A.5: Development and installation of 1 kW, S-Band, upgraded pulsed RF system for 20 MeV injector microtron

A recently developed 1 kW, solid state S-Band pulsed amplifier, along with integrated pulse width and delay control system, has been added to the existing microwave system of the microtron. The new amplifier has been placed in the microtron control room and it replaces the old 300 W/75 W driver amplifiers which were placed near the klystron in the radiation area. A new, low-loss co-axial line has also been laid between the microtron control room and the klystron, reducing the transmission loss by more than 7 dB. The higher power of the amplifier along with the reduced loss in the transmission line enabled placement of klystron driver amplifier in the microtron control room which is away from the klystron. From the control room, performance of the amplifier can be monitored without entering the radiation area or stopping the accelerator, leading to easier and faster diagnosis. Further, the pulse width and delay control system, which formerly was a separate module, has been integrated in the amplifier chassis, thereby reducing the size and complexity of S-Band microwave system.

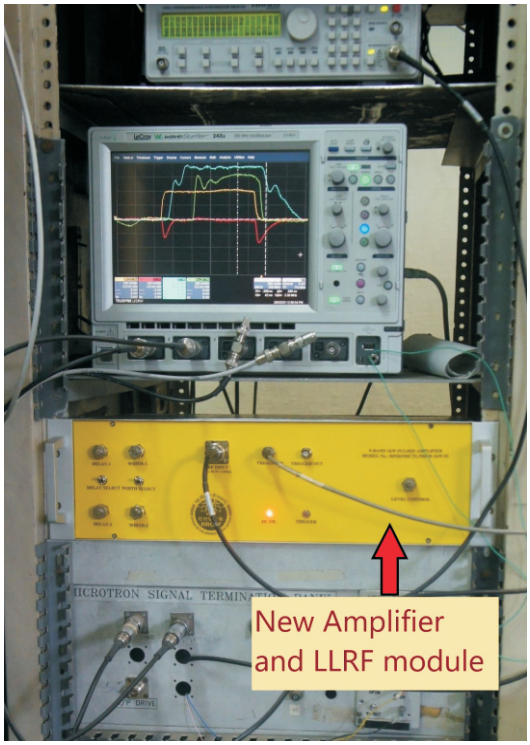

Fig. A.5.1: The 1 kW amplifier with integrated pulse width and delay control installed in the microtron control room. The forward power, reflected power, FCT and emission signals are displayed on DSO.

The amplifier can provide a maximum drive power of 55 dBm (325 W) to any of the two klystrons (old and new), installed inside the shielded area, which is well above the requirement of ~200 W with some margin. Figure A.5.1 shows the amplifier installed in the microtron control room. Figure A.5.2 shows the output power of the amplifier as observed on a peak power analyzer.

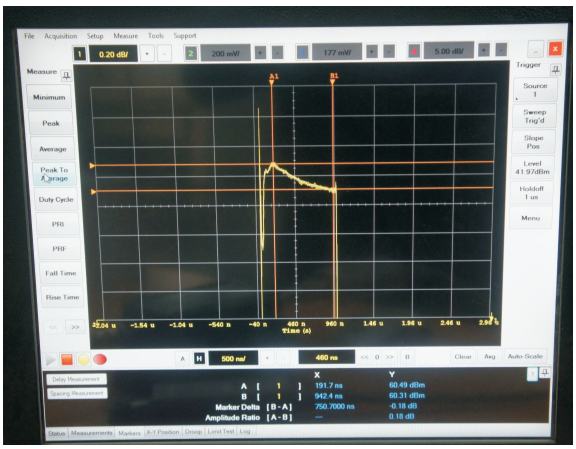

Fig. A.5.2: The output of 1 kW amplifier as seen on a peak power analyzer with vertical scale of 0.2 dB/division. The peak to peak variation in output power is less than 0.2 dB. The saturated output measured was 60.49 dBm (~1120 W) at maximum point and 60.31 dBm (~1074 W) at its minimum point.

The high-power amplifier has been developed using S-Band LDMOS transistors combined using in-phase planar combiners. Four transistors of 300 W have been combined to generate the output in excess of 1 kW. The amplifier system provides a saturated gain of around 50 dB. The output power can be varied by 0.5 dB (12.5%) by varying the drain voltage of the output stage. Fixed attenuators are used to reduce power in excess of 1 dB. The amplifier is operated in saturated mode to have better stability of output power.

The system features two independently adjustable pulse width and delay settings for two different modes of operation which enables the user to easily change the microtron beam parameters for experimental purposes, without disturbing the existing settings. The pulse width of the output microwave power can be adjusted from as low as 100 ns to more than 5 µs. The jitter between trigger and the output microwave power is of the order of 10 ns.

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