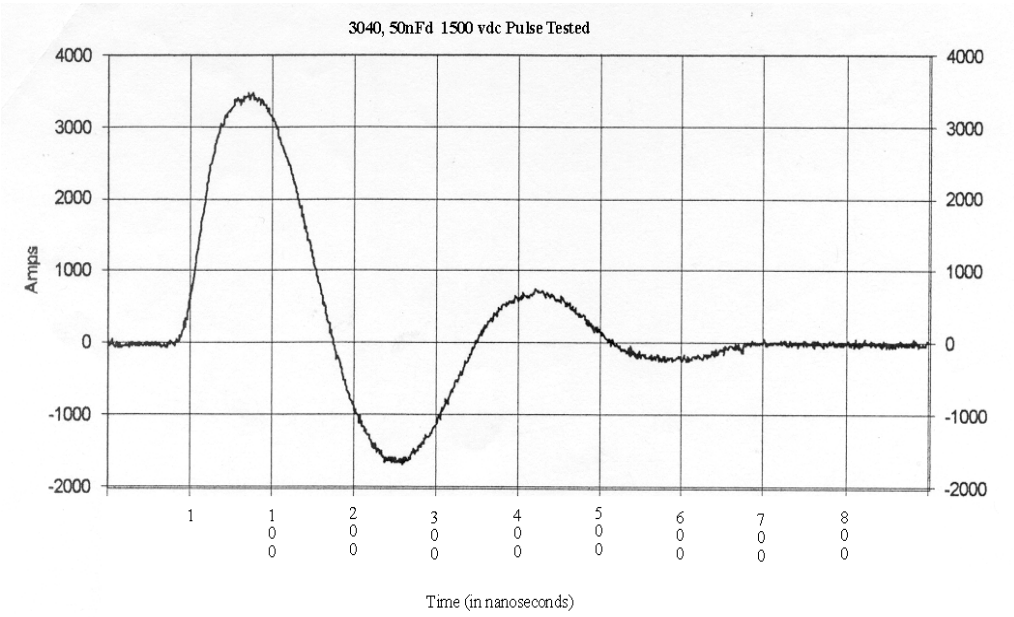


Graph 3

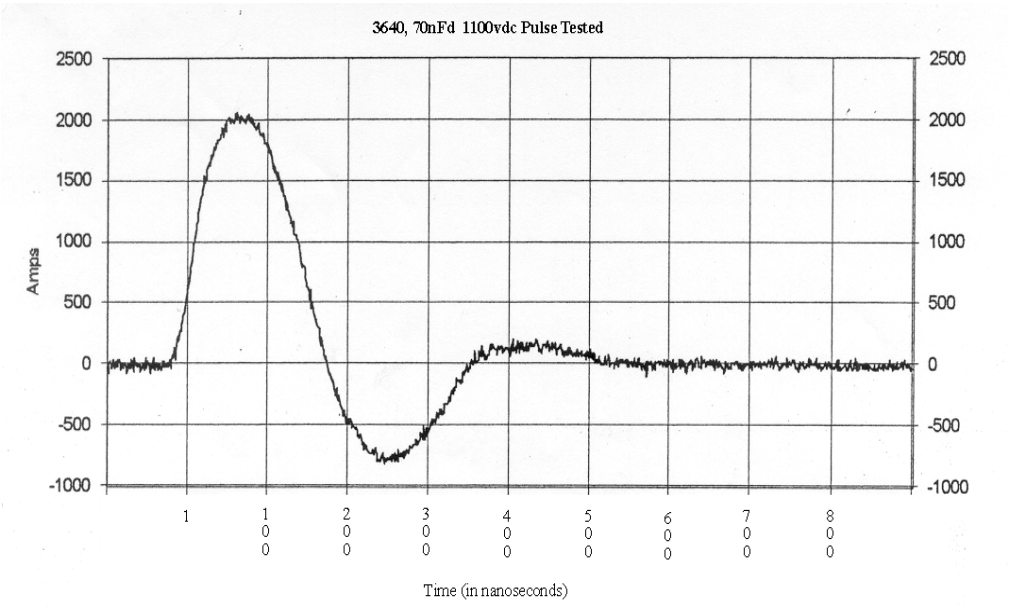


Graph 4

A typical building block is a 3040 size with a nominal capacitance of 50 nFd at 1500 Vdc rating and a 3640 size 70 nFd at 1100 Vdc rating. Typical current deliveries for these types of capacitors are shown in Graph 5 and 6. These rates are dependent on circuit load and resistance/inductance. Capacitor size, length/width and thickness can be changed to achieve similar delivered energy by maintaining similar volume ratio (ie: .360 x .400 x .100 will achieve same energy density as .350 x .300 x .137).



Graph 5



Graph 6

Please consult with NOVACAP to best determine the part number design to meet your requirements. Many of the Pulse Power capacitors are custom built based on application. To help design the proper solution, please provide the application energy delivery time, load, charge time, applied voltage, and frequency of pulse if not a single pulse. Contact Novacap at (661) 295-5920, Fax (661) 295-5928, visit our website at www.Novacap.com or call direct to Frank A. Duva, Vice President Corporate Technology/Advanced Product Development.

Novacap is a Dover company, with over ten sister companies servicing the electronics industry with equipment and components throughout the world. NOVACAP operates from two modern manufacturing facilities located in Valencia, California and is ISO9002 certified. NOVACAP produces multilayer capacitors, using advanced ceramic and electrode formulations, with thin, dense and precise dielectric layers to satisfy unique and difficult requirements with unsurpassed quality. Product offerings include surface mount capacitors from the miniature 0402 size chip to larger high voltage units, rated to 20kV, for both commercial and high reliability applications, to satisfy EIA and MIL STD specifications. Products include the entire range of popular chip sizes and dielectrics, and further specializes in Application Specific Products, which include High Temperature SMT Capacitors, Thin Profile, Ring Detect, Certified Lightning Strike Capacitors, Medical Grade Capacitor Arrays, Capacitor Assemblies for Switch Mode Power Supplies, and Leaded capacitors in various styles.