

Everything Equalizers



Table of contents

Chapter 1 – Fundamentals of EQ

Types of Equalizers and Their Applications 5

The Magic of Passive EQ 13

Should You Be Using Linear Phase EQ? 20

Chapter 2 – EQ In Action

Rock The Low End 28

Drum EQ Tips 40

Introduction

I seem to spend a lot of time trying to put square pegs into round holes. Writing, producing, recording and mixing music for other people often involves interpreting someone else's feelings or vague descriptions into musical moments. "Can you make the singer sound closer?" Or "can we make the guitar solo spin around at the end?" That's life in pop music. At the other end of the spectrum, I have some producers who I engineer and mix for who would rather I not touch an EQ or compressor and just "let the music be." I'm all for both approaches and the key is understanding when or why to move a mic, choose a different guitar or fix it in the mix. EQ is often applied to subtly shape or tilt a sound so that it blends in or stands out and sometimes EQ performs the plastic surgery needed to turn a sow's ear into the proverbial silk purse. This eBook is all about equalizers and hopefully, the articles here will shed some light on how to best approach the use of equalizers, no matter what genre you are working in.

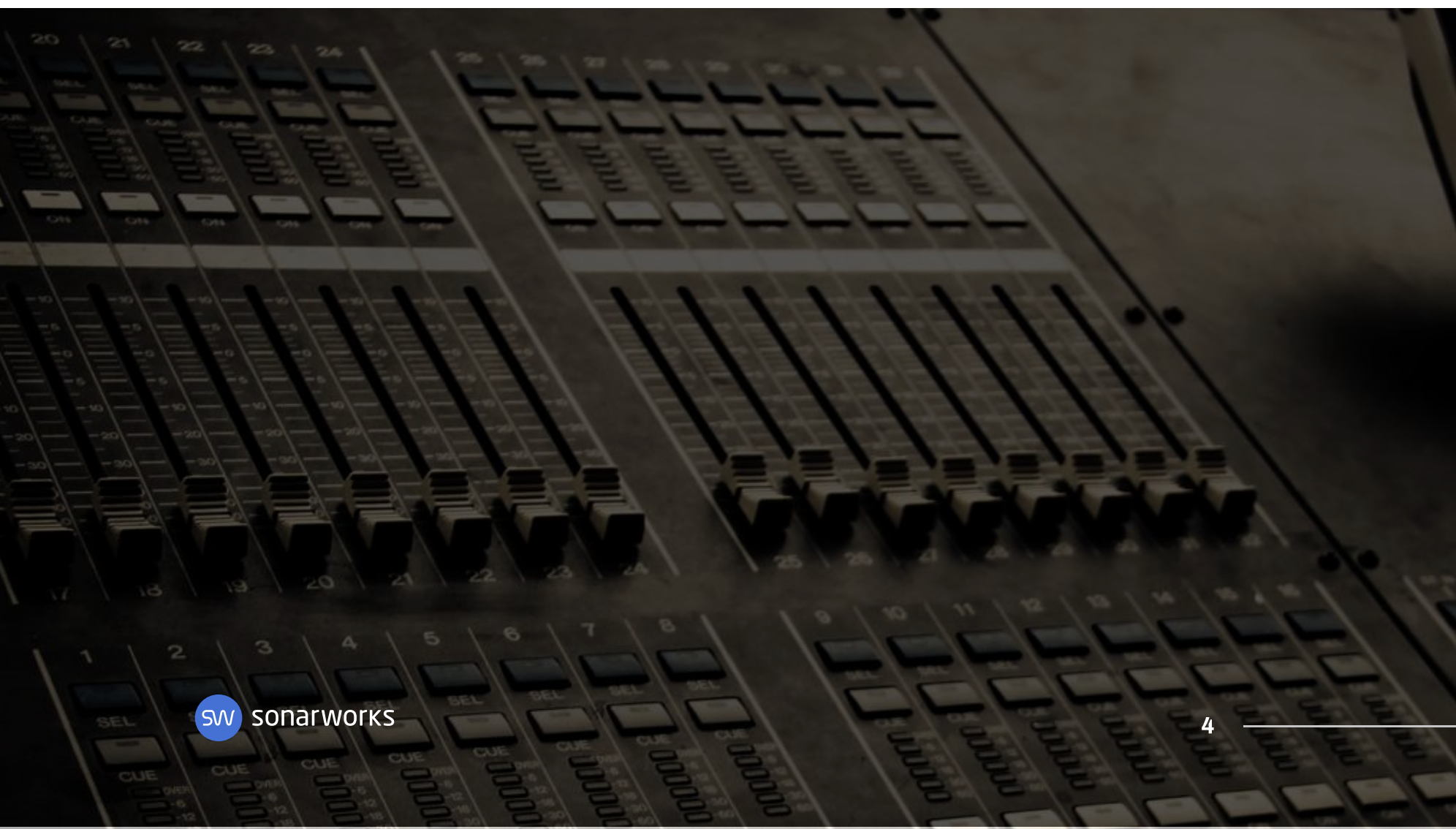
"I approach playing acoustic guitar more of as a percussive instrument"

Billie Joe Armstrong

Chapter 1

The Fundamentals of Equalizers

Anyone who has used a car stereo, guitar amp or almost any home entertainment system should be familiar with simple bass and treble controls. Equalizers may have two knobs or they may have dozens of parameters, colorful meters, and even built-in analyzers. No matter how simple or complex the EQ may be, the principles remain the same. In this section, we cover the nuts and bolts of equalizers and their function.



Types of Equalizers and Their Applications

by Brad Pack

When it comes to tools of the trade, the equalizer is easily the most important signal processor in any audio engineer's arsenal. But in order to use EQs properly, you need to understand how all the different types of equalizers work.

In this blog, we'll break down everything you need to know about filters, graphic EQs, parametric EQs, linear-phase EQs and dynamic EQs. We will also talk about what each type of EQ is best used to help you on your path to mastering the craft.

Filters

Filters are considered to be one of the basic building blocks of signal processing. Generally speaking, a filter is considered to be any device or circuit that changes the tone, or timbre of an audio signal. In the real world, most people refer to a filter as a type of EQ that specifically removes unwanted material. In this article, we will mainly discuss "pass" type filters, which only allow certain frequencies through, while rejecting others.

