

The CERN Linac4 LLRF

Linac4 is a new 86-m long normal-conducting linear accelerator that will provide 160 MeV H⁻ to the CERN PS Booster, and replace the present 50 MeV proton Linac2. The commissioning in the tunnel of the RFQ starts in October 2013. The rest of the machine will be progressively commissioned between end of 2013 and 2015. The LLRF system has to control two choppers, three bunching cavities, twelve accelerating cavities and one debuncher in the transfer line to the booster. Tolerances in field control are one per cent in voltage amplitude and one degree in phase. The machine is PPM, "Pulse to Pulse Modulated" to accommodate multiple users which poses a particular challenge for the LLRF control with parameters and chopping pattern changing from one pulse to the next. To optimize the filling of the 1 MHz PSB bucket, the machine includes fast choppers (synchronized with the PSB RF) and a voltage modulation of the last two PIMs that will provide Longitudinal Painting for optimum filling. The LLRF is composed of one tuner loop per structure, and one field control loop per generator with one 2.8 MW klystron feeding two structures in some cases. Four different VME cards are being developed. For each generator, a single VME module generates all required clocks for up/down mixing and sampling the 352.2 MHz RF signals. The RF is mixed with an LO at $f_{LO} = 15/16 f_{RF} = 330.1875$ MHz and the resulting IF signal at 22.0125 MHz is sampled at four times this frequency, 88.05 MHz for IQ demodulation. After digital IQ demodulation the entire processing chain runs at 88.05 MSPS (Xilinx Virtex-5 Family). A dedicated high-speed gigabit serial link is used to transmit the essential signals for observation and diagnostic purposes to data storage and analysis hardware at an effective rate of 50 MWord per second (16 bits).

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