

# Transient signal of cavity BPMs

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## Abstract

Cavity BPM outputs a position sensitive signal through the selective coupler and the frequency filter. In order to estimate the performance of the coupler, we observed the signal without the frequency filter. A transient signal was observed at the leading edge. Signals of three types of cavity BPM were compared.

## 1 Introduction

Beam passage excites various modes in a cavity BPM. Among the modes, only the dipole mode which is sensitive to the beam position is read out by the selective coupler and the frequency filter. In order to check the mode-selection performance of the coupler, the cavity output signal was measured without the frequency filter. We compared three types of cavity BPM installed in the extraction line.

## 2 Setup

Figure 1 shows the electronics used in this experiment. In the cases of PAL and KEK cavity, only one port was read out and the opposite port was terminated. Usually, a band pass filter (BPF) is installed upstream of the electronics for further mode selection. The center frequency is 6.4 GHz and the band width is 400 MHz. In this experiment, the BPF was removed to observe all the signal from the cavity output. In this case, a pulse shape illustrated in Figure 1 was observed. A fast component which was not seen in the usual setup appeared in the leading edge of the signal.

We measured the pulse shape while changing the beam orbit. The beam position at the cavity was calculated from the layout of the strip-line BPM which was used to monitor the beam position and the steering magnet used to change the beam orbit. The sensitivity of the cavity BPM was measured from the amplitude of the dipole mode (slow component). We estimated the amplitude of the fast component, how much position it corresponds.

## 3 Result

Pulse shapes of the three types of BPM are shown in Figure 2. Even if the beam was on the center of the BPM (no slow component) the fast component remains.

Since BPF can reject the component, it is not the dipole mode signal. It is assumed to be a common mode or a mixture of higher-order modes. If it is dominated by the common modes, it should be greatly suppressed by combining the opposite port signal in the anti-phase. We tried "with hybrid" setup shown in Figure 3 for PAL BPM. The scope pictures are the case the beam was steered near the cavity center. No apparent change in the fast component was seen. (Since the power of the dipole mode was doubled by the combiner, the fast component may be a little suppressed relative to the dipole mode.) The fast component is not dominated by the common mode.

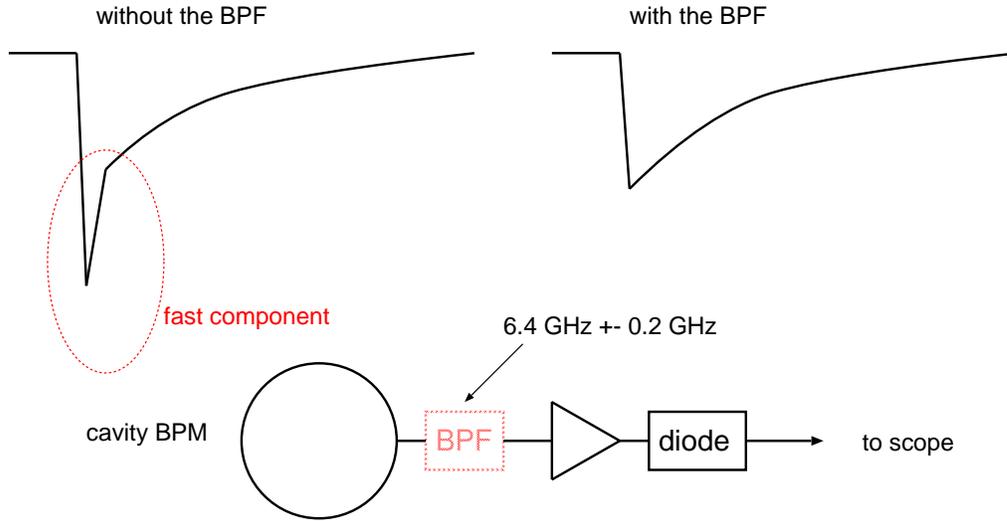


Figure 1: Setup of the measurement and signal seen in the scope.

## 4 Summary

Normalizing by the sensitivity of the slow component to the beam position, the amount of the fast component was estimated. The result is summarized in the Table 1.

BINP cavity has the largest transient signal among the three. We guess that it is due to the asymmetric design of the cavity structure (two output ports). It seems that the poor efficiency of the coupler makes KEK cavity to have the smallest transient signal.

Since the transient signal is estimated to be smaller than the saturation level of the detection electronics, there should be no problem in the PAL cavity even if without the BPF.

