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Development of a 500 MHz direct RF sampling low-level RF system for ALBA and ALBA-II

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ALBA Low-Level RF (LLRF) system has provided over a decade of reliable operation and has been adopted by other synchrotron facilities. To meet the evolving requirements of ALBA and ALBA-II, a new LLRF system has been developed. This system features FPGA and ADC/DAC MTCA boards designed by SAFRAN, enabling direct 500 MHz signal sampling without down/up-conversion. These enhancements reduce system complexity, minimize noise, and simplify maintenance. SAFRAN also supplies peripheral modules and the Tango device server generator, while ALBA implemented it and developed a new GUI. Upgraded GPIO and RF signal patch panels complement the new hardware. The legacy VHDL code has been updated to improve readability and functionality, incorporating advanced features such as octant selection and a harmonic direct feedback selection method. The latter, based on IIR filtering, isolates positive and negative revolution harmonics in the I/Q domain, feeding them back to amplifiers to effectively mitigate transient beam loading caused by the storage ring bunch train gaps. This upgraded LLRF system delivers enhanced performance and greater flexibility to address the future needs of ALBA and ALBA-II.

Footnotes

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