Worship Sound Guy Presents:

Ultimate Compression Cheat Sheet

Compression Basics For Live Sound

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Do your mixes PUNCH??

Do they have low-end control? Do they feel "glued together" in a musical way? Chances are...they really don't. A solid 90% of the church mixes that I listen to are just a mess of sounds that are stepping all over each other with little to no control, punch, or definition. Well...it's time for that to change!

Let's get started!

-Worship Sound Guy

What Is Compression?

First, what is it? What we're typically talking about when we use the term compression is "Dynamic Range Compression"…which still sounds like something we'd need a doctorate to understand, and so, in the doctoral spirit, let's dissect it: first is the term "dynamic range". This refers to the variance or difference between the loud parts and soft parts in a given sound. In a wave (electrical or physical) like a sound wave, it's the comparative change in amplitude over a given time…ok, that sounded a little doctor-y, let me rephrase that: if you were looking at an audio waveform on your favorite recording software or on an oscilloscope , the dynamic range would be the difference from where the waveform is small (aka a quiet part) to where the waveform is big (aka a loud part). That difference/change is the dynamic range.

Remember back in high school when you learned about a wave's "Peak" and "Trough" in science class? It's the same thing here. Dynamic range is simply the variation between the peak and the trough of our sound wave.

What Is Compression?

Now we move to the second part of the definition "Compression". Compression simply means to make smaller, or to squeeze something so it fits in a smaller area.

So if we put all that together, we can define dynamic range compression as "a process to reduce the difference between the loud and soft sections of a sound". What does that mean for music and for the ears of our congregation? It means after compression, things will be a more even volume.

What Is Compression?

Next, how does this process happen? Typically, it happens in one of two ways, the first is called downward compression and it's what we usually think of when we talk about an audio compressor. Its function is to make louder sounds softer and leave soft sounds alone.

The next, slightly less common way, is through upward compression (also called Expansion). This has the function of taking sections of audio that are soft and making them louder, while leaving loud sections alone. In short, a compressor will either make loud sounds softer, or soft sounds louder, but the end result is always that there is less difference between soft and loud parts of a sound.

What Is Compression?

So...why? Why does this even matter, and how can it help us with our mixes?

There are a couple answers and it has to do with the two most common ways we'll be using a compressor:

1. **To even out the volume of a signal. This is great for something like a vocal that is very loud at some parts and very quiet at others. Compression will even out those differences.**
2. **Envelope control. The "envelope" of a signal is just a fancy way of talking about the Attack, Sustain, and Decay of an audio signal. Think about a drum hit. It has a HUGE burst of energy right at the beginning (that's the Attack), then it rings out for just a moment (that's the Sustain), and then the sound fades away (that's the Release). We can use a compressor to change the sound of those three elements to add more punch or sustain to our drums.**

Next, let's get in to how to use compression!

Threshold

Now, lets look at some of the features on a few typical compressors.

I like to start by talking about "Threshold" because all the other functions depend on it, as we'll see shortly.

The threshold of a compressor is the volume level (or amplitude level if you like science and stuff) that a signal must cross in order for the compressor to turn on.

In other words, the Threshold sets how loud a signal needs to be before the compressor kicks in and says "ok, I'm going to start turning this signal down".

Threshold

The Threshold control is arguably the MOST important control on the compressor because it controls whether the compressor is actually doing anything or not.

The amount of compression that's happening is displayed on a "Gain Reduction" meter (sometimes just labeled "GR") which is measured in decibels. Every compressor will have one so that you can see how much compression you're actually doing. So if you see your GR meter reading -4 dB, that just means that your compressor is acting on the signal and reducing the volume by 4 decibels.

If your threshold is set too high, the compressor will never actually kick in and no gain reduction will happen.

If your threshold is set too low, you'll be slamming your compressor resulting in a ton of gain reduction and getting unnatural pumping sounds and a signal that sounds "squashed".

Ratio

Once the signal crosses the threshold the next function is for the compressor to actually react and turn down (or compress) the signal, but how does it know how much compress? That's where the ratio control comes in. The ratio tells the compressor how much to attenuate (or turn down) the signal once the threshold has been reached. Before the threshold, no gain reduction occurs, but once the threshold is crossed, the ratio tells the compressor how much reduction will take place.

You'll see ratios listed as numbers like 2:1 or 4:1 or 20:1 or something like that. What those number indicate is the ratio of input to output.

