

Tip #44 More Power to You

OK, we're going to talk about a pretty advanced subject now: the concept of Power Response vs. Frequency Response. When people talk about loudspeaker measurements, they are almost always referring to Frequency Response. We covered that in Tech Tip # 40, so you have a good grasp of that already.

Simply stated, Frequency Response is the ability of a loudspeaker to reproduce the input signal in an accurate, linear fashion, from one frequency extreme (in the bass) to the other (in the treble). Ideally, the speaker's output would not deviate from the input signal at all, such that if you were to graph the result, it would be a flat line: no deviation from input to output.

This is known in audio parlance as "flat response," and it's the Holy Grail of loudspeaker performance. Perfection. The ultimate goal.

Unfortunately, two different loudspeakers can have very close to "flat response," and yet they sound noticeably different from each other. Much more different than their slightly different frequency responses would suggest.

Why is that? Well, assuming that other factors of gross speaker misbehavior are not coming into play (things like distortion, limited power-handling, wildly different room positioning with respect to major room boundaries, etc.), the main determinant of a speaker's overall tonal character is what acoustic engineers refer to as "Power Response."

The standard, normal speaker Frequency Response measurement is performed *on axis*; that is, the measuring microphone is placed directly in front of the speaker, very close (only a few feet away, in what's called the near field). It's a nice convenient way to do the measurement and it affords a good deal of consistency for easy comparison of one speaker's measurement to another's. (See fig.1.)

But that's not how you listen to a speaker in your living room, is it? You don't sit directly in front of them; you're probably off to the sides ("off axis") of the Left and Right speakers. Also, you're probably several feet back from the speakers, so that some of their sound reflects off the walls, floor and ceiling before reaching your ears.

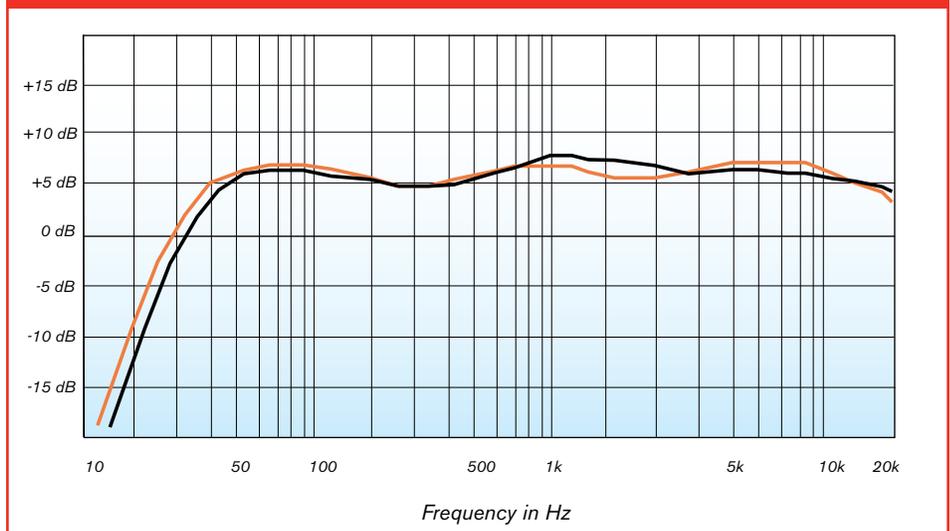
So that being the case, doesn't it make sense to also measure the speaker's output far away, in the actual listening position (technically called the *reverberant or far field*)? You're nodding your head "yes," so you're understanding this now, aren't you?

That's what we call a Power Response measurement. Here's how it's defined: It's the sum of the total radiated acoustic output of a loudspeaker as measured at several points on- and off-axis in the far (reverberant) field. This measurement essentially captures the total sound emitted by a loudspeaker at all frequencies, in all directions, and is therefore more representative of how speaker will sound in an acoustically well-balanced listening environment than what can be inferred from a simple on-axis frequency response measurement.

Got that? Good.

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Figure 1 Speaker On-Axis Frequency Response



Speaker A and B match closely within 3 dB across audio band, but they sound very different.

Other Tech Tips:

Tip 40: What is Frequency Response?

Tip 41: Why the 6.1 Is So Good

Tip 42: Center Channel Dispersion

Tip 44: H-PAS Technology

Now you can understand that while two speakers might have very similar on-axis Frequency Responses, they will likely have very different Power Responses, so they will sound markedly different from each other. (See fig. 2.)

What causes two speakers with similar on-axis response to have such different power response? It has mostly to do with dispersion—how much sound a speaker sends off to the sides, and consequently how much sound is reflected around the room.

