Speaker Transfer Function

By: Hewlett-Packard Company

Purpose:

To show how to obtain the transfer function of an audio speaker.

Equipment:

- HP 54645A Oscilloscope
- HP 54657A FFT Module
- 3 inch cheap audio speaker with metal frame
- HP 33120A Function/Arb Generator
- microphone (Radio Shack 33-3025)
- adapter (Radio Shack 278-254)
- adapter (Radio Shack 274-326)

After the Speaker Resonance experiment, I knew my speaker resonated at about 300 Hz. Or did I? Could I find another way to verify the resonance? I made my way to Radio Shack, bought a $20 microphone intended for interfacing to a PC. It looked nice and fell within my budget. With a little aluminum foil applied judiciously to enhance a poor connector solution, I was in business.

I set the function generator to sweep from 100 Hz to 6 kHz, fed it into the speaker, set the microphone next to the speaker and watched the oscilloscope tell me the transfer function. Keep in mind, this is the transfer function of *both* the speaker *and* the microphone together [the function generator and scope had a very flat response]. I'm sure the microphone had some bandwidth problems, but since a calibrated $1000 microphone was not in my budget, I just assumed it was flat compared to the speaker.

I made a single sweep, and captured the whole thing on the scope:
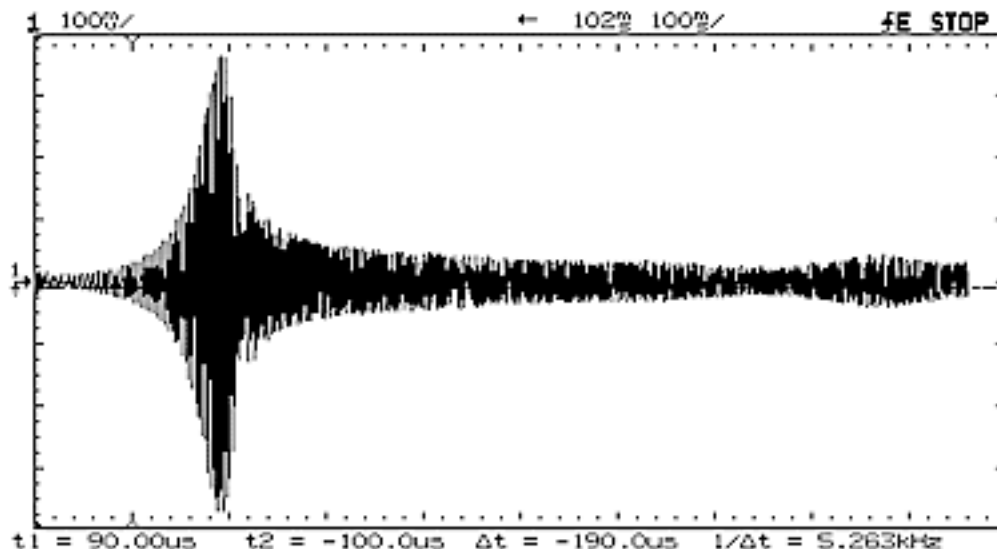
Then, again using post-acquisition pan and zoom, I spread the low-frequency signal to fill the screen:
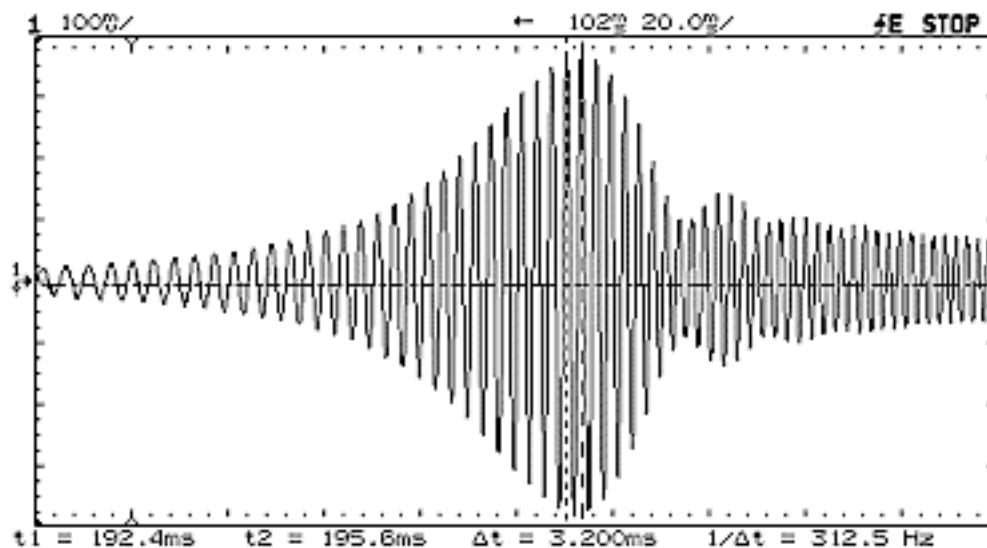
The cursors measured the frequency at the peak of the waveform, and voila… the same resonance that we saw in the FFT example. For a little more resolution, I spread the waveform some more, and found the resonance to be at about 333 Hz:
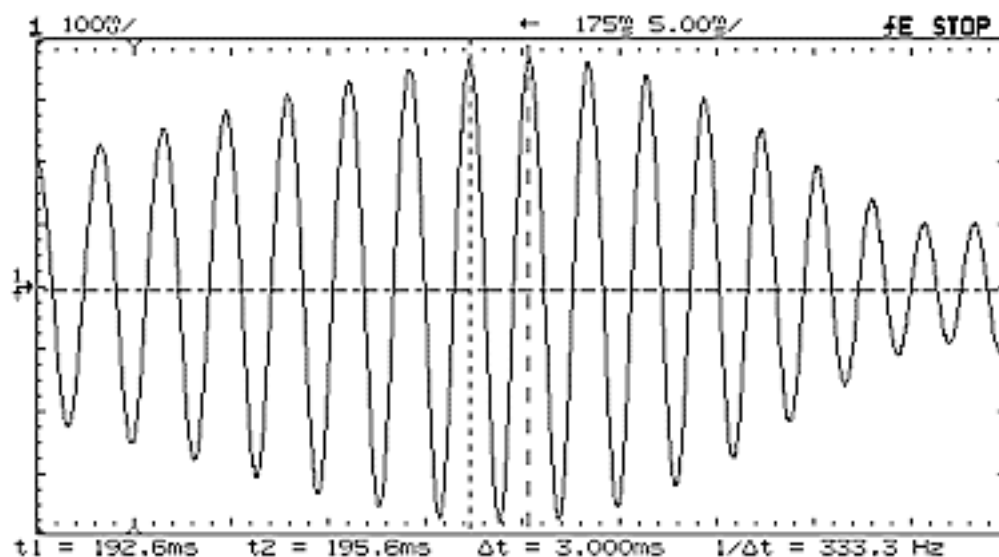
One word of caution: If your students do this experiment with everyone sweeping a function generator and speakers all over the lab going "woooooooop", "wooooooop", be sure to have some earplugs handy, or you will go *crazy*.