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FBCT Fast Intensity Measurement Using TRIC Cards

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At the CERN PS complex, precise fast intensity measurements are very important in order to optimize the transfer efficiencies between the different accelerators. Over the last two years a complete renovation has been ongoing, where the old electronics, based on analogue integrators, have been replaced by a fully digital system enclosed in a single VME based card.This new system called TRIC (Transformer Integration Card) is based on a 12bit, 212MS/s ADC and an FPGA for the signal processing. Also located on the same board one finds a 250V/1.5W DCDC converter used to generate precise calibration pulses.

Summary

Beam intensity measurements are typically based on the inductive coupling of the magnetic field produced by the beam to a high permeability magnetic material. In the case of the Fast Beam Current Transformers (FBCT), where the observation short beam pulses is required, a bandwidth in the order of 100MHz is needed. In order to transmit the FBCT signals out of the accelerator tunnel on long cables a preamplifier (Head Amplifier) is added in the tunnel, mainly for the low intensity signal.

Due the large variety of beam signals to be measured, selectable gain and high speed sampling is required to translate the analog beam signal into the digital domain. A calibrator which simulates the beam by injecting a well-defined current into a calibration winding is also necessary in order to maintain accuracies in the order of 1%.

Summarizing all these requirements a VME 64X based card has been developed to fulfil all the specifications of the system. This new card, known as the TRIC (Transformer Integration Card), is based on an Altera Cyclone EP2C20 FPGA which contains the entire control of the system and signal processing. A VME bridge between the FPGA and VME controller has been implemented using an EPM2210F256C3 CPLD, allowing remote upgrades to the firmware.

Two 30MHz analog bandwidth, 12bits 212 Ms/s ADC channels are used for FBCT signal acquisition, connected to a low gain (no head amplifier) and high gain (head amplifier included) signal path. These are both equipped with three remotely programmable attenuators (0, 14dB, 28dB) to adjust the gains for different beams.

The calibrator uses a miniature 250 V/1.5 W a DCDC converter to have two different calibration methods either by voltage (charge) or by current. The "Voltage Calibration"uses a 10nF, 250V/1% capacitor discharge, while the "Current Calibration"uses a switched current source to inject a selectable (up to 100mA), highly reproducible (< %0.1 standard deviation) current into the system.

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