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But This Goes to 11…

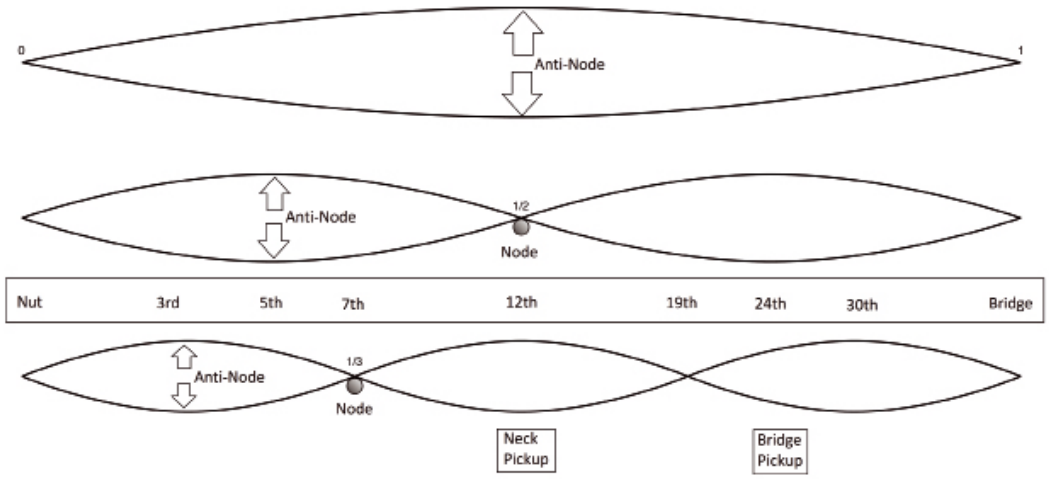
Welcome to the world of bass rigs.

Last time we veered off the path of amplification and went back to looking at what happens when you pluck a string. As most of us play basses with traditional magnetic pickups, we shall have a look at how they turn these vibrations into a signal that we can amplify.

A single-coil pickup has a narrow aperture which picks up the movement of the string directly above it. As we saw in last month's diagram, the movement of the string is made up of a series of harmonics, each of which has a shorter wavelength than the one before, and thus higher frequency (pitch), plus a collection of percussive non-harmonic overtones (string noise, fret rattle and buzz, finger/pick-on-string sounds etc). The more that each component of the sound causes the string to move within the aperture of the pickup, the more of that component you hear.

Right, let's look at the open strings and imagine that our pickup is at the 12th fret (I know it can't be there because that's the middle of the neck but humour me …).

If we pluck an open string, the 1st harmonic has nodes (points of minimum movement) at the nut and bridge and an antinode (point of maximum movement) at the 12th fret. So a pickup at the 12th fret would pick up the 1st harmonic (aka 'fundamental') very loudly. The 2nd harmonic has a node at the nut, 12th fret and bridge, and antinodes at the 5th fret and 24th fret, so our 12th-fret pickup won't really hear the 2nd harmonic. The 3rd harmonic has a node at the nut, 7th fret, 19th fret and bridge, and antinodes at the ~3rd, 12th and ~30th fret, so our 12th-fret pickup will hear that 3rd harmonic loud and clear. And so the process continues …



This means that the position of our pickup has a huge effect upon the tone we hear – simplistically, the closer to the bridge it is, the more it picks up the higher harmonics, and the less the lower harmonics as we move further from their nearest antinodes. But what about with two pickups? If you use either pickup on its own it behaves exactly like a single-pickup bass would with a pickup in the same position. When you start mixing the two it gets complicated!

So let's now imagine we have a two-pickup bass with one pickup at the 12th fret and one at the 24th fret. When we pluck a string, the 1st harmonic has an antinode at the 12th fret, so the 'neck' pickup hears it loud, the 'bridge' pickup not so loud. The 2nd harmonic has a node at the 12th fret, so the neck pickup doesn't really hear it, while the bridge pickup hears the antinode at the 24th fret loud.

The 3rd harmonic has an antinode at the 12th fret and an antinode at the ~30th fret, so we might assume that because both pickups hear that harmonic pretty loud it'll come out of the bass equally loud. However, we have a different issue to deal with, as at the neck pickup the string is moving in one direction while at the bridge pickup the string is moving the other way. This means that when the neck pickup is generating a positive voltage, the bridge pickup will be generating a negative voltage and vice versa, which means that the voltages partially cancel and you hear much less 3rd harmonic.

This series of some harmonics reinforcing and some cancelling continues all the way up to where the bass ceases to produce sound (which can be remarkably high with fresh roundwound strings). Clearly we don't want to waste our lives trying to work out what the overall effect of this is, but in

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general, if you have a pair of similar pickups, the further apart they are, the more the sound will be scooped out in the mid range when they are both at full. This is why one of the most popular jazz bass sounds involves having the bridge pickup all the way up and the neck pickup backed off very slightly – this gives a sound with a scooped mid range that's tilted more towards the upper mid-range growl. If you backed off the bridge pickup slightly it would tilt the mid-range scoop to give you more lower mid-range body. Reducing the volume of one of the pickups reduces the cancellation of certain overtones and thus brings back some mid range – yes, turning something down can make you louder!

What is easily forgotten is that the relationship between the harmonics and the pickup positions changes as you fret notes – the higher you go up the neck the shorter the string becomes, so the lower harmonics tend to come through more. This also shows why you needn't obsess over the finest details of pickup position – it matters, but the idea of a 'sweet spot' was created by a (talented) marketing department; if it's a sweet spot when you play an open string it certainly isn't when you're at the 12th fret! Before you get too hung up on the effects of pickup position, pan all the way to your neck pickup, then listen to how the sound changes as you shift your plucking hand from up over the 12th fret to right back by the bridge. Then pan to the bridge pickup and repeat. By changing how and where we pluck the string we're directly changing the harmonic balance – true 'digital' tone controls. If you can't make your bridge pickup sound supermellow and fat, or your neck pickup sound strident, honky and aggressive, then you're not trying hard enough! Repeat the same experiment with both pickups up equally and you'll notice that although you can get even more variation in tone by changing where you pluck, the mid-range scoop due to the dual pickup phase cancellation is always there. So next time you're lost in the mix on a gig, turn one of your pickups down and reclaim some mids!