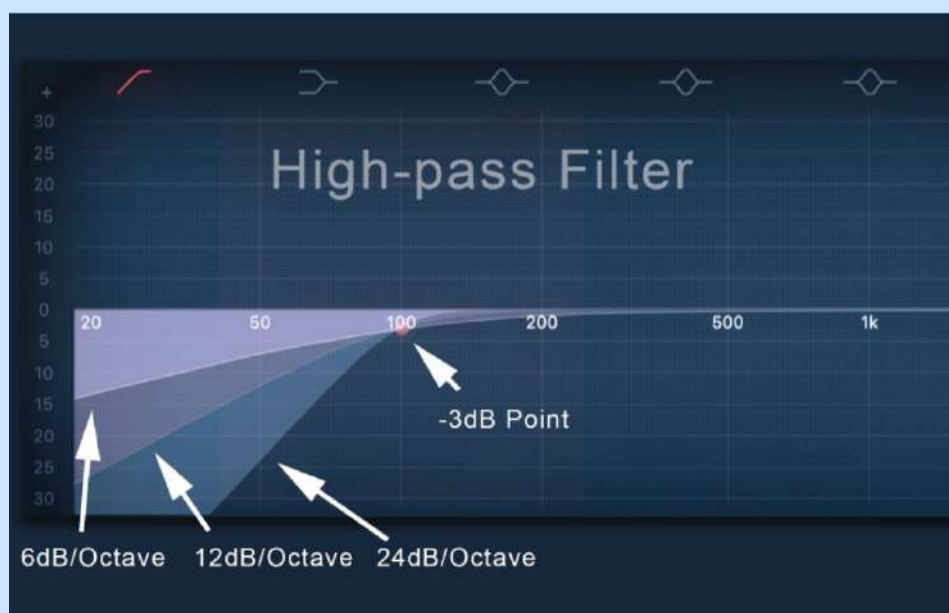
High-pass filters, for instance, cut frequencies below a selected point, attenuating the low frequencies and allowing the high frequencies to pass through. Alternatively, low-pass filters cut frequencies above a selected point, attenuating the highs and allowing the lows to pass through. High-pass filters on microphone channels typically remove low frequency rumbling from air conditioning noise or trucks outside your studio.

Band-pass filters cut both the high and low frequencies, allowing only the midrange to pass through. The opposite of a band-pass filter is a band-rejection filter, also known as a notch filter, which removes a narrow frequency band and leaves most of the signal unaltered. Band-pass filters can create effects like music played through a cell phone speaker.

The slope of a filter affects the shape of the transition between the filtered frequencies and the passed frequencies. Most analog filters have slopes of between 12dB and 24dB per octave, with higher numbers correlating to steeper slopes. Some advanced filter designs create a peak resonance at the cutoff point for extra emphasis.

Filter slope

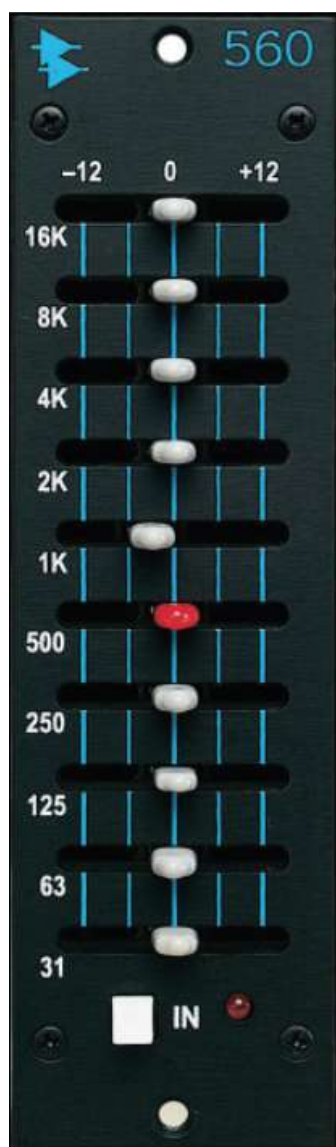
In a typical high-pass filter, the filter frequency, referred to as the -3dB point, indicates the point where the filter has attenuated the level by 3dB. This diagram displays three different slopes of 6dB, 12dB and 24dB per octave. Notice that each slope crosses 100 Hz at the same level, even though the slopes are different.



The sonic characteristics of a filter are based on the type of circuit, or algorithm that it uses to attenuate frequencies. For example, the well-behaved Chebyshev filter has a smooth slope; the easy to implement Butterworth filter may have notable phase nonlinearities; the gentle Bessel filter has minimal phase shift artifacts, and the Elliptic filter has the steepest filter slope.

Filters are used in almost every stage of audio processing. They're built into instruments, amplifiers, and equalizers and are used by everyone from musicians to mastering engineers.

Graphic Equalizers



Graphic equalizers (see the API 560 graphic EQ pictured here) are basically a collection of fixed-frequency peak/notch filters that can be used to cut or boost signals. Graphic EQs come in various sizes, including 31-band, 15-band, and 10-band (give or take a band).

31-band or “1/3 octave” graphic EQs feature 31 bands spaced in 1/3 octave intervals—in other words, three bands cover the range of one musical octave. These models typically offer gain adjustments up to 12 or 15 dB and feature a fixed Q value of around 4. With the ability to easily notch out multiple frequencies, 31-band graphic EQs are an excellent choice for live sound applications and precise subtractive EQ.

Some graphic EQs, like the 10-band API 560, use proportional Q technology for a musical tone, while 1/3 octave EQs work well for notching out resonances, but struggle to create smooth EQ curves.

15-band, or 2/3 octave graphic EQs, are commonly seen in smaller live sound setups, built into bass and guitar amps, or mounted in studio racks. 10-band graphic EQs are available in rack mount and 500-series units for the studio, as well as guitar pedals. With broader Q values, smaller graphic EQs are well suited for gentle tone shaping.

By using multiple bands simultaneously, graphic EQs can be used to create more sophisticated EQ shapes like shelving or bell curves, similar to parametric EQs.

Parametric Equalizers



With dedicated controls for frequency, gain, and bandwidth, sometimes called Q, parametric EQs offer more flexibility than graphic or selectable equalizers. Analog parametric EQs typically range from three to eight bands, while digital parametric EQs may offer even more bands. (See SSL 611E parametric EQ pictured here)

Parametric EQs come in two basic variants: semi-parametric and fully-parametric.

Fully-parametric EQs include frequency, gain, and Q (bandwidth) controls for each frequency range, like low, low-mid, mid, hi-mid and high, allowing for advanced tone shaping capabilities. These are commonly found in high-end mixing consoles and analog studio equipment.

Semi-parametric EQs offer frequency and gain controls, but not fully adjustable Q controls for each band, and are commonly found in studio and live sound consoles. The famous Neve 1081 EQ, for example, lets you select the frequency and gain for each band, but only lets you choose between narrow or wide Q on the two mid-band sections.

Parametric EQs often contain high and low EQ bands that can be switched between shelving and bell shapes. Shelf EQs boost or cut a signal above or below the specified frequency, while bell curves boost or cut the signal centered on the selected frequency.

Although they're not technically parametric EQs and do not offer adjustable Q controls, selectable-frequency EQs like the API 550A/B offer a choice of frequencies and gain for each band, along with a proportional Q circuit. A proportional Q circuit automatically widens the bandwidth with gentle gain settings and narrows the bandwidth at more extreme boost and cut settings.

Linear-Phase Equalizers

Traditional or standard analog and digital EQs are also called “minimum phase” equalizers. These EQs cause a small amount of latency when modifying frequencies, which affects the phase of a signal. “Phase smear,” as it's sometimes called, can create audible artifacts in your signal, which may be an interesting color or an unwanted distortion depending on the desired EQ effect.

Don't get the wrong idea, there's nothing wrong with minimal phase EQs. In fact, most EQs—from your trusty Neve 1073 to your favorite SSL or API channel strip—are minimum phase EQs. In fact, all-analog EQs are minimum phase EQs.

Minimum phase EQs sound great in most instances, but during mastering or when applying delicate EQ adjustments to acoustic instruments it's often best to use linear phase EQ plug-ins.

Linear-phase EQs do not alter the phase of a signal, creating a more natural tonal effect and may also work well for parallel EQ duties. However, linear-phase EQs suffer from greater latency and high CPU usage, which means they can't be used during tracking or in large, CPU intensive mixing sessions.