This can be an intentional design consideration by the engineer or it can be totally random, the result of an amateurish speaker designer who doesn't know what they're doing. Some designers want to limit the amount of room reflections (because room acoustics

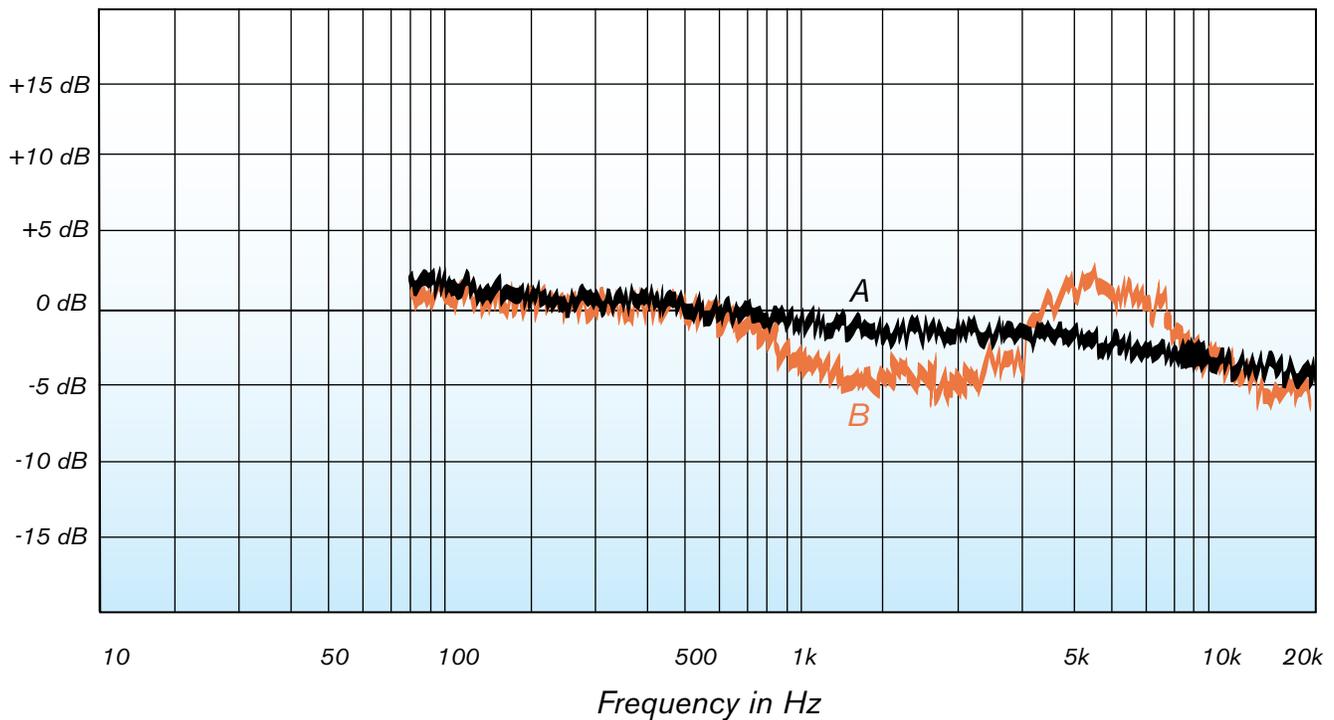
are maddeningly variable and unpredictable) and hence they go for a narrow-dispersion speaker that aims most of its sound directly at your ears. Some designers like to go for very wide dispersion, believing that wide dispersion lends more “airiness” and “life” to the sound, with the added benefit that everyone in the room gets the “good seat.”

Atlantic leans more to the wide-dispersion end of things. Our exclusive Low Resonance Tweeter (LRT™) handles more of the midrange frequencies than a conventional tweeter, relieving the woofer of having to “stretch up” to higher frequencies that it's not well-suited to play. When woofers try to play high midrange frequencies, they ‘beam’ those frequencies like a flashlight beams

light: pretty much only straight ahead, and very little side-to-side. So in the critical midrange area—the vocals, the on-screen effects, guitar, saxophone, etc—a conventional speaker has poor dispersion, and thus poor Power Response. (See fig. 2.) The advantage of the wide midrange dispersion of Atlantic's Low Resonance Tweeter is that it maintains a smooth far-field Power Response while exhibiting superbly accurate on-axis Frequency Response. (See The Tip # 11.)

Most speaker designs are a balance of these (and other) considerations. It's complicated stuff, this speaker design business. Next time you hear two speakers that sound completely different, you'll have a better idea as to why.

Figure 2 Speaker Power Response



The same two speakers sound markedly different with different Power Responses. A—(with Atlantic's LRT™) is smooth and natural B—(with conventional tweeter) sounds 'thin' and uneven.