Timing System Upgrade for Top-up Injection both to PF and KEKB

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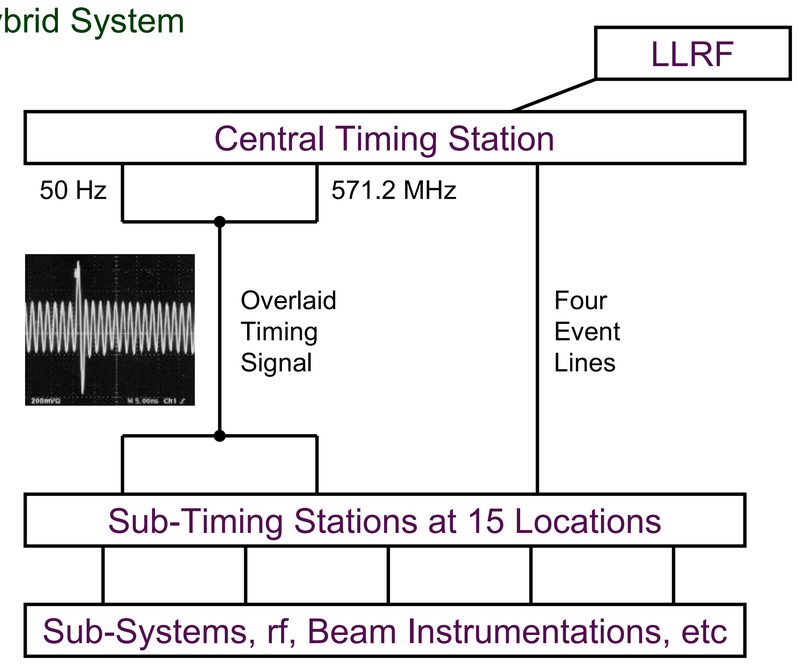
KEK 8-GeV Linac provides electrons and positrons to Photon Factory (PF) and B-Factory (KEKB). Because of the nature of those factory machines, both quantity and quality of the beams are required. In order to improve the injections, quasi top-up injections of electrons to PF and KEKB rings have been planned and a new beam transport line was built. Fast beam switching mechanisms are being developed and installed. The timing and control system is also reinforced to realize fast (50Hz) switching of rf timing pulses, low-level rf, beam instrumentation parameters, and beam feedback parameters. The present timing system provides precise (jitters down to 3ps) timing pulses to 150 devices. Many of the signals will be upgraded to enable the fast switching scheme with an event system. At the same time a double-fold synchronization between asynchronous Linac and PF rf signals was developed to achieve precise injection timing mainly because both rings have independent circumference correction systems.

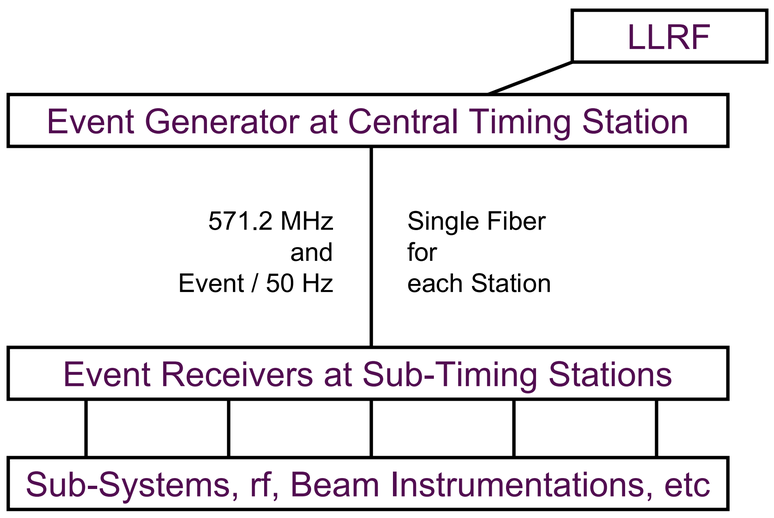
Timing / Event Distribution System

Present Hybrid System



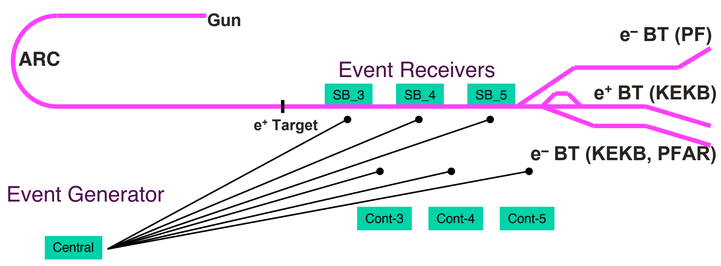
~150 Timing Signals with Jitter of ~3ps are provided.
Each Station consists of Many VME or CAMAC modules.

New System with Event Generator and Receivers



~180 Timing Signals with Jitter of ~3ps will be provided.
Event Generator and Receivers (EVG/EVR200 from MRF) simplify the system, and they enable the fast switching of timing, digital and analog parameters.

Event System Configuration



An Event Generator and 6 Event Receivers are installed at first in Sectors Number 3, 4 and 5, where fast switching of many accelerator parameters are required to enable the fast Beam Switch.

