



PowerMod Technology Breakthrough Brings High Availability to High Power Electronics

PowerMod™ Magnetron Transmitters



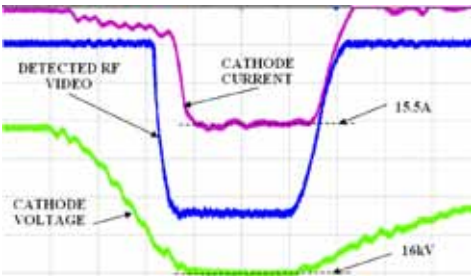
DTI 50 kW Ka-Band solid-state modulator with magnetron oscillator. Size 15" x 10" x 9", weight ~40 lb excluding VED. The overall assembly mounts inside an on-mount RF package and is fully air insulated for light weight and ease of maintenance.

Diversified Technologies, Inc. (DTI) has recently developed compact, solid-state magnetron transmitters that deliver peak powers of 3 kilowatts, 50 kilowatts and 1 Megawatt at frequencies ranging from K-band to S-band. Descriptions of transmitters developed for K-, Ka-, and C-bands are shown in the table below. These compact, solid-state systems can replace tube-based designs and lower-reliability first generation solid-state systems. The transmitters are built upon new circuit topologies developed at DTI that meet the magnetrons' unique requirements for dv/dt control and constant current operation.

The transmitter designs employ direct solid-state, cathode-switched, and hybrid solid-state/transformer-coupled switching topologies. A "direct-switched" solution, using DTI's compact, highly-regulated high voltage power supply and modulating switch, is a recommended replacement for cathode pulsed, "hard-tube", active-switch modulators, and thyatron-switched, line-type modulators. A "hybrid" modulator combines DTI's advanced solid-state switches with a state of the art pulse transformer in a very compact footprint. These designs can deliver pulsed pairs and bursts with extremely good pulse shape and stability for all pulses in a group.

DTI's cathode modulator provides fully variable pulsewidth (50 ns – DC), adjustable on a pulse-to-pulse basis, and supports pulse repetition frequencies up to 400 kHz. In normal operation, the cathode switch is closed for the duration of the desired pulse, presenting very low impedance between the power supply and the cathode. The system may include a resistive pull down, or a second solid-state switch as an active "tail biter", if fast fall time or operation with closely spaced pulse pairs are requirements.

DTI's K- and Ka-band transmitters utilize a hybrid modulator topology to meet strict size, weight and pulse fidelity specifications. The hybrid circuit uses high speed IGBTs that switch approximately 1000 volts driving a low turns-ratio pulse transformer. Transmitters are packaged in ruggedized environmental enclosures.



Detected RF envelope (top) for Ka band transmitter
Peak value approximately 50 kW at 16 A.

DTI's high voltage switches are built from modules containing from four to twenty individual transistors (typically IGBTs) which, in turn, are placed in a series assembly to meet specific requirements for transmitter cathode voltages. An external gate drive controls all modules in the assembly simultaneously. The modular construction leads to flexibility, economy, and ruggedness.

Ka-Band, K-Band, and C-Band Magnetron Radar Modulator Characteristics			
Parameter	Ka-Band	K-Band	C-Band
Tube	Rising-Sun Magnetron	Coaxial Magnetron	Coaxial Magnetron
Peak Power	50 kW	3 kW	1 MW
Pulse Width	150 ns	300 ns	2 μs variable
RF Rise Time	15 ns	< 50 ns	< 100 ns
RF Fall Time	40 ns	< 50 ns	< 200 ns
PRF	4 kHz	> 2 kHz	2 kHz
Peak Voltage	15 kV	3.6 kV	38 kV
Peak Current	16 A	3 A	65 A



The Ka-band transmitter is “plug and play” with two multi-pin circular connectors and two BNC connections in addition to the magnetron. The system is designed to address both EMI and safety concerns in its construction. The high voltage circuitry (208 volts input all the way to the 16 kV output) is contained in the lower compartment with restricted access. The low voltage control circuitry (15 volts or less) is housed in a separate compartment referred to as the “dishpan”. Measurements or fine tuning can be performed via the dishpan with the lower high voltage compartment sealed.

DTI has also developed transmitter designs for high fidelity, megawatt-class applications. Current efforts are focused on C-band systems in rack-mount and environmentally-rugged versions, as well as high power CFA and IOT transmitters. When powering CW magnetrons, DTI’s highly regulated, stable current power supplies with low stored energy offer built in fault protection. These compact and cost-effective systems scale to high average power without the reliability problems common in “rack-and-stack” alternatives.

DTI’s expertise in magnetron transmitter design and construction is readily applied to custom transmitter requirements and upgrades of existing transmitters



DTI 1 MW C-band direct-switched magnetron modulator. Size is approximately 35½”l x 26”w x 21”h. The unit mounts directly to an antenna mount. Approximate weight 537 lbs. with oil.



C-band modulator operation. Detected RF at 38 kV cathode, 56 A, 630 Hz. Nominal 1 μs wide double pulses spaced at 1.9 μs.