Linear phase EQs also introduce their own type of distortion called pre-ringing, which some very picky people find offensive. In practice, pre-ringing is rarely audible or much of a concern. Many modern EQ plugins, like Fab Filter Pro Q, Sonarworks Reference and Izotope's Ozone EQ allow the user to audition and choose between linear phase, minimum phase and even mixed phase EQ modes.

Dynamic Equalizers

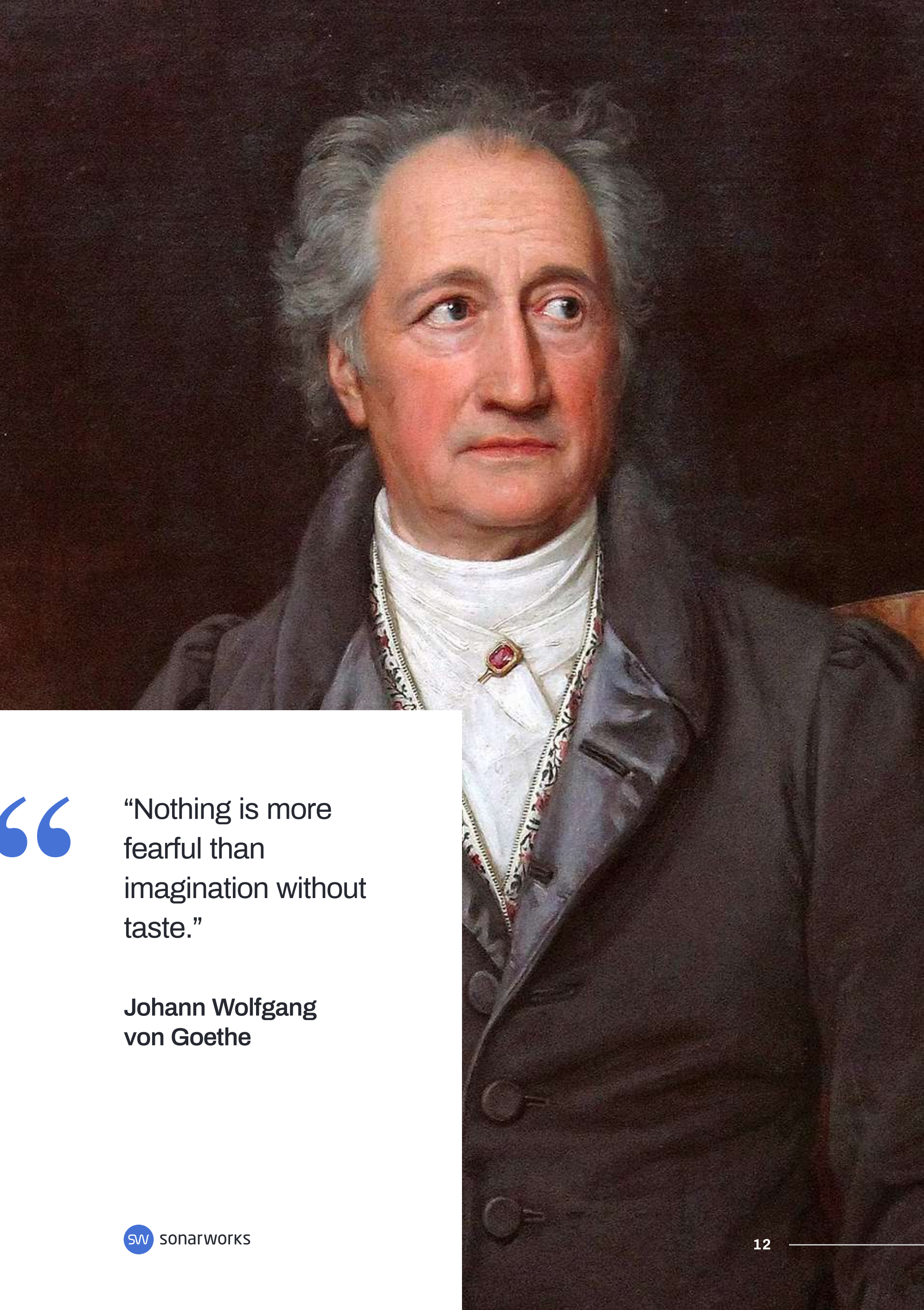
Sometimes it can be tough to dial in the right tone with a traditional equalizer. At any given moment during a performance, there's either too much of one frequency or not enough of another. You can't find the right frequency balance and it feels like the song is changing right in front of you and you're just mixing in circles. This is where dynamic equalizers come in.

Dynamic EQs work similarly to multi-band compressors, except they affect the frequency response and not the signal's dynamics. Each band features frequency, gain, and Q settings along well as a threshold setting and maybe even speed controls. The selected frequency's gain self-adjusts when that frequency's threshold is reached to automatically turn up or down the level of a particular frequency band.

Let's say you tame a harsh-sounding hi-hat in the overhead mics by applying a high-frequency shelf to cut the highs. Then, when the drummer switches from playing the hi-hat to the ride cymbal in the chorus, the overheads sound dull and flat. By using a dynamic EQ, the high-frequency cut would only engage when the harsh hi-hat is being played and the signal would remain unaffected during the chorus, leaving the overheads sounding even and balanced throughout the entire song.

Dynamic EQs can be especially helpful when mixing dynamic instruments, like drum kits, guitars, and vocals. They can also be helpful for subtle tone shaping on instrumental and mix busses. And in more specialized scenarios, they can be used to carve out space between two competing instruments, such as a kick drum and bass guitar. Dynamic EQs are especially useful for evening out the occasional boomy or strident word in an otherwise great vocal performance.

There is an equalizer optimized for every tone-shaping task you can imagine, so go out there and try some different types of EQs on every sound you come across. You may find it useful to try one particular EQ plugin on everything for a few songs and then switch to another EQ and use that one for a few songs. After a short time, you will instinctively know what EQ is best for any given situation.



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“Nothing is more
fearful than
imagination without
taste.”

**Johann Wolfgang
von Goethe**

The Magic of Passive EQ

by Adam Kagan

Equalizers top the list of creative tools used to shape our productions, mixes, and masters. Each of us is familiar with at least a few parametric equalizers and probably some graphic EQs as well as some channel strip EQ emulations. Every modern DAW provides excellent stock EQs and each one of those plugins is more than capable of performing quite well, so you shouldn't let a lack of EQ options hinder your workflow. More is better, or at least more inspiring, so this post will introduce (or reintroduce) you to a classic EQ that belongs in your arsenal.

Along with the myriad of parametric, graphic, dynamic, mid-side and adaptive equalizers, you are doing yourself and your music a huge disservice if you don't spend some time to investigate traditional passive equalizers. The classic devices provide a certain mojo and inherent musicality, which can add dimension and life to your tracks and masters. Though passive equalizers have been around for more than 60 years, many folks aren't familiar with passive EQs or aren't even aware that they may already be using passive equalizers.

