

# What Makes Electric Guitar Sounds Differ?

**I am looking at some of the basic 'never mentioned' issues that affect electric guitar sounds... from a designer's perspective.**

**What Pickups Can Or Cannot Do:** Right off, it must be said quite honestly, that pickups **cannot** alter the individual harmonic structure of the sound your guitar makes. That is decided by the materials it's constructed from. Guitar pickups do not have the ability to hone into a harmonic and boost or attenuate it. Neither do they have the ability to add something to the sound that was not there in the first place. What they **can** do, is increase or decrease loudness or alter the ratio of treble to bass of the sound the guitar produces. Therefore, they **can** alter the guitar's tone\* to make it more pleasing.

For example, putting a Stratocaster pickup (PU) in a Telecaster will **not** make the Telecaster sound like a Stratocaster. However, what it will do is give the Telecaster the same tonal attributes that it gives to the Stratocaster. It is the location of the PUs that account for the basic differences between the two instruments. To go into this statement deeper, I will compare the Strat and Tele a little more closely later on.

*\*I use the word 'tone' meaning the ratio of bass to treble output. Not the more common American use, which implies a change of harmonic structure of the signal. In English, the latter would be covered by the word 'sound'. Like: a 747 has a distinctly different 'sound' to a man talking (Joe). It is the harmonic structure of the two 'sounds' that makes them distinguishable... not the tone. You can add or subtract treble or bass to 'Joe's' voice... but it will still be recognisable as 'Joe.'*

**Materials:** First, we have to acknowledge that the materials the guitar is made from will affect their tone or sound. Whilst most Fender instruments, for example, are made from very similar woods, etc... even if you take a hundred Stratocasters consecutively from the production line, you'll find that they all sound a little different. That's because of material variances and tolerances in the hardware fitted to them... but they'll all sound basically like Strats. Some will be nicer than others for different players. But that will be a subjective viewpoint. There is no such a thing as a perfect guitar!

**Pickup Positions:** This is truly a **key topic** to how guitars sound! As we all know, electric guitars generally have more than one pickup, some have three or four even. And there's a very good reason for this. The upper harmonics in the sounds generated by the strings vibrating, vary in intensity along the string's length. Near to the bridge, the harmonics tend to be stronger than the (fundamental) bass note of the string. So having pickups fitted in different locations along the string produces sound variations which can be selected by the player. Hey... we already know this, don't we? Well, that's true, but what many players don't know is that not all guitars have their pickups fitted in exactly the same places on the guitar! And this makes a huge difference to the way those guitars sound!



Here's a **DiPinto** 'Galaxy IV' as used by the Nashville 'surf' band **Los Straitjackets**. This guitar has a 'mix' of Strat and Jazzmaster tones provided by careful pickup placement. Surf music is traditionally served by those instruments.

I would like to suggest that you take a look at this document here: <http://www.award-session.com/pdfs/Fender.pdf> It shows some of the different Fender models lined up, so that you can see each model's pickup positions in relation to the Telecaster standard. Quite an eye opener and makes you realise what is the real secret behind guitar sounds!

**Strat & Tele Comparison:** OK, now back to the Strat and Tele comparison. This bit is essential if you are going to understand how important even the smallest changes in pickup locations will subtly affect each instrument. If you have these two classic instruments in your possession, then get them out now. And while you're at it, find a ruler too!



The twelfth fret is the most important fret on the guitar, from a guitar designer's point of view. Because it's from the twelfth fret that you measure where the pickups will be placed. It's the 'datum' point.

Now you have your guitars out, measure from the centre of the twelfth fret to the centre of the neck pickup pole pieces on the Tele. It should measure about 165mm. Now measure the Strat's distance... it should be 168mm. Yeah, it's only 3mm, but that 3mm accounts for the subtle difference in sound between the two guitar's neck pickups. And to many, that sound difference is very noticeable!

Hardly any guitarist I've discussed this topic with has ever noticed that the Tele and Strat bridge PUs are at different angles. Both have their centres the same distance from the twelfth fret, but the Telecaster has a much larger angle. This is the reason the Telecaster has a much bigger bottom E sound and a much sharper top E sound than a Stratocaster on the bridge PU. That angle is responsible for the Telecaster's unique sound signature! For Tele addicts like me, it's the one SOUND that Strat players just don't get! Their loss! But that's just a personal POV!! In fact, I have several Strat-like guitars with the Tele bridge PU angle... I want it all!! Ha-ha!

