PEFP MONITORING SYSTEM THROUGH AN ANALOG INPUT TO ETHERNET CONVERTER*

Y. G. Song#, I. S. Hong, Y. S. Cho
PEFP, KAERI, DeaJeon, KOREA.

Abstract

Proton Engineering Frontier Project (PEFP) has above 40 magnet power supplies for the 20MeV proton linac. Because some power supplies have analog interfaces, we chose ATEC (Analog Input To Ethernet Converter) to monitor their output currents and voltage by supporting the protocol conversion function. Software components of the Experimental Physics and Industrial Control System (EPICS) have been ported to a VME single board computer based on a Power PC microprocessor (MPC7410). This paper presents the software component and processing of analog input values between EPICS on the PowerPC based board and ATEC operating as Server Mode.

INTRODUCTION

Power supplies for quadrupole magnets for 20MeV DTL are integrated with PEFP control protocol (EPICS Process Variable) which is monitored through ATEC and IOC (Input Output Controller) server. Network can distribute the host computer of OPI (Operator Interface) connecting information network, control network like PLC, field network like all sorts of sensors and devices. We have chosen EPICS [1] to integrate a variety of protocol of interfacing PEFP instruments. Also because some power supplies of analog interface should be integrated with EPICS Channel Access (CA), their output current and voltage is processed by ATEC. EPICS composed of server and client is able to access each other by using CA protocol. Graphic User Interface (GUI) on a variety of OS is able to control sequentially and save PV's from IOC. We have two storage systems based on channel archive engine [2]. One is file based storage system. The saved files are shown on ArchiveViewr [3]. The other simulation system composed with Apache; PHP and Mysql can save all data in the database and all data from DB can be shown on web page.

ANALOG TO ETHERNET CONVERTER AND SERVER SYSTEM

PEFP has above 40 magnet power supplies for drift tube magnets have been installed and commissioned to guide the 20MeV proton linac [4]. Some power supplies have analog interfaces. To obtain signal values of analog current and voltage for monitoring the power supplies of output interface, we have chosen NetEye3000 (ATEC). ATEC supports differential analog input 16 channels. Network-based independent analog input to ethernet conversion device has embedded standard hardware TCP/IP kernel, Ethernet chip, 22MHz CPU, 64Kbytes flash memory, 32Kbytes SRAM data memory, and analog input process circuit. Also ATEC is able to support a variety of input range with 24bit resolution.

Table 1: Analog Input Interface

Effective resolution	24-bit
Channel	16 Differential
Input Type	mV, V, mA
Input Range	±100mV, ±500mV, ±1V, ±5V, ±10V, ±20mA, 4~20mA
Accuracy	±0.1% or better
Sampling Rate	12 sample/sec (about total channel)
Input Impedance	20M ohm

Each channel of ATEC can be selected within analog input range. Maximum hex value is OxFFFFFF and minimum hex value is 0x000000 at each analog range. Input hex value at the voltage of 0.0 is 0x7FFFFF. Exceptionally in case of 4~20mA, 4mA is 0x000000 and 20mA is 0x660000. The difference of two values of Ch+ and Ch- is changed into the digital value. It represents ATEC as the differential analog input monitoring device.

ATEC divides 48 bytes input data of each channel into 3bytes each. The hex value range for the 3bytes is shown in Table 2.

Table 2: Hex value Range of Analog to Ethernet Converter

Input Value (Voltage) 10V, 5V, 1V, 500mV, 100mV, 20mA	Hex Value (3 bytes)	exception (4~20mA)
Maximum value : 0.0 voltage : Minimum value	0xFFFFFF : 0x7FFFFF : 0x000000	20mA : 0x660000 : : 4mA : 0x000000

ATEC for raw data communication has simple and clear protocol. IOC Sever sends analog input request 1byte command of 0x52h to the ATEC and then ATEC returns the status stream respectively of all 48bytes for 16 differential channels.

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# ygsong@kaeri.re.kr

We have chosen EPICS to compose integrated control system as standard and middleware development for PEFP control system. IOC server and client communicate each other through CA based on TCP/IP protocol. Also IOC server is developed with async module, socket system call, and bit manipulation function. Because async module supports low level driver, this can reduce development cost and time. We have already developed the IOC for power supply of analog interface operating on the Intel Pentium 4 and Power PC (MVME5100). This IOC server is currently running on the Linux OS built Intel CPU and we are planning to install vxWorks IOC in the Power PC VME. Overall block diagram to monitor DTL magnet power supply system is shown in Fig 1.

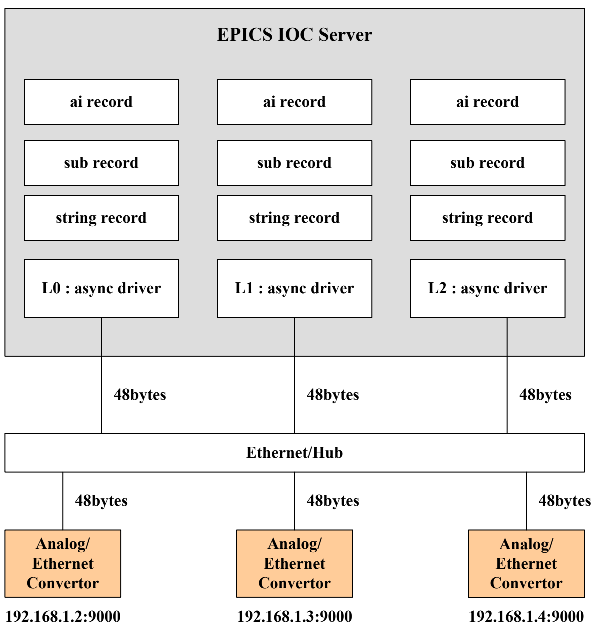

Figure 1: Overall block diagram to monitor DTL Magnet Power Supply System

As you see the Fig 1, ATEC uses 10 channels to monitor analog current and voltage of 5 magnet power supplies each ATEC. Also IOC server opens TCP/IP port for ATEC TCP/IP access. The driver of each port reads 48bytes stream from this port and then forward string record. String record charges 48bytes stream from driver to transfer sub record. After the stream data received from string record is accomplished from data processing of 3bytes each and calibration, 10 PV's are finally forwarded at ai record. OPI can monitor and save PVs through CA based on TCP/IP [5].

