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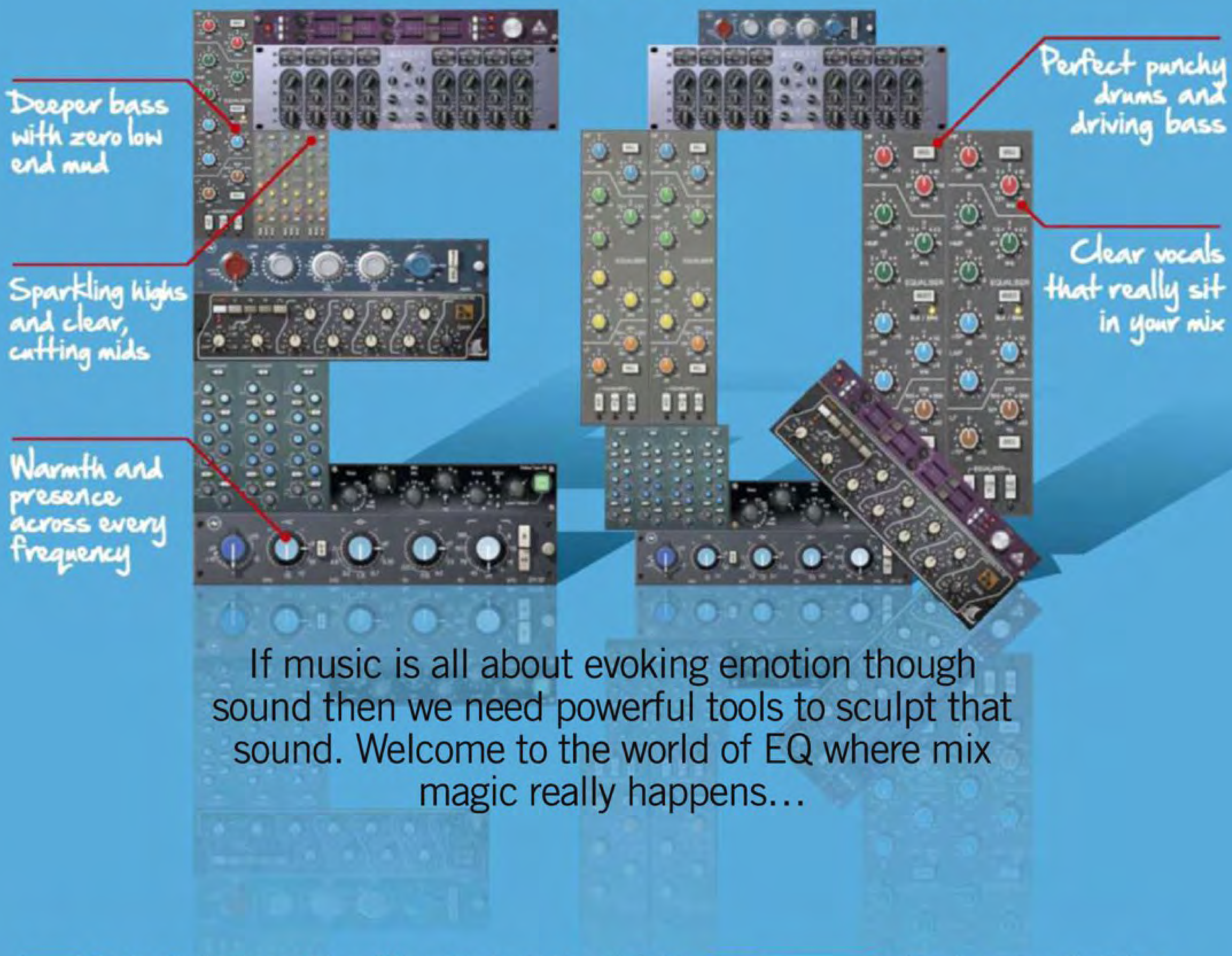
THE PRO PRODUCER'S GUIDE TO



If music is all about evoking emotion though sound then we need powerful tools to sculpt that sound. Welcome to the world of EQ where mix magic really happens...

EQ, or 'equalisation', is a powerful tool that lets you literally shape the sound of your music, balancing and enhancing the tone of every instrument for maximum impact.

