

The DAMC-DS5014DR: A High-Speed, High-Performance RFSoc-Based Digitizer Utilizing AMD Zynq UltraScale+ Technology in a MicroTCA.4 Form Factor for Diverse Scientific Applications

Thursday 4 December 2025 09:30 (15 minutes)

This talk reviews the DESY MicroTCA card, DAMC-DS5014DR, designed for high-speed multi-channel data acquisition and signal generators. Based on the AMD Zynq Ultrascale RFSoc ZU47DR, it features eight 14-bit, 5 GSPS ADCs, eight 14-bit, 8.92 GSPS DACs, extensive programmable logic (PL) resources, and an ARM-processing system (PS). In this AMC card, the AC or DC coupling options precondition the input signals and feed them to the ADCs, leaving enough room for the user to perform custom signal conditioning at the RTM side. The interface between DAMC-DS5014DR and RTM follows the MicroTCA.4 concept. The board offers a QSFP28+ interface that supports 100Gb Ethernet or optical PCIe Gen.4 x4 (16 Gbps/lane) data streaming, while the second set of PCIe Gen.4.0 x8 available on the card provides data transfer to the MicroTCA.4 backplane. Eight independent timing/trigger inputs can be used to capture event-coincident data. To support high-throughput applications, the card incorporates three 16-GByte, 64-bit DDR4 memory banks, ideal for managing and processing fast data streams. A high-frequency clock synthesizer generates synchronized clocks for the ADCs, DACs, and PL, with inputs selectable from the backplane, front panel, or a local precision oscillator. The board is designed to be compatible with the CERN White Rabbit protocol, allowing receipt of White Rabbit trigger signals via the QSFP module. Supported by AMD's comprehensive toolchain (Vivado, HLS, Yocto, PetaLinux, SDSoC, SDAccel), the DAMC-DS5014DR integrates a powerful FPGA, high-performance ADCs/DACs, and a capable CPU, delivering an advanced platform for high-speed digitization and real-time processing while minimizing development time.

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Session Classification: Session 7