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Design of a 30MJ capacitor-based pulsed power supply for EML

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We are developing a 30MJ high power pulsed power supply (PPS) system with 10kV operation voltage for EML research. The PPS system can be divided into several functional subsystems: pulse forming subsystem, control subsystem, charging subsystem, and measurement subsystem. Matrix type structure and modular architecture are adopted in the design of the PPS. The PPS is assembled in two 40'general purpose containers in order to meet the requirements of field experiments and transportation.

The pulse forming subsystem consists of 30 parallel pulse power modules. Each module includes three 334kJ pulse forming units in parallel. The pulse forming unit mainly includes a 6680μF metallized film capacitor, a 35μH foil type inductor, a 200kA high power thyristor stack and a 200kA high power diode stack. The control subsystem has a two-level control structure. The primary level control device is a remote master controller and the second level is a pulse power module controller. With optical fiber synchronous network, the remote master controller sends synchronous clock signal of pulse discharging to each pulse power module to achieve an accurate sequential discharging control. The charging subsystem is composed of 30 high voltage capacity charging power supplies (CCPS). Each pulse power module is configured with one CCPS. The core component of CCPS is a series resonance converter based on IGBT bridges. The measurement subsystem adopts a PXI bus based data collection system and a master-slave network structure with optical fiber synchronous communication.

With electrical parameters of the PPS and railgun being assumed, numerical studies of the railgun launch process have been down with Matlab/Simulink platform. At present, 2 PFU and 1 CCPS have been built and debugged successfully. The 30MJ PPS is expected to be built soon after and will be used for EML research.

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