

LE Linac Waveform Generator Calibration

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During the testing and calibration of the Frequency Control System Logic Modules (0230-EC-4560), it was discovered that different stations had different timing for both the driver and modulator waveforms, which can cause the regulation loop for cavity frequency not to work. Some adjustments to the waveform generator are required when changing modules. I have attached the list of information required to make this adjustment, which at the base level, requires setting the modulator waveform flattop to last longer than the sample time delay of the Frequency Control System Logic Module.

1. Determine time on each system from the start of beam.
2. Presently we have the following beam start times after Tzero
 - a. L:TCHTON (Tuneup/Study) 1992.3 us
 - b. L:TCHHON (HEP) 1992.2 us
 - c. L:TCHNON (NTF) 1992.0 us
3. Ideally, these should all be set to the same time, say 1992.0 us
4. All of the LE Linac stations are turned on the RF ON pulse. We know that L:TRFON (LE Linac RF On) is set at 1764.4 us after Tzero. This is delayed approximately 230 us before beam to allow each station time to turn on the driver, then ramp up & stabilize the modulator waveform before beam arrives.
5. Since all stations may have different delays between beam and the RF on pulse, due to delay time in cables and beam transit time factors, then the delay between the RF on pulse and the start of beam may vary slightly. This delay should be measured on all stations and documented.
6. Using the system with the shortest time measure in the previous step, set we can then set the driver start time (call Modulator Start Adjustment on the Waveform Generator) to the minimum value on the shortest time, and adjust all other stations to match. The Mod Start Adjustment can be varied from a minimum of 5 us to a maximum of 75 us.
7. Once all the drivers are calibrated to start a fixed time from the rising edge of beam on all stations, then the Modulator Stop Adjustment can be adjusted to allow for proper operation of the slug tuner. The Cavity Slug tuner samples the gradient and forward power. The adjustment time of this is typically calibrated to be 300 us after the start of the driver RF pulse (which is used to trigger this module). Some cavity regulators are set to different sample times, which may be listed on the module. It is important for the gradient to be flat during this time, so the Modulator Stop Adjustment must be set on all stations to be at least 300 us after the driver start. Ideally, we should set this flat top end time to 310 us to allow for small errors.
8. After the Modulator Stop Adjustment, the Driver Stop Adjustment can be set. This is used to determine the amount of time after the modulator turns off that we can turn off the driver pulse. Since the accelerating cavities can apply reverse power to the tube since they are set at 80 ohms impedance (overcoupled), then we desire to wait to turn off the driver until the gradient decays to almost nothing. We can adjust anywhere from 5-15 us.