

**BEGINNER INTERMEDIATE AND**  
**ADVANCED**  
**HOT ROD TECHNIQUES**  
**FOR GUITAR**  
**A WIRING GUIDE FOR THE FENDER STRATOCASTER**

by

Timothy A. Swike

## **Please Read This FIRST**

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This book is dedicated to my friends, family, and  
wonderful collection of strats.

## ASSEMBLING A STRAT

Let's talk about the legendary Stratocaster guitar. Personally, I don't think you can find a better sounding guitar anywhere. The unmistakable strat sound is more tapered, with less highs and lows than other guitars, and it has more midrange. Much of the strat's popularity comes from the sound generated by its hollow pickup cavity, and its neck and middle pickups. The strat is perfect for playing the blues, jazz, country, or rock. These guitars are often described as having a glassy, quacky, or even smokey sound. All I know is they sound good.

Before we go into the specifics of wiring a strat, let's put one together. All of the components below were bought online and were fairly inexpensive. Below is a list of what you will need to build your own strat. Don't forget to purchase a set of screws if they don't already come with each of the parts listed below.

**1 – neck**

**1 – neck mounting plate**

**6 - tuners ( 6 in line)**

**1 – string tree**

**1 – guitar body**

**2 – strap knobs**

**1 – bridge**

**1 – output jack**

**1 – output jack plate**

**3 – single coil pickups**

**3 – 250K potentiometers**

**1 – 5-way switch**

**1 – *on/on/on dpdt mini toggle switch (optional)***

**1 – strat pickguard**

**1 – volume knob**

**2 – tone knobs**

***1 – 25+ Watt soldering iron***

***1 – roll of 22 AWG wire***

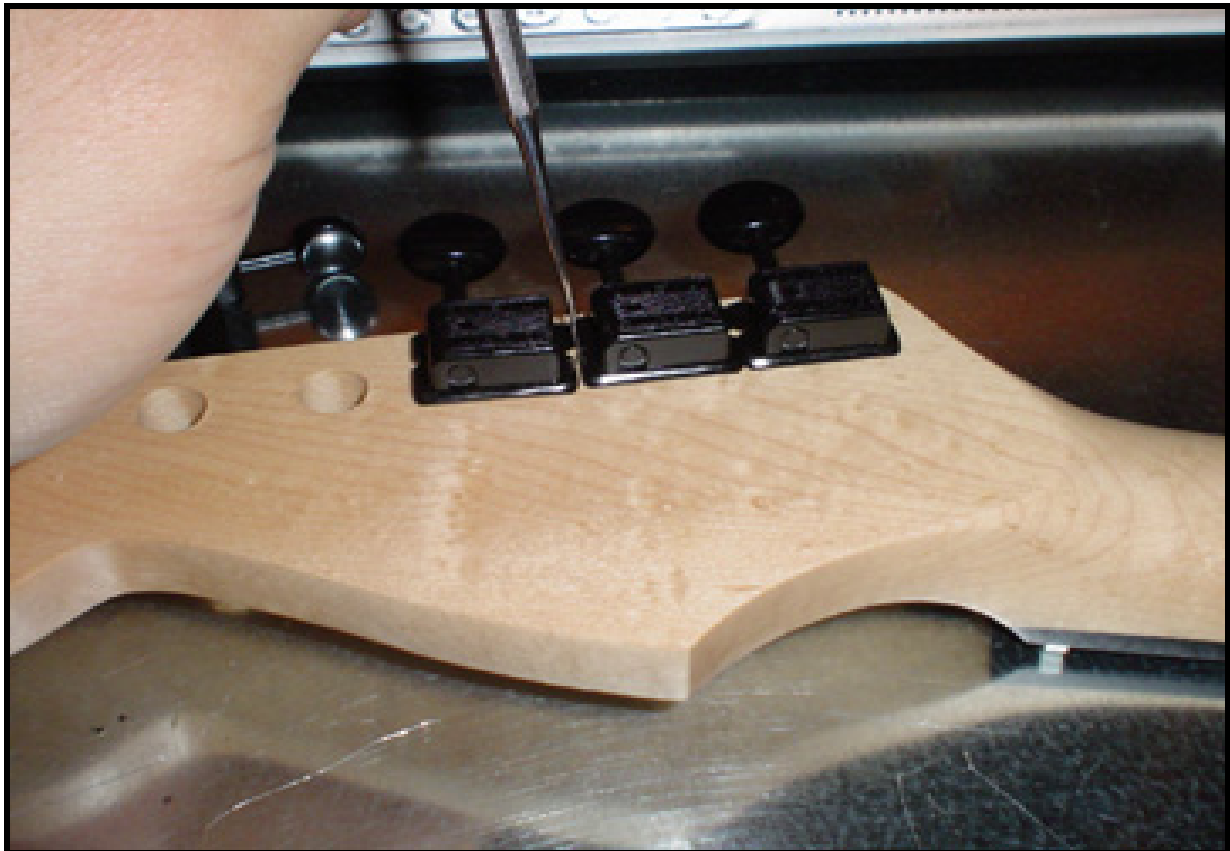
***1 – roll of rosin core solder***



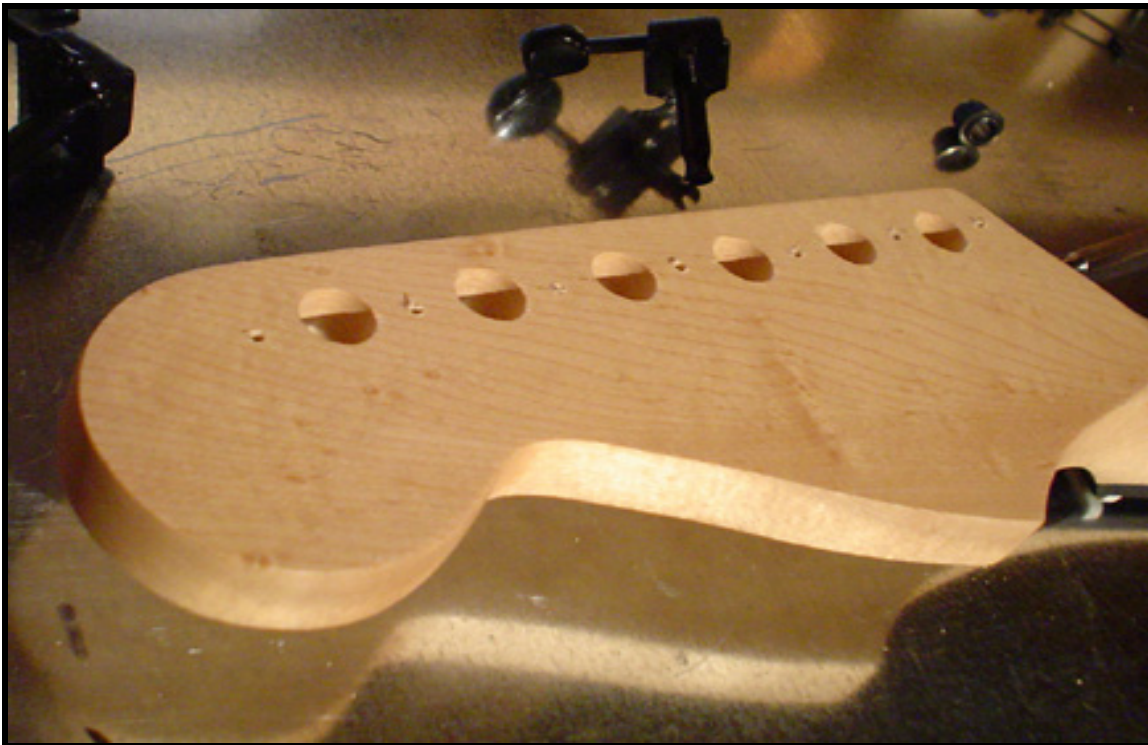
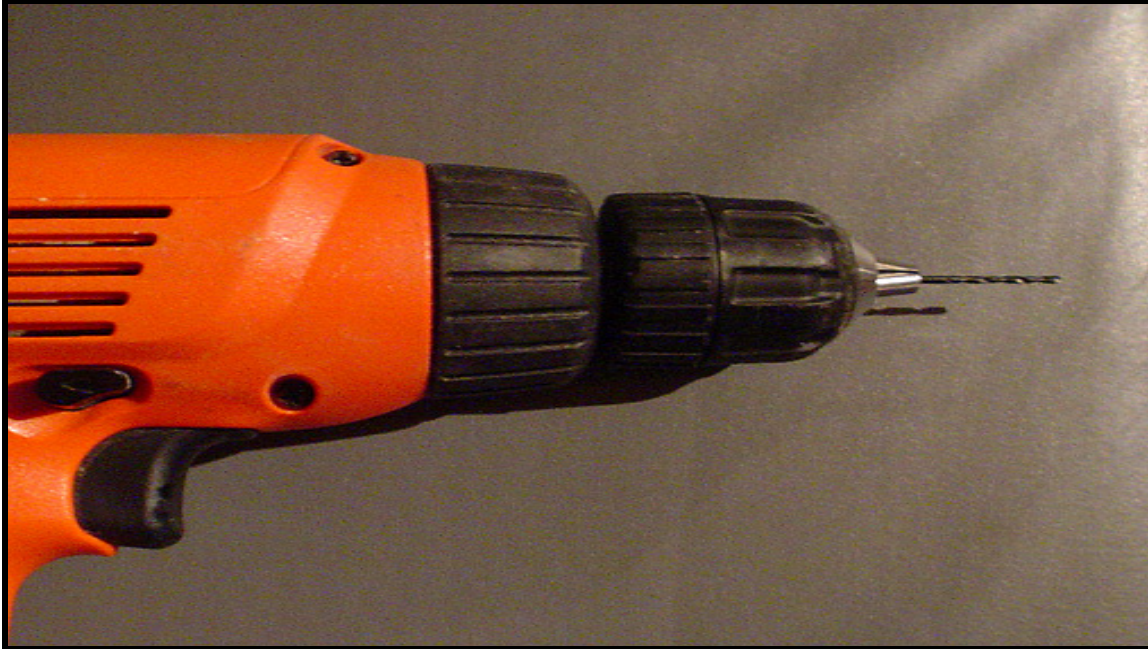
This strat is going to have a neck pickup that is actually a mini humbucker, so for this task I purchased a **14K** Ohms humbucking pickup that fits into a standard strat pickguard. I am going to coil cut this pickup, so I also bought a **dpdt on/on/on mini toggle switch**. So the neck pickup alone will have three tones (north coil on, both coils on, or south coil on).

*Note: if you are just assembling a regular Stratocaster with three single coil pickups, then you do not need to buy a dpdt mini toggle switch.*

First, let's start with the neck. We need to attach the tuners to the headstock. Lay down the tuners exactly how you want them to be situated on the headstock. Then mark the headstock with a dental pick, or a pen, in the spot where each of the tuner screws go.



Now you need to drill holes where the tuner screws go. Use a very small bit, and only drill into the headstock about 1/8".





Now insert the mounting hardware in the holes and install the tuners.

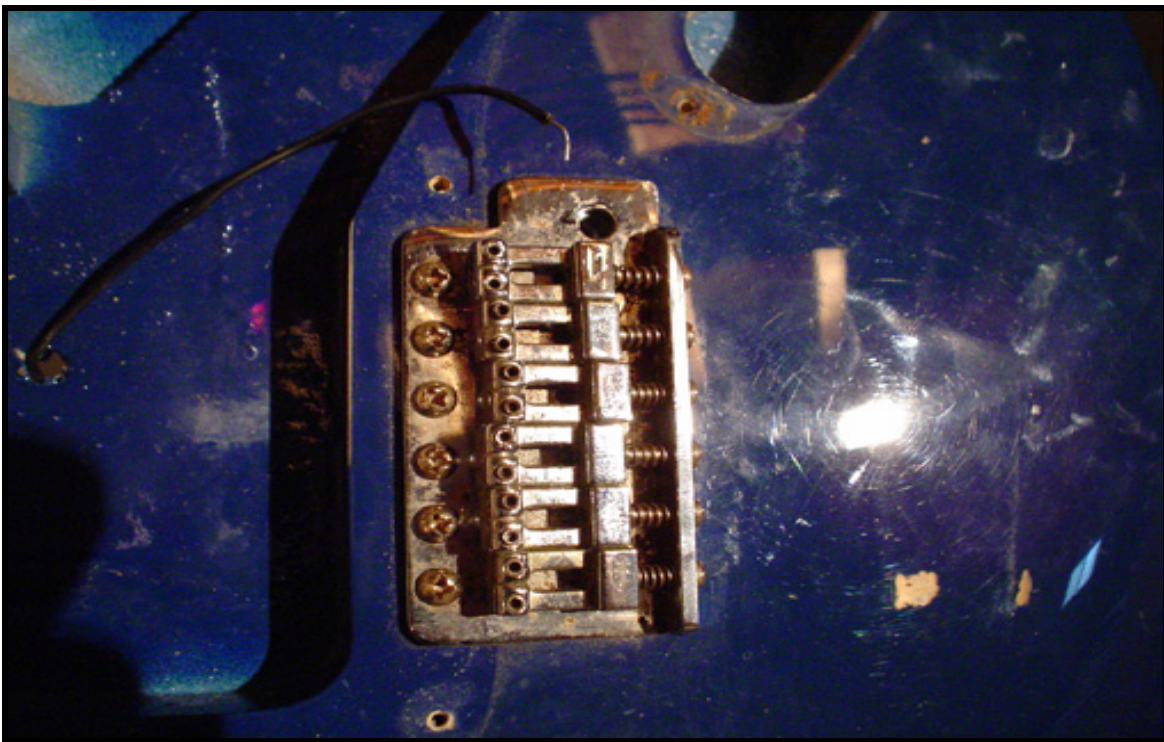
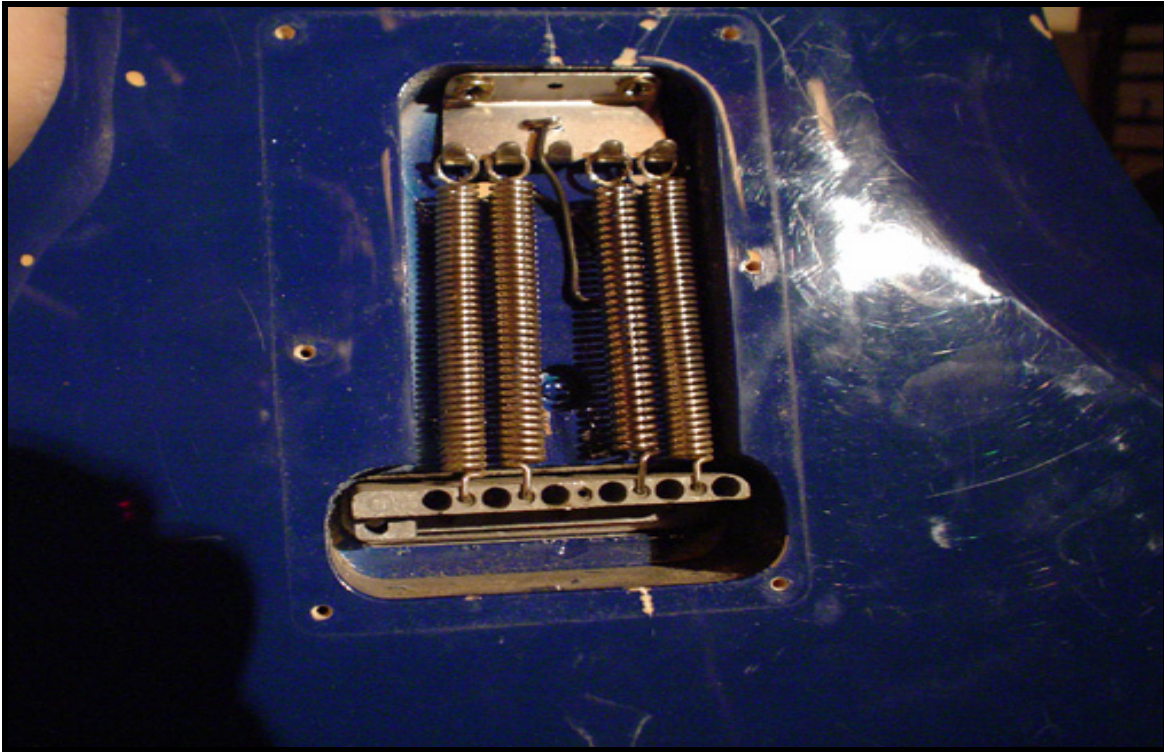


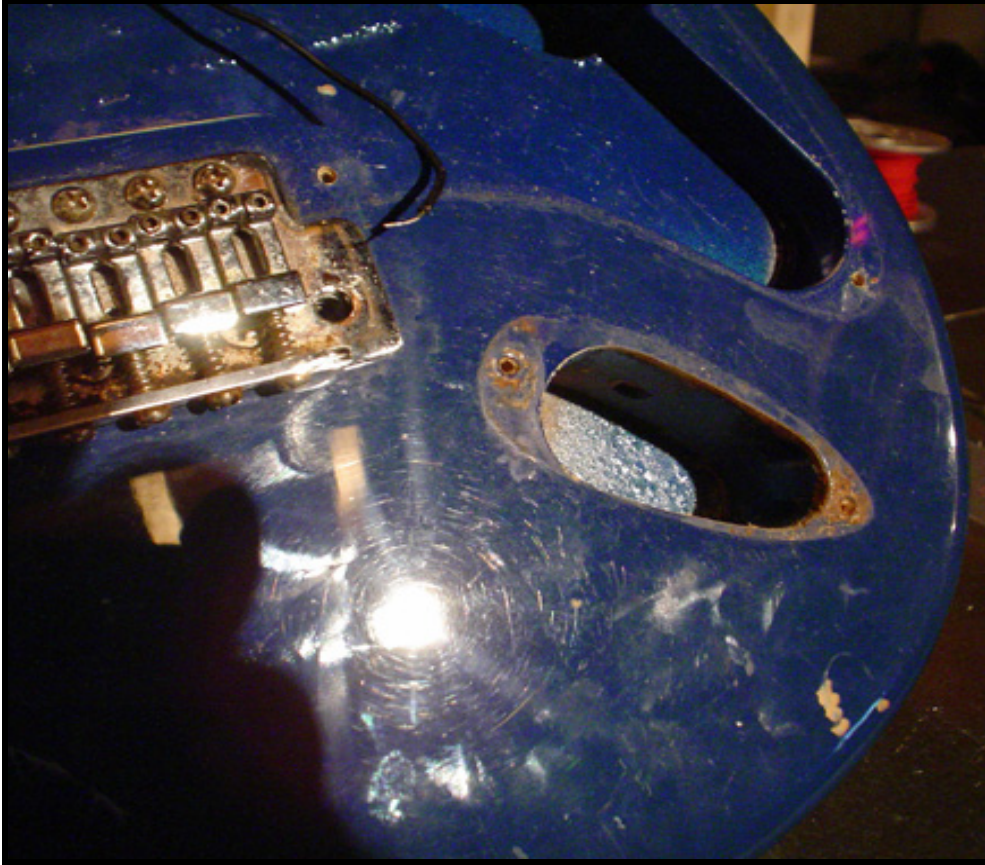


Now do the same for the string tree or trees. Some people prefer one, and some prefer two string trees. Be sure not to drill too deep into the headstock. These will guide the highest strings to the tuners.

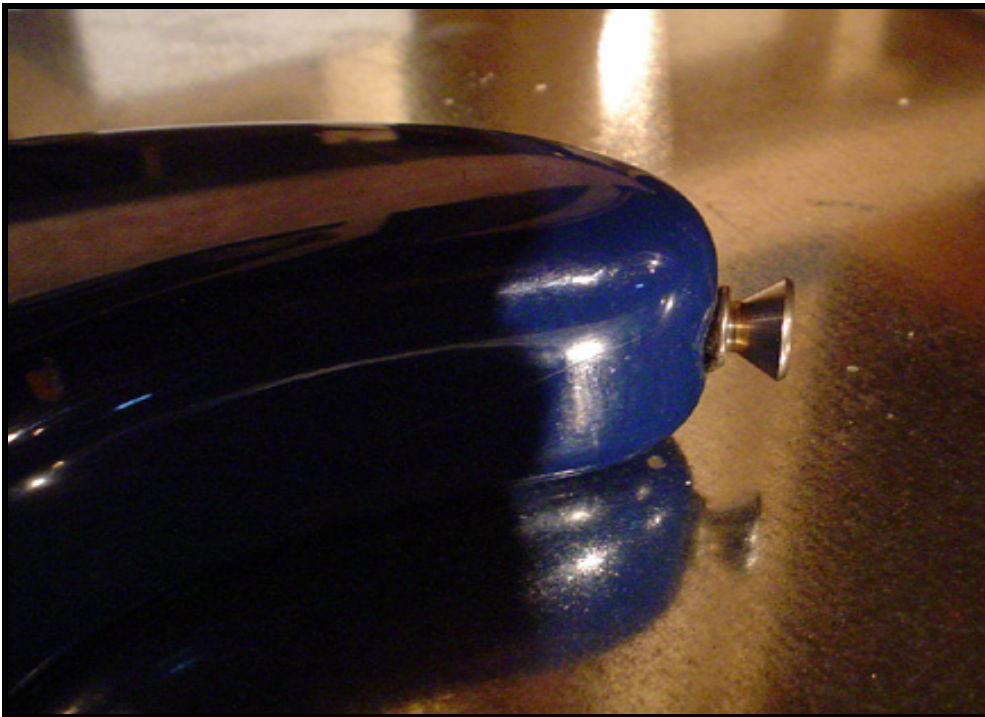


Now let's look at the body. Notice the bridge, tremolo claw, and springs are already installed, and the bridge ground, or string ground is soldered to the tremolo claw. The tremolo claw screws adjust the spring tension for the tremolo bar.

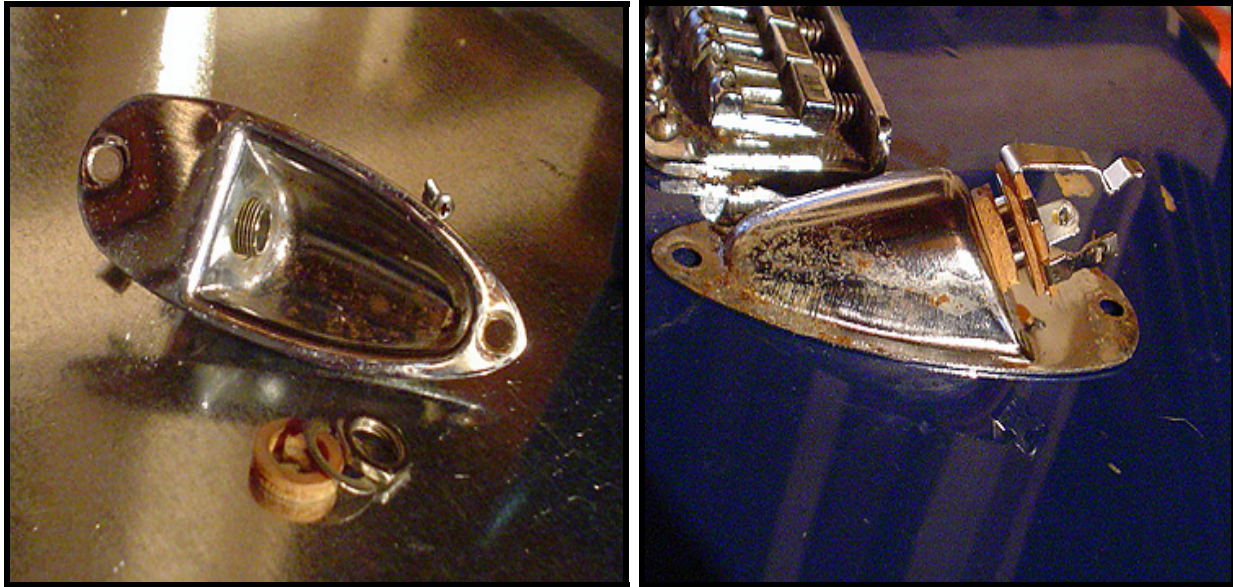




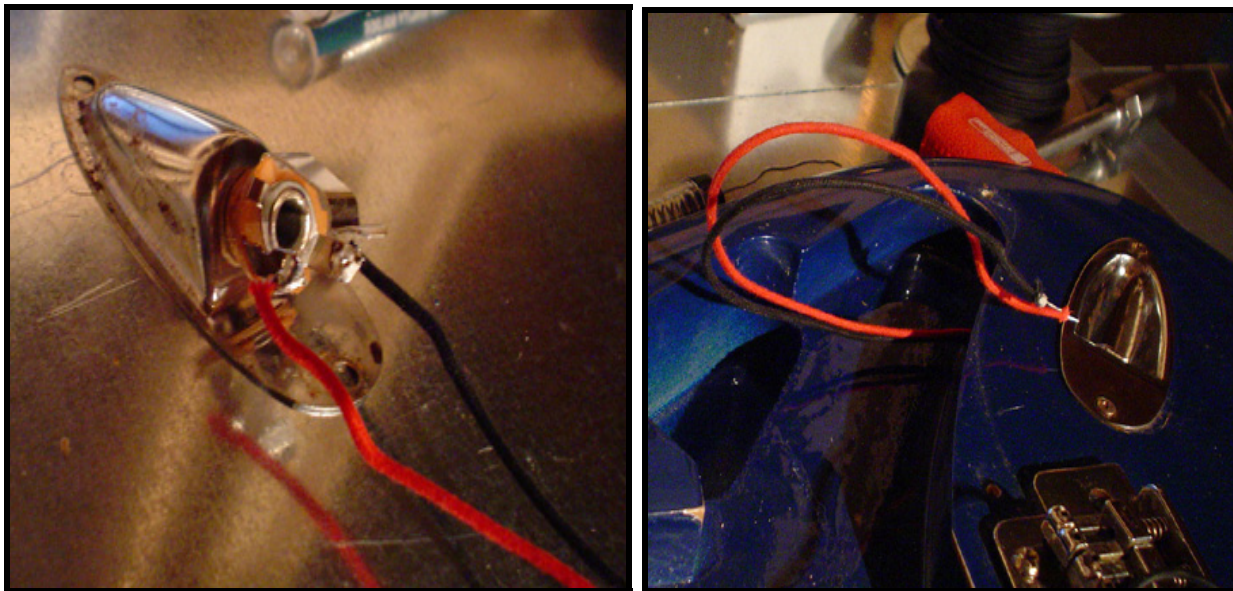
The strap knobs also came installed in this body. They just screw right in.



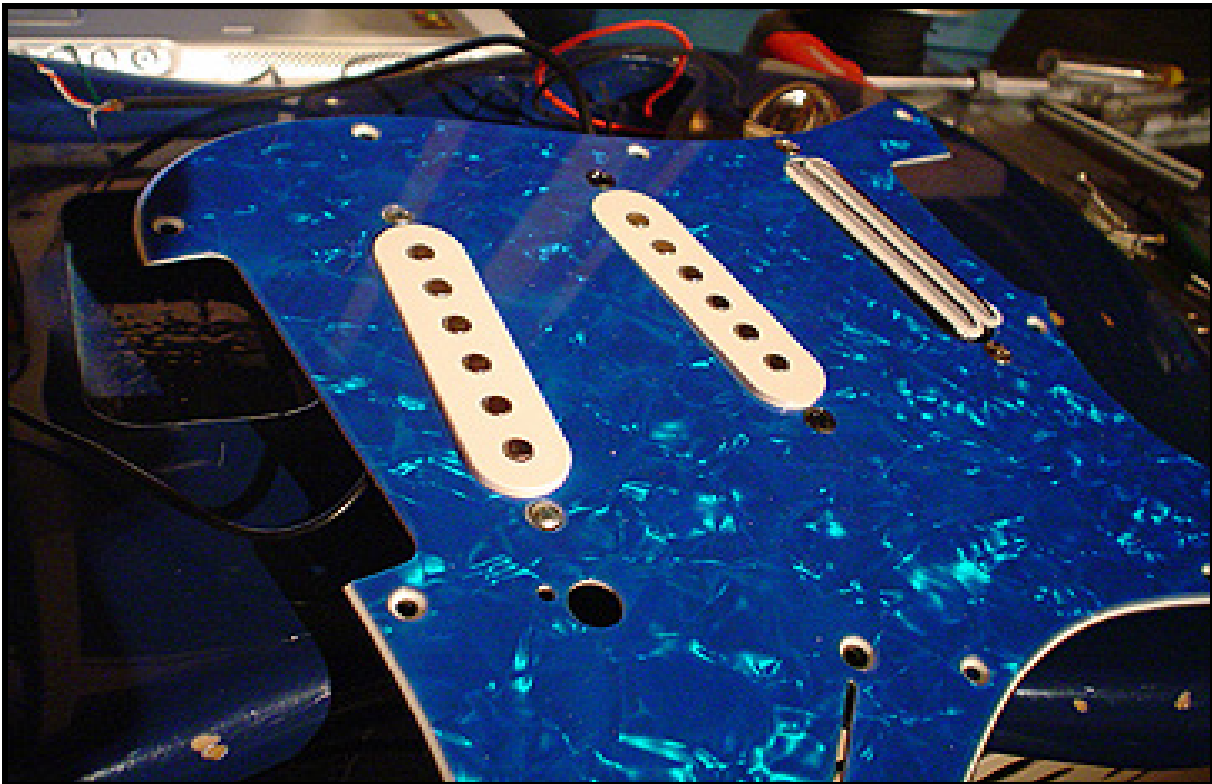
Next we are going to screw the output jack into the output jack plate.



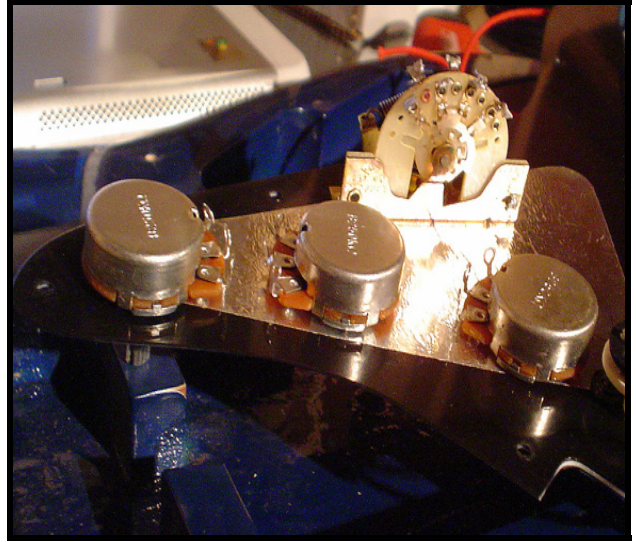
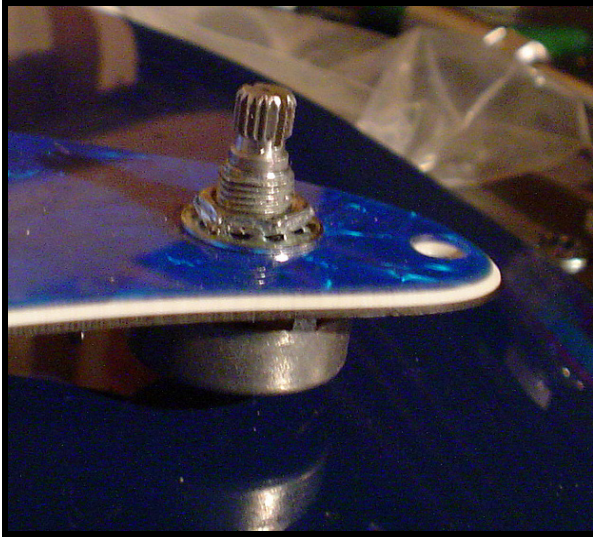
Before you screw in the output jack plate, solder a hot (red) and ground (black) wire to the appropriate lugs. The next chapter on wiring will explain this process in detail. Pull the wires through the hole in the body, and then screw down the output jack cover plate.



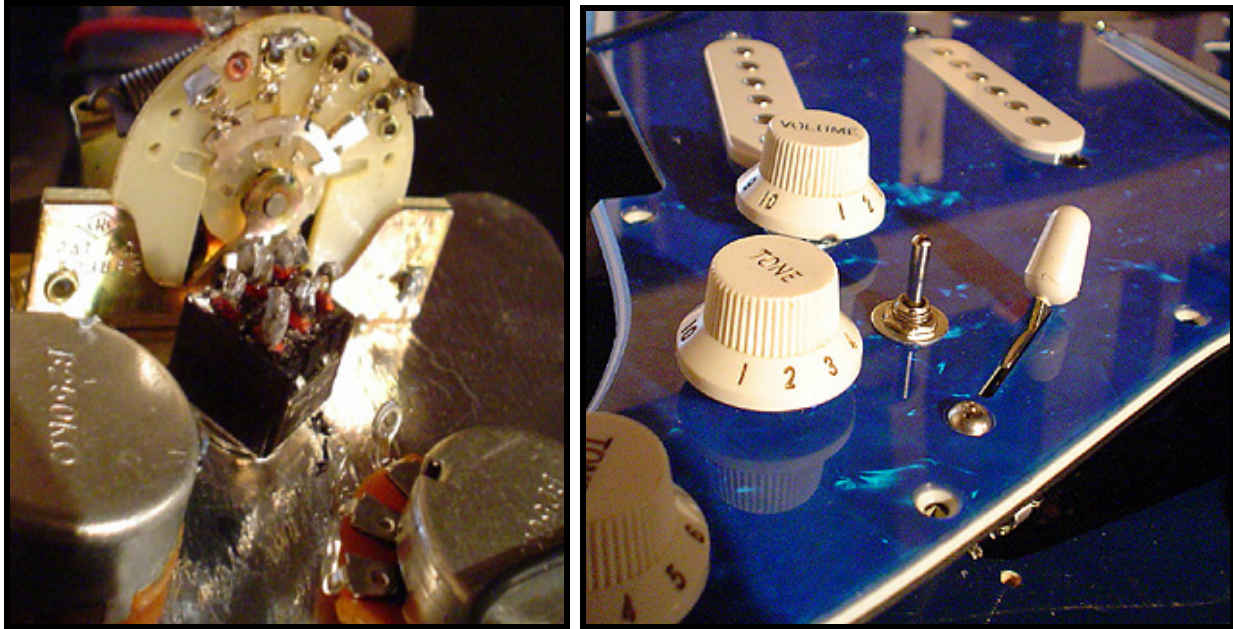
Now screw the pickups into the pickguard. Notice there is a small spring on the outside of each screw that holds the pickups in place.



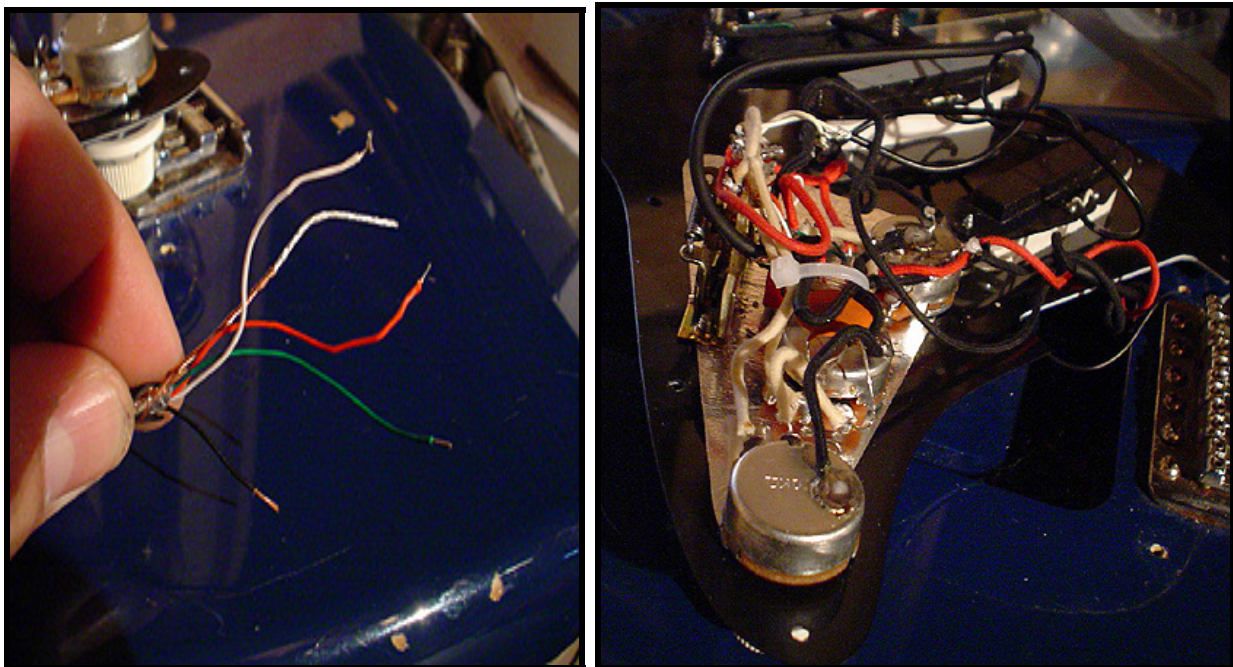
Next, add the potentiometers and 5-way switch to the pickguard.



We are almost ready to start soldering. We just need to add the dpdt mini toggle switch to the pickguard. Drill a small hole and screw it in. *Do this only if you are using a 4-wire humbucker as one of the pickups.*



Now that everything is in place, you can solder the pickup hot and ground wires. A detailed description of this process is shown in the next chapter. Notice how the neck pickup is a 4-wire humbucker. It will need to be coil cut with a **dpdt on/on/on mini toggle switch**. You will find out more about dpdt switches in the chapter on switches, and more about coil cutting in the hot rod section.





When you are finished wiring the guitar, check to see if the pickups work. When the guitar is plugged in, you can tap on the pickups with a screwdriver to see if they are on. Test this in all 5 positions on the pickup selector switch.

Note: When testing out the coil cut switch, it may be hard to determine which coil is on when you are tapping rail humbucking pickups with your screwdriver. However, you still should be able to hear slight differences in the tone when the toggle switch is moved throughout each of the three settings.



Screw on the neck and install the strings and your done.





Type this address in your web browser to hear this guitar:

<http://tinyurl.com/2DSLXF>

## WIRING A STRAT

First, we need to talk about the tools you will need for changing your electronics.