Familiar Friends

Before we get into the use and benefits of passive EQs, let's discuss some of the most popular passive units and their plugin counterparts. The most iconic of all passive EQs is the Pultec EP1-A, and to a lesser extent, its brother, the MEQ-5. These units have graced racks in studios, radio stations, and mastering facilities since the 1950s. The next most well-known passive EQ is arguably Manley's Massive Passive. This beast has been around for 2 decades and may be the world's finest passive EQ. The Abbey Road RS56 originally showed up in 1956, quickly making its way from the mastering room into the tracking rooms at Abbey Road Studios. SPL re-invented the modern passive EQ with its powerful Passeq Mastering Equalizer. These and many other passive EQ designs have graced our beloved musical tracks and remain at the top of the food chain for musical, high-quality tone control.

Passive is Simplicity

Passive equalizers create tonal changes without using any powered components, like transistors, opamps, or tubes. Instead, they use only passive electronic components—resistors, capacitors, and inductors. Since only passive components are used, the equalizer does require a make-up amplifier to boost the EQ'd signal back up to its original level. An obvious advantage of passive EQs, then, is their simplicity. A simple passive filter may have only 5 components, while a single band of an active EQ circuit may be made up of dozens of transistors, sophisticated opamps, tubes, capacitors, and resistors. Passive circuits inherently do less harm to audio, especially when it comes to smeared transient response, various distortions and other unwanted colorations. Passive EQs basically allow much more tone shaping with much less coloration.

Inductors

Passive EQs utilize inductors as part of their tone-shaping circuit. An inductor is basically a coil of wire that acts as a frequency-dependent resistor and creates electrical inductance. Inductors, as part of a filter or EQ, also benefit audio signals in some musical ways. Inductors, like transformers, saturate slightly, which sounds very nice to our ears. Low frequencies become fatter and more harmonically rich, and high frequencies can be boosted significantly without adding harshness or sibilance. Inductors saturate until they can't, at which point they become a frequency-based limiter. A well-designed inductor-based equalizer can provide incredibly musical boosts and cuts and can include bandwidth controls to create shelving, bell or parametric filters.

Coloration from MakeUp Gain

Once our signal has been tone-shaped, we need to boost the signal back up to its original level; so passive equalizers include makeup gain amplifiers. These amplifiers may be tube-based circuits or solid-state circuits. Tube makeup amplifiers provide the beneficial harmonic coloration of tubes, while solid-state amplifiers, like API's 2520 opamp, may be used for makeup gain, again adding their own characteristic color. Passive equalizers also typically employ transformer balanced input and outputs, which provide their own sonic colorations. Many hardware passive EQs are available with various amplifier or transformer options to provide a wide range of musical coloration.

Getting Your Hands on Passive EQ

The best passive hardware EQs, mentioned above, carry hefty price tags and may be out of reach for the average personal studio, but if you have the budget, it would be a treat to experience the magic of the classic passive hardware EQs. For the rest of us, we will make do with plugins. Fortunately, the digital emulations of passive equalizers do an excellent job of retaining the musical qualities of their hardware forefathers. Plugins may struggle to capture the subtle non-linear saturations and color of the tubes and transformers, but the tone of the equalizer and overall musicality of the equalizers is captured by the plugins.



Common Passive Equalizers Plugins

Pultec EQP or MEQ Emulations:

UAD Pultec Collection

Softube Tube-Tech Collection

IK Multimedia EQP-1A

Waves Puigtec

Other Passive EQ Plugins:

Manley Massive Passive

SPL Passeq

Native Instruments Passive EQ

Waves Abbey Road RS56

What To Expect with Passive EQ

These days, I almost always prefer the plugin to the same model hardware processor, simply because the plugin provides more flexibility than the hardware. For instance, the Manley Massive Passive hardware, while an amazing box, sometimes provides more saturation, or softness, than I desire. The plugin can be more transparent and subtle, but just as effective and musical at extreme settings. Most importantly, though, the plugin allows for many simultaneous instances in a session, so I can try the Massive Passive on all the tracks in a mastering session and leave all the plugins running live while I work. The hardware box, obviously, only works on one signal at a time.

I find passive equalizers extremely useful on drum busses, vocal busses, electric guitar busses, live strings, piano, and almost any acoustic-style mix. Passive EQs provide warm, wide low end without cloudiness or added punch, as well as silky high frequencies without harshness or sibilance. Passive devices usually provide a sense of depth and dimension that is unique to their own signature.

Many passive EQs, like the Pultec EQP-1A provide useful reciprocal equalization curves where the low frequencies, for example, may be both boosted and cut at the same time to provide wonderfully shaped curves. Each model of passive EQ provides its own characteristic personality and tricks and while I find many console-style EQ plugins sound great, each particular passive plugin provides its own special mojo. Next time you are looking to spice up a mix or sweeten a master, be sure to audition at least one of the many passive equalizers available. Like any audio processor that may be new to you, spend some time learning the subtleties of each device, as mixing music is a cumulative process and seemingly small changes add up to large changes to a full mix.

In any mixing or mastering situation, be sure to optimize your playback system for the best acoustic representation of your music. Read our tips about setting up and calibrating your room and try Sonarworks Reference software to fine-tune the sound of your speakers or headphones. Most of all, be creative and enjoy the process!



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“I grew up on the Beatles; I love Linkin Park and Green Day. I heard hip-hop for the first time at 11 and realized what I was missing.”

Billie Eilish

Should You Be Using Linear Phase EQ?

by Adam Kagan

During a quick search on a popular online music retailer, I found no less than 342 different models of equalizers. Some plugin brands produce as many as twenty different EQ models. With all those options, how is one supposed to choose an appropriate EQ for a given situation? My usual advice to beginning engineers is to limit your choices to a few devices and use them until you feel like you really understand their strengths and limitations. After that add another device to your arsenal. This way you build a vocabulary of processors the way a guitarist builds a collection of guitars. Each instrument or processor has a unique personality and you will begin to instinctively reach for a particular tool for a specific application.

I will admit that many of my EQ choices are based simply on the user interface and the features of the plugin. If I want to make my drum overheads brighter, I'll reach for an EQ plugin that has an easy-to-read and uncomplicated high-frequency section. I don't want to flip through pages or adjust more than two or three parameters to simply "make this brighter." I may also limit my choices to EQs that also provide a polarity switch. Many times I'll flip the polarity while I EQ a sound to make sure that I'm aware of its interactions with other instruments. This is especially true for acoustic drums and low-end instruments (drums, basses, synths) that tend to mask each other. I have also become quite attached to EQs that let me solo individual frequency bands.

Common EQ types include graphic, parametric, semi-parametric, shelving and dynamic equalizers. Circuitry options would include solid-state, tube-based, inductor-based or passive circuits—and all these modeled in plugins. These may be styled after constant-Q or proportional-Q circuits and some EQs even automatically hunt down and correct tonal variations and resonances.

As the market saturates with reproductions and variations of so many classic equalizers, companies have begun to bombard us with something referred to as a Linear Phase Equalizer. Marketers would have us believe that audio Nirvana can finally be reached via this elusive and magical tool. Should we jump in and replace our beloved equalizers with linear phase equalizers? As we all know, there is no free lunch, so let's dive into the world of linear phase and see what's what.

Typical equalizers (and all analog EQs) are referred to as minimum phase equalizers since one of the design goals for equalizers is to minimize phase shift artifacts. Simply put, analog equalizers rely, in part, on capacitors and inductors, which induce tiny time delays and cause phase shifts that vary with frequency, filter shape and the amount of gain applied. Phase shift seems like it may be bad, but I think of phase shift like salt. Too much salt certainly tastes bad, but the right amount of salt brings forth dimension and complexity to flavors. Phase shift, like salt, imparts interesting depth and exciting dimension to musical sounds. Too much phase shift, unsurprisingly, smears harmonics and muddies up our musical intentions. Each brand and model of minimum phase equalizer owes a lot of its personality to the particular phase shift artifacts they impart.

