



Contribution ID: 117

Type: **Poster presentation**

Data transfer methods in Real Time controller of Ion Cyclotron High Voltage Power Supply

Friday, 10 June 2016 10:30 (1h 35m)

High Voltage Power Supply (IC-HVPS) with dual output (27kV & 15kV, 3MW) is operational at ITER-India lab with a Diacrode based RF source to be used for ICRF (Ion Cyclotron RF) system. Controller for ICHVPS is based on LabVIEW Real-time (RT) PXI controller to support all control and monitoring operations of the PSM based power supply. Besides regulation of output voltage, the controller supports all essential features like, fast dynamics, low ripple and protection for source and loads. This is managed by close integration between RT system and FGPA inside controller.

Two types of data transfers inside RT controller are implemented, 1) Between FPGAs (Field Programmable Gate Array) and RT controller, 2) Between internal algorithms. RT controller and FPGAs are inter-connected together with PXI bus. Critical functions, signal generations, monitoring & data acquisition and interfaces are assigned to FPGAs. All these processes are managed by Real Time Operating System (RTOS) installed in controller. Most of the processes initiated by RT controller ends up performing certain task by invoking the algorithm inside FPGA leading to some action to outer interfaces. Some of the processes are implemented for managing the internal algorithms.

This paper discusses different techniques used for transfer of information between RT controller and FPGAs. Information includes critical signals, data, measurements, commands and configuration required for internal algorithms. Algorithms use various methods like DMA-FIFOs, local variables, arrays, Trigger lines to transfer information. RT-FIFOs are used to handle bulk data in runtime to improve performance. Methods have been chosen carefully to fulfill critical requirements, balancing the available resources while managing limitations. Discussion also includes some specific choices made for synchronized and asynchronous transmission of parallel and sequential data.

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Session Classification: Poster Session 2

Track Classification: Control, Monitoring, Test and Real Time Diagnostics Systems