### TOOLS FOR THE JOB

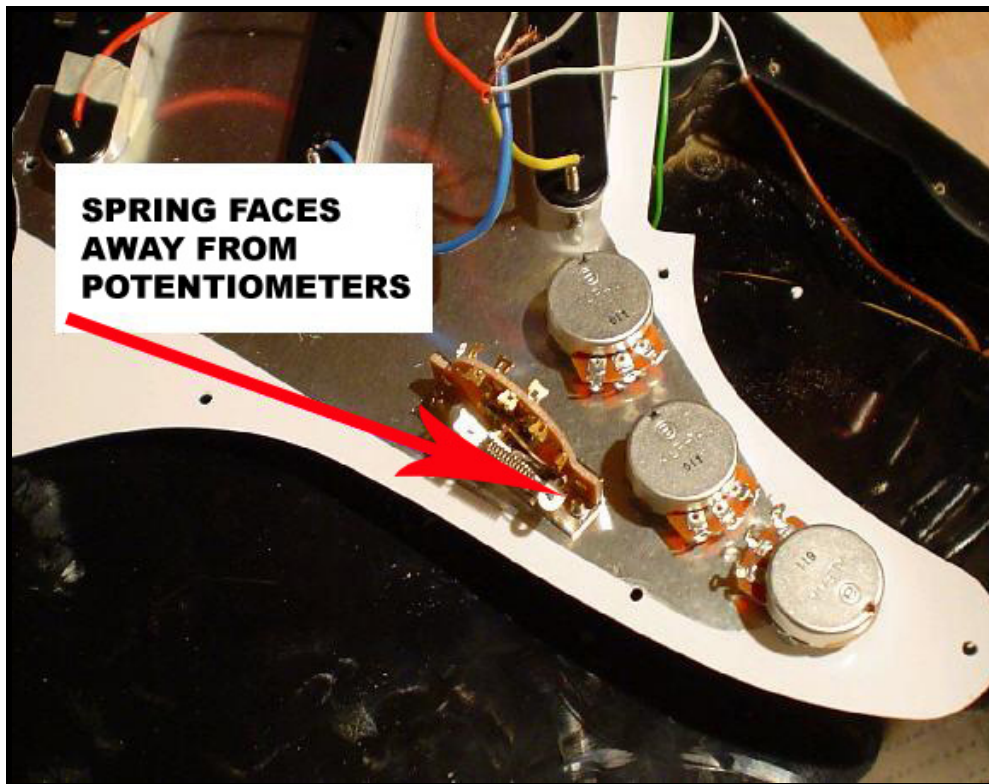
- 1 - output jack
- 3 - 250K pots
- 1 - .020 microfarad - .1 microfarad capacitor (bigger capacitor=more bass)
- 1 - 5-way lever switch
- 1 - guitar wire 22 AWG, red or white
- 1 - guitar wire 22 AWG, black
- 1 - 25+ Watt soldering iron (I recommend a Weller)
- 1 - Phillips screwdriver
- 1 - wire cutting and stripping tool
- 1 - roll of rosin core solder

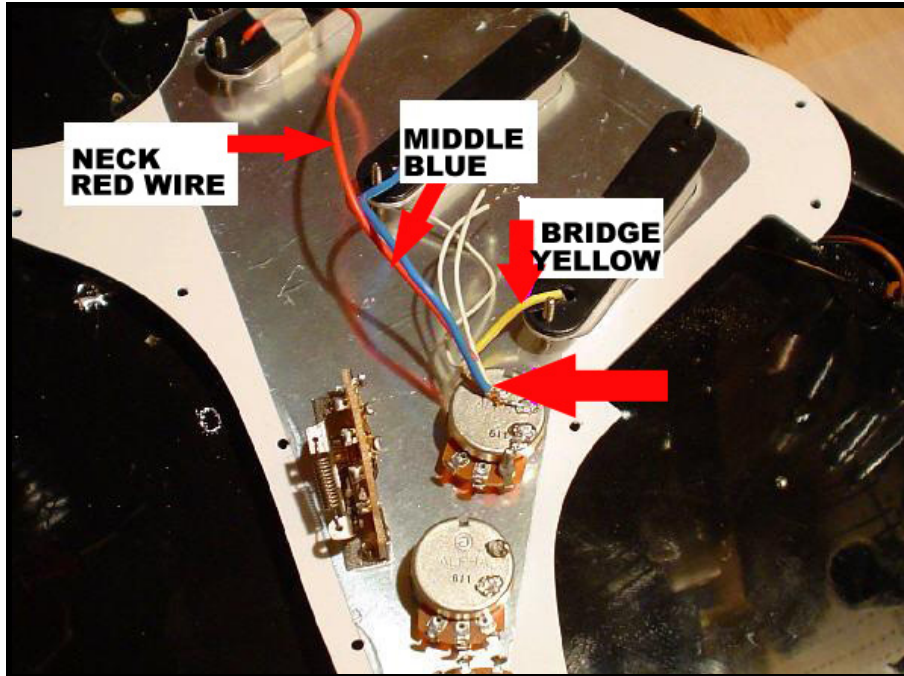




## ASSEMBLING THE PICKGUARD

Install the potentiometers, or pots, and the 5-way switch in the pickguard. When the pickguard is upside down, the spring on the 5-way switch will be facing away from the pickups. Align the two tone pots so that the lugs are facing each other. The volume control will be closest to the pickups.





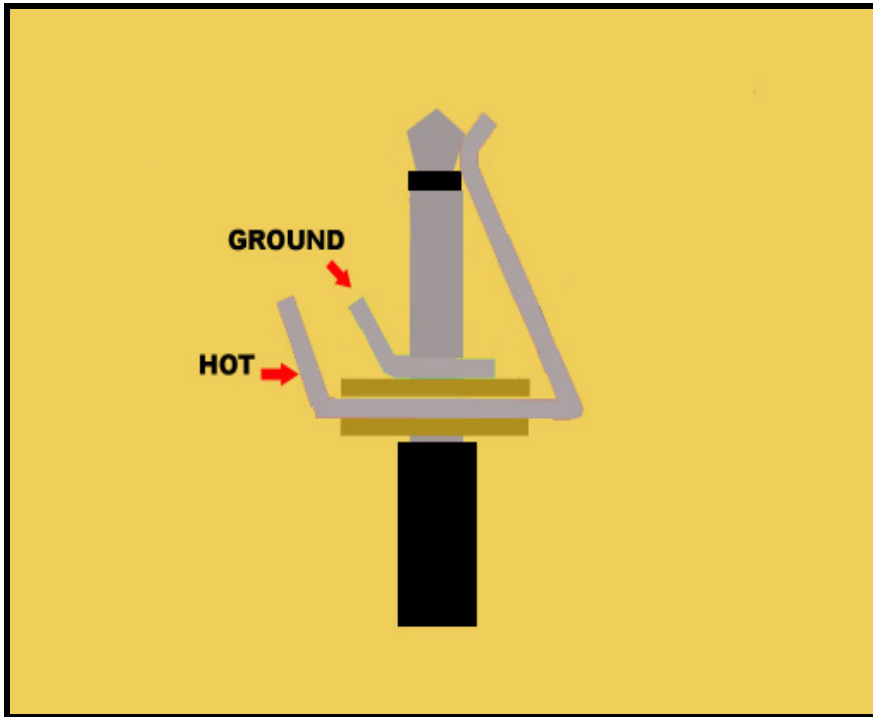
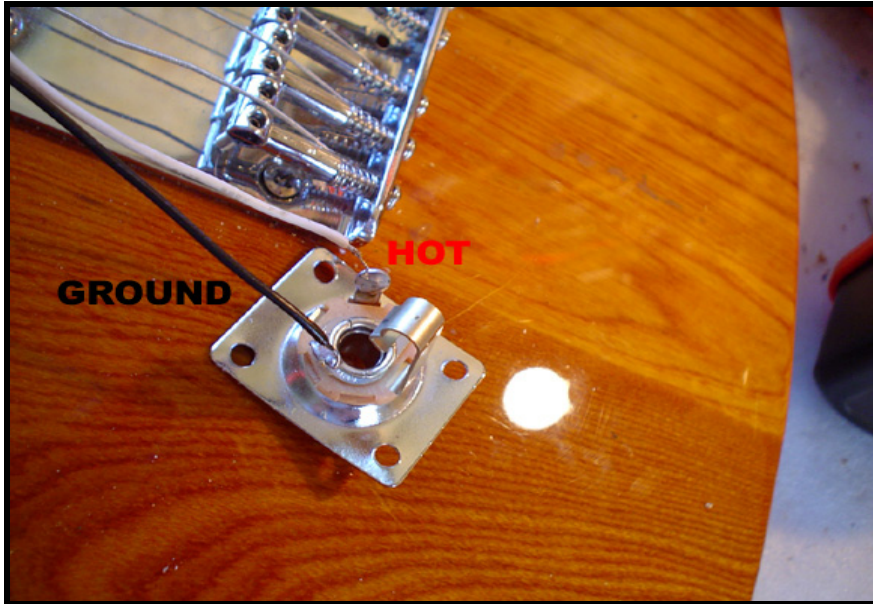
## HEATING UP THE SOLDERING IRON

Lets get the soldering iron ready. Plug it in and let it heat up in its holder. Remember, your soldering iron can get up to 700 degrees, or more, so be careful.



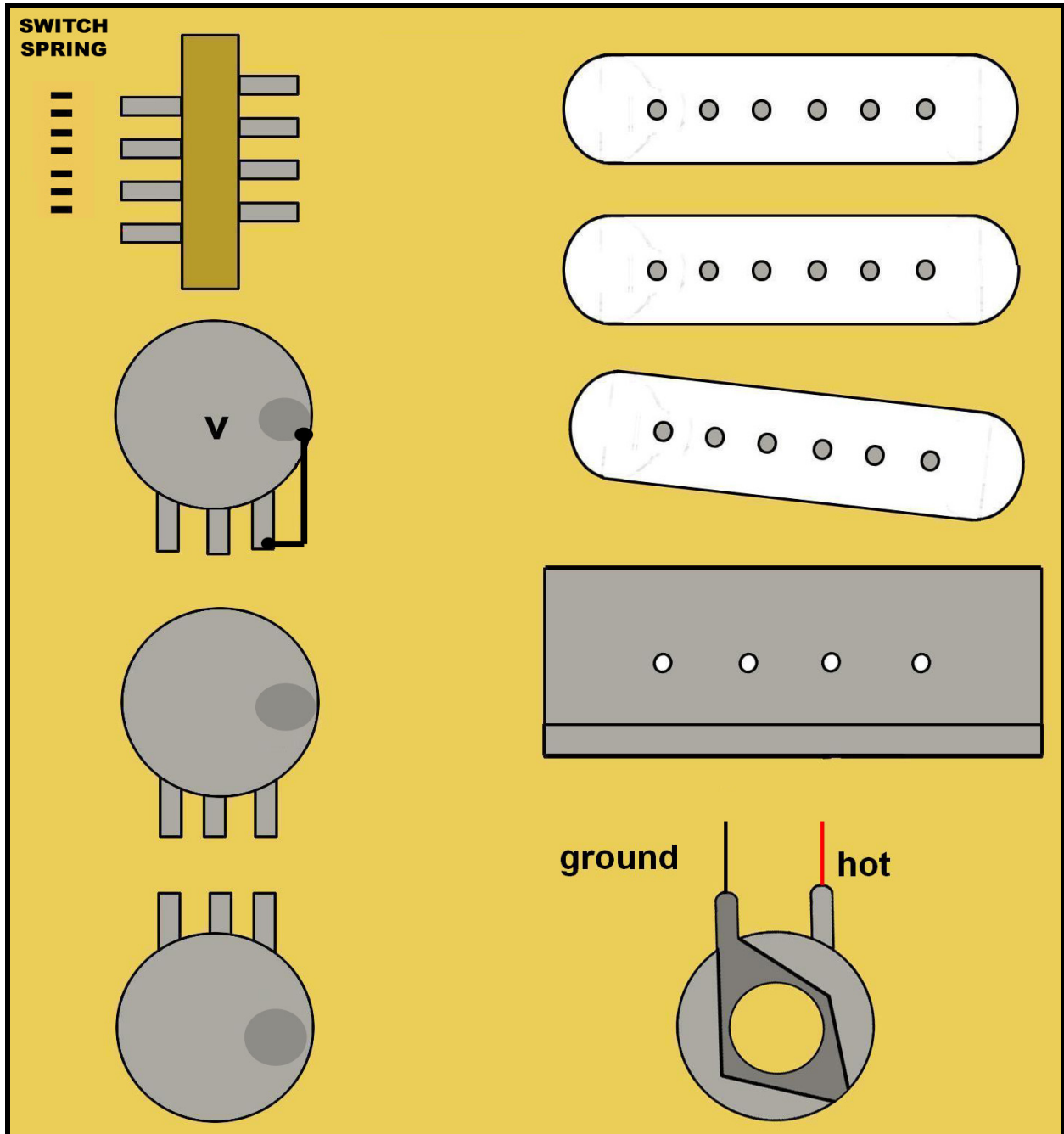
## SOLDERING THE OUTPUT JACK

Next, we are going to solder the ground wire and hot wire to the output jack. The lug that connects to the prong is the hot connection. Solder the hot and ground wires to the output jack. Then screw the output jack into the guitar.



## SOLDERING THE POTS

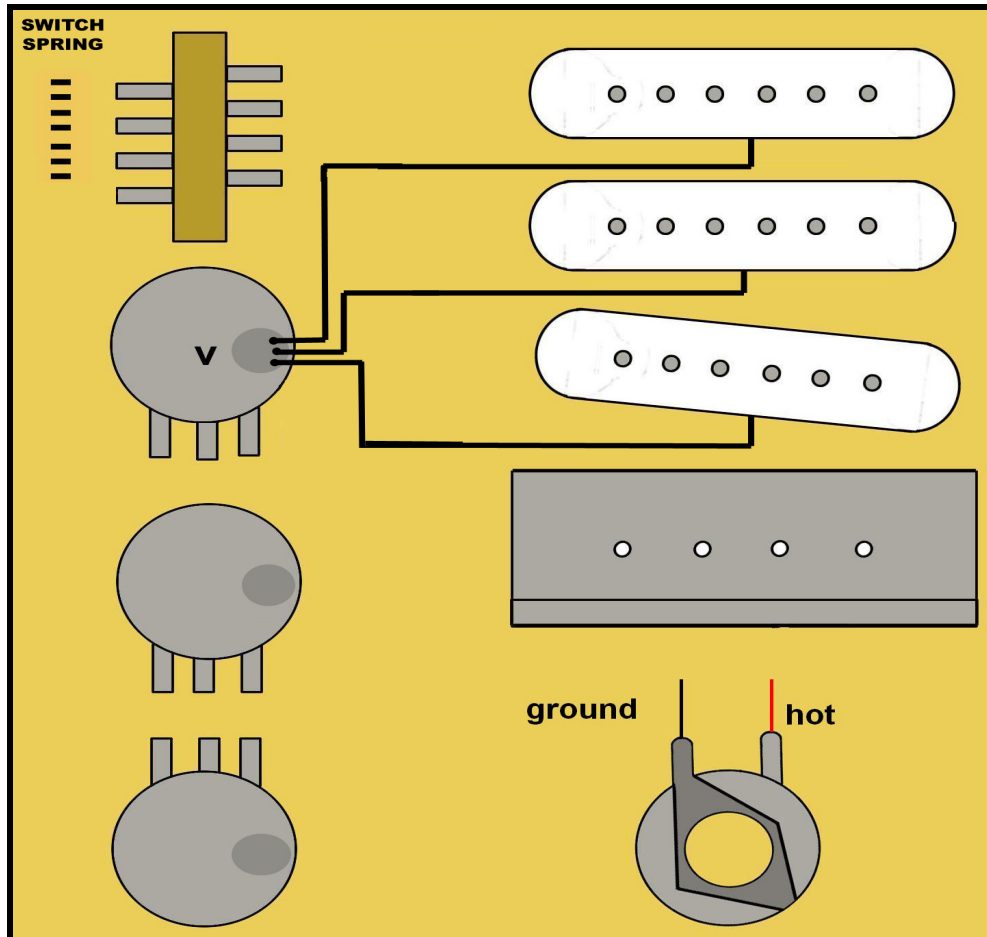
Add solder to the volume pot, and tone pot cases. All of the ground wires will be connected to each other on the pot cases. Now connect the far right volume pot lug to its own case. You can use a wire for this connection, or just bend the lug until it touches the case, and then add solder. Now add solder to the potentiometer cases. Solder the right volume pot lug to its case.





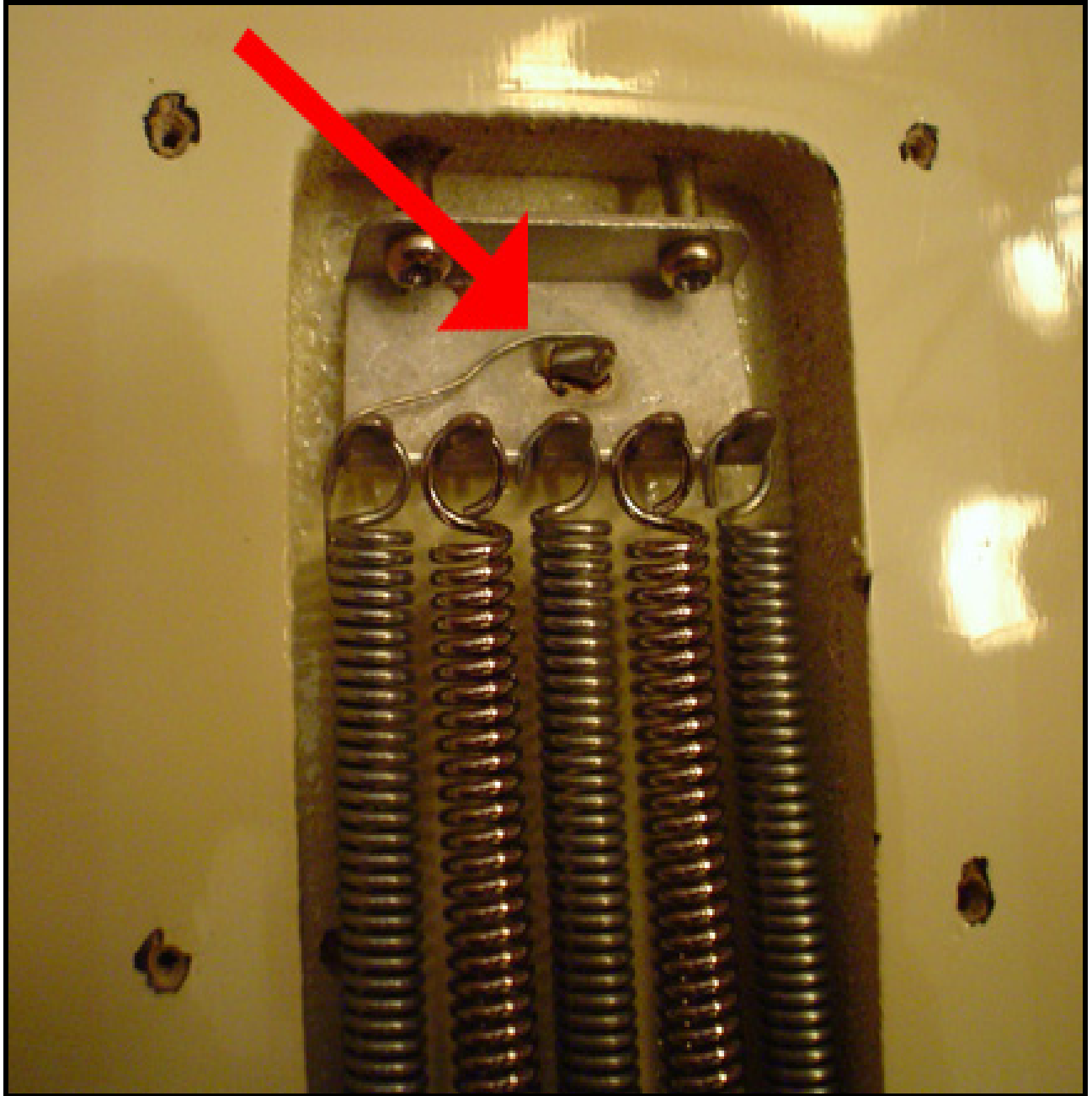
## SOLDERING THE PICKUP GROUND WIRES

Find the 3 ground wires that come out of the pickups. Normally, they will be black wires, or they will be unshielded. The colored wires are usually the hot wires. Twist the three ground wires together and solder them to the volume pot case.

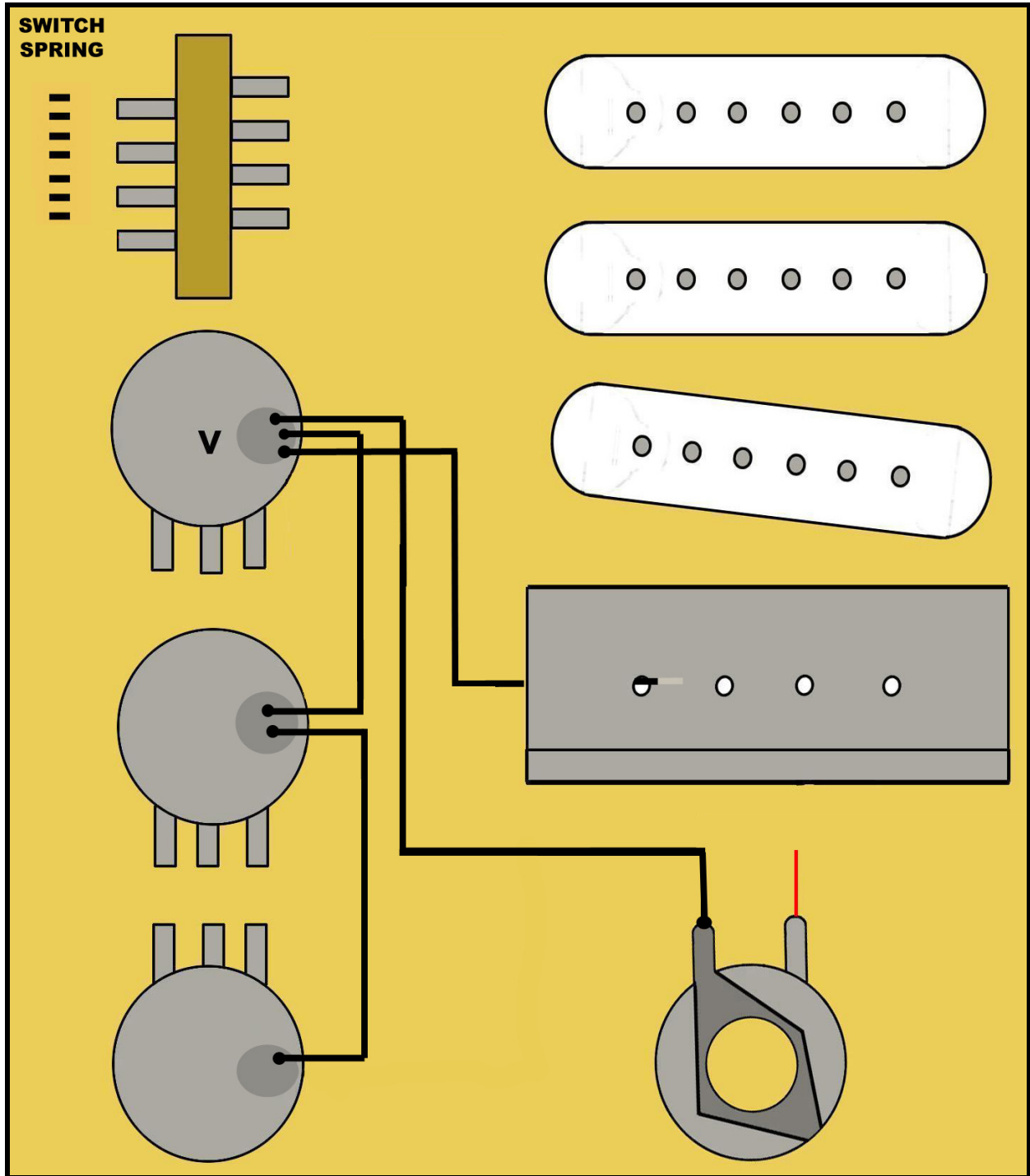


## SOLDERING THE REST OF THE GROUND WIRES

Next, you are going to find the bridge ground wire and solder it to the volume pot. You are also going to solder the output jack wire to the volume pot. After that, you will connect the volume and tone pots with 2 more wires. The bridge ground will probably already be connected to the tremolo claw on the back of the guitar, if you have a tremolo bar. If it is not connected, you can always attach it to the bridge. All you have to do is send the wire under the bridge, and put it through one of the screw holes on the bridge. Then wrap the wire around one of the screws while it is being tightened down. This will prevent the bridge ground from moving.

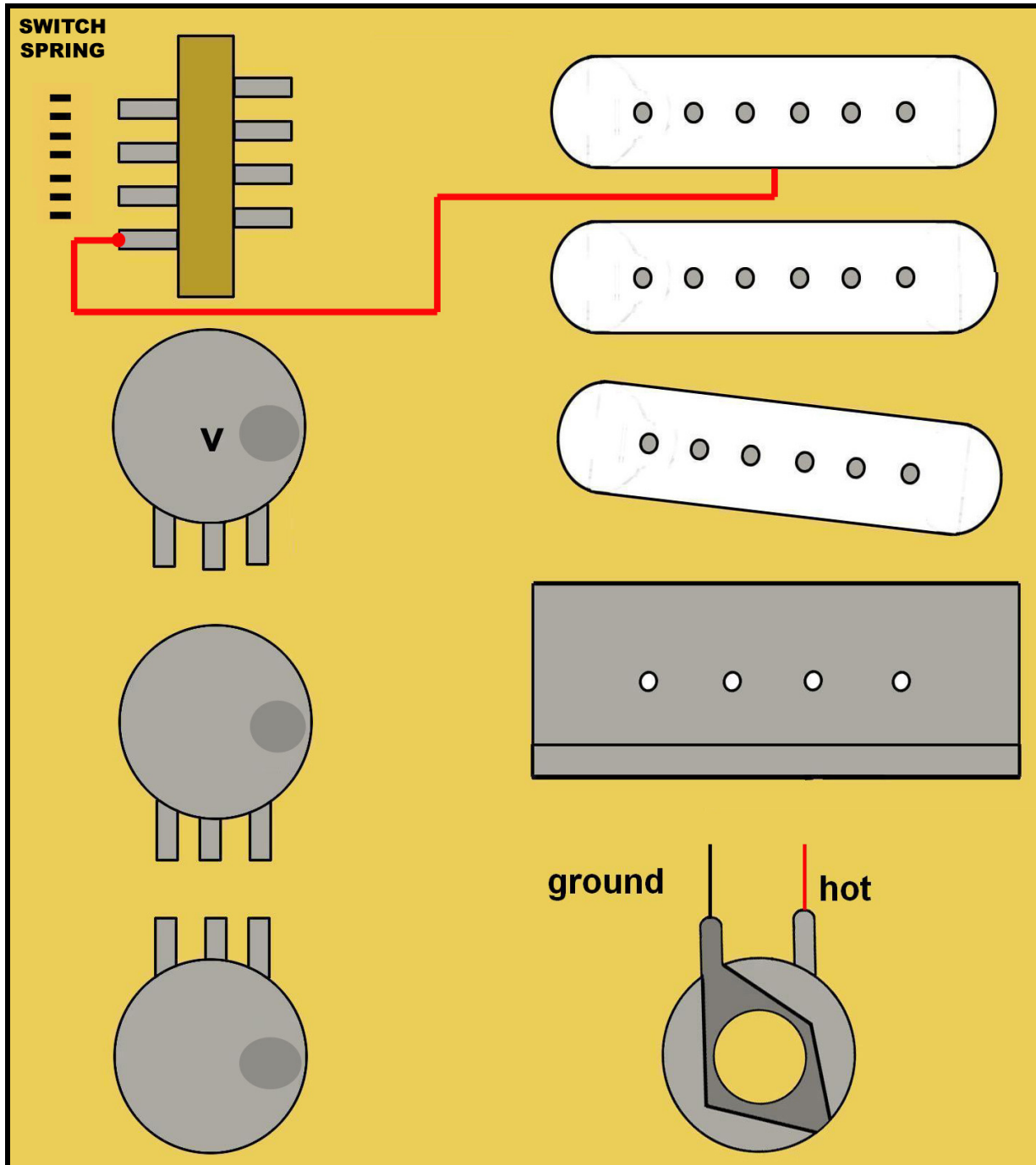


Now connect the rest of the ground wires.

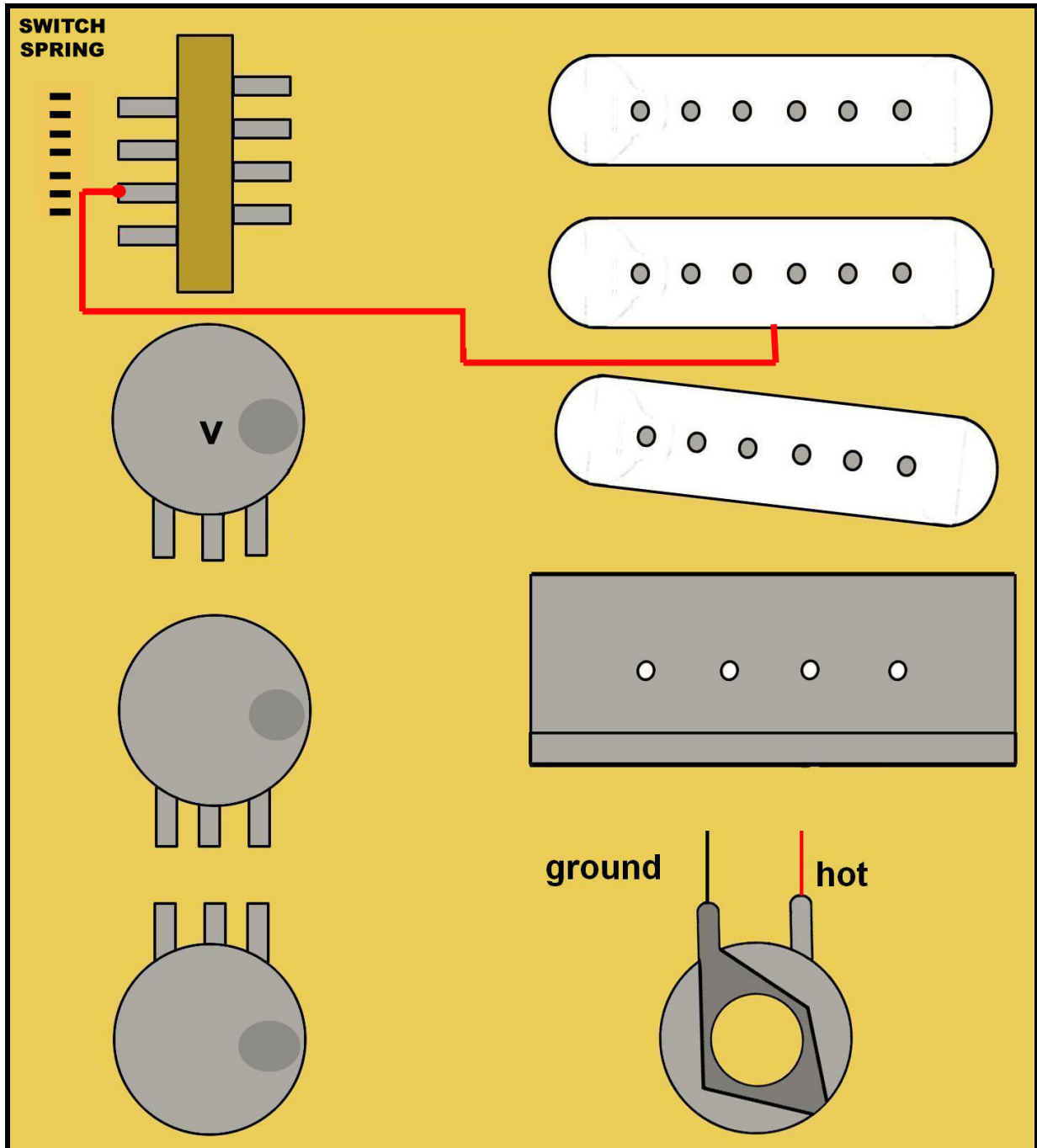


## SOLDERING THE PICKUP HOT WIRES

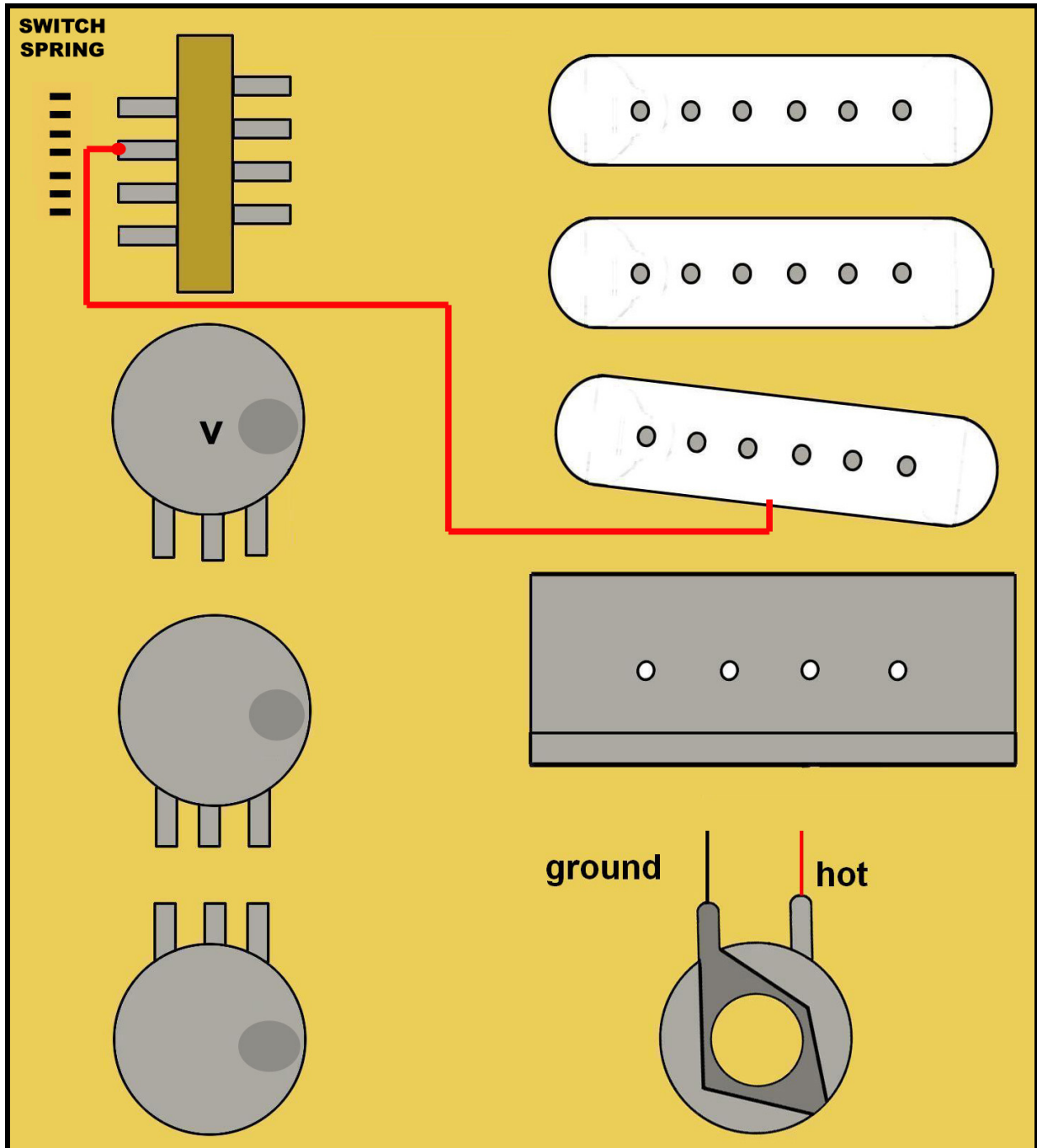
Next, you will solder the hot wires from the pickups to the left side of the 5-way switch. Connect the neck pickup. Note: this diagram is intended for Stewart-McDonald 5-way switches. If you have a Fender or CRL 5-way lever switch, please check out the section on **switches** now (page 69). Wiring them is a little different. Basically, their sides, or poles are reversed.



Next, connect the middle pickup.

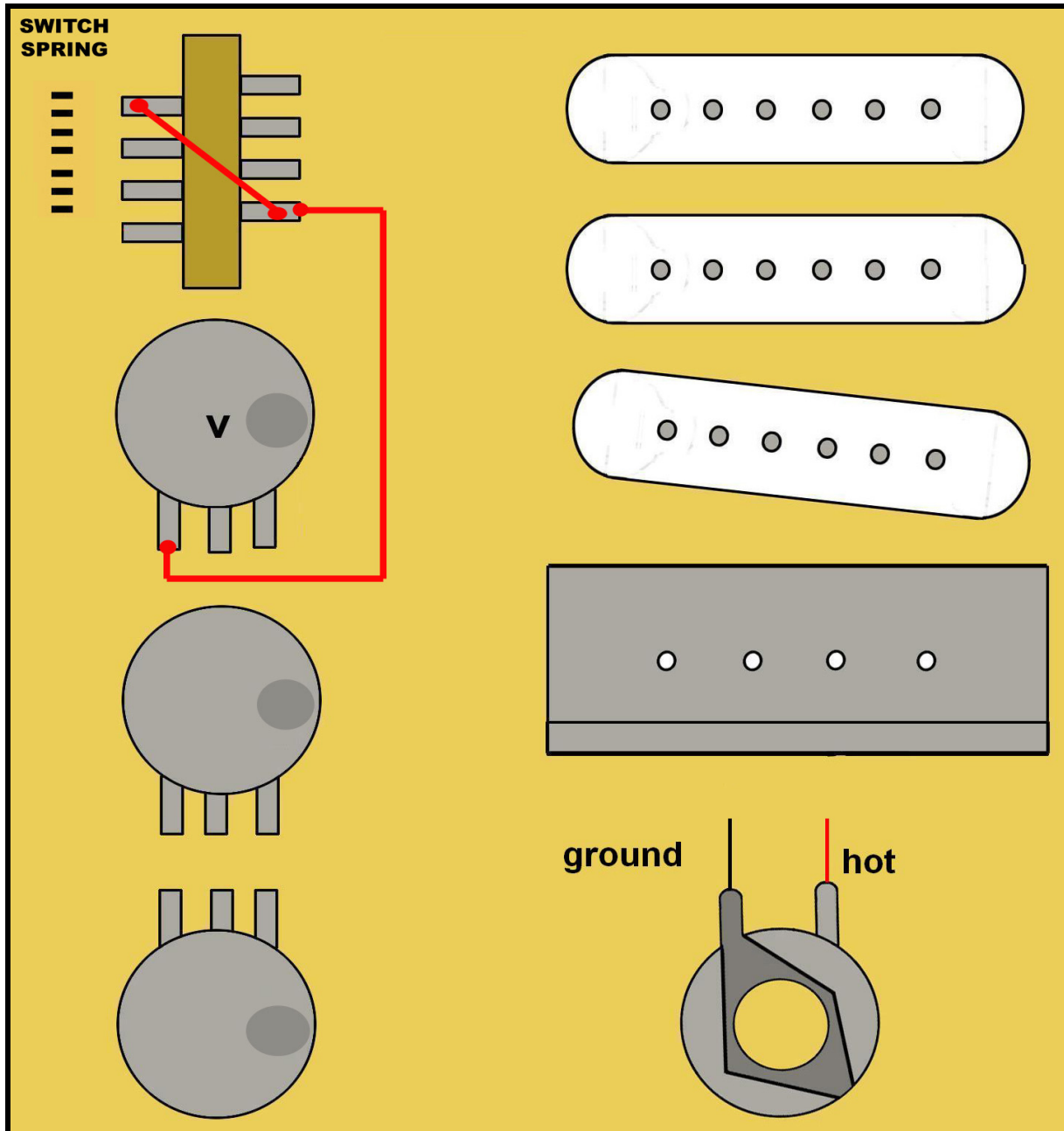


Now do the same for the bridge pickup.



