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Development of High Voltage IES Pulse Chargers Using SI-Thyristor and IGBT

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Studies in recent years of pulsed power technology have led to applications in various fields such as medical, environmental, and agriculture. For practical applications, both energy efficiency and system simplicity are important. The nanosecond pulse discharge system developed by our research group generates pulsed power with a rise time of 5 ns and a peak voltage over 60 kV, resulting in low heating loss of discharge and enabling highly efficient gas treatments. The system consists of a DC charger, microsecond pulse generation circuit, nanosecond pulse forming line, transmission line and a load. Current problem which should be solved is the large size and complexity of this system. In this study, it was focused on the microsecond pulse generation circuit in order to solve this problem. Current microsecond pulse generation circuits are based on capacitive energy storage (CES); conversely, use of inductive energy storage (IES) would both reduce and simplify the system. Fortunately, the technology of power devices has developed dramatically in recent years, and semiconductor devices that enable interruption of large currents in the high speed region have also been developed. This enables development of pulse voltage sources based on induced energy storage instead of capacitive energy storage. Here, we introduce two compact and low-cost microsecond pulse generation circuits based on IES using SI-Thyristor and IGBT as opening switches. The comparison and evaluation of these circuits with current CES microsecond pulse generation circuits were also carried out.

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