Ratio

I don't want to get too math-y cause that's not fun for anyone, but bear with me for a minute. Lets start with the ratio of 1:1. That ratio means that no compression is happening. What you put in is what you get out. If you put 100 dB of sound in, you'll get 100 dB of sound out. No change at all. Now, lets go to 2:1. That means that for every 2 decibels you go over the threshold, you get only 1 decibel of actual volume increase. You see what happened there? We went 2 dB over the threshold and we only got 1dB out because the compressor turned on and reduced the signal by the amount we specified. 2 dB in, 1dB out…2:1…got it? Ok, lets apply that math to some more numbers. Let's say our threshold is 100 dB (meaning the compressor will turn on and effect any signal over 100 dB) and we put a sound through the compressor set on 2:1 that's at 104 dB…what will come out? The answer is 102 dB, because we went 4 dB over our 100 dB threshold and that extra 4 dB change will be compressed to only a 2 dB change because of our 2:1 ratio.

Ratio

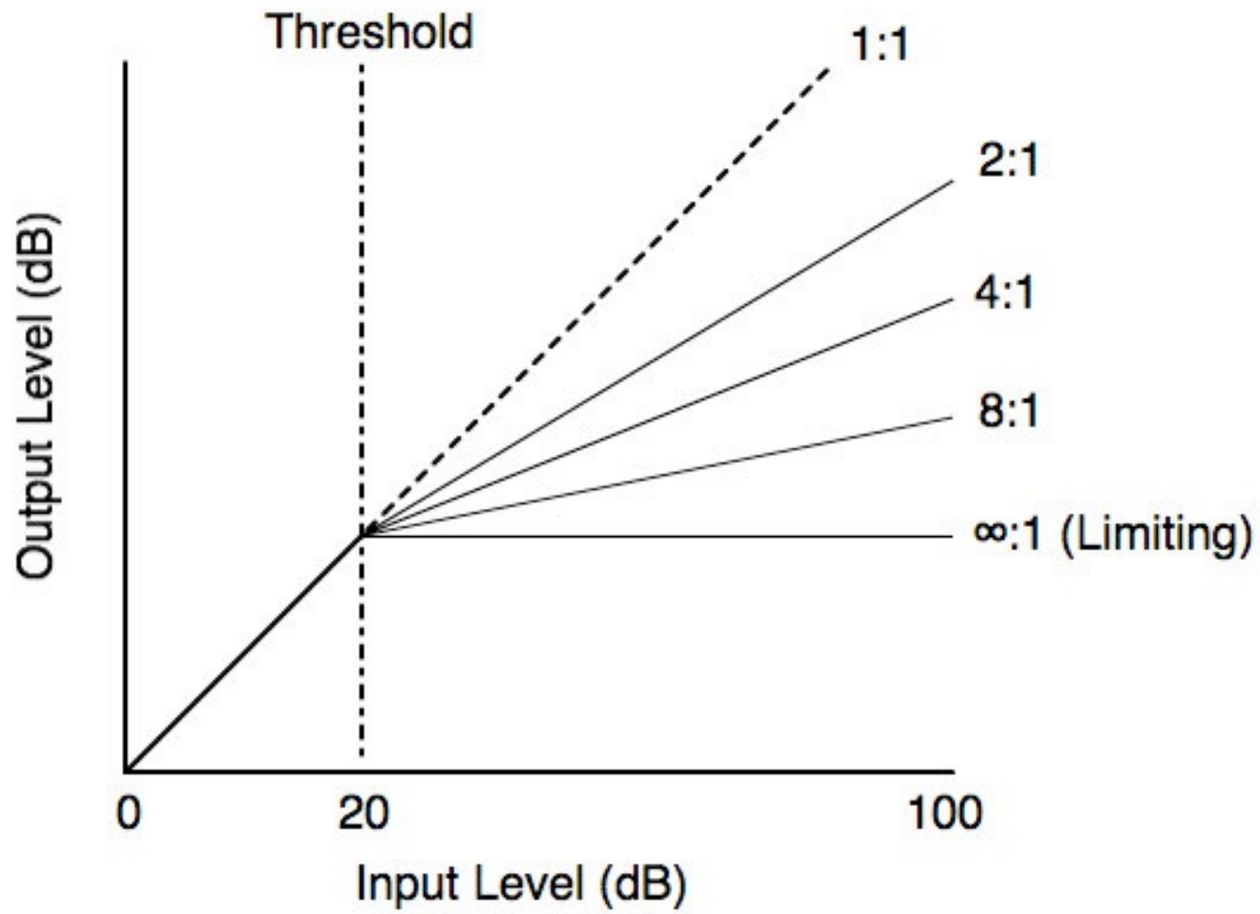
Ok are anyone's brains melted yet?? No? Ok, just a couple more things!

