FPGA based Programmable Pulse Generator for Solid-State Marx Generators

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FPGA BASED PROGRAMMABLE PULSE GENERATOR FOR SOLID-STATE MARX GENERATORS

KEYNOTE SPEAKER

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ABSTRACT

In this contribution, we present an FPGA control system to generate the control signals needed for our Flexible Solid-State Marx generator (see [1]). The control system generates (at least) 20 individual control signals with 2.5ns precision and up to seconds in length. It is implemented on a Pynq-Z2, a cheap FPGA development board with embedded ARM SoC. The system is live-reprogrammable, so the Marx output pulse shape can be changed multiple times per second. Furthermore, bursts of pulses can be made by repeating a pulse shape. An interface in Python takes care of translating Marx pulse shape to control signals, including calculating deadtime. This interface can be combined with any measurement system to create a feedback loop. For instance, an oscilloscope can measure the Marx output pulse and tune the control signals to improve the measured waveform. Alternatively, the system can be connected to a plasma diagnostics system and change the pulse shape based on the plasma behavior. Finally, we present some preliminary results on future improvements, including a delay system using programmable delay lines in the FPGA to reduce the time precision from 2.5 ns to about 20ps.

[1] J.J. v. Oorschot, M. Azizi, A.J.M. Pemen and T. Huiskamp “Fast & Flexible Impedance-Matched Solid-State Marx Generator for PAW Generation”, EAPPC 2020, Aug. 29 – Sep. 02 2021, Biarritz, France.