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A Zynq –based flexible ADC architecture combining real-time data streaming and transient recording

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The RFX-mod2 Nuclear Fusion experiment is an upgrade of RFX-mod. Among the other improvements in machine structure and diagnostics, a larger number of electromagnetic probes (EMs) is foreseen to provide more information about plasma instabilities and to allow an improved real-time plasma control. An Analog to Digital Converter (ADC) architecture able to provide both transient recording and real-time streaming is foreseen in RFX_mod2. Transient recording provides full speed data acquisition (up to 1 MSample/s) by recording data in local memory and reading memory content after the plasma discharge. Real-time streaming of subsampled data is required for active control. The chosen technology is based on the XILINX Zynq architecture that provides in the same chip a multicore ARM processor tightly couple to a FPGA. Time critical functions carried out by the FPGA in this context are:
1) The management of a circular data buffer and the DMA transfer in RAM of pre and post trigger samples after the trigger has been received;
2) Antialiasing filtering and subsampling of the samples to be streamed. The resulting samples are enqueued in a FIFO accessed by the processor.
The functions carried out by the processor are:
1) The management of the configuration setting, received via TCP/IP or HTTP. The processor validates the configuration and write the appreciate registers in the FPGA;
2) Offline data readout of acquired samples in transient recording;
3) Network data streaming of subsampled data read from the FIFO and sent in UDP packets to the active plasma control system.

Description

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