

Meeting Minutes

Linac Toroid Measurement Upgrade

Discussion of the Digitizer and Requirements for the DAQ Front-End

East Booster Tower, Cooler Meeting Room

Friday, September 02, 2011

11:00 am to 12:10 pm

I. In Attendance:

Mike Kucera,	AD/Controls Engineer and meeting chair
Mike Sliczniak,	AD/Controls Front End Programmer
Bob Florian,	AD/Controls Engineer
Manfred Wendt,	AD/Instrumentation Head
Aisha Ibrahim,	AD/Instrumentation Design Engineer, Toroid Systems
Ning Liu,	AD/Instrumentation Design Engineer, Digitizer Module
Fernanda Garcia,	AD/Proton Source Linac/ Head
Craig Drennan,	AD/Proton Source Engineer

II. Introduction

The meeting was called mainly to discuss the capabilities of the high speed digitizer, VME module, to be used in reading out Linac Toroids. A presentation by Ning Liu provided an overview of the digitizer specifications and algorithms implemented in its firmware for digital integration of the toroid signals. There was discussion of the requirements for the Linac beam current measurements and the limits of the front-end data acquisition with the goal of choosing an optimal sampling rate and sampling interval. At the end of the meeting plans were made to implement a longer sampling interval and have a full test, reading out all the toroid data from one of the eight channel digitizers.

Additionally, there were several short discussions over installation details and clarifications on details of the measurement specifications.

III. Points Made Regarding Installation

- We will continue to use the existing toroids in the Linac beam line except there will be a new, large aperture toroid at the momentum dump and three new toroids will be installed in the 750KeV area for the new RFQ.
- There are 10 toroids and historically 10 toroid measurements in the 750KeV area. Only two are considered by operations at this time, and only the three new toroids, in the 750KeV area, will be present after the new RFQ is installed.
- Eight new, eight channel toroid digitizers will be installed in seven locations down the Linac. Two of the digitizers will reside in the Diagnostics Room. There will be a ninth digitizer installed in rack BGW-100 / LG1-RR3-3 for toroids near the spectrometer magnet, the straight ahead dump and the momentum dump.
- The toroid measurement includes a pre-amplifier before the digitizer input. In many installations, this preamp is housed in a small Pamona box or a rack mountable chassis.
- Aisha has stated that the preamp and digitizer will be the standard method used for reading out the toroids. This approach is to be used with HINS and NOVA as well as for the Linac.
- At the end of the meeting there was discussion on how to proceed with testing and installation, and Manfred proposed some goals.
 - It was agreed that a full set of toroids at one of the seven locations was to be instrumented first and evaluated. The goal was to have this ready in 1 month.
 - A second schedule goal was to have all of the available toroids in Linac instrumented by December 2011.
 - Fernanda stated that almost all the Linac toroids were examined daily in evaluation of the Linac performance, but there were some that were critical to Linac operation and to NTF operation that these should wait to be changed over. More details are given below
 - Instrumentation of the Momentum Dump toroid and the new 750 keV toroids would wait until after their installation. These installations are expected to occur during the 2012 shutdown. Hardware and
- Fernanda followed up the meeting with a list of toroid measurements that could not be switched over to the new system until a shutdown or possibly a downtime period.
 - 1) L:D7TOR
 - 2) L:TO1IN (needed for LLRF st 1)
 - 3) L:TO3IN (NTF uses this signal - needed for LLRF st 2 and st 3)
 - 4) L:TO4IN (needed for LLRF st 4)
 - 5) L:TO5OUT (needed for LLRF st 5)
 - 6) L:RF3INT (used for BBM application for Linac beam budget. It seems the RF3IN signal goes to a buffer module where the integration is made. Therefore, it is tied into TO3IN toroid).

IV. Points Regarding Data Acquisition

- The currently proposed sampling rate for the digitizer is 100 MHz followed by a decimation of 10 of the sampled data record. This gives an effective sampling rate of 10 MHz.
- The maximum sampling interval was determined to be 100 microseconds. This is what the Linac is capable of and could possibly be requested for a study or some extension of some future MTA experiment beam request. (This maximum interval was determined after the meeting.)
- A Linac Beam Sync pulse is available in each location for triggering the digitizers.
- The digitizers will run in a mode where they are always armed and ready to begin data acquisition once the Beam Sync pulse is detected.
- The minimum Linac beam pulse, for which an accurate beam current measurement would be desired, was specified as 1 microsecond. It was decided that at the effective sampling rate of 10 MHz would be sufficient. Ning agreed to consider adding some additional logic for a trapezoidal approximation for the digital integration algorithm, to improve the measurement.
- Data transfer to and data processing in the front-end processor was discussed with Mike Sliczniak and the other AD/Controls participants. The estimates for data transfer from the digitizer, across the VME backplane to the front-end processor were made for the 9 channels of data in the Diagnostics Room, the most demanding case.
- At 10 MHz sampling for 100 microseconds there would be 1000 words (16 bits) of data for each channel. At the time of the meeting Linac was considering only a 40 microsecond data acquisition intervals, with only 400 words of data for each channel. For the 400 words per channel, it was estimated that VME transfer would require 233 microseconds per channel and that transfer of all 9 channels could be accomplished in less than 3 milliseconds. Extrapolating this to 1000 words per channel we have 582.5 microseconds per channel and approximately 5.24 milliseconds for 9 channels.
- AD/Controls stated that having all of the data transferred before the 40 millisecond mark into the 15 Hz cycle was a requirement in order to complete processing and meet the plotting requests made by ACNET.

V. Follow-up and References

Further meetings were not set at this time. Manfred Wendt did request that they meet again in 1 month. Documentation, including Ning Liu's slides for the meeting can be found in the docDB at Beams-doc-3685-v1.

The meeting adjourned at 12:10 pm.

Recording Secretary was Craig Drennan