

L.12: Development and Integration of High Voltage Pulse Slicer Unit in 7 MeV LINAC for Pulsed Radiolysis Investigations

Radiation and Photo Chemistry Division, BARC has a 7 MeV LINAC procured from Radiation Dynamics Ltd. UK in 1986. Since then, this LINAC is being widely used for pulsed radiolysis investigations. The LINAC normally delivers a 2µs duration electron-pulse and shorter pulses of durations 500ns, 50ns and 25ns are generated by a high voltage switching unit based on planar triodes. However, during last several years the LINAC has been operating either at 2 µs or 500ns pulse duration only due to ageing of the planar triodes. In order to revive this facility a variable duration (30ns to 2µs) high-voltage pulse slicer unit has been developed and integrated with the 7 MeV LINAC as shown in Fig.L.12.1.

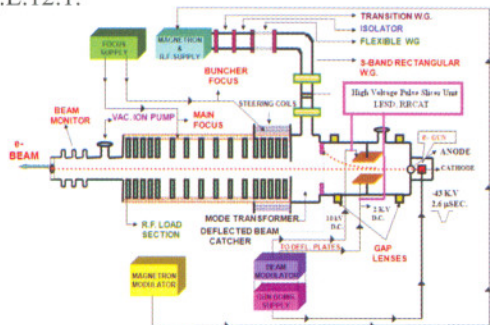


Fig.L.12.1: Schematic diagram of the 7 MeV LINAC operational at RPCD, BARC for pulsed Radiolysis Application

Since the load (deflecting plates of the beam modulator unit) is of differential nature, one can design two floating switches and activate them after introducing some delay to generate gate pulse for the deflecting plates. The pulse slicer unit is based on MOSFET based two high voltage fast switches with response time better than 5 ns. The high voltage switch consists of 20 MOSFETs (IRF 840) in series to get switching voltage up to 10 kV and 3 such stacks are connected in parallel to achieve pulsed current up to 120Amp. The adjustable switch amplitude from 1-10kV can be achieved by varying the HVDC bias of the two switches without affecting response time.

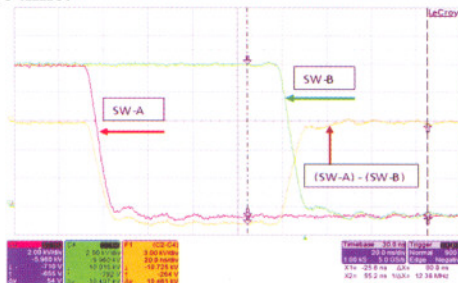


Fig.L.12.2: Switching waveforms of the two high voltage switches delayed by 120 ns and the corresponding differential pulse applied to the deflecting plates

The switching waveforms along with the differential pulse output are shown in Fig.L.12.3. To drive the MOSFET based high voltage switch, an isolated gate transformer coupled driving has been implemented to get floating mode operation. Two such switches are connected in differential mode across the deflecting plates of the 7 MeV LINAC as shown in the block diagram Fig.L.12.3.

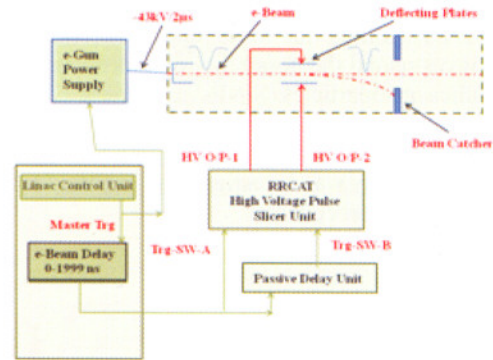


Fig.L.12.3: Block diagram shows integration of the pulse slicer unit with 7 MeV LINAC

The first switch is operated by the master trigger generated from the LINAC control unit followed by the activation of the second switch after some delay. Thus by varying the triggering delays between the two switches using a passive delay unit, high-voltage pulses of durations 25 ns to 300 ns has been generated. For the longer pulse duration >300 ns the single switch configuration has been implemented where the single switch has been activated across the deflecting plates and by varying the delay of the master trigger with respect to the electron beam the initial part of the electron beam is sliced as per the requirements. In this way the pulse duration from 300 ns to 2 µs has been generated. As a result of this the high voltage pulse slicer unit is capable of generating continuously tunable pulses from 30 ns to 2 µs. Evaluation and calibration of variable pulse duration electron beam generation from the LINAC was carried out. The radiation dose provided by the LINAC can now be varied from 6 Gy to 167 Gy. The table shows the variation in the pulse width and the corresponding radiation doses. For RFI/EMI shielding the high voltage pulse slicer unit has been enclosed in a shielded Aluminum box.

Pulse width (ns)	Dose (Gy)
2000	167
1530	143
1030	85
500	41 - 43
300	25 - 26
200	20 - 23
100	10 - 11
30	6 - 7

Table shows changes in radiation doses corresponding to the pulse width variation

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