

Attaining Tonal Balance

Getting a handle on EQ essentials

By Dennis Bohn

You may have heard it said that equalizers are nothing more than glorified tone controls. That's pretty accurate and helps explain their usefulness and importance.

Simply put, equalizers allow you to change the tonal balance of whatever you are controlling. You can increase (boost) or decrease (cut) on a band-by-band basis just the desired frequencies.

Equalizers come in all different sizes and shapes, varying greatly in design and complexity. Select from a simple single-channel unit with 10 controls on 1-octave frequency spacing (a mono 10-band octave equalizer), all the way up to a full-featured, two-channel box with 31 controls on 1/3-octave frequency spacing (a stereo 1/3-octave equalizer).

There are graphic models with slide controls (sliders) that roughly "graph" the equalizer's frequency response by the shape they form, and there are parametric models where you choose the frequency, amplitude, and bandwidth desired – the filter parameters – for each band provided.

Far and away, the simplest and most popular are the 1/3- and 2/3-octave graphics. They offer the best combination of control, complexity and cost.

OH, BEHAVE!

In selecting graphic equalizers, the primary features to consider are the number of input/output channels, the number of boost/cut bands, the center-frequency spacing of each, and the bandwidth behavior.

This last one may at first seem a bit odd, but it is perhaps the most important characteristic. Bandwidth behavior is either constant-Q or variable-Q. The quality factor, or Q, of a circuit relates to its bandwidth in an inverse manner. That is, narrow bandwidths result from high-Q circuits and wide bandwidths come from low-Q circuits.

Variable-Q designs have varying bandwidths (the shape changes) as a function of boost/cut amount. They start out very narrow for small amplitude changes and become quite wide for large changes. The constant-Q design maintains the Q regardless of the amount of boost or cut to the filter. By contrast, in the early '80s, Rane developed the constant-Q design to preserve the same shape (bandwidth) over the entire boost/cut range.

EQ can do wonders for a sound system. Let's start with loudspeaker performance. An unfortunate truth regarding budget loudspeakers is they don't sound very good, usually because they have fewer components in the passive crossover network, so there is less loudspeaker-level EQ in the box than for more-expensive passive loudspeaker systems.

Usually this is due to an uneven frequency response. Also, an "ideal" loudspeaker possesses what is often referred to as a flat power response. This means that if you pick, say, 1 kHz as a reference signal, use it to drive the loudspeaker with exactly one watt, measure the loudness, and sweep the generator over the speaker's entire frequency range, all frequencies will measure equally loud.

However, to attain a flat power response, a loudspeaker would have a flat frequency response AND identical polars at all frequencies. There are



An EQ by any other name... Well, the most familiar terms are parametric (top), console (center) and graphic.

few, if any, loudspeakers in existence that have both a flat frequency response and a flat power response! Further, a flat frequency response is actually a flat pressure response at a given point in space.

Equalizers can help these frequency deficiencies. By adding a little here and taking away a little there, pretty soon you create an acceptable frequency or pressure response – and a whole lot better sounding system. It's surprising how just a little equalization can change a poor sounding system into something quite decent.

The best way to deal with budget loudspeakers – although it costs more – is to commit one equalizer channel for each cabinet type. This becomes a marriage. The equalizer is set, a security cover is bolted-on, and forever more they are inseparable. Use additional equalizers to assist with the room problems such as low-frequency coupling, humidity and temperature changes.

ROOM INDEPENDENT

And now for the hard but most important part: If doing measurements outside (no reflections off walls or ceiling) and up in the air (no reflections off the ground), the primary goal is getting a very accurate picture of just the loudspeaker's response, free from room effects. This provides the room-independent response, which is really important because no matter where this box is used, it has these problems.

Of course, be sure the cost of the budget loudspeaker plus the equalizer is substantially less than buying a really flat loudspeaker system. This comes about quite often. But remember, the truth is that most cabinets are not flat. It is only the very expensive loudspeakers (incorporating advanced DSP correction) that have world-class responses. (Maybe that's why they cost so much!)

Another thing to be achieved with equalizers is to improve the way each venue sounds. Every room sounds different – fact of life, fact of physics. Using exactly the same equipment, playing exactly the same music in exactly the same way, different rooms sound different, guaranteed. Each enclosed space treats your sound differently.

