RF DRIVE SYSTEM WITH HIGH POWR SOLID-STATE AMPLIFIER FOR 200 MEV LINAC

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Abstract

This paper describes a RF drive system with high power solid-state amplifier for the 200 MeV electron linear accelerator injector of Hefei light source at NSRL. In this system we have selected the higher reliability multi-channel power amplifier with parallel connection power combining method, by using four levels magnifying and four tunnels magnifying power combine technology in the circuit. The RF drive system with 300W high power solid-state amplifier was installed and tested in February 2001. The results of measurement and operation have indicated that the RF drive system satisfied the requirement of the 200 MeV LINAC. The RF drive system has operated successfully for over one year.

1 INTRODUCTION

In the Phase-II Project of the National Synchrotron Radiation Laboratory at USTC requires the old RF drive system of 200MeV electron linear accelerator to be transformed. The linac is an injector of Hefei Light Source (HLS). The original amplifier consists of a medial power klystron EVl025-BJ and a medial power modulator that is not works well, lifetime short and always failure down; in addition, we have no commodity of the medial power klystron to purchase in domestic market. It has to be instead by a new one. A high power solid-state amplifier is a best option for the new drive system. The key device is the 300W high RF peak power solid-state amplifier in the RF drive system. It has been carried out and in operation now.

2 RF DRIVE SYSTEM OF 200MEV LINAC FOR HLS

In the RF drive system of injector for HLS [1] has used a high RF peak power solid-state amplifier to replace the original amplifier which mainly consist of a medial power klystron EVl025-BJ amplifier and a medial power modulator [2]. The RF solid-state amplifier output peak power is 300W with frequency of 2856 MHz. It drives the first high peak power klystron KMFl017A to amplify the 300Watt of the solid-state amplifier to a level of 8.5 MW. This power will be fed to prebuncher、buncher and first accelerating tube. Simultaneously, a level of 15 kW from the first klystron is divided into 5 branches to drive other 5 high power klystrons along the new main drive line. The RF drive system of 200 MeV Linac is shown in Figure 1.

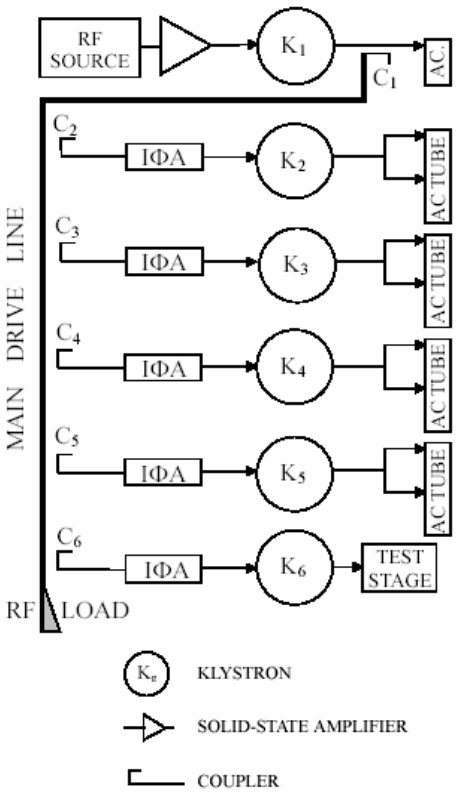

Figure 1: RF drive system of 200 MeV LINAC.

In order to ensure the microwave power going through the main driving line and each IΦ A Unit reaching the entrance of every high power klystron has enough power level, it has been calculated that the coupling of each directional coupler (C1-C6) are 27dB、10.5dB、8.5dB 7.0dB、5.3dB and 3.5 dB.

3 HIGH RF PRAK POWER SOLID-STATE AMPLIFIER

The function of the solid-state amplifier is to amplify 10mW output of the microwave signal generator to a level of 300W at 2856 MHz.

3.1 Consider Strong EM Noise

When we prepare to design 300 W high RF peak power solid-state amplifier, we must to consider the following practice: There are strong EM noise source from the 6 high voltage modulators of 200 MeV Linac in klystron gallery. The very bad noise problems were encountered during commissioning the linac [3]. The working of the RF solid-state amplifier will be interfered. Therefore the solid-state amplifier has been designed to two parts. The microwave signal source and pre-amplifier are installed in Linac control room, to isolate from the strong EM noise of high voltage modulators; the high RF power solid-state amplifier is installed near by the KMFl017A high power klystron which is to be drove. This way is in order to reduce the attenuation of microwave power level and raise efficiency

3.2 Use Power Combining Method

In the design of the amplifier, in spite of the power combining method with many single-tube parallel connections is fairly simply, but the requirement of each single-tube parameter consistency is higher and the reliability is lower. We have selected the higher reliability multi-channel power amplifier parallel connection power combining method [4]. The four levels magnifying and four tunnels magnifying power combine technology have been used in the real circuit. It is shown in Figure 2.

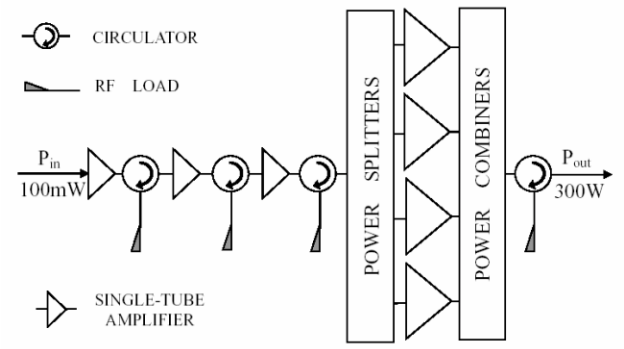

Figure 2. RF solid-state amplifier block

3.3 Parameters of the Amplifier

The main parameters of the RF power solid-state amplifier are as listed in Table 1.

Table 1: Main Parameters of the Solid-State Amplifier

Operating frequency	2856.04 MHz
Frequency range (-1dB)	＞3.0MHz
Peak power	＞300W
Pulse width (flat top)	＞2.0μs
Pulse rise time	＜100ns
Pulse fall time	＜50ns
RF repetition rate	50, 100, 300 pps

Figure 3 and Figure 4 show the Power waveform of pre-amplifier and the peak power waveform of the solid-state amplifier.

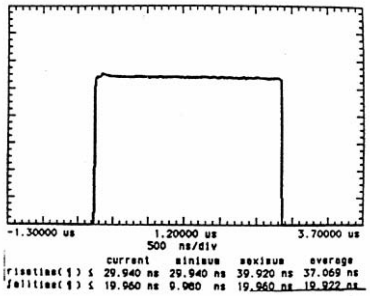

Figure 3. Power waveform of pre-amplifier

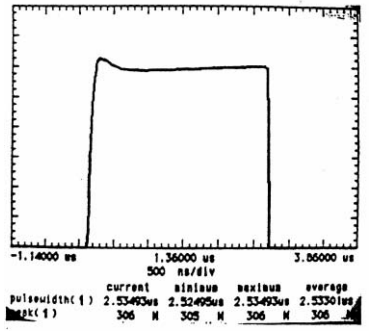

Figure 4. 300W peak power waveform of solid-state amplifier

4 PERFORMANCE OF THE SYSTEM

The RF driving system of injector for HLS has been transformed. According to the goals of the upgrading plan of the Phase-II Project of NSRL [5], the RF drive system with 300W high power solid-state amplifier was installed and tested in February, 2001. The results of measurement and operation have indicated that the performance of the RF drive system satisfied the requirement of the 200 MeV Linac. The RF drive system has operated satisfactorily for over one year, and has no failure occurred.

5 REFERENCES

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