BRUCE BARTLETT AND JENNY BARTLETT

How To Use EQ

● Even if you can record a performance accurately, you might not like how it sounds. This is where the equalization (EQ) process comes in. EQ lets you improve on reality: it makes an instrument sound warmer or less harsh, removes noises and adds punch.

EQ adjusts the bass, treble and midrange of a sound by turning up or down certain frequency ranges. To do this, it operates on the spectrum of the sound source—its fundamental and harmonic frequencies. The spectrum helps give the instrument its distinctive tone quality or timbre.

If some of these frequencies change in level, the tone quality changes. An equalizer raises or lowers the level of a particular range of frequencies (a frequency band), and so controls the tone quality. That is, it alters the frequency response. For example, a boost (a level increase) in the range centered at 10 kHz makes percussion sound bright and crisp. A cut at the same frequency dulls the sound.

TYPES OF EQ

Let's review the types of equalizers from simple to complex. The most basic type is a *bass and treble control* (often labeled LF EQ and HF EQ). Its effect on frequency response is shown in *Figure 1*. Typically, this type of EQ provides up to 15 dB of boost or cut at 100 Hz (for the low-frequency EQ knob) and at 10 kHz (for the high-frequency EQ knob).

You have more control over tone quality with a *multiple-frequency equalizer*: you can boost or cut several frequency bands (see *Figure 2*).

Sweepable EQ is even more flexible; the exact frequency range needing adjustment can be "tuned in." (see *Figure 3*) Sweepable EQ is often incorrectly called "parametric," which also allows control of bandwidth. You won't find a true parametric equalizer in home-studio equipment, however.

The *parametric equalizer* allows continuous adjustment of frequency, boost or cut, and bandwidth—the range of frequencies affected. *Figure 4* shows how a parametric equalizer varies the bandwidth of the boosted portion of the spectrum.

A graphic equalizer (see *Figure 5*) is usually external to the mixing console. This type has a row of slide potentiometers dividing the audible spectrum into 5 to 31 bands.

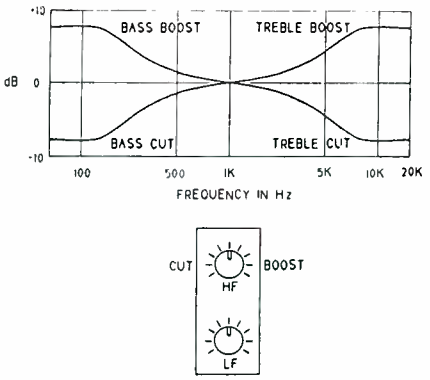
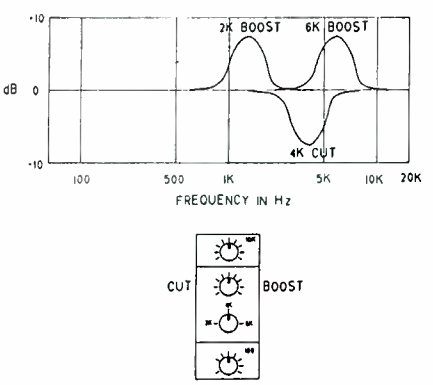


Figure 1. Bass and treble EQ.

Figure 2. Multiple frequency EQ.



When the controls are adjusted, their positions graphically indicate the resulting frequency response. Usually, a graphic equalizer is used for monitor-speaker EQ.

So far we've classified equalizers according to the frequency bands they control, but they can also be classified by the shape of their frequency response. A *peaking equalizer* (see *Figure 6*) creates a response in the shape of a hill or peak when set for a boost. With a *shelving equalizer*, the shape of the frequency response resembles a shelf, as in *Figure 7*.

A *filter* causes a roll-off at the frequency extremes. It sharply rejects (attenuates) frequencies above or below a certain frequency. *Figure 8* shows three types of filters: lowpass, highpass and bandpass.

For example, a 10 kHz lowpass filter (high-cut filter) removes frequencies above 10 kHz. Its response is down 3 dB at 10 kHz and more above that. This reduces hiss-type noise without affecting tone quality as much as a gradual treble roll-off would. A 100 Hz highpass filter (low-cut filter) attenuates frequencies below 100 Hz. Its response is down 3 dB at 100 Hz and more below that. This removes low-pitched noises such as room rumble, microphone handling noise and mic breath pops. Finally, a 1 kHz bandpass filter attenuates frequencies above and below a frequency band centered at 1 kHz.

The crossover filter in most monitor speakers consists of lowpass, highpass and bandpass filters that send the lows to the woofer, mids to the midrange, and highs to the tweeter.

