DESIGN AND DEVELOPMENT OF L-BAND SOLID STATE PULSED 200W AMPLIFIER

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Abstract

A L-Band 200 W Pulsed Solid State Power Amplifier operating with the following specifications Gain – 50dB, Frequency – 1.25 GHz to 1.35GHz, Pulse repetition rate - 10 Hz, Pulse width - 2msec is under development at RRCAT. This will be used for test and measurement of RF cavities and other accelerator components under pulsed conditions. The amplifier is being developed using a LDMOS pallet for high power stage, predriver and driver stage have been designed using MMIC amplifier and switches. RF PCBs for the predriver and driver stages have been designed and built in house using a PCB prototyping machine. At present the testing of predriver and driver stages have been completed, high power pallets have been ordered and are expected to arrive soon.

In this paper we describe the design details and the developmental work done for realization of amplifier.

INTRODUCTION

Solid State amplifiers are fast replacing the tube based devices in the RF system of particle accelerator due to various advantages like compact size, maintenance free, free of high voltages, elimination of focussing and filament supplies. In this paper we present the design and development aspects of a 200W, 1300MHz pulsed amplifier system, which is being developed as a driver stage for high power klystrons and for test and measurement of RF cavities and other accelerator components under pulsed conditions. The table 1 illustrates the design specifications of the amplifier system.

Table 1: Amplifier Design Specifications

Parameter	Value
Operating Frequency	1300MHz ± 50 MHz
Output Power(Pulsed)	200 W
Gain	≥ 50 dB
Pulse width	1.8 msec
Pulse Repetition Rate	10 Hz

RF DESIGN AND TESTING

A block diagram of 200W L-band SSPA is shown in Figure-1. The amplifier is designed as a three stage amplifier consisting of predriver, driver and high power stages. This modular design enables us to test each module separately and provides scope for further enhancement/ modifications in case the need arises. The details of each stage are mentioned in following text.

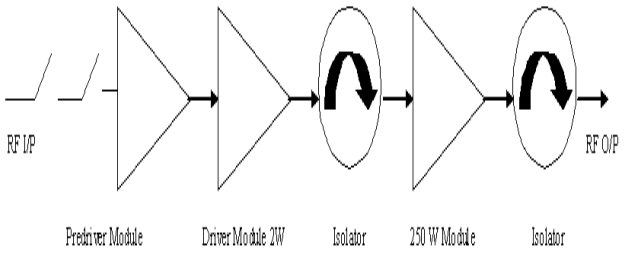

Figure 1 Block Diagram of 200W amplifier System.

Predriver Stage

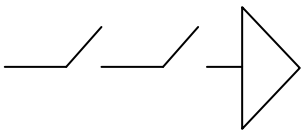

Figure 2 Predriver Stage

Predriver stage consists of a two stage RF switch followed by a low power amplifier. The RF PCB for the same has been designed and fabricated in house. Figure-2 shows the developed preamplifier module. Predriver stage provides 18dB gain with saturated O/P power of 20dBm at 1.3GHz. Isolation between ON and OFF stage is greater than 40dB.

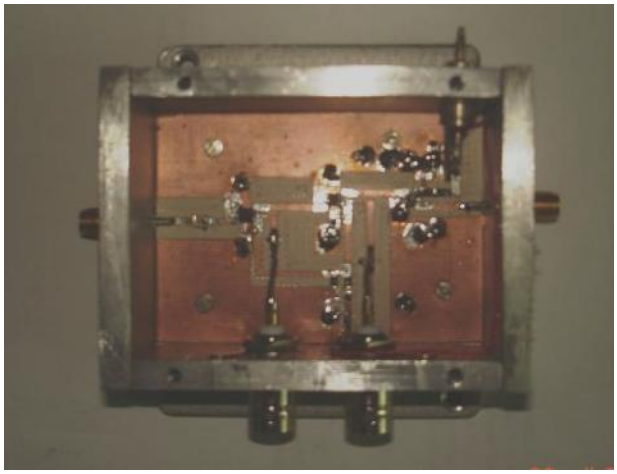

Figure-3 L- Band Predriver Module

Driver Stage

Driver stage is designed using LDMOS transistors. It provides 2W power with 13dB gain to the high power stage. Microstrip network based on ARLON made AR450 RF substrate was used for matching of I/P and O/P impedance. Smith Chart based software tools were used for impedance matching.

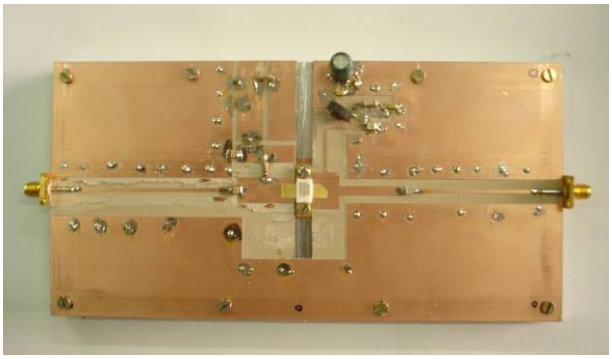

Figure-4 L Band Driver Module

High Power Module

1.3GHz, 250W LDMOS Pallet amplifier was selected as the high power stage. This LDMOS pallet amplifier provides 250W of o/p power with 23dB gain at 1300 MHz. The pallet amplifier is internally matched and thus minimizes the design efforts. The high power Pallet amplifier will be used in AB mode to so as to have reduced power requirement and less heat load.

Design for RF enclosure for the High power pallet has been done and the same is under fabrication. To protect the pallet from any impedance mismatch an isolator is used at the output of the module.

TRIGERRING AND PROTECTION

In order to minimize amplifier failure, driver and high power stages are being protected from reverse power by using isolator at both the stages. The module is designed to be air cooled and a thermal switch is used to prevent overheating of the high power stage.

Two RF switches are controlled separately via two monostable multivibrator ICs which are used for pulse width control of the amplifier (switches are incorporated in the predriver module), the use of two switches not only enhances the ON/OFF isolation but also prevents device damage in case of accidental failure of any switch.

CONCLUSION

The 200W pulsed amplifier design has been completed and the pre driver and driver stages have been developed and tested. The amplifier will be integrated and tested after receiving the final stage modules.

ACKNOWLEDGEMENT

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REFERENCES

[1] Mohania P.Shrivastava P., et.al. "S- Band 300 W Pulsed Solid State Microwave Amplifier Development for driving High Power Klystrons for Electron Accelerators" Proc. of InPAC-2005, VECC, Kolkata, Mar., 1-5,2005,p.418.