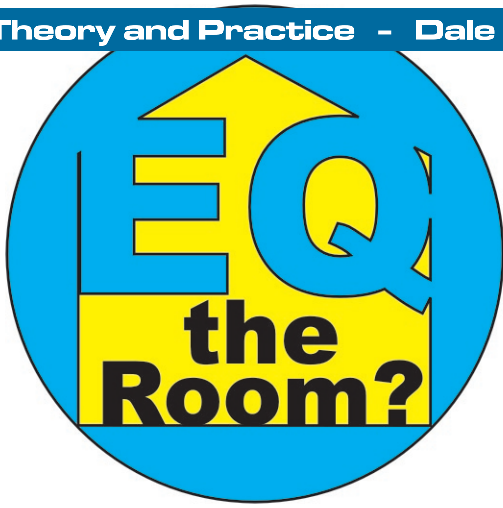


Much has been said about how a room can't be equalized electronically - that it takes construction tools and materials. Some have taken this to the extent of equalizing the system in the shop. Yet in the field a given system may sound great in some rooms, while in others it just sounds better to roll some frequencies off a bit with the equalizer. Is this really a case of equalizing the room?

Power Response

Think about this. Was the system equalized in the shop for flat on-axis response, or for flat power response? Power response is the total sound power radiated into whole space vs. frequency. It can be measured by placing the loudspeaker in a reverberation chamber which integrates the energy radiated in every direction or it can be calculated from the polar information.

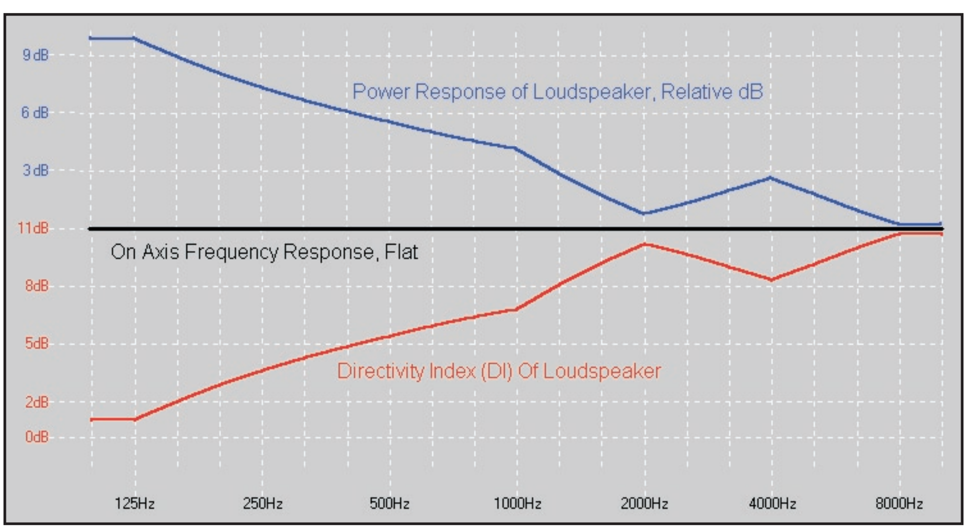
I'll give you an example. A typical 12" cone driver in a typical small 2-way box may be omnidirectional up to about 200 Hz or so, and from there becomes more directional with increasing frequency. Let's say it has flat on-axis response from approximately 100 Hz to 2 kHz. The power response of this speaker is flat up to several hundred Hertz, then it falls with increasing frequency, eventually reaching 6 dB per octave. That's right. As frequency rises, it is radiating less and less power, but it is also confining it into less and less area, so that the on-axis response remains flat. And if that's not bad enough, at around 2000 Hz we crossover into an undersized horn that lacks directional control at it's lower frequencies and do it all over again.

So your PA rig has much greater sound *power* output at 200 Hz than it does at mid and high frequencies. When you place it in a room with enough "room gain", or reflected energy at 200 Hz to integrate the side and rear output to the listener's position, it will sound too heavy at that frequency. If you had the choice of a slider that controlled the loudspeaker Q, you would pick it every time.

Many of the rooms we work in today have decay times that are significantly longer at low frequencies than at high frequencies. This is due to the use of carpet and other thin fuzzy materials that absorb only high frequencies. This decay characteristic, when combined with a PA speaker that has a bass-heavy power response yields a boomy, muddy sound. This is also why a guitar amp sounds like "mush" at the back of the room, and why we want to roll-off the lows and sometimes even the low-mids in stage monitors.

Room Response

While there are exceptions, real rooms generally don't have statistical acoustic parameters that change radically with small frequency changes. There can be



If you invert the directivity curve, which is directivity expressed in decibels, and add it to the on axis frequency response, you get the power response.

The data shown is for a 12 inch 2-way speaker.

resonant items which cause localized hi-Q effects, and if they are near a loudspeaker their effect may be heard over a large area. If there is a large quantity of these resonant items, they can affect the total sound. Absorption coefficients are measured in octave bands and few non-resonant materials have significant variations that would be missed at that resolution. While room modes in a small room can cause uneven response up into the lower midrange, in large performance venues, they are rarely an issue. All that is to say that rooms don't have acoustic problems that in any way resemble the squiggly-wiggly EQ settings claimed to fix them!

So What Am I Hearing?

Please understand, I'm not suggesting that the sound isn't improved for the concert experience by tweaking the EQ. We all like to tweak! But don't think for a minute that you can electronically "EQ the room". The best you can do is to equalize the system so that it's faults are less obtrusive in this room. Let me repeat that. The best you can do is to equalize the system so that it's faults are less obtrusive in this room. In the case mentioned, the room is reflective enough at 200 Hz to bring to light the fact that the system has excessive sound power output (insufficient directivity) at 200 Hz.

So what is the best way to deal with this? The "EQ in the shop" approach is effective over that frequency range where no room surfaces are within 1/4 wavelength of loudspeaker or mic, and where directivity is constant, Under these conditions the power response parallels the on-axis response. Where these conditions do not exist, the system response is best "optimized" in it's final location. At high frequencies our ears discriminate well between direct sound and reflections, and we identify a "sound of the speaker" and a separate "sound of the room." Therefore, equalization considering only the direct sound is effective. At lower frequencies, our hearing system integrates over a longer time span. Therefore to some extent, reflected energy must be taken into account at lower frequencies. How much, of course, gets into the area of personal taste in equalizing, and may also vary for different types of program material.

This is why good sound system designers insist on good directivity control to as low a frequency as space, aesthetics, and budget allow. They also try to reduce sound radiation onto any reflecting surfaces near the loudspeaker. It is also partly why certain low-Q, wide dispersion speakers are sometimes judged to be more "musical" in real rooms, because they have less variation of Q with frequency. Of course the Q must be high enough to provide adequate intelligibility.

Power response is not something you can directly experience, there's no magic spot you can stand to hear it. Yet it has a definite effect on the overall sound and performance of a sound system, and must be considered in sound system design and optimization. *ds*