

UNDERSTANDING PHASING IN ELECTRIC GUITAR REPAIR

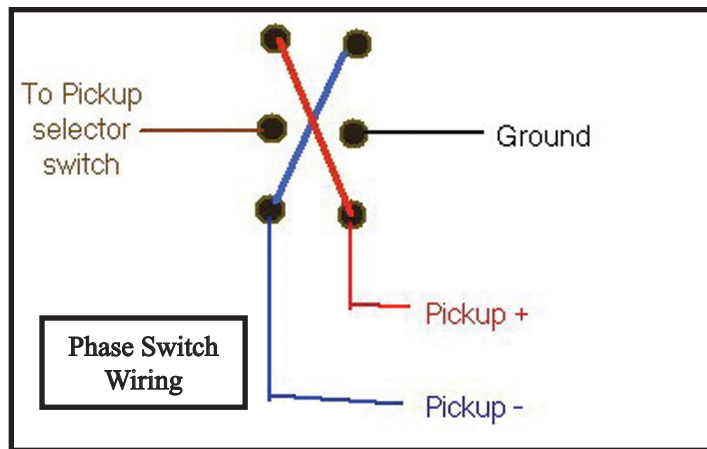
By Roger Sadowsky

One of the most basic pieces of knowledge essential to electric guitar and bass repair is understanding phasing relationships in any instrument with more than one pickup. Nothing is more frustrating than to spend a great deal of time wiring an instrument, reassembling and restringing, only to plug it in and hear a very thin and tinny sound when two pickups are on together. This is a symptom of two pickups being out of phase. My hope is to share my experience and knowledge to avoid you having to experience this.

Let me begin by saying that I have never studied electronics or electrical engineering. Everything I have learned over the last 42 years is the result of trial and error and the generous sharing of knowledge from this wonderful community of instrument makers to which we all belong. One of my main mentors in guitar electronics was Ron Armstrong, who sadly passed away recently. I met Ron at a Gibson service seminar in Kalamazoo in 1977...we became fast friends and I was able to call him whenever I needed advice. Keep in mind that at that time there was no internet or YouTube videos and you could count the number of books written on guitar repair and construction on one hand.

Before we delve into pickup phase in more detail, let me digress for a moment. On the classic Fender Stratocaster, the original switch was a three way which gave you the neck, middle or bridge pickup. Those were the only choices. Soon, players discovered if they could maneuver the switch to stay in a position between the neck and middle, or the middle and bridge, they could obtain a new sound which eventually became the sound that is most recognizable as the “Strat” sound. It became so popular that the switch was reconfigured to have 5 settings, rather than 3. Many players referred to these two settings as the “out of phase” setting, but that is a misnomer. The pickups are in phase. The difference in sound is the result of the two pickups being on together combined with their physical locations. So be clear, there is no “out of phase” setting on a Strat with a 5-way switch.

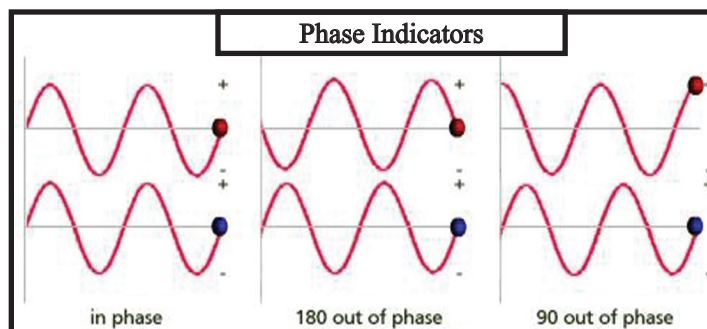
The period of electronic “mods” essentially begin in the late 70’s. After the 5 way Strat switch, the next popular mod was the phase switch. This was primarily employed in two pickup guitars like Les Pauls. The idea was that you could reverse the phase of one pickup so when the two were on together, you could simulate the combination sound of a Strat. Unfortunately the resulting sound was so thin, as to be fairly useless. I cannot remember installing a phase switch anytime after 1980.



Phase Switch Wiring

DPDT mini toggle (double pole, double throw) On-On switch So lets begin with the very basics. A mono speaker can be visualized as a bell curve, or sine wave. When you have stereo speakers, both speakers must be “in phase”. This can be visualized by the direction of the sine wave being the same. If the sine waves are going in opposite directions, the speakers are out of phase. The result of this is a cancellation of mutual frequencies that produce a thinner sound. That is why most speakers have a red or white terminal and a black terminal. On good speaker wire, one of the two leads has a marking on the insulation. If the marked leads are both connected to the same terminals on the speakers, they should be in phase.

