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EPICS SUPPORT IOC FOR MONITORING WAVEFORM DATA OF PEFP 100-MeV PROTON LINAC

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1. Introduction

The Proton Engineering Frontier Project (PEFP) is constructing a 100-MeV proton Linear Accelerator (Linac), consisting of a 50-keV proton injector, Low Energy Beam Transport (LEBT), a 3-MeV Radio Frequency Quadrupole (RFQ), a 20-MeV Drift Tube Linac (DTL), 100-MeV DTL, and beam lines [1, 2].

For PEFP commissioning and operation, remote control and monitoring system of the RF and beam current signals is essential for operators. To monitor and control the RF and beam signals from subsystems of the 100-MeV proton accelerator, VME PMC ADC boards and oscilloscopes are equipped. The measured signals are transmitted and displayed on operator consoles in a control room. The VME baseboard and oscilloscope must support Ethernet based TCP/IP protocol for communication interface and the monitoring systems must be integrated with control systems for PEFP project. To achieve these goals and minimize the development period, the EPICS middleware and extension tools are adopted [3]. The EPICS IOC has been tested to control and monitor the subsystems of PEFP. The EPICS IOC supports to create various database records to access I/O data and setting parameters. One of EPICS database records is the waveform record to acquire array signals of the device and the waveform record can support the remote control and monitoring of control system by using various devices including oscilloscope instrumentations, VME ADC boards, PXI, cPCI, etc. Operators can observe the waveform using some graphic viewers. The implementation of EPICS waveform support for the PEFP is described in this paper.

2. Configuration of control system

In order to monitor RF and beam current signals for the 100-MeV proton linac, the commercial fast ADC digitizer and oscilloscope are selected. The EPICS IOC supports to acquire the waveform data from the measurement instruments and transmit promptly the acquired data to display panel.

The monitoring and control of RF signals driving SSA, forward, reverse, and cavity are achieved by using a VME single board computer and a field-programmable gate array (FPGA) PCI PMC extended board [4]. The acquisition of beam current from current transformers (CT) is accomplished by using the commercial digital oscilloscopes (TDS5054B) and a Soft-IOC. The TDS5054B consists of 100 Mbps Ethernet, 500 MHz bandwidth, and 5 Gs/s sample rate, etc. These EPICS IOCs, which create waveform support, are implemented to interface the scope Soft-IOC with VXI 11.2 LAN connectivity of oscilloscopes. The schematic layouts of the component configuration for monitoring of the RF and beam current are shown in Fig 1 and 2.

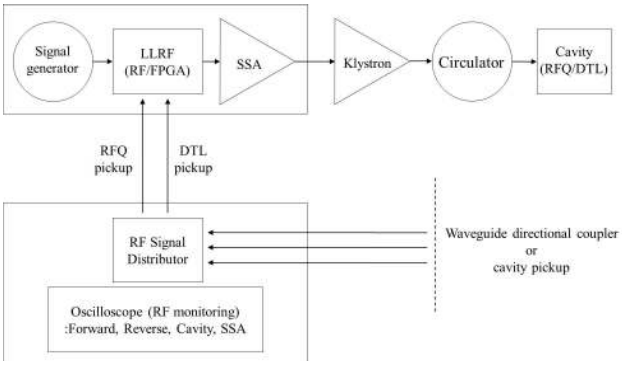

Fig. 1. Schematic layout for RF control and monitoring

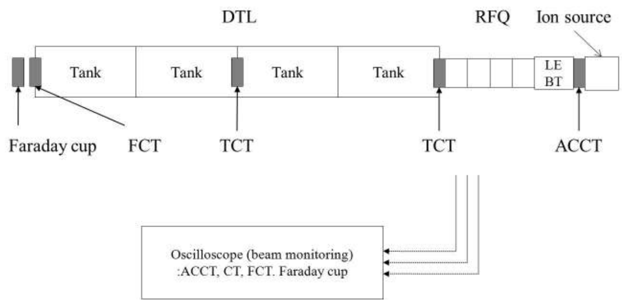

Fig. 2. Schematic layout of beam current and measurement system

3. Implementation of IOC

An EPICS IOC, which interfaces subsystem devices, produces Channel Access (CA) Process Variable (PV). EPICS clients are connected with the IOC and display waveform data on several graphic tools. The EPICS extension has valuable display tools including Extensible Display Manager (EDM), Motif Editor and Display Manager (MEDM), etc. These graphic tools have many advantages because it makes implementation of Operator Interface (OPI) much easier and quicker. EDM has a graphic widget that we can point at the VAL field of a compress record to plot the stored history. The other functions are storage and timestamp for waveform data. The typical solution for this requirement of the integrated development environments is shown in Fig 3 and 4. The EPICS IOC solution consists of various record supports, such as analog input (ai), analog out (ao), and binary out (bo) as well as waveform [5].

