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Packaging and Evaluation of 100 kV Photoconductive Switches

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In practice, it is challenging to integrate a Photoconductive Semiconductor Switch (PCSS) capable of switching on the order of 100 kV into a package with small parasitic inductance such that the sub-nanosecond rise time of the PCSS is still achievable at current amplitudes of hundreds of amperes. The lateral geometry PCSS is built on a 2.5 cm x 1.3 cm GaAs sample with a gap distance of 2 cm to achieve rise-times less than one nanosecond. Another challenging aspect of a practical GaAs PCSS is the filamentary nature of the current which leads to shortening of the device lifetime. This is addressed by using an appropriate electrode profile at the contacts to produce a mostly uniform electric field between the electrodes, thereby decreasing field enhancement points and filament "hot-spots."Fully 3D, transient electric field simulations of the switches, also incorporating the field dependent conductivity of the GaAs material, enable optimization of the switch package while keeping the electric field stress at acceptable levels during the fast, 10 μs application of the charging voltage. The switches are packaged such that the semiconductor is encapsulated in EFI dielectric to mitigate breakdown driven by the electric field across the GaAs surface. High-gain lock-on conduction mode is utilized so that the triggering system does not require high laser power to switch the PCSSs into their on-state. The high voltage design of the PCSS package is presented and initial switching results are discussed.

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