Intro To Compression

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Signal Processing

Introduction

This tech note offers a basic explanation of compression for beginners. If you've just purchased a compressor and aren't sure how to use it, or are considering the purchase of a compressor, this note will help you understand what compressors are used for.

What a compressor does

Most types of signal processors, such as reverbs, equalizers, and delays, are designed to make an obvious change in the sound. But a compressor's action is much more subtle; when used properly, most listeners won't be aware that signal processing is being used. Only if you hear the original dynamic range of a signal and compare it to the compressed version will the effect be noticable. Yet, compressors are essential in modern audio work. Almost every lead vocal on a pop record is compressed during tracking or mixdown. Often the entire stereo mix may be compressed or limited during the mastering process. Finally, when you hear the song on your favorite radio station, it passes through yet another compressor before it's transmitted.

A compressor/limiter, like the Alesis 3630 or NanoCompressor, is essentially an automatic volume control. Imagine an engineer with his hand on a fader and his eyes on an input level meter. As long as the meter stays below a certain point (the threshold), he leaves the fader all the way up and the gain is unchanged. But the instant the sound gets louder, the engineer pulls down the fader by a certain amount. After the sound gets soft again, the engineer will push the fader back up. That's what the compressor is doing, except much faster and more accurately than humanly possible.

Paradoxically, by cutting the peak levels, a compressor allows you to raise the average level of a sound using the Output control and make it sound louder. By using the threshold and ratio controls, you can set a stable sound that will hold its position in the mix whether the singer is whispering or screaming.

What the controls do

Let's go back to the "engineer with his hand on a fader and eyes on the meter" analogy. The front panel controls simply tell the "engineer" what rules he should follow. [THRESHOLD] tells him how high the input meter can rise before he has to start pulling down the fader: if it's turned full clockwise, he won't pull down his fader until the red +6 LED comes on; if it's turned counter-clockwise, he'll have his hand on the fader even before the lowest green -30 LED lights. [RATIO] tells him how far he should "pull the fader down" when the signal is above the threshold level: should he pull it down just a little bit (compression) or pull the fader as far down as necessary to make sure the output level is never higher than the threshold (limiting)? The [HARD/SOFT] switch affects how he reacts as signal approaches the threshold: does he reduce it exactly by the ratio only after it crosses the threshold, or does he gradually ease into the full ratio as it gets close? The red LEDs of the reduction meter tell you how much the "engineer" is pulling down the "fader" at any time. If these LEDs aren't on, his hands are in his pockets.

The [ATTACK] and [RELEASE] controls involve the speed of the engineer's response, as does the [PEAK/RMS] switch. Short attack times order the engineer to get his hands on the fader 1/10,000th of a second after he sees a too-loud signal; long attack times tell him to let transients less than 1/5th of a second pass. [RELEASE] tells the engineer how quickly he should push the fader back up again after a loud signal has stopped; when it's turned counter-clockwise, he pushes the fader back up instantly, and when it's full clockwise, he'll take three seconds to push his fader back up to unity gain. If the compressor is in PEAK mode, the engineer responds to the highest voltage peaks, and in RMS mode the engineer responds to the longer-term average signal level (and the [ATTACK] and [RELEASE] controls have no effect). It's as if the engineer is looking at a fast-acting LED meter in peak mode, and a slow old-style mechanical VU meter in RMS mode.

The [OUTPUT] control is simply a gain control located after our "automatic engineer in the box". The [INPUT/OUTPUT] switch allows you to see the levels before the engineer does his job, or after.

The most important controls are the [THRESHOLD] and [RATIO] knobs. They both interact to get the effect you want, and that requires some experimenting. For example, if your average input signal is 0 dB, a ratio of 2:1 with a threshold of -12 dB will give you 6 dB of gain reduction, as will a ratio of infinity with a threshold of -6 dB. But the latter setting will sound more "squeezed" than the former.

Avoid common compressor mistakes

Extreme settings will lead to extreme results. If you set an infinite ratio and turn the threshold down to -40 dB, the compressor will do what it's being told to do: turn the level way down. If you then try to compensate by cranking the [OUTPUT] control to its maximum, you'll amplify the noise of your mixer, EQ, mic preamp, and the compressor itself. The noise will fade itself in whenever the input signal stops, resulting in the classic "pumping" and "breathing" problems. Noise is present in every system, and improper use of any compressor will amplify it to an obnoxious level.

If the ratio is set to 1:1, it doesn't matter where the [THRESHOLD] control is: the NanoCompressor is being told not to change the gain at all, even if it's above the threshold level. None of the REDUCTION LEDs will light, and you may as well have the NanoCompressor in BYPASS mode. Similarly, if the ratio is infinite and the threshold is high, or the input trim of the mixer or microphone preamp is too low, you will get no compression (and, if you raise the [OUTPUT] level control, you'll be amplifying the noise floor). **For low noise operation, make sure your mixer, compressor, and amplifier settings are set properly.** As a general rule, you want as much gain as possible in the front of the system (at the microphone preamp), so that a good line-level signal is travelling through the whole signal path. If you have a weak signal to start with, and then amplify it at the end of the signal path (by turning the main outputs of the mixer all the way up, for example) it will be excessively noisy.

When using a compressor on a live P.A. system, improper settings can cause feedback. Make sure that a channel is well below the feedback point when there is no gain reduction active. If you hear feedback every time the music stops, you must lower the overall level of the system.

About stereo compression

The Alesis Nanocompressor is, in fact, two separate compressor channels joined by one set of controls. The detectors of the two channels are linked. This means that if the left channel's signal rises above the threshold, the right channel's gain will be reduced by the same amount as the left channel, and vice versa. This keeps the stereo image from wandering from left to right when compressing a stereo mix.

The Alesis 3630 compressor allows you to to decouple the left and right channels into two mono compressors so you can plug one instrument into the left, and another into the right without them interacting.

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