There are some situations where wish to avoid phase shift from our EQ. Thanks to digital signal processing, we can have equalizers that do not produce any phase shift artifacts. These EQs are called Linear Phase Equalizers. These equalizers avoid phase shift by analyzing the frequency content and applying gain with FIR filters, a process that takes a lot of time (latency). The processed audio is subsequently shifted earlier to try to keep everything in time. This time shift produces an audible echo, called a pre-ring, that immediately precedes sounds with strong transients, like drums. This pre-ring can smear or weaken the attack of drums and picked or plucked instruments. Getting back to the no free lunch idiom, linear phase equalizers trade phase shift for pre-ringing artifacts. We have now established that both minimum phase and linear phase equalizers have good and bad attributes. Now let's explore the best uses of linear phase EQ.

For most applications of EQ, like sweetening instruments or mastering mixes, the actual phase shift is minimal because we use broad bandwidths and gentle boosts and cuts. For extremely narrow cuts or boosts, like when removing a resonant frequency from a snare drum, phase shift will drastically affect the frequencies surrounding the EQ'd frequency. In this case, linear phase EQ would be a wise choice and would remove the offending resonance without affecting the overall sound of the drum. Likewise, a steep high-pass filter that removes rumble from a vocal mic or guitar cabinet could wreak havoc on phase at frequencies well above the cutoff frequency. Phase shift artifacts may cause instruments to sound strange, so linear phase EQ would be a great choice. We can say that narrow cuts and boosts and steep bandpass filters are two situations where you might consider linear phase over minimum phase EQs. Keep reading—there are more uses for these magical devices.

Parallel processing instruments or subgroups in a mix would be another situation for linear phase EQ. Let's say we have a vocal track and wish to duplicate the track and add some high-frequency shimmer by applying a high pass filter and compression to the duplicate (parallel) track. Minimum phase EQs, especially high pass filters, can induce phase shift that adversely affects the combination of the two tracks, causing unintended tonal changes. You can't simply "flip the phase" and fix this problem. So, for parallel EQ duties, the linear phase EQ, with its lack of phase shift, may be our new best friend. You should audition both linear and minimum phase for parallel processing since in some cases you might find that phase artifacts sound interesting.

How about blending a top and bottom snare mic? For similar reasons to the above example, a linear phase high pass filter on the bottom snare mic (or hi-hat mic) may help retain the natural body of the snare while removing some low-frequency mud. The same goes for EQ'ing multi-miked guitar cabinets. For stereo miking, however, minimum phase EQ may be just fine since we are typically applying the same eq curve to both mics and both mics contain very similar source audio. Again, try both linear phase and minimum phase to hear what each does in your mix.

Another consideration when deciding whether to use linear-phase EQ is latency and CPU power. Many linear phase equalizers load your CPU slightly more than traditional equalizers and all linear phase equalizers can impart extreme amounts of latency. Linear-phase EQ latency can range from around 3,000 samples to over 20,000 samples. At a 44.1kHz sample rate, that translates to between 100 milliseconds and more than half a second. While most DAWs provide plugin delay compensation, you may near the compensation limit once you exceed 10,000 samples. Pro Tools, for example, provides about 16,000 samples of delay compensation at a 44.1kHz sample rate.

Many modern plugin equalizers, like those from Izotope and Fabfilter, provide linear-phase, minimum-phase, and even mixed-phase modes. Mixed modes provide some benefits from each type of EQ. You should audition these modes on various sources to find the best uses of each type. Further, many equalizers provide resolution or quality settings to further optimize your preferences of sonic character vs latency.

To answer the question of “Should I use linear phase EQ?” the answer is, as usual, it depends. Minimum phase equalizers, with their familiar personalities, would be my first choice most of the time. In certain situations, like narrow bells and steep filters, linear phase probably has the advantage. For parallel processing and multi-miked sources linear phase also probably comes out on top.

The best recommendation I can make is for you to add a linear phase EQ to your toolbox and learn where it best works for you.

Popular Linear Phase Options

Blue Cat Liny EQ

DMG EQUALITY

Fabfilter Pro-Q3

Izotope Ozone 9 or Neutron 3

Logic Linear Phase EQ (Stock Logic Plugin)

Melda MEqualizer LP

Nugen SEQ-S

T-RackS Linear Phase EQ

Waves Linear Phase EQ

Chapter 1

Key Takeaways

- ☐ Familiarize yourself the main EQ types (Graphic, Parametric, Semi-Parametric)
- ☐ Advanced EQs, like dynamic EQ and linear phase, are also available
- ☐ Understand the parameters of Bandwidth, Gain, and Frequency
- ☐ Corner frequencies of bandpass filters are the -3dB point
- ☐ Passive EQs have a sound of their own
- ☐ Know when to try linear phase EQ instead of minimum phase
- ☐ Build a vocabulary of equalizers!

Chapter 2

EQ In Action

Now that we are comfortable with the functions of equalizers, let's delve into how to put them to best use. Some of the most requested topics regarding equalizers revolve around producing a solid low-frequency foundation for mixes and how to create powerful and natural drum sounds. The two articles in this section provide some perspectives on creating that low end that you can be confident in and also how to shape great drum tones. Be sure to check out Tiki's cheat sheet at the end of his article.

Rock The Low End

by Eli Krantzberg

The holy grail of mixing is creating mixes that sound great when played back on different systems in different environments. Mixes that do not translate well invariably suffer from problems in the low end of the frequency spectrum. In popular music genres like rock, pop, and country, the quality of the bottom usually comes down to two elements of your mix. 1. The bass. 2. The bass drum. These guys need to solidly blend together, and at the same time, stay out of each other's way. How can we give each of these instruments punch and clarity and have them work well together?

Clear The Way

The first thing to consider is keeping other instruments out of their way. Many instruments, like electric guitar, organ, and keyboards, generate sub-harmonics that extend below their fundamental frequencies. EQ'ing out some low frequencies on these instruments helps leave room in the mix for the instruments that need lows the most. Bass, and bass (kick) drum. Be careful, though, not to filter out too much low end on other instruments, or they can become thin and weak. Low-cut EQs, either as high-pass filters or shelving EQs, are useful for this.

Visualize the Roots

Since the kick and bass generally occupy overlapping areas of the frequency spectrum, EQs can be used to bring out their fundamental tones, which lie in slightly different ranges. Focusing the kick drum in the 40 – 70 Hz range, and the bass in the 70 – 200hz range is generally a good starting point. A spectrum analyzer (part of many EQs) can help you visualize where the energy of each instrument is most focused for your particular mix. Focus on each instrument and watch the analyzer (and listen!) to find their strongest fundamental frequencies. You may even find that the bass fundamental changes between different sections of a song.



The Waves H EQ provides a spectrum analyzer that overlays the frequency response on top of the equalizer settings.

Simple bell-shaped EQ dips and boosts work fine but may not always yield the best result. A high pass filter with a gentle slope and slight resonant peak at the cutoff point will boost either the bass or the kick drum right where it's needed, while gradually attenuating the lower frequencies. Some EQs create this shape with one band, but you can also create this shape with a high pass filter and a bell-shaped boost playing against each other.



