A DEVICE OF AMPLITUDE AND PHASE STABILIZATION FOR THE FEL INJECTOR IN THE L-BAND

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Abstract

A device of amplitude and phase stabilization for the FEL injector in the L-Band is developed in CIAE. without the distortion of the pulsed envelops, the stabilities of amplitude and phase of the closed circuits in the device can be better than ± 1% and ±1° respectively. The device is used in the FEL injector in the CIAE Linac Laboratory.

1. CONSTRUCTION OF THE DEVICE

There are two component parts in the device, i,e. Amplitude and phase stabilization part. The amplitude stabilization part mainly consists of a source (S), electronic attenuator (EA), power amplifier (PA), level amplifier (LEVEL), detector (DT) and load(L) or buncher cavity(B), as shown in Figure 1.

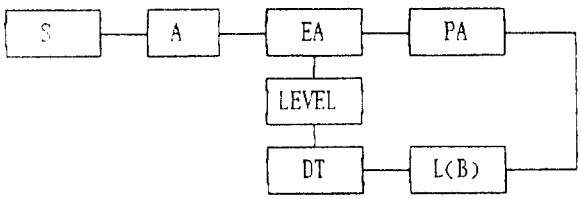


Fig 1. Schematic of amplitude stabilization part

In the amplitude stabilization part of the device, a sampling signal from the load or the buncher cavity, through the DT and the LEVEL, is back fed into the EA. The rf amplitude in the EA will be adjusted negatively. And also the amplitude of the rf field in the load or the buncher cavity will be balanced and stabilized at once.

The Phase stabilization part mainly consists of a source (S), electronic phase shifter (EPS), power amplifier (PA), double balanced mixer (DBM), level amplifier (LEVEL)and load (L) or buncher cavity (B), as shown Figure 2.

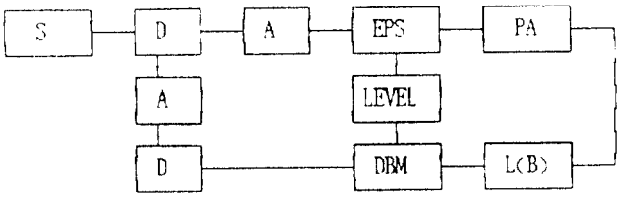


Fig 2. Schematic of phase stabilization part

In the phase stabilization part, the phase of the rf field in the load or the buncher cavity may be changed by some disturbances, and a sampling signal of the rf field phase from the load will be compared with the conference signal from the S in the DBM. The amplitude of the output signal voltage from the DBM will be made to be proportion to the phase difference between them. Then the voltage signal is back bed into the EPS through the LEVEL, the phase of the rf field in the load or the buncher cavity will be adjusted negatively and stabilized at once [1].

2. PERFORMANCES OF THE DEVICE

In order to secure the device and get the best performances of the device, the rf power level through it must be limited below 50mW. But the device in the rf system (as shown Fig 1 and 2) can control and stabilize with the rf power of Mws in the system.

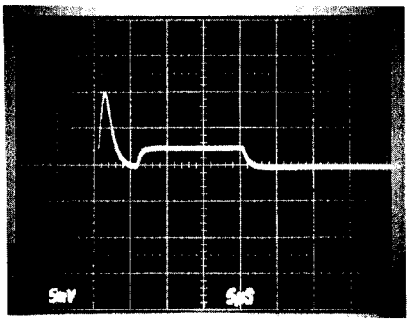
The operating frequency of the rf power signal in the device is 1300MHz ±10MHz in the L-band. The device can be used in the continuous wave model or the pulsed wave model. The pulse duration

for the FEL injector can be from one μs to tens μs. The response time of the closed circuits in the device is about 2 μs.

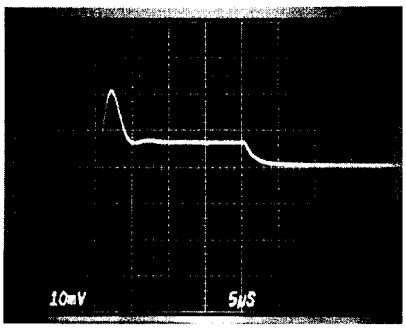
The capture range of the amplitude stabilization can be about ± 50% of the relative amplitude. The stability of the closed circuit in the device can get better than ±1% of the relative amplitude, if the amplitude of the open circuit is changed within ±10% of it.

The capture range of the phase stabilization can be about ±30° of the phase in the device. The stability of the closed circuit can get better than ±1° of the phase, if the phase of ±10° of the open circuit is changed.

The pulsed envelops of the rf signal must be kept to be approaching rectangles and can not be distorted in the adjustment and the test. The oscilloscopic envelops of the closed circuits in the device, as shown Figure 3.



(a) The Amplitude envelop



(b) The phase envelop

Figure 3. The oscilloscopic envelops of the control signal in the closed circuits.

The device has been used and operated normally in the injector; but the regulation of the injector has not been completed get and the are still a lot of the works have to do.

3. REFERENCE

[1] M.T.Lynch, P.J.Tallerico and E.F.Higgins. "Phase and Amplitude Feedback control system for the Los Alamos FEL", IEEE Trans, on Nuclear Science, Vol. NS-32, No.5. October 1985.