In this article you'll find out how to clarify a muddy mix by removing unwanted frequencies, plus suggestions of which ones you can use to add 'air', 'warmth' or 'thump' and so on, where needed.

We'll look at techniques that enable you to sculpt an instruments' frequency-response to sit well within a mix, and which EQ shape is the best way to achieve it – plus, how to find exactly the right frequency to cut or boost for any instrument.

We'll look at different types of EQ, both analogue and digital, and the advantages and disadvantages of each. First though, it'll be helpful to understand a little about what EQ is, and how it works. We constantly talk about sound using words borrowed from things we can see. We talk about things being 'bright' or 'dull', about being 'muddy' or 'clear', 'sharp' or 'smooth' sounding.

EQ is like colour for sound

People with a condition called Synesthesia actually see specific colours when they hear certain sounds, and most of us associate colours with sound at least to some extent. There is a fundamental link between the colours we see, and the 'colours' we hear.

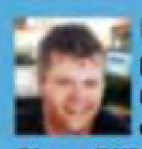
The colours we see are determined by the frequency content of the light waves that reach our eyes, whereas the colours we hear are determined by the frequency content of the sound waves that reach our ears. So, low-frequency light waves are brown, red or orange in colour, and these 'sepia' tones are often colours we associate with lower-pitched notes and 'warm', 'analogue' sounds, whereas higher-frequency 'brighter' and more 'metallic' notes and sounds are often connected in our minds with colours like blue or cyan.

Coincidence? Probably not. At the end of the day, all this stuff is just our brains trying to make sense of the world around us, and the association of blue with cold water or red and orange with the dying embers of a fire goes back a long, long way.

Luckily for us, this instinctive connection means that controlling the frequency content of your music using EQ – its colour, if you like – gives us a powerful way to control the affect it has on anyone listening – which is exactly what music is about, after all! Read on to learn how to maximise this effect and let your music sing.

THE EXPERT

Ian Shepherd
Mastering Engineer



Ian is a professional mastering engineer, Blu-ray/DVD author and musician. He runs Mastering Media and the Production Advice website. He is passionately opposed to the so-called CD 'Loudness Wars', and in 2010 founded Dynamic Range Day to help raise awareness of the issue.
productionadvice.co.uk

The facts:

What is EQ?

EQ is equalisation – but equalisation of what?

We can control the frequency content of our music using EQ or equalisation, but what does that name mean? It comes from the earliest use of equalisers – correcting the uneven frequency response of telephone lines. Using the 'phone, you want a person's voice to sound as close as possible to the real thing – so it needs flat, or linear frequency response.

The very first telephone electronics were very far from ideal, so the frequency response of the signals needed to be 'equalised', so that what you got out was roughly the same as what went in.

Nowadays, digital audio systems are designed from the ground up to have a very linear frequency response and more often that not we use EQ to stop things having an even frequency response, by adding colour – but more on that later.

Natural EQ

Thinking about the original meaning of equalisation, it's interesting that the natural frequency response of much acoustic music is often already quite flat – meaning roughly equal at all frequencies. If you look at the frequencies produced by a piano, symphony orchestra or even a Rock band recorded without much processing, you'll see most frequencies are represented fairly equally, sloping gently down in the high frequencies.

This makes sense – if all the instruments made sounds at the same frequency, it would be much harder to tell them apart. This natural EQ is determined by the fact that low-frequency sounds have a lower pitch, and high-frequency sounds have a higher pitch. For some rules of thumb about different frequency ranges and how they work with instruments, see *Using EQ*.

> "If a guitar is fighting with the vocals, try using a different chord inversion"

Writers naturally choose instruments with different frequency characteristics to balance and contrast against each other, and when you put them all together, they cover the whole range.

EQ without an equaliser

Using these ideas can give us a powerful way to control the 'EQ' of a mix, without ever touching an EQ unit. If a guitar line is fighting with the vocals in the mix – try a different chord inversion, or moving one of them up or down an octave to make space for the other.

Even if changing the arrangement isn't an option, it's possible to get a very different sound for each part.