Unfortunately, there is no such standard with guitar pickups. So this is where the need arises to be able to determine phasing before a pickup is even attached. The method I am about to describe was taught to me by Tim Shaw, who during the years I was attending the Gibson service seminars in the late 70’s, was the head R&D person for their guitar electronics department. The only piece of equipment you will need for this is a very basic analog multimeter meter, or ohm meter (no—it does not measure your state of meditation)... A digital meter will not work for this method. These were always available at Radio Shack prior to their recent demise, but they are readily available online. You can spend \$300 for a quality Simpson meter, but a \$25 unit will do the job just as well. My personal favorite is the Tippettt 310, which costs about \$100. You can also use this to measure pickup resistance, which will give you an indication if a pickup is bad, as well as know if a pickup is wound in the correct range of resistance. it will also help you diagnose shorts in the circuitry. Aside from a soldering iron, an ohm meter will be your most important tool for guitar electronics.

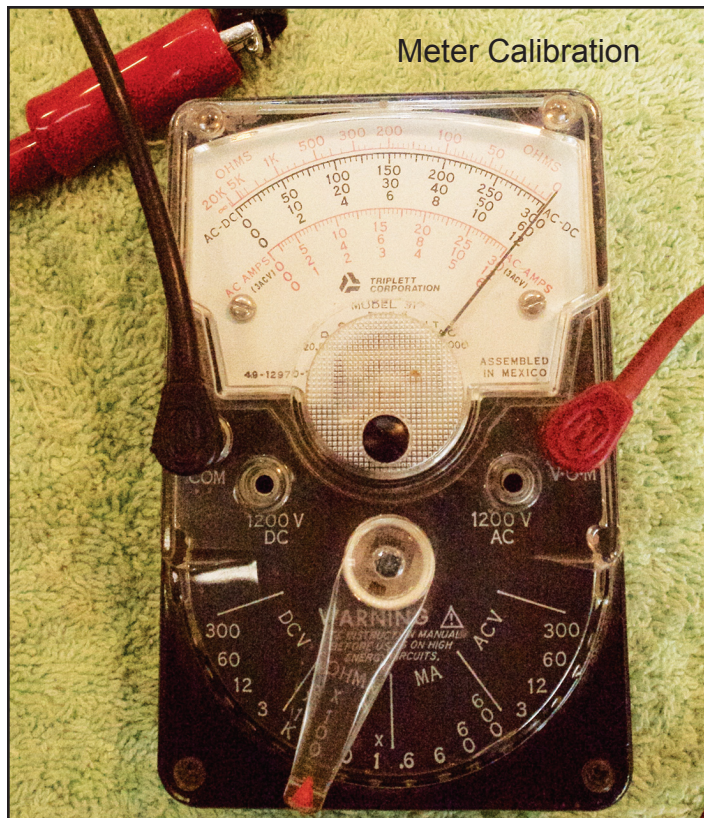


So here is how to determine the phase of a pickup. Let's begin with a simple single coil pickup, like a Strat pickup that has two conductors (wires). Usually the black wire is the ground wire and the white is the "hot" wire, which connects to the switch. Similarly, there are two leads on the meter. One is usually black and connects to a terminal that says "common", meaning ground. The other is usually red and connects to the terminal that says ohms or VOM. If your meter does not come with leads that have a small alligator clip on the end, you can purchase test leads that have clips on both ends (or modify the leads that came with the meter)

The first next step is to calibrate the meter. Attach the two leads together and turn the calibration wheel until the meter reads "0". Attach the red clip to the "pickup "hot" and the black lead to the pickup "ground" This will leave your hands free to do other things. There is a dial in the middle that has a multitude of settings. You want to be in the range: ohms X100. You are now ready to begin to measure your pickup. A typical Strat pickup will have a resistance reading in the range of 6000-8000 ohms. This will read 60-80 on the meter scale and when you multiply by 100, you get 6000-8000. Almost all pickups I have encountered will read between 6000 and 20,000 ohms. If you get a reading almost all the way to the left on the scale,