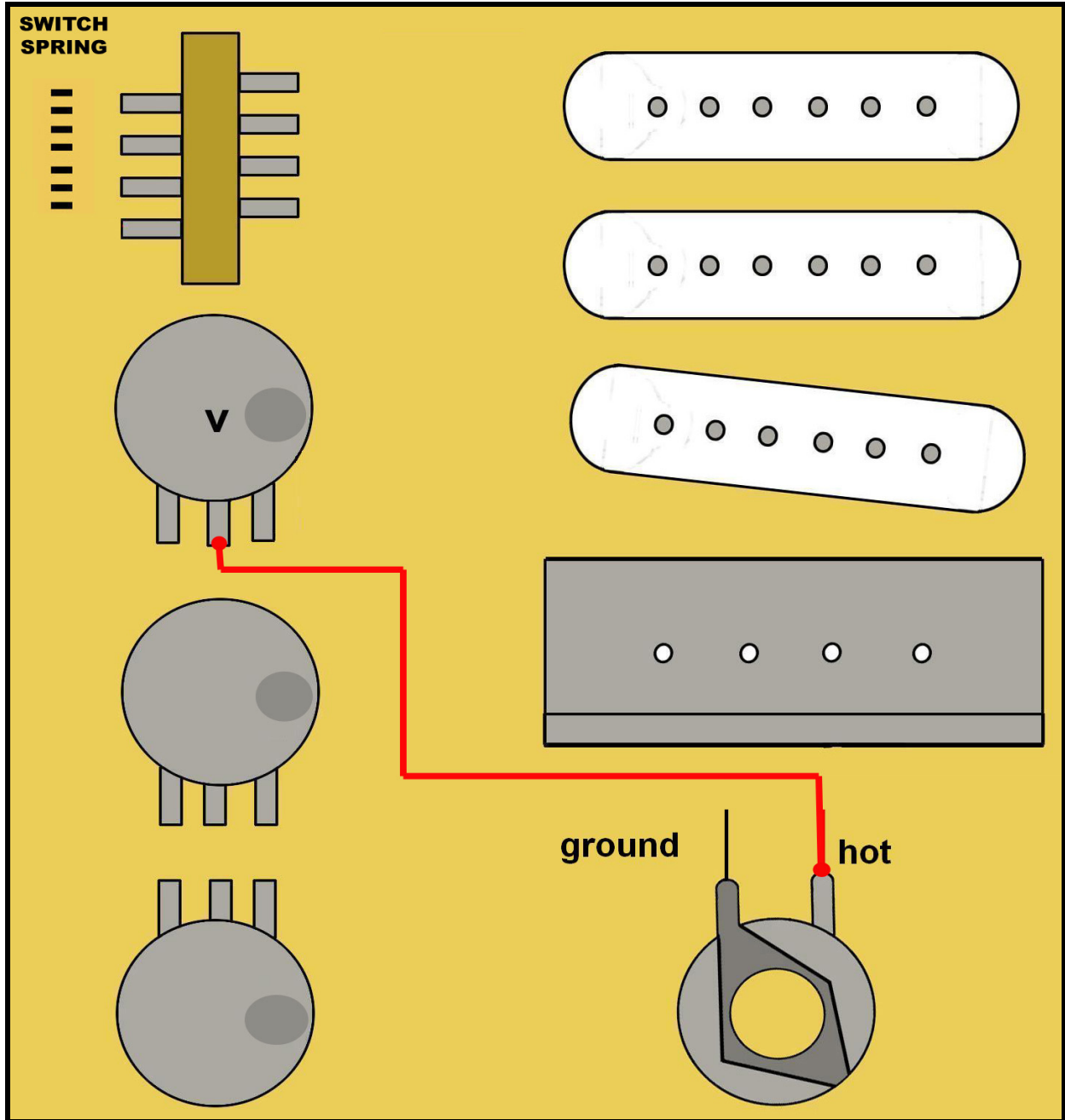
## ADDING THE JUMPER

Now connect the top left lug to the bottom right lug on the 5-way switch. Twist another wire to the right lug wire, and solder it to the left volume pot lug. By doing this, you are connecting the left and right sides, or poles, of the 5-way switch. Now connect the switch output wire to the volume pot lug.



## CONNECTING THE VOLUME POT TO THE OUTPUT

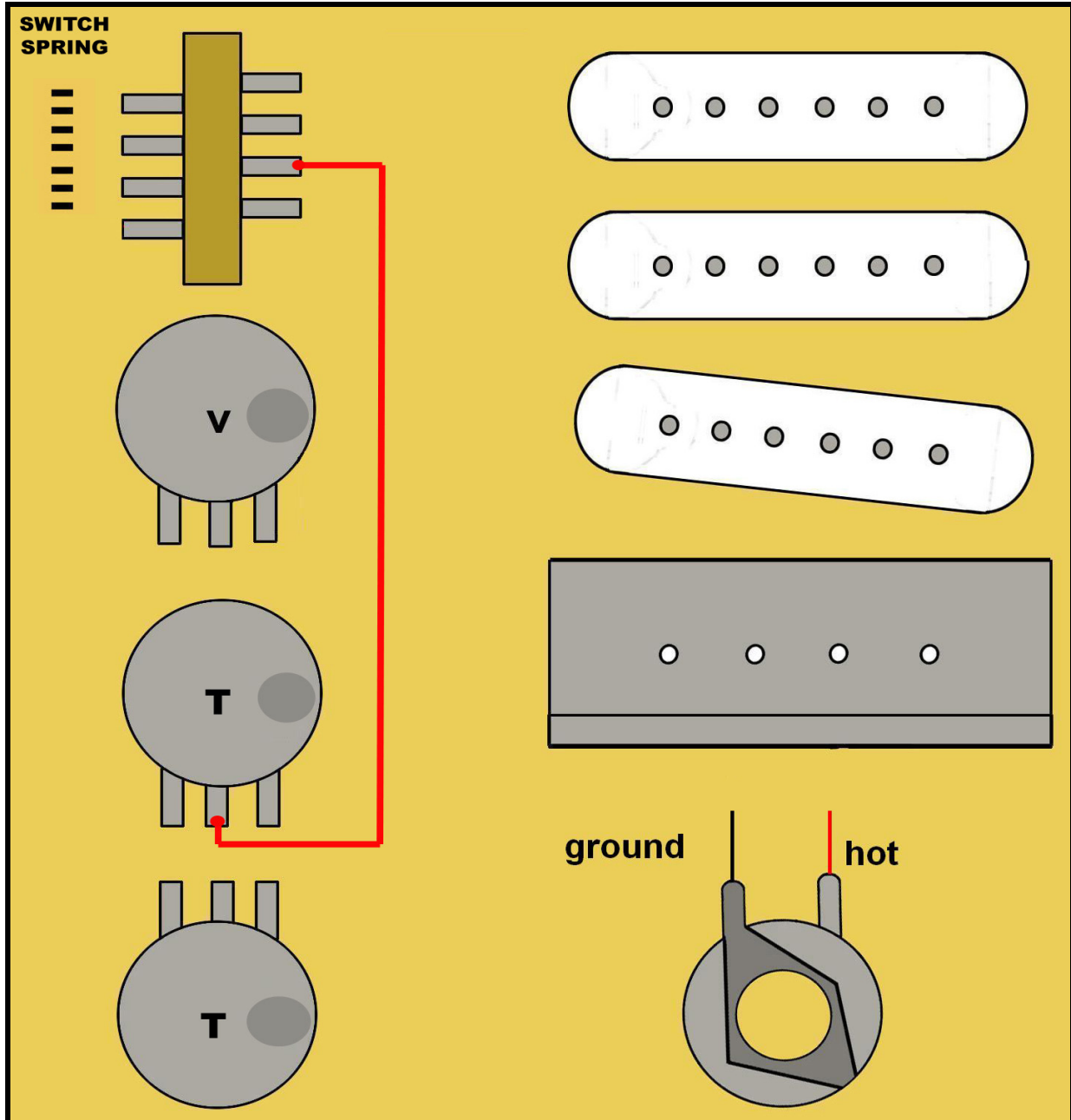
Now you can connect the middle volume pot lug to the output jack.



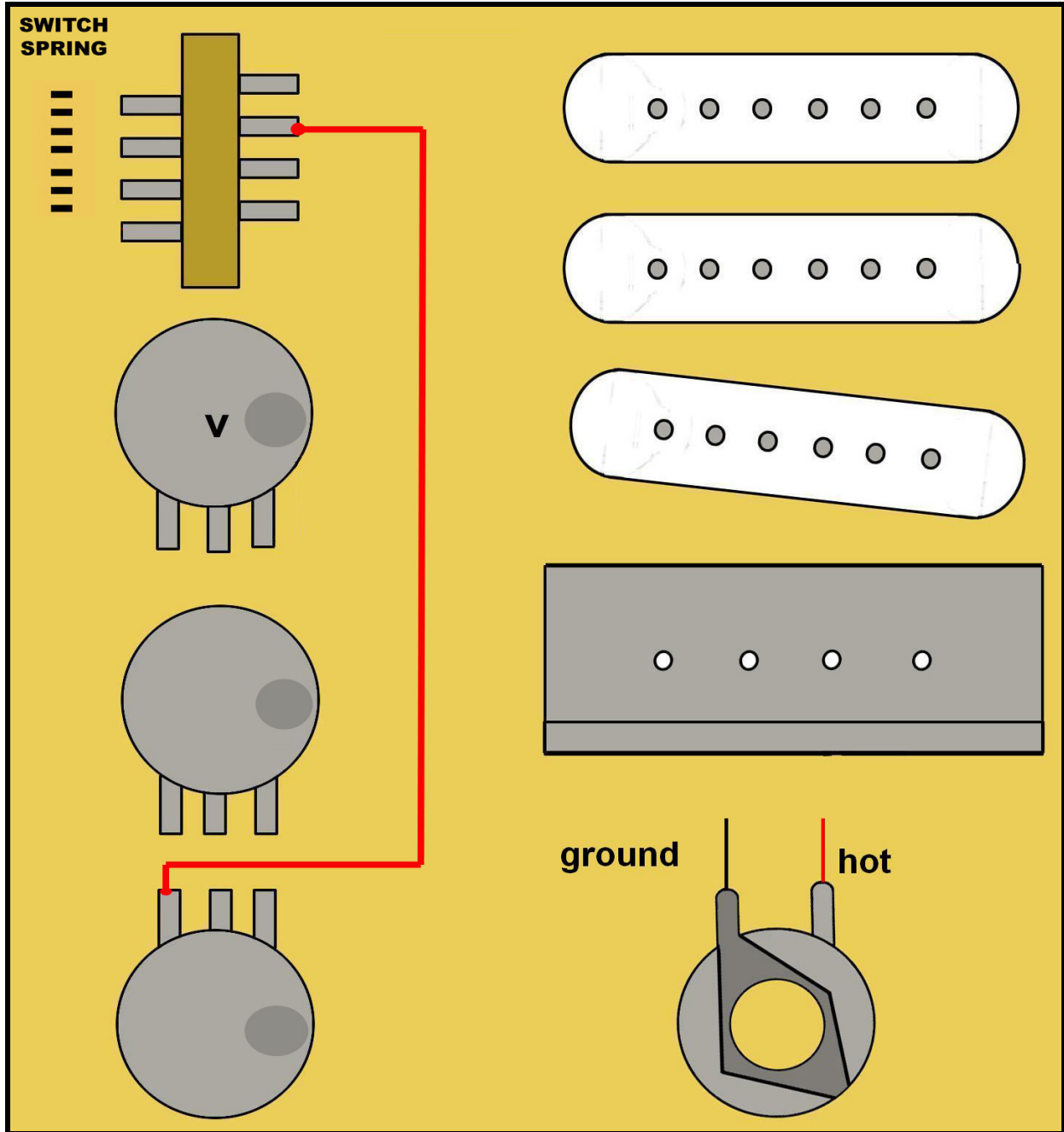


## CONNECTING THE 5-WAY SWITCH TO THE TONE POTS

The next step involves soldering the switch to the middle tone pot lug.

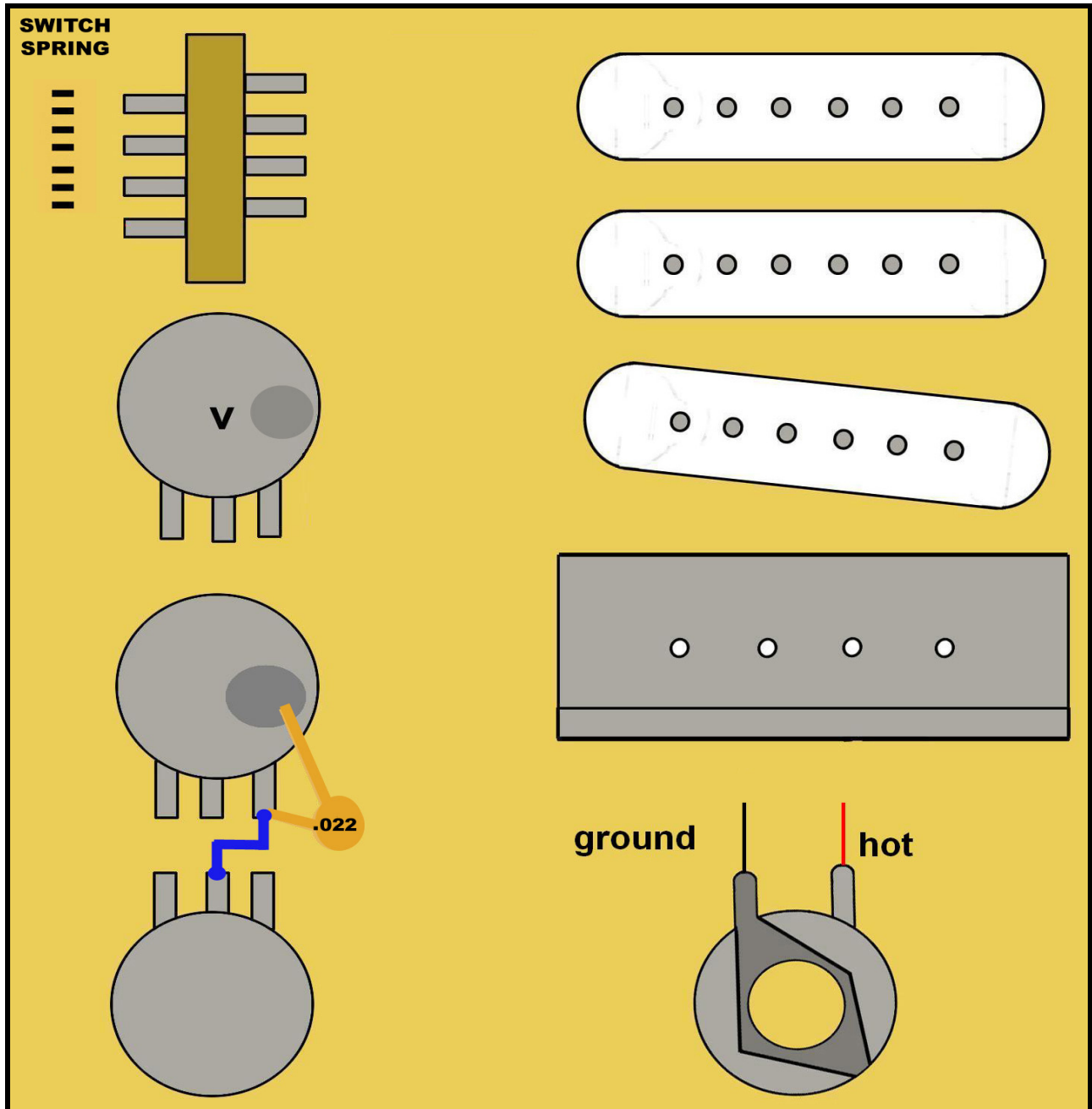


Next, you are going to solder the 5-way switch to the bottom tone control. Connect it to the left lug.

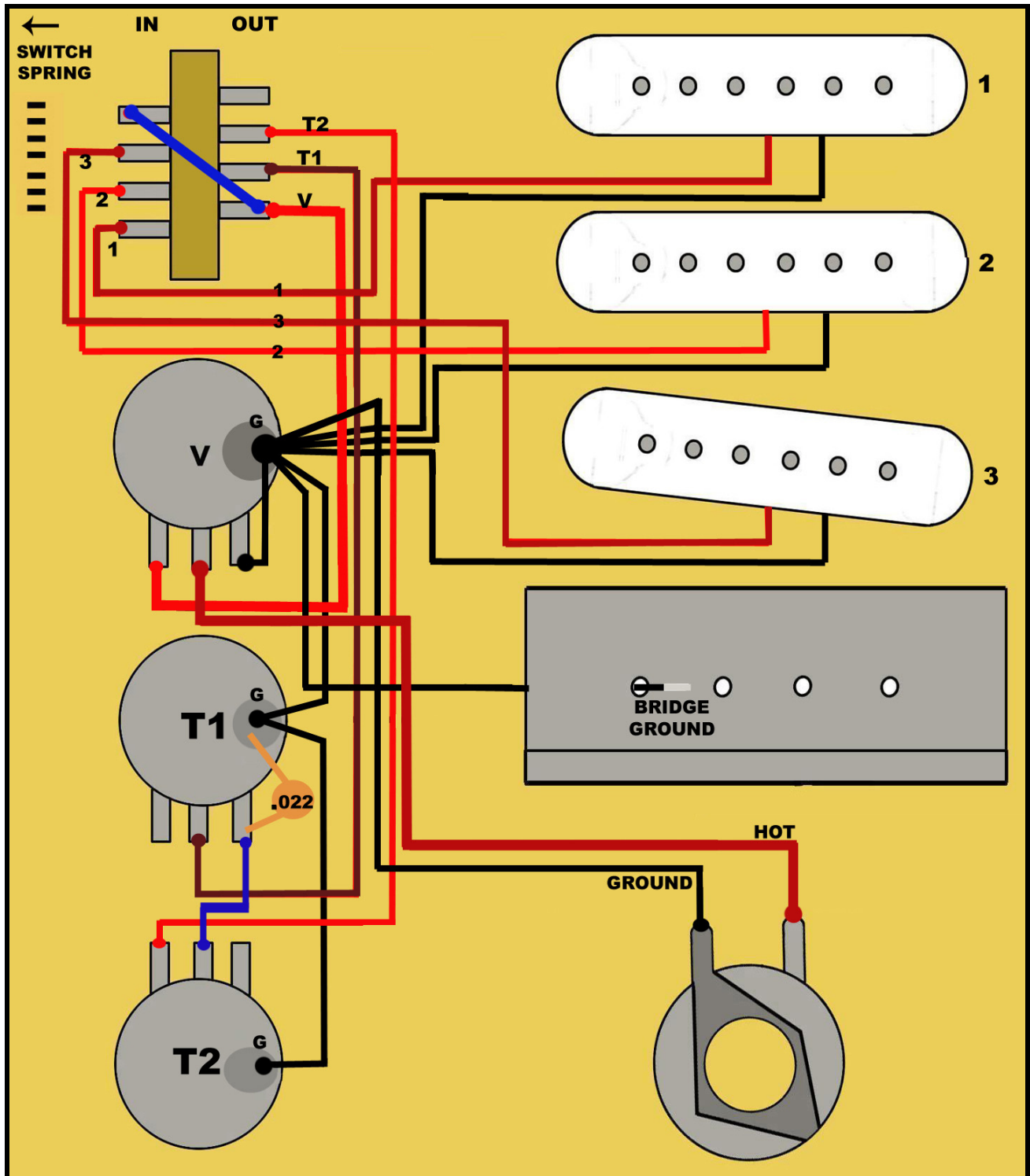


## ADDING THE CAPACITOR

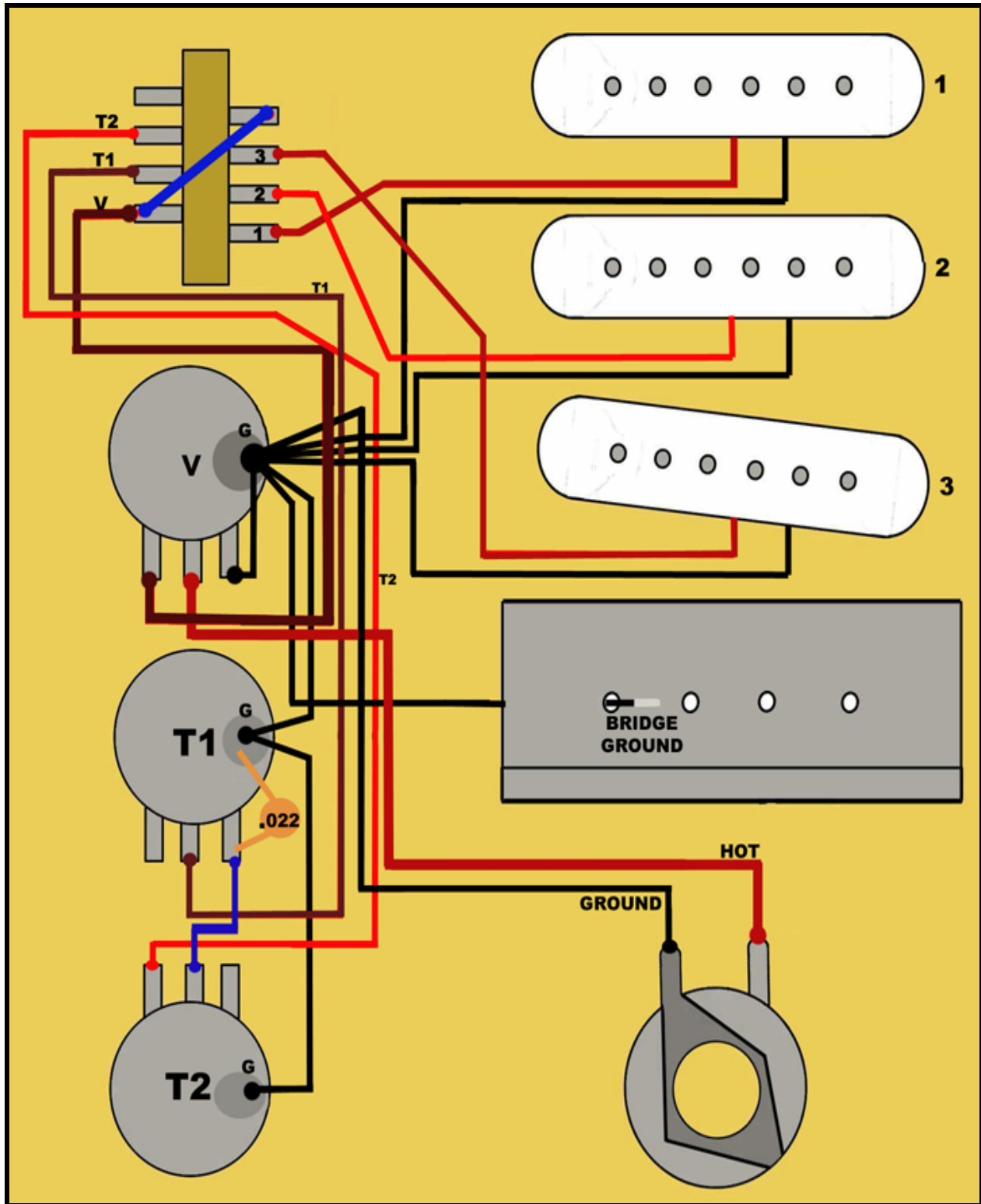
Solder the capacitor to the middle tone control. Remember, the stronger capacitor you use, the more bass your guitar's tone can have. Connect the capacitor to the right lug on the middle tone control, and then solder it to the case. That same lug will also connect to the middle lug on the bottom tone control.



That's all there is to it. Here is the finished wiring using a Stewart McDonald lever switch. Notice that when the switch is upside down, it has the lower set of lugs on its left side.



Here is the finished wiring using a Fender or a CRL switch. These lever switches have their sides switched around. Notice that they have the lower set of lugs on their right side.

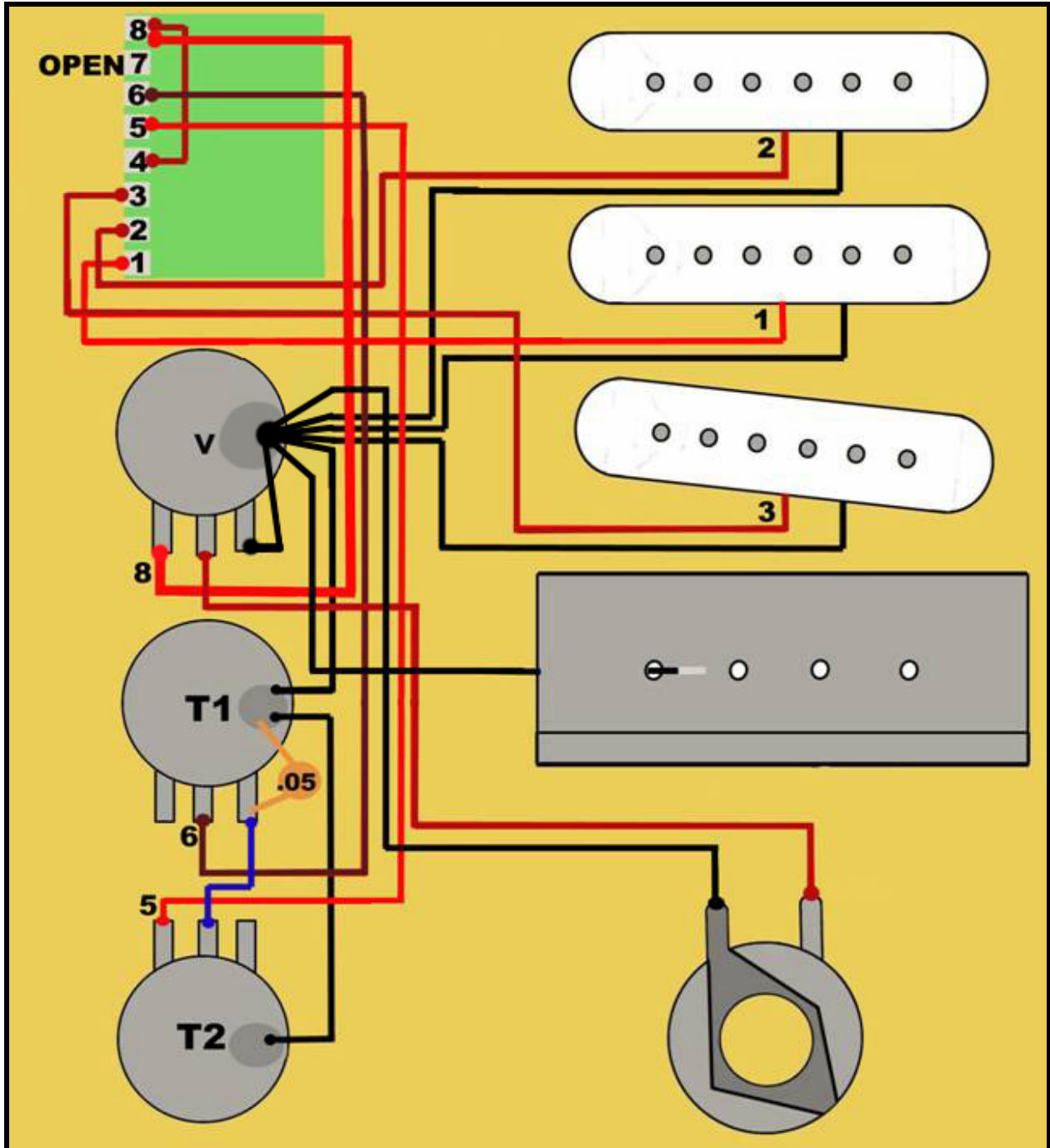


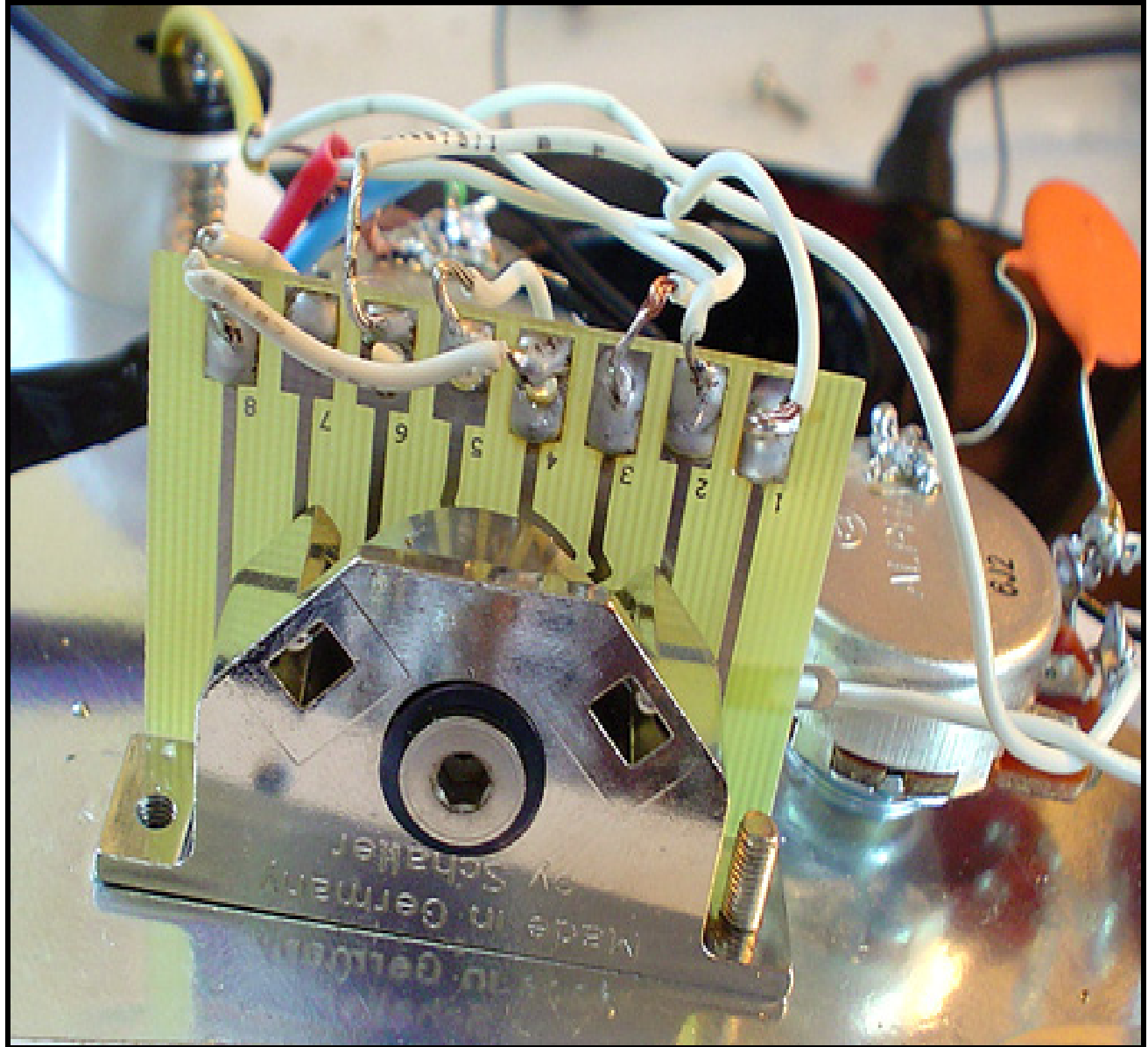


Type this address in your web browser to hear this guitar:

[HTTP://TINYURL.COM/YPJUQ6](http://tinyurl.com/ypjuq6)

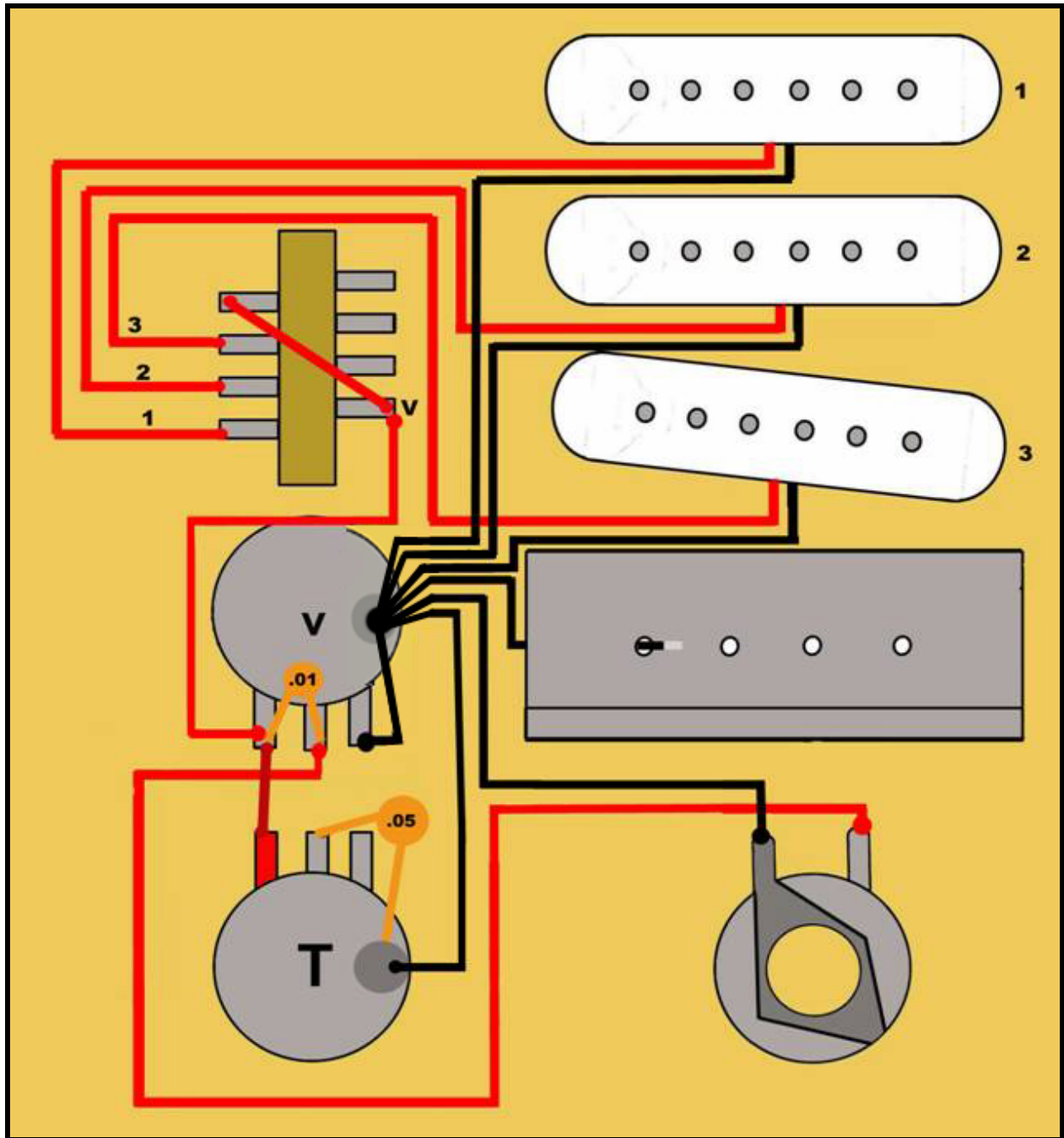
If you are using a **megaswitch** instead of a lever switch, then you can wire the guitar like this. The **megaswitch** is a higher end version of the import switch.



