LONG-PULSE RADIO FREQUENCY SEPARATOR TEST FACILITY*

J. W. Dawson, A. Moretti, and J. J. Peerson
Argonne National Laboratory
Argonne, Illinois

Summary

This paper discusses a long-pulse, line-type modulator facility which has been built to operate either one or two SLAC-type klystrons for long-pulse RF particle separator studies. The modulator is capable of driving two klystrons to a peak beam power of 80 MW, 250 kW average, for 50 μs pulses or one klystron to a peak beam power of 40 MW, 125 kW average. The modulator has two 25 μs pulse-forming networks which can be operated individually to drive a single klystron or in parallel to drive two klystrons from a common pulse transformer. In addition, test results for long-pulse operation of the SLAC-type klystron are presented.

Modulator Design

A long-pulse, line-type modulator has been built for testing RF particle separator structure performance for pulse lengths as long as 50 μs. The block diagram for the modulator is shown in Fig. 1. It has two 25 μs, 25-section pulse-forming networks (Fig. 2). The main section inductors are 11 μH ±10% individually tunable, and are made of 4/0 copper welding cable on a 5 in diameter plastic cylinder. The capacitors are 0.088 μF and are tested to 65 kV. The lines have a characteristic impedance of 11.18 ohms. Each network is charged to twice the charging supply voltage through a charging inductor and diode, and negative going transients are dissipated by the end-of-line clipper.

The networks can be discharged separately or in parallel by two CH1191 hydrogen thyratrons into a multiple tap 250 kVA quadrifilar pulse transformer. The tap is selected to present a slight mismatch to the networks and, therefore, to turn off the CH1191.

The four racks shown on the left of Fig. 3 are the modulator master control. The racks on the right contain the low and medium microwave power sections. The master control racks contain both the modulator and klystron heater and focus controls. Monitor cables are also brought out on BNC connectors for monitoring all vital parameters of the modulator and klystron operations.

Microwave System and Klystron Test Results

The first rack on the right of Fig. 2 contains the low power microwave system. It consists basically of a 15 mW signal generator and 1 W TWT amplifier. The intermediate power is provided by an Eimac 4K3SN klystron amplifier and housed in the second rack. The 4K3SN together with its pulse modulator, the third rack, is capable of providing a peak power of 7.5 kW at 1% duty from 2800 to 3050 MHz. The microwave system is more than adequate for testing two SLAC-type klystrons for peak power, long-pulse performance.

Figure 4 shows the high power microwave test setup for the SLAC LOLA III test separator section. The lower right corner shows the RCA 8568 klystron and top portion of tube and pulse transformer oil tank. The dark vertical cylinder is a section of the SLAC LOLA III separator. The horizontal cylindrical objects are the 150 liters/s ion pumps. At the far left end is the high power calorimeter load.

The RCA 8568 klystron, a tube rated at 21 MW at 3.2 μs, has delivered 10.5 MW peak for 50 μs. The tube has performed at this level for over 300 hours without developing any faults or showing any deterioration.

Acknowledgments

The authors acknowledge the many helpful comments and the original impetus provided by John H. Martin of Argonne National Laboratory. The construction, testing, and a considerable part of the hardware design were done by Melvin Rebuehr, Raymond Fuja, and Alfonso Tovar of Argonne National Laboratory. The authors also acknowledge the comments, suggestions, and generosity of G. A. Loew, Charles Kruse, Carl Olson, Herman Zaiss, and the late Otto Altenmueller of Stanford Linear Accelerator Center.

*Work performed under the auspices of the U. S. Atomic Energy Commission.

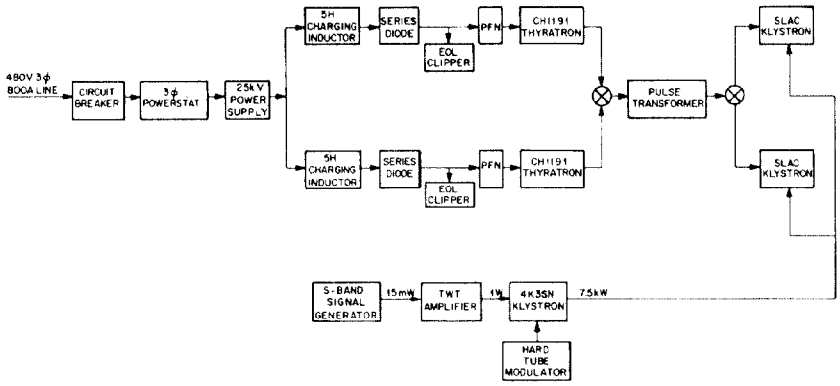

Fig. 1 - Block diagram of long pulse modulator

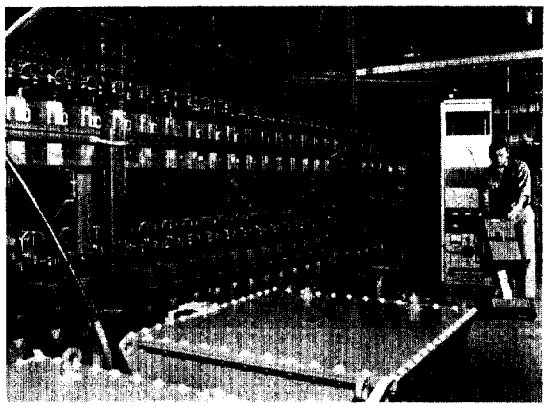

Fig. 2 - Two 25 μs, 25-section pulse forming networks

Fig. 3 - Modulator master control and low and medium power microwave racks

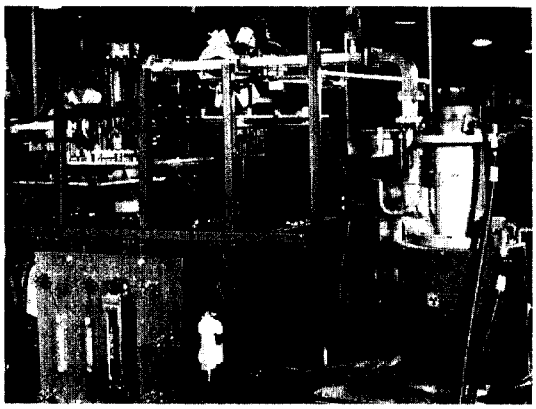

Fig. 4 - High power microwave test setup for SLAC LOLA III RF separator