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Instrumentation & Control System For PLS-IM-T 60 MeV LINAC

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Abstract

The PLS*IMT* is a 60 MeV LINAC as a preinjector for 2 GeV LINAC of PLS project. The instrumentation and control system have been designed under the institutional collaboration between the IHEP (Beijing, China) and POSTECH (Pohang, Korea). So far, the I&C system are being set up nowadays at the POSTECH of Pohang. This paper describes its major characteristics and present status.

I. Introduction

The Concept Design Research(CDR) of PLS 60 MeV LINAC has been completed in 1989. The construction of PLS 60 MeV started in July, 1991. The accelerator column and electron gun have been installed earlier. The gun pulser has been tested with 3.5A 2ns pulse width with success and Modulator, microwave system and I&C system will be set up soon. The commissioning of whole system would be completed around the end of this year or next spring.

The I&C system of PLS 60MeV is a compact and complete hierarchical distributed control system. Therefore it is small system and it includes all of the essential control structure and various beam monitor, high speed electronics modules etc. for LINAC operation.

II. System Structure

In a centralized control system, computer failure will cause a failure that will shut down the entire system. However, a distributed system is more costeffective and becomes easily modified.

According to the requirements of physics and our previous experience, and considering the entire budget, schedule of I&C of PLS 60MeV, we compared various structure of control system [1], and adopted the Intel BITBUS architecture. The major reasons are as follows:

* BITBUS distributed control system is a commercial product

* High performance microprocessor could be useful for local station.

* Powerful software support such as RMX286 and RMX51 are an excellent developing environment. The function that have to be explicitly coded can be greatly reduced by making system calls. A BITBUS drive can be run under the RMX286 which allows messages passing across the SBX interface on down the BITBUS network.

* More second source: We should consider the situation that developing this system is in China, and commissioning and maintenance is in Korea. So we must get these products easily from the market of both country.

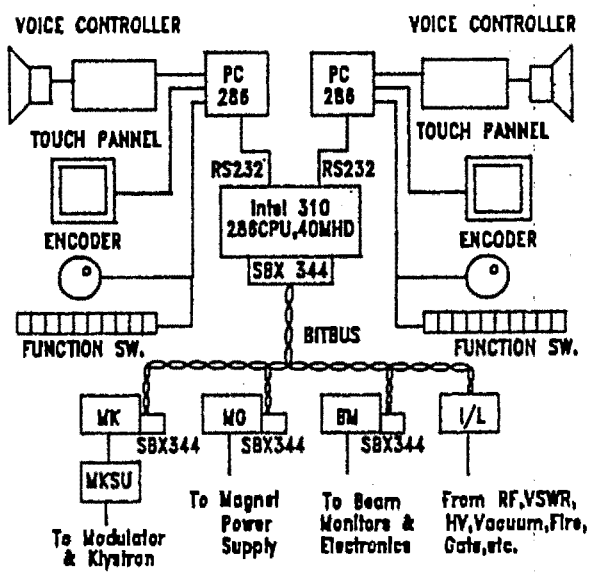

Fig.1 I&C architecture for Preinjector of PLS

According to the considerations above, the system architecture is illustrated in Fig.1.

There are four stations linked with BITBUS network, each station has its own resource and tasks respectively. Those local stations are Modulator-Klystron Station(MK), Magnet power station(MG), Beam diagnostics station (BM) and Interlock station(IL).

In general, entire task are hierarchically managed. Each local station completes data acquisition and data control during the 5ms period. the details of MK local station

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will be discussed as example. Intel 310 (CPU 286, HD 40M) can be used for task management, data sort, data processing and BITBUS communication control. Two sets of industrial level console computer (CPU 286, HD 40M, RAM 2M) which can be used for humanmachine interaction.

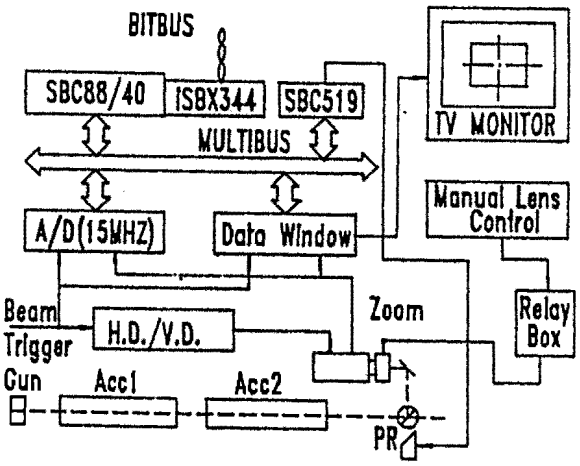

Fig.2 Beam Station Schematic

III. Hardware System

A. Local station

Each local station has own iSBC 88/40 microprocessor and various I/O interface boards which are linked together on the Intel's MULTIBUS.