Reflected sound causes the problems. What the audience hears is made up of the direct sound (what comes straight out of the loudspeaker directly to the listener) and reflected sound (it bounces off everything before getting to the listener).

And if the room is big enough, then reverberation comes into play, which is all the reflected sound that has traveled so far, and for such a (relatively) long time that it arrives and re-

arrives at the listener delayed enough to sound like a second and third source, or even an echo if the room is really big.

It's basically a geometry problem. Each room differs in its dimensions; not only in its basic length-by-width size, but in its ceiling height, the distance from you and your equipment to the audience, what's hung (or not hung), on the walls, how many windows and doors there are, and where.

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Audio Basics

Every detail about a space affects sound. And regretfully, there is very little that can be done about any of it. Most of the factors affecting sound cannot change. The room dimensions can't be changed; the windows and door locations can't be altered. But there are a few things that can be done, and equalization is one of them.

Before equalizing, it's vital to optimize how and where the loudspeakers are placed. This is probably the number one item to attend to. Keep loudspeakers out of corners whenever possible. Remove all restrictions between the loudspeakers and audience, including banners, stage equipment, and performers.

The idea is for most of the sound the audience hears to come directly

from the loudspeakers, with all reflected sound minimized. With careful loudspeaker selection and placement, combined with proper equalization, then the direct sound output should be good. So what's left is to minimize the reflected sound.

BEEF UP OR ROLL OFF

Use equalization to help with some of a room's more troublesome features. If the room is exceptionally bright, beef up the low end to help offset it, or roll off some of the high end. Or, if the room tends to be boomy, tone down the low end to reduce the resonance by either reducing the bass response or by notching out those frequencies to prevent excitation of those particular room resonances.

Another way that EQ can be quite effective is in controlling troublesome feedback tones. Our old friend feedback is that terrible squeal or scream that sound systems make when the audio from the loudspeaker gets picked-up by one of the stage microphones, re-amplified and pumped out the loudspeaker, only to be picked-up again by the microphone, and re-amplified, and so on.

Most often, this happens when the system is playing loud. Which makes sense, because for softer sounds, the signal either isn't big enough to make it to the microphone, or if it does, it is too small to build-up. This is because there is more level at the microphones from the speakers than from the sources being amplified, and is known as exceeding unity gain.

The problem is one of an out-of-control, closed-loop, positive-feedback system building up until something breaks, or the audience leaves. Use EQ to cut those frequencies that want to howl and squeal, and as a side benefit, the system can play louder. The technical phrase for this is maximizing system gain before feedback.

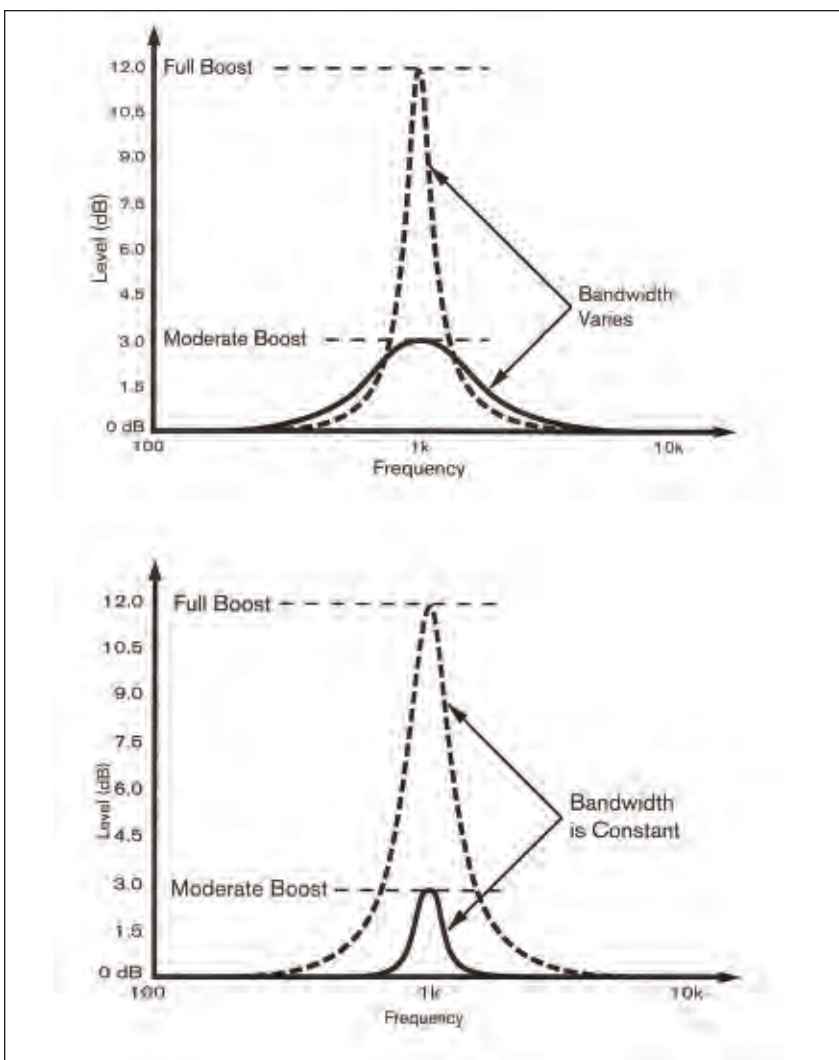
It's important to understand from that outset that equalization can't fix a room's related sound problems, but the trouble spots can be moved around. By sonically rearranging things, excesses can be tamed. You win by making it sound better. Equalization helps.

