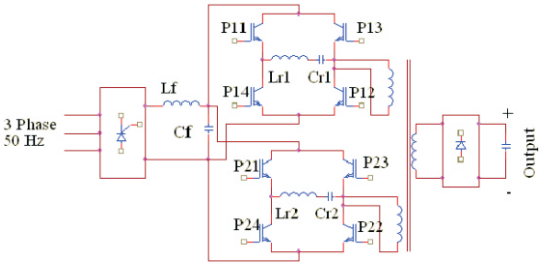
A.3 :Development of high stability, high power capacitor charging power supply

A capacitor charging power supply (CCPS) technology is developed for high stability, high pulsed power applications at PSIAD, RRCAT. This power supply will be used to charge pulse power circuit capacitors of septum /kicker pulsers. Presently this topology is tested for 25 Hz repetition rate. In this power supply, short circuit proof series resonant converter with adjustable constant current output is used. The CCPS is designed, simulated and tested to charge 50 uF energy storage capacitor from 0 V to 1500 V in 35 ms exhibiting a charging power of 1.6 kJ/s. The measured output voltage stability at 25 Hz operation is ±0.01%. CCPS available in market normally have stability specifications of the order of ±0.1%.

The high stability is achieved by establishing three phase SCR preregulated DC bus feeding twin phase shifted series resonant converters (SRC) and voltage sensing and comparator loop in temperature controlled environment. The high voltage capacitor charging power supply consists of two identical full bridge resonant converters feeding two primary windings of a transformer. The rectified secondary voltage is connected to load capacitor (Fig. A 3.1) Topology selection is based on the fact that the series resonant converter with switching frequency f_s below 50% of the resonant frequency f_r ($f_s \geq 0.5 f_r$ discontinuous conduction mode) act as a current source. The tank circuit resonates at 42.37 kHz and IGBT bridges are driven by phase shift PWM IC UCC 3895 at 19 kHz.

The complete process (Fig. A 3.2) is divided into three modes: (1) High power charging mode: both the HF transformer primary windings are driven in phase by SRC (2) Low power refresh mode: The voltage feedback loop drives HF transformer primary windings nearly out of phase resulting in very low output charging rate (3). Output pulse delivery mode :IGBT bridges are driven off and capacitor discharges into load via SCR switch and the process repeats itself at 25 Hz.



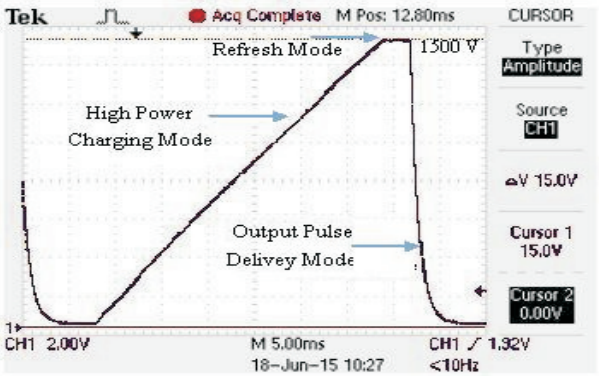


Fig. A.3.2: Measured voltage waveform at 1500 V

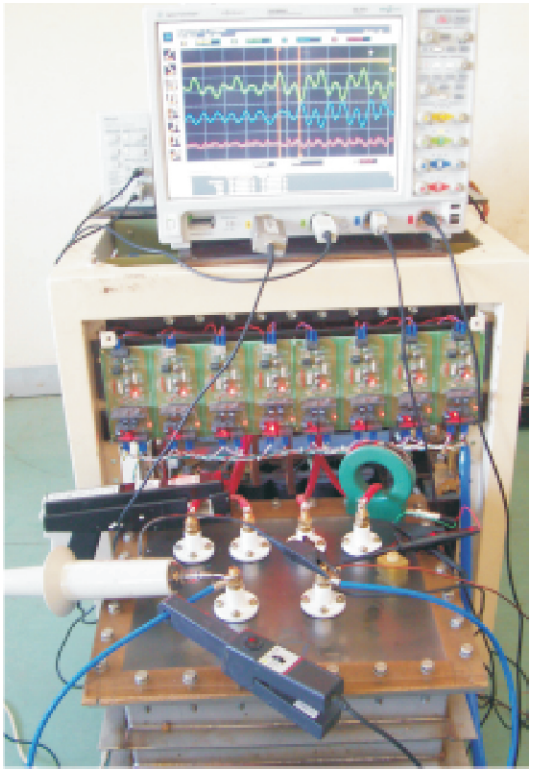


Fig. A.3.1: Photograph of developed power supply

The power supply is assembled in 1020 X 640 X 800 mm cabinet (Fig. A.3.1). The linear charging behavior of output voltage confirms constant current charging characteristic of CCPS. The power supply is tested for the quoted parameters. Performance of power supply is found in agreement with the design parameters. The developed technology will be useful in development of pulsed power supplies required for high brilliance source.

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