

MTCA.4 based LLRF control system for the J-PARC MR

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The J-PARC Main Ring (MR) is a high intensity proton synchrotron that accelerates protons from 3 GeV to 30 GeV. Its output beam power for fast extraction reached 515 kW, corresponding to 2.66×10^{14} protons per pulse, in April 2021, and studies and hardware upgrades are underway to achieve higher beam intensities. We observed longitudinal coupled bunch instabilities (CBI) above 450 kW due to the beam loading effect. The CBI causes beam loss during acceleration and large momentum fluctuations in the extracted beam. Beam loading compensation for a wider range of harmonics is required for the acceleration of high intensity proton beams with CBI suppressed. The FPGAs on the original digital low-level RF (LLRF) control system are obsolete and difficult to maintain. Therefore, we developed the new LLRF control system based on MTCA.4 platform. The multi-harmonic vector RF voltage control function was implemented in the system to suppress the beam-induced wake voltages in the RF cavity. We achieved the acceleration of the proton beam with the new LLRF control system in 2023. In this presentation, we present the system configuration and the preliminary commissioning results.

Keyword

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