Moving a microphone can capture a very different sound – close-micing an acoustic guitar will often get a warmer, richer sound. With synths, editing a patch (or choosing a different one in the first place) is often a better way to achieve clarity and separation than trying to EQ the sounds afterwards. You can also use EQ to achieve the same effect though, of course. This technique is known as 'frequency carving' and is covered over the page…

EMI's TG EQs have helped craft thousands of classic recordings

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In practice:

Using EQ

Practical and creative EQ techniques

As with any audio processing, the key to great results is to know what you want to achieve. There are many reasons you might want to use EQ, for example:

To balance a sound within the mix – e.g. more edge on the vocals to help them cut through, or more thump on a kick drum or bass.

To fix a recording problem, for example too much boom on a bass sound, mic pops on a vocal.

To balance the overall sound of a mix – to add more bass, for example

To create an entirely new or unique sound – for example transform something into a bassline by cutting all the high frequencies. Whatever the goal, having a clear idea of what you want to achieve is essential. First, you need to know how frequencies are measured and labelled.

Measuring frequency

The frequency of a sound is measured by how many times its wave oscillates per second. It's measured in 'cycles per second', or Hertz (Hz).

The lowest note on a piano has a fundamental frequency of 27Hz, and the highest of 4186Hz, or roughly 4kHz (kilohertz). Our ears can hear much higher, though – right up to 20kHz for some young children – and there is plenty of important information in this area.

EQ bands

Learning what different frequencies sound like, and the effect they have on the sound of different instruments is an invaluable skill. These are the names I use to think of the bands, and the frequencies are only approximate – others may disagree, so use your ears!

20-60Hz – Sub-bass: Gives boom, depth and richness – too much sounds flabby and out of control. Small speakers don't reproduce this

60-150Hz – Bass: 'Thump' and punch in drums, especially kick and snare, richness in bass and guitars. Too much sounds thick and woolly

150Hz-1kHz – Lower mid: Important for warmth but too much sounds thick and congested. 500Hz-1kHz region especially is crucial for a natural vocal tone, but too much sounds boxy and nasal

1-3kHz – Upper mid: The most sensitive area of the ear, important for edge, clarity and bite, but too much will sound harsh and tinny

3-8kHz – Low top: Fizz and sizzle, edge and aggression in guitars – too much sounds thin and brittle

8-12kHz – Top: Gives openness, air and clarity – too much sounds over-bright and glassy

12-18kHz – Very high top: These frequencies can add sheen and sparkle and sweeten things up, but too much sounds unnatural, gritty and forced

