

Development and Commissioning of a Bunch-by-Bunch Phase Measurement Module for the CERN Super Proton Synchrotron Beam-Based Loops

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The accurate measurement of bunch-by-bunch phase is of utmost importance for optimizing beam control and performance in the CERN Super Proton Synchrotron. We present the development and commissioning of Low-Level RF modules designed for this purpose.

The phase module utilizes a high-speed 5 Gbps ADC and a wideband pick-up system to monitor individual bunches. A pipelined FFT processing technique, coupled with a numerically controlled oscillator (NCO) locked to the accelerating RF, generates a beam synchronous phase signal (200Mps). This signal is transmitted over 10 Gbps serial links to the beam loops module.

Notably, the beam loop module can receive data streams from up to three pick-up processing chains and seamlessly switch between them during a machine cycle. This combination of features proves particularly valuable for scenarios such as slip-stacking, where two beams are independently controlled within the same ring, and for fixed target ions, where an amplified pick-up is employed after de-bunching.

The implementation of the module on Ultrascale+ MPSoC and MicroTCA platform is presented, along with commissioning results.

Keyword

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