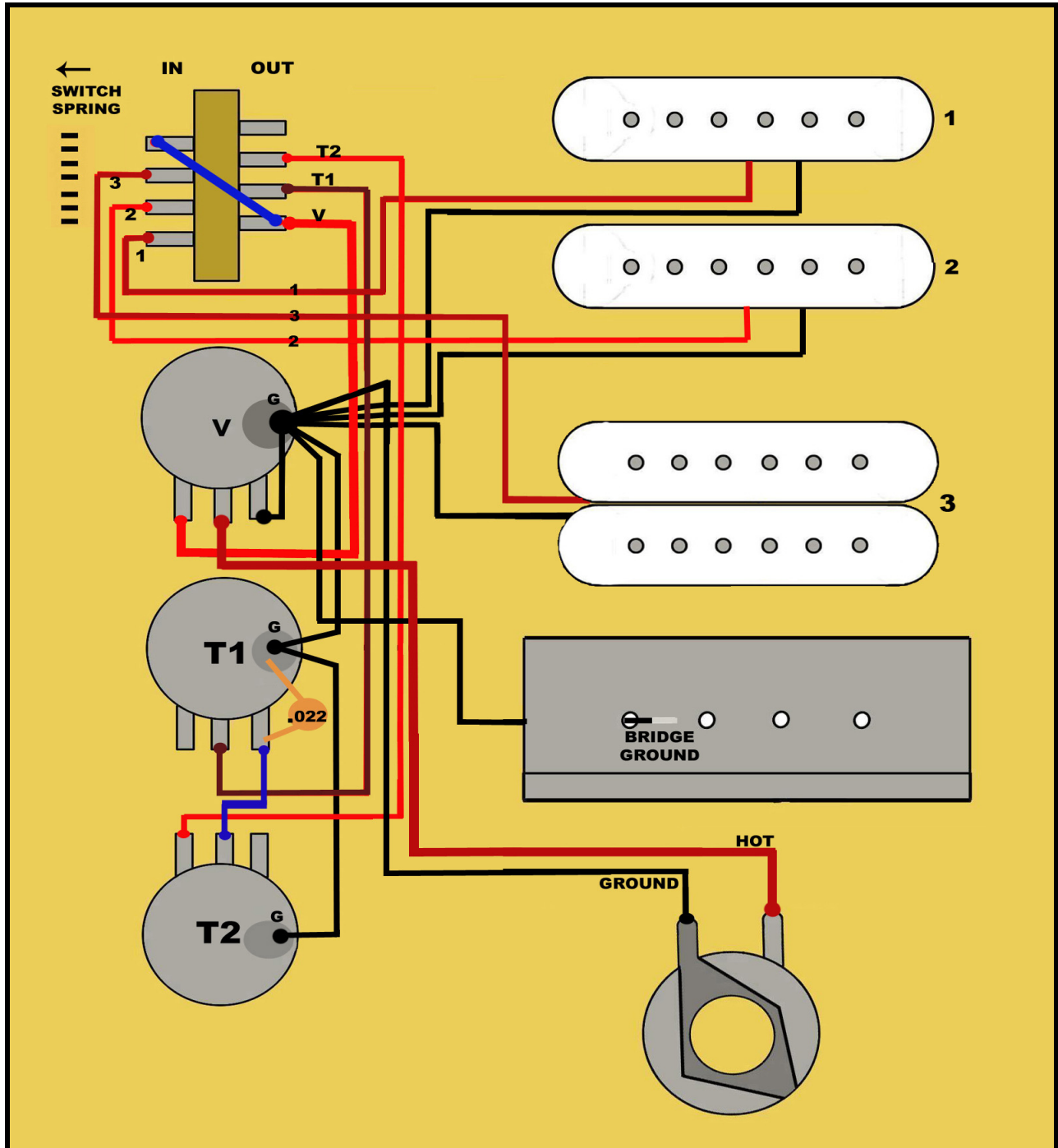




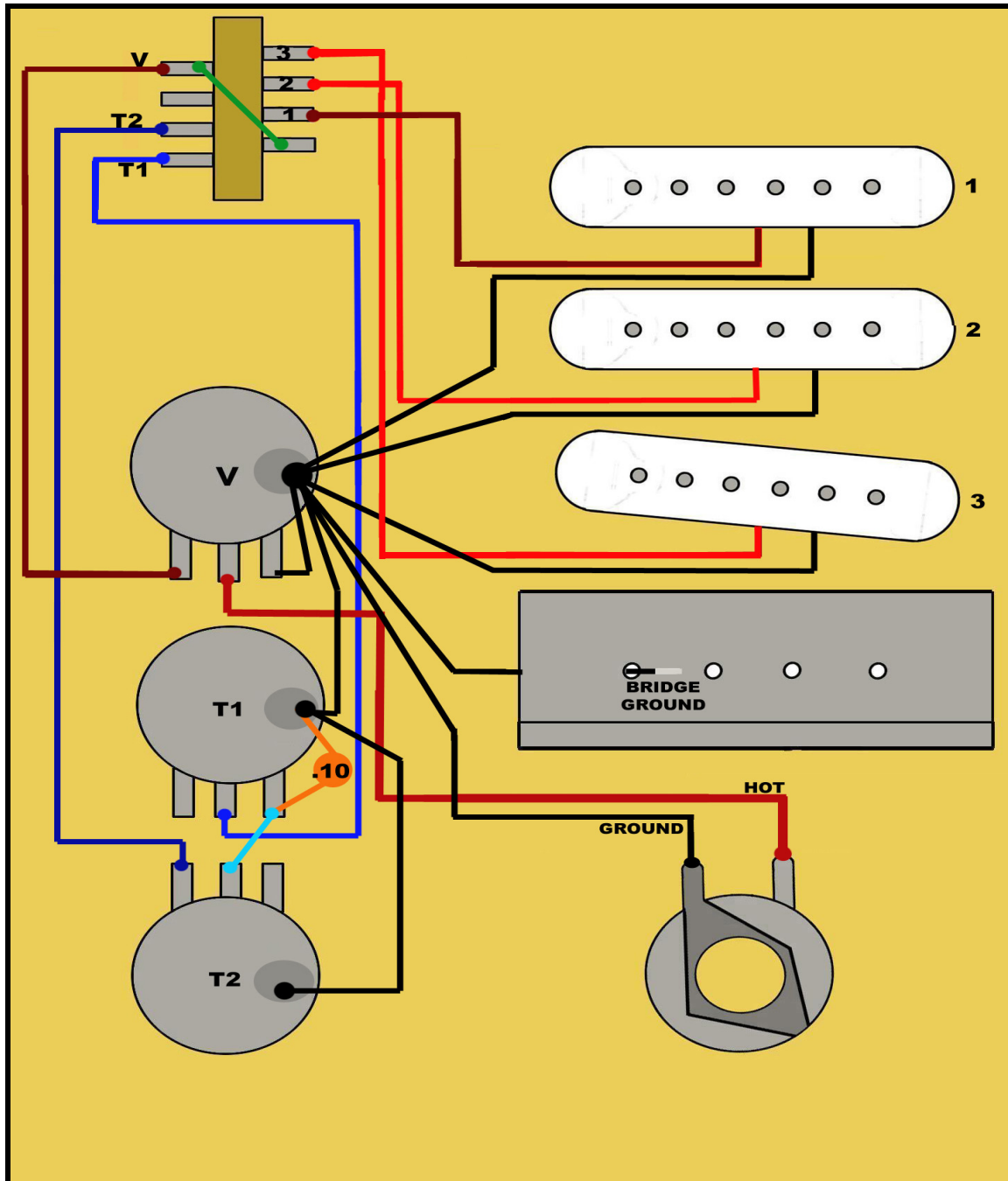
If you just wanted one master volume and tone control for all three pickups, you could wire the guitar like the diagram below. This would also give your bridge pickup a tone control. Notice a .01 capacitor has been added to the volume pot to take out some of the highs, and then put them back in the circuit before they go to the output. This prevents some of the highs from naturally bleeding out of a 250K pot. This is normally used on telecasters, and not strats.



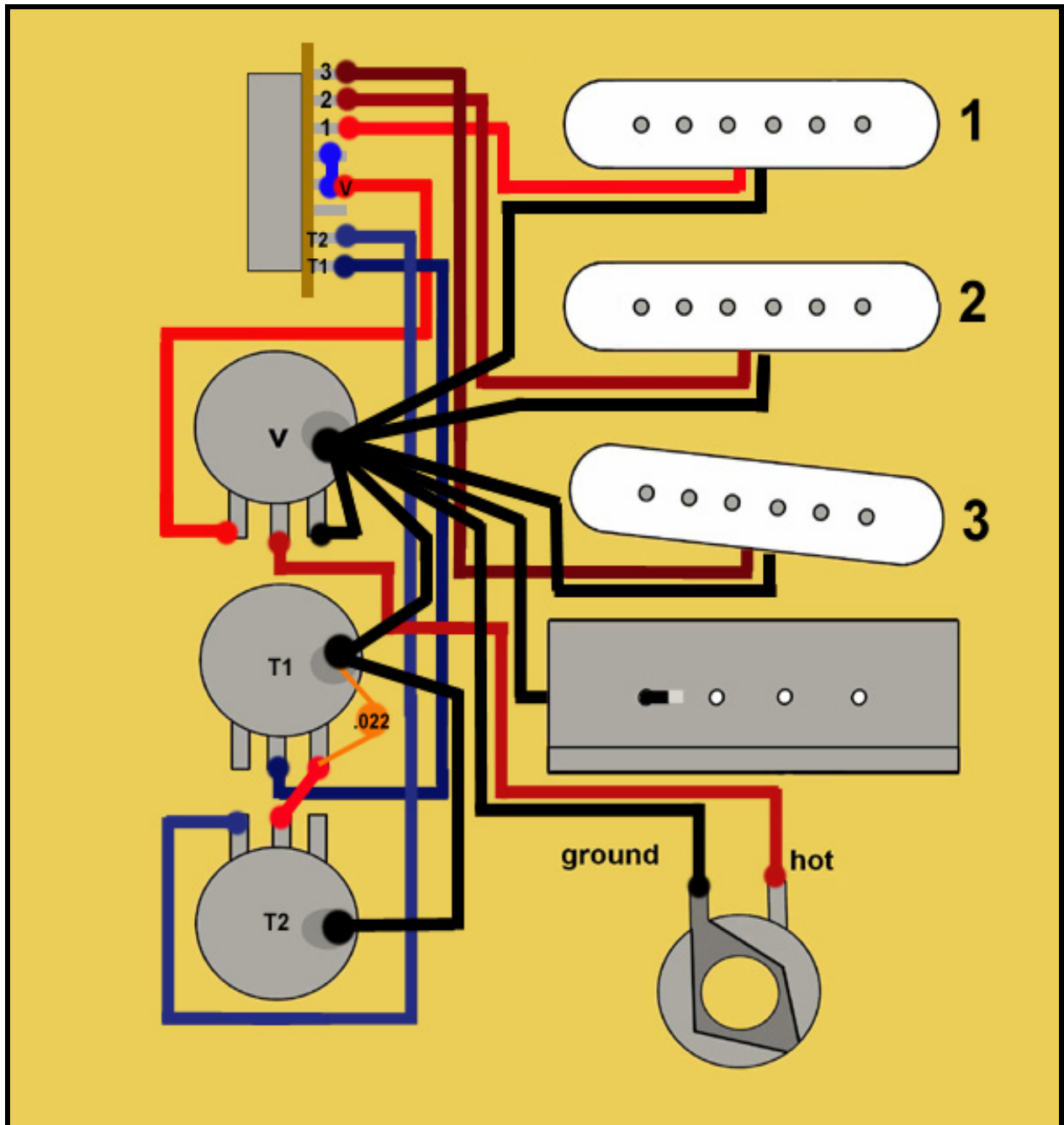
If you are playing a fat strat, with a humbucker in the bridge position, then you can wire your guitar this way. It's basically the same as a regular strat. If you have a four or five wire humbucker in the bridge position, then check out the hot rod section for the wiring instructions.



If you are going to setup your guitar with a 3-way selector switch just like the 50's strats, then the wiring would look like this. Each of the three positions only turns on one pickup. The capacitor is .1 microfarads.



If you are using a 5-way import switch with 8 lugs, then the wiring would look like this. In fact, the wiring is the same for an import 3-way switch as well. That would only turn one on pickup during each selection.



If you want to try something different with your switching, this might be worth a shot. By adding another jumper wire, you can change two of your switching options. Here is how the diagram on the next page works with this type of wiring.

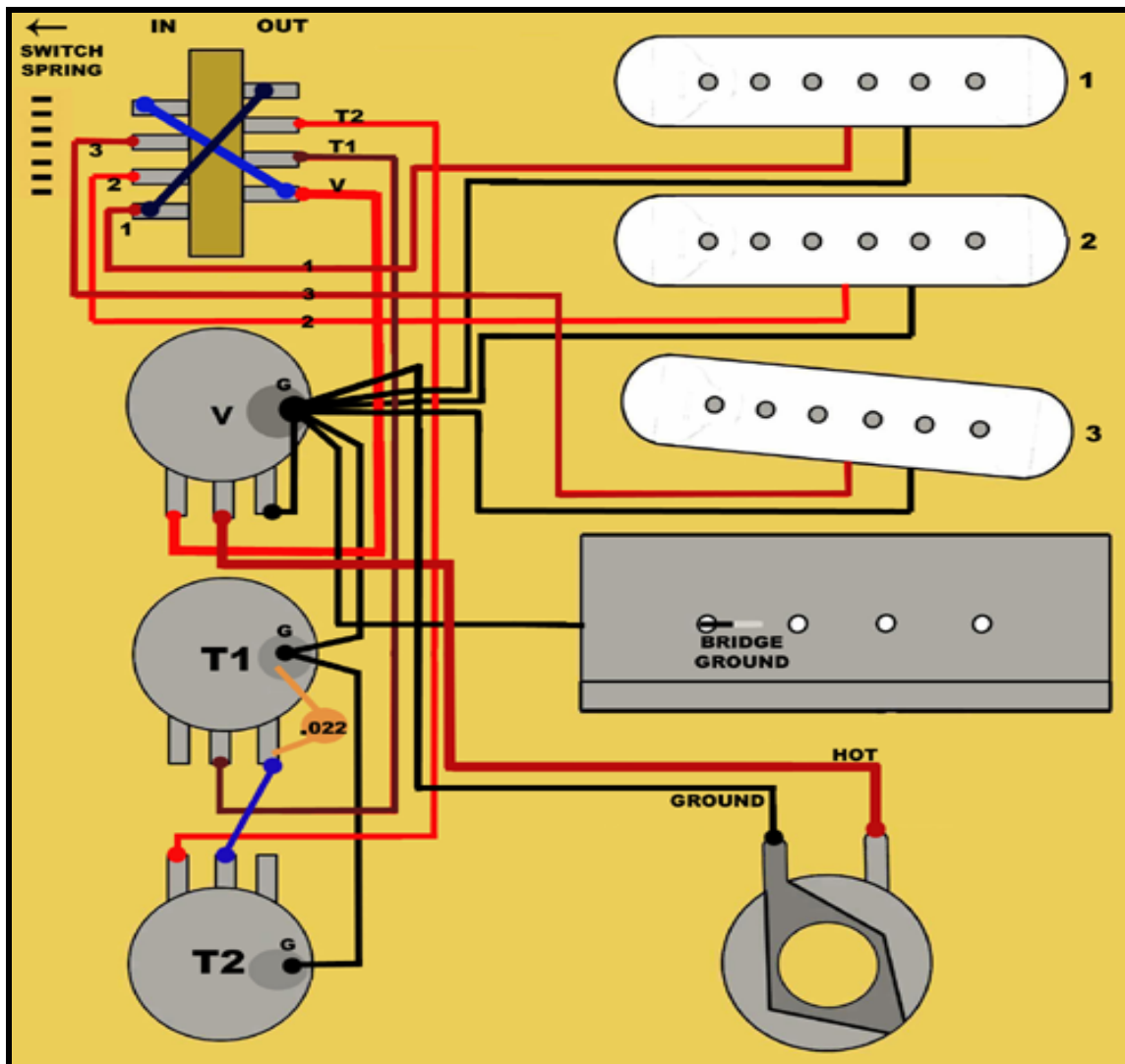
position 1 = neck

position 2 = neck and middle

position 3 = middle

position 4 = neck and middle and bridge

position 5 = neck and bridge



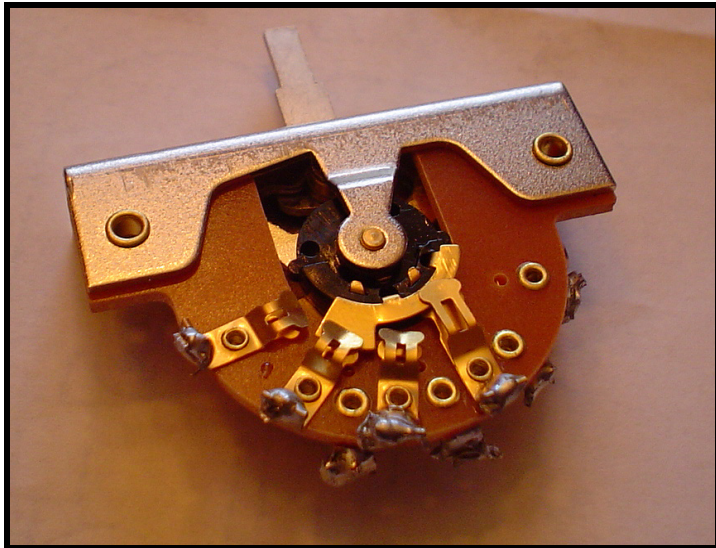
## UNDERSTANDING SWITCHES

Almost every guitar uses some type of switching. They are essential for turning pickups off and on. If you are going to be doing any type of wiring, then you are going to have to know your way around switches. The modern strats of today use the 5-way switching that you are probably already familiar with, but the vintage strats from the 1950's and 1960's used 3-way switching, where each setting only turned on one pickup, so you had to place the lever in between the pickup settings in order to turn on multiple pickups. If you are going to build a 1950's replica strat, then you will need to use the 3-way switch.

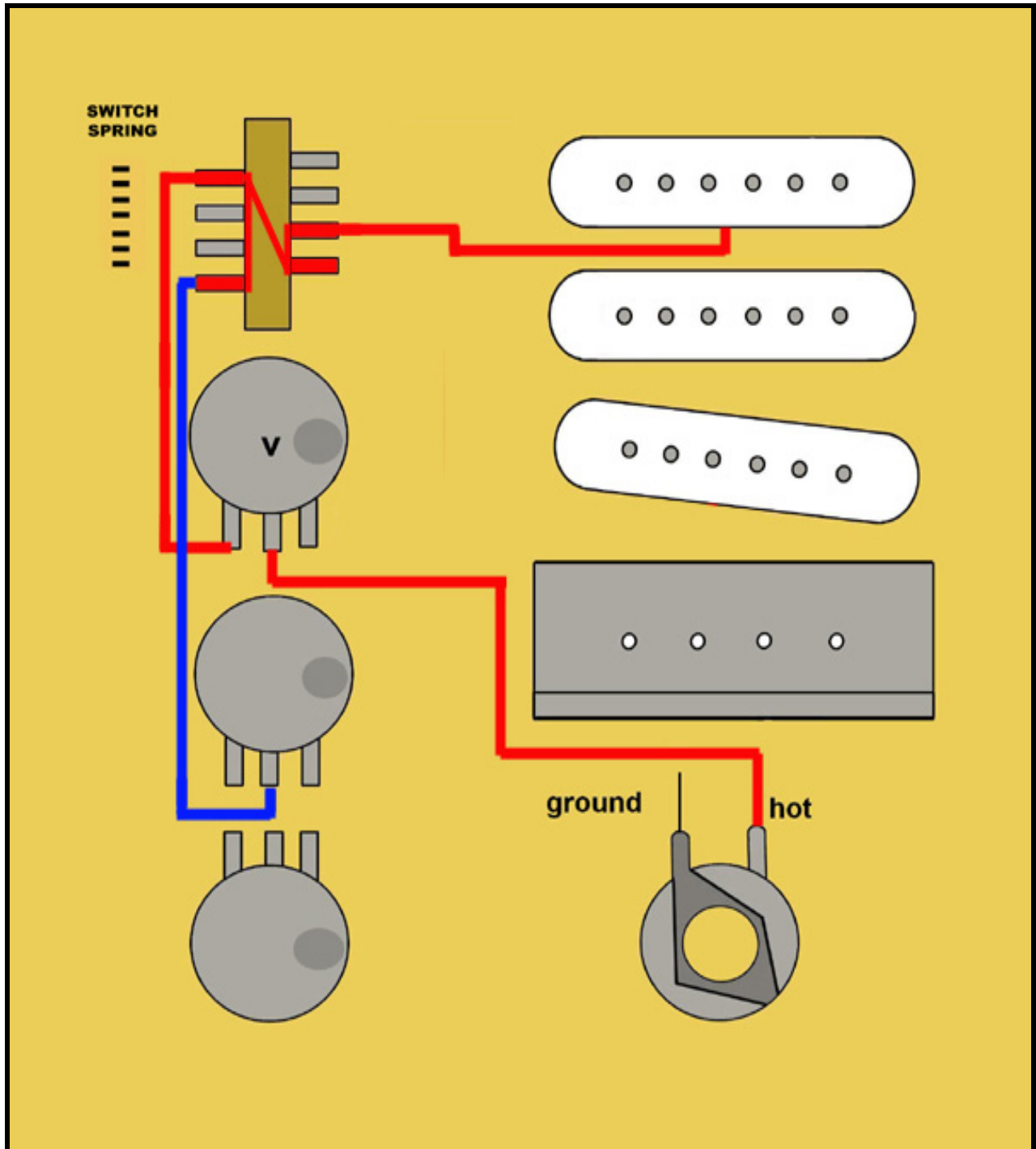
### UNDERSTANDING 3-WAY SWITCHES

In order to wire 3-way switches, you first need to understand how they work. Basically, you have a hot wire from a pickup that goes into the switch, and a hot wire that goes out of the switch to the volume potentiometer. From there, the signal goes to the tone potentiometer and to the output jack. The pickup combinations are neck pickup on, middle pickup on, or bridge pickup on.

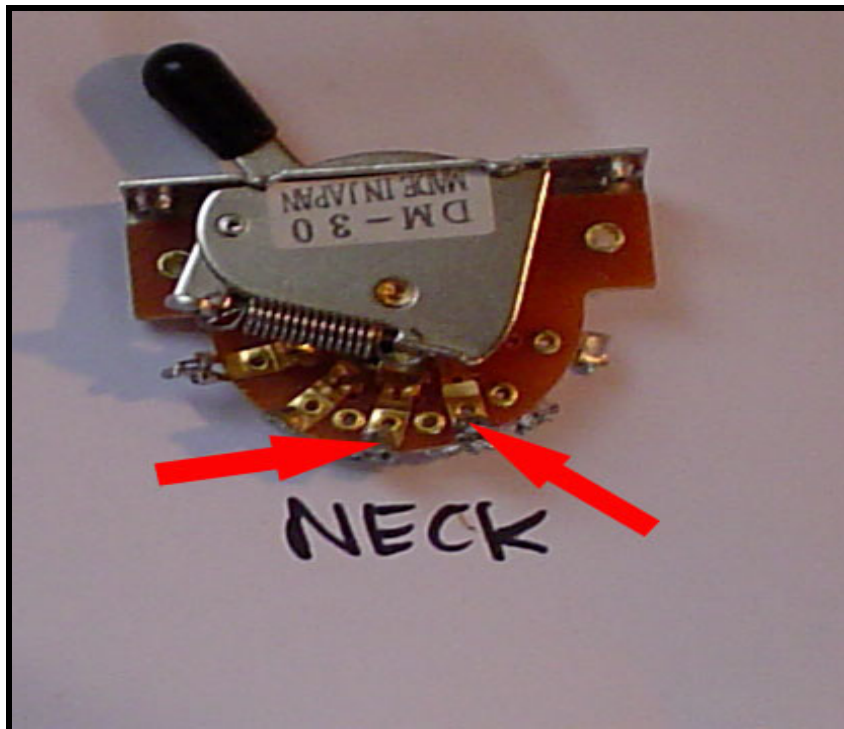
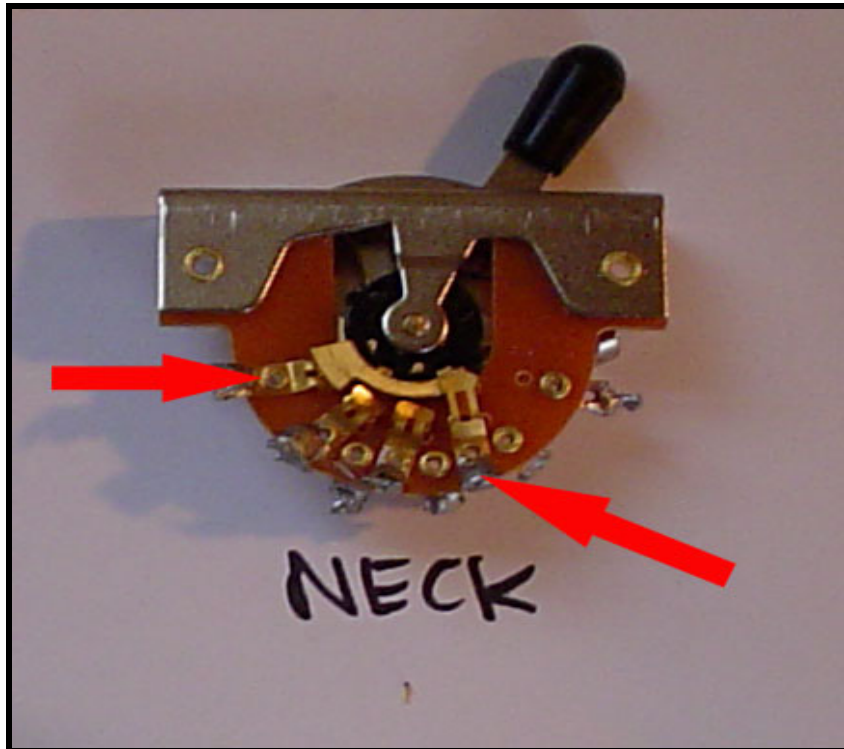
Now, notice the following diagrams for each position. The lugs colored in red show where the hot signals travel when the switch is activating the pickup. Any pickups connected to those red lugs will be on. Also, notice the jumper wire that connects the right and left sides (poles) of the switch. This allows each pickup signal to exit out of the same lug, and connect to the volume potentiometer. Also, pay attention to where the switch spring is located when installing the 3 and 5-way switches. Look at the end of this section for an explanation of the Stew Mac, CRL, and Fender switching differences.



Here is the 3-way switch in the neck position.

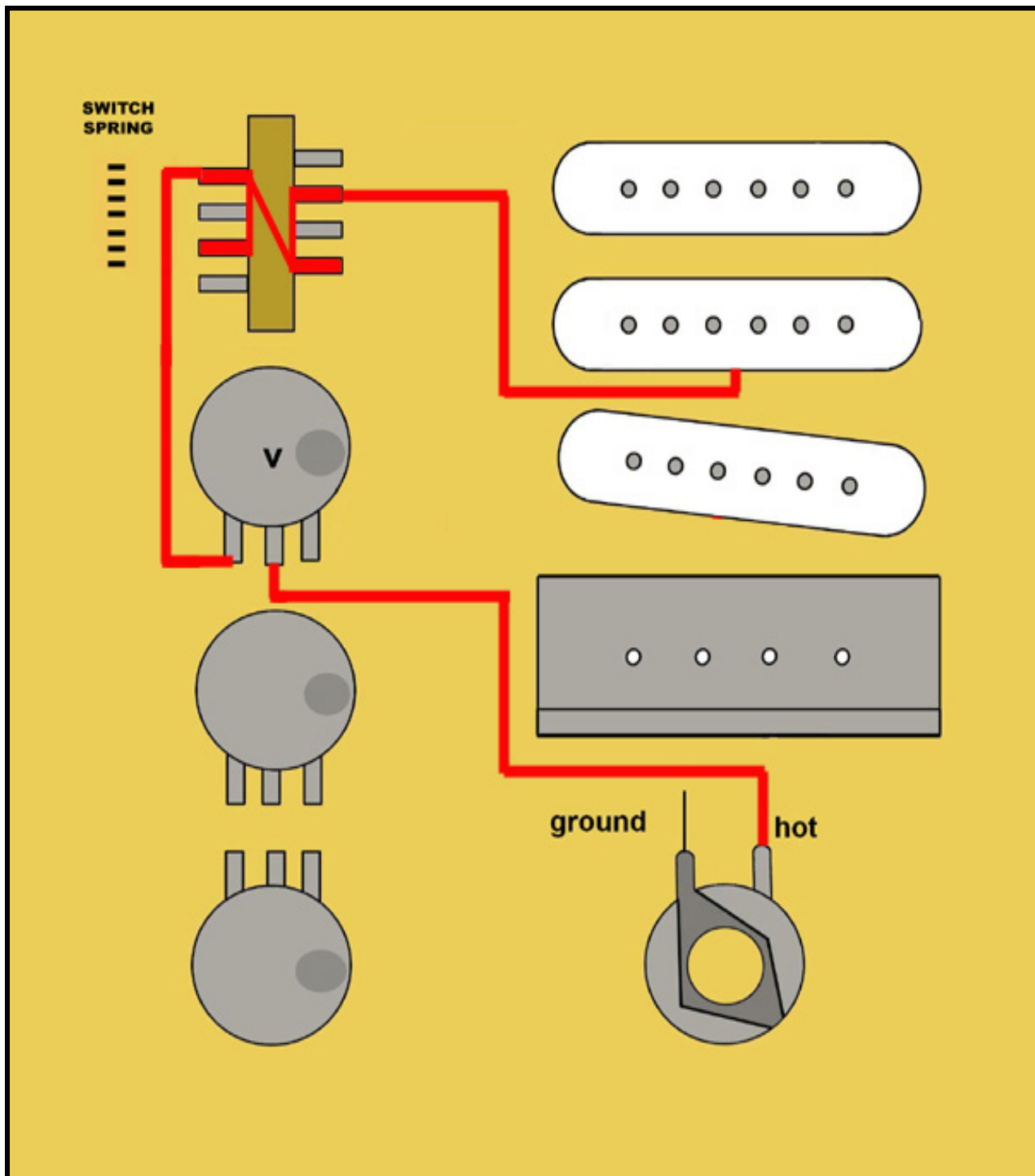


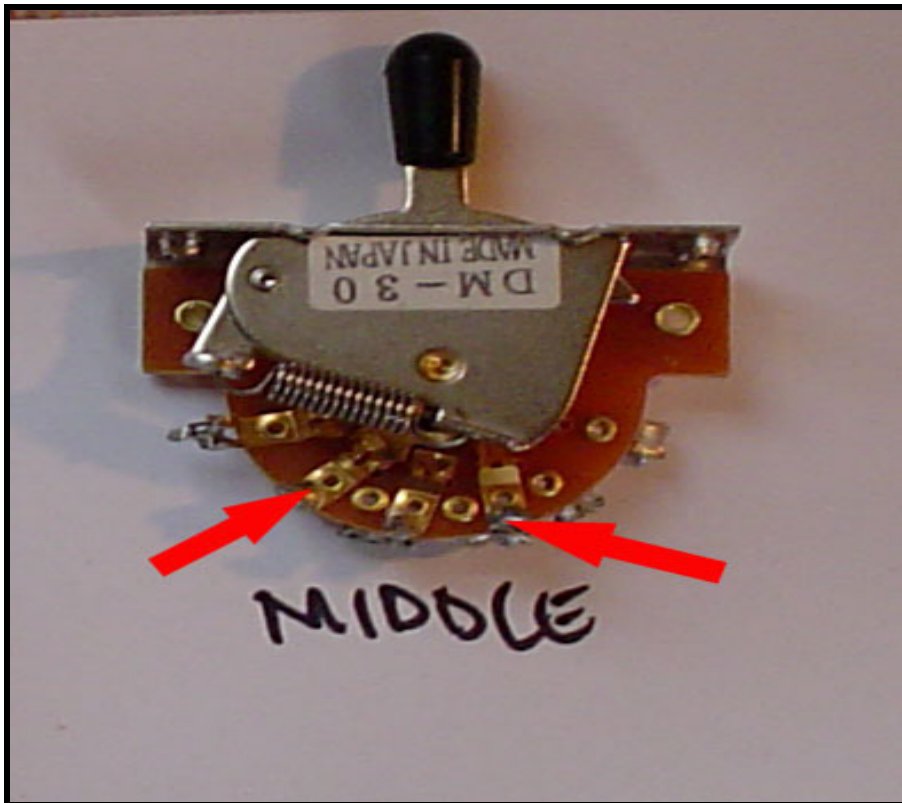
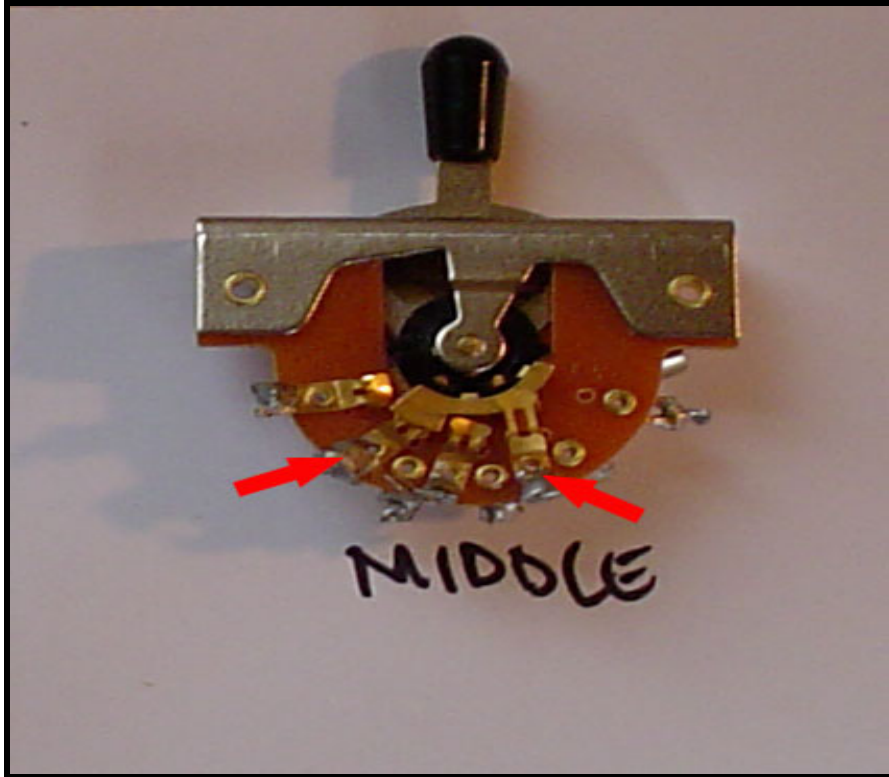
Here is what the actual switch looks like in the neck position. The red arrows show which lugs have the signal moving through them.



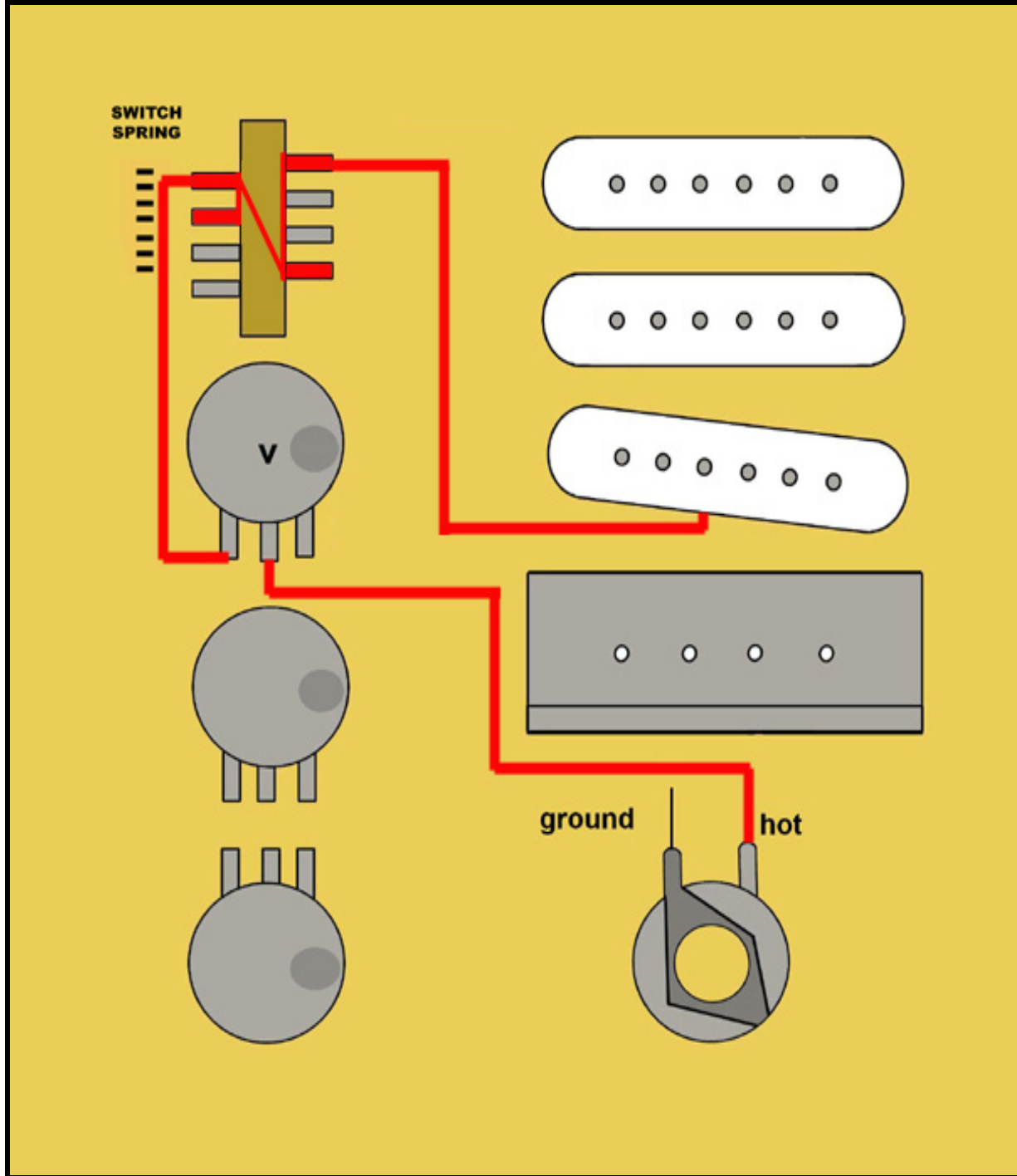


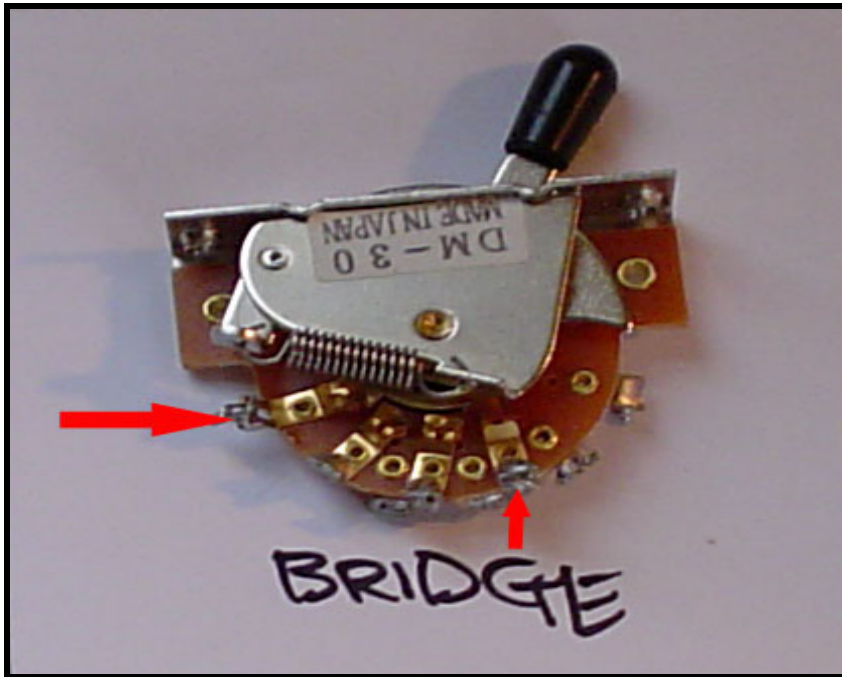
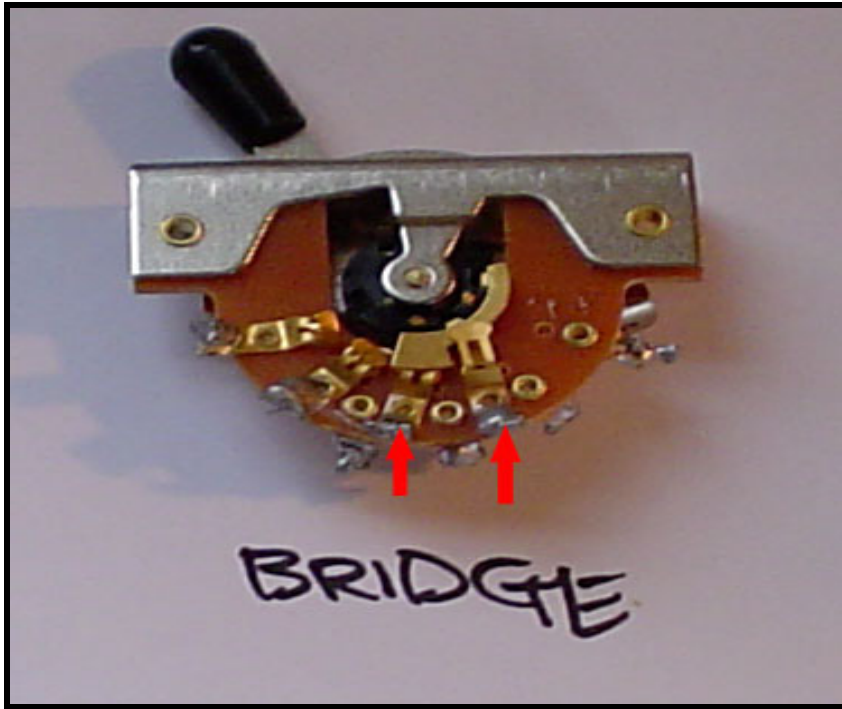
Now we are going to look at the switch in the middle position.



