Understanding EQ

Moderators: mauro_p, EasySleazy, Alu, seyd, ARIBAI

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11 posts • Page **1** of **1**

Understanding EQ

by **Brohymn** on Mon Oct 23, 2006 9:25 pm

Equalization-EQ

Types of EQ

To begin to understand the EQ, we need to first define the two categories it falls in, Passive and Active.
Passive EQs

These types of EQs have the distinction of being extremely simple in design and, more importantly, they cannot boost frequencies, only cut. The way they work is actually very much to do with perception.

By cutting, for example, low frequencies (bass), they make the mid and high frequencies sound ‘louder’.

Passive EQs do have their uses. Although they are inflexible, they can perform reduction tasks reasonably well. By cutting high frequencies, they are able to cut or lower hiss (high frequency noise). However, by their very nature, passive EQs, or filters, have to then have the signal boosted to compensate for the cut. This, in itself, introduces noise into the signal path. The noise coming from the amp used to boost the signal.

Active EQs
Because of the limitations of passive EQs, most EQs are built around active filter circuits which use frequency selective components, together with a low noise amplifier.

And it is this type of EQ that we are now going to concentrate on.

Fixed Frequency EQ

Pretty self explanatory, this EQ allows cut/boost of one or more frequencies. There are no additional controls over the usual components, like bandwidth, Q, etc.

Peaking EQ
A peaking EQ is an EQ which boosts a specific band of frequencies.
Whereas a shelving filter has a shelf like curve, this filter has a bell shaped curve.
The Q setting determines the width of the bell, while boost or cut determines the height or depth of the bell.

Two Band or Three Band
These types of EQ simply have two or three separate frequency ranges. Usually denoted as low, mid and high, these bands can only be cut or boosted.

Shelving Filter/EQ
We have touched on the use of tone controls that are forms of EQ. These controls control a type of filter that is called a shelving filter. In the case of the bass and treble knobs, low pass and high pass shelving filters are used respectively.

A low-pass shelving filter passes all frequencies below its cut-off frequency, but attenuates all frequencies above its cut-off frequency. Similarly, a high-pass filter passes all frequencies above its cut-off frequency, but affects all frequencies below its cut-off frequency.

This is the simplest type of active EQ. This EQ can shape response in a number of ways: boost/cut low frequencies, boost/cut high frequencies. This is why I have included the graph to demonstrate what happens with the filters, low and high pass, in this type of EQ.

Most mixers will allow for low and high frequency EQ, and in the case of shelving filters, their mid frequencies are usually fixed.
It is also common for the filter slope to be 6 dB per octave. This allows for a gentler effect. The shape is shelf like, so the boost or cut is progressive over a range. Filters do not have a no-effect at a frequency and then instantly

jump and suddenly reappear at the next frequency.

They have to get there somehow. The way, and by how much, they get there is called the gradient or slope. In the case of the shelving filter, the most common slope is 6 dB gain change per octave (doubling of the frequency). It takes time for the filter to attenuate frequencies, in proportion to the distance from the cut-off point. This is the slope.

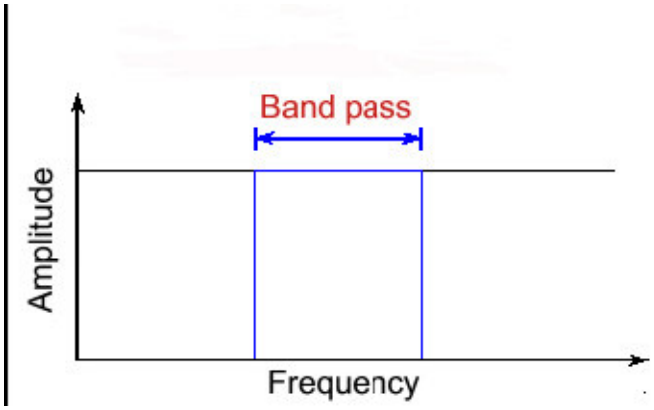
The diagram below illustrates what happens if you cut or boost frequencies in a lowpass and a hi-pass filter.

Image

Graphic EQ

A graphic equalizer is simply a set of filters, each with a fixed centre frequency that cannot be changed.
The only control you have is the amount of boost cut or in each frequency band. This boost or cut is most often controlled with sliders. The sliders are a graphic representation of the frequency response, hence the name 'graphic' equalizer.
The more frequency bands you have, the more control and accuracy you have over the frequency response.
Mixing consoles rarely have graphic EQs, but PA mixers often have a stereo graphic EQ for EQing the final stereo output.
A graphic equalizer uses a set of band-pass filters that are designed to completely isolate certain frequency bands.
The diagram below shows the frequency response of a band-pass filter.