Table 1: Summary of the result

cavity	amplitude of fast component	
BINP(SLAC)	800 $\mu\text{m}$	
PAL(ATF2)	80 $\mu\text{m}$	70 $\mu\text{m}$ (with hybrid)
KEK(Inoue)	20 $\mu\text{m}$ (not clear)	

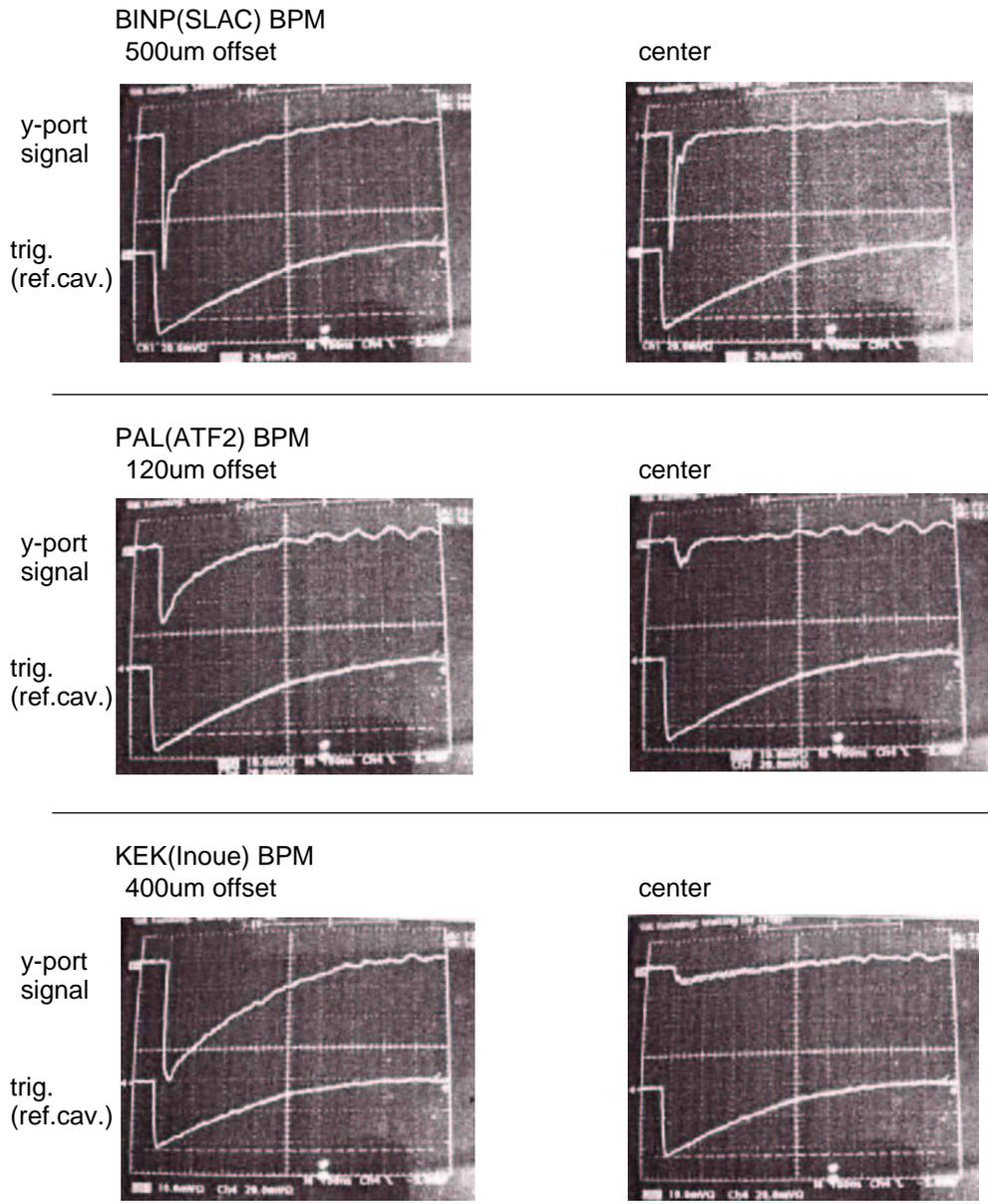


Figure 2: Signal of the three types of BPM.

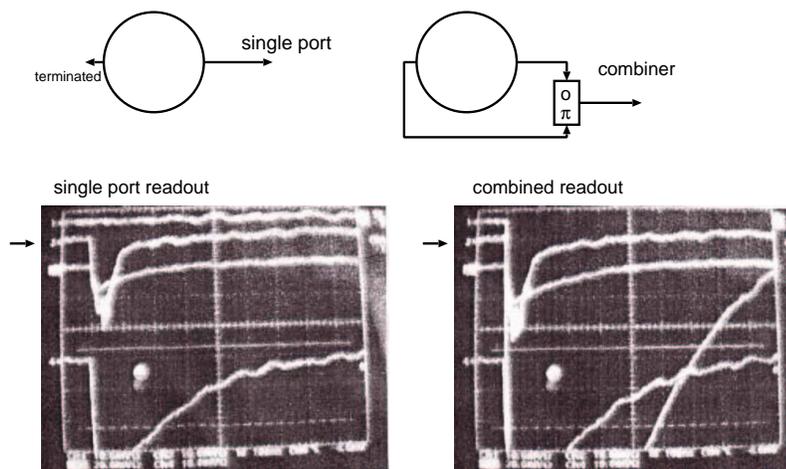


Figure 3: Setup with hybrid and the result of PAL BPM.