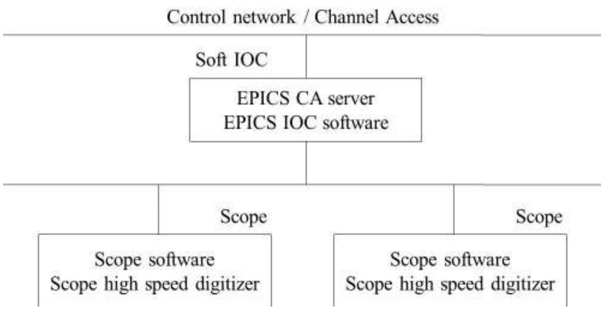

Fig. 3. Layout of implementation structure for EPICS based scope Soft-IOC

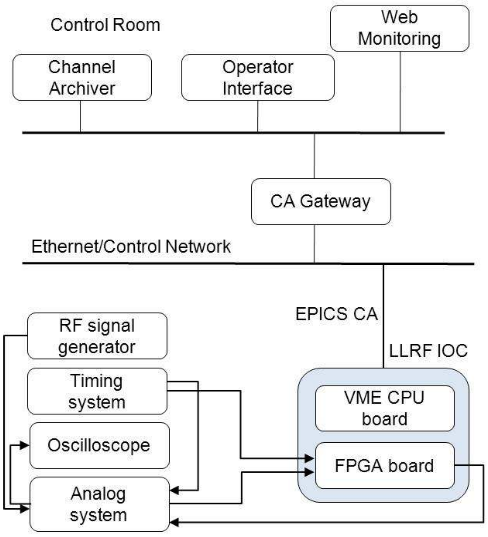

Fig. 4. Layout of implementation structure for EPICS based RF control and monitoring

The EDM can provide the ability to create and edit display content using graphic, text, meters, buttons, plot, etc. It executes various contents resulting in the dynamic presentation of live data. Operators can observe waveform data using display manager as shown in Fig 5 and 6.

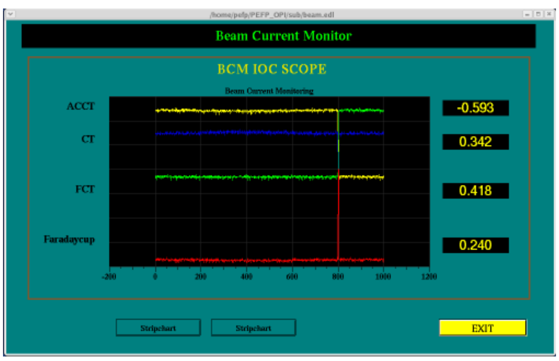

Fig. 5. Operator interface for beam current monitoring using EPICS based IOC and Asyn module

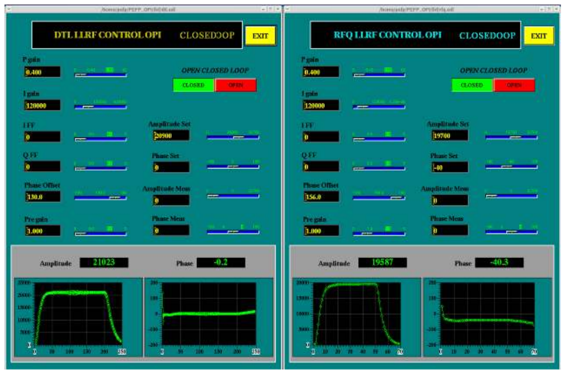

Fig. 6. Operator interface for RF feedback control and monitoring

4. Conclusions

The monitoring and control system for all waveform acquisition instrumentations have been implemented with EPICS support modules. The prototype IOCs to communicate with the specific instrumentations was built and preliminary tests of EPICS waveform supports was performed with 20-MeV proton linac. These solutions will be improved continually and will be applied for the 100-Mev proton linac PEFP.

Acknowledgment

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