A.3: Development of 50 V, 700 A hot swappable DC power supplies with active redundancy for solid state RF amplifiers

A 50 V, 700 A modular hot swappable DC power supply has been designed and indigenously developed in RF Power Supplies Lab., to bias 32 numbers of 500 W, 505.8 MHz solid state RF amplifiers along with their driver amplifier of a 12.5 kW RF rack, to improve the availability of Indus-2 RF system. This power supply has replaced 33 numbers of dedicated 50 V, 20 A DC power supplies, one for each RF amplifier of the RF rack. It employs 7 numbers of 50 V, 100 A DC power modules which are operated in parallel to form a 50 V, 700 A common DC bus and share load current equally. The detailed scheme of 50 V, 700 A DC power supply having 35 RF output ports (33 RF amplifiers + 2 spares) is shown in Figure A.3.1.

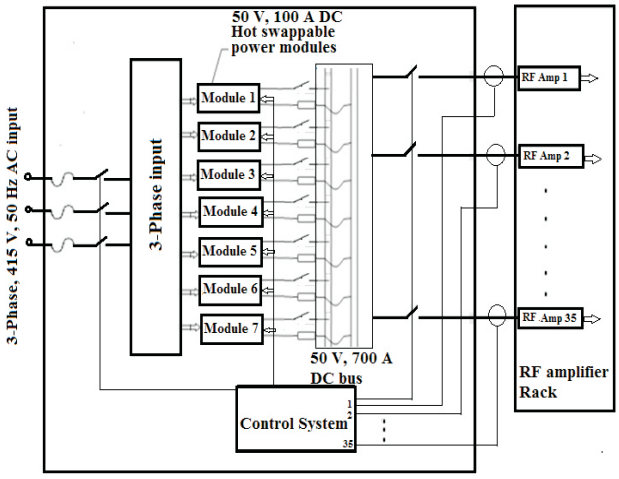

Fig. A.3.1: Scheme of 50 V, 700 A DC power supply.

The input section of this power supply employs adequate EMI/EMC filtering and active power factor correction stage to achieve low input harmonics and high input power factor. Thus the input current drawn by the power supply reduces for the same RF output power, resulting in lower cable losses and requiring lower rated switchgear. This power supply has two unique features namely hot swappability and active redundancy. The hot swappable feature incorporated in this power supply enables online isolation of the faulty module and also facilitates its online replacement without affecting the operation of RF amplifiers, thereby reducing the down time of the overall RF system. Faulty modules taken out from the system can be repaired independently. Again, each RF amplifier draws maximum current up to 18 A, so the total maximum current demand from this power supply is 33 x 18 = 594 A. which can be met by 6 numbers of 100 A power modules in parallel. However, one power module is intentionally kept as active redundant called N+1 active redundancy. In typical operating condition, 12.5 kW RF amplifier load takes only 488 A load current which keeps two power modules as active redundant called N+2 active redundancy. Thus the power supply continues to operate even if one or two of its power modules are faulty. Active redundancy along with hot swappable feature increases the mean time between failures (MTBF) and reduces the mean time to repair (MTTR), thereby significantly improving the overall availability of power supply system, as system availability = (MTBF) / (MTBF+MTTR).

This power supply has a dedicated controller, which monitors the healthiness of RF amplifiers and power modules, controls the equal sharing of load current among these modules as well as isolates the faulty RF amplifiers and power modules. Easier maintenance, modularity and interchangeability of modules are some of the salient features of this power supply. The performance parameters of 50 V, 700 A DC power supply with 12.5 kW, 505.8 MHz RF amplifier are shown in Table A.3.1. Figure A.3.2 shows the photograph of this power supply. Seven units of 50 V, 700 A DC power supplies are operating satisfactorily in round the clock mode with RF Station #1, #3, #5 and #6 of Indus-2.

Table A.3.1: Performance parameters.

Output voltage	=	50 V DC
Output current	=	488 A DC
Output voltage stability	≤	± 0.2 %
Output voltage ripple (pk-pk)	≤	± 0.2%
Input power factor	≥	0.98
Typical current THD	=	6.5%
Typical voltage THD	=	1.6 %
Efficiency	≥	90%

Fig. A.3.2: Photograph of 50 V, 700 A DC power supply.

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