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Implementation of the DIAC control system

Dae-Sik Chang*, Doh-Yun Jang, Jeong-Tae Jin, Byung-Hoon Oh
Korea Atomic Energy Research Institute, Daedeok-daero 989, Yuseong-gu, Daejeon, Korea
**Corresponding author: dschang@kaeri.re.kr*

1. Introduction

DIAC (Daejeon Ion Accelerator Complex) is being installed at KAERI to apply heavy ion beams for material test, nano science, and others. DIAC system was developed, and operated at JAEA of Japan by KEK team with a name of TRIAC (Tokai Radioactive Ion Accelerator Complex) during 2004 to 2010.

The TRIAC control system was based on LabView and had two independent control units for ion source and accelerator. To be an efficient system, it is necessary to have an integrated control capability. And the control software, which had implemented by using LabView at TRIAC, will be changed with EPICS in order to give an effective beam service to the users.

In this presentation, the old TRIAC control system is described, and a new control system for DIAC is discussed.

2. Layout of the Accelerator

The layout of the transferred facility is given in Figure 1. Some equipment is not transferred to use it in Japan and Figure 2 shows a schematic drawing of the newly designed accelerator facility.

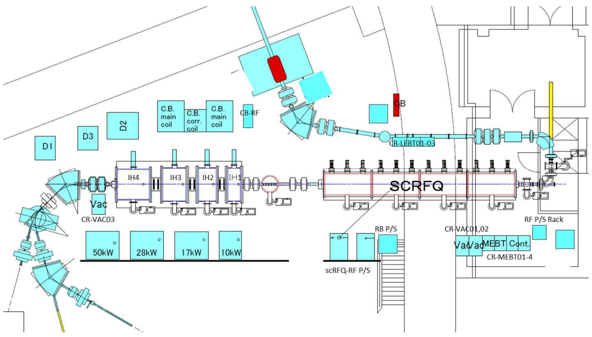

Fig. 1. Layout of the TRIAC

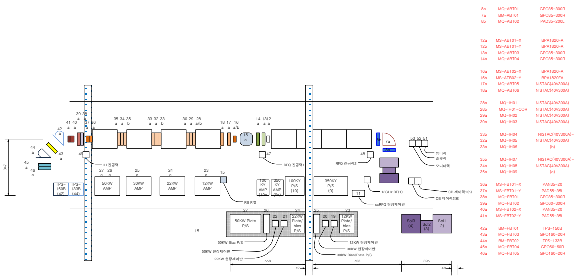

Fig. 2. Layout of the DIAC

3. DIAC Control System

3.1 Overview of the control system

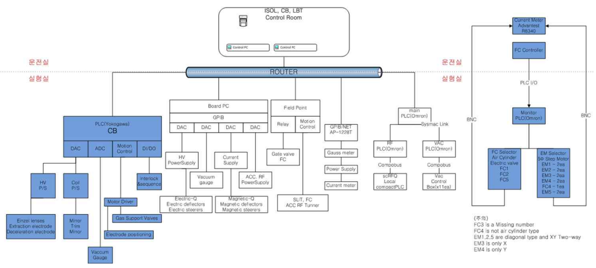

Fig. 3. Diagram of the TRIAC control system

Figure 3 shows the diagram of the control system. The interface hardware of it was made up with many different platforms such as programmable logic controller (PLC) and remote IO using Combo-bus, and Field Point (FP) and GPIB-NET100 module via Ethernet connection. The interface programs of it were using LabView which was installed in the Window-XP based PC in the control room.

3.2 Accelerator RF Feedback Control

DIAC includes two types of heavy-ion linear accelerator (linacs). i.e., a 26MHz split coaxial radio frequency quadrupole (SCRFQ)-type linac and a 52 MHz interdigital H (IH)-type linac[1]. There are three main feedback control issues to operate the accelerator. One is the cavity resonance frequency, another is the RF voltage, and the other is the phase lag between cavities. Each parameter is controlled in parallel, as shown in Fig. 4. ~ Fig. 6.