The versatile FabFilter Pro-Q3 can create a high-pass filter with a resonant boost at the cutoff frequency. This shape can boost the fundamental frequency while cleaning up the muddy subs. You can also see the frequency analyzer displayed behind the EQ curve.

The Pultec EQ Trick

Simply boosting and cutting frequencies is only a starting point. Another excellent way to give one low-end element focus while leaving space for other sounds is by using the Pultec EQ Trick. The Pultec EQP-1A (and its many emulations) has a low-frequency section with separate gain knobs for boosting and attenuating the same frequency. The boost and cut, however, have slightly different curves and different amounts of gain, so boosting and cutting simultaneously can fill out the low bass while carving out a nice notch, centered at the corner frequency. The resulting curve leaves space for other instruments in the upper-bass range. Most DAWs and third-party plug-in developers offer Pultec emulations for just this application.



The Pultec EQP-1A low-frequency section shown with its response curves and resonant shapes.



The typewriting machine, when played with expression, is no more annoying than the piano when played by a sister or near relation.

Johann Wolfgang
von Goethe

Sidechain Compression

Compression is another processing tool that helps low-frequency instruments stand out in a mix. For the bass drum, the right compression can add weight and presence. For bass, it can add a nice gritty edge to the attack and smooth out the sustain. In rock, pop, and country music, the kick drum and bass parts often intersect rhythmically—sometimes they play together, and sometimes they don't. A tried-and-true technique to help these instruments play well together is sidechain compression.

Set up a sidechain compressor by first inserting a compressor on the bass track. Normally, a compressor reacts to the signal playing through it, but with sidechain compression, the compressor looks at a separate trigger signal, or side-chain input, to tell it when to compress. We can bus the kick drum signal into the bass compressor's side-chain input—usually done via a send. The compressor on the bass will then react to the kick drum signal rather than the bass. The result is that when the kick drum plays at the same time as the bass, the kick triggers the compressor and the bass is compressed (dipped) out of the way of the kick drum. The compressor remains inactive when the kick drum is not playing, leaving the bass uncompressed. During sidechain compression, just as with regular compression, the bass level will be compressed as defined by the compressor's threshold, ratio, attack, and release settings.



Here we can see the Bass Drum track is sending signal into the sidechain of the Waves H-Comp, which is compressing the Bass track. The Sidechain section selects which aux bus triggers the compressor.

Dynamic EQ

A hybrid approach to focus each instrument in their respective range, which combines the best of side-chain compression and EQ is known as dynamic EQ. Dynamic equalizers combine the precision of an equalizer, with the gain change ballistics and response of a compressor or upward expander. A Dynamic EQ allows you to set some EQ dips or boosts where you need them, and then introduces a variable gain component based on the frequency content of the signal. Think of dynamic EQ like a regular EQ, but with a threshold setting for each frequency band.

A dynamic EQ tries to normalize the level of energy in each band of the frequency spectrum. In other words, the EQ reacts as the frequency content of a sound changes. The result is that an EQ band will dip or boost from its static setting based on the band's threshold. For example, you can retain the natural accents in the bass part, but dip only the low E notes (41.2Hz) whenever they are played too loudly. Or, the EQ can boost certain weak bass notes while leaving the louder ones alone.

Many dynamic EQs also include a side-chain function, so you can set up a static EQ to boost your bass, but have a specific band dip slightly when the kick drum hits along with the bass.



The Waves F6 provides a 6-band dynamic EQ with sidechain input for sophisticated spectral control.

Glue the Low End

In addition to working individually on bass instruments, there are ways of tightening up the bottom end of the mix as a whole. Multiband compression on a mix bus, or applied during mastering, is an excellent way of evening out the dynamics in a specific frequency range. Try this: Set the crossover points to restrict the lowest compressor band to below 100 Hz. Set the threshold and ratio so that a few dB of gain reduction is happening during the loud sections. Make sure not to use extremely quick attack or release times to avoid compression artifacts. This type of frequency-specific compression can create evenness and a smooth quality to the low end.

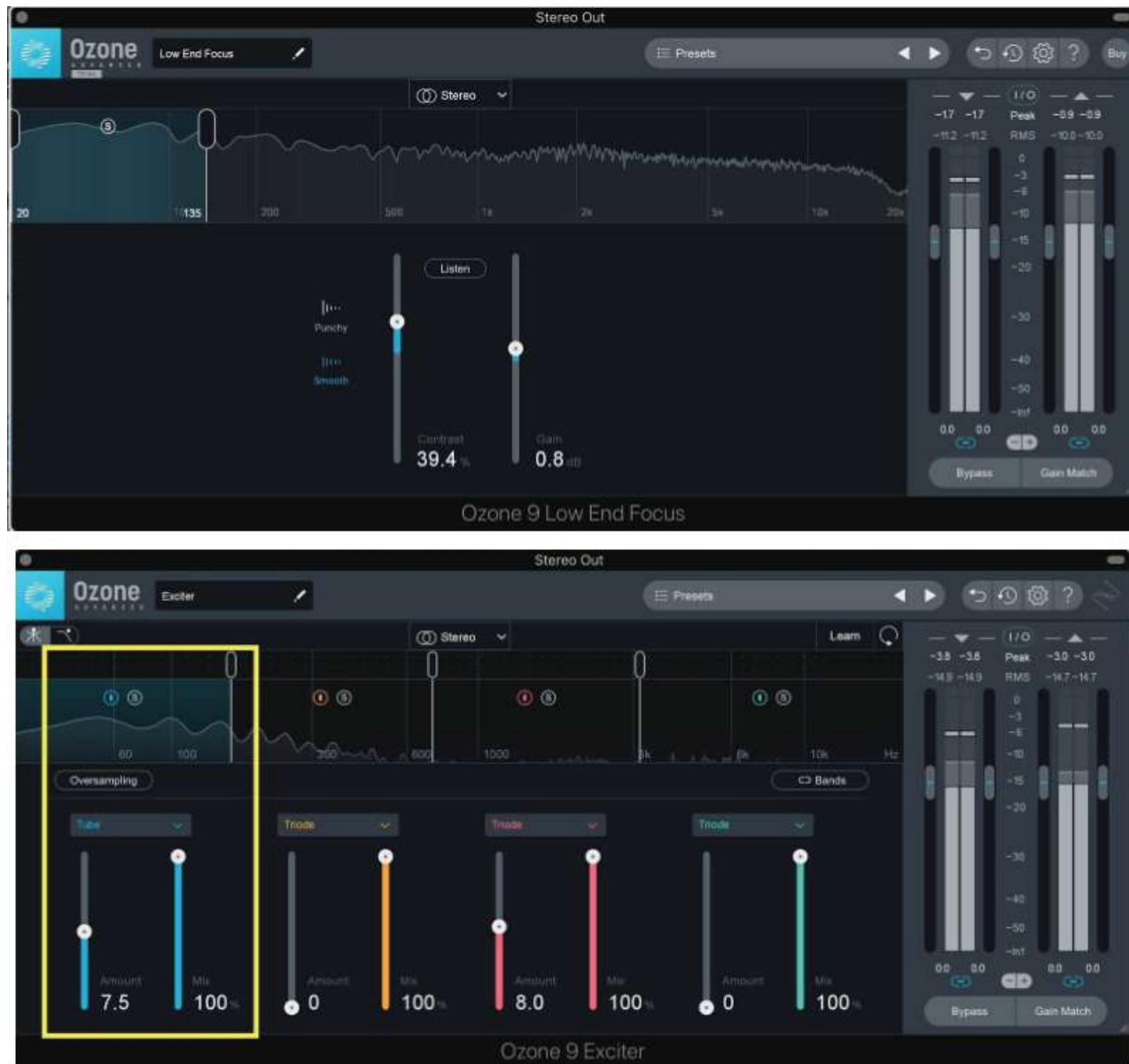
Add Some Density

There are several specialized plug-ins that can generate harmonic content and add excitement and intensity, particularly in the low register. Vitamin from Waves is a multi-band harmonic enhancer that can instantly warm up the lows on almost any mix.



