DIVERSIFIED TECHNOLOGIES, INC.®

PRODUCT BRIEF

PowerMod Technology Breakthrough Brings High Availability to High Power Electronics

PowerMod™

High Energy Physics

DTI's hybrid modulator. The capacitors, 80 kV solid-state switch, and a 6.33:1 pulse transformer are insulated by transformer oil and reside in two isolated sections of a single large tank. System controls are in the small enclosure on top of the tank.

DTI's PowerMod™ modulators and power supplies are employed in many areas of high energy physics. Their modularity permits the design of a wide range of topologies and configurations that match a customer's requirements precisely.

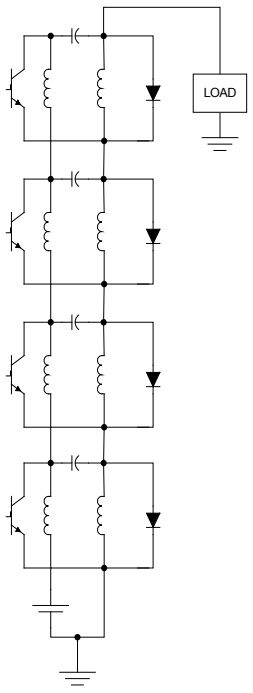
Accelerator Modulators

Solid state modulators may be used as cathode or mod-anode modulators in typical accelerator systems. They can be configured at very high voltage and moderate current to switch microwave devices directly; or combined with pulse transformers at lower switch voltage and high current. Output pulses achieve very fast risetimes and falltimes, resulting in improved operational and cost efficiencies.

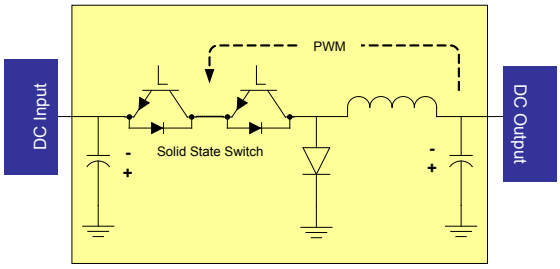
One DTI design is a "hybrid" modulator which uses a storage capacitor, a solid-state switch and a pulse transformer. The modulator provides high current pulses into the pulse transformer at 80 kV using IGBTs in series. Designed to drive two NLC klystrons, it achieves an efficiency of about 80%, and offers easy maintenance. Careful attention was paid to inductance in the primary circuit because of the very high primary currents and fast risetimes required.

A second, transformerless, direct-switched modulator design is based on a solid-state Marx bank topology. Marx generators are widely known for high power pulses accompanied by inefficiencies and frequencies of a few pulses per second. As a result, they have not been employed where moderate pulse frequencies are required. In conventional Marx generators, closing switches (i.e. spark gaps or SCRs) are used to fire the pulse, which discharges essentially all of the energy stored in the capacitors.

In DTI's Marx design, the switches connect the capacitors in series only for the duration of the pulse. At the end of the pulse, when the switches open, the capacitors have



DTI's Marx bank switching topology.



DTI's high power buck regulator power supply.

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only fractionally discharged, resulting in significantly improved efficiency. The need for pulse-forming networks is eliminated, allowing wide flexibility in pulse width.

DTI's on/off switched Marx Bank concept uses inductive decoupling and provides directly switched voltages approaching 1 MV. It yields faster risetime, higher efficiency, a flat top pulse, and low life-cycle cost. The improved modulator efficiency translates directly into lower operating costs.

DTI's opening switch built for the Advanced Photon Source at Argonne National Laboratory

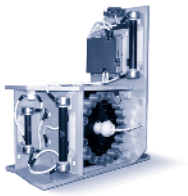
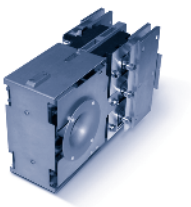
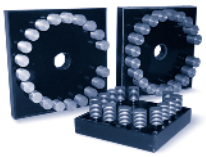
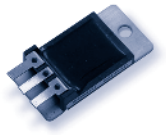
Crowbar Replacement

A related application is an "opening" switch, a system in which a single PowerMod series switch provides both pulse modulation and arc protection. DTI's switches can open in less than a microsecond, so are effective as "fast fuses" that can intercept arcs on a pulse by pulse basis. They can be closed again almost immediately, greatly minimizing system downtime due to arcs.

Solid-state opening switches have significant advantages compared to other approaches to tube protection. They use no hazardous mercury, offer high circuit efficiency and far lower fault currents (by orders of magnitude in many cases), and impose significantly lower stresses on upstream power components such as transformers, circuit breakers, and capacitors. Any high voltage system using a crowbar for load protection can be upgraded to a fast opening series switch.

High Power Tube Testing and Conditioning

Manufacturers of high power VEDs use PowerMod systems for testing and conditioning of RF tubes destined for use in large-scale high energy physics projects. Modulators rated up to 140 kV / 500 A peak, and buck regulator power supplies up to 160 kV DC-DC enable a testing environment unachievable using conventional vacuum tube technology.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