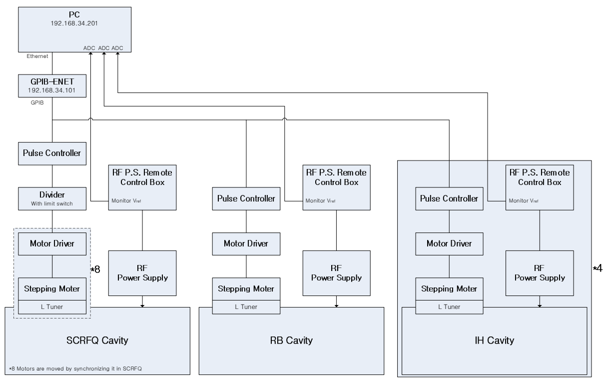

Fig. 4. Schematic diagram of the cavity resonance frequency control

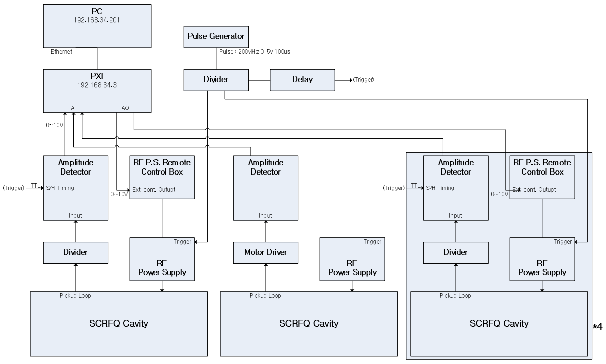

Fig. 5. Schematic diagram of the RF voltage control

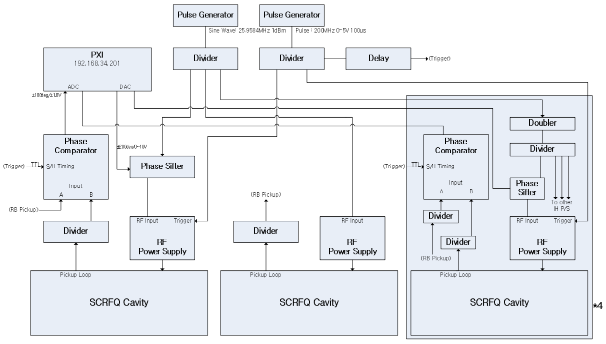

Fig. 6. Schematic diagram of the phase lag between cavities

3.3 Subsystem control issues

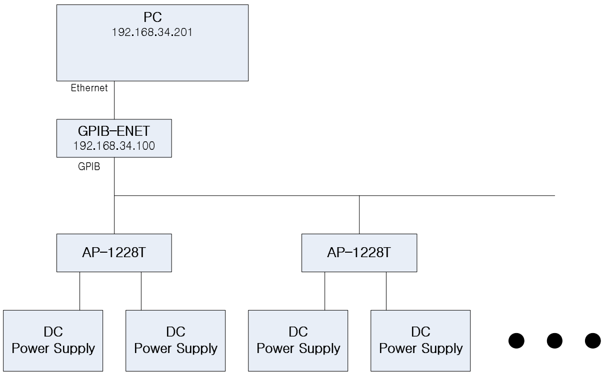

Fig.7. Schematic diagram of the Magnet Power Supply

In the magnet control of the accelerator, there is no feedback control and only electromagnet power supplies are controlled from PC with DAC via AP-1228T GPIB interface made by TAKASAGO, as shown in Fig. 7.

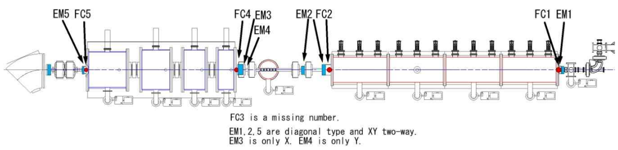

Fig. 8. Positions of the beam monitor1234

The beam monitor system has 4 Faraday cups and 5 emittance monitors on beam line. Their position and their beam monitor method are shown as Fig. 8, and Fig 9

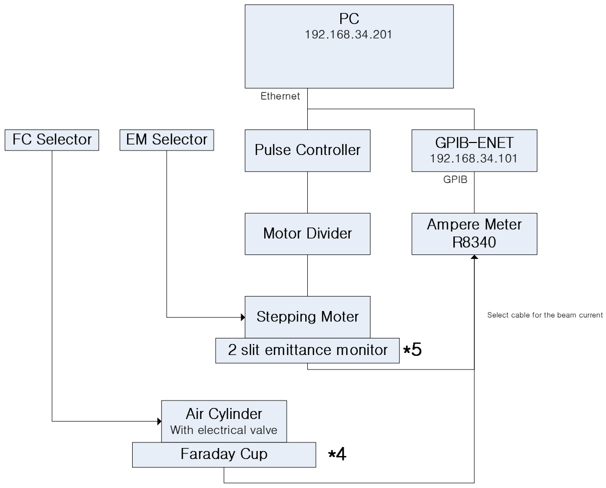

Fig. 9. Schematic diagram of the beam monitor control

Most of the vacuum controls i.e., to start and stop pumping can only be conducted locally. But some status and vacuum levels can be monitored in the control room.

Finally, the interlock system of it watches only the operation status of the equipment of the accelerator i.e., temperature, flow rate of water, and vacuum level. When an abnormality is detected, the PLC turn off the output without shutting down the power supply of the equipment producing the signal in trouble

4. Implementation Status and Future Plan

The control system of DIAC is based on TRIAC. But it is gradually improved performance using EPICS toolkits and changing some digital interface hardware of it. Details of the control system will be demonstrated during the conference.

REFERENCES

[1] M. Okada, K. Niki, Y.Hirayama, N. Imai, H. Ishiyama, S.C. Jeong, I. Katayama, H. Miyatake, M. Oyaizy, and Y. X. Watanabe "Low-background prebunching system for heavy-ion beams at the Tokai radioactive ion accelerator complex", Physical review special topics – accelerator and beams 15, 030101 (2012).