Waves' Vitamin plugin provides multiband saturation and can add a nice density to a mix or bus.

Ozone 9 from iZotope includes several mastering modules designed for low register enhancement. Low End Focus and the multi-band Exciter are both tools to add subtle warmth and drive to the bottom and help glue the mix together.

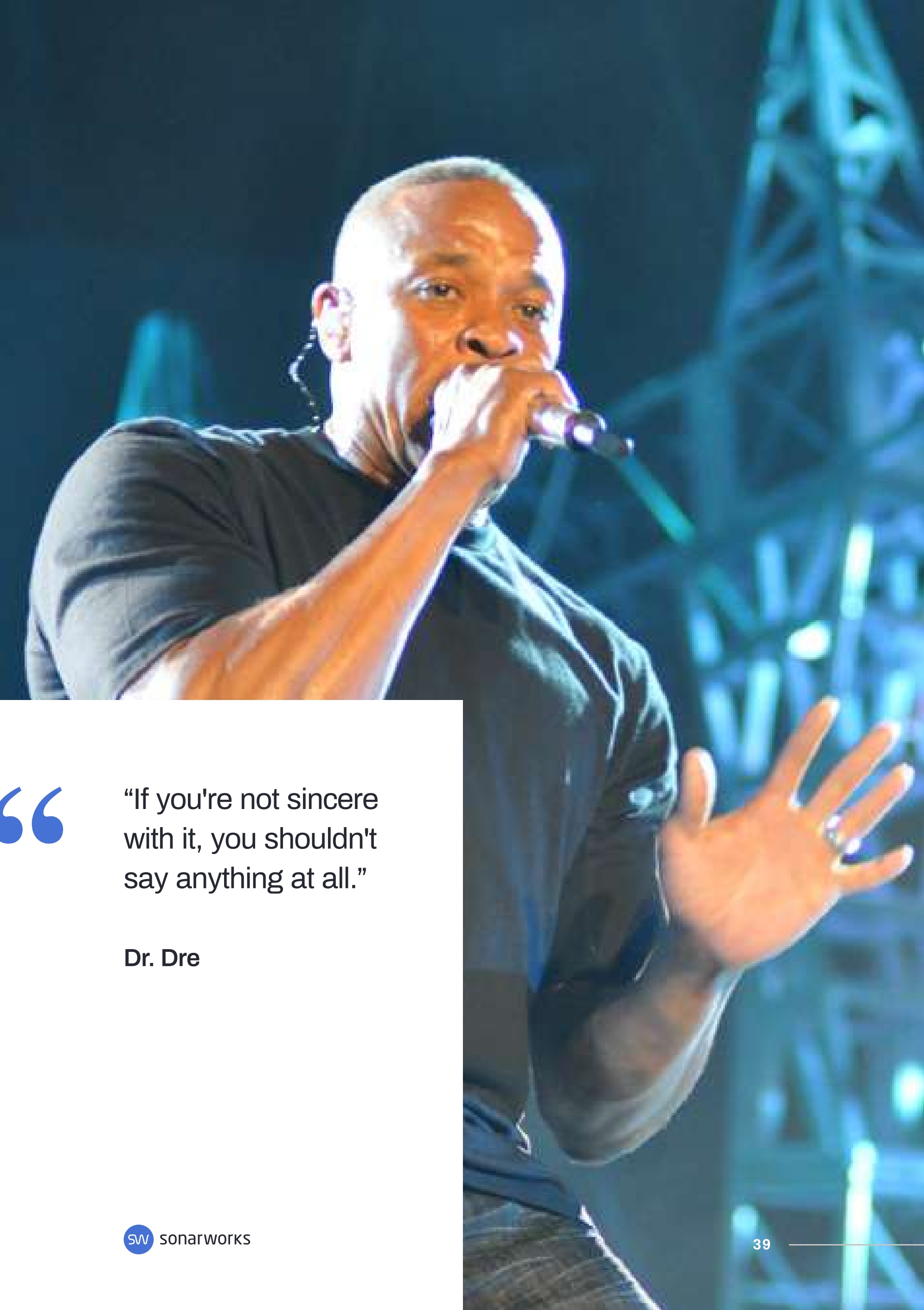


Izotope's Ozone 9 bundle includes a multiband exciter and the Low End bass enhancer that can both add life and clarity to the bottom of a mix.

Don't Overdo It

A great bottom end may be what separates the pros from the amateurs, but remember not to over-process your mixes. Too much of a good thing quickly becomes a bad thing when used in excess. In addition to various audio processors and a good spectrum analyzer, you always need monitors that are well-calibrated and tuned to your room. Quality monitoring is the best insurance against muddy or weak low frequencies in your mixes and masters. As mixers, we need to be able to trust what we hear, above all else.

Go ahead and rock the low end on your mixes with confidence!



“

“If you're not sincere
with it, you shouldn't
say anything at all.”

Dr. Dre

Drum EQ Tips

by Tiki Horea

This article is to follow-up to Brad Pack's great article on [Equalizers](#), I'll be providing an overview of EQ-ing drums along with a downloadable Drum EQ Cheatsheet at the end of the article.

I used to be against cheatsheets, but then I had an epiphany. Even though every mix is slightly different than anyone you have worked on previously, mud is always mud, harshness is always harshness, and each quality resides in its respective frequency range. Cheatsheets help point you in the right direction. If the cheatsheet says "cut at 300Hz to get rid of muddiness", that specific value might work for your mix, or it might be close, but it's great to have a checklist of starting points close at hand. Remember, the frequency ranges listed here are guidelines that apply to most situations and you may find that modifying the frequency range slightly may improve your results.

Balance is key

It's important to remember one thing: the balance of all the tracks in the mix is the backbone of your mix. Anything else you do (EQ, compression, spatial effects, saturation, etc) is standing on the shoulders of how you balanced your mix. Superstar mixer Billy Decker has been quoted as saying "I'm all about balance. If something is out of balance, everything is out of whack."

Keep in mind that every tiny change you make affects the tone of your mix. Generally, when working on EQ, think about cleaning up the problem frequencies first (they're usually resonances), then do whatever it takes to enhance the tracks. Only after a clean tone has been sorted out should you consider doing your final EQ moves.

Stay away from the solo button

A word of warning: don't EQ individual drums in solo. The main vocal is the only element of your mix that you may want to EQ in solo. If you were to EQ the close drum mic tracks by themselves, you'd notice a lot of resonant frequencies, but clearing those up will kill off the mojo of your tracks. This may possibly make the individual sound clearer, but the overall drum sound would be lame. You want your drums to kick down the door, not politely knock and ask for permission to enter.

