



Applied Pulsed Power, Inc.™

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MAP I ion diode driver and control rack

MAP I™ Ion Diode System

Large area pulsed ion beams
High voltage
High current
Five pulses per second

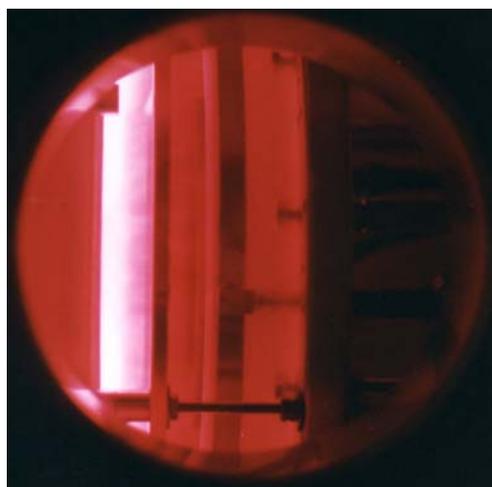
The MAP I ion diode system delivers high purity, intense, pulsed ion beams when integrated with a suitable high voltage pulse generator. The system was developed for ion beam surface treatment.

Hydrogen, nitrogen, argon and helium ion beams have been produced using pulse generators operating from 200 kV to 600 kV at currents of up to 40 kA. The unique MAP I system produces high purity, single or multiple species ion beams.

Anode Plasma Source

A high density, highly ionized plasma is inductively generated from a single or multiple species annular gas puff. Since the process uses neither electrodes nor surface flashover, the device lifetime is long and a consistent, high purity plasma is produced.

The anode plasma source of the MAP I ion diode system may be used in other industrial applications as a repetitively pulsed plasma source or as an igniter of steady-state plasmas.



Edge view of H₂ plasma

The MAP I™ system anode plasma source uses a low pressure gas puff injected by a high speed gas valve with a supersonic nozzle. A fast risetime magnetic field coil inductively generates a plasma from the gas. This rising magnetic field also drives the plasma towards the anode electrode of the ion diode, forming an anode plasma for each pulse and resulting in a high purity beam. Changing ion species is accomplished by changing the gas used.

The MAP I™ system magnetically insulated ion diode has anode and cathode electrode assemblies and pulsed magnetic field coils. The insulating magnetic field prevents electron flow to the anode. The absence of any surface flashover eliminates this potential source of debris and extends the maximum achievable voltage pulsewidth. A virtual cathode is produced by electrons emitted from the outer cathode electrode ring and confined by the magnetic field. The titanium cathode electrodes and the pulsed magnetic field coils are integrated into a single water cooled assembly.

MAP I™ system electrical drivers and power supplies are equipped with a full set of safety interlocks and are controlled by a PLC. The electrical drivers use solid state switching and are enclosed in a double wide rack cabinet, except for the fast risetime coil driver, which uses thyatron switches and has a separate enclosure. The driver for the insulating field coils recovers the inductive energy, minimizing power supply requirements.

Applications

The MAP I ion diode system is the heart of a unique, high throughput, industrial surface treatment system. QM Technologies in Albuquerque, New Mexico, mates APP's MAP I system with a 400 kV pulser, producing a new thermal surface treatment which uses intense ion beams to enhance hardness, corrosion resistance and smoothness of surfaces, without using chemicals or solvents.

Typical MAP I System Specifications for Ion Beam Surface Treatment

Accelerating voltage	400 kV
Beam current	40 kA
Beam current density (at anode)	200 A/cm ²
Pulsewidth	100 ns
Repetition rate	5 pulses/s
Energy density at target	> 5 J/cm ²
Target area	>100 cm ²
Design lifetime (excluding consumables)	>10 ⁷

The MAP I system is suitable for other applications that require repetitive, reproducible intense ion beams with controlled ion species and 1µs or shorter pulsewidths. Ion beam energy, current and pulsewidth are determined by the high voltage pulse generator. The system can be tailored for a variety of beam parameters and pulse generators.

Since 1990, the mission of Applied Pulsed Power, Inc. has been the development of products for industrial applications where pulsed power technology has compelling advantages over existing methods. APP has been developing ion beam technology for industrial surface treatment for five years. The company also designs and supplies prototype systems including high power pulse generators, pulsed high magnetic field coils and high speed gas valves. We can work closely with you to meet your needs, often by modifying proven designs with a minimum of engineering costs.