

L.7: 10kV Flashlamp Power Supply for High Power Nd: Glass Laser Amplifier

A 10kV pulsed power supply has been developed at LESD to energize flashlamps in Nd:Glass laser amplifiers. The power supply consists of four capacitor banks of 250 μ F/10 kV, a 1.25 kJ/sec constant current capacitor charging and triggers circuits for flashlamp pre-ionization. A hardwired control unit has been developed to operate it. This power supply is suitable for energizing large size and multi-beam amplifiers under development.

The charging circuit is based on dc-dc LCL-T resonant converter to charge all the banks simultaneously at constant average current of about 250 mA. The constant current charging is desirable as it provides automatic short circuit protection, as this condition is quite likely in large banks with many capacitors in parallel. Input to the charging circuit is 3-phase 415 V, 50 Hz. A 3-phase rectifier and filter form the frontend of the converter. Frontend provides unregulated dc bulk voltage of about 530 V with ripple factor of 0.1%. IGBT modules connected in full bridge configuration have been used in the converter to provide square wave input to LCL-T network. This network consists of two inductors and one capacitor connected to form a two port T-network. A step-up transformer, connected at the output port of LCL-T network, provides galvanic isolation and steps up the output to match the load requirement. Transformer output is rectified using fast recovery diodes to get constant amplitude dc pulsating current of average value \sim 250 mA for charging. This circuit is capable of charging all capacitor banks to 10 kV in nearly 40 seconds.

Four series-triggering based flashlamp trigger circuits pre-ionize individual flashlamp pairs. Each trigger circuit generates 15-20 kV, \sim 2 μ s duration pulse across the corresponding pair thereby triggering it. It uses a HV pulse transformer and SCR-switched series LC circuit.

Special attention has been paid to the safety and ease of maintenance of the supply. Each bank has its own dump circuit consisting of a high wattage resistor and a HV relay of 10kV contact rating. All dump circuits are connected such that in case of failure of any of the discharge path, the corresponding bank gets discharged through other normal paths. Further, voltage on each bank is continuously monitored and displayed on individual DPMs, located on the front panel of power supply cabinet. This enables quick view of all bank voltages by an operating or maintenance personnel. All components are mounted in such a manner that they are easily accessible for preventive and corrective maintenance.

Operation of power supply involves setting the charging voltage, initiating the charging of the bank, maintaining the charging voltage when the set voltage is reached and initiating

the discharge of bank energy into the lamp by triggering the flashlamp. The power supply has been successfully tested with flashlamp loads consisting of a four series-connected pairs of 280 mm- arc length flashlamps. Figure L.7.1. shows the measured flashlamp current pulse through one of the flashlamp pairs at charging voltage of 7 kV. Figure L.7.2 shows photograph of the power supply.

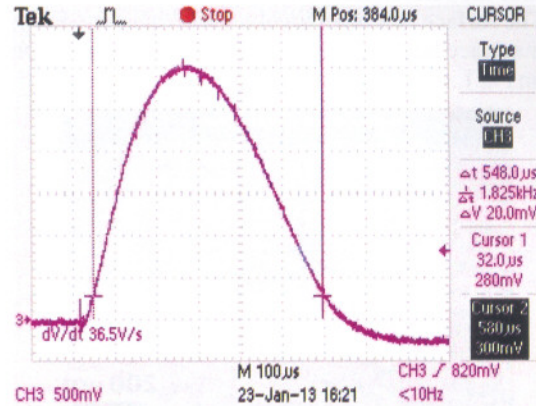


Fig. L.7.1: Measured flashlamp current pulse through one of the flashlamp pairs at charging voltage of 7 kV. Peak Current is about 6 kA.

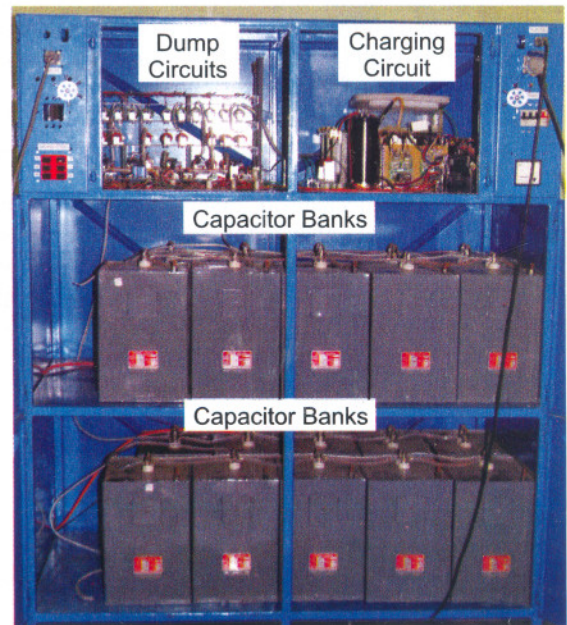


Fig.L.7.2: 10 kV Flashlamp power supply showing charging and dump circuits at top floor and capacitor banks in middle and bottom floor

Reported by:
Bhupinder Singh (singh@rrcat.gov.in), M.S. Ansari and C.P. Navathe