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The update of CSNS-II RCS LLRF system based on MTCA.4

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In the upcoming second phase of CSNS (CSNS-II), the beam power will be increased to 200–500 kW. To improve the bunching factor, three additional second-harmonic cavities loaded with MA material will be installed in the RCS. For the CSNS-II RCS LLRF system, we have decided to migrate from the CPCI bus-based hardware platform to the MicroTCA.4 architecture for the following reasons: First, several key components required for the custom CPCI backplane are no longer available, making it infeasible to upgrade the backplane to support additional FPGA controller cards for the new MA cavities. Second, the bandwidth limitations of the CPCI bus have already become apparent in the CSNS RCS LLRF system. The actual bandwidth utilization has exceeded 200 MB/s, approaching the maximum capacity of the CPCI bus. Unlike ferrite-loaded cavities, MA cavities— with their relatively low Q value—require dedicated monitoring and suppression of higher-order harmonics, which significantly increases data throughput within the LLRF system. The new MicroTCA.4-based LLRF system comprises 11 digital signal processing AMC modules paired with 11 corresponding analog signal RTM boards (8 sets dedicated to ferrite-loaded cavities and 3 sets for the MA second-harmonic cavities), along with a dedicated timing AMC module. The installation and commissioning of the entire system have already been completed.

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