So, to sum up, it's the PU positions that matter so much to the SOUND. But the types of PUs fitted can produce interesting TONE variations on that 'pre-determined' positional platform.

**Pickup Basics:** There is a lot of confusion about what pickups actually contribute to guitar sounds. With that comes a lot of mystery, mojo or snake oil! To help wade through all this, perhaps it is best to remember that there are only two active components in a pickup... the coil (copper wire) and the magnet(s). Everything else just supports those components. To be honest, there's not much there to get too excited about, in reality.

Magnets are either AlNiCo or ceramic, but magnets do not have a 'tone!' It's just magnetism. The early 'permanent' magnets were AlNiCo construction and for many years that's all there was. Then along came ceramic magnets which can be made into complex shapes and are extremely powerful. Now of course, we have neodymium magnets, which are 5 times more powerful than a similar sized ceramic magnet. But at the end of the day... they are just magnets! I won't even bother to talk about copper wire!!

Generally speaking, *over wound* pickup coils produce increased bass output. Whereas, those with *under wound* coils will be bright and tinny sounding... think cheap copy Strat guitars. Quite often the real cheapos have weak magnets too, so they're quiet and tinny at the same time. However, some class PUs do have small coils and sound great. Many Gretsch and Guild PUs do. That's because they tend to have more powerful magnets to bring up the volume. So, as a rule of thumb... loud pickups = powerful magnets... bass heavy pickups = large turns of

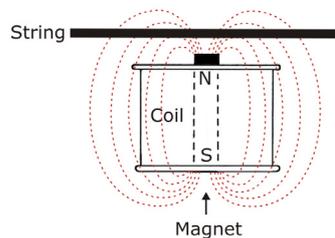
copper wire. Contrary to popular belief, *over winding* PU coils does not really make them louder, just more bass output.

The human hearing is often fooled into thinking that more bass is louder. Our hearing does not hear bass at low volumes very well. Only at higher volumes. This why amps sounds better turned up loud! So, 'more bass' fools your brain into thinking that the volume *must be* high! For more on this, Google 'Fletcher & Munson' whom carried out experiments that prove this back in 1933.

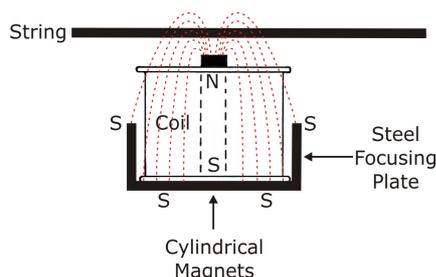
Now let's look at some of the most popular Fender style PUs and see how their simple, but clever, design can give us the opportunity to 'acquire' the right types of PU for any given TONE you are looking for. And there is a lot of marketing gibberish talked about them. Therefore, I hope this article helps you all to 'cut through the bull'.

**Stratocaster Pickups:** This is the common single coil type and found on the world's most popular guitar, the Fender Stratocaster. It has a medium 'field of pickup' (FOP). But much of its magnetic field is lost outside the coils, so may not be as loud or bright as it could be. Some would say it's perfect... and it certainly does the job well!

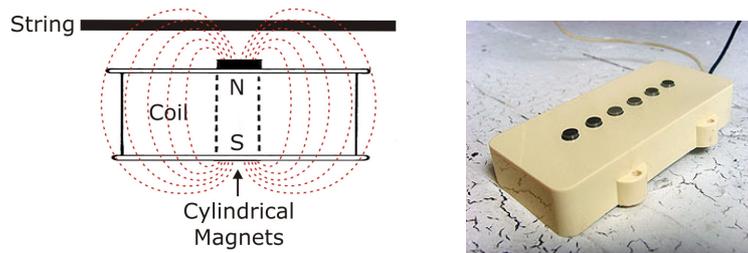
Because the magnets are inside the coil bobbin, it is actually more efficient than say, a Gibson P90 for example, as more of the magnetism (flux) passes directly through the coils. It is also, for me, quite bright in tonality, which has its place confirmed by the numbers of Strats sold every year! The coils have a resistance in the region of 6.5k. This produces adequate bass output, but is nearly double the resistance of some Gretsch pickups that are noted for their very bright edge. But Gretsch PUs generally employ strong magnets to bring up the volume to more respectable levels.



