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A Marx-Based Power Converter topology as a Current Source for Pulsed Magnets in Particles Accelerators

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In particles accelerators pulsed magnets are typically used in Linacs, transfer lines, as well as in injection and extraction areas. The required power converter current and voltage ranges can be very wide and depends on the beam energy, and the actual magnet and building configurations. This is even truer for large physics research facilities such as CERN.
It is of great importance that the powering solutions for such big facilities is standard and modular in order to reduce the cost, the maintenance efforts, and the spare parts number. Typically the power converter topology used for these applications is based on capacitor discharge and resonant principles. Magnets used in Linacs, transfer lines and injection/extraction septa, often require a current "bump"with a flat-top. Solutions combining capacitor discharge based topologies with active filter rated at a fraction of the total power are typical.
This paper presents a modular topology based on the solid state Marx generator. This topology is typically used in high voltage applications; however, it is demonstrated that a modified version of it can be used as a modular high pulsed current supply for magnets. The basic principle of charging capacitors in parallel and discharging them in series is conserved. In contrast with pulsed voltage source application, a Marx-based pulsed current source with an inductive load presents an output voltage reversal during the negative di/dt phase. The technical solution to cope with this is presented. To shape the desired current it is possible to time-shift the discharge of different Marx cells. Furthermore an active filter rated at a fraction of the converter nominal power is used to precisely tune the desired current shape. This flexible converter can be easily used for all pulsed (ms range) current converters in accelerator facilities with a high degree of modularity.

Author: Dr AGUGLIA, Davide (CERN)

Co-author: Mr TODORCEVIC, Todor (CERN)

Presenter: Dr AGUGLIA, Davide (CERN)

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