Time Multiplexed Multitones

A new way to test filters?

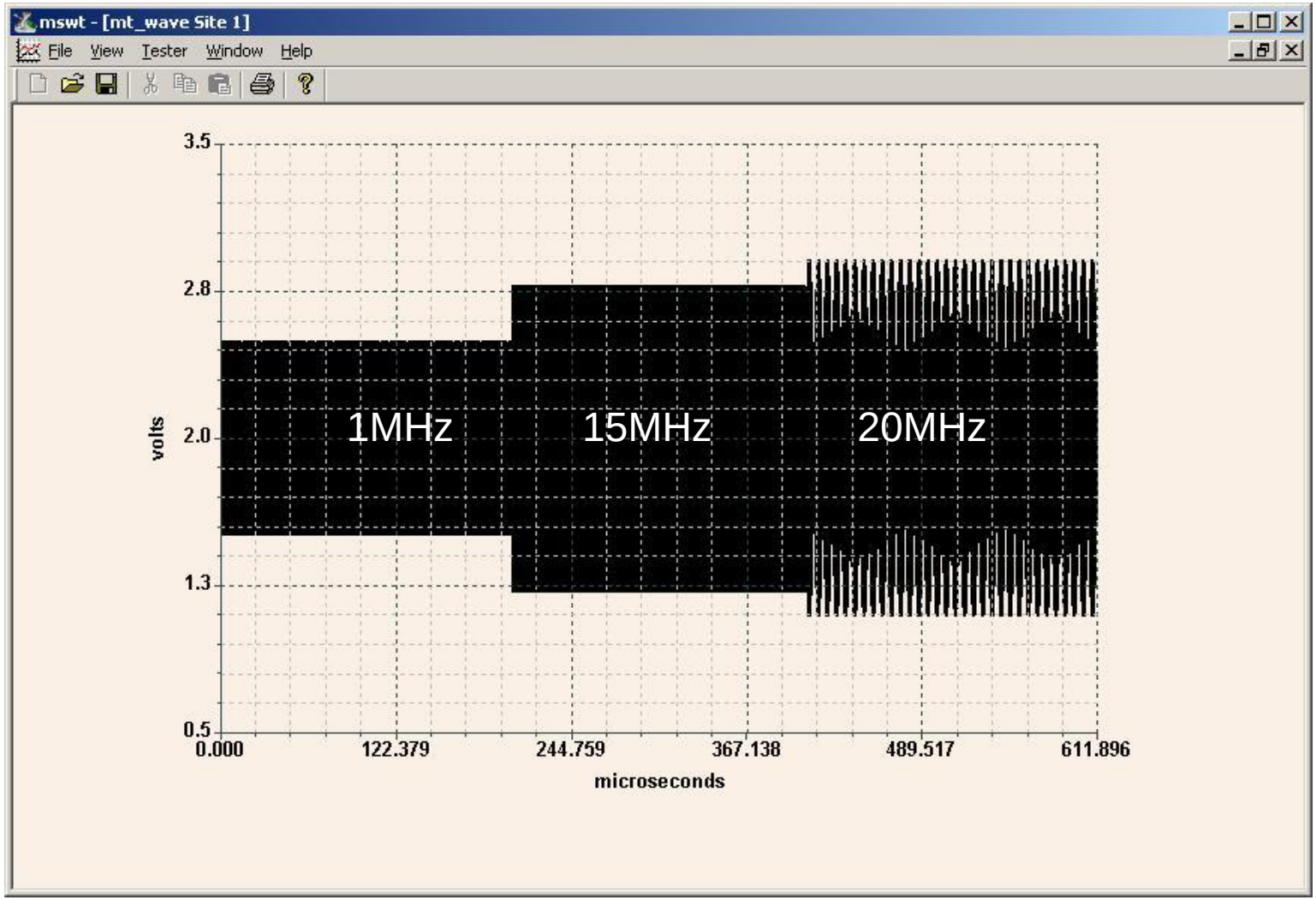
Multitone testing

- Pluses –
  - Very fast
    - Don’t have to setup, burst, capture and process each tone.
- Minuses –
  - Somewhat error prone
    - Amplitude of each tone is limited by the peak amplitude of the tone set.
      - Random phases helps reduce crest factor, but still can’t have full amplitude signal for each tone.