**Jaguar Pickups:** They're just like a Strat PU, but notably have a steel plate wrapped around the bottom and up the sides of the pickup coil. This plate becomes part of the magnet and causes the FOP to constrain its magnetic field to a narrow range, thus creating an output rich in upper harmonics. It's the sound you can hear plainly on any 'Beach Boys' record. It's their 'trademark' guitar sound. However, the guitar has a twist to it... its short 24 $\frac{3}{4}$ " neck scale lowers the harmonic content of the guitar a tad. Again, part of the complex mix of factors creating its unique sound. But the PU positioning is prime to this. Jaguars are becoming quite popular again with young bands looking to find new sounds at the time of writing this.



**Jazzmaster Pickups:** This type is the exact opposite to the Jaguar. It has a very wide coil and FOP, which leads to a mellower tone. This is because there is a high risk of 'out of phase' harmonics cancelling each other out and reduces treble output. Having said that, Jazzmasters are quite bright all the same... but not in the same way as a Strat or Jaguar! They do have a subtle 'muted' air about their tone. The fact that the neck PU is 179mm from the twelfth fret (Tele 165mm), it will start to take on the sound of a Strat middle PU! Hence the quirky Jazzmaster neck PU sound. If you could slide it right the way back to the middle position, it would sound exactly like a Strat middle PU! Surprise, surprise!!



**Jazzmaster Psychology:** Not only did Leo Fender make his Jazzmaster PUs 'feel comfortable' to jazz players by making them visually and sonically similar to P90s, he even shortened the sustain of the instrument by introducing a long string length post bridge!



What happens is this: As the string vibrates, the string on the anchor side of the bridge vibrates in the opposite direction... so the bridge acts as a fulcrum. The 'counterbalance' act created takes energy out of the strings on the PU side of the bridge. Thereby, shortening the sustain. In contrast, on most modern 'rock' orientated guitars, there is virtually no string after the bridge, which serves to maximize sustain. However, sustain (energy) is still absorbed, through the bridge and top nut or frets into the body and neck. The neck is the biggest offender of energy absorption, as it's the weakest part of the guitar... so always buy guitars which have chunky necks if you want maximum

sustain and brighter tone - but material quality is also a big factor!

Funnily enough, the guitar was not really embraced by jazz players, but instead found favour with one huge American instrumental band of the day - The Ventures. On their records, you can clearly hear the unique bright, but gentle, short sustain properties of this under valued genius instrument. Now 'the' surf music guitar to own - along with the DiPinto as well!



I don't own one, but I did convert a Squier Strat into a Jazzmaster-like instrument, so that I could have near Jazzmaster tone, but on the more convenient Strat body. For me, this was a good compromise.

The neck PU is 179mm from the twelfth fret, but this guitar does have 22 frets, so it looks closer to the neck than it would do with a standard 21 fret JM neck. Also the bridge PU has been straightened up and is in the JM location at 278mm from the twelfth fret. I just left the middle PU there as an added extra and to confuse people! The TONE is more 'in-your-face' than a real JM, due the bridge (longer sustain) and brighter Strat PUs, so I just turn down the treble. Nice!

Many pickup manufacturers won't like me too much for saying this, but pickups are very limited in how they can change a guitar's tone. As said earlier, the one thing they **cannot** do, is alter the harmonic structure of the signal, that's decided by where the pickup is placed under the strings and by the body's materials.

All of these 'rules' apply to Gibson or any other make of guitar too. I'm not going into those pickups at the moment, but I may expand this article to include them at a later date, when I get the time.

Here's some of my 'odd ball' guitar designs from the mid 2000s!



The only guitar actually made was the first 'cherry' one. I have three! Named J6M3 in honour of the town that's been good to me over the years... Basingstoke! **Junction 6** on the **M3** motorway! Lol.

**Comment:** I made my first guitar pickups around 1971 before 'replacement' pickups were in general supply. The very first one I made was a copy of a P90. As a typical Aquarian, I like to find out how things work. I did think about making them to sell, but reached the conclusion that it's not the PU that makes the sound... it just 'collects' what's already there.

To my mind, the right decision... but not such a good business decision! As Mighty Might, DiMarzio, Seymour Duncan and many others have proved! Ah well, I'm happy not to be making PUs to be honest.

Have Fun!!

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