BEAM POSITION MONITOR AT THE PLS BTL*

S. C. Kim#, W. W. Lee, Y. J. Han, M. H. Chun, D. T. Kim, and J. Y. Huang, PAL, KOREA

Abstract

Electron Linac at the Pohnag Accelerator Laboratory (PAL) has been operated continuously as full energy for storage ring, 2.0-GeV since 1994 Dec. and 2.5-GeV since 2002 Oct. At the BTL, BCM (Beam Current Monitor), BLM (Beam Loss Monitor), BPRM (Beam Profile Monitor) and BPM (Beam Position Monitor) are used for beam operation. Thirteen BPMs has been installed from Linac end to BTL end at Aug. 2004. In order to measure of the beam position, 500 MHz Log-Ration (LR) BPM boards are used. Data acquisition system consists of NI S-series data acquisition board and NI Lab-View Version 7.1. For monitoring of BPM data at EPICS control system, BPM data acquisition system is developed as EPICS IOC. BTL BPMs are going to use optic correction and beam energy feedback at PLS normal beam operation.

INTRODUCTION

Electron Linac at the Pohnag Accelerator Laboratory (PAL) has been operated continuously as full energy for storage ring, 2.0-GeV since Dec. 1994 and 2.5-GeV since Oct. 2002. The linac consists of 12 klystron-modulator systems, 11 pulse compressors, and 44 accelerating columns. Pre-injector section of the linac has a 1-ns, 80 kV, 2 A thermionic electron gun, a pre-buncher, and a buncher. After passing through the pre-injector section, the beam is compressed to three mocro-bunches. Operation frequency of the linac is 2,856 MHz [1]. There are 13 Beam Current Monitor (BCM) and 12 Beam Profile Monitor (BPRM) for diagnostics in the PLS linac and BTL. There are also two beam analysing stations in the linac. The delivery ratio of the beam current from Linac to SR depends mainly on the beam optics. Thirteen BPMs were installed from Linac end to BTL end at Aug. 2004 and completed data acquisition system. BPM strip-line length is 100 mm.

BEAM POSITION MONITOR (BPM)

Stabilized beam injection demands for constant beam position from linac to storage ring (SR). Therefore monitoring of beam energy and optics using BPM is very important.

Beam Position Monitor for PLS BTL

A conventional strip-line type BPM was designed with a $\pi/2$ rotational symmetry. The total length of chamber is 150 mm, length of strip-line is 100 mm and diameter of strip-line position is 30 mm. Length of strip-line was decided by BPM electronics frequency. The angular width of the electrode is 52 degree in order to avoid a strong electromagnetic coupling between electrodes. A 50 Ω SMA-type feed-through is connected to the upstream side of each electrode, while downstream ends are short-circuited to the chamber. Fig 1 shows the strip-line type BPM for PLS BTL

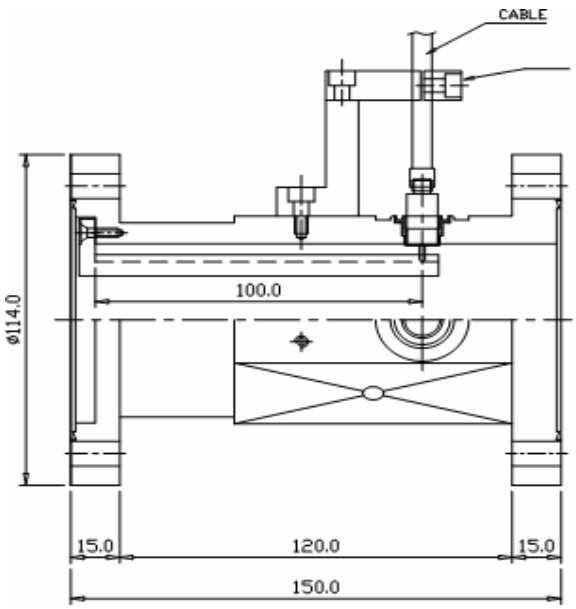

Figure 1: The strip-line type BPM for PLS BTL.

Fabrication and BPM Test

BPM chamber of Fig. 1 is fabricated using stainless steel material body and strip-line. Feed-thorough for pickup of BPM signal is a KYOCERA 50Ω SMA-type. Specially designed nipple is used for welding between feed-through and chamber. Fig. 2 shows fabricated BPM.

