Compact 200 kV–50 Hz Marx Generator for Charging a Dipole Antenna

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Abstract— This paper presents the design and development of a compact 200-kV Marx generator for generating high-power wideband RF signals using a dipole antenna [1]. This approach simplifies the generation of high-power microwave (HPM) signals compared to conventional systems with separated antenna setups [2, 3]. The Marx generator consists of five stages, with each stage equipped with a 940-pF capacitor. For charging of Marx generator the inductors were used and fabricated using 3D-printed technology. The stainless-steel spheres served as the spark gaps with interelectrode gaps precisely adjusted using innovative 3D-printed components. The stray capacitance of each stage was primarily attributed to the spark gaps and estimated to be 3 pF. The entire assembly was mounted on a 3D-printed Nylon 12 structure with insulation provided with SF6 gas and high-density polyethylene (HDPE) liner. The output was routed through a PEEK feedthrough, with a V-dot sensor on the metallic collar for voltage measurements. The mass of Marx generator was 9 kg, with a flange diameter of 125 mm and a 436 mm height. The Marx generator is charged using a battery-powered dc power supply and it is controlled via fiber optics or wirelessly for outdoor use. The system was tested at 50 Hz single-burst mode. The electric field measured at 1 m distance with a radiating antenna was more than 250 kV/m. Future plans include implementing electrical triggering to minimize voltage fluctuations and a reduction in the system's weight to enhance portability and usability [4].

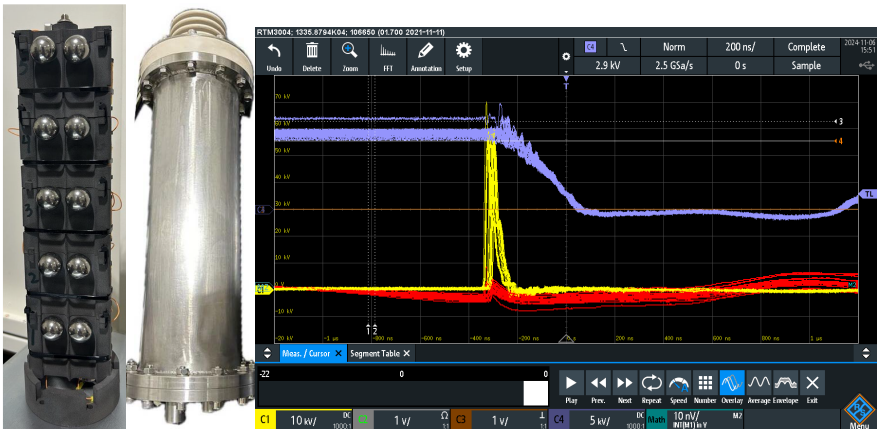

Figure 1: Marx generator & voltage measurements from sensors.

REFERENCES

1. Mayes, J., et al., "Development of a dual-polarity Marx generator designed for pulse charging a dipole antenna," *Proceedings of the IEEE International Power Modulator and High Voltage Conference*, 617–621, 2010.
2. Ryu, J., et al., "An integrated antenna-source system of very high ultra-wide-band gain for radiating high-power wide-band pulses," *IEEE Transactions on Plasma Science*, Vol. 40, No. 4, 1019–1026, 2012.
3. Pecastaing, et al., "A 250KV-300PS-350HZ Marx generator as source for an UWB radiation system," *PPC 2009 — 17th IEEE International Pulsed Power Conference*, 51–56, 2009, 10.1109/PPC.2009.5386201.
4. Mayes, et al., "A compact high power wideband system," *Proceedings of the IEEE International Power Modulator and High Voltage Conference*, 612–616, 2010, doi: 10.1109/IPMHVC.2010.5958433.