Lets change up our ratio just a little bit by going to 4:1. Now, we've still got our 100 dB threshold and we're still introducing a 104 dB signal. Now what comes out? It's 101 dB! This is because our ratio being 4:1 says that 4 dB must be introduced above the threshold to get 1db of actual volume increase after compression. So, with our 100 dB threshold, if we put in 108 dB, we'd get 102 dB out, if we put in 112 dB we'd get 103 dB out, if we put in 116dB we'd get 104 db out. You all see the pattern? Let's do a one more at 8:1 (8 dB over the threshold in equals only 1dB of actual volume increase) so now, with our threshold still set at 100 dB, 108 dB in gives us 101 dB out, 116 dB in gives us 102 dB, and 124 dB gives us 103 dB out.

Ok, enough math for now! Let's look at a picture!

Ratio

This is a visual of exactly what we just talked about:



Ratio

You can see the line (representing the level of our audio signal) coming up from 0 dB, until it reaches the threshold point where compression happens.

After that, depending on the ratio, we can see the volume of the signal increasing at a different rate depending on the ratio.

The higher the ratio the more strictly it get's compressed. There's even "Limiting" which is what happens when the ratio is so infinitely high that NOTHING gets over the threshold level. You set your threshold on your limiter at 80 dB and then feed in a 120 dB signal? Guess what? Only 80 dB comes out. Limiters are great for protecting your system from accidental damage from loud sources which is why a lot of system processors include a limiter as a safety function.

Next up we've got Attack and Release controls!

Attack

It sounds so simple, right? The typical definition that people give when asked about attack time is "it's the time it takes for the compressor to kick in and start compressing once the signal crosses the threshold".

The fact is…that's not even close to the truth.

If you think about that definition for a second, it'll occur to you that it seems like the attack time is really just a glorified delay control. The signal comes in, it crosses a threshold, then…there's a period of time when nothing happens…then the compression starts. That's how we've always thought about it, but actually that's not how it works at all.

This myth is SO common that you'll see it told as fact on forums and even in pro audio books! But now you know better!

Attack

Let's start with the correct definition of attack time: Attack is the length of time it takes a compressor to apply roughly two-thirds of the targeted amount of gain reduction.

I say 'roughly two-thirds' because there is no agreed-upon, industry-accepted standard for what this spec actually is. Yes, you read that right: no two compressor designers will agree on exactly how to define, and therefore measure, attack. My definition above is within the ballpark of most thinking, so I'm running with it.

Ok, let's talk about exactly what the heck that means...cause that sounds complicated. It's really not too bad: first, we need to realize that attack TIME is really more like attack RATE. Increasing the attack time doesn't slow down how long it takes for the compressor to respond, it actually slows down the RATE at which the compressor applies gain reduction.

It always responds instantly, but it "moves" slower.

Attack

Here's a GREAT analogy: imagine you're at a red light in your car with your foot hovering over the gas pedal. When the light turns green (when the signal goes over the threshold) you hit the accelerator immediately, every time. With a fast attack, you slam your foot on the pedal and speed up quickly. With a slow attack, you press the pedal gently, and it takes longer to get up to speed.

Each time, the initial response is identical: you step on the accelerator as soon as the light turns green, and you start moving right away. The compressor myth says that a longer attack means you'd wait longer to step on the pedal. The truth is that a longer attack means simply you'd press on the pedal more slowly.

To sum it all up: attack time is NOT a delay before when the compressor starts. Attack time IS how long it takes the compressor to fully apply the gain reduction once the signal crosses the threshold. It always starts applying gain reduction instantly no matter how long or short the attack time is.

Release

Here's another classic compressor myth:

"Release is the time it takes a compressor to release compression after the signal drops below the threshold."

Without going into crazy detail, let me just say that the above definition is not only incorrect – but it would actually be an impossible thing to assign a single value to.

The correct definition of release will come as no surprise given what you've just read about attack:

Release is the time it takes a compressor to restore roughly two-thirds of the reduced gain to the compressed signal.

