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SIA-Smaart® Pro Case Study #7
Measuring a Measurement Microphone

By Michael Moe, MOE CO, Inc.

I was recently asked if Smaart Pro could be used to compare the response of a questionable test microphone to a known, high-quality calibrated measurement microphone. For the purposes of this case study we will call the microphone in question the “unknown test microphone” so as to not single out any manufacturer. We believed this microphone, which is priced at about $100.00, to have a high-frequency (HF) roll off at around 4 kHz. I thought that if I could use a real-time transfer function measurement to compare the acoustical output of a speaker with the electrical output of my mixing console, why not two microphones?

I began my test by connecting a high-quality measurement microphone, which I know to have extremely flat response across the audible spectrum, to one input of my measurement system mixer. I then connected a popular cardioid condenser microphone that I know to also have very flat frequency response to a second mixer input. I mounted the two mic’s on a single stand and tried to get the diaphragms as close together as possible. The microphone stand was then positioned about 3 feet from a small self-powered loudspeaker so that both microphones were on axis with the speaker and pointed directly at it.

Finally, I connected a pink noise source to a third mixer input and connected the mixer’s main output to the self-powered speaker. I used the mixer’s auxiliary bus outputs (Aux. 1 and Aux. 2) to feed my computer’s left and right line-level sound card inputs. I then ran up the pink noise in the powered speaker and sent the output of each microphone to the computer. With the Smaart Pro Real-Time module running in Transfer function mode, I selected the FPPO setting, a Hanning data window and 20 averages. The results of this first measurement, using the calibrated measurement mic as the reference signal and the output of second microphone as my measurement signal, are shown in *Figure 1* on the next page.

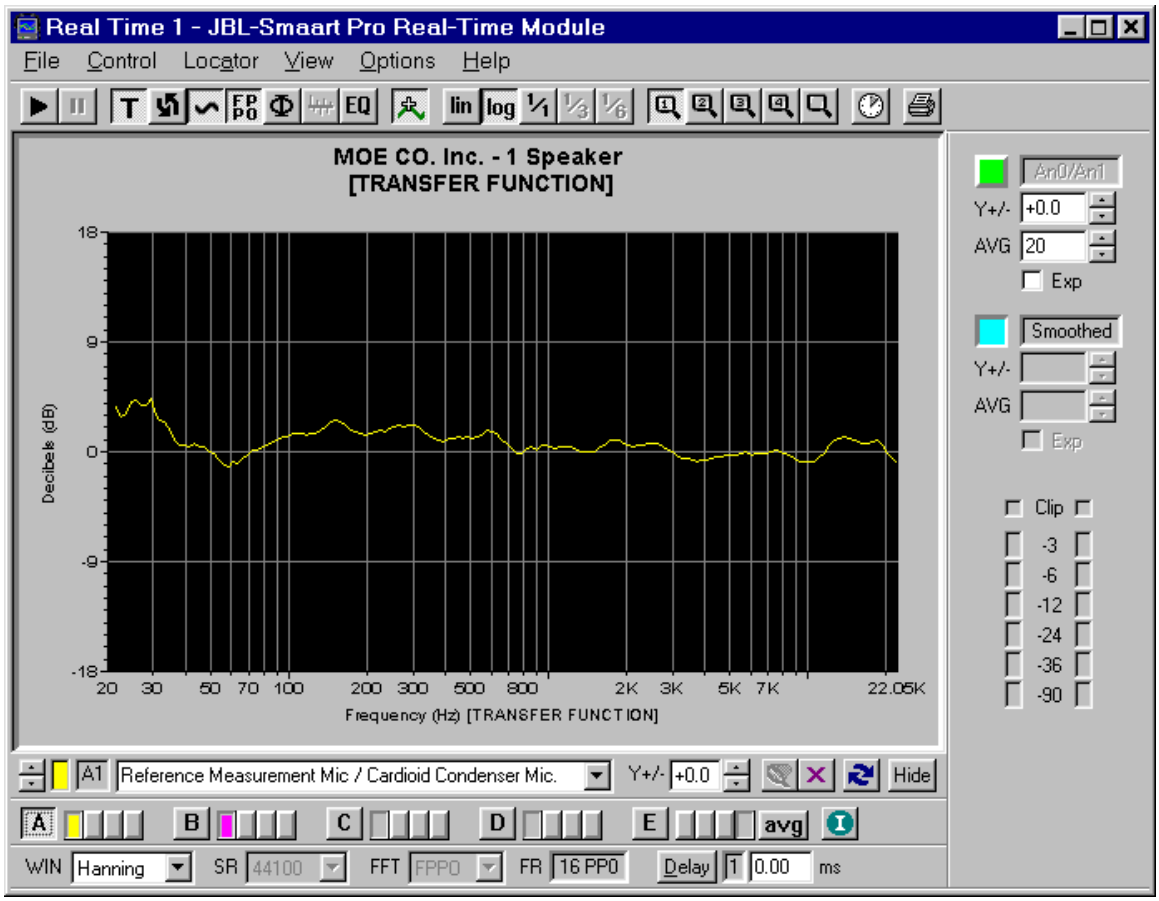

Figure 1: Transfer function measurement comparing a high-quality measurement microphone to a popular cardioid condenser microphone. In this measurement, the output of the measurement microphone is used as the *reference* signal and the output of the cardioid mic is the *measurement* signal.

