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Development of low-level RF control system for Injector of Hefei Advanced Light Facility project

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Hefei Advanced Light Facility (HALF) is a fourth-generation synchrotron radiation source based on diffraction limited storage ring. It comprises a 180-meter injector and a 480-meter storage ring. The injector incorporates a digital low-level radio frequency (LLRF) control system based on MTCA.4, ensuring a stable and adjustable microwave field for the acceleration structure. This article outlines the structure of the LLRF system, encompassing both hardware and software components. Within the software, we have mitigated signal drift induced by environmental temperature fluctuations by adding a reference tracking module. Building upon the existing IQ closed-loop functionality, we have successfully implemented separate amplitude and phase closed-loop functions. In high-power online testing, the IQ closed-loop demonstrated amplitude and phase stabilities of 0.0411% (RMS)/0.0638° (RMS), respectively. Furthermore, the phase stability achieved by the phase-independent closed-loop function reached 0.0646° (RMS). Currently, the LLRF system has fulfilled the design requirements of HALF.

Footnotes

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