

A.10: Programmable trigger generator for Linac of electron beam radiation processing facility

The Linac for electron beam radiation processing facility (EBRPF) has been developed, and deployed for irradiation of agricultural and medical products. A timing system for precise time-synchronized operation of Linac subsystems, measurements, irradiation process verification, process interrupt handling of various parameters and faults is required. Various delays are to be precisely adjusted to match with sub-system characteristics with respect to the master reference trigger. To facilitate the above requirements, a 16 channel programmable trigger generator (PTG) module is developed at RRCAT.



Fig. A.10.1: Snapshot of programmable trigger generator for Linac of EBRPF.

A PTG module for Linac as shown in Figure A.10.1 has an FPGA based controller board with optical fiber transmitters for interfacing field devices like RF modulator, beam energy measurement system, beam pulse current measurement system and BPM, etc. The PTG module is facilitated with front panel LCD display to indicate current status like pulse repetition rate (PRR), operating mode, local/remote status, serial communication and system interlock status. A 4 x 4 key pad is interfaced for setting of PRR, delay time and some other commands. RS232/RS485 communication ports are used for remote operation of the facility from control room. The output trigger pulse generation is interlocked with Linac integrated system healthy interlock, so that trigger pulse output stops in case of fault. 16 trigger output channels have been provided for different subsystems requirement and an input channel to synchronize with external sync pulse.

Main features:

- PRR setting range: 1 Hz – 500 Hz
- Adjustable delay range with respect to master trigger pulse: 2 μ S – 2000 μ S
- Provision to synchronize trigger output with external pulse e.g., scanning magnet current fly-back time pulse
- PRR limit set facility with authentication
- Selectable free running/count mode, Count mode range: 00001 – 30000 count pulses

- Selectable operation/diagnostic mode, Diagnostic mode facilitates beam parameters measurement to verify the Linac system.

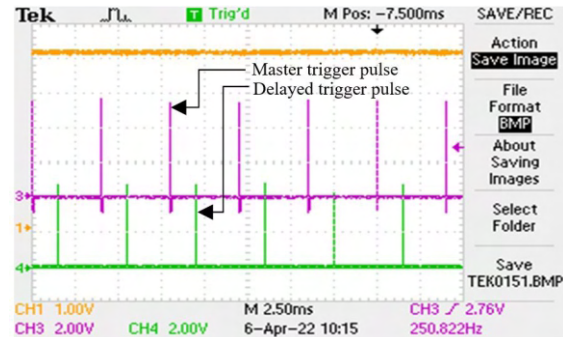


Fig. A.10.2: Snapshot showing trigger pulses without synchronization.

Figure A.10.2 shows snapshot of trigger pulses without synchronization. Here, purple trace shows the master trigger pulse and green trace shows the delayed trigger pulse without synchronization.

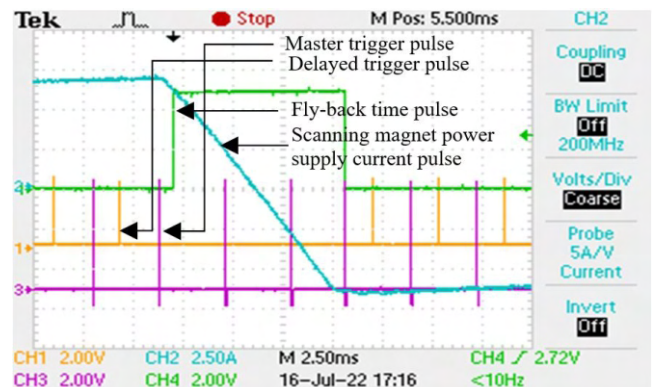


Fig. A.10.3: Snapshot showing trigger pulses with synchronization.

Figure A.10.3 shows snapshot of trigger pulses with synchronization. Here, purple trace shows the master trigger pulse and yellow trace shows the delayed trigger pulse. Blue trace shows the scanning magnet power supply current pulse and the green trace shows the scanning magnet current fly-back time pulse. The trigger pulses are synchronised with trailing edge of fly-back time pulse. During fly-back time, only master trigger and modulator related trigger pulses are present and all other subsystems trigger pulses are inhibited.

The PTG module is developed and tested successfully with scanning magnet power supply current and scan time pulse.

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