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SOLID-STATE MARX GENERATOR FOR CLIC BREAKDOWN STUDIES

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A new semiconductor based Marx generator converter, using SiC discrete MOSFETs (Metal Oxide Semiconductor Field Effect Transistors), has been designed to meet specifications for carrying out high electrical gradient RF breakdown research for the Compact Linear Collider (CLIC) study: CLIC is an international collaboration working on a concept for a machine to collide electrons and positrons (antielectrons) head-on at energies up to several Teraelectronvolts (TeV). For this experimental research, the load of the Marx generator is a spark gap. The load can generally be considered to be capacitive in nature: normally the load will not conduct, however it will occasionally breakdown (when there is high voltage across it, it can transition into an electrically conducting state). The purpose of the high-gradient breakdown studies is to determine the long-term breakdown rate of the spark gap under different test conditions. Thus the Marx generator must be designed to operate reliably with both a capacitive load and following an electrical breakdown of the load.
The requirements for the Marx generator include applying positive voltage pulses to a 150 pF capacitive load, at a repetition rate from 1 Hz to 1 kHz, with a flattop of up to 10 kV pulse amplitude and 500 ns to 100 µs pulse width, having rise and fall times of 100 ns, from 5% to 95%. Ideally there will be no ripple during the flattop: the equipment is used for breakdown studies and, for a given geometry of the sample under test (i.e. the load), the breakdown rate is approximately proportional to Voltage^30 (i.e. a small ripple can give a large change in breakdown rate). To minimize ripple the circuit inductance is kept to a reasonable minimum.
Preliminary experimental results from the Marx generator connected to this load will be presented and discussed in view of the proposed application and initial requirements.

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