

Design and Testing of a 300-kV PFN-Marx Generator for High-power Microwaves Applications

U. Hashmi, A. Alali, G. N. Appiah, H. Deiban,
F. Albarracin, M. Al Mansoori, F. Vega, and C. Kasmi

Directed Energy Research Center, Technology Innovation Institute, Abu Dhabi, United Arab Emirates

Abstract— This paper presents the development, modeling, and experimental validation of a low-impedance pulse forming network (PFN)-Marx generator, delivering a matched load voltage of 300 kV for high-power microwave applications. Traditional Marx generators, widely utilized in pulsed-power systems, exhibit a double-exponential voltage output unsuitable for specific use cases [1]. To address this limitation, additional capacitors were integrated into each stage, enabling the PFN configuration to achieve a more uniform, flat-top output voltage. The 300-kV PFN-Marx generator features a risetime of 20 ns and a pulse duration exceeding 100 ns, implemented using a 12-stage zigzag architecture [2, 3]. Each stage incorporates four 10 nF, 50 kV ceramic capacitors housed in 1-meter-tall, 0.4-meter-diameter pressurized vessels. 60 μ H charging and discharging inductors are mounted on threaded plastic rods. The chamber insulation uses SF₆ gas at different pressures. Experimental testing demonstrated an impedance of 22 Ω determined through short circuit and matched load tests. To optimize erection efficiency, the stray capacitance of the initial four stages was increased by modifying the capacitor holder strips. Stainless steel electrodes with a 2.5 mm gap were utilized in the first stage, and the output was directed to a diagnostic setup comprising resistive loads, a Rogowski coil, Current Viewing Resistor (CVR) and V-dot sensors for current and voltage measurements respectively. Performance metrics were validated experimentally, confirming the expected results from circuit and full-wave simulations from CST Studio®. These results encourage the development of further PFN-Marx configurations.

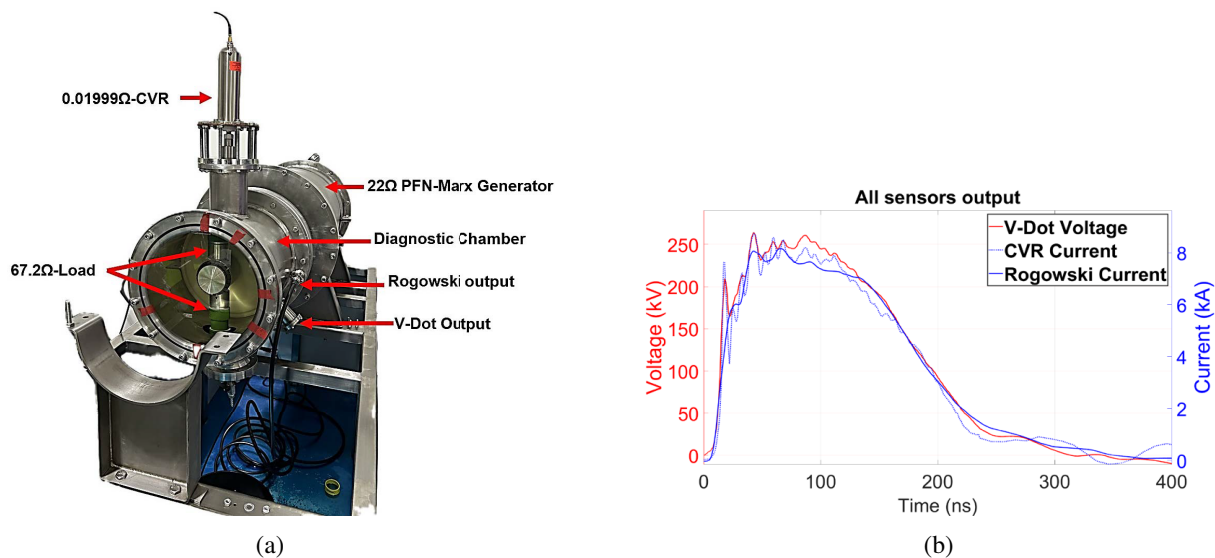


Figure 1: (a) PFN-Marx generator prototype, and (b) the measured waveforms.

REFERENCES

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