Time Multiplexed Multitones

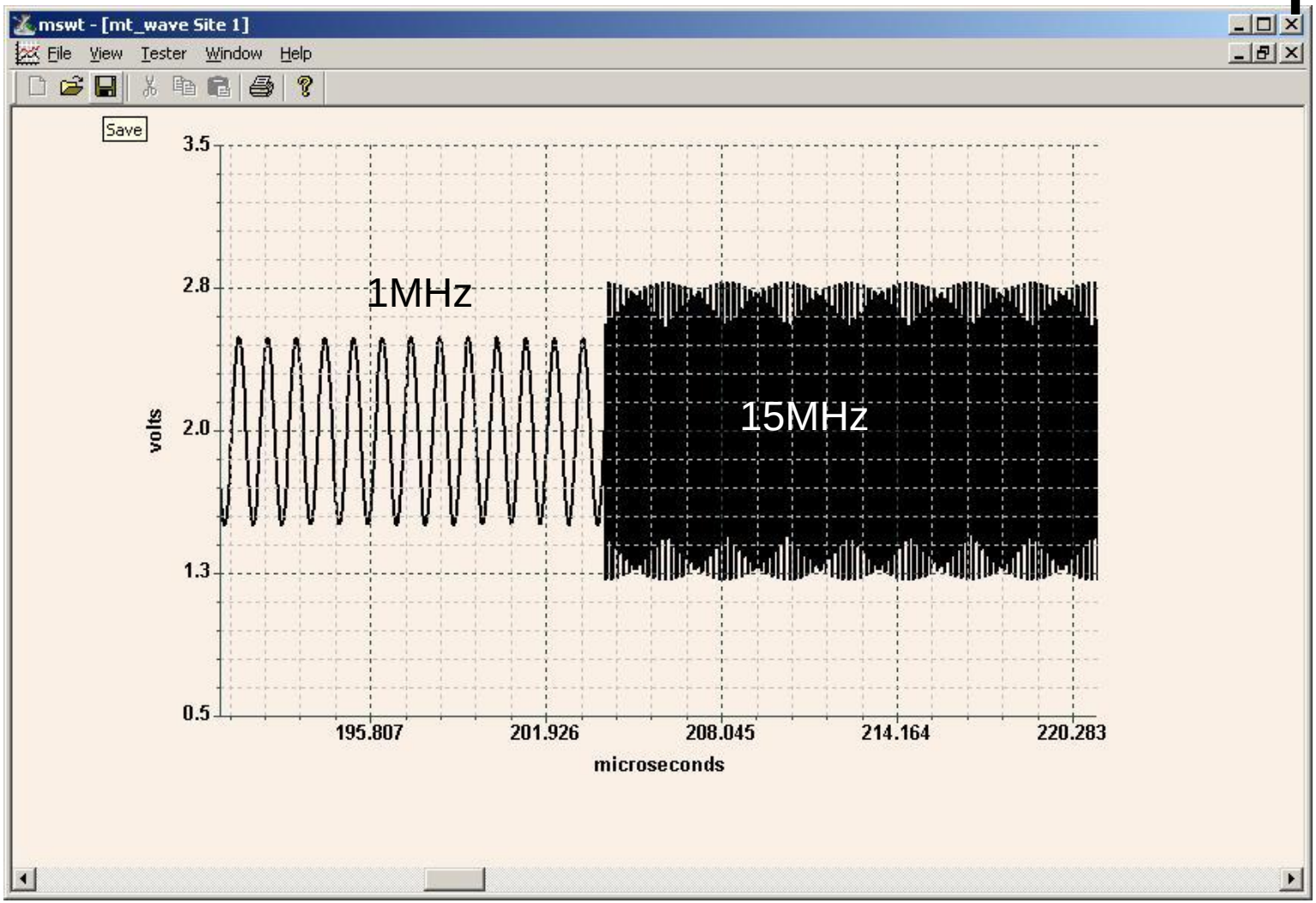
- Create each tone in time domain.
- Concatenate them together “end-to-end”
- Start AWI and ACI together as phase aligned pair.
- Download individual tones from the ACI
- Process
  - Add them together, then do FFT for speed or
  - Perform FFT on each individual tone for accuracy

