Speaker Transfer Function

By: Agilent Technologies

Purpose:

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

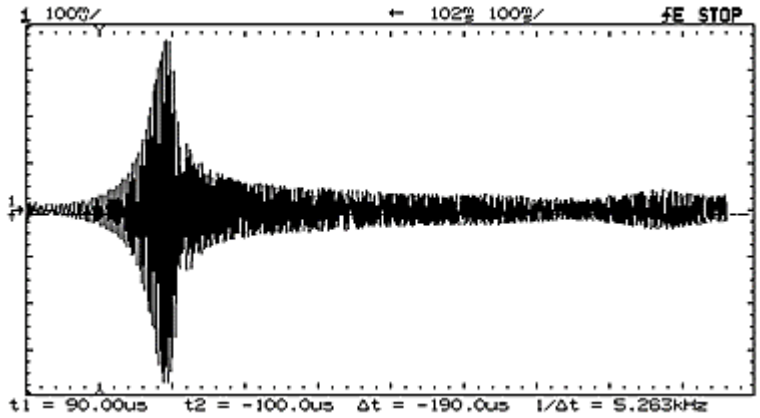
Equipment:

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

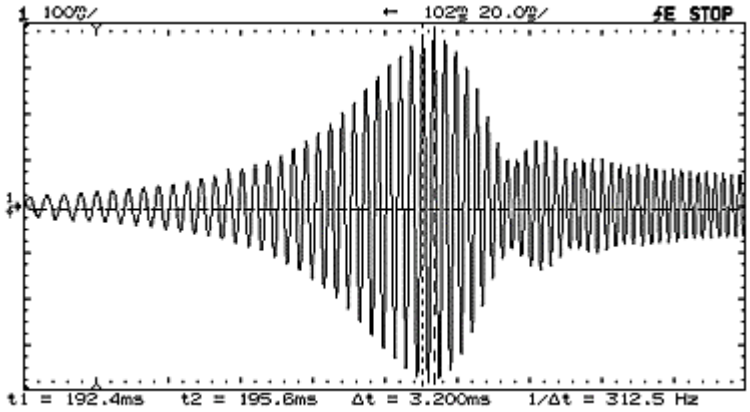
After the Speaker Resonance experiment, I knew my speaker resonated at about 300 Hz. Or did I? Could I find another way to verify the resonance? I made my way to Radio Shack, bought a $20 microphone intended for interfacing to a PC. It looked nice and fell within my budget. With a little aluminum foil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

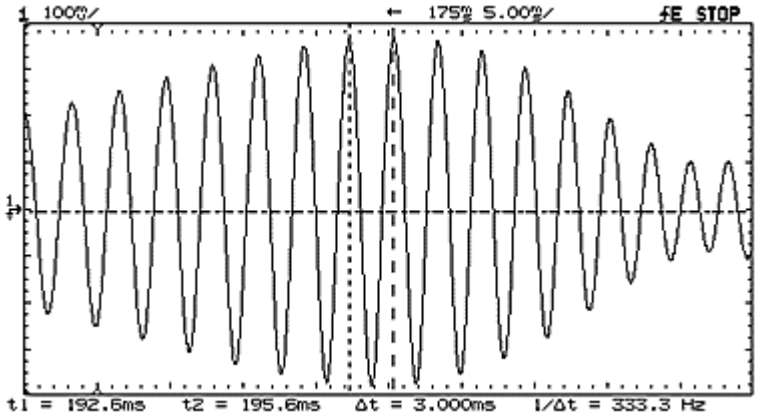
I made a single sweep, and captured the whole thing on the scope:



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 "wooooooop", "wooooooop", be sure to have some earplugs handy, or you will go crazy.