

THE KEKB TIMING SYSTEM

M. Suetake, N. Akasaka and Y. Ohnishi
 High Energy Accelerator Research Organization (KEK)
 1-1 Oho, Tsukuba, 305 Japan

Abstract

The KEKB control system required a new timing system to match low longitudinal acceptance due to low alpha machine. This timing system is based on frequency divider/multiply technique and digital delay technique. The KEKB timing system is a little complicated, because KEKB ring RF frequency (508.887MHz) is not a divisor of Linac RF frequency (2856MHz). The KEKB ring frequency and the Linac frequency is locked with a common divisor frequency (10.385MHz). The common divisor frequency determines injection timing. This paper describes the overview of KEKB timing system and RF bucket selection system.

1 Introduction

1.1 The difference of injection schema between TRISTAN and KEKB

At TRISTAN they adopted 5-bunch injection system which means that 5 bunches of Linac beam are merged into a bunch of TRISTAN beam. We can't inject multi-bunch beams in order to match low longitudinal acceptance, for KEKB ring is low alpha machine. Timing jitter between injected beam and RF bucket is allowed less than 30 psec. That of low-level control system is limited within several psec. So we intended to inject single and high current bunch beam. Furthermore we synchronize KEKB RF frequency (508.887MHz) and Linac frequency (2856MHz) so that we can always catch Linac beams at the same phase of KEKB RF frequency.

1.2 2856 MHz and 508.887 MHz

Although KEKB RF frequency is not a divisor of Linac RF frequency, those frequencies have a common divisor frequency (10,385MHz). Because of the existence of common divisor frequency, we can synchronize KEKB RF

bucket timing and Linac beams at the common divisor frequency intervals. Linac RF frequency and KEKB RF frequency are locked by common divisor frequency with a newly developed multi-synthesizer.

2 Multi-synthesizer

There are two types of multi-synthesizer that are newly developed for KEKB. We now introduce one type of synthesizer. Fig.1 shows block diagram of synthesizer. Source of the synthesizer is 571.2 MHz that is used with subharmonic buncher in Linac. The frequency 571.2 MHz is multiplied by 5 and generates 2856 MHz that is used as LINAC RF frequency. Simultaneously, the frequency 571.2 MHz is divided by 5 and generates 114.2 MHz frequency, which is also used with another subharmonic buncher. The 114.2 MHz frequency is divided by 11 and generates 10.385MHz frequency, which is common divisor frequency. The common divisor frequency is multiplied by 5 and mixed with 571.2 MHz frequency and finally generates 508.558MHz frequency, which is KEKB RF frequency. All frequencies are connected and locked with the common divisor frequency 10.585 MHz. All reference frequencies are listed in Table 1.

Table 1

The reference frequencies used in KEKB ring and LINAC

KEKB ring reference	LINAC reference
	2856 MHz
	571.2 MHz
508.887 MHz	508.887 MHz
	114.2 MHz
10.385 MHz	10.385 MHz

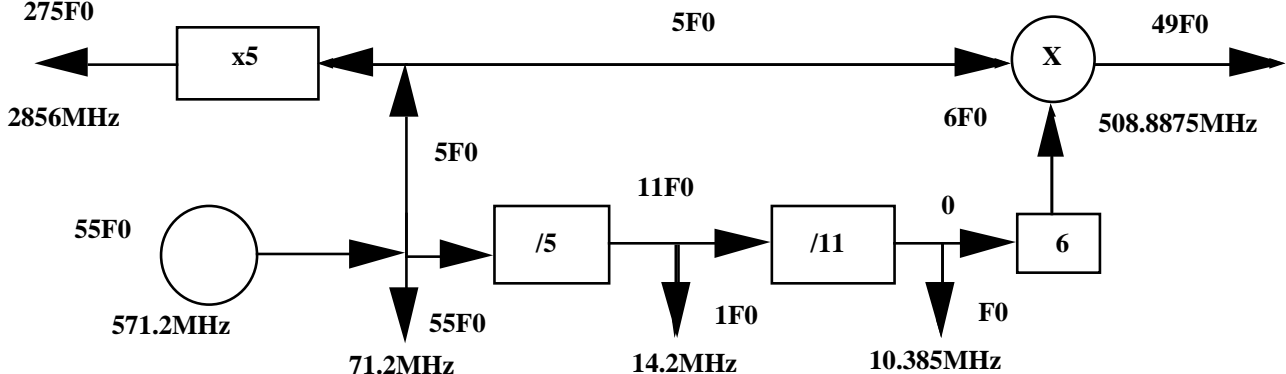


Fig. 1 KEKB Multi-synthesizer

4.2 Injection Phase and Collision Phase

We can match the phase between KEKB RF bucket and LINAC beam with changing KEKB reference

frequency phase. The phase between electron and positron collision timing at intersection region can be adjusted by changing LER RF phase.