Post-Cal Source TM Multitone



Amplitudes are not equal because of sin(x)/x and channel response

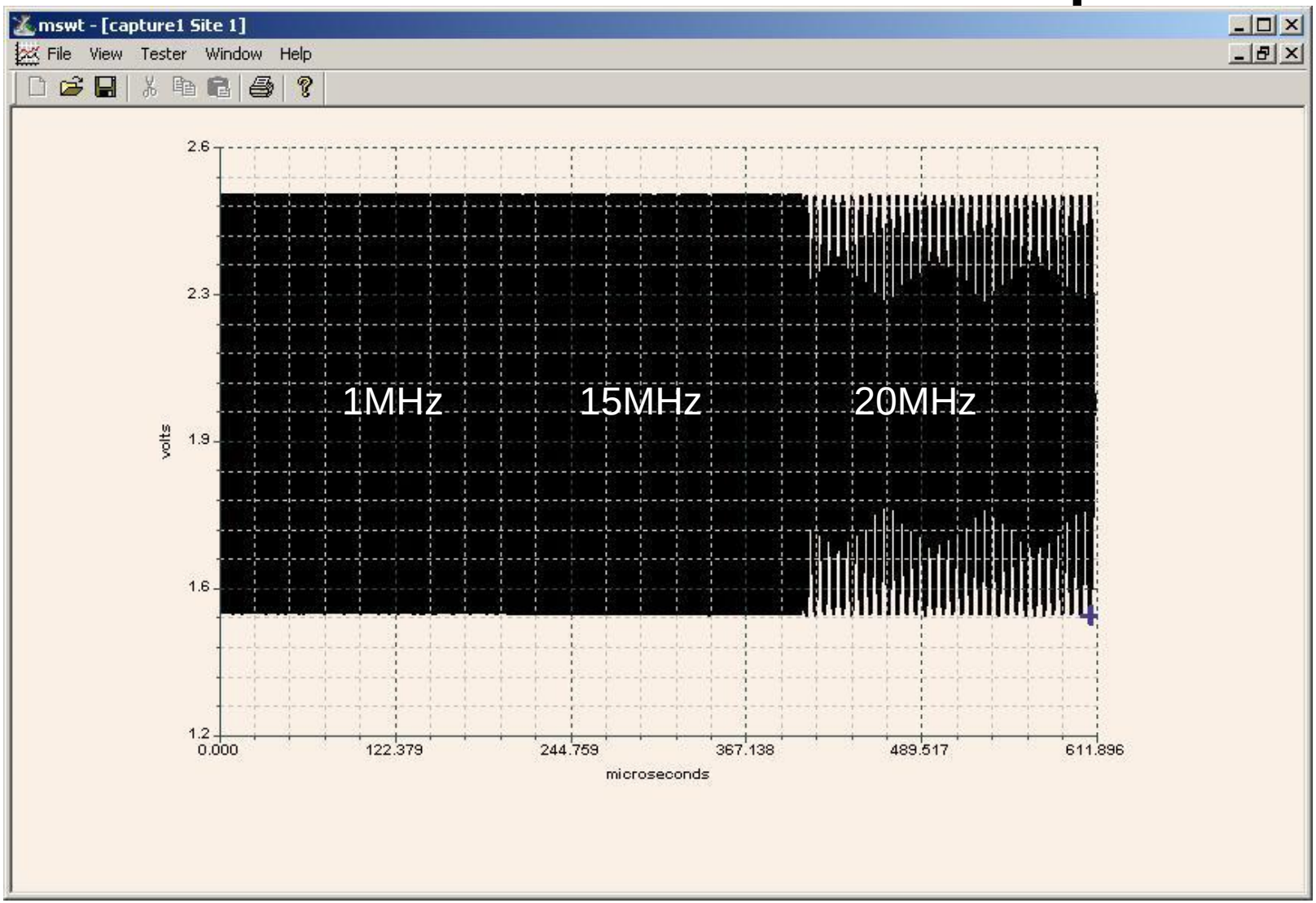
Post-cal TM Multitone closeup



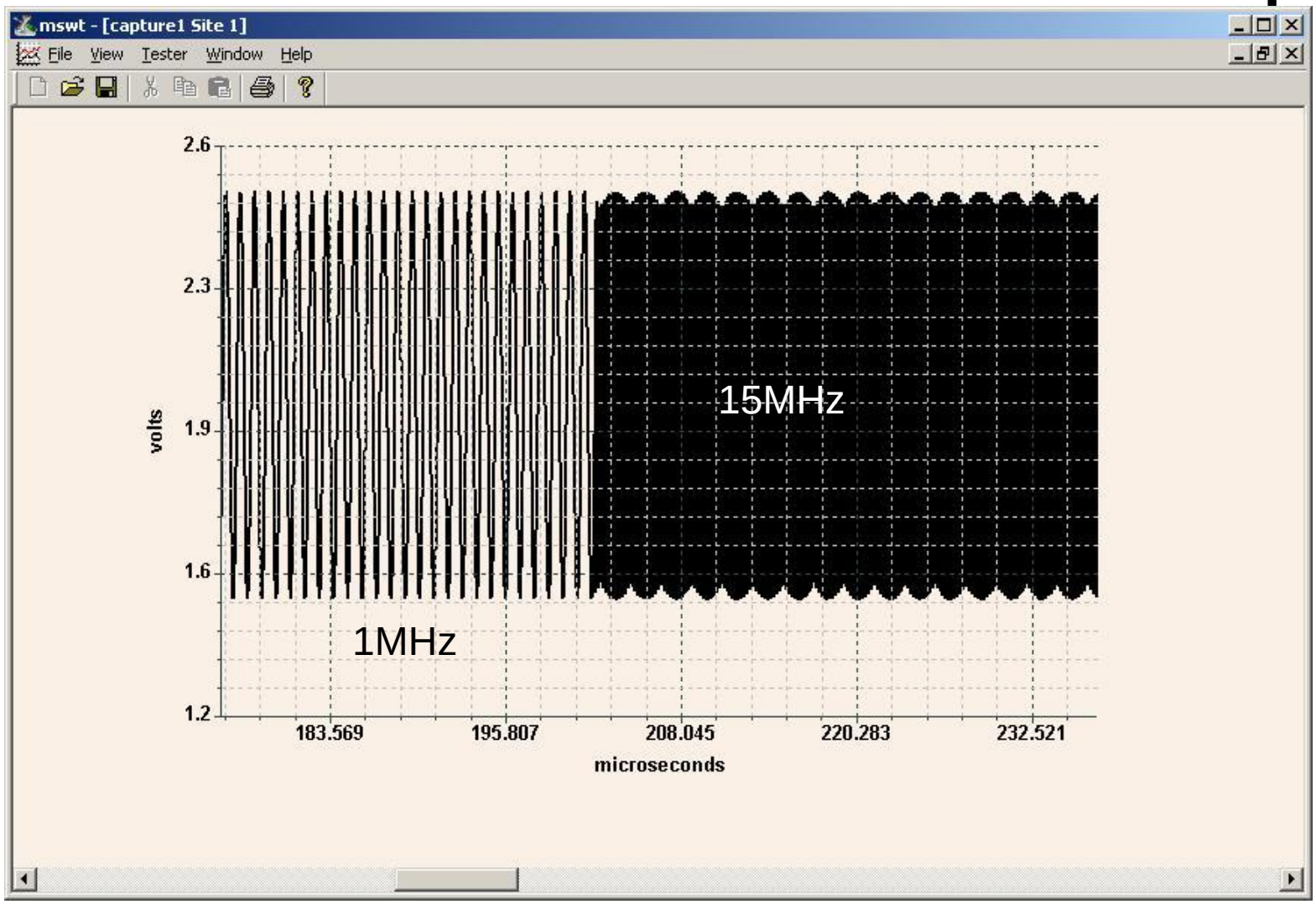
TM Multitone Calibration

- Just like in any frequency response test, the source and capture pair must be calibrated to establish a baseline before injecting the DUT in the path.
- The Time Multiplexed Multitone waveform has a strange shape afterwards, due to the fact that higher frequencies have to be gained up due to both sin(x)/x and test channel band pass issues.
- This happens in time-concurrent multi-tones too, but is less noticeable because they are combined.