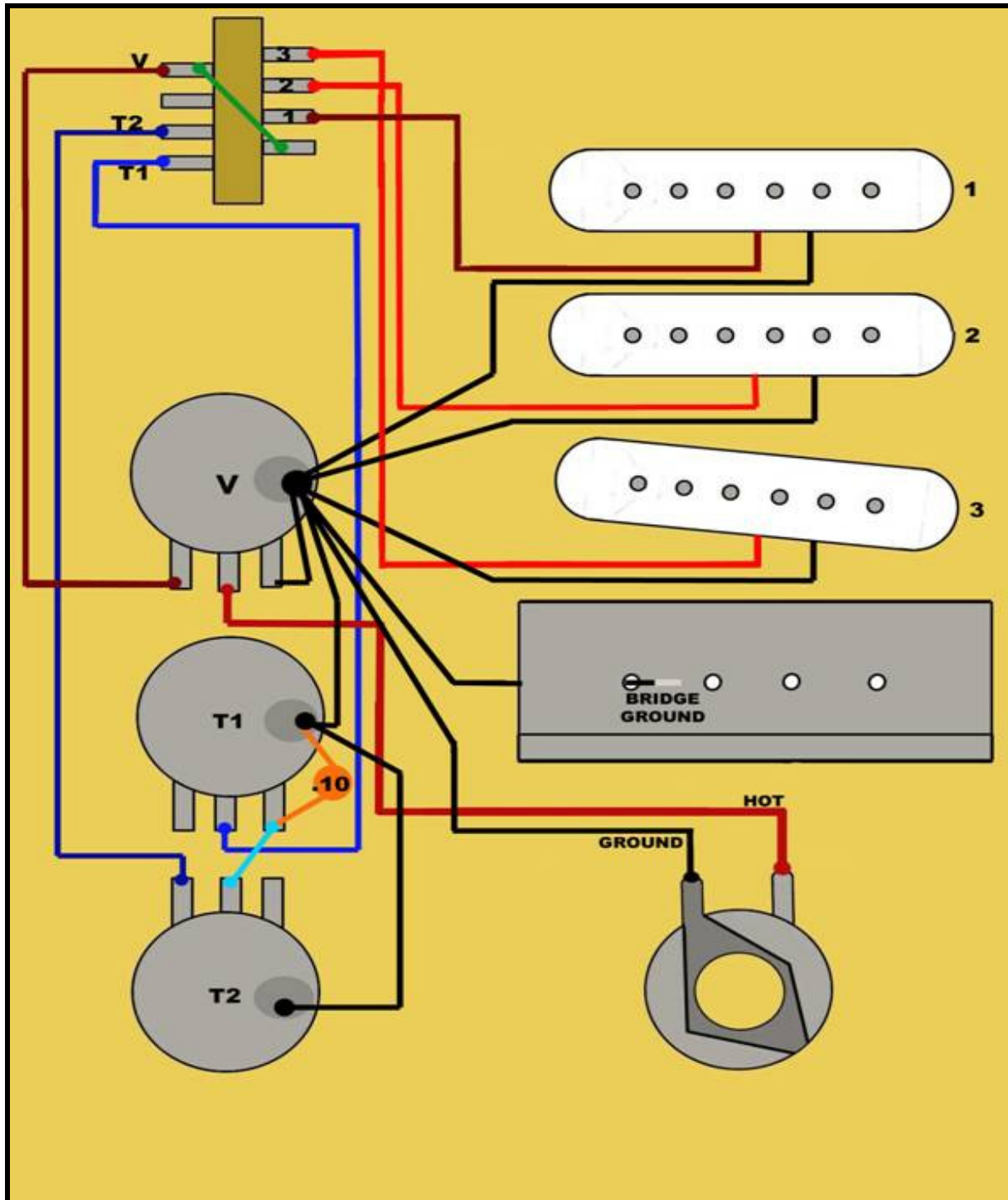


Now take a look at the bridge position.

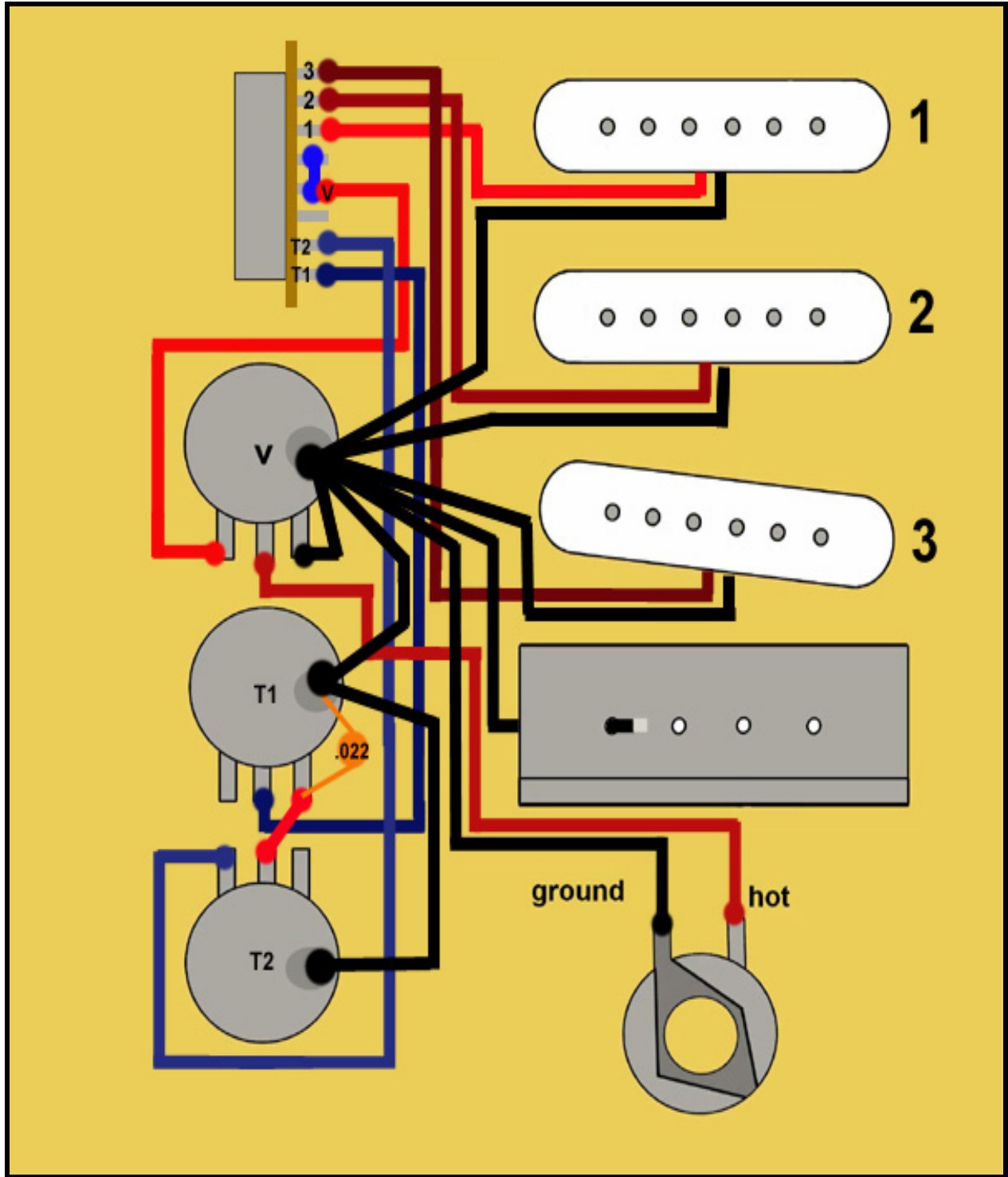




Here is a strat wired with a 3-way switch. If you are using a Fender or CRL 3-way switch, please refer to page 69. The diagram below shows a strat wired with a Stewart Macdonald lever switch.

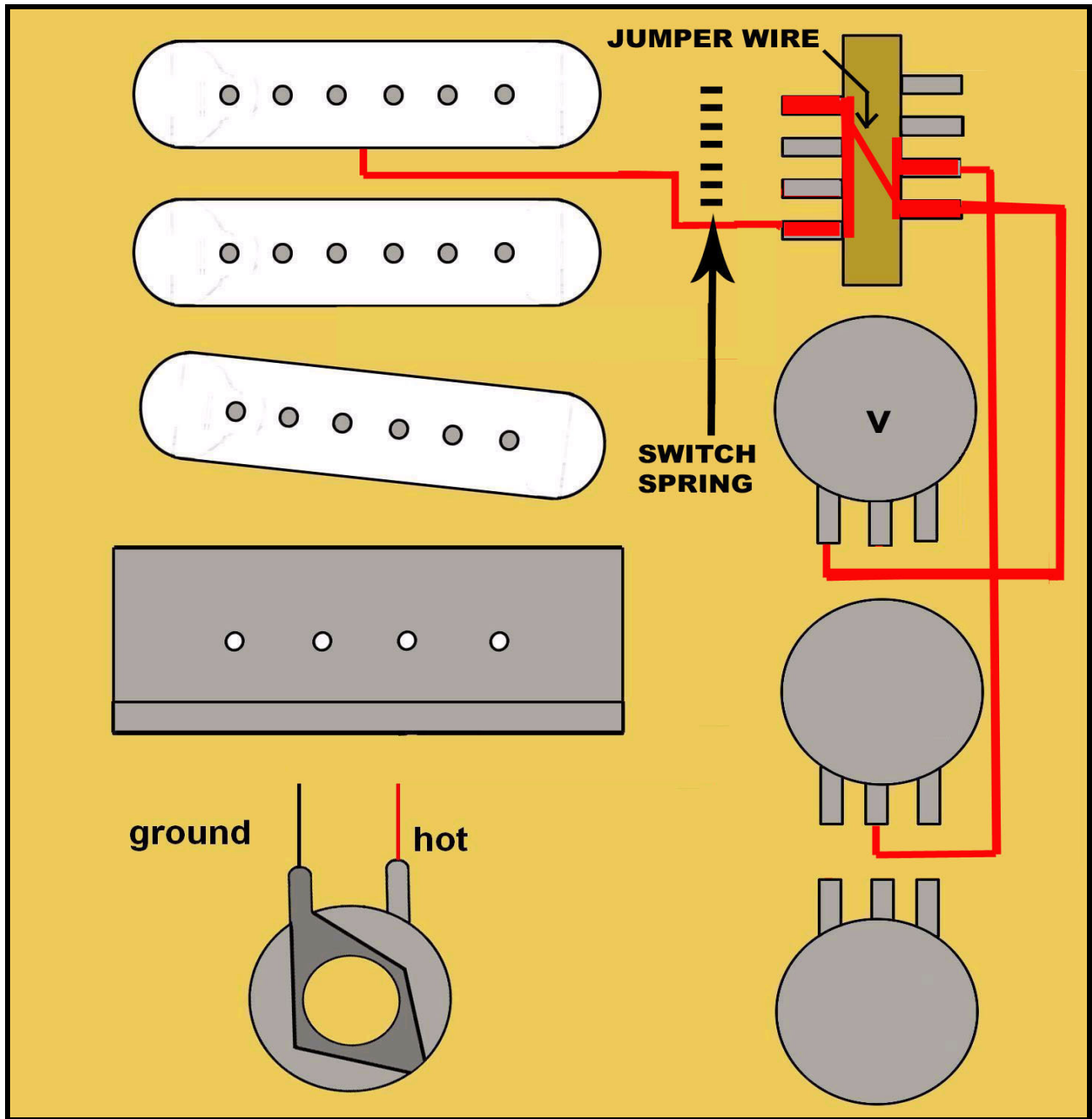


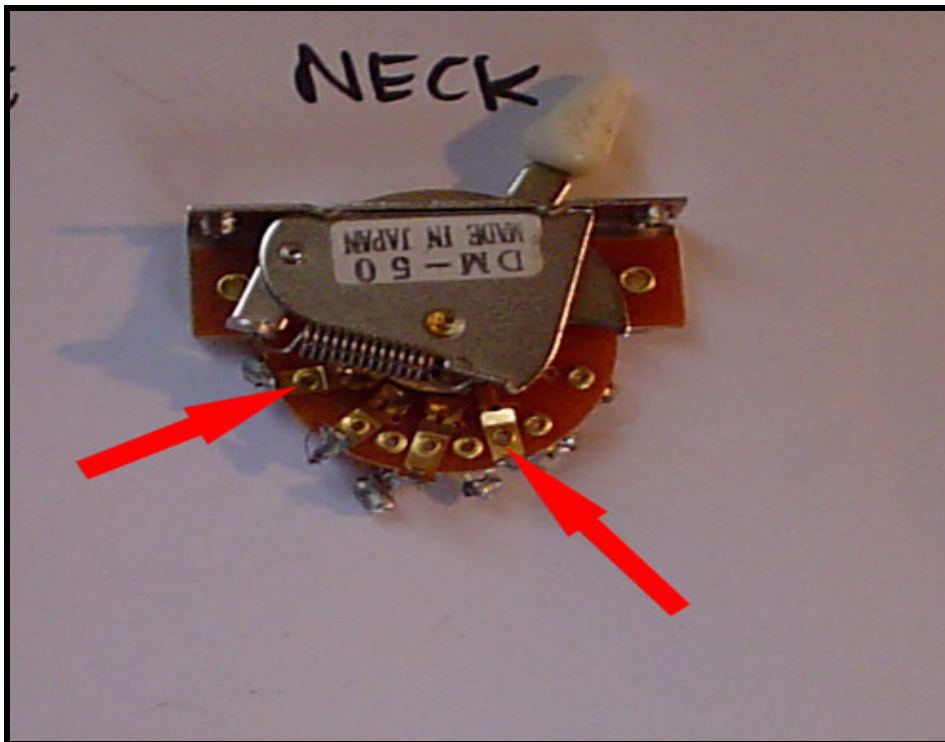
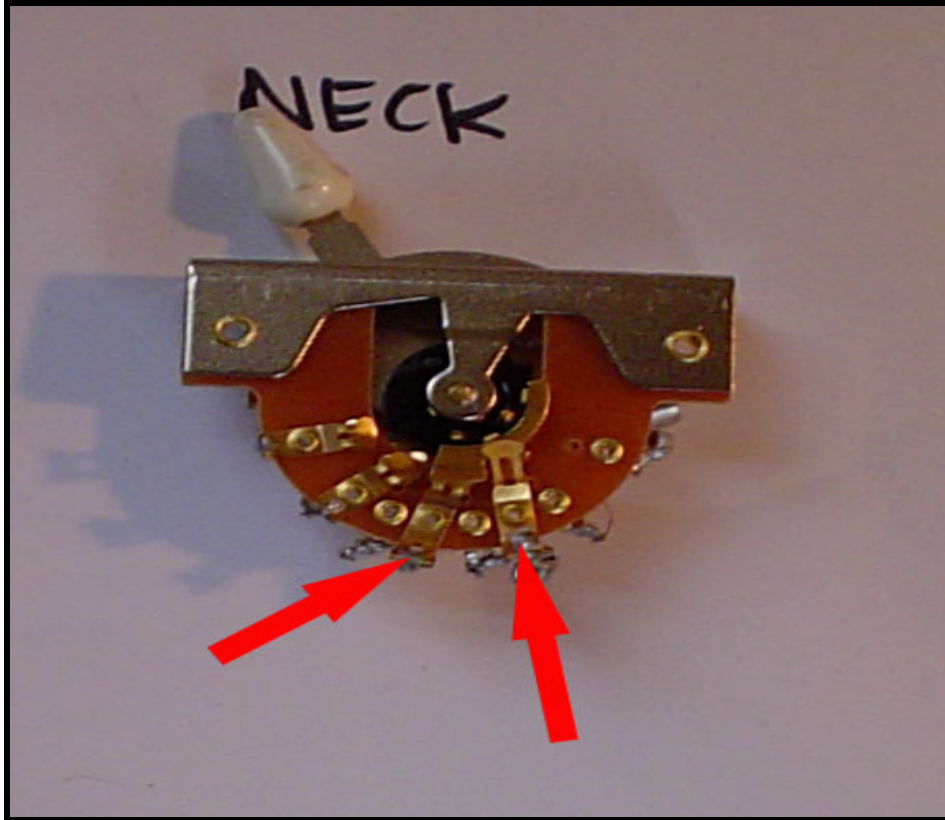
Here is the wiring for an import 3-way switch. Each selection will turn on only one pickup at a time.



## UNDERSTANDING 5-WAY SWITCHES

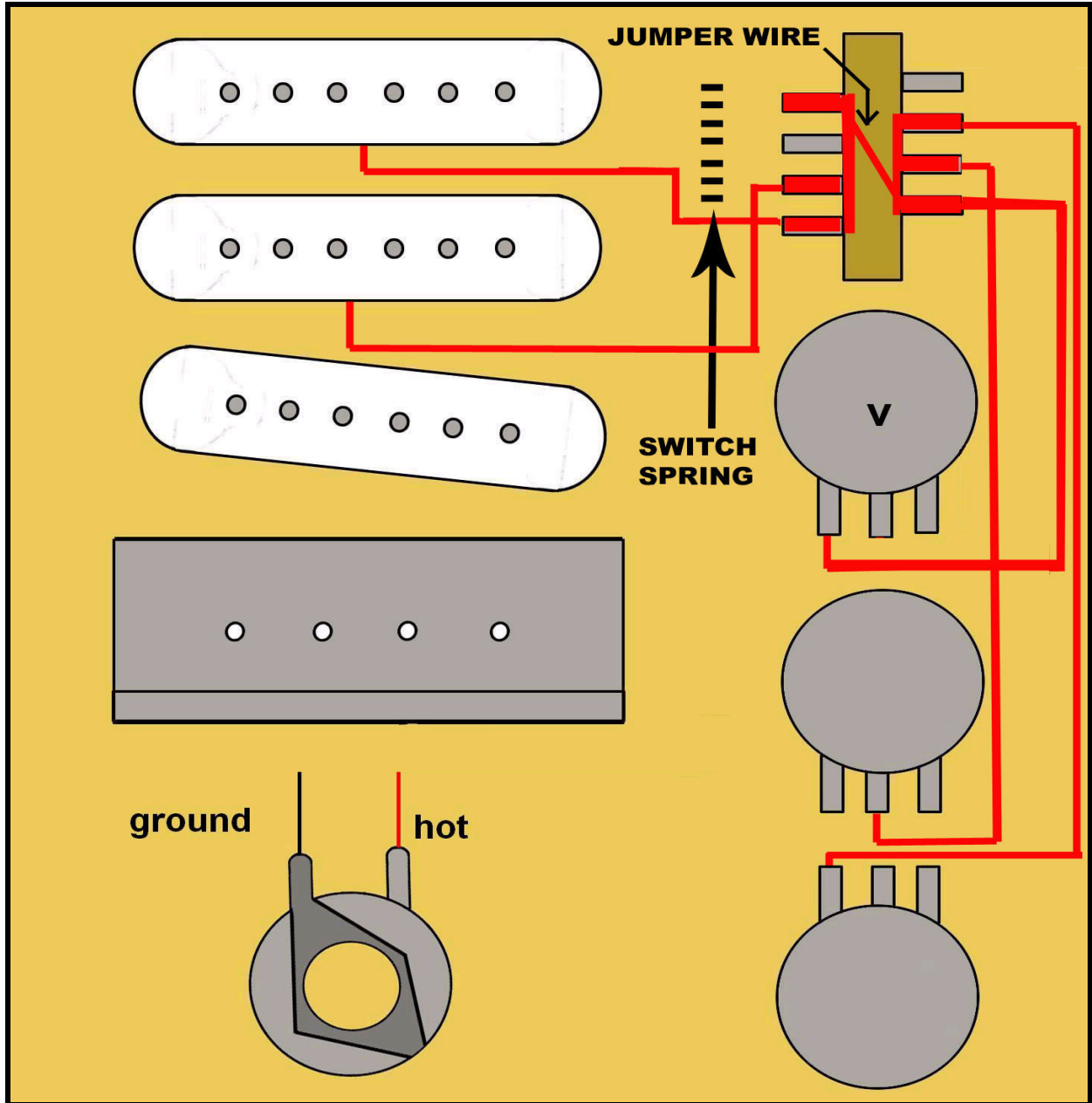
The 5-way switch is similar to the 3-way switch, with 4 lugs on each pole. But it has more lugs touching each other to come up with more combinations. The choices for this switch are neck pickup on, neck and middle pickups on, middle pickup on, middle and bridge pickups on, and bridge pickup on. The diagram below shows the neck pickup on.

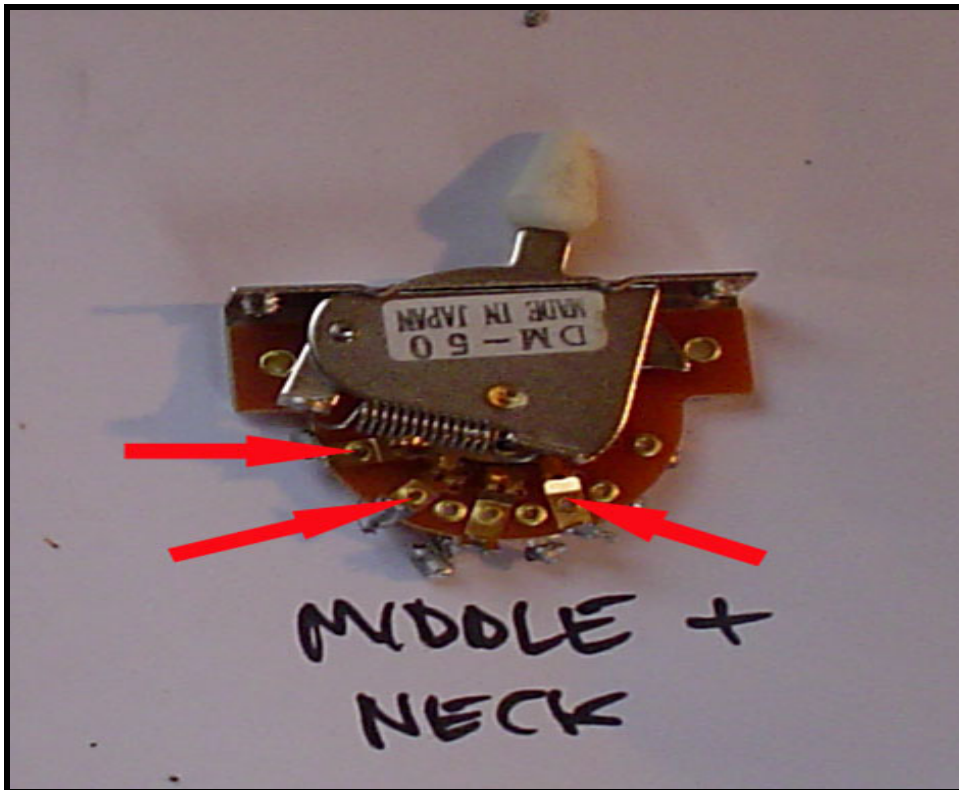
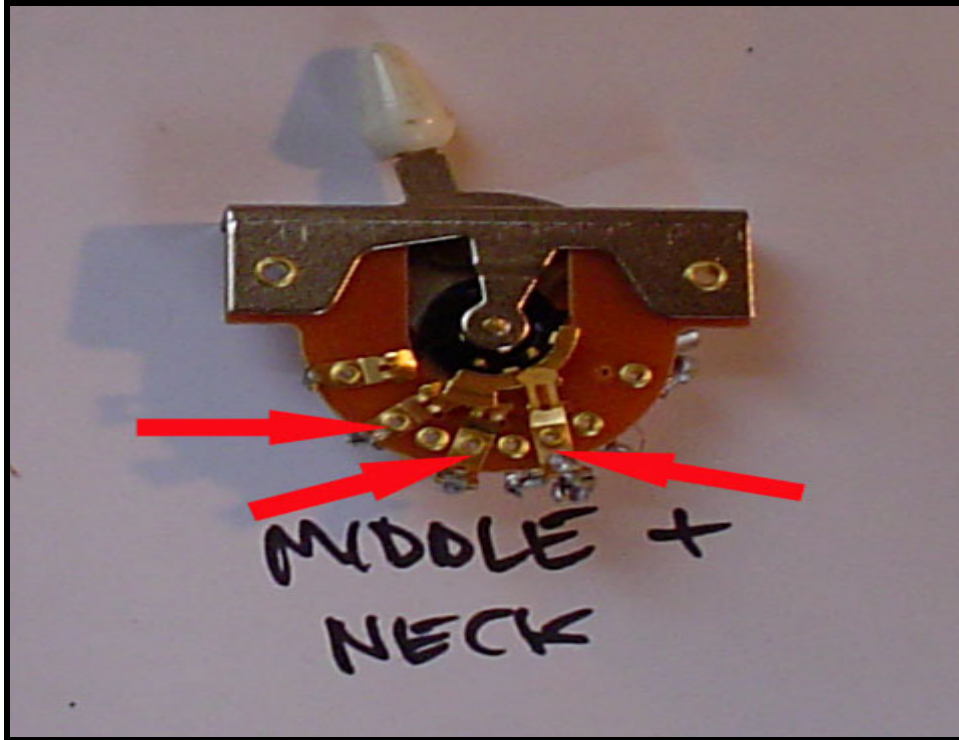




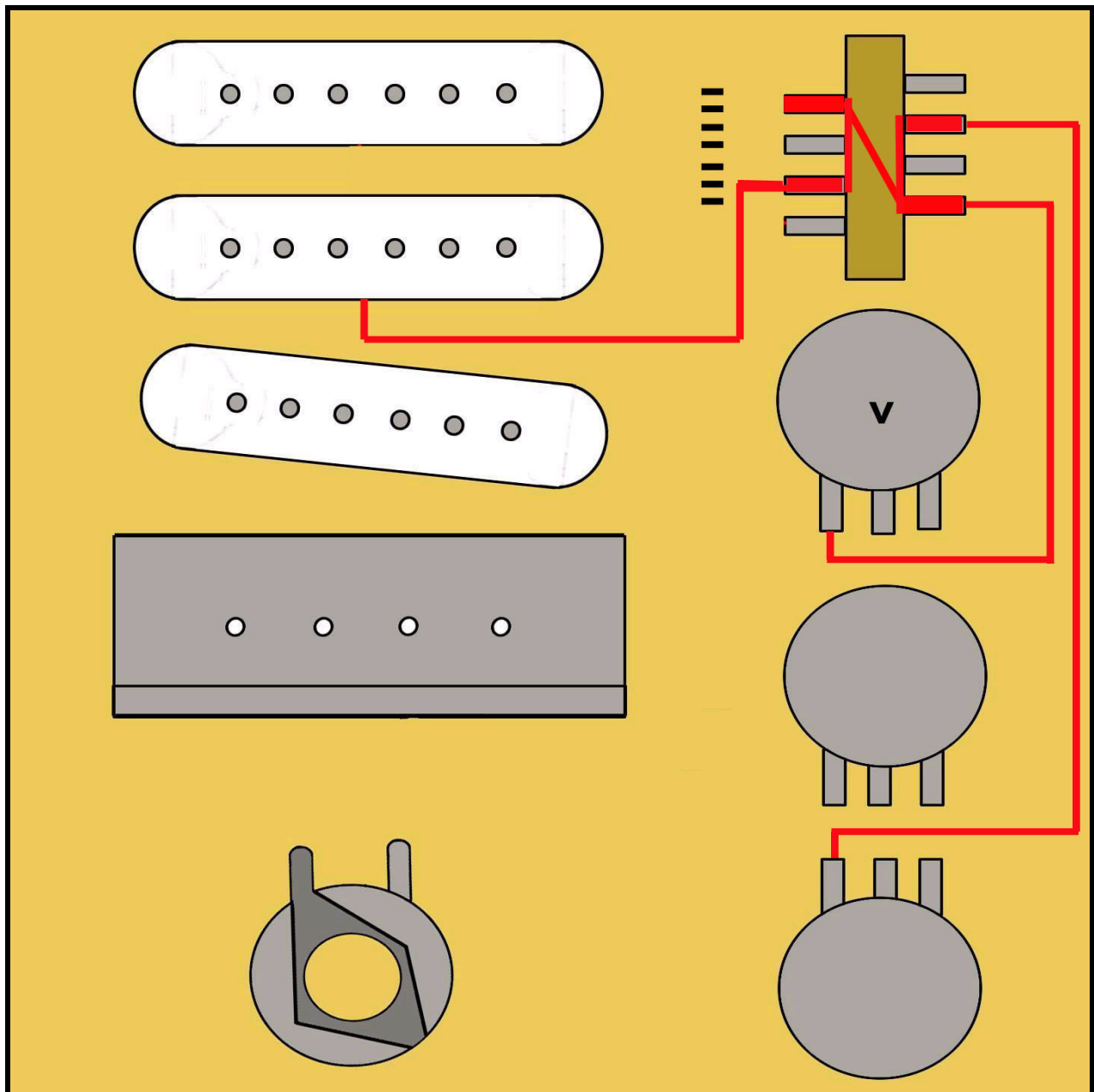


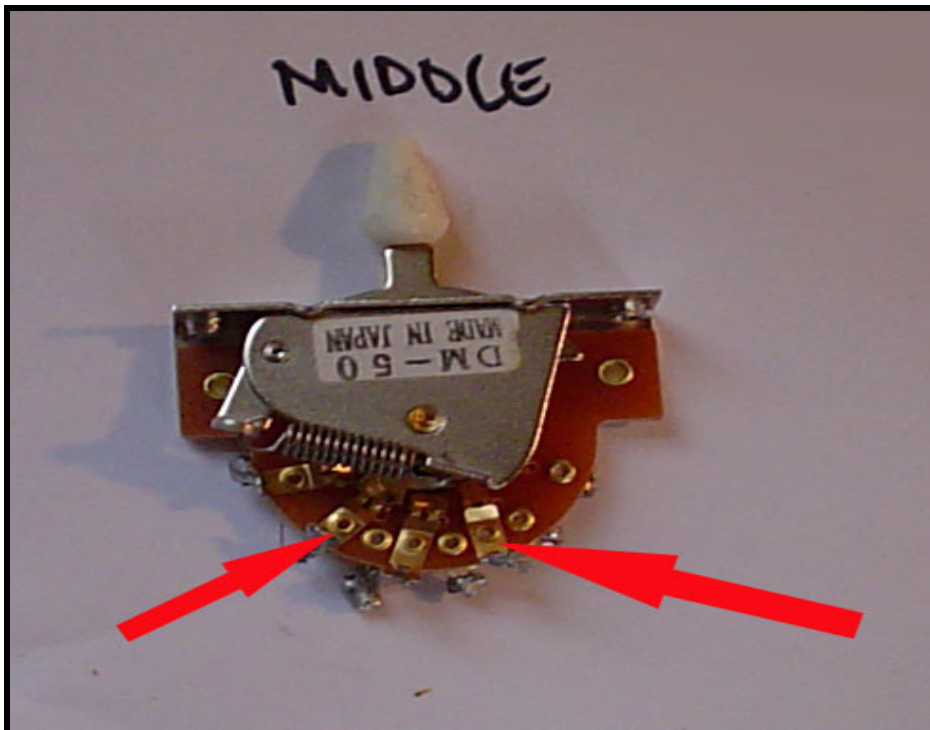
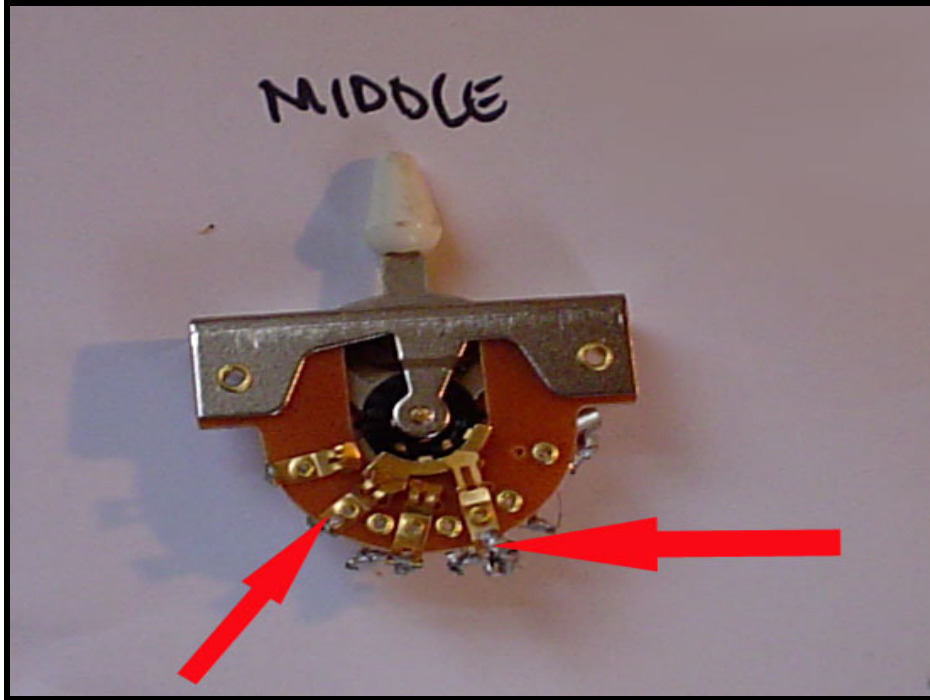
Here is the neck and middle pickups on. Adding the middle pickup gives you more mid range.



