

RF Backplane for MTCA.4 Based LLRF Control System

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The Low Level RF (LLRF) control system developed for linear accelerator based Free Electron Lasers (FEL) require real-time processing of thousands RF signals with very challenging RF field detection precision. To provide a reliable, maintainable and scalable system a new development of the LLRF control based on MTCA.4 architecture was started in DESY for FLASH and European-XFEL. In contrast to standard RF control systems realized in 19" modules, we could demonstrate setup with field detection, RF generation, RF distribution, DAQ system and the high-speed real-time processing entirely embedded in the MTCA.4 crate system. This unique scheme embeds ultra-high precision analog electronics for detection on the Rear Transition Module (RTM) with powerful digital processing units on the Advanced Mezzanine Card (AMC). To increase system reliability, maintainability and reduce performance limitations by RF cabling network, we developed and embed in the MTCA.4 crate an unique RF Backplane (uRFB) for RTM cards. This backplane is used for distribution of high-performance Local Oscillator (LO), RF and low-jitter clock signals together with low-noise analog power supply to analog RTM cards in the system. In this paper we present the architecture of the MTCA.4 crate with the uRFB, the RF Backplane design and successful laboratory test results of the LLRF control system demonstrating the performance of our development.

Primary author: Dr CZUBA, Krzysztof (ISE, Warsaw University of Technology)

Co-authors: Dr LUDWIG, Frank (DESY); Dr SCHLARB, Holger (DESY); Dr JEZYNSKI, Tomasz (DESY); Mr LESNIAK, Tomasz (ISE / Warsaw University of Technology)

Presenter: Dr CZUBA, Krzysztof (ISE, Warsaw University of Technology)

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