A filter is named for the steepness of its roll-off: 6 dB per octave (first-order), 12 dB/octave (second-or-

der), 18 dB/octave (3rd order) and so on.

HOW YOU USE EQ

If your mixer has bass and treble controls, their frequencies are preset (usually at 100 Hz and 10 kHz). Set the EQ knob at 0 to have no effect ("flat" setting). Turn it clockwise for a boost, counterclockwise for a cut. If your mixer has multiple-frequency EQ or sweepable EQ, one knob sets the frequency range while another sets the amount of boost or cut.

Table 1 shows the fundamentals and harmonics of musical instruments and voices. For any particular instrument, turn up the lower end of the fundamentals for warmth and fullness. Turn down the fundamentals if the tone is too bassy or tubby. Turn up the harmonics for presence and definition; turn down the harmonics if the tone is too harsh or sizzly. Avoid excessive boost because it can distort the signal. Try cutting the lows instead of boosting the highs.

Here are some suggested frequencies to tweak for specific instruments. If you want the effects described below, apply boost. If you don't, apply cut.

Bass: Full and deep at 60 Hz, growl at 600 Hz, presence at 2.5 kHz, string noise at 3 kHz and up.

Electric guitar: Thumpy at 60 Hz, full at 100 Hz, honky at 600 Hz, presence at 2-3 kHz, sizzly and raspy above 6 kHz.

Drums: Full at 100 Hz, wooly at 250-600 Hz, trashy at 1-3 kHz, attack at 5 kHz, sizzly and crisp at 10 kHz.

Kick drum: Full and powerful below 60 Hz, papery at 300-800 Hz (cut at 400-600 Hz for better tone), click or attack at 2-6 kHz.

Sax: Warm at 500 Hz, harsh at 3 kHz, key noise above 10 kHz.

Acoustic guitar: Full or thumpy at 80 Hz, presence at 5 kHz, pick noise above 10 kHz.

Voice: Full at 100-150 Hz (males), full at 200-250 Hz (females), honky or nasal at 500 Hz-1 kHz, presence at 5 kHz, sibilance ("s" sounds) above 6 kHz.

SETTING EQ BY EAR

You can set an equalizer by ear as well as by knowing the frequency ranges of an instrument. One way is to tune the equalizer to the approximate frequency range you need to work on (you'll soon know where by experience). Then apply full boost or cut so the effect is easily audible. Finally, fine-tune the frequency and amount of boost or cut until the tonal balance is the way you like it.

For example, if a close-mic'd vocal sounds unnaturally bassy, reach for the low-frequency EQ (say, 100 Hz) and turn it down, adjusting the cut for the desired tonal balance.

If you hear a coloration in the tone quality of an instrument, set a sweepable equalizer for extreme boost. Then sweep the frequencies until you find the frequency range matching the coloration. Cut that range by the amount that sounds right. For example, a piano mic'd with the lid closed might have a tubby coloration—say, excessive output around 300 Hz. Set your low-frequency EQ for boost, and vary the center frequency until the tubbiness is exaggerated. Then cut at that frequency until the piano sounds natural.

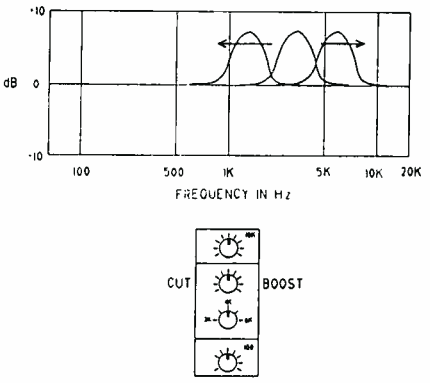


Figure 3. Sweepable EQ.

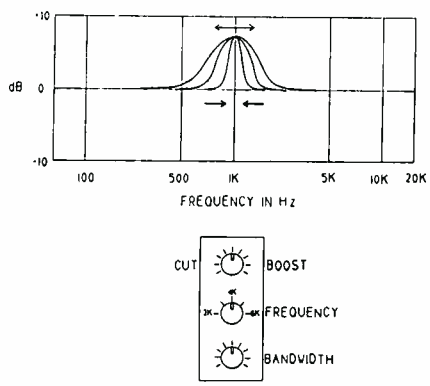


Figure 4. Parametric EQ.

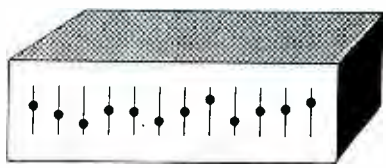


Figure 5. A typical graphic equalizer.