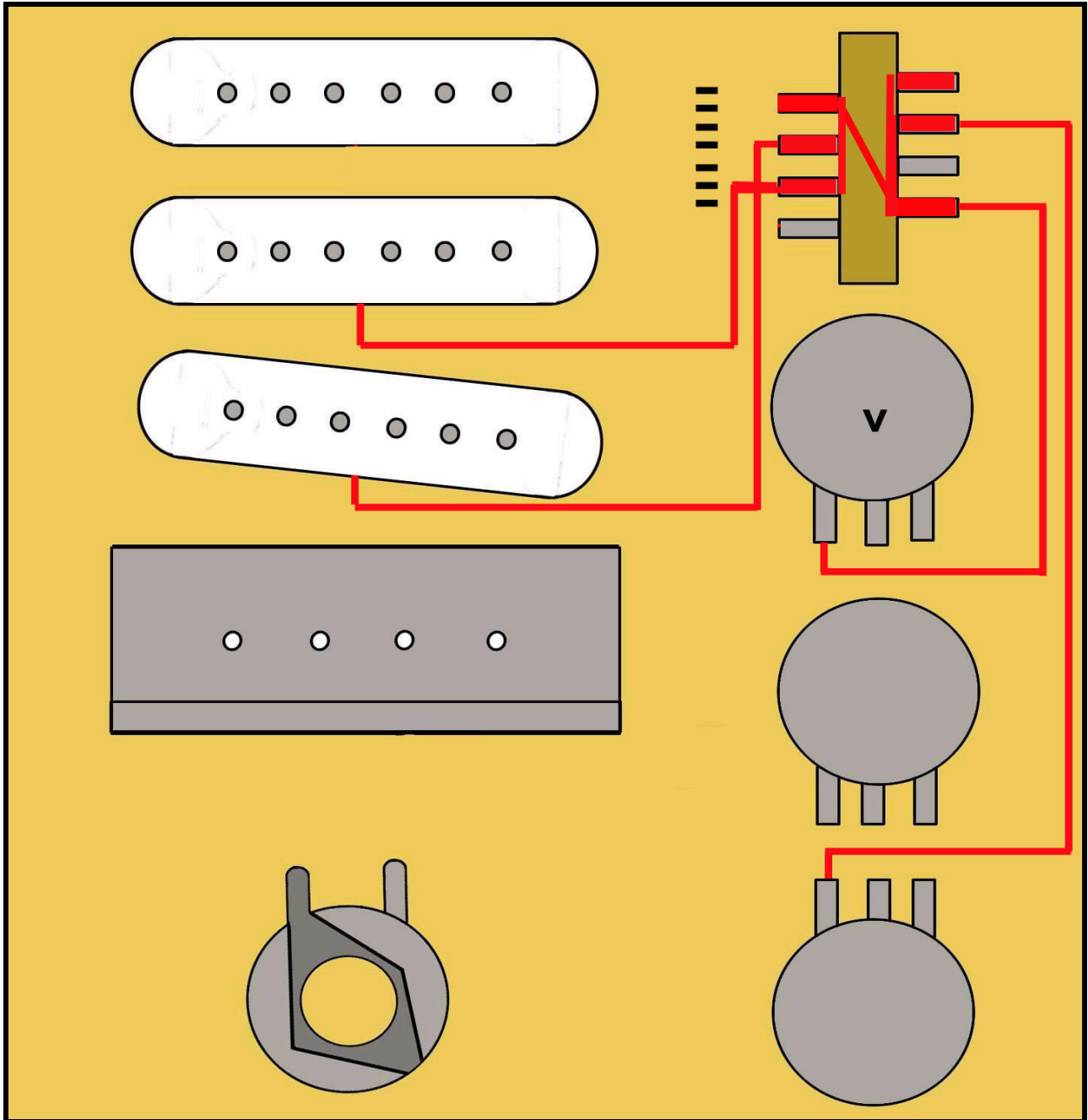


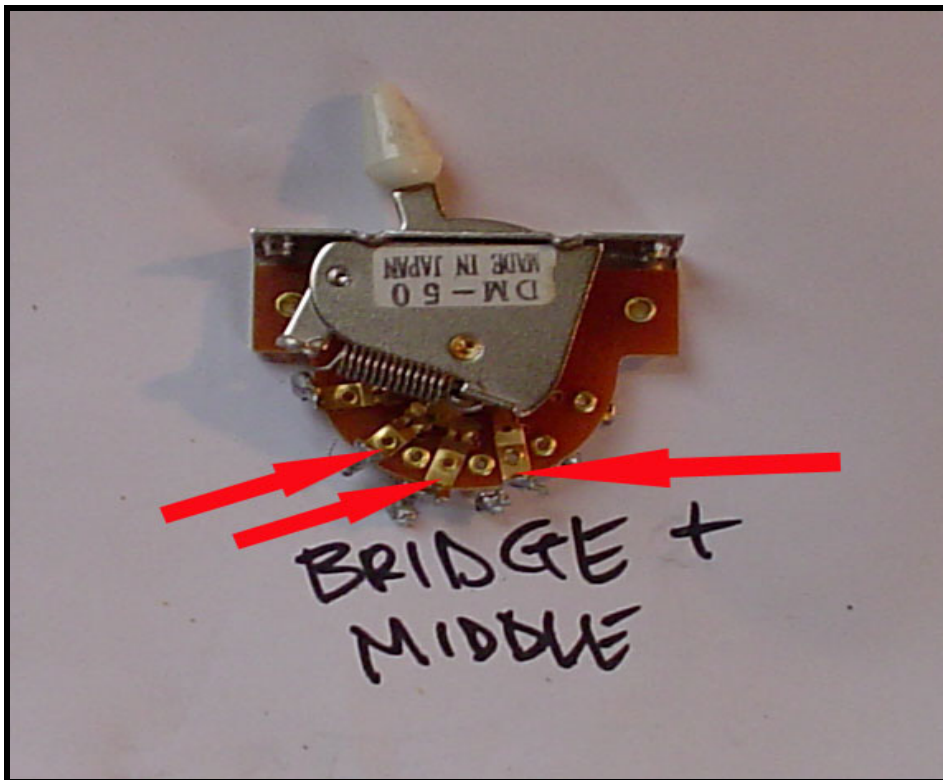
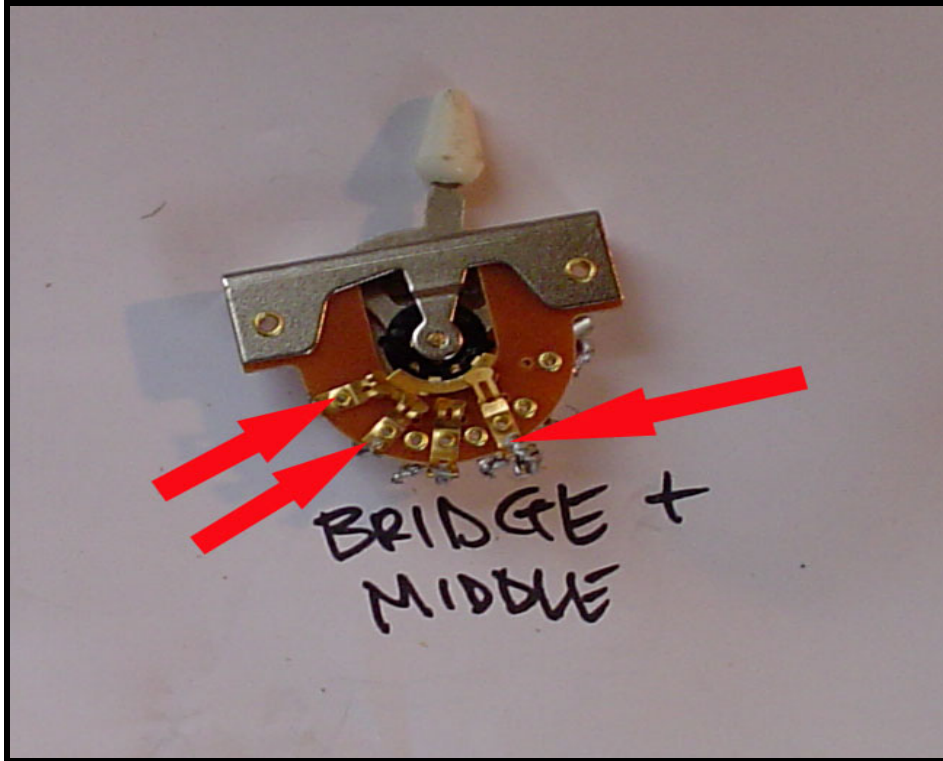
Let's talk about the middle position. The hot signal enters the switch on one side and travels through the jumper cable and out to the volume and tone pots on the other side. The tone pot farthest away from the volume pot controls the middle pickup's tone. This pickup combination is probably the least exciting out of the 5 choices available. It lacks the highs and lows that the other combinations have.



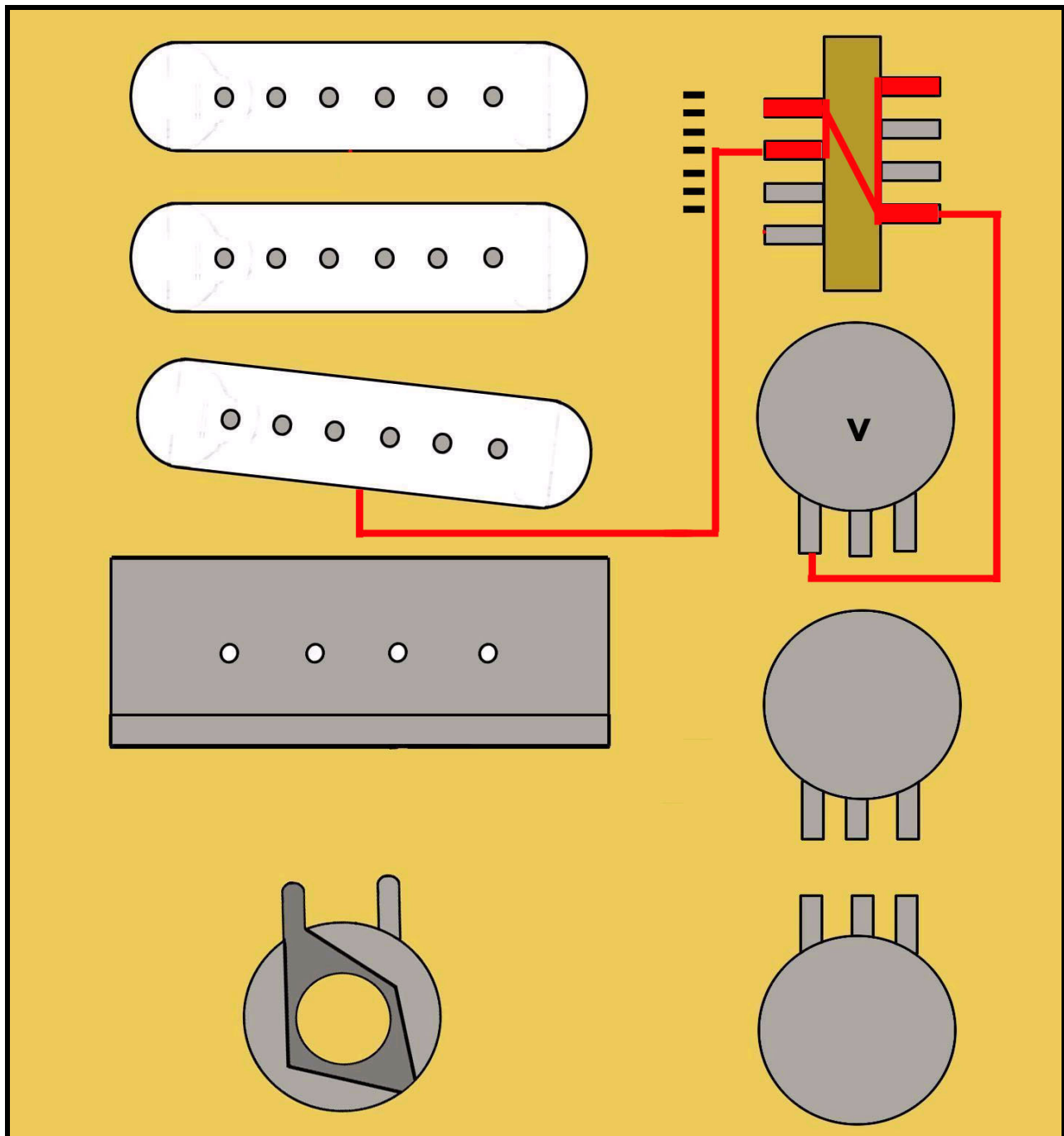


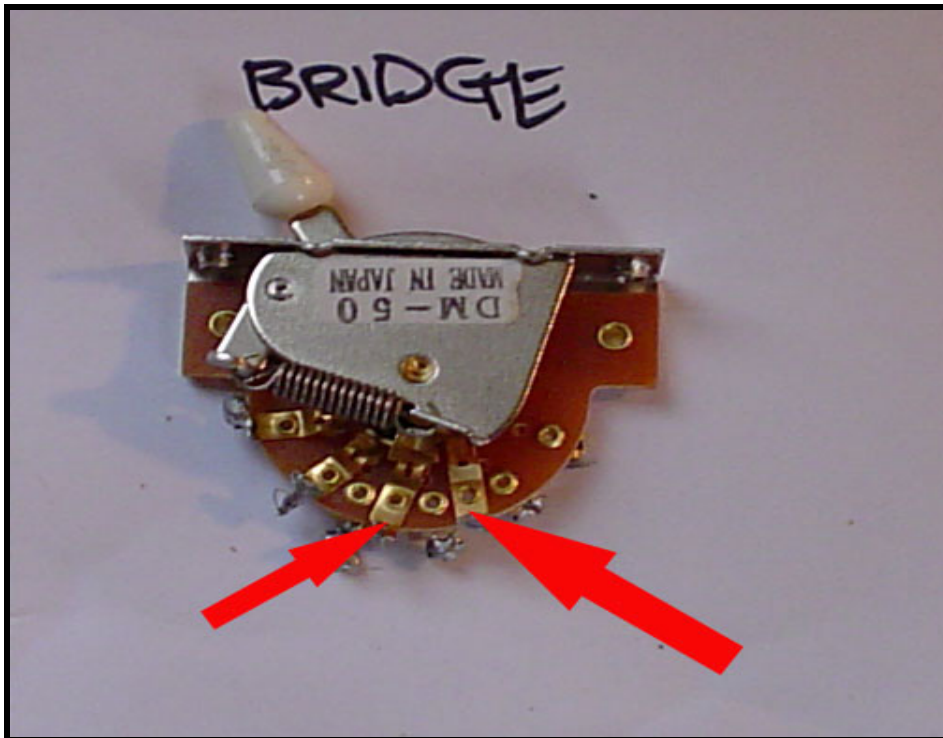
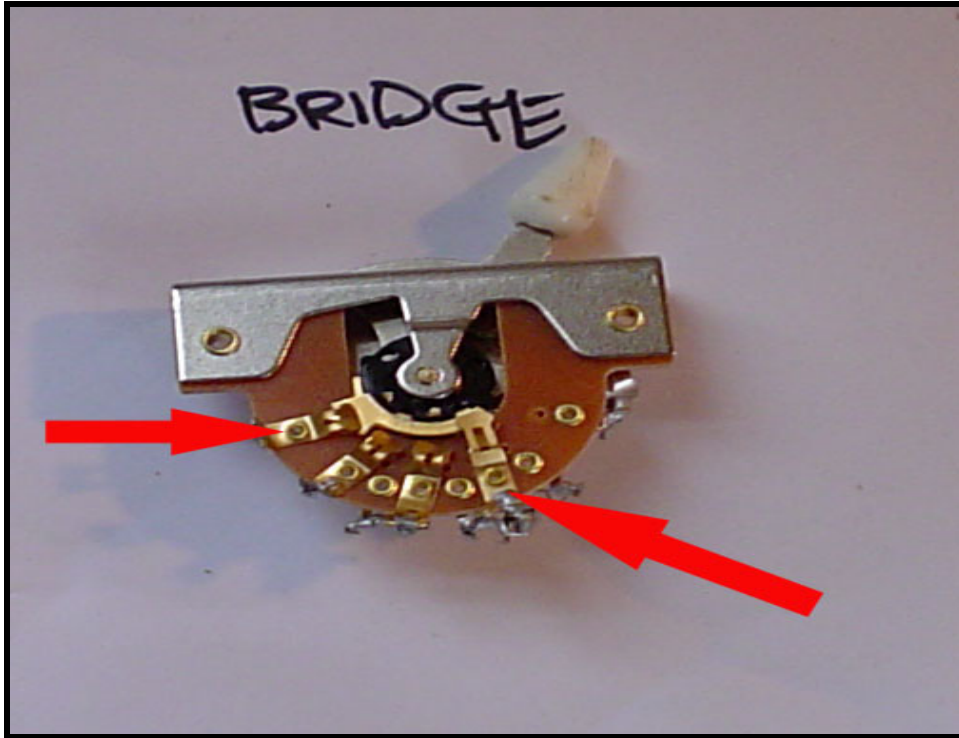
The next selection is the middle and bridge pickups on.



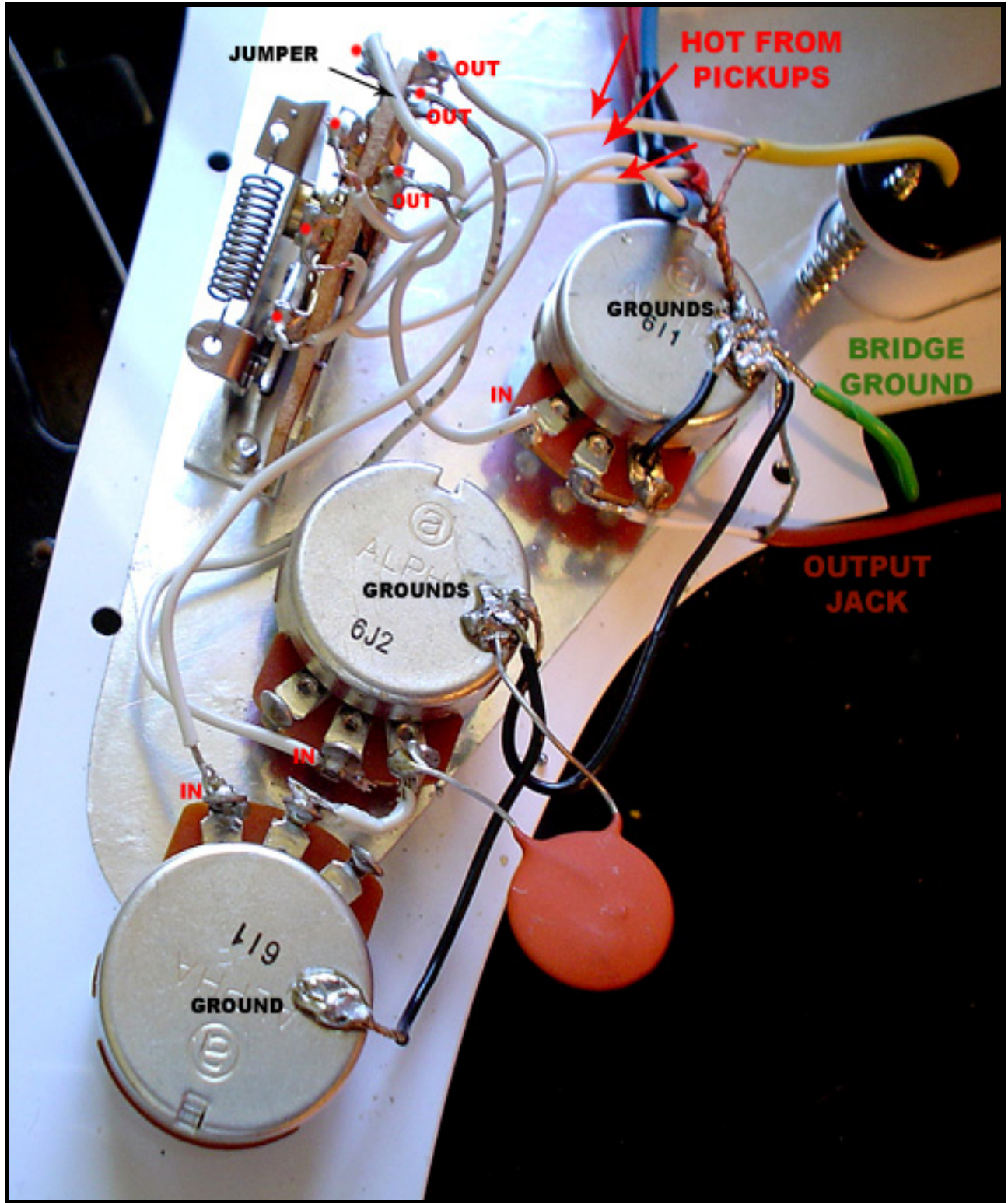


The last choice is the bridge pickup selection. This choice offers a lot of treble, and is perfect for playing heavy distortion with artificial harmonics. You can make the guitar scream with the bridge pickup. Notice there is no tone control for the bridge pickup. If you want more bass or midrange, then you need to select a different pickup, or modify your guitar.

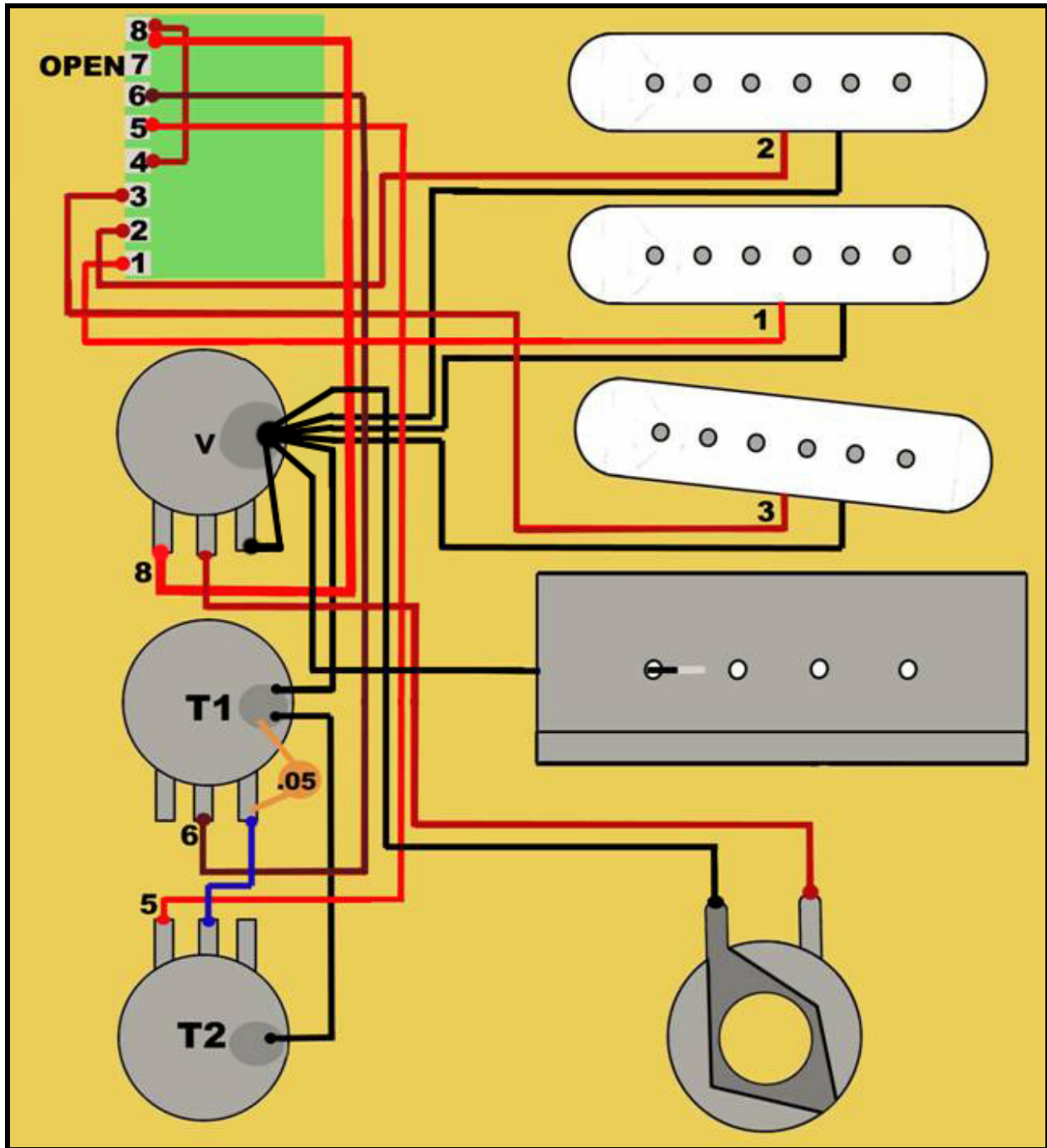


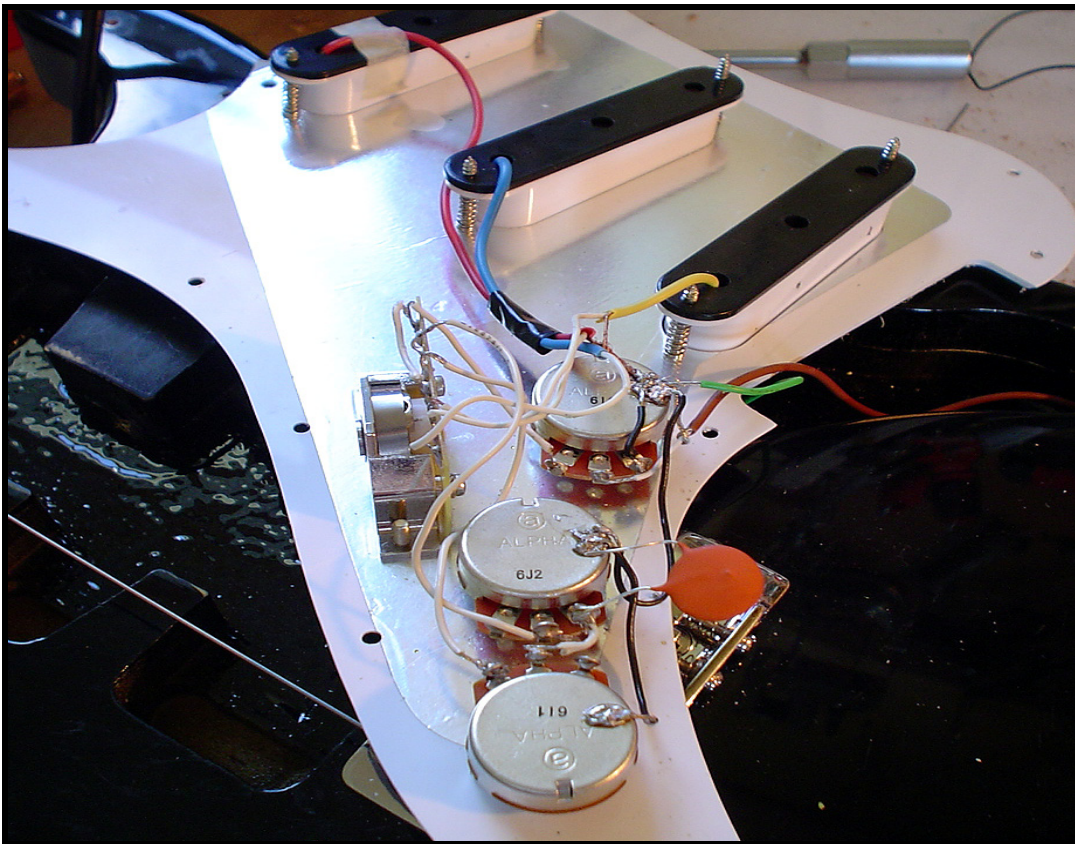
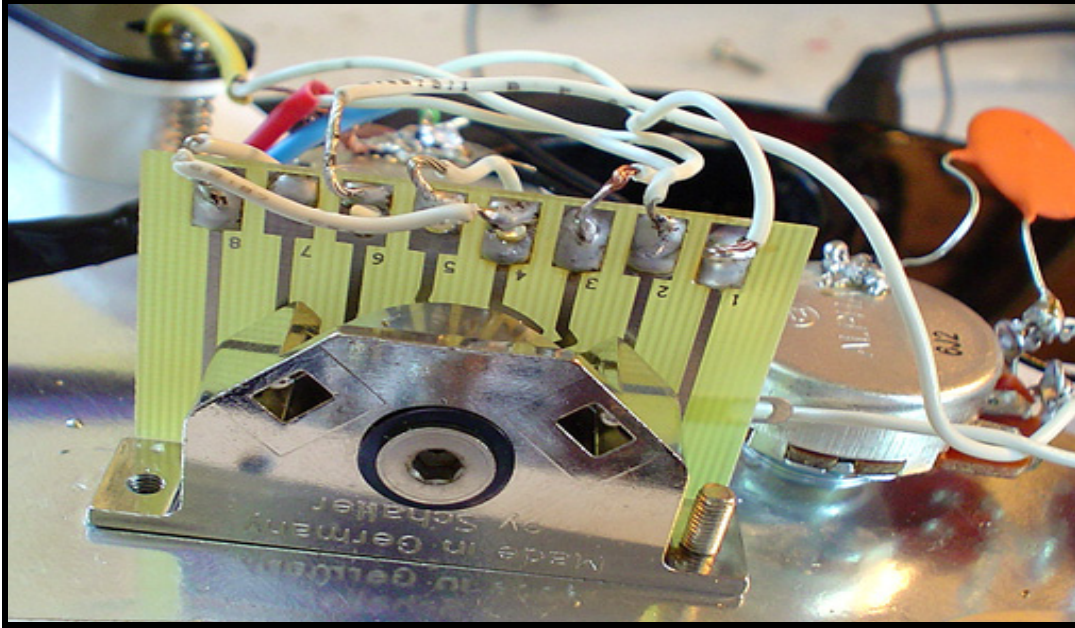




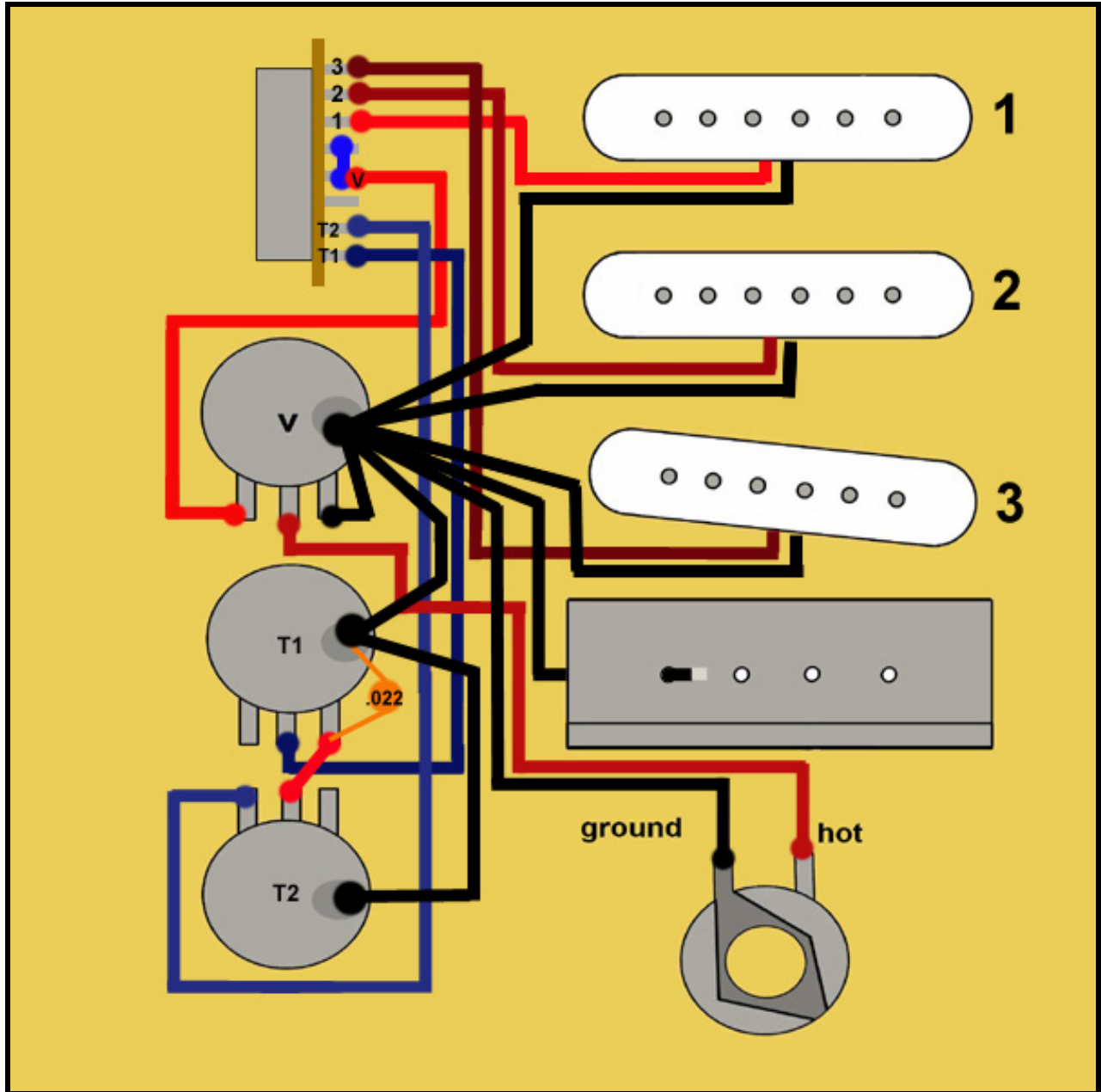


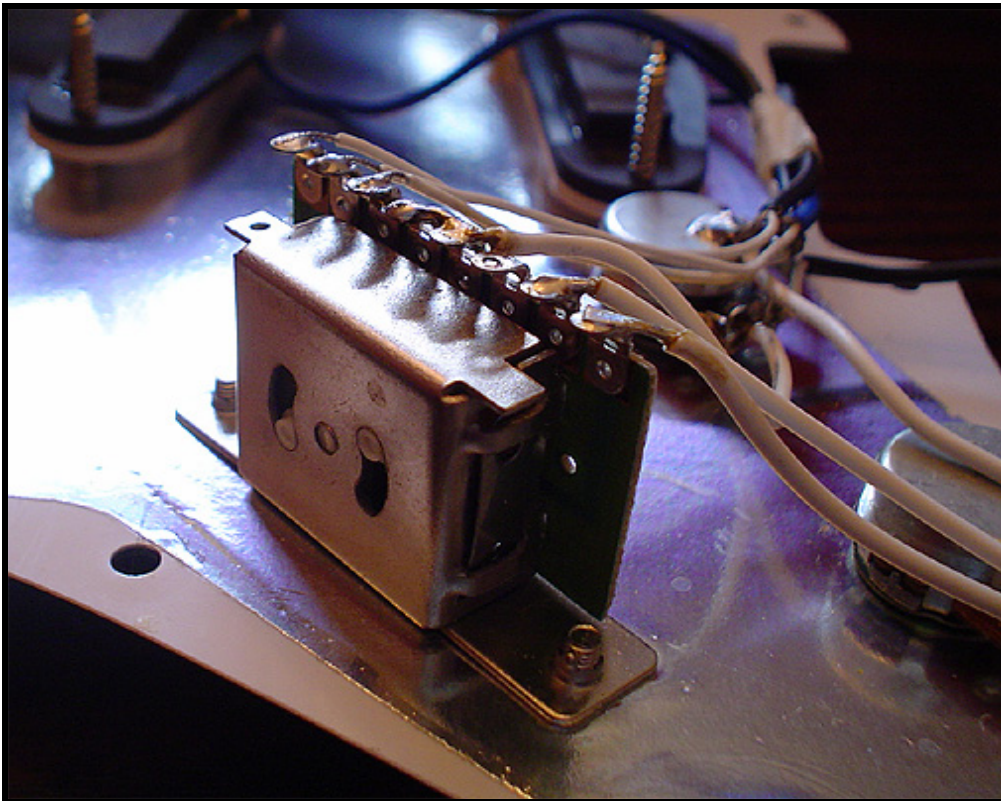
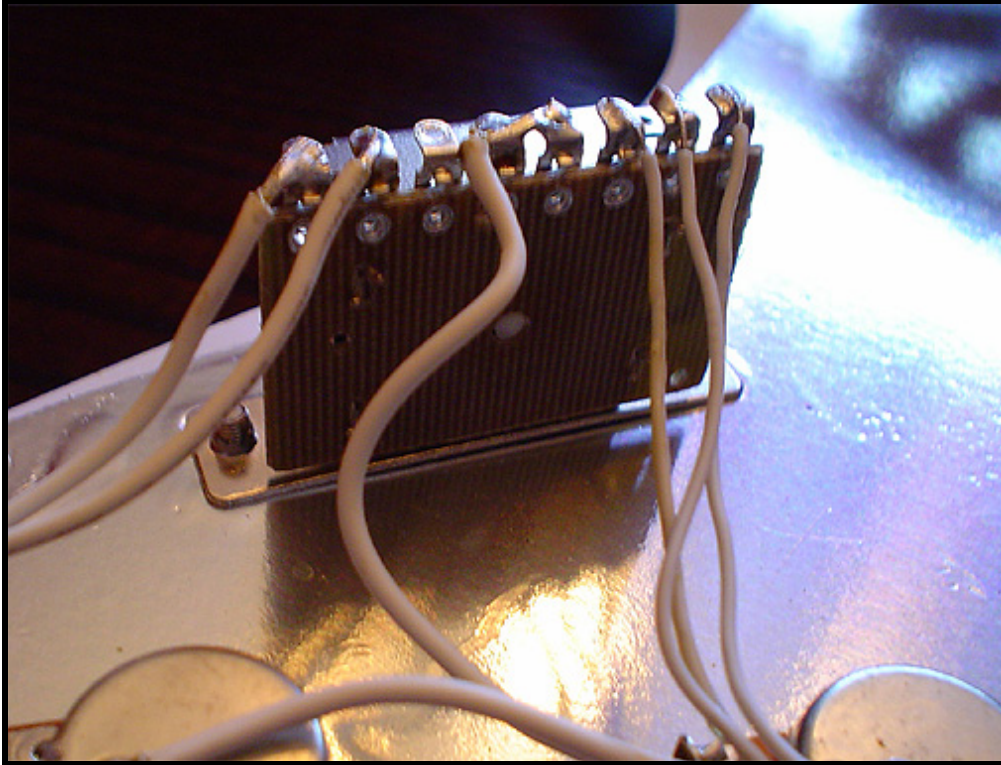
If you want to install a 5-way **mega switch** in your strat, then you can wire the guitar like this.



