

## A.7: Ultra-capacitor Charger Power Supply

A compact, scalable, standard 4U card sized constant-current Ultra-Capacitor Charger (UCC) using high frequency, soft-switching resonant converter (Fig.A.7.1) has been developed by Power Supply Division, RRCAT. Ultra-capacitors, also known as super-capacitors, offer many advantages over batteries such as : large number of charge-discharge cycles, low ESR, high efficiency, high power density, and low heating. Therefore, ultra-capacitors are being increasingly used in portable electrical and electronic devices and also for transportation in conjunction with batteries. It is hoped that in near future, automotive industry will deploy ultra-capacitors as a replacement for batteries. Another advantage of ultra-capacitor is that it gets charged very quickly.

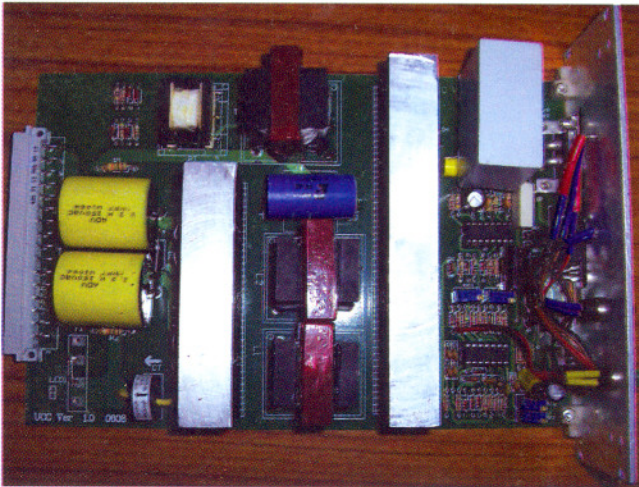


Fig. A.7.1: Photograph of ultracapacitor charger.



The power converter is an inherent current source with passive output voltage clamping capable of direct parallel operation (to increase output current) without any current sharing control. Required control and interface is simple and therefore rugged for industrial application. The

developed charger has been designed for  $\pm 48$  V DC input, 10 A output current, 15 V maximum charging voltage, and tested with 58 F ultra-capacitor. The same card can easily be re-configured for other specific application requirements.

Figure A.7.2 shows ultra-capacitor charging waveforms with single charger. When two chargers are operating in parallel, total charging current doubles and the charging time reduces as illustrated in the waveforms of Fig. A. 7.3.

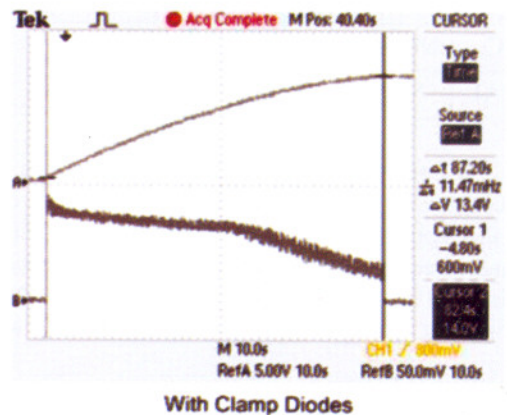


Fig. A.7.2: Charging waveforms. Ref A: capacitor voltage (5V/div) and Ref B: charging current (5A/div).

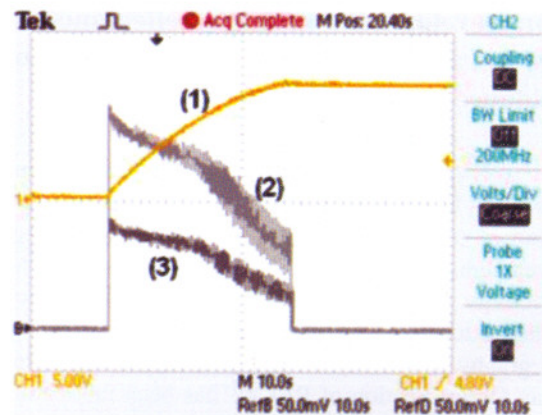


Fig. A.7.3: Charging waveforms with two chargers operating in parallel. (1) Capacitor voltage (5V/div), (2) total charging current (5A/div), and (3) individual charger current (5A/div)

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