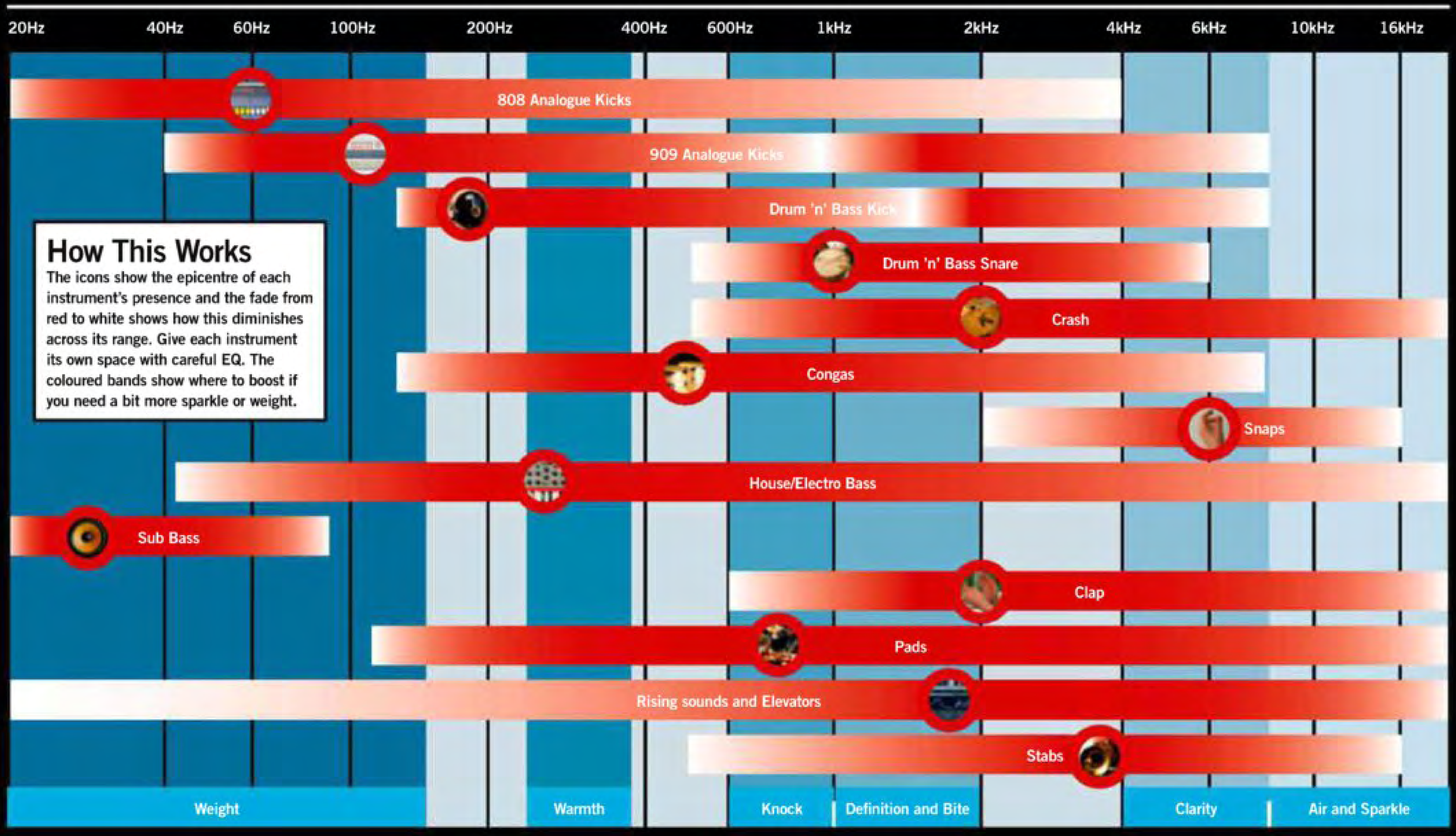
For more really in-depth information about the different frequency bands and how they relate to different instruments, check out the chart below.

It's all about balance – or is it?

As you may have gathered from the rules of thumb above, every frequency has an important role to play, but too much of any one area will sound unnatural – so, having the right balance of each is essential for a natural sound.

But actually, that's not quite true. The sound of the overall EQ needs to be balanced, but individual sounds on their own don't need to be, provided they work within the mix. In fact, if all the instruments in a mix sound perfectly balanced by themselves, this can often lead a muddled, cluttered mix.

A great example is acoustic guitar – when close mic'd, there's a lot of warm, boomy bass information in the sound. This may sound great on its own, but will often just clutter things up and make them sound muddy within a mix. The solution can often



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be to reduce the low-mid and bass boom to help the guitar cut through the mix and sit right.

This technique of restricting the frequency range of instruments to create a space for them to sit in the mix is an extension of the idea of choosing sounds that complement each other sonically, and is known as 'frequency carving'.

If there are two parts that are fighting in the mix because they occupy the same frequency range, it can sometimes help to boost EQ on one of them, and cut the other at the same frequency. Then, reverse the strategy and boost the second sound in a different place, while cutting the other. This emphasises the contrast between the two parts, with gentler boosts, and helps avoid things sounding unnatural.

Finding the frequency

This is probably the most useful EQ technique you can ever learn. Let's say there's a honky mid-range resonance in the vocal for the song you're working on. You know it's somewhere in the lower mid, but you're not sure exactly where. To pinpoint it exactly:

Solo the channel you want to EQ

Listen carefully and remember what the frequency you're trying to find sounds like

Using a parametric EQ, add a large boost with a fairly narrow Q

Slowly sweep the frequency of the boost up and down

Listen for an extreme version of the frequency region you want to find

When the boost hits it, you'll hear it 'sing out', or 'ring'

Now use the EQ to make a big cut instead, and double-check by rocking the frequency up and down again

Now reduce the cut until you start to hear the problem frequency again

Tweak the Q. Too broad will cut out too much around the problem frequency, but too narrow will sound 'pinched' and unnatural

Finally, un-solo the track and listen carefully again in context – experiment with more or less cut on the selected frequency to find the perfect amount.

