TEN MINUTE MASTER
No31: Sidechain processing

Sidechain processing is the key that unlocks a number of advancing signal processing techniques. **Mark Cousins** takes a look at the principles involved.

Techniques like de-essing, key gating, ducking and frequency-conscious compression can be incredibly useful ways of controlling unruly elements in a mix, such as sibilant vocals and sloppy bass parts, as well as creating some innovative sound treatments. Common to all these techniques is a unique and sometimes misunderstood facet of signal processing – the sidechain.

Many signal processors work by 'listening' to an audio signal and responding to changes that occur over time. Consider the example of a compressor – it monitors an incoming audio signal and when the signal exceeds a given amplitude threshold it reduces the gain accordingly. Logically, the output of the compressor has a direct correlation to the material it is presented with – as the signal gets louder, the gain reduction increases proportionally. But what would happen if the compressor were listening to something other than the original source audio?

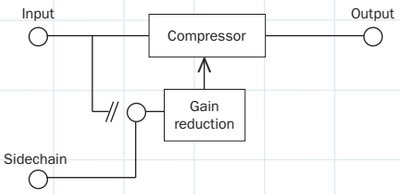
Sidechain processing makes the crucial differentiation between the signal being processed (coming in via the audio inputs) and what the processing circuitry is listening to (coming in via the sidechain inputs). A sidechain input could be a subtly different version of the original sound (perhaps with some mild form of EQ) or a completely different sound, depending on what your objectives are.

Frequency conscious

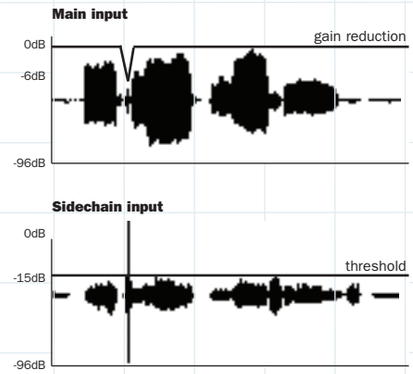
If you've ever attached a single-band compressor over something like drum overheads, you'll understand how problematic low-frequency sounds can be to a compressor working with full-spectrum material. Generally speaking, low frequencies define the majority of a track's sound energy, so rather than the loud snares tickling the compressor's threshold, you'll probably find the bass drum largely dictating when gain reduction is being applied. In short, the compression is biased towards low-frequency sounds, as they generate most of the threshold peaks, resulting in a sound that seems to pump alongside the peaks generated by the bass drum. In terms of auditory perception, our ears respond more to peaks in the mid-range frequencies (around 1kHz), so although the compression is technically correct, it's somewhat contradictory to how we perceive sound.

But what if we could change how the compressor perceives the sound of the drums to make it more akin to how our ears operate? In frequency-conscious compression, a duplicate version of the original sound is EQ'ed and patched into the sidechain inputs of the compressor. The compressor now listens to a modified version of the signal, and therefore responds in a different way to the material presented.

Configuring the EQ has an almost reverse logic to it – by boosting frequencies in the sidechain EQ, the compressor will, in turn, apply more gain reduction, effectively turning down the equivalent frequency peaks in the original material. Conversely, if you want the compressor to ignore specific frequencies, these should be removed from the sidechain EQ accordingly. Remember that in configuring the sidechain EQ, you can be as extreme as you like – the sidechain input should never be audible in the end result.



Inserting an external sidechain input on a compressor removes the main input's control over the gain-reduction circuitry.



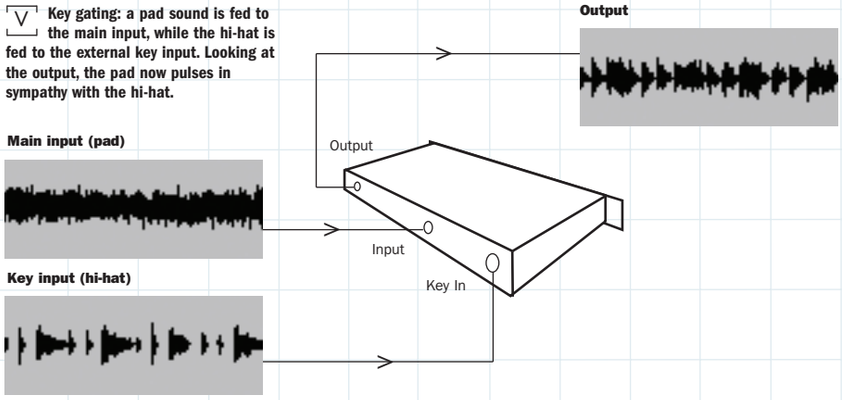
De-essing: note the sharp spike on the EQ'ed sidechain (this is heavily EQ'ed sibilance) and the corresponding dip of the gain reduction across the main input as this occurs.

De-stressing de-essing

In essence, de-essing is another example of frequency-conscious compression – just a very application-specific one. In this case, making the compressor respond to excessive sibilance in a vocal track. In de-essing, the sidechain EQ becomes even more important – the compressors must specifically respond to the sibilance and cannot be swayed by any of the part's other vocal signal. Exact frequencies need to be boosted (by up to 12dB) to pick out the sibilance (generally around the 5-8kHz region, but the actual frequency varies between vocalists) so make sure you use your ears.