Band Pass Filter



A filter that passes frequencies between two limits is known as a band-pass filter.

This is a great filter. It attenuates frequencies below and above the cut-off and leaves the frequencies at the cut-off. It is, in effect, a low pass and a high pass together. The cool thing about this filter is that you can eliminate the lower and higher frequencies and be left with a band of frequencies that you can then use as either an effect, as in having that real mid range type of old radio sound, or use it for isolating a narrow band of frequencies in recordings that have too much low and high
end.

Try this filter on synthesizer sounds and you will come up with some wacky sounds.
It really is a useful filter and if you can run more than one at a time, and select different cut-offs for each one, then you will get even more interesting results.

Interestingly enough, band pass filtering is used on formant filters that you find on so many softsynths, plug-ins,

synthesizers and samplers. Emu are known for some of their format filters and the technology is based around band pass filters.

It is also good for thinning out sounds and can be used on percussive sounds as well as creating effects type of sounds.

I often get emails from programmers wanting to know how they can get that old radio effect or telephone line chat effect or even NASA space dialogue from space to Houston. Well, this is one of the tools. Use it and experiment.

You will enjoy this one.

Notch Filter – also know as Band Reject Filter

The inverse of a band pass is the notch filter.
This is a very potent EQ/filter. It can home in on a single frequency band, and cut/boost it.

Used specifically for 'problem' frequencies, the notch can be one of the most useful filters.
This is the exact opposite of the band pass filter. It allows frequencies below and above the cut-off and attenuates the frequencies around the cut-off point.

Why is this good?
Well, it eliminates a narrow band of frequencies, the frequencies around the cut-off, so, that in itself is a great tool. You can use this on all sounds and can have a distinct effect on a sound, not only in terms of eliminating the frequencies that you want eliminated, but also in terms of creating a new flavour to a sound.
But its real potency is in eliminating frequencies you don't want. Because you select the cut-off point, in essence, you are selecting the frequencies around that cut-off point and eliminating them.
An invaluable tool when you want to hone in on a band of frequencies located, for example, right in the middle of a sound or recording. I sometimes use a notch filter on drum sounds that have a muddy or heavy mid section, or on sounds that have a little noise or frequency clash in the mid section of a sound.

Parametric
This filter controls three parameters, frequency, bandwidth and gain. You select the range of frequencies you want to boost or cut, you select the width of that range and use the gain to boost or cut the frequencies, within the selected bandwidth, by a selected amount.

The frequencies not in the bandwidth are not altered. If you widen the bandwidth to the limit of the upper and lower frequencies ranges then this is called shelving. Most parametric filters have shelving parameters.
Parametric filters are great for more complex filtering jobs and can be used to create real dynamic effects because they can attenuate or boost any range of frequencies.
Basically, the parametric EQ places several active filters across the frequency spectrum. Each filter is designated to a frequency range, low, mid, high etc. You have the usual cut/boost, resonant frequency and bandwidth. It is these qualities and the control over them that places this particular EQ in the producer's arsenal of dynamic tools, and makes it detailed and versatile.

However, you need to understand what you are doing when using a parametric EQ, otherwise things can go very wrong.

Understand frequencies and sound, and you will be in total control.

Quasi-parametric EQ
This is just another form of parametric EQ but without the bandwidth control.

Sweep EQ
This is very similar to a band pass filter, but with variable centre frequency, and no control over the width of the filter response (Q).
You will find that most mixers will have band pass EQ, and some will have sweep EQ (where the centre frequency can be varied, also known as 'tuneable'), but very few, mainly digital, will have parametric EQ.

Paragraphic EQ
This is another variation on the graphic EQ. This EQ provides control over the centre frequency of each band.

Phase the bi-product
A very important aspect of EQ, in relation to affected and non-affected frequencies, is that of phase.
We know that affecting the frequencies that we have chosen for equalization, also affects the phase of those selected frequencies, in relation to the unaffected frequencies. The process itself also affects the frequency response of the signal being treated. We are talking about tiny offsets here. Every time a frequency range is selected and treated, the affected frequencies will exhibit displacement, in relation to the unaffected frequencies. This offset is phase. Whereas we are not talking about
big swirling phase effects, as in guitar phasing, we are, however, talking about the pure definition of phase. This is probably not something that you will hear as phase, but it is something that affects our perception of the treated frequencies.

Depending on the nature of the displacement, we perceive the treated frequencies as distance.