ON THE DVD

> On the DVD you'll find a step-by-step example. First the source audio, then sweeping for the right frequency, and finally with the cut in place.

EQ Parameters

Equalisers come in different varieties, each with different parameters and control. Choosing the right type for the effect you need is essential

All EQ boosts or cuts certain frequencies, but exactly how it does this varies. The simplest type is the high or low cut – these do exactly what they say on the tin, removing everything above or below a particular frequency.

Shelving EQs allow broad boosts or cuts above or below the chosen frequency, and parametric EQ centres around the chosen frequency. The 'Q' control decides how broad or narrow the band is – lower values give a broad boost and a high Q creates a narrow 'notch' EQ.

ON THE DVD

> On the DVD you'll find examples of each EQ type in use. First the flat audio then Hi-Lo Cut, Shelving and Parametric EQ.

Hi and low-cut: Cutting out-of-control low frequencies can help clean up a muddy mix. Take care not to make everything too thin, though! More advanced EQ types allow you to control the steepness of the cutoff.

Shelving: Great for making smooth, gentle alterations to a whole mix. A high-shelf boost can be a nice way to add 'air' to sweeten a vocal or dull mix without making anything in particular stand out.

Parametric: The most powerful form of EQ, allows 'surgical' changes and fixes at any frequency. Very narrow boosts create a resonant sound that can make a great musical effect swept up and down through a broadband sound like a synth pad.

Pro production:

Advanced EQ Techniques

Taking your use of EQ to the next level

The engineers and producers who worked on many of the classic albums of all time could only have dreamed of the power and flexibility of modern digital EQ, where three or four fully parametric equalisers on every channel is taken as standard.

And yet, some of the most expensive and highly-regarded digital EQ plug-ins available today are emulations of the classic analogue hardware that was used on those same albums. Why is this? Were they better, in some way – able to do something that digital EQ can't?

Not on paper. In fact, the first thing you'll notice using one of those emulated Pultec or Neve EQs is actually how limited they are. They restrict the choices of frequency, the number of different filters and their types, and they sometimes change the sound of the signal even when all the dials are set to zero.

They sound great, though! And the reason is the choices that led to those restrictions. You'll often hear people say how much easier it is to get a great sound using a classic EQ. That's because choices the designers made – which frequencies to make available, what shape the curves should be and so on – effectively guide our hand to make great decisions. So even though your choice of frequency may be limited, it's limited to creative, musical-sounding options. And even though the technical specs can't match digital EQ in simple numeric terms, the ways that they don't match up more often than not make things sound better, not worse!

Another factor is the way they work – with a 'vanilla' digital EQ, you get exactly what it says on the tin – numerical, mathematical performance. Whereas classic analogue EQs were often designed 'by ear', and the results you get can vary depending on how extreme the settings are. Once you're used to it, this can be very creatively inspiring, adding to the art and pleasure of using them.

Luckily, modern emulations by companies like Universal Audio and Waves work hard to get very close to the ergonomics and original sound of those classic analogue originals in a digital world, allowing us to (almost) have the best of both worlds.

Minimum phase Vs phase-linear EQ

Even in the world of digital EQ there are choices to be made. Most standard digital parametric EQs sound very similar to each other, despite the fancy interface differences – you pay extra to get the 'imperfections' built back in, as we've seen. But digital technology allows one trick that really is worth looking at – phase-linear EQ.

Traditional EQ not only changes the frequency response of the input

Essential Advice

DOs & DON'Ts

DO: Use high-pass filters to remove 'wild', out-of-control or unnecessary bass. For example, a hi-hat seldom needs anything below 1kHz

DON'T: High pass everything. This can be a great way to clean up a muddy mix, but if you take it too far, it can sound thin

DO: Experiment with 'unnatural' EQ – this can be a great way to add interest and character, without overusing effects

DON'T: Add the same EQ to everything. Build-up of EQ in this way is a sure way to clutter and confuse a mix

DO: Use extreme EQ if you need it! I once added 24dB at 40Hz to get the warmth I needed. This could have been a recipe for disaster, but it worked – if it sounds right, it is right!

