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CTF3 Note 012 (Tech.)
(Timing)

TIMING FOR CTF3 PRELIMINARY PHASE

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Abstract

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Geneva, Switzerland
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1 MODIFICATIONS TO CENTRAL TIMING

1.1 De-coupling from PS

The central Master Timing Generator (MTG), which provides the timing for the PS complex, uses a beam description, which locates the relative times of the cycles in different accelerators according to injection and ejection rendezvous points, where the beam is transferred between machines. The current LPI accelerator has lepton transfer rendezvous with the CPS accelerator, and hence it has a super-cycle, cycles for electrons or positrons, and it is controlled by the LPI telegram which pilots the PS standard PPM mechanism, real time tasks, and application programs.

Suppressing the LPI telegram completely, even if there were no CTF3, would be a very big job as it involves deleting the LPI machine from the Oracle database and consequently rebuilding almost the entire PS complex control system.

The CTF3 will not be strongly coupled with the CPS machine, although their may be some second order reasons for doing so, such as avoiding undesirable side effects from electrical noise, or other factors affecting repeatability. The CTF3 may also need to tag acquisition data with a basic period number, or perhaps a universal time stamp as in other machines and, having acquired the data, it must store them somewhere where they can later be accessed by application programs. Some slow timing will be needed to co-ordinate this activity, especially if correlation of data from physically separate processes is to be achieved.

The CTF3 will also need to control the production or dummy timing selection currently piloted by the IKBOX RT task via the LPI telegram.

For these reasons the telegram concept would still seem to be relevant to the CTF3 machine, and the 1.2 s and 1 kHz trains defining the coarse timing and the Basic Period also will be needed. Building a CTF3 super-cycle, however, is completely irrelevant.

We propose to leave the LPI telegram in place, and create the alias “CTF” by which it can be referenced. The structure of the CTF telegram will include “groups” i.e. parameters controlling production-dummy timing selection, the EPA bucket filling scheme, 3GHz synchronised RF or not (see section 2), and acquisition tags. We propose to declare the CTF machine as “loosely-coupled” to the MTG, suppressing completely the idea of super-cycle and to pilot the data in the CTF telegram via MTG equipment calls and external conditions. This will require some modifications to the PLS-Editor application program, to the MTG volatile logic (FIDO), and to the super-cycle update process. Estimated very roughly in the order of about 1 man month of effort.

1.2 IKBox clean-up

There are currently 120 declared timings for the IKBOX controlled from the DSC DLPITIMG. Those not required for CTF3 should be identified and removed.

1.3 Zero-point crossing synchronisation

By this we mean coarse timing 1KHz re-synchronised to the network 100Hz**.** Many of these timings can be suppressed completely, and others derived directly from the MTG. This will be better understood when we have a clear idea about how the CTF will be operated.

1.4 Suppression of old serial telegram

The old style 256 bit serial encoded telegram is strobed by Hx.WPLS, which is 100Hz synchronised. This old style telegram distribution should be replaced by the new CTF telegram distributed over the MTG timing drop net for the Tg8s. Today the LPI telegram pilots the production/dummy mode, and it must be distributed synchronously with the linac period to avoid jitter between the C-train and the 100Hz which would result in losses in control of the first linac period in a Basic Period.

2 RF SYCHRONISATION

At present, there is no synchronisation between the 3 GHz LIL and 19 MHz EPA RF systems. All digital delays (for gun, klystrons etc.) are derived from the EPA frequency. A simplified layout is shown in Fig. 1. A 3 ms train of 19 MHz pulses is generated, synchronised to the 50 Hz network zero-crossing, and with the first pulse selectable to fill the required EPA bucket. This train is then sent to the GPPC CAMAC counters, which generate the timing pulses.