As I expected, I got a very flat transfer function trace, indicating that the frequency magnitude response of the two mic's was very similar. You can see in *Figure 1* that from 800 Hz to 22 kHz the response is very close and from 35 Hz to 800 Hz the mics were still within +/- 1 or 2 dB of each other.

Comparing the two known microphones and getting the results I expected convinced me that my approach was basically sound so I moved on to my original objective. I replaced the cardioid condenser microphone with the "unknown test microphone" in my test setup, leaving the reference measurement microphone in place, and made a second transfer function measurement. The results of the second measurement are shown in Figure 2 on the next page.

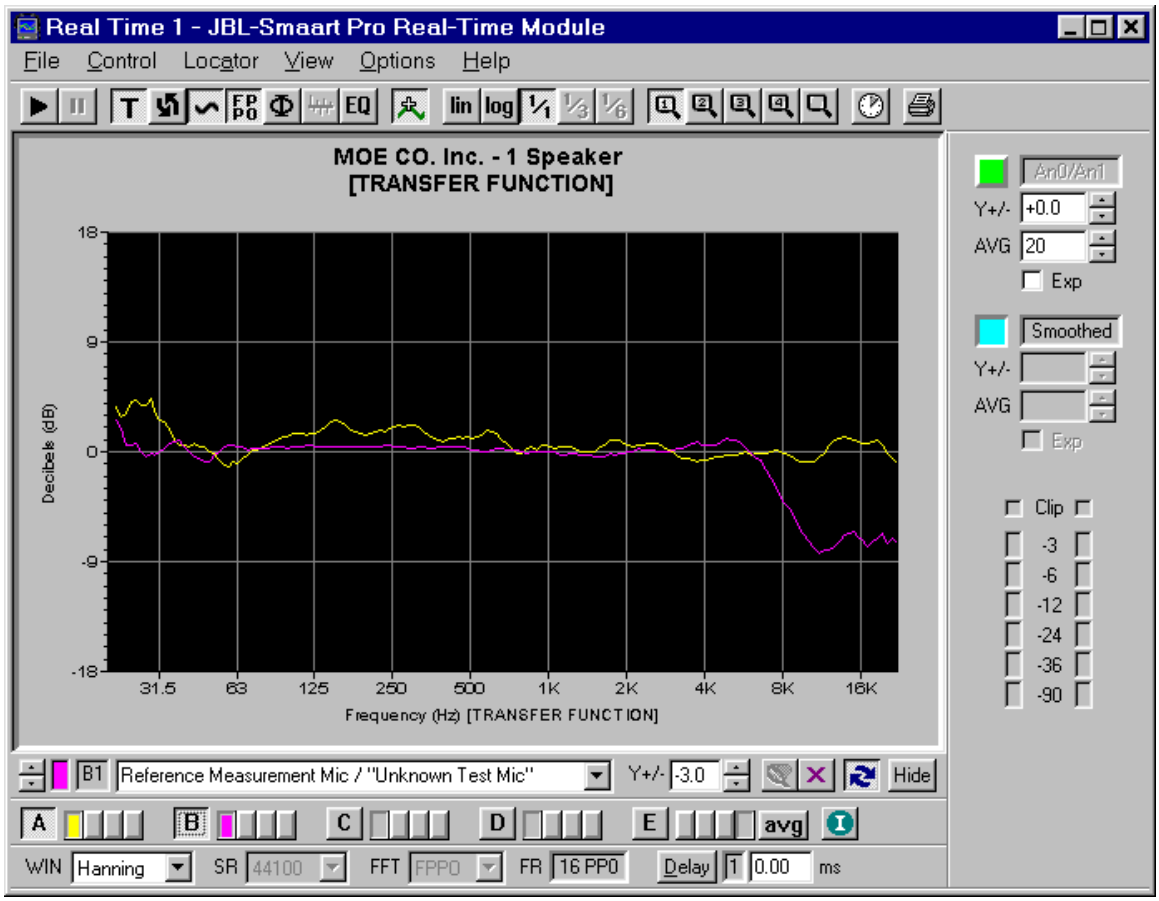

Figure 2: The results of the second transfer measurement (in purple) comparing the response of my reference measurement microphone to the "unknown test microphone." Notice that in Transfer Function mode, when the 1/1 (octave) button is pressed, the grid lines and frequency labels on the graph appear at octave, rather than decade intervals.

You can see in *Figure 2* that the second microphone did indeed have a HF roll-off as we had believed. From 25 Hz to 6 kHz its frequency response was very close to that of the reference microphone. Above 6 kHz however, the "unknown test mic" rolled off like a HF shelving filter, reaching -8 dB at 11 kHz.

In conclusion I just want to say that in my opinoin, being able to compare the response of two microphones is yet another extremely useful capability of Smaart Pro — and one that is not even mentioned in the marketing materials!