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Design and Development of Control Grid Power Supply for RF Amplifier

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ITER require 20 MW of RF power to a large variety of plasmas in the Ion Cyclotron frequency range for heating and driving plasma current. Eight RF sources of 2.5MW RF power level each collectively will accomplish the above requirement. Each RF source consists of Solid State Power Amplifier (SSPA), driver, and end-stage, above which driver and end-stage amplifier are a tube (Tetrode/Diacrode) based which require DC power supplies viz. Anode, filament, screen grid, and control grid DC power supply. DC power supply has some stringent requirements like low stored energy, fast turn off, and low ripple value, etc.
This paper includes a detailed study of Zero Voltage Switching (ZVS) resonant converter based buck converter, understanding with the help of mathematical equations of its various modes, simulation of the design in PSIM software and power supply development. The Control grid of RF tube needs a negative biased DC power supply which would be operating in three modes of operation namely viz. i. Cut off mode (-500V, 10A), ii. Conduction mode with no RF power extraction (-350V, 7A) and iii. Conduction mode with RF power extraction (-350V, 2A to 7A). Depending upon the application, it needs to fulfil the requirement of constant voltage variable current when operating in conduction mode with RF application. A 500V, 10A modular DC power supply has been developed and tested on resistive load; it has four modules of 125V, 10A each in series for obtaining 500V at the output with 1% peak to peak ripple voltage in the output and stored energy well within the limit. The power circuit of each module consists of 6 pulse rectifier unit with DC link capacitor followed by resonant buck converter with switching frequency of the IGBT switch is of the order of 20 kHz.This paper addresses the analysis, design and hardware implementation of CGPS for Diacrode based system.

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