Studies with 30-stage inductively charged Marx Generator

Figure 1. Experimental set-up. (1) Hand held 80 V trigger, (2) 50 kV trigger circuit, (3) Controller of 40 kV-40 mA DC Power Supply, (4) 30-stage inductively charged Marx Generator with the peaking capacitor, and peaking spark gap and (5) Load. This load can be either the MCG-like coil, the oscillatory circuit with the gas discharge switch assembly, BWO or the X-ray diode. DC Power Supply barrel and the charging barrel are placed on the left of the cabinet.

Experimental conditions

- Experiments are carried out with 30-stage inductively charged Marx Generator.
- Capacitance per stage of the Marx Generator is 18.4 nF.
- Charging voltage of 9 kV/stage was used in Figures 2 and 3.
- For 9 kV per stage charge, the generator stores 22 J.
- At 30 kV per stage, the maximum energy that the system can store is 248 J.
- Characteristic impedance of the Marx Generator was found to be about 100 Ω.
- At 30 kV per stage and with peaking circuit currently employed, the generator relieves the output current of 10 kA and the output voltage of 600 kV into 60 Ω load
- The interior of the generator is placed in the enclosure made of reinforced epoxy. The diameter of the enclosure is about 16 inches (40.6 cm).
- The height of the enclosure is 25 inches (63.5 cm).
- The epoxy enclosure of the Marx Generator employs a proprietary shield designed to prevent the HPM/RF signal generated by the Marx Generator itself to be transmitted to the output.
- When the peaking circuit is absent, the voltage waveform of the generator measured against the resistive load of 50 Ω has a quasi-Gaussian shape (See Figure 1). This waveform resembles the voltage waveform obtained with the exploding wire. See "Energy Compression Experiments: Simulation of Small-Size MCG To Obtain a Radio Frequency Source."
- With the simple peaking circuit attached to the generator, the rise-time of the pulse can be improved. If care is taken to terminate the Marx generator with the pure resistive load, the rise time falls to the sub-nanosecond range. Figures 1 and 2 were recorded with an off-the-shelf, 2-foot long, 50 Ω resistor.

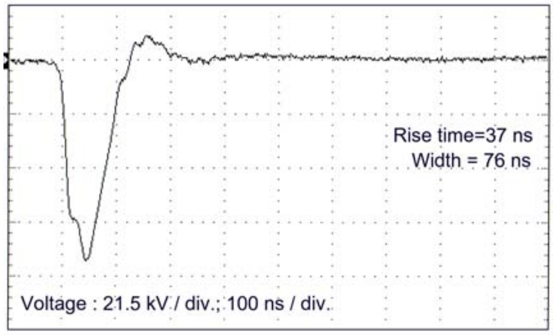

Figure 2. Voltage waveform obtained with the Marx Generator and 50 Ω resistor. The peaking circuit is absent**.**

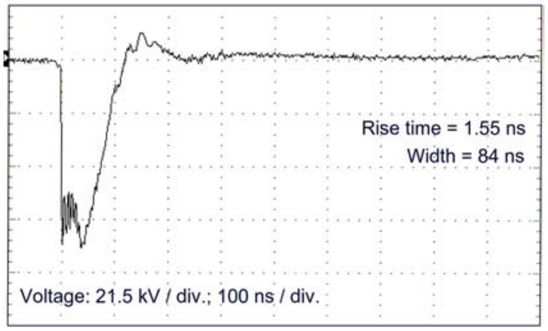

Figure 3. Voltage waveform obtained with the Marx Generator and 50 Ω resistor. Here, a simple peaking circuit is present. For other application, the peaking circuit currently employed can be kept and a vacuum diode assembly introduced to yield pulsed X-ray system suitable for flush X-ray photography.