What's the matter, honey?

Before you unleash your EQing skills on the mix, think about the root of the problem. Often one frequency range will mask another. If the snare sounds dull and lifeless, there could be a strong resonance in the mids, detracting from the high-end detail. Cut that midrange resonance and you'll most likely hear the snare come to life.

Another classic example is a kick that “has no body” (is that a ghost kick?). There's a strong chance the problem is too much low mid energy, which masks the low frequencies. Once you carve out the low mids, you'll suddenly unleash the kick's strapping low end.

Phase Check Before EQ

A word of warning: don't EQ individual drums in solo. The main vocal is the only element of your mix that you may want to EQ in solo. If you were to EQ the close drum mic tracks by themselves, you'd notice a lot of resonant frequencies, but clearing those up will kill off the mojo of your tracks. This may possibly make the individual sound clearer, but the overall drum sound would be lame. You want your drums to kick down the door, not politely knock and ask for permission to enter.

Finding Nasty Frequencies

When it comes to subtractive vs additive EQ, think of it this way: cut out the bad and enhance the good. Here is the easiest way to determine what frequencies to cut: Create a narrow band EQ and apply a large boost. Then sweep around the spectrum until you hear something horrible, and cut the EQ until it sounds better. Don't be afraid to boost 9 or 10 dB to find the resonant frequencies and you can begin with a wide Q until you find a problem area. Then narrow the Q to fine-tune the precise problem frequency. Watch your monitor/headphones volume as resonant frequencies can jump out at very high volumes during this exercise.

Jump on the Bus

A great way to chisel out the ideal tone for your drums is to bus or subgroup them together. Insert a stereo EQ on the group fader and sculpt away. You can easily clear out the mud from all the drum tracks this way, or add a bit more sparkle or attack. Just keep in mind that you're affecting all the drums at the same time. Once you're done with EQing the drums bus, examine the individual tracks to create the best tone. Remember, the balance and tonality of the entire drum kit will make or break the sound more than any individual tracks, so get a good balance before you grab the EQ.

General tips for Drum Tones

DRUM BUS

- You can fine-tune your low frequencies by applying a high pass filter and also pushing some low end around 50 - 100Hz. This provides a resonant boost without blowing up your subs.
- Boxiness lives between 300 - 400Hz, so cut that gently, if needed.
- 500Hz will add some body to the entire kit
- Try reducing 2.5kHz to get rid of harshness and make room for guitars and vocals.

KICK

- Kick drums can be high pass filtered at around 30Hz. Anything below that is all rumble, which is something you want to avoid if you want a tight low end. Be careful about electronic drums as 808-style bass drums may have their fundamental as low as 30Hz.
- Cut the low mids-mids at around 300-600Hz to get rid of boxiness. Sweep around to find the boxiest frequency and rid your life of it. Nasty!
- Boost highs for attack. Metal needs the highs boosted between 4-8kHz for some click, whereas indie, rock, and pop may boost at 1.5-2.5kHz for some smack.
- If you want to reduce bleed from the rest of the drums (especially the cymbals) in the kick drum track, you can achieve this by low pass filtering from 5kHz and up, but be careful not to lose the click or smack of the kick drum. A gate may be more effective than simple EQ for noise reduction.

SNARE

- If the kick drum is bleeding into the snare mic too much, it may be introducing nasty low end into the mix. In order to combat this, you can filter the snare track(s) below 100Hz with a steep slope (The SSL high-pass filter is 18dB/octave).
- Make your snare grow chest hair by boosting in the “body” range, between 100Hz and 250Hz.
- Add more attack to the snare by bringing up the 1.5 - 3kHz range.
- Add more rattle to the bottom of the snare around 5kHz
- If the snares of the snare drum are too loud, but the drum isn't bright enough, use a high-shelf boost at 9kHz-10kHz. This can make the drum brighter, without emphasizing the snares.
- Snare drums are prone to have nasty resonances, so sweep around and get rid of 'em.

HI-HAT

- Hi-Hats may have too much snare or tom bleed and can be high pass filtered at 300 - 400Hz.
- Thickness can be added around 600 - 800Hz, while clarity and openness can be found from 6kHz up to 12kHz.
- Clearing out the range from 800Hz - 2kHz can remove the nasal harshness of some hats.

CYMBALS/OVERHEADS

- Different genres use overhead microphones for different reasons. Metal, for example, uses them as purely cymbal mics, while blues and rock styles may achieve most of their drum sound solely from the overheads. Genres that need the full drum sound should be high-passed more gently (if at all) as compared to genres that use overheads mainly for cymbals.
- Cymbal harshness resides at 2.5kHz. Sweep around for the exact spot where the ear-breaker lives. Cutting in this area will not dull your cymbals. In fact, they'll sparkle in the mix without burning your eyebrows.

The bottom line is:

cheatsheets are inherently good.

Balance is important.

Checking phase is vital.

What works for mix 1 might not work for mix 2.

Enjoy

DRUM EQ CHEATSHEET

Kick Drum

- 40 - 60Hz: Bottom end
- 80Hz: Power
- 150 - 250Hz: Mud, hollowness
- 300 - 600Hz: Boxiness
- 1.5 - 2kHz: Attack for softer genres
- 4 - 5kHz: Attack for heavy genres (metal)

Snare Drum

- 120 - 250Hz: Fatness
- 500Hz: Body
- 900Hz: Mids presence
- 3kHz: Clarity
- 7kHz: Snap

Rack Tom

- 120 - 200Hz: Low end
- 150 - 300Hz: Mud
- 250 - 500Hz: Fullness
- 700 - 900Hz: Boxy
- 5 - 7kHz: Attack

Floor Tom

- 70 - 90Hz: Low end
- 150 - 300Hz: Mud
- 250 - 500Hz: Fullness
- 700 - 900Hz: Boxy
- 5 - 7kHz: Attack

DRUM EQ CHEATSHEET

Room

- 80Hz: Low end
- 150 - 350Hz: Mud
- 5 - 8kHz: Presence, sparkle
- 8kHz and above: Harshness

Drum Bus

- 40 - 100Hz: Power
- 300 - 400Hz: Boxiness
- 500Hz: Thickness
- 2.5Hz: Harshness
- 6 - 12kHz: Sparkle, sizzle.

Hi-Hat

- 200Hz: metallic “clang” sound that cheapens any recording
- 400Hz: Ambience, resonances.
- 600 - 800Hz: Thickness
- 6 - 12kHz: Sparkle, sizzle.

Overheads

- 80 - 120Hz: Low end
- 150 - 300Hz: Mud
- 400 - 700Hz: Boxiness
- 2.5kHz: Harshness
- 12kHz: Sparkle, sheen

“Most great records really start with the drums”

Billy Corgan

Chapter 2

Key Takeaways

- ☐ Try thinking about EQ in terms of musical notes
- ☐ Use tricks like the Pultec trick or reciprocal EQ'ing
- ☐ Exciters can sometimes work in place of equalizers
- ☐ Cut distracting frequencies and boost complimentary frequencies
- ☐ Listen for masking and phase issues before applying EQ
- ☐ Keep a cheat sheet handy to remind yourself of strategic frequencies for a given instrument or drum



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