

# The Science of Sub Bass

How low can you go? Sub bass can be surprisingly tricky to control in your productions. **Greg Scarth** gets to the bottom of it

**W**hether you're making Electronic music or Thrash Metal, the bottom end of the frequency range is seriously important. Those booming, earth-shaking low frequencies provide some of the biggest thrills to clubbers and rockers alike. We all know that sub bass is the low stuff, but the exact definition is a little vague. Broadly speaking, we're looking at frequencies from around 100Hz down but this certainly shouldn't be considered a hard and fast rule.

Essentially, it's the type of bass you feel shaking your organs rather than actually hearing it. This month we're going to look at how you can work with it in your tracks. Things are about to get seriously low.

## History

Let's start by considering what sub bass meant before Electronic music. In fact, let's think about what it meant before the advent

of recorded music altogether. In the days when all music was played live, the lowest instruments around could still produce serious sub bass. The bottom strings of four-string bass guitars and double basses are typically tuned to E1 (41.2Hz) but five-string versions go down to B0 (approximately 30.9Hz), a tone higher than the lowest note on a piano (A0, 27.5Hz). Contrabass tubas can typically be played as low as G0 (24.5Hz), while some church pipe organs can play even lower than that.

So, sub bass existed long before the advent of recorded music, but the invention of early radios and recording technology introduced a new set of issues to contend with. The weak low-end response of early audio technology meant that even bass sounds were difficult to reproduce accurately. Advancements in reproduction technology coincided with the invention of electronic instruments and drum machines that could produce frequencies even lower

than acoustic and electric instruments, way beyond the lower limit of the human hearing range. Together, they laid the groundwork for modern bass-heavy production styles, with sub bass elements derived from acoustic, electric or electronic instruments.

## Monitoring

Before you even begin to think about sub bass, you absolutely must make sure that your monitoring setup is adequate. Inaccurate monitors in a badly treated environment simply won't cut it here. A subwoofer isn't necessarily essential, but a well chosen sub with a flat response will certainly make things easier if your monitors don't offer enough accuracy at the bottom end. Room acoustics play an equally important role. Low frequency resonances or room modes will severely hamper your ability to get the mix right, so it's impossible to overstate the importance of adequate acoustic treatment in order to ensure that your monitors can do their job properly.

## Sources

We're going to concentrate primarily on electronic sources of sub bass, but the same principles we discuss in this article also apply to recordings of acoustic and electronic instruments. The main difference is that you can't just turn up a knob marked 'sub bass' on an acoustic instrument, so you'll have to pay closer attention to how you generate the signals in the first place, either through careful mic application or by using a sub-harmonic synthesizer to fill in the gaps for you. Otherwise, the production and mixing techniques are very similar.

Needless to say, sub bass requires special consideration. The first step is to generate the signal, and for most of us it's going to be synthesised. The easiest way to create sub bass is simply to mirror your bassline lower down the frequency range (for instance, by adding a sine wave oscillator tuned an octave below the bass). However, you'll have much more control over the two elements if you separate them and process them individually. Remember that sub bass doesn't necessarily have to follow the same pattern as the bass.

With so much action in the low frequencies, it's crucial to pay attention to the way the kick, bass and sub bass interact. There is an argument that it's worth applying a hi-pass filter to your bass part in order to clear space for the sub to do its thing. In some cases, kick drums, bass samples or synths with sub-harmonic content might make it difficult to create room for sub bass. Of course, the flip side is that you could easily reduce the impact of the parts if you filter them too drastically. Tuning the three elements manually is

Roland's TR-808 drum machine is famous for its incredibly low sub bass capabilities



always preferable to using sidechain compression or similar approaches.

## Harmonics

Harmonically rich sub bass can be a major issue. If we play a harmonically rich sub bass note, the harmonics are likely to hit the exact frequency range where our kick drum and bassline are operating. At the very least, this is going to make things difficult to mix. As such, the cleanest, most controllable sub bass is a pure sine wave. It's by no means a strict rule, but as a general guideline, keeping your sub bass synth set to a single oscillator sine wave patch tends to make things a lot easier in the long run. Very short attack and release times are best avoided so as not to induce unwanted thumps and clicks as the notes trigger. Of course, the sine wave isn't the only way to go. TR-808 fans will be well aware of the way kick drum sounds can help to carry sub bass elements.

The classic 808 kick drum is based on a sine wave with a fast pitch sweep. When sampled and played back at different frequencies, the 808-style kick is great for sub bass, with the attack element at the start of each note giving the sub a real punch. The same principle can be applied to any sine wave sub by layering it with an attack sound, adding a filtered white noise element or using a fast pitch envelope to emphasise the start of each note.