Ideally, an extreme cut below this given frequency should also be applied, which is best done using a high-pass filter, although shelving or parametric EQ can also have a good stab at it, given plenty of cut (12dB or more) to get the attenuation required. In terms of the compressor, most engineers will use short attack and release times (to get in and out of the sibilance as quickly as possible) with a medium ratio of about 4:1, although

Key gating: a pad sound is fed to the main input, while the hi-hat is fed to the external key input. Looking at the output, the pad now pulses in sympathy with the hi-hat.



Vocoding is the mother of all sidechain processing techniques. Emagic's EVOC20 uses a sidechain input to form the modulator, or 'analysis', signal.

If you're feeling lazy, there are several software plug-ins (like TC Works' Compressor/De-essor) that include pre-configured de-essing elements – just set the frequency and the amount of gain reduction required.

Pro Tools had a sidechain facility long before most other audio sequencing platforms, although Digidesign refers to it as an 'external key'.

higher ratios might be required with more extreme sibilance.

Nothing beats the flexibility of using a number of hardware processors for de-essing, but it can be an expensive way of sorting out a vocal if you lose a compressor and EQ unit in the process. Thankfully, there are a number of dedicated vocal processing units, both hardware and software, that include pre-configured, pre-patched de-essers.

The key to the gate

So far we've only considered sidechains with compressors, but the use of side-chaining extends much further than this – it's equally important when working with a gate. In a further – and possibly confusing – twist, the terminology can change (although the theory remains the same), with a gate's sidechain usually being referred to as its 'key'. When set to an internal key, the gate responds to the signal arriving at the inputs. When set to an external key the gate now appears to work in much the same way as a sidechained compressor, with the gate responding to its key inputs, rather than its audio inputs. In reality, these terms ('keys' and 'sidechains') are interchangeable to some extent, and can be found on both compressors and gates.

The use of keys on gates tends to be a little more radical than sidechained compressors that use just an EQ'ed version of the original signal. Many of the accepted techniques actually involve using a completely different sound as the external key to the gate. Easily the most clichéd example (possibly because it's the most fun) is that of 'key gating'. Here, a long, sustained sound (like a pad) is sent to the gate's input while a shortened, repeating percussive element is sent to the gate's key inputs. The result is that the longer sound being fed to the inputs appears to pulse, in a way that corresponds to the signal being fed into the key inputs. Trance music has built itself on this technique, sending deep synth pads through a gate keyed from a hi-hat pattern, but the possibilities extend much further than that.

Although less popular nowadays, key gating is still a quick and easy way of tidying up sloppy kick and bass parts. Here the bass is gated using an external key, fed from the kick drum track that turns down the bass whenever the kick isn't playing, bringing the attacks more in line with each other. Carefully tweaked, this can produce the impression of a tighter, more refined rhythm section, although you'll need to take care in preserving at least some of the original characteristics of the bass.

EQ'ing the sidechain, or key input (as with compressors), makes the gate frequency-conscious. Indeed, this is such a useful feature (especially when trying to gate close-mic'ed kick and snare drums) that many gates incorporate some form of basic key filter controls. The filters are usually quite tame and of the low- and high-pass varieties, so the option to still use external EQ (patched to the key input) is a welcome one.

Ducking to fit

Although we've looked at gates using completely different sources for their key inputs, the same technique can also be applied to compressors – an approach best exemplified by 'ducking'. Ducking is often used in broadcast studios to automatically reduce the level of background music in response to the presence of a voice-over – an announcer talking over the title music of a TV program, for example.

In this scenario, the music is fed to the compressor's input, while a copy of the announcer's mic output is sent into the compressor's sidechain input. As the announcer begins to speak, the threshold is triggered and the gain reduction is applied with smooth, graduated attack and release times to ensure that the music doesn't pump in and out too quickly. Some pro-level gates also provide a ducking control (essentially reversing the way the gate works in response signals above the threshold), which can provide a more reliable and controllable means of ducking broadcast material.

The vocoder story

Vocoding is easily the juiciest example of sidechain processing, and was covered in depth in a Ten Minute Master in Issue 7. Like all the other sidechain techniques, it uses two types of input signal: the modulator signal (from which the vocoder will analyse the amplitude of the various frequency bands), and the carrier signal (used by the vocoder to re-synthesise its output).

Interestingly, the carrier/modulator theme could be applied to all the examples we've looked at – in key gating, for example, the pad is the carrier and the hi-hat is the modulator. Many software vocoders require a sidechain to work properly – Emagic's EVOC20 uses the sidechain input as the source for its modulator (or 'analysis', as it calls it), while the carrier comes from either the audio track or integrated synth section.

Sidechain processing is the bedrock of advanced signal-processing techniques. Master the possibilities it offers and you will hugely expand the your production horizons. MTM

TECH TERMS

Sibilance
The over-emphasis of 's', 'ch' and 'sh' sounds in the 5-10kHz range of speech and singing. A poor choice of microphone and/or over EQ'ing can exaggerate the effect.

Threshold
The point (defined in decibels) at which a compressor or gate begins applying gain reduction. A compressor applies gain reduction above the threshold, while a gate applies it below.

Full-spectrum
A sound or piece of music that contains a comprehensive range of frequencies across a large proportion of the audio spectrum. Examples include drum overheads and complete mixes.

Auditory perception
Auditory perception defines the mechanics of listening and how our brains identify, interpret and attach meaning to given sounds.

FURTHER INFO

More information

- **Logic has had proper sidechain processing since version 5. The webpage below outlines some of the interesting creative possibilities of plug-ins such as the ES1 and EXS24: www.emagic.de/support/tipsNtricks/sidechains.php?lang=EN**
- **There are plenty of interesting articles on the web about compression, some more technical than others: www.trinitysoundcompany.com/compression1.html**