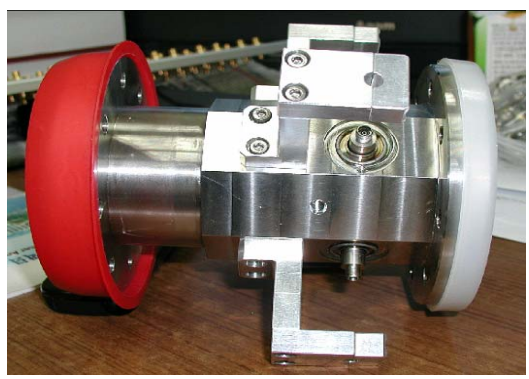

Figure 2: Fabricated strip-line BPM.

Sensitivity and accuracy are measured by using 1ns pulse generator and 500 MHz log-ratio BPM board. Beam position moving was simulated by wire applying 1ns pulse. Fig. 3 shows BPM test stand for sensitivity and accuracy measurement and calibration.

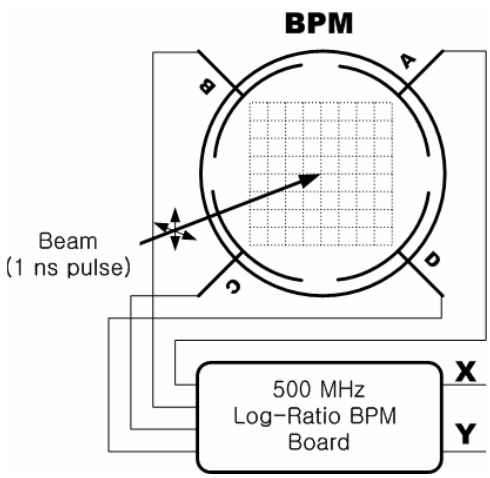

Figure 3: BPM test set-up.

Installation

The BTL consists of three major sections: linac-side section, horizontal section, and vertical section. There are four quadrupole magnets in the dispersion-free space of the vertical section [3]. BPMs at the BTL are installed at upstream of quadrupole magnets and up-down stream of bending magnet for beam optic measurement. Therefore, two BPMs at linac-side section, six BPMs at horizontal section, and five BPMs at vertical section are installed. Fig 4 shows installed BPM at linac-side section.

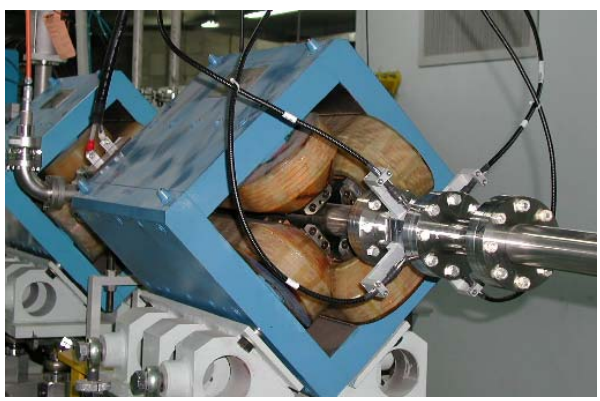

Figure 4: Installed BPM at linac-side section.

BPM Electronics

PLS BTL BPM electronics has adopted Bergoz[4] 500 MHz log-ratio (LR) BPM board. In LR-BPM, the signal from the pickup electrodes is processed simultaneously thru four independent channels. Each channel consists of an input band-pass filter, followed by an amplification chain with logarithmic response. When a short pulse signal is applied to the band-pass filter, it will oscillate at its own resonant frequency for about 250 ns, allowing enough time for logarithmic amplifier to detect the log its amplitude. Log signal from opposite pickup electrode are deduced from one another to obtain Log(A) – Log(C) = Log(A/C) [4]. Fig 5 shows Log-ratio BPM block diagram.

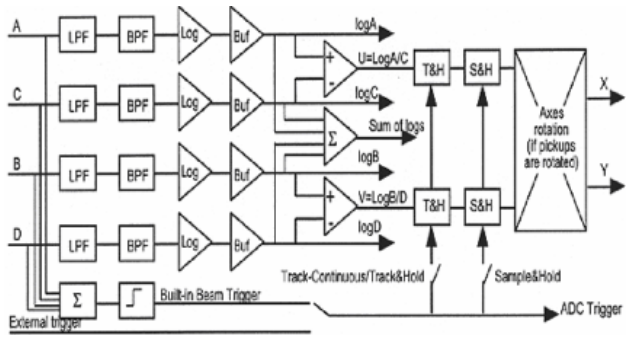

Figure 5: Log-ratio BPM block diagram.