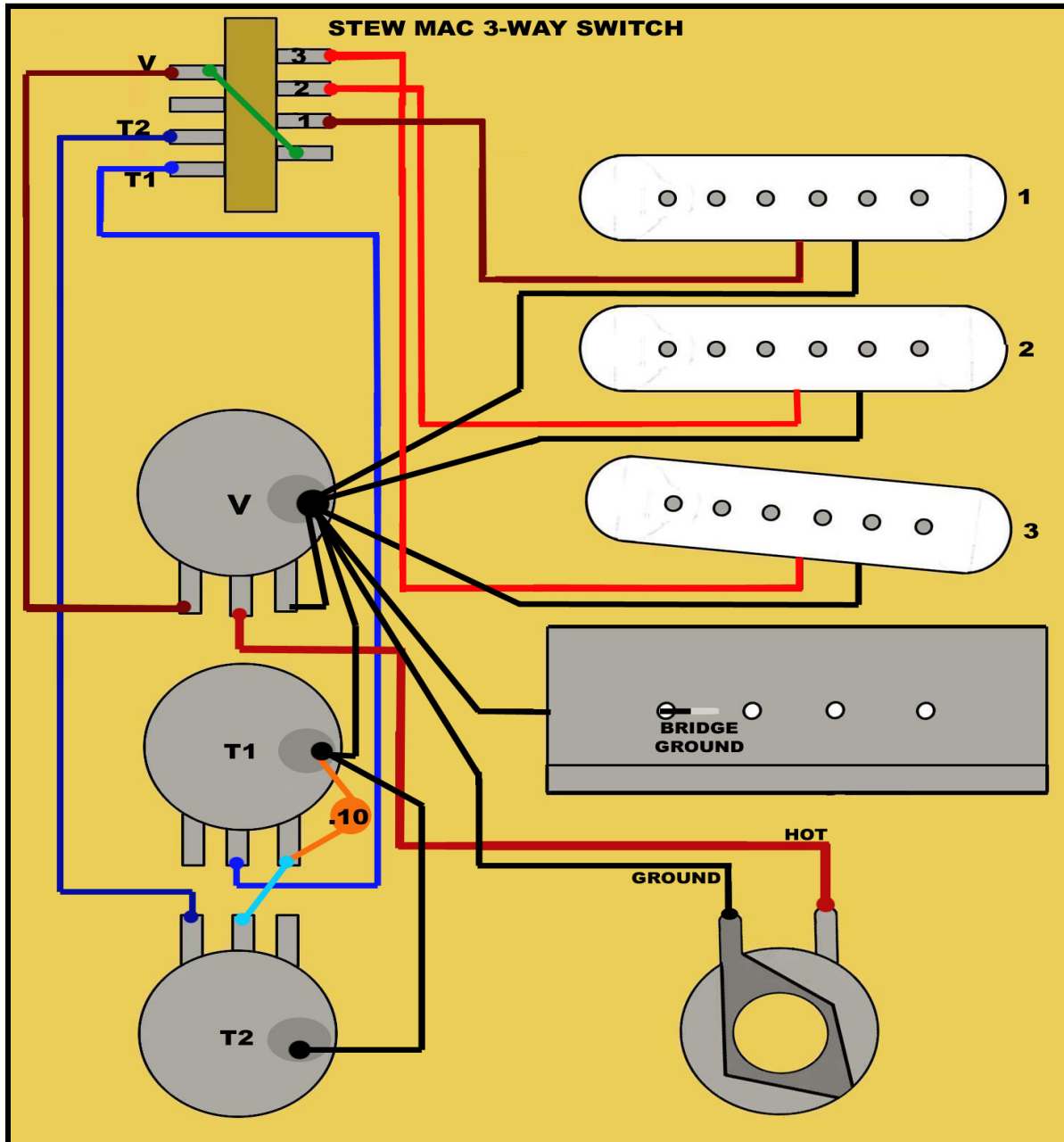


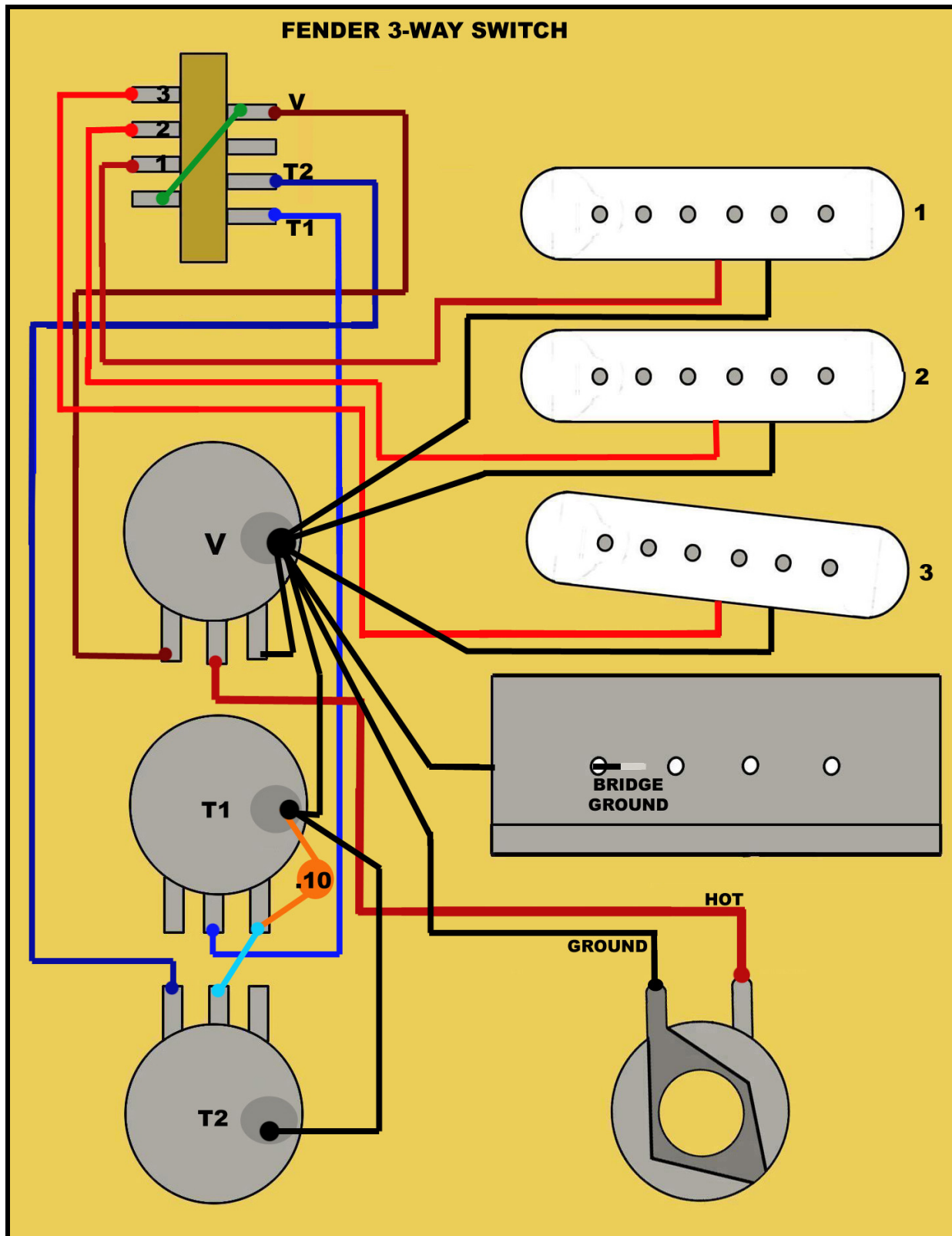
If you are using a 5-way import switch with 8 lugs, then the wiring would look like this. These switches are very inexpensive, but also very easy to wire.



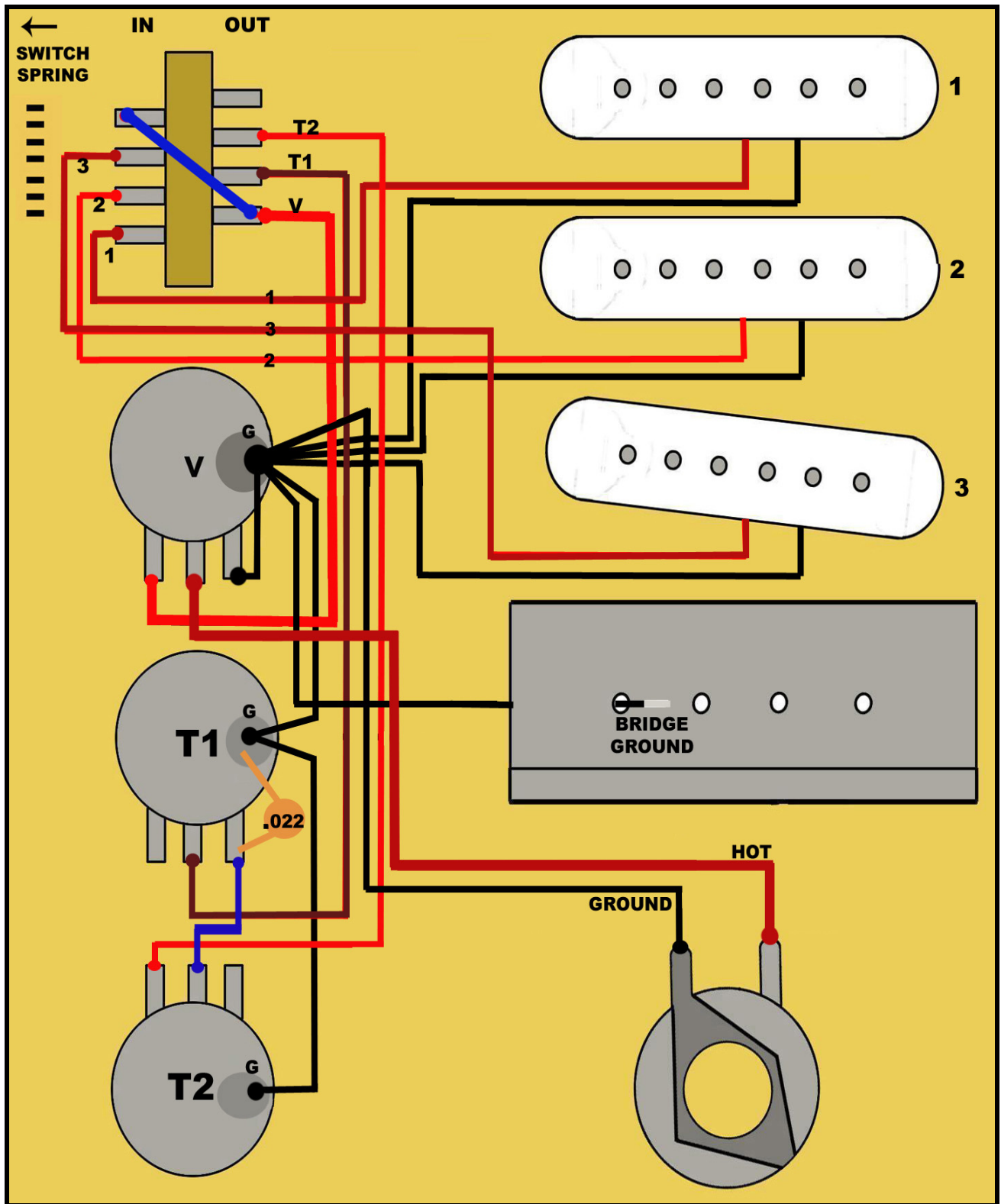


**Question: I've noticed the Fender and CRL selector switches look different than the Stewart McDonald selector switches. Will this change how to wire a guitar?**  
 Yes, it will. Basically, the Fender and CRL switches and the Stew Mac switches have their sides reversed. So the left side of a Fender or CRL switch is actually the right side of a Stew Mac switch. Fender and CRL switches look alike. Just pay attention to which side has the higher or lower set of lugs, and to what gets soldered to those lugs. Take a look at the diagrams on the next few pages.



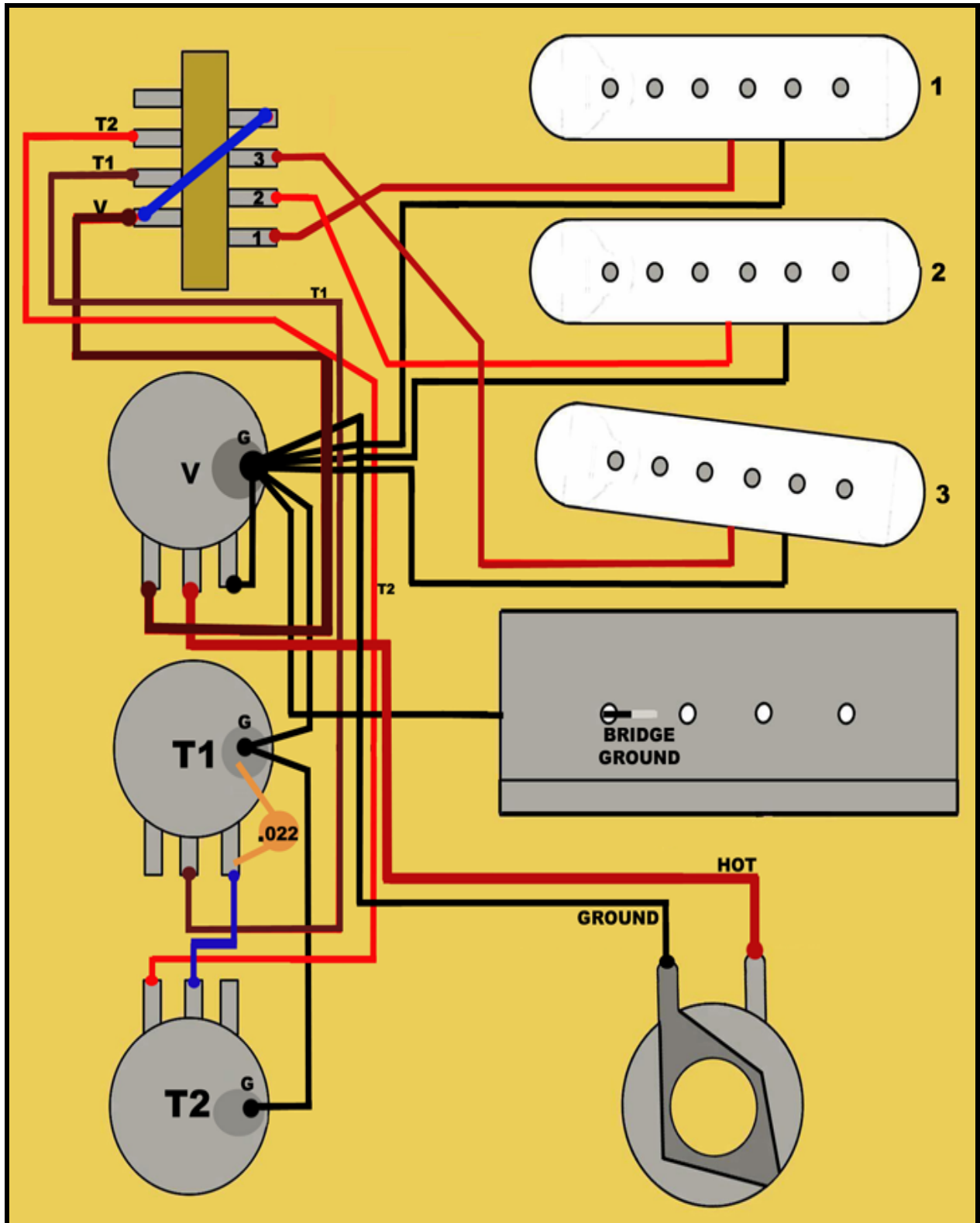


### Stewart McDonald 5-way switch

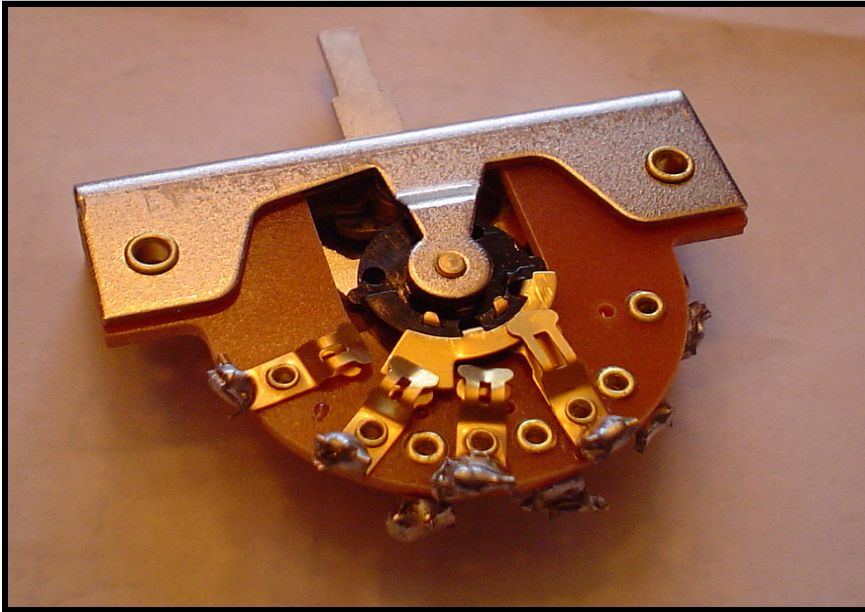




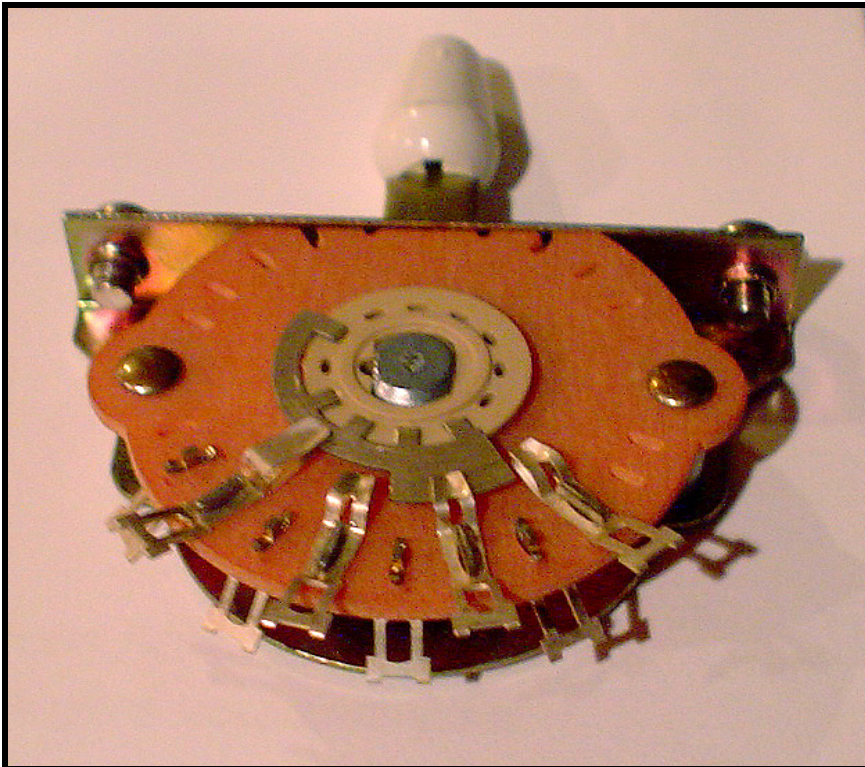
### Fender and CRL 5-way switch



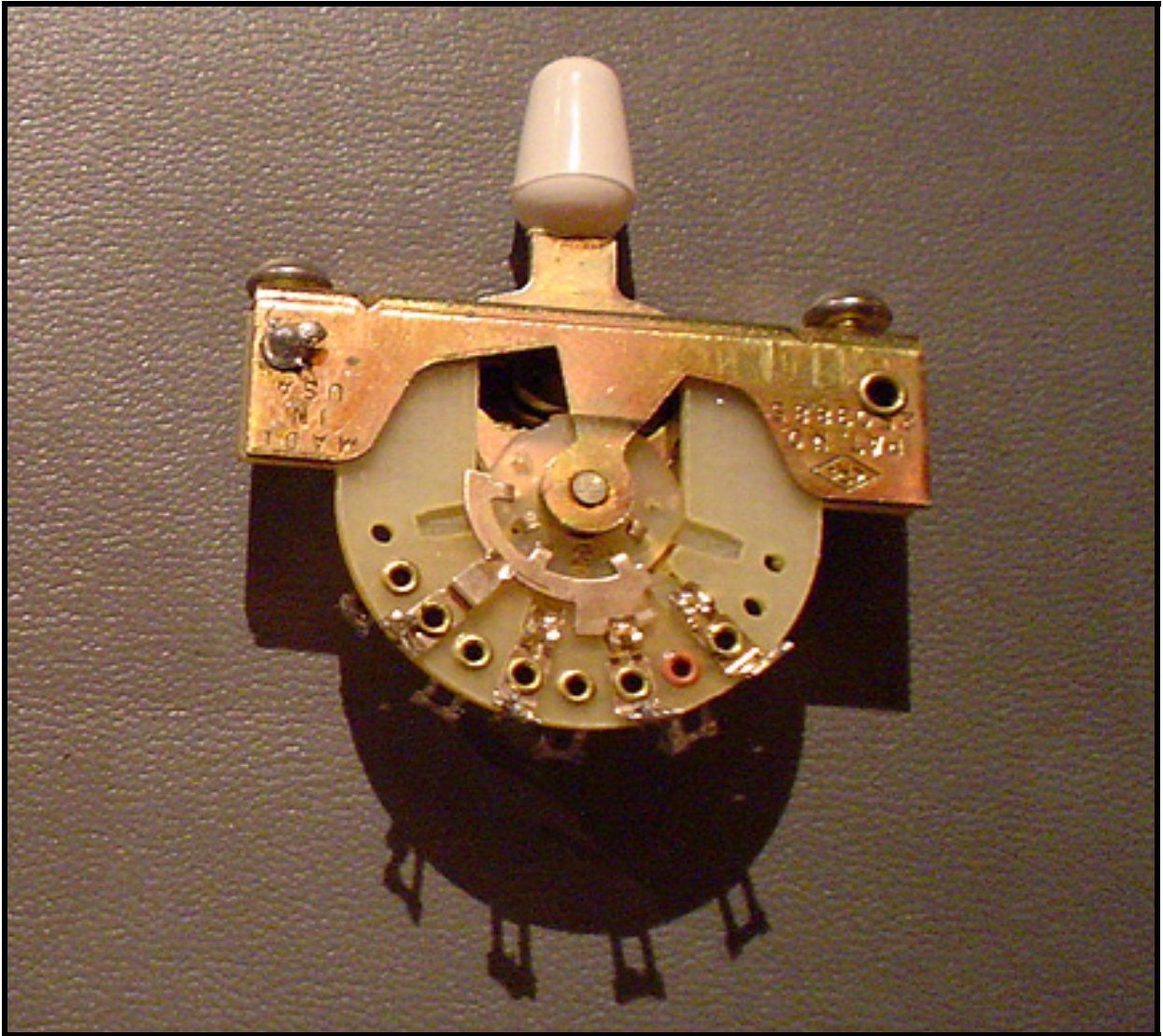
Stewart MacDonald lever switch from Japan



Fender lever switch

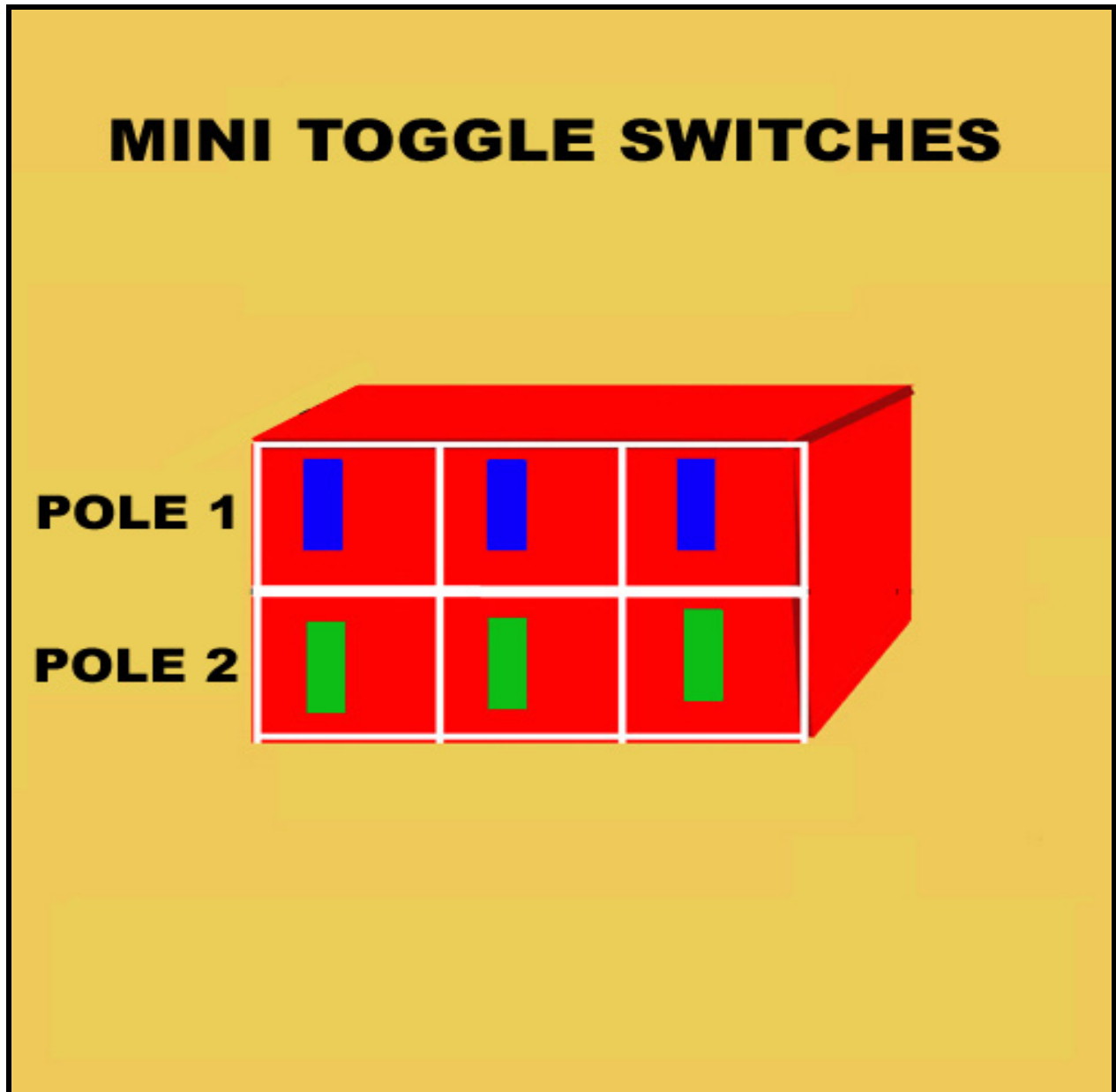


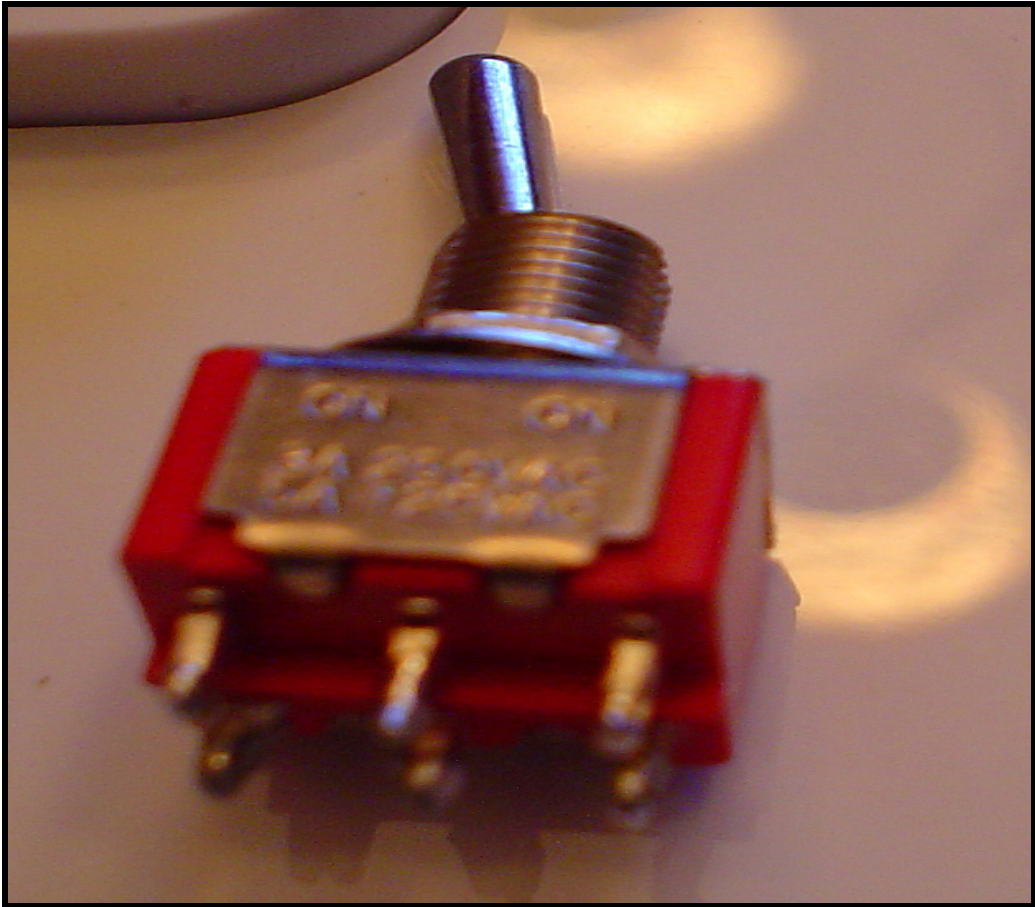
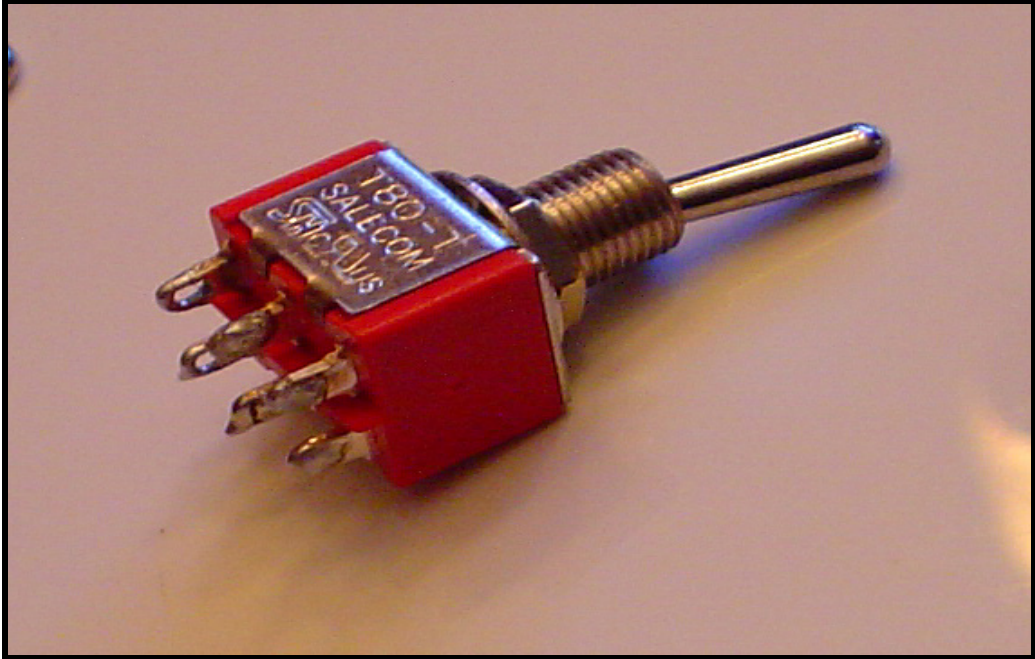
CRL lever switch from the USA



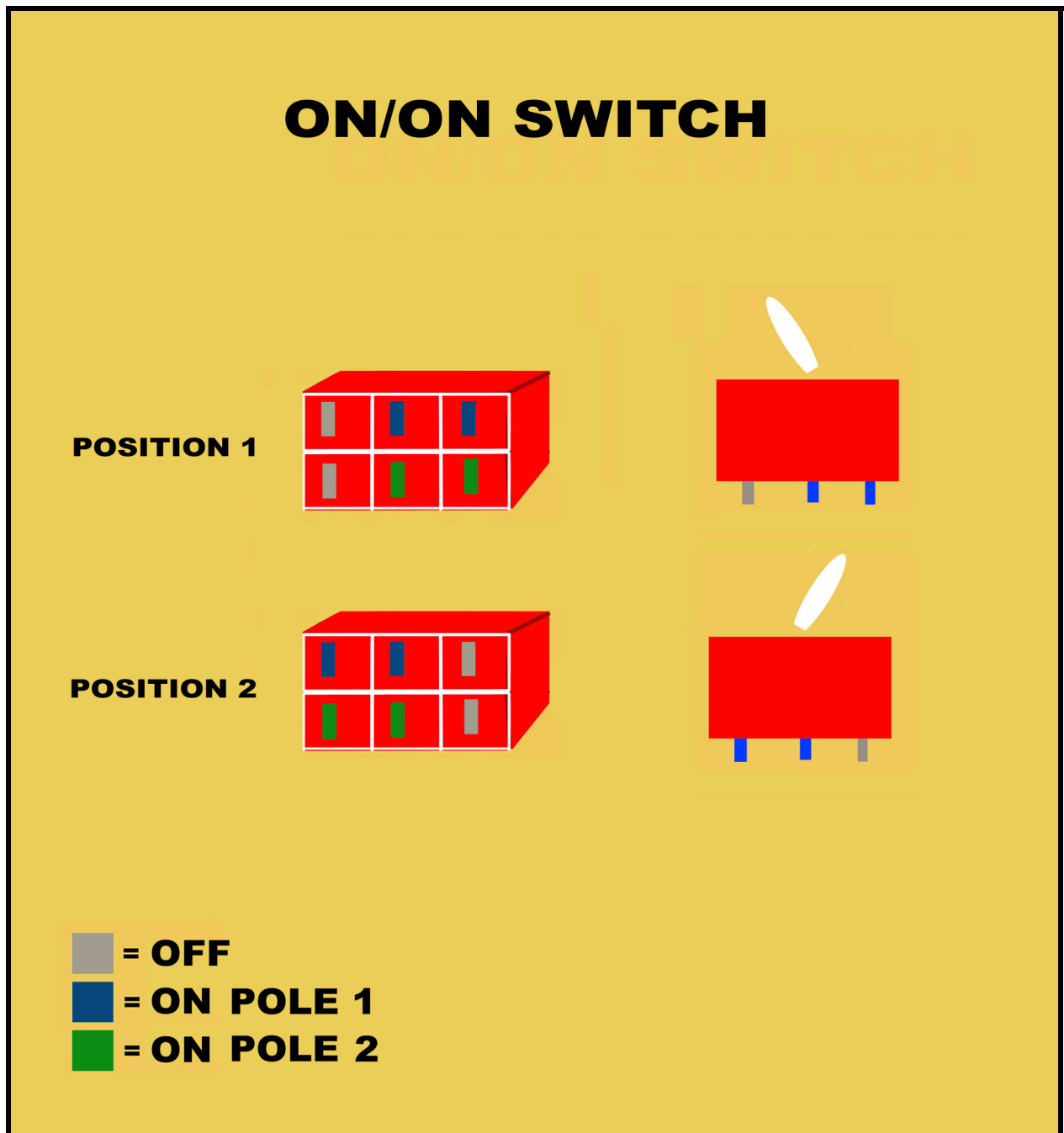
## UNDERSTANDING TOGGLE SWITCHES

Toggle switches open or close a circuit. In other words, they turn a signal on or off. They can be used for all types of guitar modifications, including series/parallel wiring, phase reversal, and coil cutting. The mini toggle switches we will be using in this book are **DPDT (double pole, double throw) switches**. Since they have 2 poles, they have two separate channels that are not connected to each other, unless you add a jumper wire.

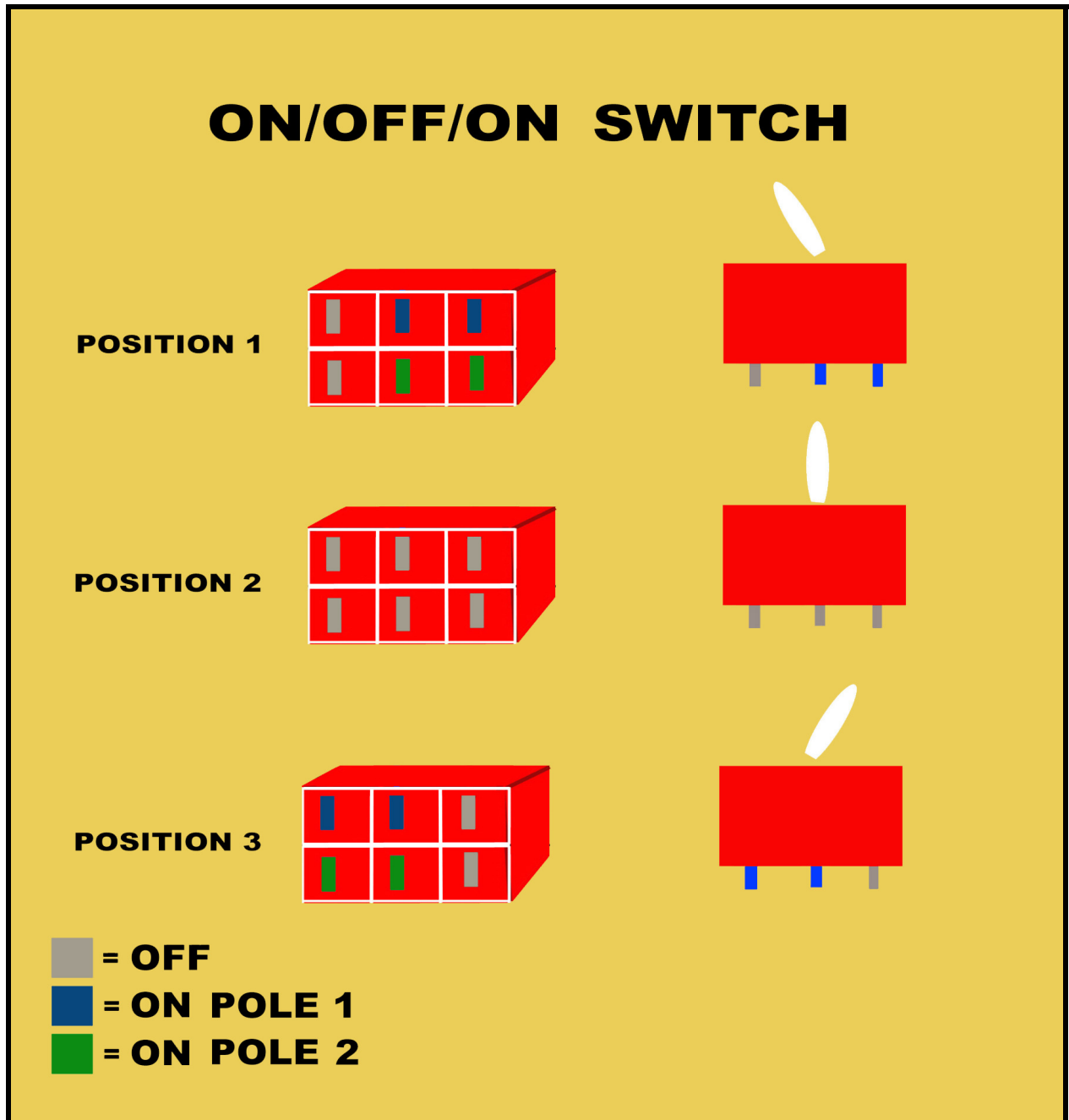




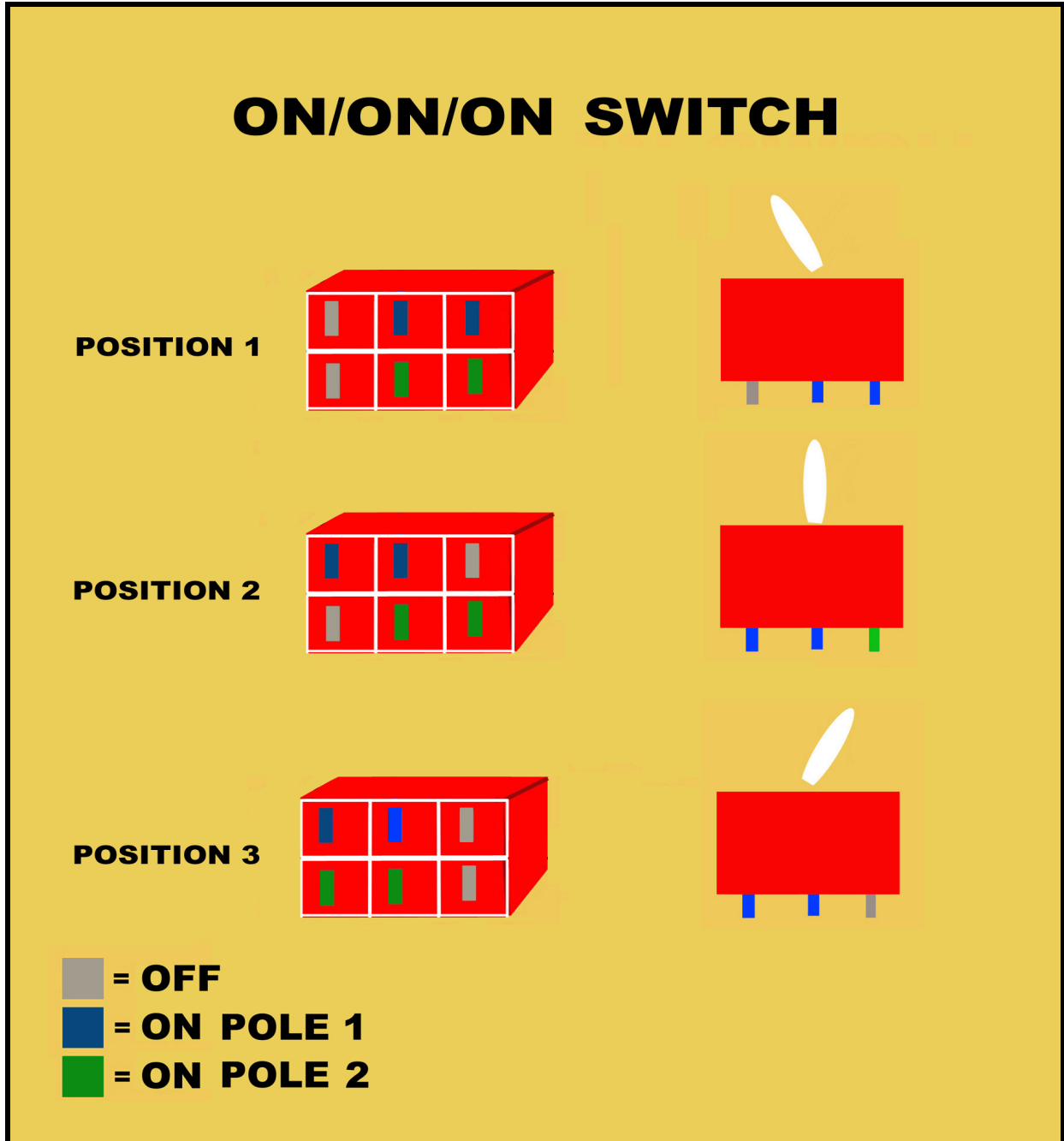
This 2-way mini toggle switch is an **on/on DPDT (double pole, double throw) switch**, and you can purchase them online for cheap. This switch is an on-on switch, meaning it turns one side on, or the other side on. So when one signal is turned on, the other signal is turned off. It has six lugs, 3 on each pole. The lugs that are hot, or "on", are colored in blue or green. The lugs that are off are colored in grey. Each color represents a different pole. If you are reading the hardcopy version of this book, be sure to check out the chapter on downloading the color ebook version.