Release

'Restoring reduced gain' is a very carefully chosen set of words. I characterized release in those terms because it's useful to think of compression as a two-way street.

When a compressor attacks, it is applying gain reduction – it is lowering the signal level.

But gain reduction is only half the picture, because for every dB of gain a compressor takes away, at some point it has to put it back. And that process – let's call it 'gain restoration' – is the business of release. The faster your release, the faster the compressor restores the gain it took away when attacking.

Release

Going back to our car analogy: you're in your car and you look up and see a stop sign. You instantly start braking, but do you slam on your brakes? Or press them gently for a gradual stop? That's the same thing as a fast or slow release time.

So just to recap:

Attack is the length of time it takes a compressor to apply roughly two-thirds of the targeted gain reduction.

Release is the length of time it takes a compressor to restore roughly two-thirds of that reduced gain.

How NOT To Ruin Your Mix

Maybe I should have titled this section "Some great starting points for your compressor" but...I wanted to scare you a little bit. Compression is a powerful tool, and you'll definitely make a few errors before you learn how to use it properly! If you do too much, your mix can sound flat and lifeless, rather than controlled and punchy.

It's always important to LISTEN to what the compressor is doing. Don't be fooled by a volume increase. Louder isn't always better. Take a moment to really listen to the "movement" that the compressor adds. It'll take some time to train your ears to hear that, but once you do, your mixes will start getting a lot tighter, controlled, and punchier!

But to get started, here are some things that I like doing:

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Compression Cheat Sheet

WSG MIX-U

How To Set Your Compressor

I like to think of compressor times as only having three settings. Fast, Medium, and Slow.

You can even simplify it further and just do fast and slow if you want to, but here's what you want to listen for with each setting:

Attack:

Fast: Beginnings of drum hits are squashed down. Not as much impact, but good for things that you want to stay a very consistent level, like a bass or maybe a vocal that has a tendency to suddenly get loud.

Medium: Great for controlling lots of signals. Many compressors have fixed attack times that are what would be considered "medium". Good starting point.

Slow: Great for things where the attack of the instrument is important. Read: DRUMS. You want to hear that initial "punch" of the drum hit before the compressor fully kicks in. A slow attack time allows this to happen.

How To Set Your Compressor

Release:

Fast: This is good for when you want the compression to be fairly "transparent". In other words, you want it to get in, do it's job, and get out. On drums a fast release is often used for this reason. Once that quick hit is over, I don't want the compressor still effecting the signal. Very fast release can sound "aggressive". Sometimes not in a good way.

Medium: This is good for sources that are very "even" in their volume. Guitars, basses, and keys are prime examples of good candidates for a medium release because their volumes typically don't change quickly/ drastically.

Slow: Once again this is for sounds that are VERY even. Most things don't use a slow release.

How To Set Your Compressor

Ratio:

The "sound" of the Ratio is sometimes a tough concept for a lot of engineers to grasp. The easiest way for me to put it is that a higher ratio will usually sound "more compressed".

Here's what I usually do to keep it simple: if I like my attack and release times, but I go "I just really want to HEAR the compressor more" I'll turn up the ratio a little bit. It's very much an ear thing. When in doubt, stay low! 4:1 is a great starting place.

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How To Set Your Compressor

Here are my general compression amounts:

Kick: 5-7dB Gain Reduction

Snare: 6-9dB Gain Reduction

Toms: 4-6dB Gain Reduction

Overheads: 3-4dB Gain Reduction on Snare Hits

Bass Guitar: 4-8dB Gain Reduction at the loudest parts

Electric Guitar: 1-3dB Gain Reduction (if needed)

Piano: 4-7dB Gain Reduction at the loudest parts

Acoustic Guitar: 3-5dB Gain Reduction

Vocals: 5-12dB Gain Reduction As Needed

How To Set Your Compressor

With these general settings, you can start to uncover a whole world of tone shaping. Try a slow attack and quick release on drums for added punch, or a fast attack and fast release on bass to even out the signal and get a tight low end, or maybe try a medium attack and a medium release on vocals to even out the dynamics of the singer's voice without being too noticeable.

Above all, experiment! Compression is an amazing tool, and you'll quickly figure out what you like, and why you like it, now that you have a deep understanding of exactly how compression works.

Good luck, and happy mixing!
-Worship Sound Guy