DIVERSIFIED TECHNOLOGIES, INC.®

PRODUCT BRIEF

PowerMod Technology Breakthrough Brings High Availability to High Power Electronics

PowerMod™

High Power VED Test Stands

DTI's high power test stands are a significant advancement in solid-state high power accelerator technology that deliver important cost savings to accelerator operations. In contrast with traditional test systems, DTI's state-of-the-art engineering eliminates the need for a large pulse transformer, replaces the typical "crowbar" with an opening switch for improved system availability and VED reliability, reduces available arc energy, and simplifies mod-anode voltage control.

Prime power is generated by one or more solid-state, high voltage switching power supplies, each capable of producing hundreds of kW CW power with 0.1% regulation. Multiple power supplies are combined in parallel to meet the overall system power requirement. The system can operate at lower average power should a power supply go off-line temporarily.

High voltage pulsed power is delivered to the VED by a solid-state modulator consisting of a stack of DTI switch plates built from commercially available IGBTs. The modulator in the Rutherford test stand pictured below employs a stack of ten switch-plates connected in series to provide a maximum voltage standoff of 150 kV. This switch presents a very low impedance, low voltage drop (~250 V) pathway between the capacitor bank and the cathode, so the cathode voltage remains constant, independent of the beam current.

The solid-state switch also protects the VED by sensing the presence of an arc when the current in the switch exceeds a preset fault-threshold value. When an arc occurs,

Solid-state high power tetrode test stand. The power system on the left consists of commercial and DTI power supplies, DTI high voltage opening switch, and DTI controls. The cabinet on the right houses the tetrode (300 kW plate supply not shown).

Klystron Power System (KPS) for the ISIS front end test stand installed at STFC Rutherford Application Laboratory, Didcot, UK. The power system consists of two, 220 kW high voltage power supplies, a 110 kV solid-state modulator, capacitor bank, and controls. The Toshiba E3740A klystron is visible on the right hand margin of the photograph.

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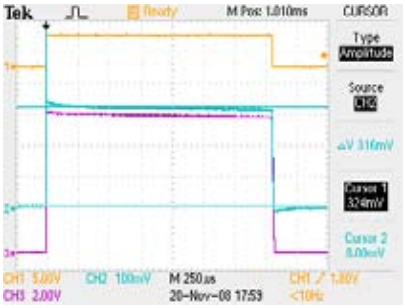
the switch opens in ~1 µs, disconnecting the high voltage from the VED. After the arc extinguishes, the modulator resumes operation, missing just a few pulses. In contrast, the entire test system may have to be shut down where protection is provided by a crowbar. Operation of a DTI test stand is not constrained by lengthy recycle times or crowbar lifetime issues common in many older systems.

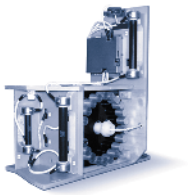
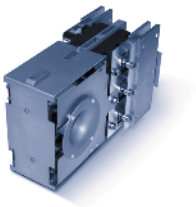
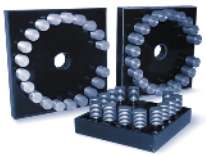
DTI test stands are typically cathode pulsed, a design criteria which simplifies the test stand architecture. Cathode pulsing enables mod-anode voltage control via a simple adjustment of the mod-anode power supply voltage, independent of cathode voltage. It also eliminates the need to reverse bias the mod-anode with respect to the cathode because the beam is fully cut off when the cathode switch is open. Separate push-pull switches on the mod-anode are, therefore, eliminated because the diodes allow this circuit to operate passively.

DTI test stands streamline testing procedures by pairing an opening switch and fast-responding power supplies. The high potting and high power burn-in can be partially, if not entirely, combined. Faulty tubes, unable to operate in a crowbar-equipped modulator, and incapable of being processed on a high potter, could be revived using DTI's fast-opening switches. Optionally, test stands can allow varying a VED's discharge energy where conditioning is more difficult.



Output pulse from the KPS modulator into a resistive load (100 kV, 42 A, 2 ms).

The test stand's modulator controls include fast fault detection and first fault identification.

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