DON'T: Boost what's not there. Adding loads of top to get clarity when there isn't any in the signal will add noise and distortion

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signal, it also changes the phase, near your chosen frequency.

Roughly speaking, this means that some parts of the original wave get delayed, compared to others. This can have a subtle but noticeable effect on the sound. Often that's exactly what we want, especially when emulating an older model EQ, but if you want to make very deep cuts or boosts in the audio signal, or use very narrow notches, these phase-shifts can start to sound quite unpleasant.

By contrast, linear-phase filters don't do this, meaning you can make much more dramatic changes, if you need, without the side-effects of a 'normal' EQ. Linear-phase EQs are often used in mastering, for this reason. Phase-linear EQ requires a lot of CPU power and always involves a delay, so it's less suited to tracking.

Using EQ on effects

So far we've only talked about using EQ on different parts in a mix – meaning, instruments, vocals and so on. You can use EQ on anything in a mix, though – and one particularly useful technique is to use it on effects, separate from the source.

So, for example, if you add lots of nice top end to a vocal to get a nice airy, breathy quality, that could end up causing a problem with the reverb. Digital reverb is notorious for catching and emphasising 'S' and 'T' sounds especially – and the extra high frequencies from the EQ will only make this worse.

EQing the reverb return can fix this – use a high shelf to reduce the effect, or even a high-cut filter to remove it completely. Even better, EQ the reverb send – that way you can tailor the sound for individual sources separately, before it gets to the EQ. This enables a range of different effects using the same EQ.

Another example could be radically EQing an effects return – for example, a rich resonant filter sweeping up and down over a chorus or delay return in a Dance track. This can be as subtle or as dramatic as you need it to be.

HANDS-ON TIPS

Boost or Cut?

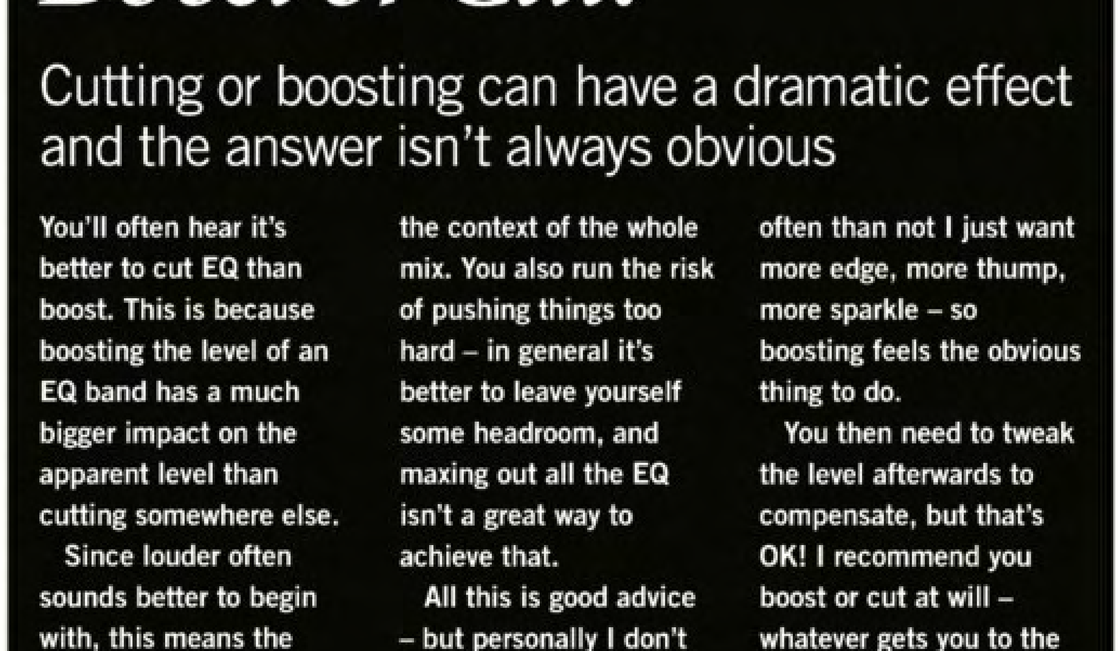
Cutting or boosting can have a dramatic effect and the answer isn't always obvious

You'll often hear it's better to cut EQ than boost. This is because boosting the level of an EQ band has a much bigger impact on the apparent level than cutting somewhere else.

