

A.10: Status of 24 MW microwave system and LLRF control for IR-FEL linac

An Infrared Free Electron Laser (IRFEL) is being built at RRCAT. Two linacs in tandem (15-25 MeV) are a part of the electron injector system. To power the linacs, an S-Band pulsed microwave system with Low Level RF (LLRF) control has been developed by Pulsed High Power Microwave Division that can deliver upto 24 MW peak power in pulse of 12 μ s with PRR upto 10 Hz.

The microwave system is built using 25 MW pulsed klystron as the main amplifier. 200 W pulsed solid state amplifier drive is developed in-house. An LLRF system is designed and developed for phase and amplitude stabilization of microwave power. Also, there is a fast feed forward mechanism to compensate beam loading and to shape the klystron output. The LLRF system has been installed at site and its performance is verified. The schematic of the system with LLRF is shown in Fig. A.10.1.

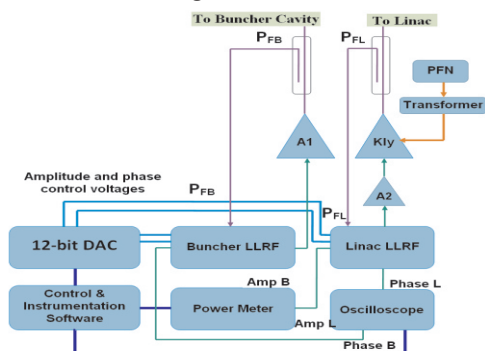


Fig. A.10.1: The schematic of the microwave system with LLRF controls

The pulse modulator for the klystron is a 'Line Type' modulator with two tunable 'Pulse Forming Networks' (PFNs) in parallel, a 50 kV capacitor charging power supply and thyatron. The high voltage deck is an oil-filled tank with a high voltage pulse transformer (1:14), the klystron and focusing electromagnets (three coils each of ~200 A current). Suitable remote/safety interlock system is developed. Lead shield is used for protection against X-rays.

WR-284 waveguide line pressurized at 2 kgf/cm² by SF₆ gas is developed (Fig. A.10.2). RF power is measured with coupler and RF power analyzer. LCW cooling is used. Various subsystems have been integrated. At present commissioning/performance trials are being run. Photograph of microwave system is shown in Fig. A.10.3. To condition the accelerator and for system performance, stage wise commissioning is planned. First trials would be done with reduced pulse width. The HV pulse transformer waveforms are shown in Fig. A.10.4. Initial results of ~ 15 MW peak RF power achieved are presented in Table A.10.1 and shown in Fig. A.10.5. Further system testing/optimization are in

progress to achieve performance for higher power, pulse width and PRR as desired for stage wise tests of the IRFEL.

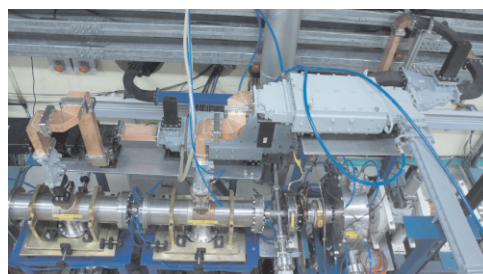


Fig. A.10.2: Photograph of waveguide system connected to the linac1 and linac2 structures



Fig. A.10.3: Microwave system. Klystron, waveguide, tank, PFN cabinet, power supplies

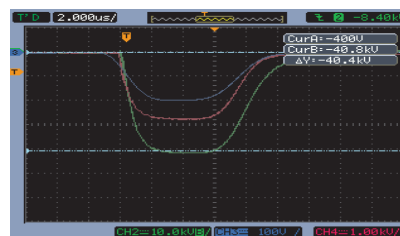


Fig. A.10.4: Modulator testing. From top, Isec @100 A/div, Ipri@1 kA/div, Vsec@50 kV/div.

Table A.10.1: First trial run results of the system.

Peak power: ~ 15 MW	Frequency: 2856 MHz
Pulse width: 5 μ s	PRR: 1 Hz
Klystron voltage: ~ 200 kV at current 200 A	



Fig. A.10.5: Microwave output power, 15 MW

Reported by:
P. Shrivastava (purushri@rrcat.gov.in)