

## IN AND OUT OF PHASE

Once we start talking about phasing, there is some confusion about calling the negative lead from the pup's coil the "ground" lead. This is sloppy shorthand, and we all do it. Every magnetic guitar pickup consists of a coil (or pair of coils) that has a "positive" and a "negative" lead. In guitar electronics shorthand, we usually refer to the positive lead as the HOT lead, and the negative lead as the GROUND lead. This is all well and good most of the time, because typically, the positive lead goes to the hot side of the guitar's circuit, and the negative lead goes to ground. But, when we talk about phase, suddenly the HOT lead is connected to the guitar's ground, and the GROUND lead is connected to the HOT... what we really mean is that, when wired out of phase, the positive lead is connected to the ground side of the circuit, and the negative lead is connected to the hot side of the guitar's circuit.

### **IN PHASE:**

"IN phase," which is what EVERYBODY uses, typically sounds sweet, and produces a "quack" or "doink" tone. The drawings in the "Parallel and Series" document illustrates in-phase connections, because both of the coils' hot leads flow to the hot side of the circuit, and the coils' ground leads flow to the ground side of the circuit. Everybody? Yup, everybody - Teles and Strats, Les Pauls and SG's, Fenders and Squires, Gibsons and Epiphones, Gretsch, PRS, etc... everybody uses IN PHASE (and, almost always parallel) as the basic setup for two or more pickups.

### **OUT OF PHASE, or PHASE REVERSE:**

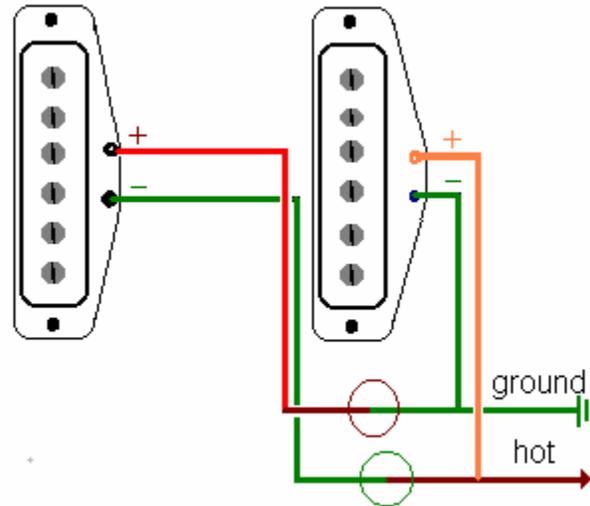
"OUT of phase" is a trick to get a very bright, thin tone out of a pair of pickups. If one pickup is connected out of phase with another, when BOTH are played, a lot of frequencies are "cancelled out" of the tone. The positive voltage one pickup creates is negated by the negative voltage the other creates. Usually, lots of the fundamental is cancelled out, and the only tones that "escape" to be heard are the tones that are harmonically different between the two pickups - so, you usually get very thin and "nasally" tones. The more alike the two pickups sound individually, the thinner their out of phase combo will sound. This is why you seldom see a phase-reverse option on a Strat - the middle pickup is too similar in tone to the other two, and is too close to them to work well in parallel/out of phase - the tone produced is just too thin for most applications. There's a way around it... But, more on that later.

Phase reversal as a mod is usually implemented with a switch, rather than hard-wired. The addition of a simple DP/DT toggle or push/pull pot can give just about any two-pickup guitar the new, biting tone of pickups played out of phase.

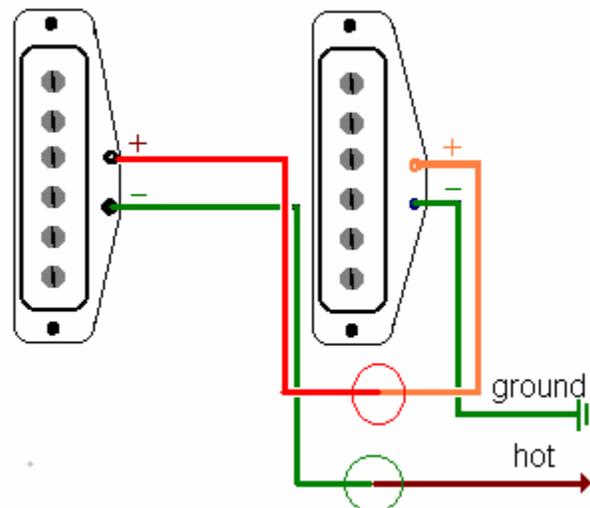
This usually brings up the question, "What does ONE pickup sound like, out of phase?" Actually, one pickup alone can NOT be out of phase - phase is a relationship, and requires TWO (or more) pickups to be on at the same time. If you are playing ONE pickup ALONE, there is no difference in its tone if it is wired in phase or out of phase to the other pickups - the phase relationship is only revealed when pickups are played TOGETHER.

### PARALLEL AND SERIES:

Pickups wired PARALLEL/out of phase still both have their own paths to hot and ground, but on ONE of the pickups, the leads are reversed. The tone produced is thin and nasally, and usually has perceptibly less volume than other pickup combos. Meter readings cannot determine phase - the reading for the circuit is that same as parallel/in-phase.