Since louder often sounds better to begin with, this means the temptation is to keep boosting EQ on a part and thinking it sounds great, but then realising it's no longer balanced in the context of the whole mix. You also run the risk of pushing things too hard – in general it's better to leave yourself some headroom, and maxing out all the EQ isn't a great way to achieve that.

All this is good advice – but personally I don't follow it! If I hear a problem area in a sound that I don't like, the quickest way to fix it is with a cut, but more often than not I just want more edge, more thump, more sparkle – so boosting feels the obvious thing to do.

You then need to tweak the level afterwards to compensate, but that's OK! I recommend you boost or cut at will – whatever gets you to the sound you want quickest – but bear in mind that if you do nothing but boost, you may end up going round in circles.



In practice:

Tips & Tricks

Here are some tried and tested tips for EQ

Although there are plenty of rules (that are made to be broken), there are some things you can only learn through practice. Here are some less textbook methods for carving and crafting your mix and some choice tips for everyday production issues.

EQ before or after compression?

Deciding where to use EQ in the chain can have a huge impact on the results you get. Generally speaking, you need far less EQ once a sound has been compressed.

EQ applied before a compressor will need bigger changes made to hear a result, because the compressor will reduce those changes. For example, if you have a mix with a compressor over the stereo buss and a bass-heavy kick drum is causing heavy pumping, removing the bass after the compression will even out the frequency balance, but won't stop the pumping.

Whereas EQing the kick drum before it hits the compressor will both balance the sound and reduce the pumping. Personally I usually use EQ before compression, unless I'm going for a particular effect. The best practice is simply to ask yourself the question: do I want to EQ my compressed signal, or compress my EQ'd signal? This applies to all chained effect decisions but if you don't know the answer, experiment!

Using harmonics

You probably already know that musical sounds are made up of much more than just one frequency, even though we only hear one pitch – many different harmonics combine to give each instrument its unique timbre.

Bear this in mind when EQing, and use it to your advantage. A narrow notch to modify just a single harmonic can have a powerful effect on the tone of an instrument.

Understanding harmonics can be useful when trying to remove mains hum or amp noise, too – if you use a narrow notch to take out some hum at 50Hz and find you're still hearing buzz, try taking some out at 100, 150, 200Hz and so on.

Dynamic EQ

Dynamic EQ only works when you tell it to – a de-esser is a very specific example, but you could also use a notch to smooth out a clicky bass sound – but only when the level is high, for example.

Some dynamic EQs can be sidechained too, allowing different bands to control each other – for example, a top-end frequency lift that only comes into play when the bass signal is very loud.

As is the case with multi-band compression, dynamic EQ offers the potential to make a huge mess of your mix, as well as big improvements – use it in moderation.

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Essential Advice

EQ Ideas to Try

Adding punch to drums

On the kick drum, boost at 50-60Hz, using a parametric EQ and a narrow Q. Watch out for the kick sounding too boomy, though – you may need a high-pass filter at 45Hz to clean it up.

On the snare, try another narrow boost, this time at around 100Hz – this is often where the weight of the snare is. Tune the frequency for maximum impact, but watch out for making the toms boomy if there is spill.

Deep, rich bass

For a deep, rich bass sound, try boosting at 60Hz, with a fairly narrow Q. Again, a high-pass filter at 45Hz can clean things up if it starts to sound 'flabby'. 100Hz is also important for bass, adding warmth and weight. These frequencies work well when the part uses the bottom string of the instruments. To help bass cut through the mix, try boosting the upper mid-range – 2.5kHz, say – but you need to watch out for guitars and vocals in this frequency range.

If you use both these suggestions, watch out for a 'scooped mids' feeling if you overdo it. The 'tight', 'muscular' part of a bass sound is around 200-500Hz. Too much of these will start to sound thin, or 'honky' though.

Warm, airy vocals

'Air' in vocals is almost always at 10kHz. If your vocal sound feels a little 'closed-in' or dull, a broad parametric EQ boost in this area will often open the sound out nicely, without adding sibilance or making it sound harsh.