1.Modulator and Klystron Support Unit (MKSU) [2] is a powerful interface between MK station and Klystron & Modulator. It was developed by SLAC in 1985. and contains various interface circuit linked with intelligent PIOP CAMAC module. In order to keep this powerful function in our system, a dedicated bus adapted from MULTIBUS to MKSU bus have been developed successfully.

2. MG station

The PLS 60 MeV has 29 sets of power supplies to be monitored and controlled for serving the solenoid coil, steering coil, analyzing magnet and quadruple magnet. A digital remote control model using data modulator and demodulator with Manchester code has been adopted. By the way, a remote D/A controller could be mounted at the magnet power supply as close as possible.

3.BM station is designed for measuring various beam characteristics such as beam profile, beam energy spread and beam emittance. This is a multifunction image processing system, illustrated in Fig.2.[3]

It consists of a profile monitor, a video signal synchronizer, a high speed A/D converter with 15 MHz inserted into the Intel's MULTIBUS. The video signal of beam spot from the camera was transmitted to the TV monitor of control room. It is easy to correct the target haircrossing line using the movable data window by the computer control. The 4000 points signal could be collected in less than 4ms. After data processing, a beam profile distributed picture and three dimensional distribution will be shown to operator immediately.

The major function is follows:

* Measuring resolution better than 0.2mm
* Data window Size: 50x80(256x25) would be possible)
* Sample rate: Max. 15MHz
* Multipurpose: profile, energy spread, emittance measurement.
* High anti-interference:

When the beam intensity is so weak that the beam profile can not be observed on TV monitor, therefore it may be clearly seen on the graphic display after eliminating background noise from the image data taken repeatedly.

In order to record the 2ns beam intensity data which is important data for accelerator operator ,high speed sample hold circuits are being developed and we intend to use it instead of 7104 oscilloscope.

B. Timing system

PLS 60MeV LINAC timing system is a small system with three triggers to electron gun, travel wave tube, and modulator. In general, we refer to the LINAC timing system of KEK because the same kind system had been running for 5 years in the Beijing Election Positron Collider(BEPC) without trouble.

C. Beam monitors

According the physical requirements and our running experience in the BEPC, three categories of monitor are adopted.

The short pulse current monitor consists of a ceramic solid resistor in the shape of a disk, magnese-zinc ferrite aluminum case with BNC connector. Its features are:

* Measuring min. limit: 0.2 ma without amplifier
* monitor sensitive: 3mv/ma
* Frequency response: >1.5 GHz

The fluorescent target typed AF955 has been mounted in the profile monitor and can be movable by console computer. The beam loss monitor is not necessary for the short distance of 60 MeV LINAC, but it could be a prototype as reference for 2 GeV LINAC beam loss system.

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IV. Software System

A. System software

The main control software on the Intel's 310 is the real time multitasking control software which is based on the BITBUS network. According to the LINAC physical requirements, it can carry out the control to each local station and make data processing. It owns its multitask scheduler. When the scheduler receives the command from the console, the related application tasks will be activated at any time. The control system uses fully operating functions, and the tasks will be put into operation in order of their priority level. The real-time data base is built in; it always holds refreshed data (over 300 signals) of whole control system. The data adjustment and command sending task is running forever after the control software is set up. It acquires the datum from each local station via BITBUS and updates the DB continuously in rate of 2-3 times/second.

B. Application software

In normal times, the control software in the local station is continuously acquiring the datum and monitoring from/to the accelerator's equipments. The major application software include as follows:

* Modulator/Klystron package [4] such as control and monitoring to modulator, drive power control, waveform digitalized control
* Magnet power control and monitoring
* Beam FWHM calculation and emittance processing etc.

The Human-Machine interactive software have been designed for those physicist and specialist who are not familiar with system software. It easy to operate and configure various control system. Please refer to "Human-Machine interface software Package" in this conference proceeding.

V. Conclusion

During the configuration of I&C system of 60 MeV LINAC, some technology, experiments and equipments such as beam monitors, MKSU, and timing are transmitted from KEK and SLAC. We believe that international collaboration has speeded up the progress of PLS 60 MeV LINAC.

Instrumentation and control system of PLS 60 MeV is designed for PLS's preinjector. So far, its commissioning with the whole machine will be in November, 1991.

It is a compact and complete control system for PLS 60MeV LINAC.

VI. Acknowledgment

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