RF Cavity Transient Phasing Procedure

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Estimated Time to Perform: ~15 minutes for first cavity (includes setup); ~5 minutes for each additional cavity

Procedure Overview

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This procedure uses the transients produced by pulsed beam to set the phase of an RF cavity to approximate crest (the expected accuracy is ±15° from actual crest). Phasing is done one cavity at a time. This procedure is generally used to adjust cavity phases when pulsed beam cannot be transported through a linac (i.e., when the use of a more efficient method of adjusting cavity phases is not possible).

Prerequisites

1. The following testing hardware is required:
   - A digitizing oscilloscope with averaging (Tektronix TDS recommended)
   - The MCC analog monitoring system (AMS)
2. Line synched >~15 μA pulsed beam (250 μs pulses).

Procedure Steps

1.0 Preliminary Setup Steps

1. Verify that the beam synch signal is connected to the oscilloscope's auxiliary input and that the oscilloscope is triggered from the auxiliary input.
2. Set Channel 1 on the oscilloscope to AC coupled (50 mV/division, 50 μs/division) and select the continuous average mode (100 samples).
3. Connect the beam synch signal to Channel 2 on the oscilloscope, and set the trigger level to +2 V (5 V/division, 50 μs/division).

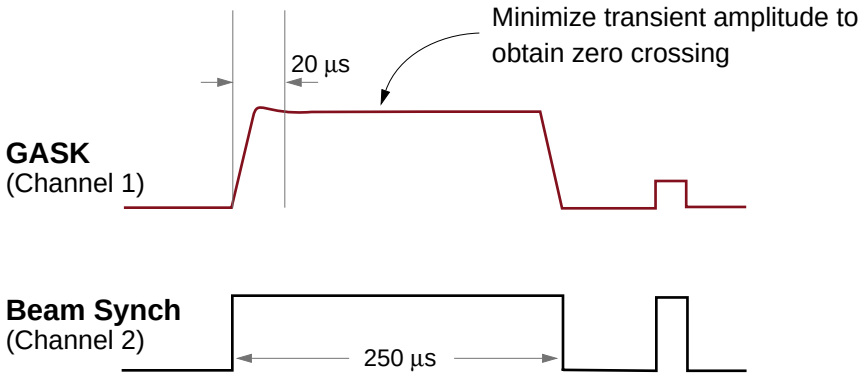
   NOTE: This step is not absolutely necessary to complete this procedure. It does, however, give a means to verify that the beam synch pulse signal is actually there.

2.0 Cavity Phasing Steps

1. Set the RF cavity to its operating gradient (GSET).
2. Are the gradient and phase loops closed and stable?

   YES NO → **A.** Close the cavity's gradient and phase loops and go to Step 3.
3. Using the AMS menu screen, select the gradient modulator drive (GASK) for the cavity that is being phased.
4. Connect the appropriate output from the AMS to Channel 1 on the oscilloscope.
5. Observe the amplitude of the beam-induced transient on the oscilloscope at a point approximately 20 µs after the pulse begins (refer to Figure 2-1). Note that, due to cable delays, the transients may be delayed with respect to the beam synch signal.

Figure 2-1: GASK and Beam Synch Waveforms



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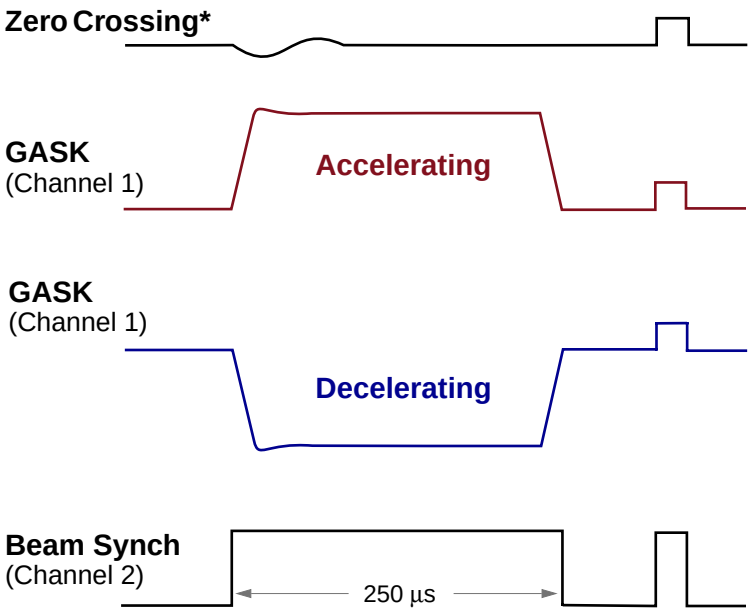
6. Adjust the phase of the cavity (PSET) to minimize the amplitude of the transient and thus set the cavity on zero crossing (see Figure 2-2).

   NOTE: You may need to adjust the sensitivity of the oscilloscope in order to obtain a good signal.

   Figure 2-2: Zero Crossing and Accelerating and Decelerating Wave Forms



   ***NOTE:** Because of beam loading in the warm region of the injector, at zero crossing there is a change in the sign of GASK during the macro-pulse. Only the first 10 µs is important for cavity phasing.

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7. Add +90° to the cavity's present PSET value.
8. Compare the oscilloscope screen to the wave forms shown in Figure 2-2 to determine if the cavity is accelerating or decelerating. Is it accelerating?

   YES NO → **A.** Add +180° to the cavity's PSET value.

   B. Go to Step 9, below.

9. You have determined the cavity's on-crest phase setting (the anticipated accuracy of ±15° from crest is considered to be adequate). Note in the *Daily Activity Log* that the cavity was phased and record its new PSET value.
10. Go to the next RF cavity that needs to be phased and repeat Step 1 through Step 9 in this section.