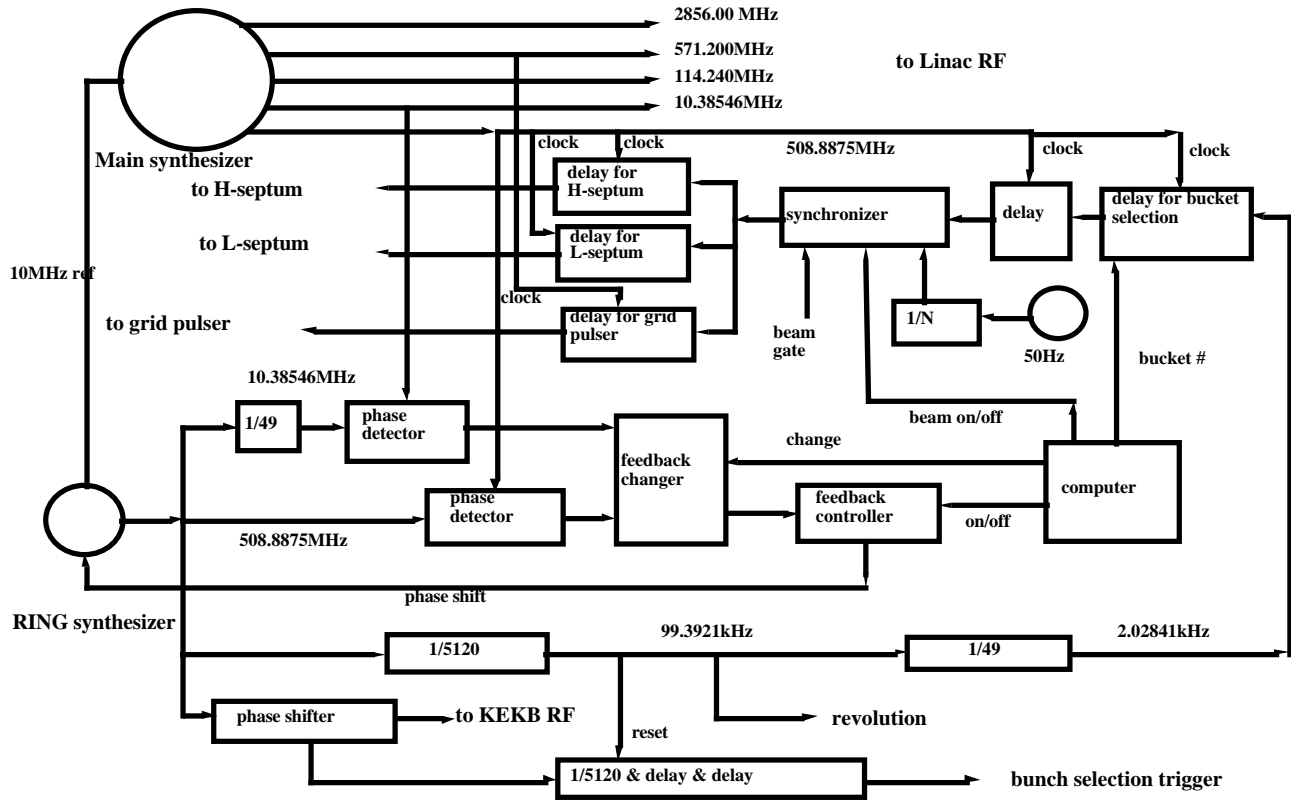


Fig. 3 KEKB Timing diagram

5 Frequency Shift and Phase Lock to Linac synthesizer

At injection timing, KEKB RF frequency and LINAC frequency are locked with the frequency 10.385 MHz. After injection, KEKB RF frequency can be changed in order to adjust ring circumference and in order to measure dispersion and chromaticity parameters. When KEKB RF frequency is changed, the frequency lock system with

LINAC frequency is killed. At next injection timing, we first lock KEKB 10.385 MHz frequency with LINAC 10.385 MHz frequency and second lock the KEKB 508.887 MHz frequency with the LINAC 508.887 MHz frequency. So we can continuously add KEKB ring beams even after frequency changing. The LINAC 508 MHz frequency and the LINAC 2856 MHz frequency are always locked with the LINAC 10.385 MHz frequency.

6 Summary

Since we introduce single bunch injection and the frequency lock system between KEKB ring frequency and LINAC frequency, we can inject LINAC beams within several psec jitters. We can select any bucket address in KEKB ring, change ring frequency freely without injection timing and inject LINAC beams continuously next injection timing.