Pickups wired SERIES/out of phase still require the current to flow through both coils, but (typically) the positive leads are tied together, and one coil's negative lead goes to hot, and the other's is then routed to ground. The advantage of the SERIES/out of phase tone over the parallel/out of phase tone is that because of the fact that the coils are wired in SERIES, the output is louder, and therefore a better match in volume with the common parallel in-phase tones. In other words, you don't get as much of a drop in gain when you switch to out of phase if you are using a SERIES connection. This would be a good option to get some out of phase tones out of a Strat, without getting too thin. Again, meter readings cannot determine phase - the impedance reading for the circuit is that same as series/in-phase.



## **REAL-WORLD CONSIDERATIONS - "UNGROUND/REGROUND" :**

Now, here's the "bad news:" With ANY SERIES (or out of phase) connection mod, IF the pickup's NEGATIVE LEAD has continuity with any metal parts - the cover or the frame - you MUST break this contact to isolate the metal cover or frame from the coil's negative lead.

### **WHY?**

Because, when you put the pup in SERIES - or out of phase - everything on the negative side of the pickup's coil is now on the positive side of the guitar's circuit. That means that a metal cover or frame - and so, its mounting screws and springs, pole pieces etc - will have continuity with the "hot" side of things. No arcs and sparks, smoke and flame, BUT, this may make the pickup more susceptible to hum, and it will certainly have the potential for unexpected and unwanted noises if you touch the pup or its screws while playing the guitar. If you accidentally touch it with a STRING, which is grounded, it will actually SHUNT that pickup out of the tone (series) or mute the guitar (parallel).

Because of this, I am in the habit of always recommending that if you just do the out of phase mod, it is the NECK pup whose phase is reversed - most players are less likely to touch the neck pup than the bridge pup while playing. Also, if you are doing a series or out of phase mod to a Tele, it is FAR easier to mod the neck pup. Many Tele bridge pups have an integral baseplate with continuity to their negative lead, and also require you to remove the bridge to get at them - too much work involved!

### **SPECIFICALLY TELE:**

On your typical Tele neck pup, there is a metal cover. One of its mounting tabs, folded under the coil, usually has a small, short jumper to the eyelet on the pup's chassis that connects the coil to the negative lead. To "unground/reground" the cover, all you need to do is carefully clip that little jumper, breaking the connection, and then add a new INSULATED wire from the cover's tab back into the control cavity, where you will attach it to any ground. Now, regardless of where you rout the coil's negative lead, the cover will stay on the shield/ground side of the circuit, offering you what protection from hum as it might. The coil now has two independent leads which you can connect any way without fear of shorts or contact with something "grounded" - like, your fingers - outside of the circuit.

### **SPECIFICALLY STRAT:**

On a stock-style Strat pup, luckily, this is never an issue. They are built on non-ferrous frames, and have plastic covers - no worries about continuity with coil's the hot or negative there. That's why I was able to so readily exploit all the series and series/out of phase combos with my rotary switches.

There IS a problem with some aftermarket custom Strat pups that are built with metal frames/chassis, and are wired up with only two conductors (leads). An example of this type of construction are the Kinman pickups. I simply do NOT recommend the use of my switches - or that any series or phase mods - be attempted with pups built like that, as it has become popular to shield (with foil) the underside of the pickguard around the pickups. If the pup's metal frame has continuity to the negative lead, it will also have continuity to ground through the mounting springs and screws touching the shielding foil on the back of the pickguard. Reverse the phase, or go series, on one of these pups, and you have an instant short circuit.

MOST pup manufactures have wised-up to the mod market, and now, if using a metal frame, wire their pups THREE-CONDUCTOR - the hot lead, the negative lead, AND a separate ground/shield wire (to ground the frame and/or cover) which has NO continuity with the coil's negative lead. An example of this type of construction are the new Lace pickups.

**SPECIFICALLY HUMBUCKERS (and P90s):**

As for HUMBUCKERS, most modern/aftermarket FOUR-CONDUCTOR wired pickups also have a FIFTH conductor, which is typically a bare wire included inside the jacketed lead that will be the ground/shield connection to the chassis of the pup, and is completely independent and insulated from any leads from the coils. No worries, if this is the case.

Where you run into the problem on humbuckers (and P90s) is if they are constructed using a coaxial two-conductor lead with a braided/external shield, like the traditional Gibsons are made. The external braided conductor is typically soldered to the pup's metal chassis, and used as the ground/shield AND the coil's negative lead - yikes! Now you have a pickup where not only the metal chassis, cover, and screws, but also the entire length of the exposed braid on the lead has continuity with the ground of the guitar! These require some special treatment to do series and phase mods with.

If you have an open-coil humbucker (no cover) or a P90, a simple trick is running a length of heat-shrink tubing over the entire length of the lead. This quick and dirty compromise works, but the mounting screws and pole pieces are still "hot." It's less than ideal, but you CAN learn to live with it.

However, this band-aid is even farther from ideal if your pickup has a metal cover. Now, you COULD, if you were an adventurous sort, remove the metal cover, go in and unsolder the coil's negative lead at the point where it is soldered to the pup's chassis and the braided shield, and solder up a new negative lead for the coil (leaving the braided shield soldered to the chassis as the ground conductor). That would certainly address all the issues, but it's a long way to go and can be hazardous to the pickup and your wallet. It is my strong recommendation that you should instead just shelf that old pickup intact, spend the bucks and get yerself a four-conductor pup to replace it.