DATA ACQUISITION

We have chosen Channel Archiver to save the data of magnet power supply and installed ArchiveViewer of java-based archive data viewer as GUI to display all saved data to operators. Because the data from Archive is saved as file form, ArchiveViewer which displays only each section between start date and stop date takes long time for processing a huge data file. Two kinds of data storage system based on channel archive engine are shown in Fig 2. The archive engine saves IOC PVs in the cfg file form and database respectively. Fig 3 and 4 show the data from IOC server and the results of saved data by Archive.

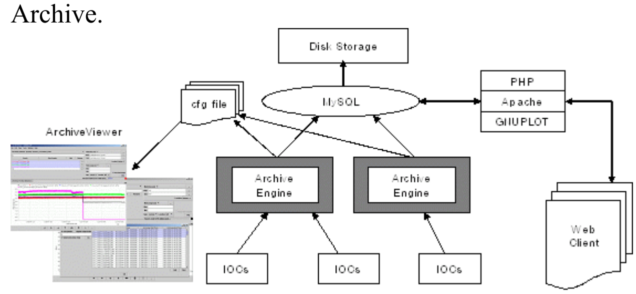

Figure 2: Schematic Architecture of PEFP data acquisition. The left side of an archive engine shows the data storage of a file form and the right side shows the web interface through database.

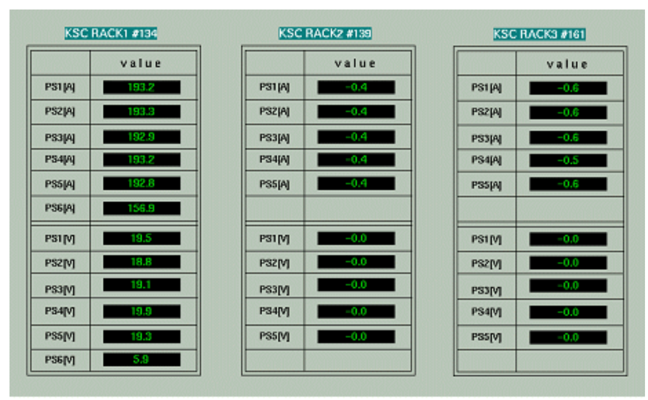

Figure 3: EDM screen that monitors the entire magnet power supplies of analog interface.

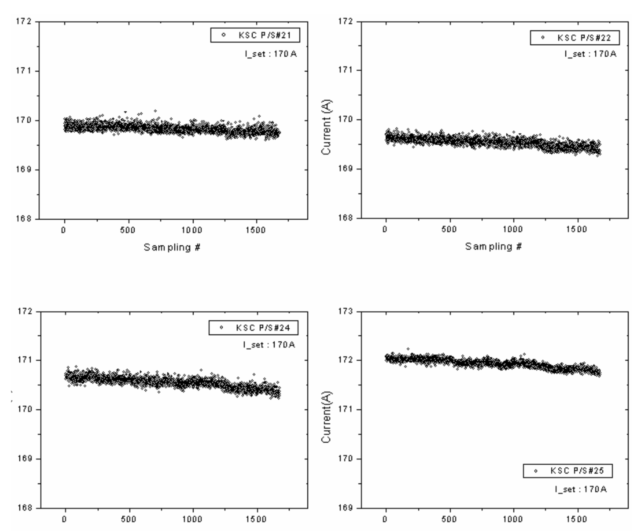

Figure 4: One part of monitoring results for magnet power supplies has been found to be quite stable and capable of saving process variables

We propose a new storage mechanism based on database. We are currently developing additional storage and GUI to support the more enhanced and convenient management process of the great capacity file data. After all data are processed in archive engine as soon as Archive saves the data of file form, these data are forwarded to Mysql. When ArchiveViewer accesses the file system, the data of double link needs the whole data file set. So this database structure improves performance and management efficiency of the data storage. When ArchiveViewer accesses the file system, the file capacity and processing relation is inverse proportion. The performance of database search is faster than search speed of ArchiveViewer. It is able to express the data on web.

CONCLUSION

We have developed a variety of hardware support drivers. EPICS IOC and Async module make easy the monitoring and storage possible of the data for magnet power supply. After we complete an additional proposal for the web interface based database. We will apply this storage mechanism to all IOCs of PEFP control system. We also need to understand and to obtain the block diagram of control logic for PEFP total system control.

REREFENCES

[1] EPICS Input Output Controller Application Developer's Guide. http://www.aps.anl.gov/epics/
[2] Channel Archiver http://ics-web1.sns.ornl.gov/~kasemir/archiver/
[3] EPISC ArchiveViewer http://ics-web1.sns.ornl.gov/archive/viewer
[4] Y. H. Kim, Proceeding of 2006 Particle Accelerator Conference (2006)
[5] N.D.Arnold and D.A.Dohan PAC2003 on Connection Oriented Relational Database of the APS Control System Hardware.

1-4244-0917-9/07/$25.00