Embedded systems for vacuum control at PEFP

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1. Introduction

Development of a front end system for a high energy proton accelerator is in progress at Korea Atomic Energy Research Institute (KAERI) for basic science and industrial applications. The proper vacuum components has been installed and operated successfully between ion source and RFQ. The reliable operation of the accelerator has been completed at vacuum system in the high and ultra high vacuum range under operating conditions. Proper control system for the vacuum instruments, based on PC operated by Windows, has been designed and constructed by control group at PAL. As PC operated by windows with inherent instability does not proper, embedded system can be replaced for reliable operation system, such as VME system operated by vxWorks.

2. KOMAC Vacuum system

Vacuum instrumentation at front end includes valves, gauges, baking pumps, high vacuum pumps, ultra high vacuum pumps, and residual gas analyzers. The layout of vacuum system of front end is presented in Fig.1. All valves have both open and closed by 220VAC power with limit switch-type indicators. High and ultra high pumps have been used to maintain high vacuum in the machine. Remote serial communication will be used to turn on/off the pump high voltage and to read pump current, pressure, and voltage. Pirani gauges have been used to monitor the low vacuum levels from atmosphere to 10-4 Torr. The high vacuum levels within the accelerator, 10-3 to 10-10 Torr, will be measured using ion gauges.

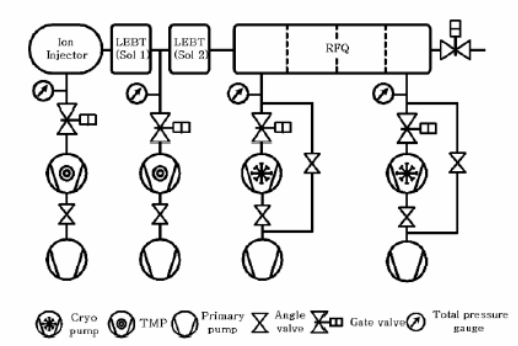

Fig. 1 Lay out of vacuum system at front end

A multiple-gauge controller will control both Pirani gauges and ion gauges. Both pumps and gauge controllers provide interlock inputs to the vacuum controls.
The residual gas analyzers will be used to characterize the residual gases in the vacuum to aid in determining the gas source such as a water leak, an air leak or component outgassing at DTL tanks.

3. Embedded system for vacuum control

3.1 EPICS based control system for vacuum monitoring

Control systems of a accelerator are basically composed of Operator Interface(OPI), Input/Output Controller, and Local Area Network(LAN). The machine is mainly controlled by OPI and IOC, while LAN is the communication network which allows the OPI and IOC to communicate[2]. Various tools of both control objects can be provided by EPICS which was confirmed several facilities. Fig.2 is the picture of EPICS control system, based on PC, adopted at a portion of front end. Still the system on PC has no trouble in working; it is desirable to be replaced by VME platforms because other control systems except the vacuum system are based on VME.

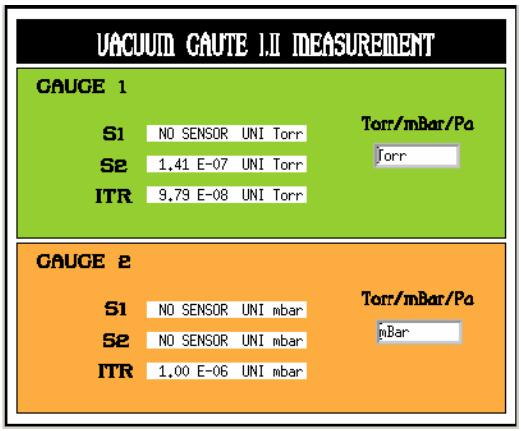

Fig. 2 EPICS based vacuum control system

3.2 Embedded system for IOC

VME controller for the Input/Output Controller (IOC), where the vacuum control system core resides has been prepared. VxWorks which is well known operating system for embedded VME platform has been ported. Fig.3 shows the picture of vxWorks porting to the target.

To support the existing and EPICS control system hardware interface, these controllers have two independent data channels to connect the IOC within controllers. Especially, the controller is designed to have Ethernet controller chip with TCP/MODBUS communication protocol. The primary function of the IOC is to provide the gateway between the global controls. The controllers are being developed for tuning the dummy with EPICS architecture concept. The prototype controller based on VME is changed from having simple functions for vacuum to adopting the EPICS IOC function.

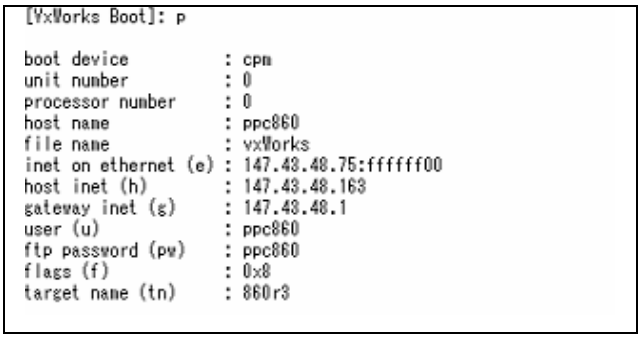

Fig3. Boot parameters of vxWorks porting

3. Conclusion

The vacuum instrumentation and control system based on VME at PEFP has been developed. A major effort on stabilization of vacuum system has been made with the aim of compatibility with the control systems of the other components.

Integrated infrastructure for embedded system has been constructed by the porting vxWorks to VME system; Embedded control system will be completed by modifying IOC drivers and OPI to be compatible to VME.

With hardware development in progress the front end control system is still under development.

REFERENCES

[1] M. Y. Park, et al, Proceeding of the 2003 Particle Accelerator Conference, p. 2884, 2003.
[2] J. H. Kim, el al, Proceeding of the 8th International Conference on Accelerator & Large Experimental Physics Control systems, p.128, 2001.

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