Avoid adding too much, as it can make things sound brittle. To keep the vocal sound warm, you can lift between 200-500Hz, but this needs caution since too much will sound muddy.

Control monster synths

Synth presets are designed to sell synths – meaning, they sound awesome right out of the box, played on their own. But their very broad frequency content, coupled with all the effects, can often mean they overwhelm a mix.

Anywhere that the synth is fighting or masking something else in the mix, use EQ to reduce it. Bass can sometimes be sliced right out with a high-pass filter, but often a low-shelf is better. For high-frequency control, I would almost always use a shelf.

ON THE DVD

> You'll find an example for each of the four scenarios above. Each is played three times: EQ on, EQ off then EQ on again. Vocal samples from Vocal Factory available at TimeSpace.com

5 Affordable Software Alternatives

What You Have Already

Any modern DAW will have very competent built-in EQ. Don't expect much analogue flavour, but for simple, precise control, a few bands of parametric EQ is all you need. In fact, it'll get you a long, long way

DDMF LP10

Not only is this a highly affordable 10-band phase-linear EQ with built-in analyser, you can actually choose to vary the phase of each band, to emulate 'traditional' EQ too, if you like. Available for only $29.

Stillwell Vibe-EQ

From the Stillwell site: "One of those plug-ins that makes things sound better just by plugging it in. Really… Vibe-EQ is all about colour. The more boost or cut you dial in, the more colour and funk you get". Stillwell also make a much cleaner EQ called 1973, a 'tribute' to the Neve 1073. Both are free to try and great value for money at $39.

Waves Renaissance EQ

The REQ is found in a great many people's plug-in collections, and for good reason – it's an intuitive, powerful EQ with analogue flavour thrown in. Not free, and perhaps a little long in the tooth, but some nice Pultec-style resonant shelf options. Available at $49 for a limited time – usually priced at $150.

Acustica Nebula 3

Nebula is far more than just an EQ – this sampling convolution plug-in can also emulate microphones, reverbs, tape saturation and many other analogue effects. You don't get a fancy GUI emulation of the original units, but the results can be stunning. 139 euros for the Pro bundle.

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5 Hardware EQ Greats

Pultec EQP-1A

A warm, open sound and the unique option to boost and cut the same frequency simultaneously – the so-called 'Pultec shelf' – allowed a lift to the bass while reducing the mid-range – great for kick drums

Neve 1073

A true industry legend. I remember the first time I used a Neve desk – I was sceptical if I would get the control I needed without multiple parametric EQs on every channel. Of course I needn't have worried!

Trident A-Range

Originally available as part of the Trident A-Range mixing console, of which only 13 were ever made. Some were taken apart, making module versions available, and there have been various clone. Instantly recognisable from the faders and its multiple high- and low-pass filters, which can be enabled simultaneously.

Massenburg 8200

George Massenburg first coined the name parametric to describe a "sweep-tunable EQ" in his 1972 AES paper, and the audio industry never looked back. The 8200 really can be regarded as an industry standard, with good reason.

Manley Massive Passive

A modern unit taking the subtractive principles of the Pultec EQs to a whole new level. There are no active components at all, hence the 'passive' in the name – it's different in usage and sound from every other EQ.

Essential Advice

Advanced Techniques

5 Ways to Automate EQ

EQ is often used in a 'set it and forget it' way, but it doesn't have to be used in such a static manner. An automated resonant filter sweep as mentioned earlier is one idea, but here are some more:

A classic Dance technique is to automate a low-pass filter – initially it cuts out everything except the very low bass throbbing of all (or most) of the mix, then it gradually sweeps higher and higher, revealing more and more of the sound – arriving at a musical high-point for maximum impact

Try using automation to switch rapidly between very different EQ sounds on a vocal

Fix problems – if a de-esser is chopping too much of the high-end life out of a vocal, switch a hand-tuned notch filter in and out as needed using automation

Or, switch a high-pass filter swiftly in and out to remove unwanted microphone pops.

If a different guitar effects pedal in the chorus messes up your carefully chosen sound for the verse, simply automate EQ changes to fix it.

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