BPM (BEAM POSITION MONITOR) OF PAL LINAC AND BTL *

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Abstract

In Aug. 2004, thirteen BPMs are installed at BTL(Beam Transport Line), and in Aug. 2005, three BPM installed at main linac for beam trajectory measurement and feedback. BPM of the Linac consist of 57mm strip-line electrodes in 100mm short chamber and SMA-R type feed-through. BPM of the BTL consist of 100mm strip-line electrodes in 150mm long chamber and used SMA-R type feed-through. These BPM electronics of Linac and BTL is adpoted 500MHz log-ratio signal processing circuits. BPM data acquisition system is developed as EPICS IOC by using NI S-series DAQ board and NI Lab-view 7.1. Maximum read-out accuracy of BPM system is measured as 20µm included BPM electronics. In this paper, we are describes on BPM characteristics of PAL Linac and BTL.

INTRODUCTION

The linac of the PAL is consists of 12 klystronmodulator systems, 11 pulse compressors, 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 as three µ-bunch. Operation frequency of the linac is 2,856 MHz. There are thirteen Beam Current Monitor (BCM), twelve Beam Profile Monitor (BPRM) and fifty-six Beam Loss Monitor (BLM) 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 is depends mainly on the beam optics. Thirteen BPMs were installed from Linac end to BTL end at Aug. 2004 and three BPM were installed main linac at Aug. 2005 for beam trajectory measurement and feedback. BPM of the linac consist of 57 mm strip-line electrodes in 100 mm long chamber, and BPM of the BTL consist of 100 mm strip-line electrodes in 150 mm short chamber beam signal pick-up is used SMA-R type feed-through. In this paper, we are describes on BPM characteristics of PAL Linac and BTL.

BEAM POSITION MONITOR(BPM) OF THE PAL

For stabilized beam injection from linac to storage ring (SR) beam trajectory measurement and energy feedback are very important and BPMs are necessary beam instrument.

BPM Chambers

A conventional strip-line type BPM was designed with a $\pi/2$ rotational symmetry. 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 and electrodes. Linac BPM consist of 57 mm strip-line electrodes in 100 mm chamber and diameter of strip-line to line is 20 mm. BTL BPM consist of 100 mm strip-line electrodes in 150 mm chamber and diameter of strip-line to line is 40 mm. 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 and 2 are show the strip-line type BPM for PAL Linac and BTL.



Figure 1: Strip-line type BPM for the PAL Linac



Figure 2: Strip-line type BPM for the PAL BTL

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Accuracy and calibration of the BPM

Accuracy and calibration of the BPM are measured by using 1ns pulse generator, and 500 MHz log-ratio BPM board at BPM test stand. Pulse applied at wire of the test stand, and X and Y output voltage of BPM board measure for each wire moving at BPM chamber inside. X and Y output voltage of BPM board each test beam position converted to real beam position. Fig. 3 is shows BPM test stand for accuracy and calibration measurement of the BPM.



Figure 3: BPM test stand for accuracy and calibration measurement of the BPM

Calibration of the BPM calculates as factor between voltage and position. Accuracy of the Linac BPM is measure by X position change to 2.00 mm step up 0.01 mm at test beam position is X = 2.00 mm and Y = 2.00 mm after BPM and BPM board calibration. Fig. 4 and 5 are accuracy measurement result PAL Linac BPM.



Figure 4: Accuracy measurement result PAL Linac BPM (10 times measurement)



Figure 5: Accuracy measurement result PAL Linac BPM (averaged data of 10 times measurement)

Accuracy of the BTL BPM is measure by X position change to 2.00 mm step up 0.01 mm at test beam position is X = 2.00 mm and Y = 2.00 mm after BPM and BPM board calibration.



Figure 6: Accuracy measurement result PAL BTL BPM (20 times measurement)



Figure 7: Accuracy measurement result PAL BTL BPM (averaged data of 20 times measurement)

Read-out accuracy of the PAL Linac and BTL BPM is measured 30 μ m and 20 μ m included BPM electronics, respectively. Table 1 lists BPM mainly specifications of the PAL Linac and BTL. Fig. 8 shows fabricated BPM of the PAL Linac BTL.

BPM	Linac	BTL
Туре	Strip-line	Strip-line
Electrode length (mm)	100	57
Chamber length (mm)	150	100
Diameter (strip-line) (mm)	20	40
BPM electronics	Log-ratio BPM Board (Berogoz)	
Accuracy (µm)	30	20
Installed no.	3	13

Table 1: Margin Specifications



Linac BPM



BTL BPM Figure 8: Fabricated BPM of the PAL Linac and BTL



BPM Data Acquisition System

Figure 9: block diagram of BTL BPM data acquisition system.

Data acquisition board is adopted Nation Instrument (NI) S-series multifunction DAO board NI6143 for data acquisition of the log-ratio BPM board beam signal(X Y). BPMs signal for beam occur almost simultaneously. Therefore all BPM value must measure simultaneously. NI6143 has capability simultaneously 16-bit, 250 kS/s/channel sampling for 8-independent analogue input. One DAO board used for BPMs data acquisition of Linac, and four DAO board used for BPMs data acquisition of BTL. All boards are simultaneously independent sampling for Linac beam trigger signal (10 Hz). Data acquisition system is consisted environment windows XP under NI-PXI. Using NI Lab-View programs data acquisition S/W. For monitoring of BPM data at EPICS control system, BPM data acquisition system is developed as EPICS IOC. Fig 7 shows block diagram of BTL BPM data acquisition system.

SUMMARY

At the PAL Linac and BTL, Thirteen BPM were installed from Linac end to BTL end at Aug. 2004 and three BPM were installed main linac at Aug. 2005 for beam trajectory measurement and feedback. BPM of the linac consist of 57 mm strip-line electrodes in 100 mm long chamber, and BPM of the BTL consist of 100 mm strip-line electrodes in 150 mm short chamber beam signal pick-up is used SMA-R type feed-through. To BPM data acquisition, 500 MHz Log-Ratio BPM board and NI S-series DAQ board (NI-6143) are adopted. Readout accuracy of the PAL Linac and BTL BPM is measured 30 µm and 20 µm included BPM electronics, respectively. Using NI Lab-View programs data acquisition S/W. For monitoring of BPM data at EPICS control system, BPM data acquisition system is developed as EPICS IOC.

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