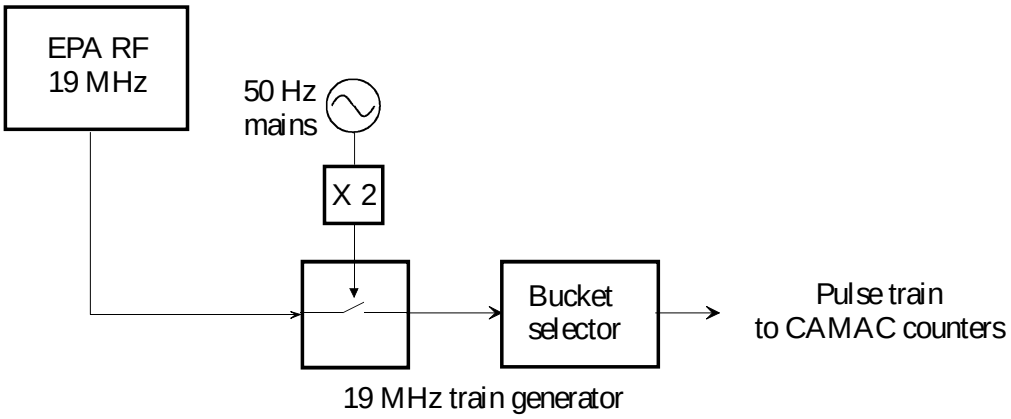

Fig 1: Current LIL 19 MHz timing (simplified).

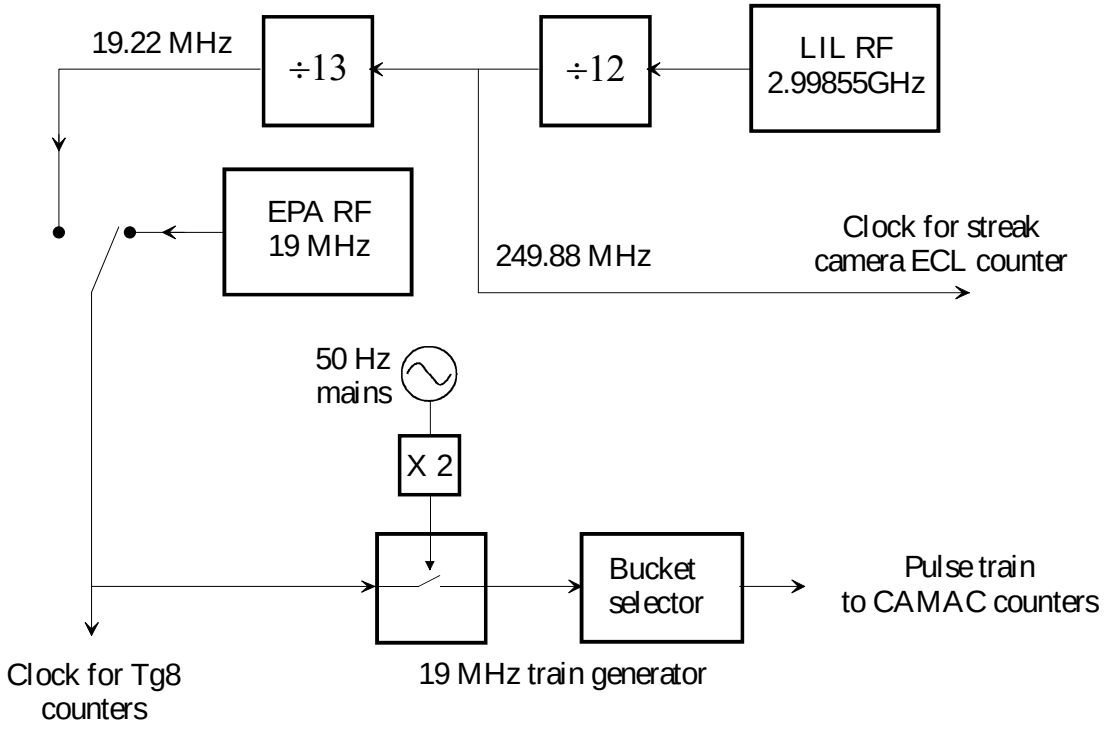

Fig. 2: Proposed synchronisation for CTF3 preliminary phase (simplified).

This scheme is not suitable for CTF3 running for the combination test. The gun and the streak camera must be synchronised to the 3 GHz. To solve this problem, two running modes are proposed, with and without 3 GHz synchronisation (Fig 2). When accumulating in EPA there will be no 3 GHz synchronisation. The two RF's will be independent and the timing will essentially be as for LIL. When testing combination in EPA, the EPA cavity will be switched off and the timing switched to a 19.2 MHz signal derived from the 3 GHz. Due to the slight frequency difference, two sets of data will be required for loading into the CAMAC counters. Division of the 3 GHz will be in two stages. The 250 MHz will be used as a clock for the streak camera trigger counter. The 3 GHz divider chain requires development.