Why is this important?
This is what differentiates the tonal characteristics of analogue hardware and digital software EQs.

The analogue EQ unit will exhibit far more musical phase changes than it's digital counterpart, and at very low gains, whereas the digital EQ unit will have the advantage of leaving the phase relationships hardly affected, thus allowing for more robust gain changes.

They both have their uses.

Last edited by Brohymn on Mon Oct 23, 2006 10:08 pm, edited 3 times in total.

Brohymn

Site Admin

Posts: 2468
Joined: Sat Mar 25, 2006 12:26 am
Location: Portugal

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Top

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by **seyd** on Mon Oct 23, 2006 9:29 pm

Thnk you Bro. Im gonna read this. Thx again.
voxx likes tits and ass, he told me!!!11
http://www.vildhjarta.com
http://www.myspace.com/vildhjarta - my band.
http://www.myspace.com/texasholdus - sideproject.

seyd

Moderator

Posts: 546
Joined: Sat Jul 08, 2006 6:10 pm
Location: Sweden

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Top

---

by **Brohymn** on Mon Oct 23, 2006 9:36 pm

Sound Quality Glossary

Airy – Spacious. The sounds sound like they are in a large and pleasant space, full of air, with a nice amount of un-coloured reverb. A high frequency response that extends to about 18 kHz.

Bassy – Emphasised low frequencies below 200 Hz.

Boomy – Excessive, and poorly damped, low frequencies around the 150 Hz mark.

Boxy – Emphasis around 200 Hz to 550 Hz. As if the sound is coming from within a box.

Breathy – Good high frequency response with emphasis on the 'breathy' characteristics of wind instruments like flutes etc.

Bright – Emphasis on high frequencies, with harmonics being strong relative to fundamentals.

Brittle – High frequency peaks or poor fundamentals.

Chesty – Used to denote a vocalist sounding as if their chest is too big. A bump in the low frequency response around 125 Hz to 250 Hz.

Clean – Free of noise, distortion, clipping, leakage etc.

Clinical – Too clean and analytical, as in the sound in a virtual domain with no body or life.

Coloured – Having timbres that are not true to life in general. Unnatural in detail.

Crisp – Extended high frequency response. Snappy.

Dark – Weak on high frequencies. Concentration of low to mid frequencies.

Depth – A sense of closeness and farness of instruments and frequencies. Good transient response that reveals the direct/reflected sound ratio in a recording.

Detailed – Easy to hear tiny details in music. Adequate high frequency response and sharp transient response.

Dry – Without effects, not spacious. Overdamped transient response.

Fat – Strong fundamentals relative to harmonics. Good low frequency response.

Good strong level around 100 Hz to 300 Hz.

Forward – Sounding close to the listener. Emphasis around 2 kHz to 5 kHz.

Grainy – The audio sounds as if it is fragmented into little segments, rather than flowing in one continuous piece. Suffering from harmonic distortion.

Grungy – Loads of harmonic distortion.

Hard – Too much upper midrange, around the 3 kHz to 4 kHz. Good, hard transient response.

Harsh – Too much upper midrange. Peaks in the frequency response from 2 kHz to 6kHz. Excessive phase shift.

Mellow – Reduced high frequencies, relaxing and chilled.

Muddy – Not clear. Weak harmonics, smeared time response, mild distortion. Too much reverb at low frequencies.

Musical – Flat response, low distortion, clean, harmonic.

Nasal – Sounds like nose is closed whilst singing. Bump in the frequency response around 300 Hz to 1 kHz.

Neutral – Accurate tonal reproduction. No colouration or bias towards any

frequencies. No serious dips or peaks in the frequency response.

Piercing – Narrowband. Upper range peaks. Screechy. Having sharp, narrow peaks around 3 kHz to 8 kHz.

Punchy – Good reproduction of dynamics. Good transient response.

Raspy – Harsh but dry. Peaks in the response around 6 kHz which make vocals sound too piercing or sibilant.

Rich – Full. Euphonic distortion made of even-order harmonics.

Round – High frequency roll-off.

Sibilant, Essy – Exaggerated s and sh sounds in singing, caused by a rise in the response at around 4 kHz to 7 kHz. Type of singer that can really piss you off by slobbering all over your 2 grand mic.

Smeared – Lacking detail. Poor transient response. Poorly focused imaging.

Smooth – Easy on the ears, not harsh or brittle. Flat frequency response, especially in the midrange. Lack of peaks and dips in frequency response.

Spacious – Conveying a sense of space, ambiance, or room around the instruments.

Squashed – Overly compressed.

