A fully digital Low Level RF controler

Safran in association with F4E and CIEMAT has developed the software and hardware of a fully digital Low Level RF controler which is responsible to control and tune the Radio Frequency (RF) cavities in the accelerator. Using White Rabbit synchronization, accurate data acquisition and multiple distributed LLRF parameters optimization has never been so easy.

The technology

The LLRF controls and tunes the radio frequency on the cavities of the accelerator. The different power levels at the RF chain output are controlled by the LLRF, which provides the correct drive to the amplifiers in order to reach the required amplitude and phase of the cavity field. This flexible and cost-effective solution includes key functionalities such as feedback and feedforward loops, frequency tuning and continuous wave, pulse and beam modes, mechanical cavity tuning, conditioning, fast interlocks, post mortem, etc…

Ultra-accurate synchronisation for post-mortem analysis

The system synchronization distributes time and frequency over Ethernet with sub-nanosecond accuracy. It allows a high reliable and real-time diagnosis and post-mortem analysis (with datalogger up to 100 MHz rate and libraries in MATLAB, python, CSS / BOY) with wide possibilities in terms of choice of diagnostic signals, trigger selection, duration and resolution of the capture, etc.

A device that can be used with any kind of accelerator

This fully digital LLRF with direct digital synthesis and sampling (high-speed DACs and ADCs) could be universally implemented in any of the 30 000 accelerators existing worldwide, providing flexibility in the design and synchronization accuracy of all the RF Master/Slave chain along the accelerator. It uses EPICS as a control system and offers a customizable user-friendly interface. Embedded widely used IT tools and Linux ensure easy operation and future maintainability.

Collaboration opportunities

The Low Level RF combined with White Rabbit synchronization has already been tested in particle accelerators. The solution is now fully available and ready to be integrated and customised to specific needs and facilities, thanks to its modular and fully programmable implementation.

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