## Mixing

Sub bass presents its own mixing considerations. A lot of the techniques you'd normally use on a bass part become redundant on most sub bass parts. A sine wave doesn't respond to EQ and filters in the same way as a harmonically rich signal because there are no harmonics other than

## Compression Conundrum

Compression can often have unexpected results on sub bass. Rather than simply controlling the dynamics of your sub, it's common for a compressor to colour the signal and add harmonic content. The wave-shaping effects of compressors are often overlooked, but at low frequencies they become even more important. Feed a low frequency sine wave into a fast compressor with short attack and release times and you'll soon hear the tone of the signal

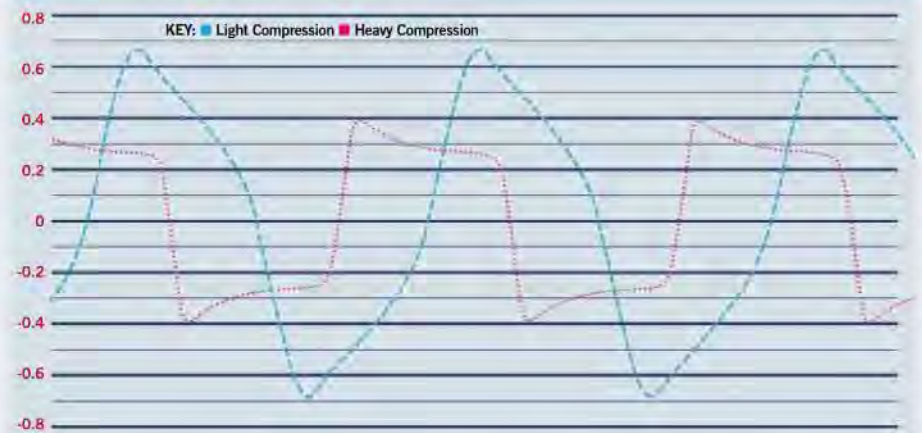
change dramatically. Check out our audio clips and the graph below to see how dramatically the sound of a 40Hz sine wave can be affected by compression.

This particular effect occurs when a compressor is set fast enough to reduce the peak of a wave before releasing in time for the next peak, chopping off the top of the waveform as it goes. Even with the threshold and ratio set so that the compressor only hits a couple of decibels of gain

reduction, the effect on the sound is easily noticeable.

The sub itself might end up sounding thicker and warmer or cutting through the mix more clearly, but the extra harmonics which result from squaring off the wave will very often clash with the kick drum and bass. It's all too easy to get caught up in a never-ending cycle of adding harmonics to the sub, then EQing them out and trying to cut it back to avoid clashes.

### COMPRESSING SUB BASS



messy and hard to balance as harmonics clash. We'd then need to EQ out a space in the frequency range, removing harmonics and taking us back in the direction we came from. Rather than trying to thicken up the sound or use dramatic harmonically rich effects, it's generally best to add interest to sub bass parts by modulating volume, glide or oscillator detuning. Mix rescue

techniques such as bass maximisers, sub enhancers and even multi-band compression can be troublesome. Many add harmonics to the bottom end in order to make it cut through, while multi-band effects are often used to paper over cracks of weak mixes.

### Common mistakes

Amid all this obsession with deep bass, it's important to remember that there is a point where sub bass becomes too low to be effective. The lower limit of the human hearing range is typically somewhere around 20Hz, but sound systems don't necessarily go this low. Most tend to struggle with bass below 30-40Hz. As such, adding low

frequency content around this range might not be a good idea. The best way to figure out the ideal frequency range for your sub is to test it on a variety of systems, but this isn't always possible. To save you the time and effort, a good rule of thumb is that 40Hz and upwards tends to be the sweet spot. Thinking in musical terms rather than frequencies, that means your lowest sub bass notes are probably going to be hitting somewhere around E1 (41.2Hz) or possibly Eb1 (38.9Hz).

As we mentioned in our investigation of stereo sound back in *FM221*, it's also advisable to keep lower frequencies in mono. Likewise, applying delay or reverb effects on sub bass usually creates a real mess. If you do decide to use stereo effects on a sub bass part, be sure to check mono compatibility very carefully. As an alternative, mid-side processing is a great way of ensuring that your track's bottom end doesn't collapse when it gets summed to mono. Keep it simple and you won't go too far wrong. **FM**

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“ Mix rescue techniques such as sub enhancers can be troublesome ”

the fundamental frequency. EQing a sine wave can only act as a frequency-dependent gain control. Likewise, applying a low-pass filter to a sine sub bass will simply progressively reduce the volume of higher notes. A lot of techniques commonly used to try and 'thicken up' sub bass are also counterproductive. If we add distortion or induce harmonics using saturation and warming effects, the mix can easily become