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Microsecond Fast, 100 kV Modular Pulse Charger

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A pulse charger module was designed and tested for use in scaled experiments. Each pulse charger module is powered with a 12 V Lithium-ion battery and set to charge a 1 nF capacitor up to 100 kV in less than 10 µs. This is achieved by initially charging a 1.5 µF capacitor to 5 kV. Using a thyristor switch, this capacitor will then discharge into two transformers paralleled on the primary side. Each transformer yields a 50 kV output, however, ground referenced with opposing polarities. Thus, by placing the 1 nF capacitor between the resulting +50 kV and -50 kV terminals while grounding the other two output terminals, a differential voltage across the capacitor of up to ˜ 100 kV was obtained.
A PIC 18F26K80 8-bit microcontroller in each charger module will be used to control the module, communicate to other modules and to a computer, and monitor voltages. Each module is kept in a low power mode when not in use and fiber optic communications is used throughout such that electrical isolation between modules and the master computer is ensured. During use, each PIC will be able to automatically detect the number of modules, as well as its position, in the set. This is important to ensure proper timing of communications between PICs and for identifying modules independently. Voltage monitoring in each module is achieved using the 12-bit A/D converter on the PIC. If an error occurs, the PIC relays the error to the other PICs as well as to the computer. The outputs of each module will then be disabled, and the PICs will wait for further commands from the user. The computer will be able to see all errors that occur in the system as well as which module was error flagged.

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