Experimental conditions

- Charging voltage of 14.2 kV/stage is used to get the data given in Figures 4 and 5 and the energy stored in the system is 56 J.
- Data shown in Fig. 4 are recorded with 3 GHz oscilloscope.
- 30-stage inductively charged Marx Generator energizes the compact structure that was described in the 2010 Megagauss Conference in the paper: “HPM generation in atmospheric air”. This structure is also used to get Figure 11 in this paper

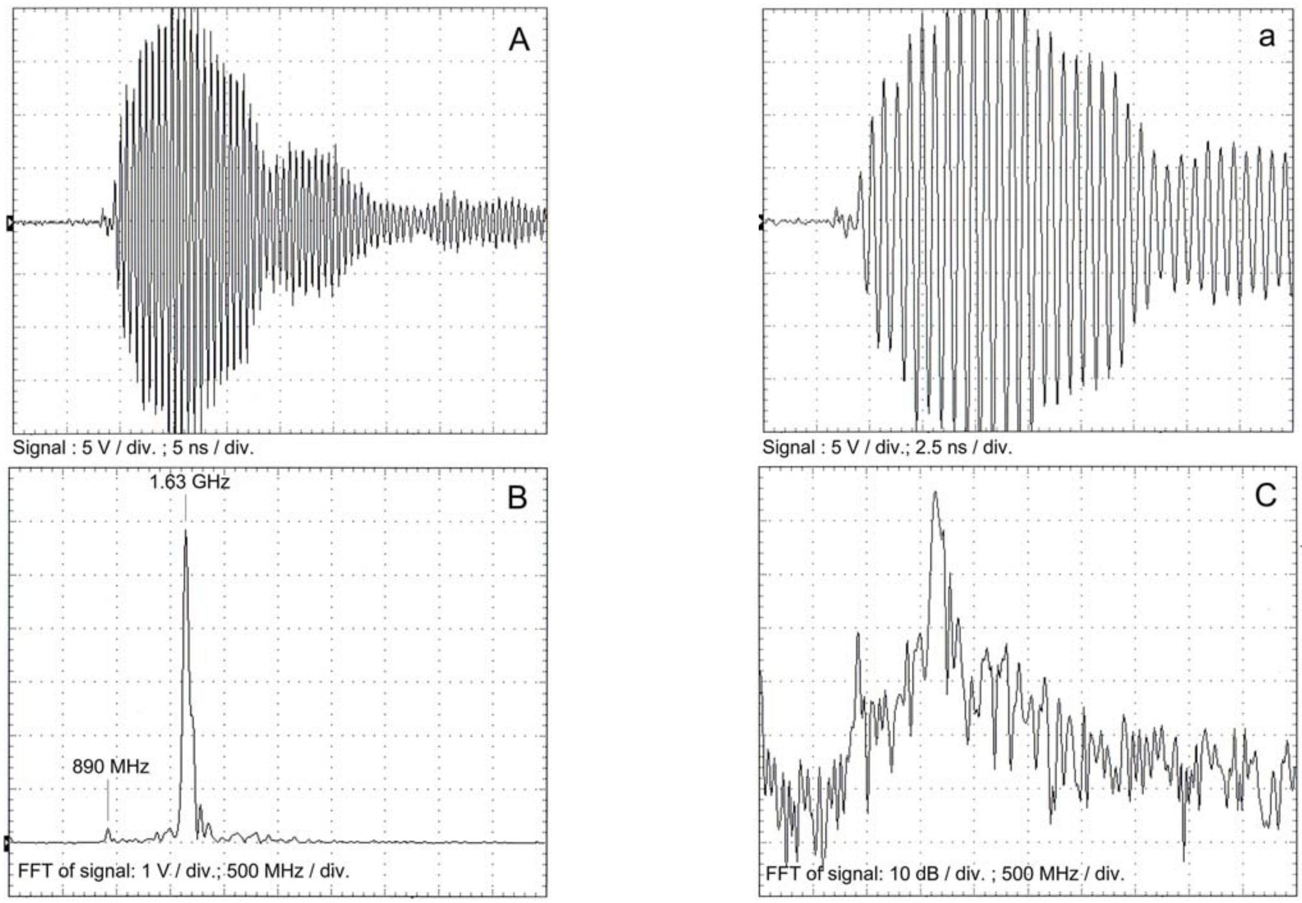

Figure 4; Experimental data**; Frame A:** Signal recorded at the time scale of 5 ns per division. **Frames B** and **C** are the FFT of the signal, shown on the linear and logarithmic scale. **Frame a:** is the signal of the frame A, but expanded on the time scale of 2.5 ns per division. B-dot probe is used. For frequency of 1.63 GHz, the amplitude of the signal of 1 Volt measured by the probe corresponds to the electric field of 1.9 kV/cm.

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