

from the shutdown of most of the nuclear power plants in Japan after the disastrous earthquake on March 11, 2011 and the successive occurrence of accidents in the Fukushima Dai-ichi nuclear power plant. We expect that the situation of electricity supply will get better and we will have the full benefit of the improvement of the RF cavity cooling system in the near future.

Developments and Upgrades of Linac

Research and Development of Beam Position Monitors for Second-Order Moment Measurement

We are installing new BPMs at the SPring-8 linac, which measure the transverse second-order moments of electron beams, as an enhancement of non-destructive beam diagnosis during top-up injection.

To design the system, we first constructed the comprehensive theory for BPMs [16]. This theory presents an analysis and design method for a stripline-type BPM that detects the multipole moments of a charged particle beam. A numerical analysis based on the finite difference method was also carried out to calculate the electric fields in a BPM.

According to this design method, we have developed six-electrode BPMs with circular (Fig. 9) and quasi-elliptical cross sections for non-dispersive and dispersive sections, respectively. The results of the numerical calculations show that the second-order moment can be detected for beam sizes >0.42 mm (circular) and >0.55 mm (quasi-elliptical). The actual beam sizes are >0.5 mm in the non-dispersive sections and >0.75 mm in the dispersive sections, that is, they are sufficiently large to enable accurate measurements of the second-



Fig. 9. Six-electrode BPM with circular cross section.

order moments using these BPMs.

The measurement of a second-order moment requires a good measurement accuracy of about 10^{-4} . Therefore, we developed a low-noise signal processor (Fig. 10) with six channels. The previous signal processor with four channels contained sample-and-hold circuits that generate large sample-and-hold noises. The new signal processor, however, does not employ any sample-and-hold circuit; thus, fast and low-noise analog-to-digital converters (LTC2393, LINEAR TECHNOLOGY) directly acquire signals from the peak-hold circuits. The dynamic range of the signal processor is finally increased to 80 dB, and the maximum signal-to-noise (S/N) ratio is 80 dB.

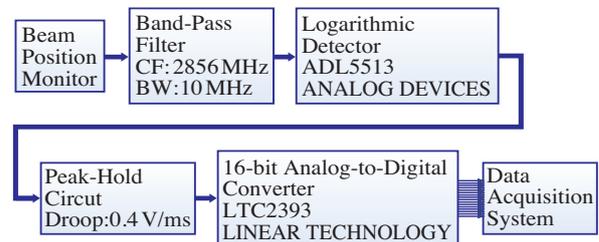


Fig. 10. Block diagram of signal processor (one of six channels).

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