Data Acquisition

Nation Instrument (NI) S-series multifunction DAQ board NI6143 are used for data acquisition of the log-ratio BPM board beam signal. BPM signal for all BPM value must be measured simultaneously. NI6143 has capability of simultaneous 16-bit, 250 kS/s/channel sampling for 8-independent analogue input. Four NI6143 boards are used for data acquisition of thirteen BTL BPMs. Data acquisition system is composed of Windows XP NI at NI-PXI. Application program is programmed by NI Lab-View version 7-1. For monitoring of BPM data at EPICS control system, BPM data acquisition system is developed as EPICS IOC. Fig 6 shows block diagram of NI 6143 DAQ board. Fig 7 shows block diagram of BTL BPM data acquisition system. Fig 8 is BPM data of BPM13 was taken at one of SR beam injection time.

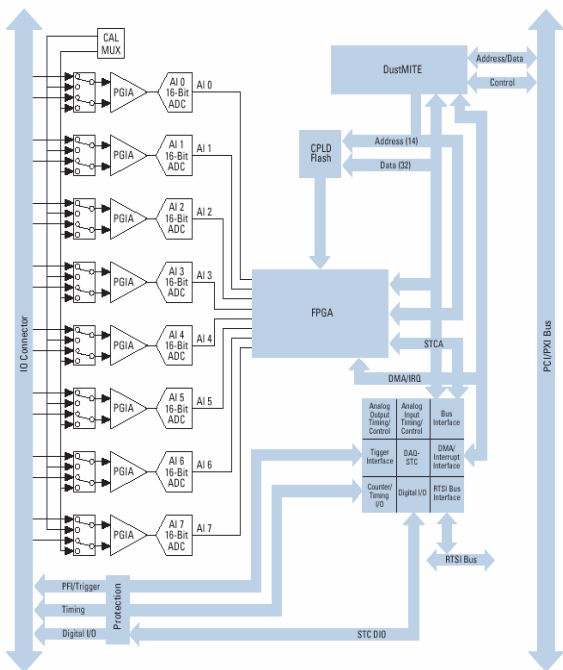

Figure 6: Block diagram of NI 6143 DAQ board.

SUMMARY

We have fabricated and tested PLS BTL BPM. It is composed of 100mm long strip-lines and 50Ohm SMA feedthrus on a cylindrical chamber, and 500 MHz Log-Ratio BPM board and NI S-series DAQ board for signal processing. Application program are programmed by NI Lab-View. For monitoring of BPM data at EPICS control system, BPM data acquisition system is developed as EPICS IOC. BTL BPM will be used for BTL beam optic correction and Linac beam diagnostic at Linac end.

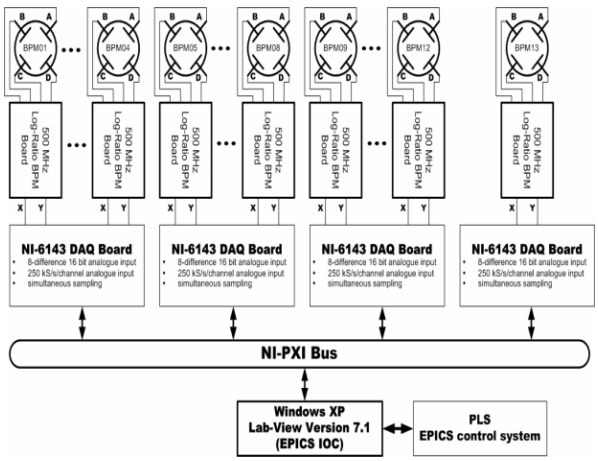

Figure 7: Block diagram of BTL BPM data acquisition system.

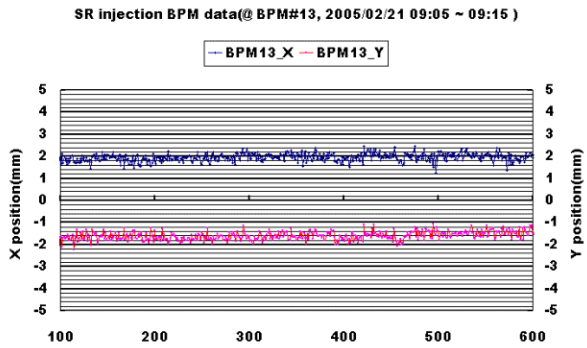

Figure 8: BPM data of BPM#13 at 2005/02/21 09:00 SR injection time.

REFERENCES

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[3] "Design Report of Pohnag Light Source (revised ed.)", Pohang Accelerator Laboratory, 1992

[4] "Log-ratio Beam Position Monitor user's manual", Bergoz Instrument