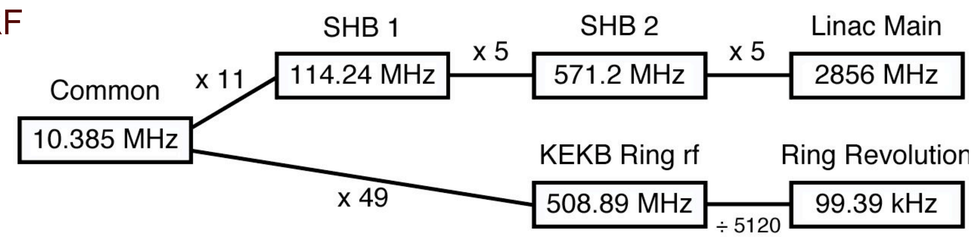
Parameter / Timing Switching (up to 50 Hz)

- ✧ Pulsed Bending Magnet
- ✧ Fast BPM read-out System
- ✧ Streak Cameras
- ✧ Wire Scanners
- ✧ Low-Level rf Parameters
- ✧ rf Measurement Parameters
- ✧ rf Active / Stand-by
- ✧ Beam Feedback Systems
- ✧ Parameter Manipulation / Display
- ✧ Archiving
- ✧ etc.

(Present System needs switching time up to 30 seconds, and will gradually be upgraded to 50 Hz.)

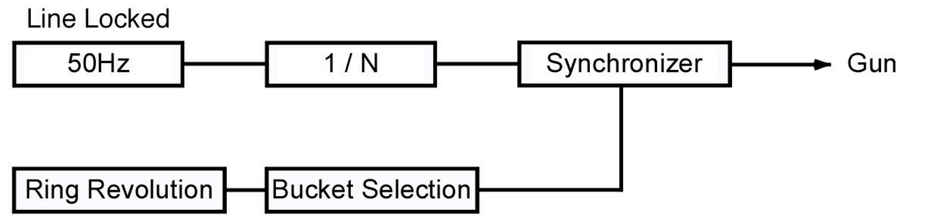
rf Synchronization System

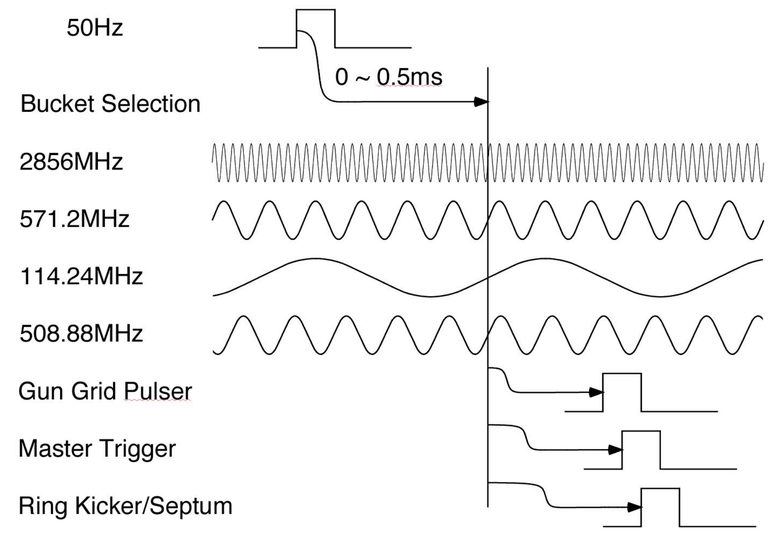
Synchronization between Linac and KEKB



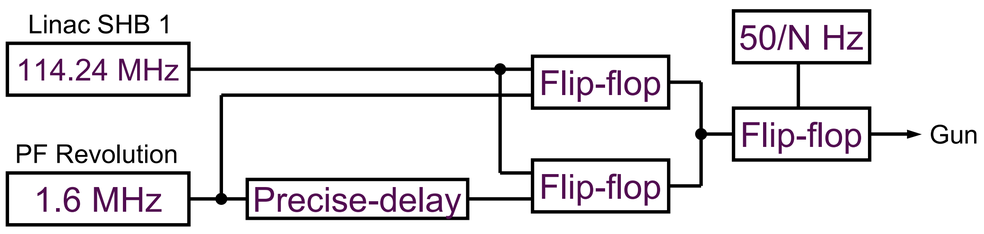
rf Frequencies are derived based on Integer Relations. They are continuously adjusted to compensate the KEKB Ring Circumference.

Beam Timing





New Synchronization between Linac and PF Ring



114.24 MHz is already defined by the KEKB ring Circumference as described above. However, 1.6 MHz (PF Ring Revolution Frequency) is also continuously adjusted to compensate the PF Ring Circumference at the same time.

This circuit provides the Synchronization between those asynchronous signals with Jitter down to 300ps.

Beam Pulse Selection

Mostly KEKB

KEKB	PF-Ring
50 Hz	0 Hz
50-1 Hz	1 Hz
50-2 Hz	2 Hz
50-4 Hz	4 Hz
50-5 Hz	5 Hz
...	...

25Hz Allocated

KEKB	PF-Ring
50/2 Hz	50/2 Hz
50/4 Hz	50/4 Hz
50/6 Hz	50/6 Hz
50/8 Hz	50/8 Hz
50/10 Hz	50/10 Hz
...	...

10Hz Allocated

KEKB	PF-Ring
50/5 Hz	50/5 Hz
50/10 Hz	50/10 Hz
50/20 Hz	50/20 Hz
50/25 Hz	50/25 Hz
50/50 Hz	50/50 Hz
...	...

Because of the constant-interval requirement to Septum/Kicker Power Supplies at the moment, Beam Pulse Selection is Restricted. Currently Above three Schemes are planned. After the Power Supplies are Tuned, unrestricted Beam Pulse Selection will be enabled.