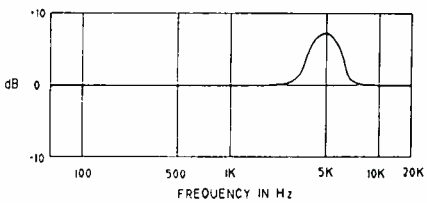
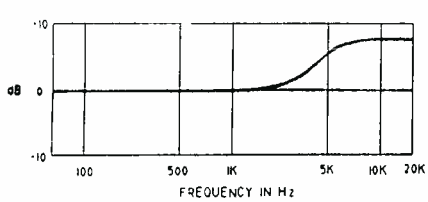


Figure 6. A peaking EQ.

Figure 7. Shelving EQ.



WHEN TO USE EQ

Before using EQ, try to get the desired tone quality by changing the mic or its placement. This gives a more natural effect than EQ.

Should you apply EQ during recording or mixdown? If you mix more than one instrument to the same track, you can't EQ them independently during mixdown unless their frequency ranges are far apart. Suppose a recorded track contains lead guitar and vocals. If you add a midrange boost to the guitar, you'll also hear it on the vocals. The only way around this is to EQ the lead guitar independently when it's recorded.

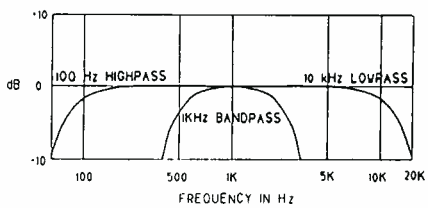


Figure 8.Bandpass EQ.

If a track contains bass and cymbals, you can EQ the low end of the bass without affecting the cymbals because the bass produces mostly low frequencies, while the cymbals produce mostly high frequencies.

If you assign each instrument to its own track, the usual practice is to record flat (without EQ) and then equalize the track during mixdown. I record with EQ, even when multi-tracking. Why? The monitor mixer in my board has no EQ, so when I play back the multitrack recording through the monitor mixer, it doesn't sound right unless the tracks are already equalized. Later, when I start to mix down, the tracks already sound good and need little tweaking.

If you're using a bass cut or treble boost, you can get a better signal-to-noise ratio by applying this EQ during recording, rather than during mixdown. But if the EQ used is a treble cut, applying it during mixdown will reduce tape hiss.

USES OF EQ

Here are some applications where EQ comes in handy.

• **Improving tone quality.** This is the main use of EQ. It can make an instrument sound better tonally. For example, you might use a high-frequency roll-off on a singer to reduce sibilance, or on a direct-recorded electric guitar to take the "edge" off the sound. As another example, boosting 100 Hz on a floor tom gives a fuller sound, or cutting around 250 Hz on a bass guitar aids clarity. The frequency response and placement of each mic affects tone quality as well.

• **Special production effects.** Extreme EQ reduces fidelity, but it can also make interesting sound effects. Sharply rolling off the lows and highs on a voice, for instance, gives it a "telephone" sound. A 1 kHz bandpass filter does the same thing. An extreme boost at 5 kHz can accent the impact of a snare drum.

• **Reducing noise and leakage.** You can reduce unwanted low-frequency sounds—bass leakage, air-conditioner rumble, mic stand thumps—by turning down low frequencies below the range of the instrument you're recording. For example, a fiddle's lowest frequency is about 200 Hz, so you'd set the equalizer's frequency range to 40 or 60 Hz and apply cut. This roll-off won't change the fiddle's tone quality, because the roll-off is below the range of frequencies that the fiddle produces.

Similarly, a kick drum has little or no output above 5 kHz, so you can filter out highs above 5 kHz on the kick drum to reduce cymbal leakage. If this filtering is done during mixdown, it will also reduce tape hiss.

Filtering out frequencies below 100 Hz on most instruments reduces air-conditioning rumble and muddy bass.

• **Remixing mono tracks.** EQ can actually change the mix between instruments within a single track. To illustrate this, suppose you have an old mono jazz recording of bass, drums and sax. Let's say you want to remove everything but the sax solo, and overdub new bass and drum tracks with a contemporary, bright sound.

Here's how. Filter out the lows and highs on the original recording to remove bass and cymbals. You're left with the midrange, which is mainly sax. Copy this sax recording to one track on your multi-track recorder. Now overdub bass and drums on other tracks in sync with the sax solo.

