



Flexible IGBT Pulse Modulators

Depending on the customer's application, there are a variety of IGBT based pulse modulator topologies available; from an IGBT pulse transformer to the IGBT Marx stacked pulsers.

IGBT Pulse Transformer

This topology is capable of delivering high current triangular or trapezoidal pulses into an inductive load. Characteristics include high switching speed, switching relatively high voltages from 1200 to 6000 V at high currents (100s of Amps), low conduction voltage drop and lower system cost are distinct advantages of this type of IGBT pulse modulator.

This IGBT technology is not limited by the pulse transformer step-up ratio. The largest units built to date operate up to 60 kW average and 125 kV peak output pulse using a 135:1 step-up transformer producing unparalleled waveform fidelity using parallel IGBT/capacitor bank units operating at primary voltages between 500 and 1500 V.

IGBT Marx Pulser

A number of applications that require <1 μsec risetimes at high voltage and current cannot easily be satisfied with the previous standard technology using low voltage components driving a large step-up transformer. We have developed several products that employ the topological erection of voltages using a Marx generator stacking arrangement of lower voltage IGBT devices. This technology does not place the semiconductors in a simple series stacked arrangement which has the drawback failure mode where the loss of a single device would over-stress the stack of IGBTs. Rather, it switches in identical low voltage subsystems that erect their voltage across HV diodes to achieve the required output pulse. This topology also has the advantage of producing variable pulse widths.

An IGBT modulator built using this technology provides 30 kV, 400 A, 1 - 50 μsec variable pulse widths, and operates at 7.5 kW of average power with peak powers as high as 2.4 MW.

Our 20-plus year legacy of delivering reliable high voltage equipment and extensive experience in practical pulse generator applications traces back to North Star Research Corporation. We combine our expertise in high voltage pulse generator techniques with an understanding of the physics and engineering involved to exceed customer requirements. We tailor and adapt technology for customer needs by starting with a well-understood existing design; then using simulation and analytical analysis, we develop a new design with a proven base. Comprehensive testing is performed on every system to ensure the delivered system meets all critical performance requirements to achieve overall customer satisfaction.

For more information about our products and services, please visit our web site at

www.appliedenergetics.com/highvoltage.asp

Applications

Flexible IGBT Pulse Modulators have applications in various markets including:

- Particle Accelerator drivers
- Plasma Ion Implantation
- Plasma studies
- Microwave Tube drivers
- Arc processing
- Flash X-ray

Pulsed power systems that would prefer to use solid-state components to achieve virtually unlimited lifetime and versatility include klystron, magnetron and plasma ion implanters. Applied Energetics has designs that provide:

- Fast Risetimes (<1 to few μsec)
- Pulse Width Variability (1 to 50 μsec or more)
- High Voltage Operation (to 100s kV)
- Solid-state Components
- Dynamic Load and Fault Tolerance
- PC-Controlled Versatility

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Application Notes

Fiber optic computerized controls can be provided to integrate with your processing equipment. The fiber optic interfaces isolate the controls from high voltages and fast switching transients that can interfere with the system controls.

IGBT Pulse Transformer

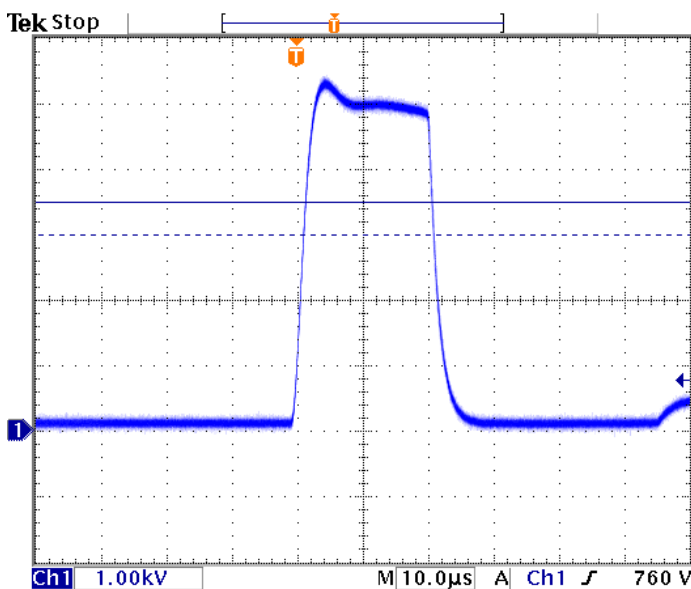
We have built a wide variety of pulse modulators based on the IGBT pulse transformer technology. These IGBT pulse generators can be designed and built to accommodate various waveforms, rise-times, fall-times, voltage, and current output requirements.

Series stacking of IGBTs is unnecessary with the design of state-of-the-art, high turns ratio, step-up transformers depending on the application. This technology has effective arc protection circuits that have been extensively used in plasma implantation and Klystron modulator applications.

IGBT Marx Pulser

In the basic topology, a DC power supply is used to charge the capacitance of individual IGBT boards through a series of chokes which will isolate individual boards during pulse erection. High voltage mitigation is achieved by defining reasonable intermediate potentials throughout the modulator. For example, an IGBT board representing 1 kV of erected potential can be used with 6 boards forming a "platter." A maximum of 6 kV isolation is all that is required from any two discrete points. Reasonable margins are used between platters and the cabinet interior to achieve 30 kV erected potentials. Ambient air and distance are used to isolate the highest voltage components from chassis ground. A fiber optically linked master trigger board mounted on each platter will simultaneously apply 6 isolated trigger signals to the gates of the IGBT boards.

We have developed a robust pulse modulator architecture using low voltage Marx-stacked IGBTs that provide sub-microsecond rise-times for driving low to medium impedance loads. Fast fault detection circuits truncate the erected pulse in case of any dynamic load arcs.



Example of an output from an IGBT pulse transformer showing a 50 kV peak output pulse. There is a 10:1 probe ratio yielding 10kV/div.

The combination of our standard bank modules and custom pulse generators allows us to provide a wide range of capabilities.

Custom voltage 0 - 200 kV

Peak power 0 - 10 MW peak

Average power 0 - 500 kW

Pulse durations 5 µsec or more

Please contact us to discuss your IGBT pulse modulator needs. The maximum pulse duration, rise-time, fall-time, voltage, and current must be specified. We will quote custom and semi-custom applications to meet your demanding specifications.