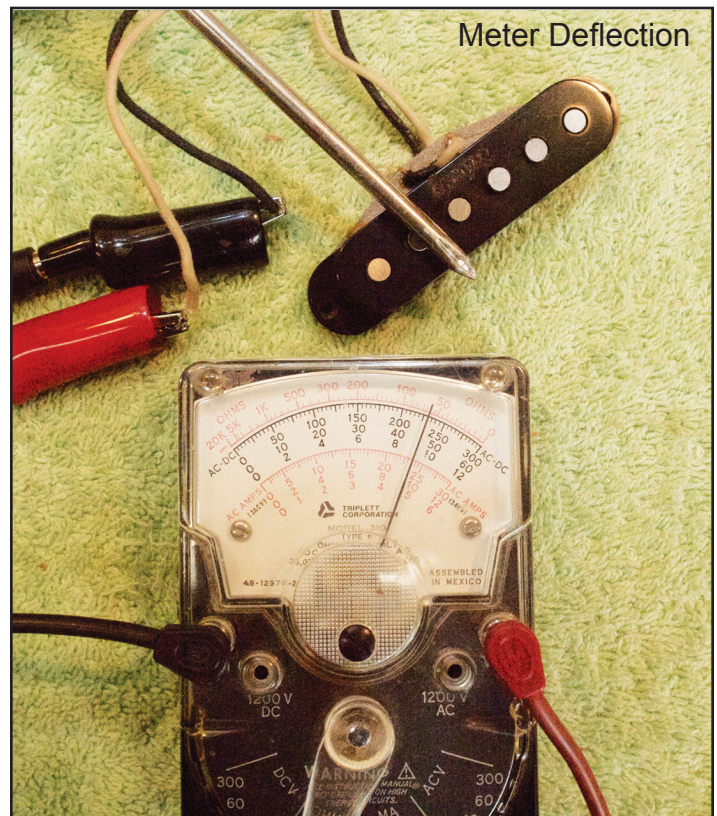


Typical Meter Reading



Meter Calibration

to the white wire of the pickup. Then take a magnetic, metallic object like a small screwdriver and tap any of the pole pieces of the pickup (on many single coil pickups, the pole pieces are the magnets). Watch the needle on the meter and you will notice that when you initially hit the pole piece, the needle will deflect to one direction or the other. Do this several times — the needle will either go left-right or right-left. Then do the same



Meter Deflection

you have a bad pickup. If you get a reading of 0, you have a completely dead pickup.

So lets say we have a set of three Strat pickups. Arrange them on your bench in order. Make sure they are facing in the normal direction they will be installed...in other words, no pickup should be upside down. Attach the black lead of the meter to the black wire of the pickup. Attach the red lead of the meter

to the other pickups. The needle should deflect in the same direction for all three pickups. If this occurs, you can be confident the pickups are in phase and everything will be good when you reassemble and restring the instrument. Please keep in mind that you must be consistent that you attach the ground lead of the meter to the ground wire of each pickup to get the correct reading. You also must be consistent that you tap all pickups on the same side of the pickup. On a single coil, if you tap the top on one and the bottom on another, they will appear to be out of phase.

As simple as this may sound, things get complicated when replacing pickups. There is very little standardization among pickup manufactures regarding the color code of the pickups. On single coils, black is typically ground and white is hot. On two conductor Gibson pickups, the bare braid on the outside of the wire is ground and the wire in the middle is hot. However, in order to make pickups more versatile, many pickups have 4 conductors plus a bare ground. So red, white, green or black could all be hot. It is very important you know the color codes

of the pickups you are using. If there is not a diagram in the package, you can access the information on the manufacturer's website. But the bottom line is all you need to know is which wire is ground and which wire is hot and make sure the needle deflections of the two pickups (even of different makes and color codes) match.

I can assure you that if you master this method, you will save many hours of having to redo work that would erase any profit you hoped to make from the pickup replacement or repair.

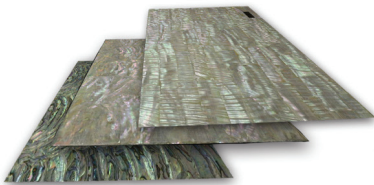
And permit me to reach out to our colleagues in Europe who refer to "ground" as "earth." □

Roger Sadowsky has been building and repairing all types of guitars since 1972. Sadowsky Guitars was established in 1979 in NYC and has served musicians in NYC and around the world. Today, he primarily makes a line of electric guitars and basses and is once again dabbling in acoustic guitars. <http://www.sadowsky.com>

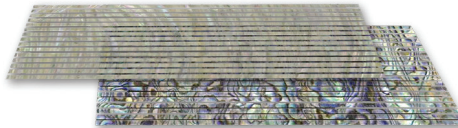
DUKE OF PEARL

EXOTIC SHELL INLAY MATERIALS

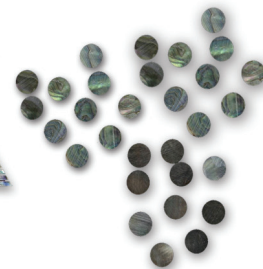
CHUCK ERIKSON



ABALAM SHEETS
VENEER SHEETS



STRIPS

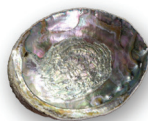


DOTS



BLANKS

MOTHER OF PEARL • GREEN ABALONE • PAUA • AWABI • AGOYA • VIOLET OYSTER • PINK MUSSEL • AND MORE



DUKE OF PEARL

www.dukeofpearl.com

410.231.2641

dukeofpearlllc@gmail.com

Visit our Facebook Page - Duke of Pearl, LLC