TM Multione Post-Cal Capture



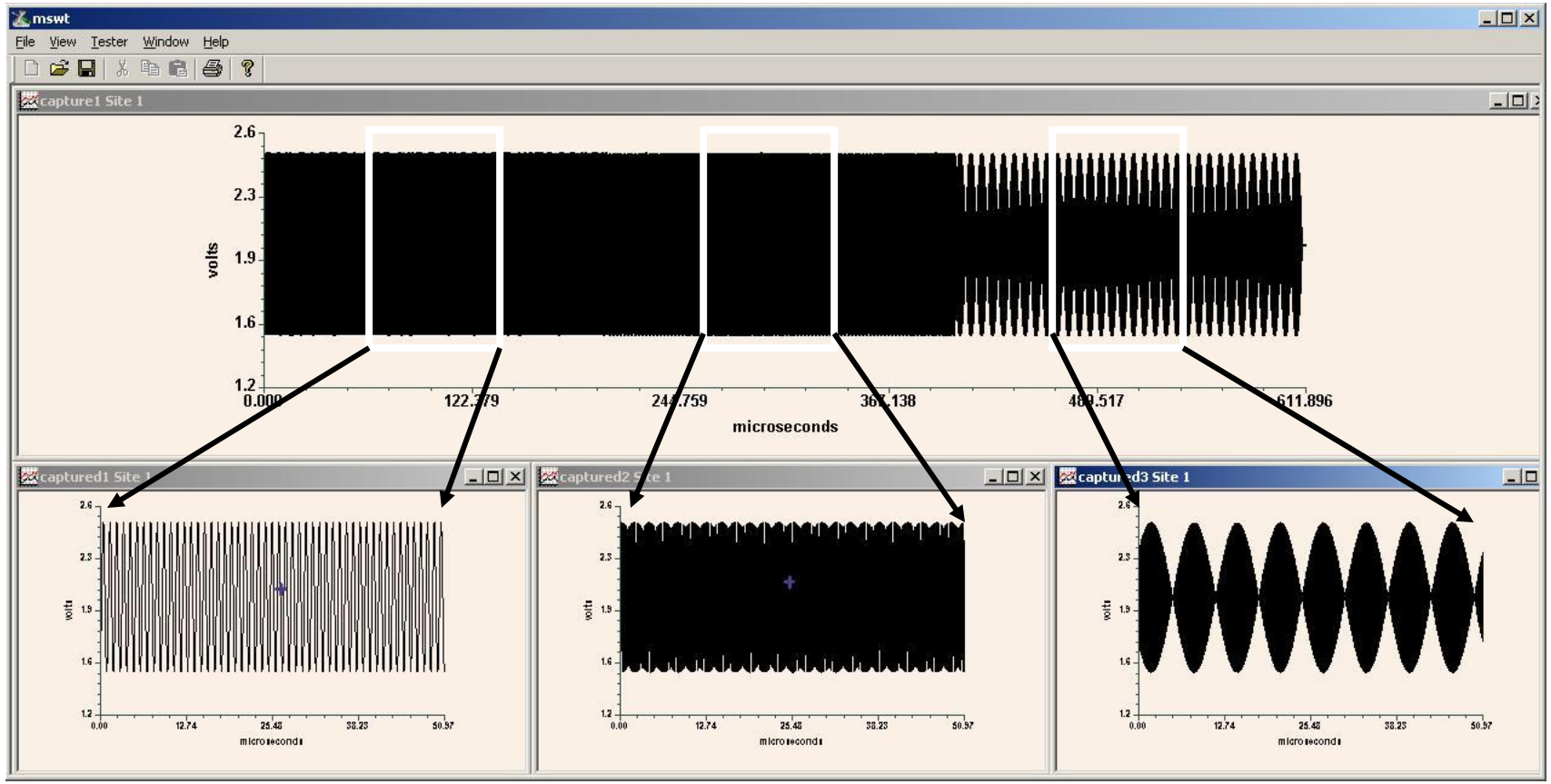
TM Multione Post-Cal Closeup



How we process

- To avoid discontinuities the source waveform sections are 4 times longer than the capture sections needed to be coherent.
  - AWI wave is 24,576 samples deep (3*8192)
- The ACI captures the wave at the same time as the waveform is being sourced.
  - We guarantee phase alignment with vector triggers.
- However only 2048 samples per tone are downloaded from the ACI for the FFT.
  - Saves time by not moving samples not needed.

Capture explanation



Note that only the relevant portions of the waveform are extracted for analysis saving transfer time to the CPU for DSP.

Post-Cal measurements

- Method 1 – Add all waves, do one FFT
  - tone1_mag = 1.000340VPP
  - tone2_mag = 1.000393VPP, 0.000457dB relative to tone1
  - tone3_mag = 1.000386VPP, 0.000393dB relative to tone1
  - testtime = **79.422943ms**
- Method 2 – Perform FFT on each wave seperately
  - tone1_mag = 0.999927VPP
  - tone2_mag = 0.999989VPP, 0.000538dB relative to tone1
  - tone3_mag = 0.999917VPP, -0.000087dB relative to tone1
  - testtime = **83.130398ms**
- The faster method isn't that much faster thanks to our very, very fast DSP! (N = 2048 in these measurements)