3 DIGITAL DELAYS

3.1 Existing LIL equipment

Timing pulses are presently generated by GPPC CAMAC modules. These and their associated blocking level drivers will remain in use for the preliminary phase of CTF3 for all existing equipment. At a later stage, it is planned to replace them by Tg8 counters or (wherever precision necessitates) ECL counters. The drivers will also be replaced. This electronics, which is currently under development, will be used exclusively for new timing requirements for the preliminary phase (i.e. gun and streak camera).

3.2 Gun timing

The gun requires two timing signals:

(i) A start pulse, approximately 50 ns pulse width.
(ii) A train of pulses with a spacing of about 420 ns, adjustable to better than 0.5 ns. There will be a maximum of seven pulses, with the possibility to independently enable or disable each one. The pulse width should be about 50 ns. It need not be variable, as the timing does not control output pulse length.

Both signals should be 50 Ω TTL

It is proposed to implement these using the newly modified PS Tg8 standard. These modules incorporate counters that can be clocked at 19 MHz (Fig 3). Resolution will be improved to 0.2 ns by the addition of an Analog Devices AD9501 delay chip at the output. Unlike the GPPC CAMAC modules, these counters will have a continuous clock input with counting enabled by a start pulse. This will facilitate clock distribution later on and corresponds to the architecture of the ECL counters described below.

As is currently the case for the IKBOX, all timings will be generated in parallel, and selected by placing a logic 1 level on the select gate. The select lines can be driven by a standard telegram driven RT task controlling a digital output VME module (VMOD DOR) each linac period (100Hz).

3.3 Streak camera timing

The streak camera requires a trigger with a short-term stability of better than 10 ps. An ECL delay card capable of this is being developed. It will be clocked at 250 MHz and have a vernier delay resolution of 20 ps. This card, which is being developed for multiple uses for CTF3 nominal phase, will not be completed for 2001. However, for the streak camera, a prototype will be available.

The ECL counter will receive its start trigger from a Tg8 19 MHz counter output.

3.4 Line drivers

For distribution of the gun and streak camera timing signals, new 50 Ω line drivers are being developed. They will be able to provide a pulse up to 10 V with a rise time of the order of 1 ns. It is planned to use these drivers extensively in the later stages of CTF3. They will replace the blocking level drivers that, due to their slow rise-times, give excessive timing uncertainty.

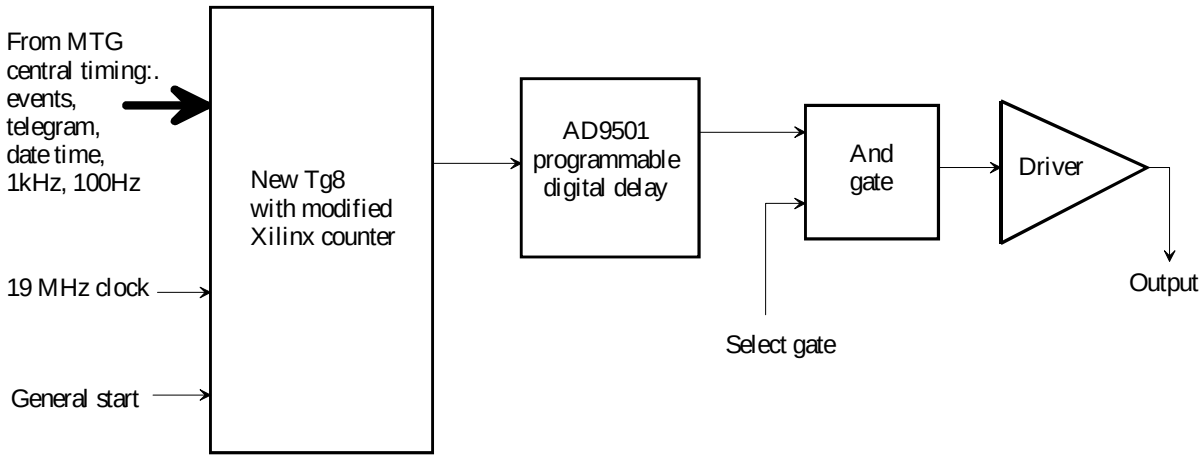

Fig. 3: General purpose Tg8 timing channel.