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LogAmp electronics and optical transmission for the new SPS beam position measurement system.

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A new front-end electronics is under development for the SPS Multi Orbit POsition System (MOPOS). Based on logarithmic amplifiers, it allows to measure the beam position and to resolve the multi-batch structure of the SPS beams. Analogue data are digitized at 10 MS/s and packed in frames by an FPGA. On every turn, a frame is sent to the readout board, via a 2.4 Gb/s optical transmission link. The first prototype has been successfully tested with several SPS beams. The system description and the first measurement results are reported.

Summary

The SPS Beam Position Monitors (BPM) are installed in the vacuum pipe and distributed all around the ring. They consist of opposite electrodes (A and B), either on the horizontal plane or on the vertical plane, which provide signals directly proportional to both beam position and beam intensity. In order to resolve the multi batch structure of the beam a new electronics is under development for the Multi Orbit POsition System (MOPOS).

The analogue part of the Front-End (FE) board is based on Logarithmic Amplifiers (LA) and a differential stage which gives a direct measurement of the beam position (Log(A)-Log(B)).

For each BPM, the input stage is made of a low-pass structure that minimizes the bunch shape variation during acceleration, followed by band-pass filters, which create suitable signals for LAs. Three LA stages are necessary to cover the large SPS dynamic range related to different kind of particles, energies, and filling schemes. Each plane generates three analogue position signals, called Delta 200 MHz, Delta 40 MHz Low Sensitivity and Delta 40 MHz High Sensitivity. Finally the summation of the logarithmic outputs of each LA gives a kind of beam intensity measurement, which will be used to detect the beam presence and validate the acquisitions.

The digital part of the FE board consists of an octal 14-bit ADC (Analog Devices), an FPGA (Xilinx Spartan6) and a Small Form-factor Pluggable (SFP) optical transceiver. Analogue data are digitized at 10 MS/s and serialized. In the FPGA, each ADC measurement is tagged with a time-stamp with respect to the rising-edge of the SPS turn-clock. Data are then packed in frame every turn and transmitted to the readout board using a 2.4 Gb/s optical transmission link.

The FE board is designed to be placed in the SPS tunnel, where a dose rate of 100 Gy/y is foreseen in the worst working condition. Several components, such as the LAs, the ADC drivers and the voltage regulators have already been validated under radiation. The FPGA, the ADC and the SFP for the final version have still to be selected.

A preproduction of the new MOPOS system will be installed in 2013 in an SPS sextant. At least for one year, both systems, the current and the new-one, will run in parallel to validate the new MOPOS electronics.

The first FE prototype, installed out of the ring and connected to a "shoe-box"(vertical BPM) and to a Stripline (horizontal BPM), has been successfully tested using several SPS beams. The beam injection oscillations have been measured in both planes. Beam bumps of +/- 5 mm and +/- 2.5 mm have been reconstructed with the foreseen precision, while the +/- 1 mm bump measurements are affected by the ADC-Drivers noise. An optimized circuit is under production. The system description and a sample of the first measurements are reported.

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