Strained – Inadequate headroom. Distorted, opposite of effortless.

Sweet – Flat high frequency response, low distortion. Highs are extended to 15kHz or 20 kHz, but not bumped up.

Thin – Fundamentals are weak relative to harmonics. Not rounded or full, lacklustre low frequency response.

Tight – Good low frequency transient response. Absence of leakage. Good low frequency detail.

Transparent – Easy to hear into the music, detailed, clear, not muddy. Wide flat frequency response, sharp time response, very low distortion and noise.

Warm – Good bass, adequate low frequencies, adequate fundamentals relative to harmonics. Not thin or excessive bass or midrange. Adequate reverberation at low frequencies.

Wooly – Sounds like a wool blanket over the speakers, muffled. Weak high frequencies or boomy low frequencies. Occasional emphasis around 250 Hz to 600 Hz.

Brohymn

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Top

---

by **dr. zoidberg** on Mon Oct 23, 2006 10:05 pm

Brohymn: you might want to fix this image in your article.
[img]http://img268.imageshack.us/img268/7831/mixingsimplified2au9.png[img]

I like the sound quality glossary... you should sticky it or put it in a FAQ so everyone has a standard reference when discussing sounds

When analyzing the frequency spectrum of my mixes I usually use the excellent (and free) voxengo SPAN vst. It has been the single most useful plugin i have (apart from GR). After all, if you dont have good speakers or are using headphones, the sound will sound different on 'real' speakers so the spectrum analyzer is your best friend.
IBM T42: Dothan 1.7GHz @1.9GHz, 1.5GB DDR333, 14.1"SXGA+, Radeon 9600 64mb
Fender Squier Strat
Zoom Fire15 Modeling amp

dr. zoidberg

Moderator

Posts: 525
Joined: Sat Apr 29, 2006 8:47 pm
Location: kitchener
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Top

---

by **Brohymn** on Mon Oct 23, 2006 10:09 pm

Sorry about the image.

Yeah nice ideia.

Brohymn

Site Admin

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Top

---

by **EasySleazy** on Thu Nov 02, 2006 4:52 am

OMG! Where the heck do you find this stuff?

EasySleazy

Moderator

Posts: 1690
Joined: Tue Jun 27, 2006 5:38 am
Location: Greece

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Top

---

by **Brohymn** on Thu Nov 02, 2006 12:48 pm

Brohymn

Site Admin

Posts: 2468
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Location: Portugal

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Top

---

by **dr. zoidberg** on Thu Nov 02, 2006 6:08 pm

google? or maybe e-books from bittorrent?
IBM T42: Dothan 1.7GHz @1.9GHz, 1.5GB DDR333, 14.1"SXGA+, Radeon 9600 64mb
Fender Squier Strat
Zoom Fire15 Modeling amp

dr. zoidberg
Moderator

Posts: 525
Joined: Sat Apr 29, 2006 8:47 pm
Location: kitchener
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Top

---

by **Brohymn** on Thu Nov 02, 2006 6:18 pm

No... Its from some books i buy some years ago. Mix recording engineering and some other.

If anyone wants some tips about anything i could paste here.
cheers

Brohymn
Site Admin

Posts: 2468
Joined: Sat Mar 25, 2006 12:26 am
Location: Portugal
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Top

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by **dr. zoidberg** on Thu Nov 02, 2006 6:26 pm

*Brohymn wrote:*No... Its from some books i buy some years ago. Mix recording engineering and some

other.

If anyone wants some tips about anything i could paste here.
cheers

Every time i go to the music store I always see those books for sale. They're really like textbooks for school... very technical. I think for a professional musician like you they're a good investment but not for other people that only do this for fun (like me)
IBM T42: Dothan 1.7GHz @1.9GHz, 1.5GB DDR333, 14.1"SXGA+, Radeon 9600 64mb
Fender Squier Strat
Zoom Fire15 Modeling amp

dr. zoidberg
Moderator

Posts: 525
Joined: Sat Apr 29, 2006 8:47 pm
Location: kitchener
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Top

---

by **Brohymn** on Thu Nov 02, 2006 6:38 pm

maybe. Knowledge is always welcome.. so... learning something more will help achieving best sound quality and all the times showing that proceduce that most of the people do, is completly wrong!!!

I have this book to (the only one i have that appears on internet):
http://www.kiqproductions.com/html/_tot ... _info.html

I have others that show the technics used in various genres (metal, rock, pop, classical...etc...) and they are a valious resource.

cheers

Brohymn

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Top

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Return to Recording/Production Techniques

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