CREATIVE SIDE

We've been focusing on speaker and system EQ, but let's move on to creative/source EQ, done either on the input strip of the mixer or via an equalizer inserted for a particular source. EQ is useful in augmenting instruments and voices.

With practice, a sound mixer/engineer can learn to use EQ to enhance sound for best personal expression: deepen the lows, fill the middle, or exaggerate the highs... Whatever is desired. Just as EQ can improve the sound of a poor loudspeaker, it can improve the sound of a marginal microphone, or enhance any musical instrument.

Equalizers offer that something



The anatomy of Variable-Q (top) and Constant-Q curves.

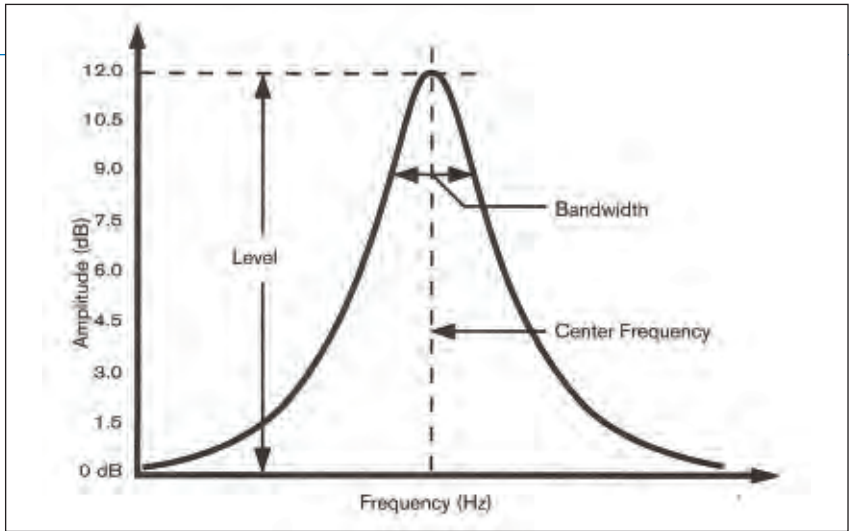
extra, that edge. (We all know where "radio voices" really come from.)

To make loudspeaker and sound system measurements easy, a real-time analyzer (RTA) is required. An RTA provides a visual of the frequency/pressure response, not only for the loudspeaker, but even more importantly, for the whole system, including the room.

Stand-alone RTAs use an LED or LCD matrix to display the response. A built-in pink noise generator (a special kind of shaped noise containing all audible frequencies, optimized for measuring sound systems) is used as the test signal.

A measuring microphone is included for sampling the response. The display is arranged to show amplitude verses frequency. Depending upon cost, the number of frequency columns varies from 10 on 1-octave centers, up to 31 on 1/3-octave centers (agreeing with graphic equalizers). Amplitude range and precision varies with price.

With the cost of laptop computers



Bandpass filter parameters.

tumbling, the latest form of RTA involves an accessory box and software that works with your computer. These are particularly nice, and loaded with special memory, calculations and multipurpose functions like also being an elaborate sound pressure level (SPL) meter. Highly recommended if the budget allows.

Happy tweaking! ■

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