POWER SUPPLY FOR ELECTROPLATING FOR CHEMICAL TREATMENT APPLICATIONS AT RRCAT

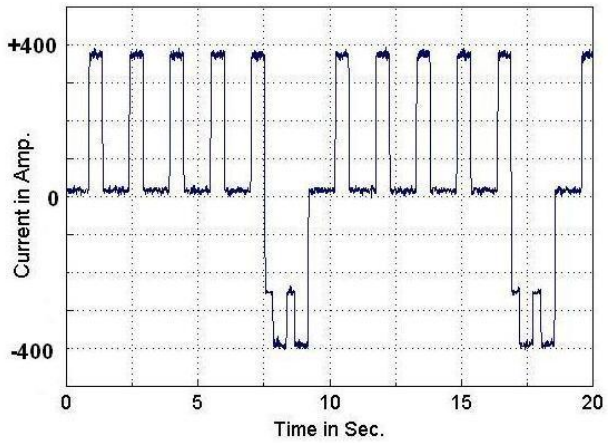
Anand Pagare[#], Ajith Kumar Amban
Raja Ramanna Centre for Advanced Technology, Indore

Abstract

A bipolar pulsed power supply for electroplating applications in Chemical Treatment Facility, RRCAT, Indore rated for ±1000A is made. This current controlled power supply is very flexible; can be used in DC mode in either polarities and also in pulsed mode. The special feature of this power supply is the Pulsed Bipolar mode, wherein the current amplitude in both polarities as well as the number of Forward and Reverse cycles and the respective pulse widths are programmable.

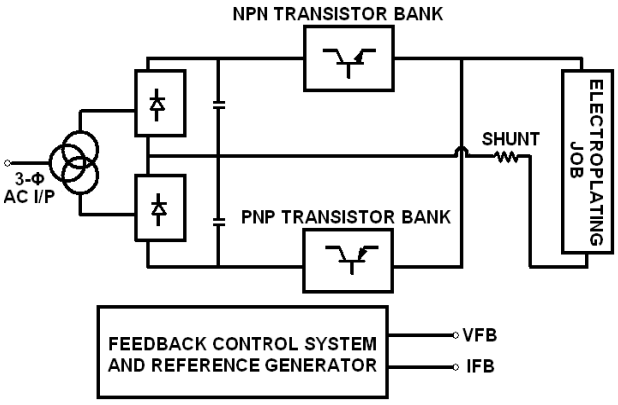
DESCRIPTION

Bipolar Pulsed power supplies are preferred over DC power supplies for electroplating as they offer superior plating properties- viz. smaller grain size, smoothness etc. Bipolar power supplies are particularly used in Accelerator applications where purity of deposited metals is important. They are helpful in electrodeposition without any additives.



A Typical Current Profile

A bipolar power supply is made using complementary power transistors MJ15003 and MJ15004. Water-cooled heatsinks are fabricated for these transistors. Each heatsink houses 20 power transistors, while 10 such heat sinks are fitted to get ± 1000A output. Low Conductivity De-mineralized Water flows through these heatsinks as coolant. A three-phase transformer with two rectifier bridges feeds DC power to these transistor banks. The transformer also uses OFHC copper tubes through which coolant water flows. Capacitive filters are connected at the outputs of rectifiers to generate two D.C. buses for positive and negative output current. A Feedback loop regulates the output current which is sensed by a shunt. Shunt is mounted in such a way so that electrical noise generated in power components does not disturb the control system. The current profile including the current amplitudes in both polarities as well as the number of Forward and Reverse cycles and the respective pulse widths, is programmed by the operator through a Front-Panel mounted keyboard. Pulse widths can be programmed from 1ms to 99s while the output current can be programmed in steps of 0.5A. The reference profile is generated in Microcontroller. Microcontroller ADuC842 is used to generate the current reference. There is also a provision that the reference signal may be generated in a P.C. and then fed to power supply for amplification. This reference current profile is sent to the control card in the power supply and compared with the actual current. The error signal is processed in Feedback loop system and after driver transistors, it is given to main transistors for power amplification in order to get the desired current.



Power Supply Scheme

A 4x 40 character LCD display on the front panel is used to show the set current and timing parameters, while a 3½ digit LED display shows the real current. Compliance voltage rating of the power supply is 15V. The job to be electroplated is seen by the power supply as a resistive load. The length of cables from the power supply to the electroplating plant has to be kept minimum possible to avail the benefits of faster rise and fall times as well as to improve efficiency. Diodes are connected across transistor banks to protect them against any reverse voltage developed in load cables due to fast rise and fall times. The power supply is equipped with protections

[#]apagare@rrcat.gov.in

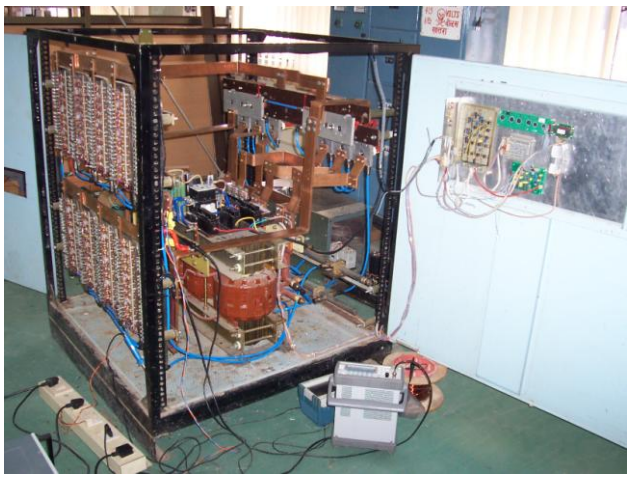
against Low water flow, Over Temperature, Low mains voltage, and Over current or short-circuit at the output.

LAYOUT

Use of series-pass transistor technology allows fast pulse rise and fall times and excellent current regulation which in turn help in getting better results while electroplating. The lay-out of power components was carefully done in view of stringent rise and fall time requirements for high current. The sensitive low power electronics is enclosed to protect against harsh chemical environment. The overall size of the power supply is approximately 1m x 1m x 1m (LxBxH).

TESTING

The power supply was tested in laboratory on dummy loads up to 300A successfully. A crucial requirement for the power supply is the operation for longer duration while electrodepositing. Therefore the power supply was tested in laboratory for more than 8 hours continuously. The output current stability was found to be better than the required specification of ±1%. The power supply was then installed in Chemical Treatment Facility in RRCAT for regular operation.



Testing in laboratory

Acknowledgements: The authors wish to acknowledge the support of Mr. P.Ramsankar from Chemical Treatment Facility, RRCAT. We are also thankful to Mr. A.C.Thakurta, Head, PSIAD, RRCAT for his guidance and co-operation.