This trick was used in the motion picture *Bird* to produce a high-fidelity sound track from Charlie Parker's original recordings. A contemporary studio bass player and drummer played along with Parker's original sax solos, which were gleaned from Parker's records by filtering out the original bass and drums.

• **Compensating for the Fletcher-Munson effect.** As discovered by Fletcher and Munson, the ear is less sensitive to bass and treble at low volumes than at high volumes. So, when you record a very loud instrument and play it back at a lower level, it might lack bass and treble. To restore these, you may need to boost the lows (around 100 Hz) and the highs (around 4 kHz) when recording loud rock groups. The louder the group, the more boost is needed. As an alternative, use cardioid mics with proximity effect (for bass boost) and a presence peak (for treble boost).

• **Making a pleasing blend.** When several instruments are heard together, they sometimes "crowd" or overlap each other in the frequency spectrum. That is, it may be difficult to distinguish the instruments by tonal differences. By equalizing various instruments at different frequencies, you can make their timbres distinct, which results in a more pleasing blend.

TABLE 1. Frequency ranges of musical instruments and voices.

INSTRUMENT	FUNDAMENTALS	HARMONICS
	Hz	Approx. range
Flute	261-2349	3-8 kHz
Oboe	261-1568	2-12 kHz
Clarinet	165-1568	2-10 kHz
Bassoon	62-587	1-7 kHz
Trumpet	165-988	1-7.5 kHz
French horn	87-880	1-6 kHz
Trombone	73-587	1-7.5 kHz
Tuba	49-587	1-4 kHz
Snare drum	100-200	1-20 kHz
Kick drum	30-147	1-6 kHz
Cymbals	300-587	1-15 kHz
Violin	196-3136	4-15 kHz
Viola	131-1175	2-8.5 kHz
Cello	65-698	1-6.5 kHz
Acou. Bass	41-294	1-5 kHz
Elec. Bass	41-300	1-7 kHz
Acou. Guit.	82-988	1-15 kHz
Elec. Guit.	82-1319	1-3.5 kHz (through amp)
Elec. Guit.	82-1319	1-15 kHz (direct)
Piano	28-4186	5-8 kHz
Soprano	247-1175	2-12 kHz
Alto	175-698	2-12 kHz
Tenor	131-494	1-12 kHz
Bass singer	87-392	1-12 kHz

This procedure also evens out the contribution of each frequency band to the total spectrum, yielding a mix that is tonally well-balanced.

If you have two instruments that sound alike, such as lead guitar and rhythm guitar, you can make them more distinct by equalizing them differently. You might make the lead guitar edgy by boosting 2-3 kHz, and make the rhythm guitar mellow by cutting 2-3 kHz.

The same philosophy applies to bass guitar and kick drum. Since they occupy about the same low-frequency range, they tend to mask or cover each other. To make them distinct, either fatten the bass and thin out the kick a little, or vice versa.

• **Compensating for response deficiencies.** The mics, tape recorder, monitor speakers and the mixing board itself may not have a flat frequency response. EQ can partly compensate for these deficiencies. If a mic has a gradual high-frequency roll-off, for example, a high-frequency boost on the console may help restore a flat response. On the other hand, if a mic "dies" above a certain frequency, no amount of boost can help it. Some directional mics have proximity effect—a bass boost when used up close. A bass roll-off on the console can compensate for this boost.

Many purists shun the use of EQ, complaining of excessive phase shift or ringing caused by the equalizer. Instead, they use carefully placed, high quality mics to achieve a natural tonal balance without EQ. The resulting sound is said to be less strained and more natural.

• **Compensating for mic placement.** Often, you must place a mic very close to an instrument to reject background sounds and leakage. Unfortunately, a close-placed mic emphasizes the part of the instrument the mic is near; the tone quality picked up may not be the same as that of the instrument as a whole. EQ can partly compensate for this effect.

For example, an acoustic guitar picked up with a mic next to the sound hole sounds bassy because the sound hole radiates strong low frequencies, but a complementary low-frequency roll-off on your mixer can restore the natural tonal balance. This use of EQ can save the day by fixing poorly-recorded tracks in live concert recordings. During a concert, the stage monitors might be blaring into your recording/P.A. mics, so you're forced to mic close in order to reject monitor leakage and feedback. This close placement, or the monitor leakage itself, can give the recording an unnatural tone quality. In this case, EQ is the only way to get usable tracks.

You may be fortunate enough to use optimally-placed mics in a great acoustic environment. In that case, EQ is not wanted nor needed, but your recording will sound better with EQ than without it. db