

A Novel Subnanosecond Pulsed Power System for Bio-Medical Applications

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There are modern developments in the pulsed power technology for applications in the food industry, pollution control, defense and bio-medical domain, that all require systems generating subnanosecond voltage impulses. For an important application in the biomedical domain, we are currently developing a pulsed power generator capable to produce impulses with a rise time in the range of picoseconds and amplitude approaching the value of 500 kV, at a pulse repetition frequency of 50 Hz. In order to understand the role of picosecond pulsed electric fields in the permeabilization of biological cells, we performed numerous experiments with an existing generator, which delivers step pulses of 20 kV amplitude, with a rise time of 200 ps and having a total duration of 500 ps. The generator was attached to an arrangement composed of two parallel plates, between which was mounted a standard electroporation cuvette. A detailed numerical analysis using CST software was performed for the complete system, that allowed a precise and accurate electric field monitoring inside the water sample containing the bacteria. The very encouraging biological results obtained show that picosecond electric field pulses of 60 kV/cm amplitude are capable to permeabilize up to 80 % of the cells.