There are a few other types of 3-way mini toggle switches that can be useful in guitar wiring. One is an **on/off/on DPDT center-off switch**. It is the same as the on-on mini toggle switch, with an additional stop in between the left and right setting. The middle position cuts the power. So it is an on-off-on switch. Here is what it looks like.

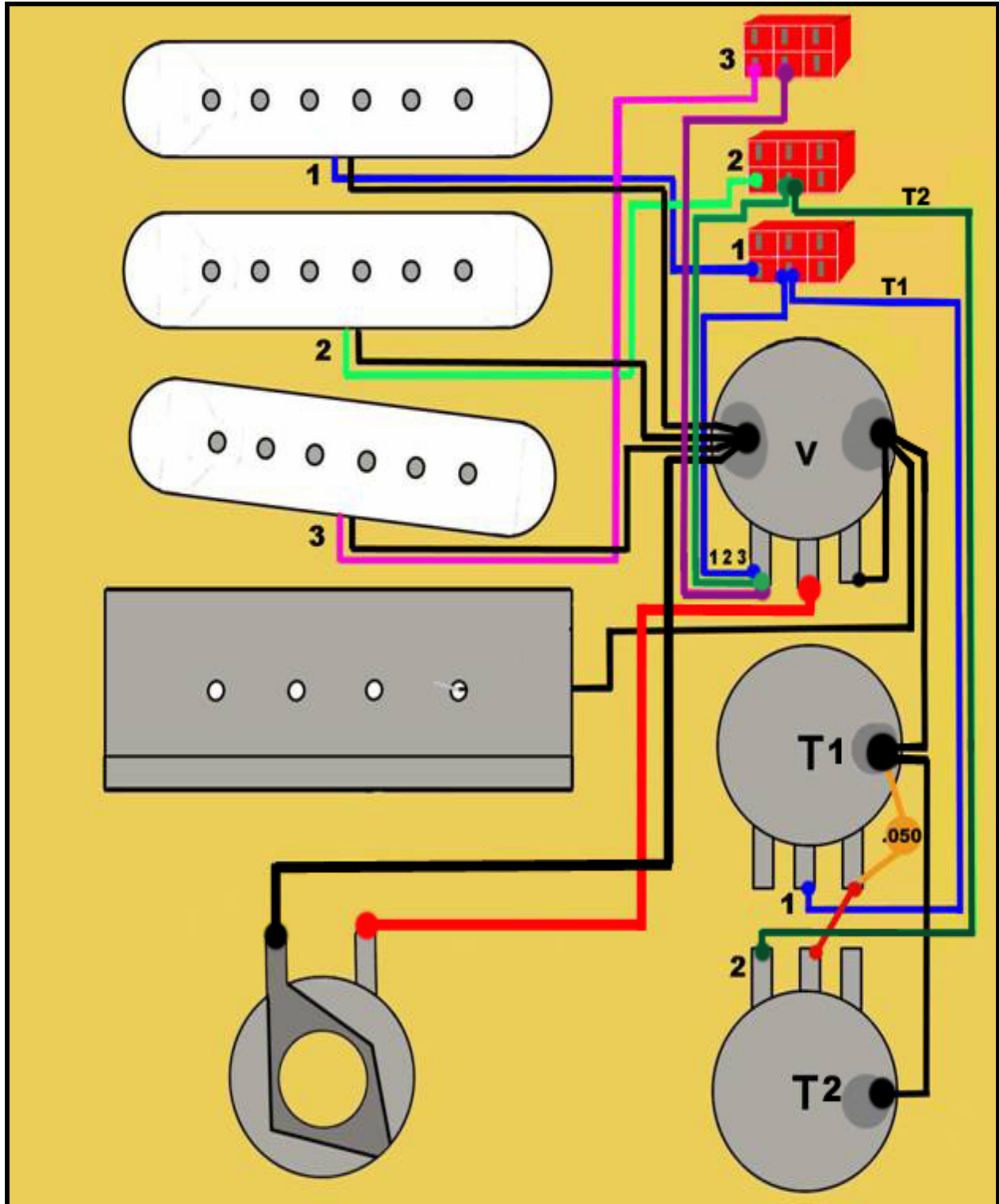


The next 3 -way mini toggle switch is an **on/on/on DPDT center-on switch**. It is used for series/parallel switching, coil cutting, and phase reversing. It turns on the top left lugs and bottom right lugs while in the middle position.

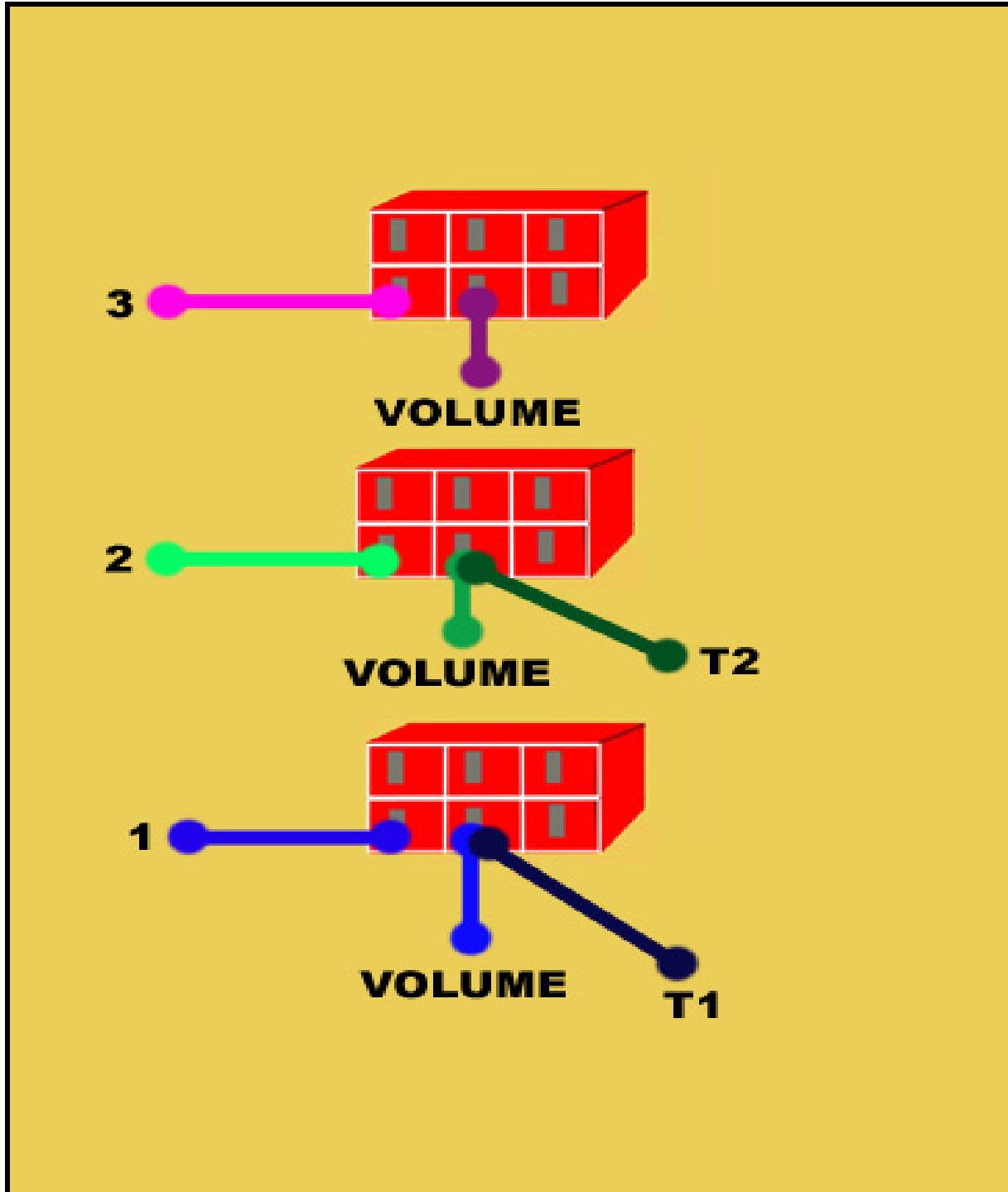




Here is the wiring for a strat with 3 mini toggle switches. Each one turns on a different pickup. You can get seven different tones with this setup. The guitar on page 80 also has a phase reversal switch with chickenhead tone and volume knobs.



Here is a close up of the mini toggle switches. They connect the pickups to the volume pots and tone pots.





Type this address in your web browser to hear this guitar:

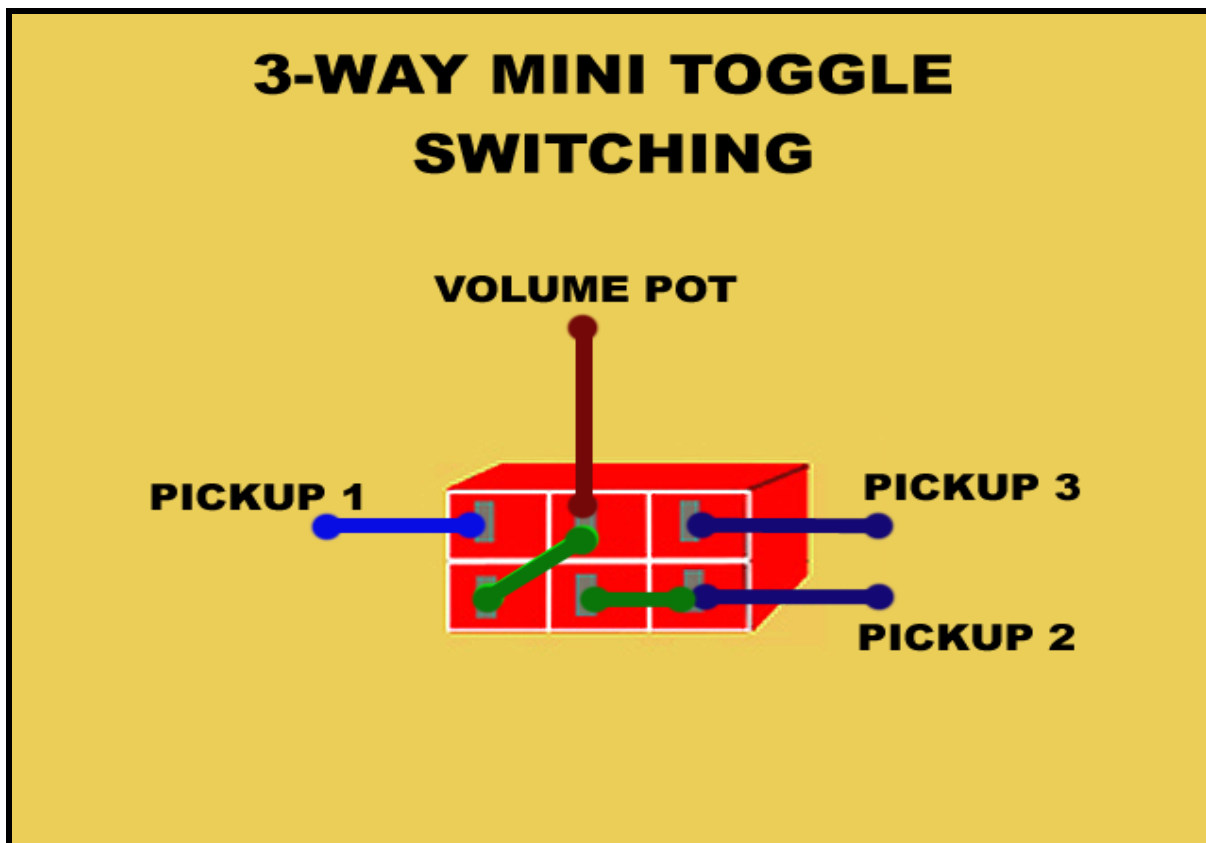
[HTTP://TINYURL.COM/YVKNDJ](http://tinyurl.com/yvkndj)

Only have room for one switch? Here is an on/on/on toggle being used as a pickup selector switch. This one is perfect for the guitarist who never uses the middle pickup by itself. The signal goes out to the volume pot, and then gets sent to a master tone pot. Check out the chapter on wiring a strat for info on guitars with a master volume and master tone control. Here are the pickup selections this switch provides:

position 1 = neck and middle

position 2 = neck

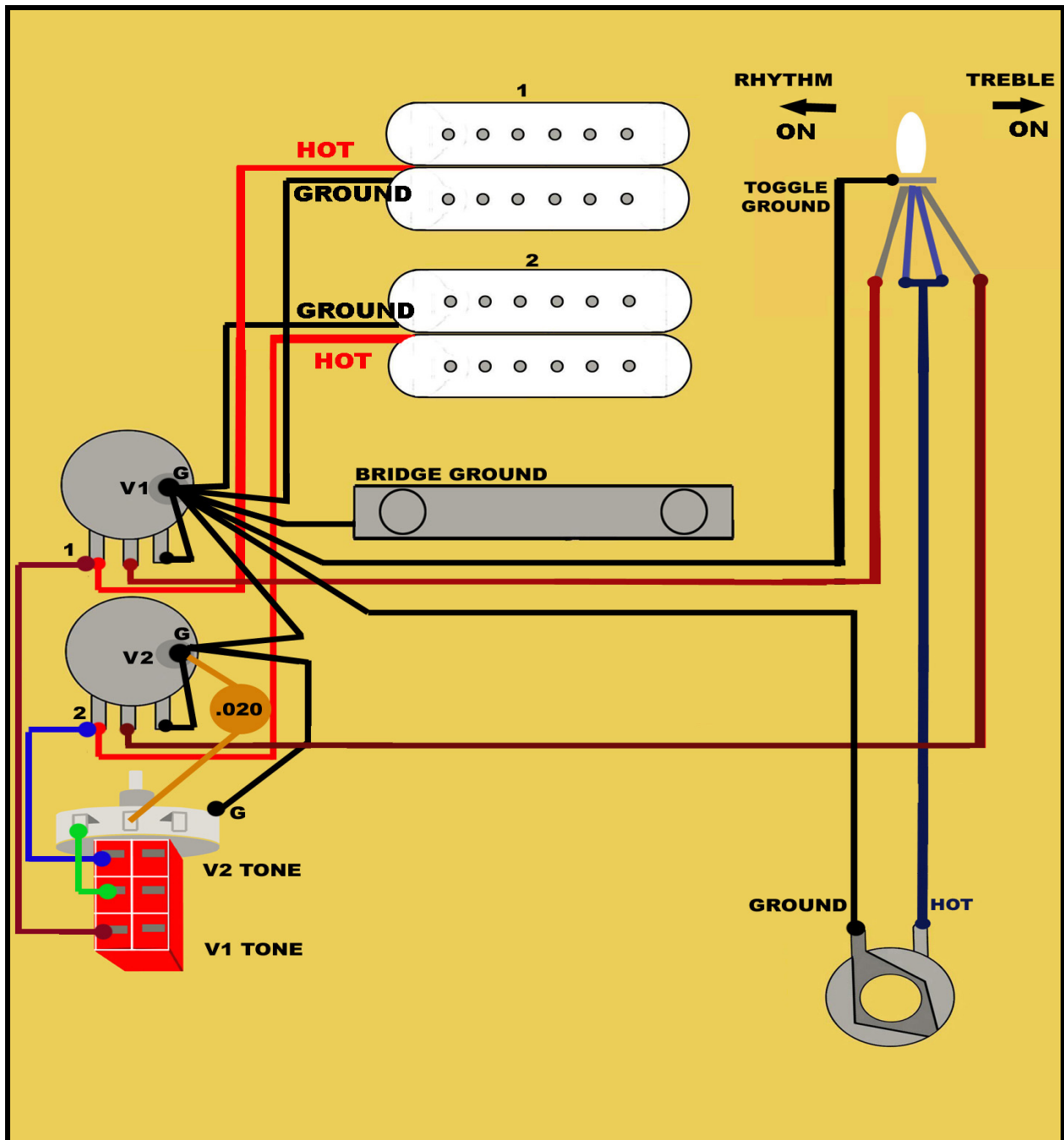
position 3 = bridge



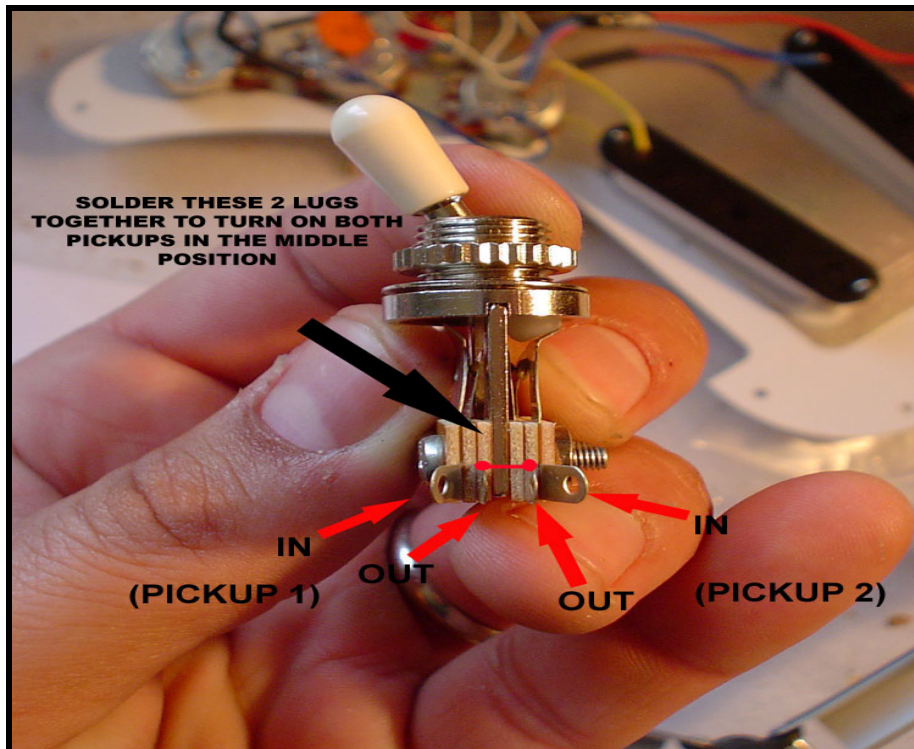
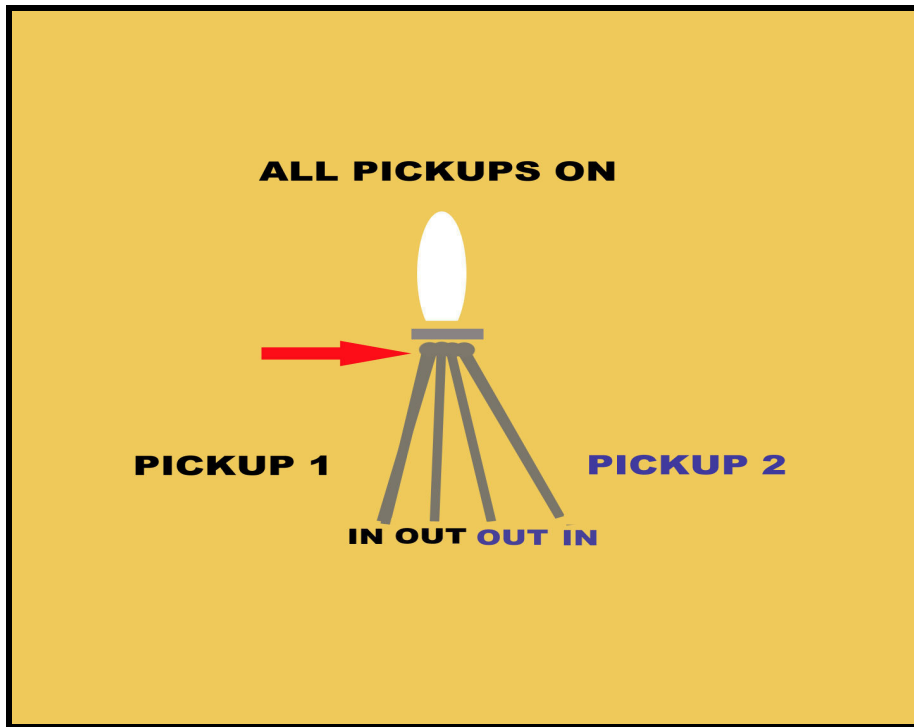
**Note:** you have to be careful when buying on/on/on mini toggle switches online. I have been burned many times. Often when I order on/on/on toggles, I end up getting on/off/on toggle switches, or switches that don't work properly. Always buy on/on/on mini toggle switches from a reputable dealer like [stewmac.com](http://stewmac.com).

## GIBSON STYLE TOGGLE SWITCH

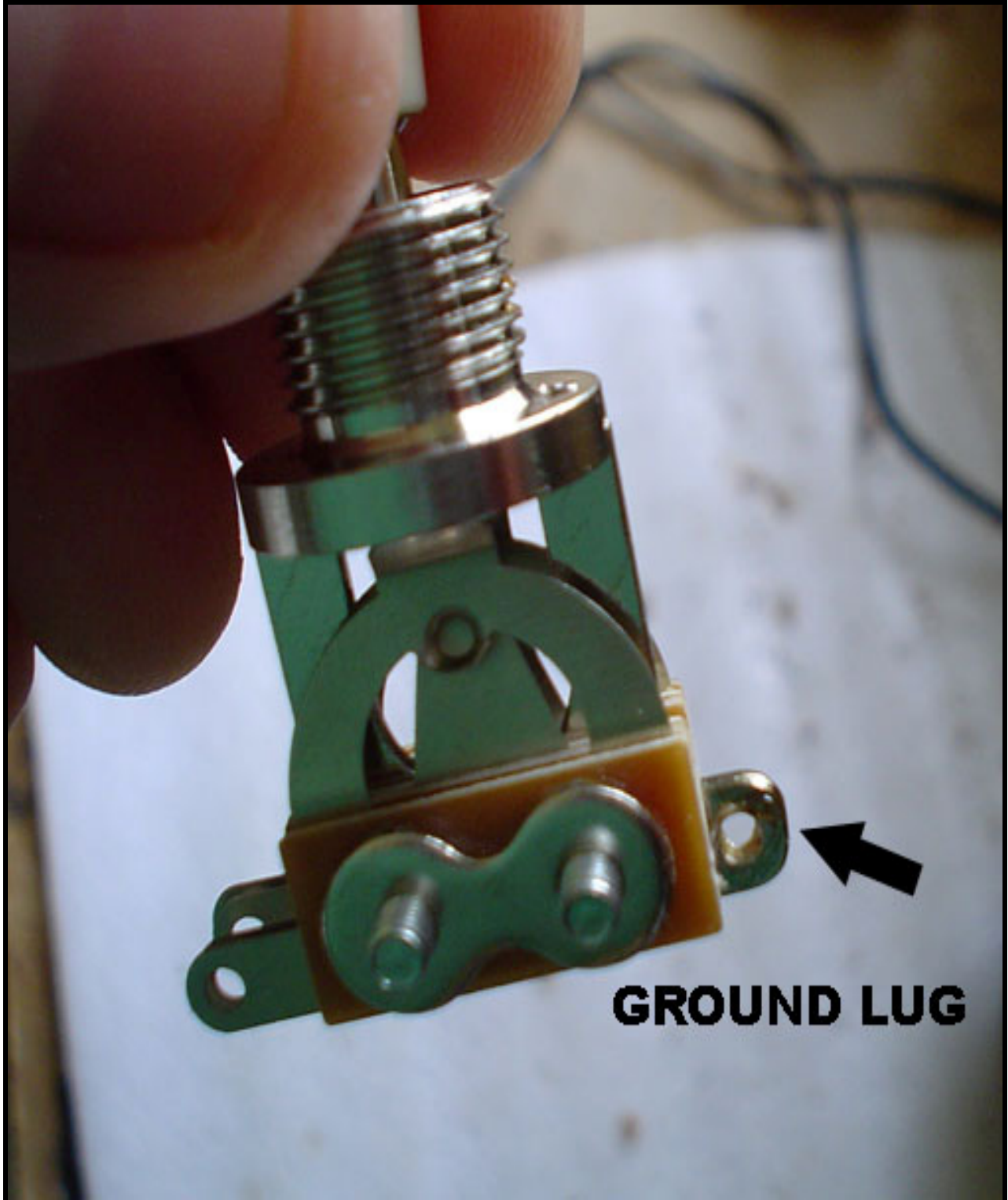
If you have a strat with only 2 pickups, then you can use a Gibson style 3-way toggle switch for your switching. It is fairly simple to wire and use. It activates the neck pickup, both pickups, or the bridge pickup. The example below shows a strat with a Gibson toggle, a volume control for each pickup, and a push pull potentiometer to control the tone of each pickup. Pull it up, and it adjusts the tone in the bridge pickup. Push it back down, and it controls the neck pickup's tone.



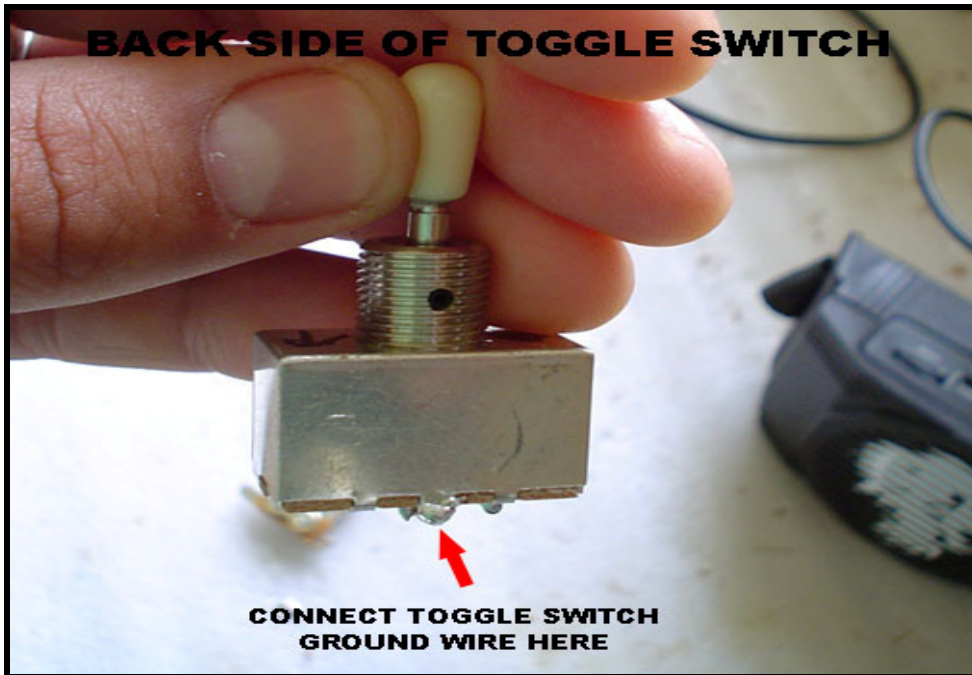
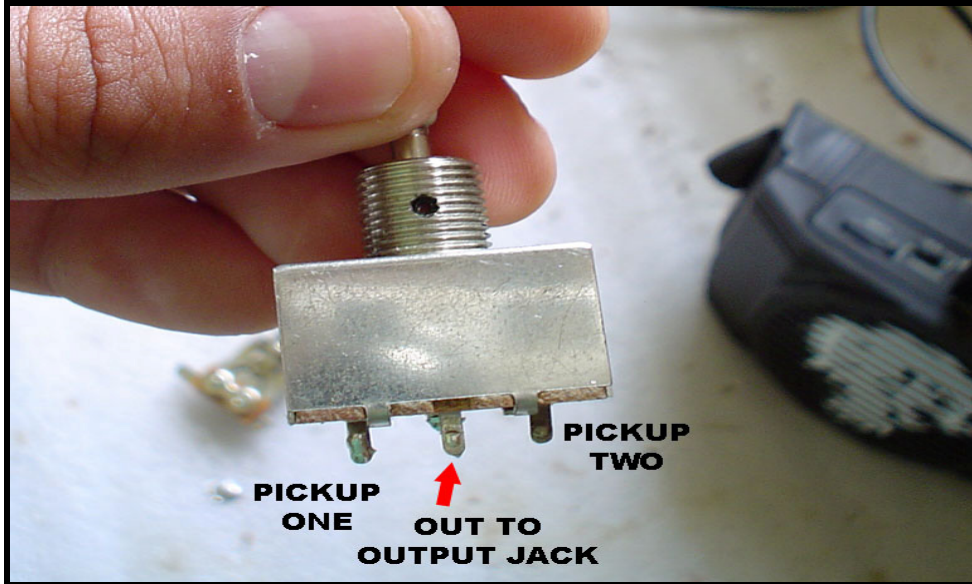
If your 3-way toggle has 4 lugs, then solder the inner two lugs together to turn on both pickups in the middle position.



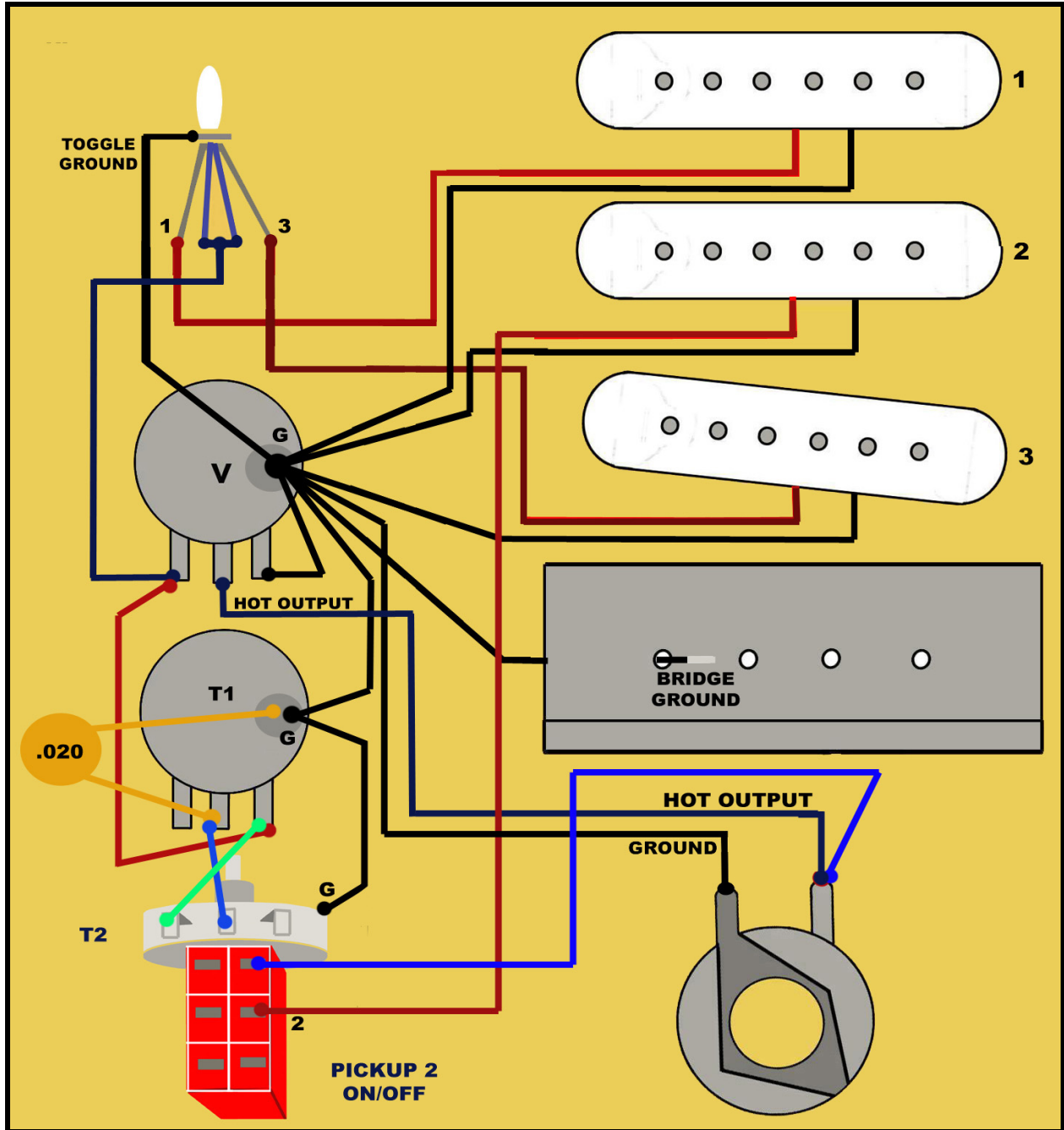








If you love the look and simplicity of a toggle switch, then you might like this type of wiring on your strat. The next diagram shows a strat with a Gibson toggle and a push pull potentiometer. The push pull pot turns on or off the middle pickup. The toggle switch activates the neck pickup, neck and bridge pickups, or the bridge pickup. To add the middle pickup, just pull up on the push pull pot attached to the second tone control. Both of the tone knobs function as master tone control in this setup. You can get 6 different sounds with this setup.



## UNDERSTANDING VARITONE/ROTARY SWITCHES

The next switch we are going to discuss is the Varitone, or rotary switch with the chicken head knob. This switch allows you to dial in specific tones for each setting, and eliminates any guesswork associated with the subtlety of tone potentiometers. This type of switch has 6 settings for 6 different tones. The first tone is usually clean, so that leaves 5 other tones to choose from. These 5 tones will be determined by the size of the capacitor that gets soldered to each lug on the switch. These switches are very easy to wire. Just solder capacitors to

each lug on the Varitone switch, then connect the open ends of the capacitors together, and send the signal out to the output jack. Also connect a ground wire to the common lug in the middle of the switch. Here is a rotary switch on a Les Paul.

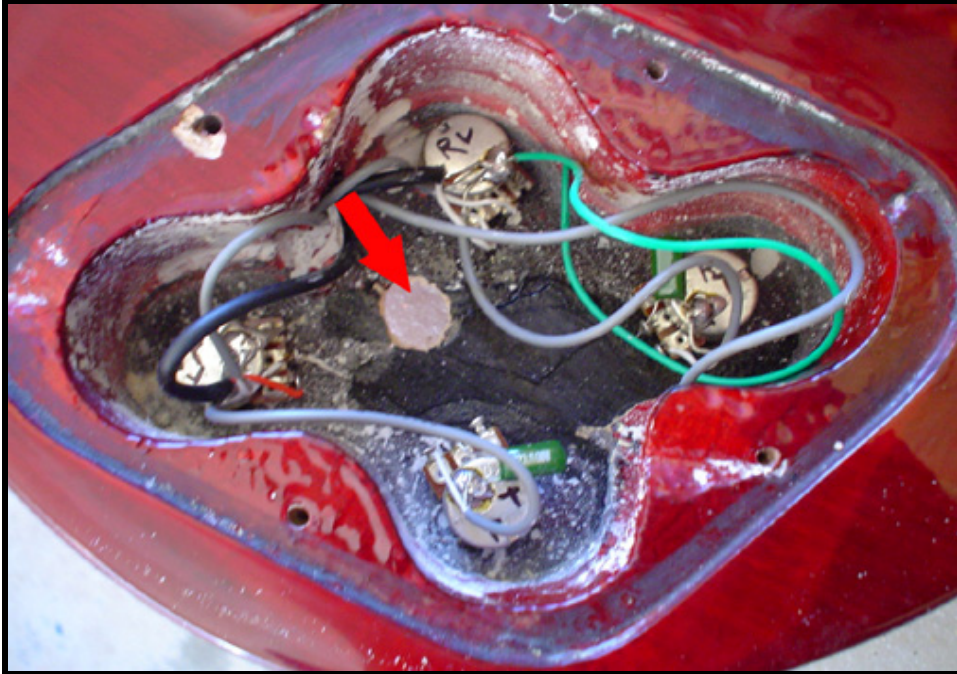


Below are some capacitor values commonly used on the Gibson 345 Lucille guitar. These values are measured in microfarads. The bigger capacitors will give you a muddier sound. You can experiment to find the tones you want by using different capacitor values.

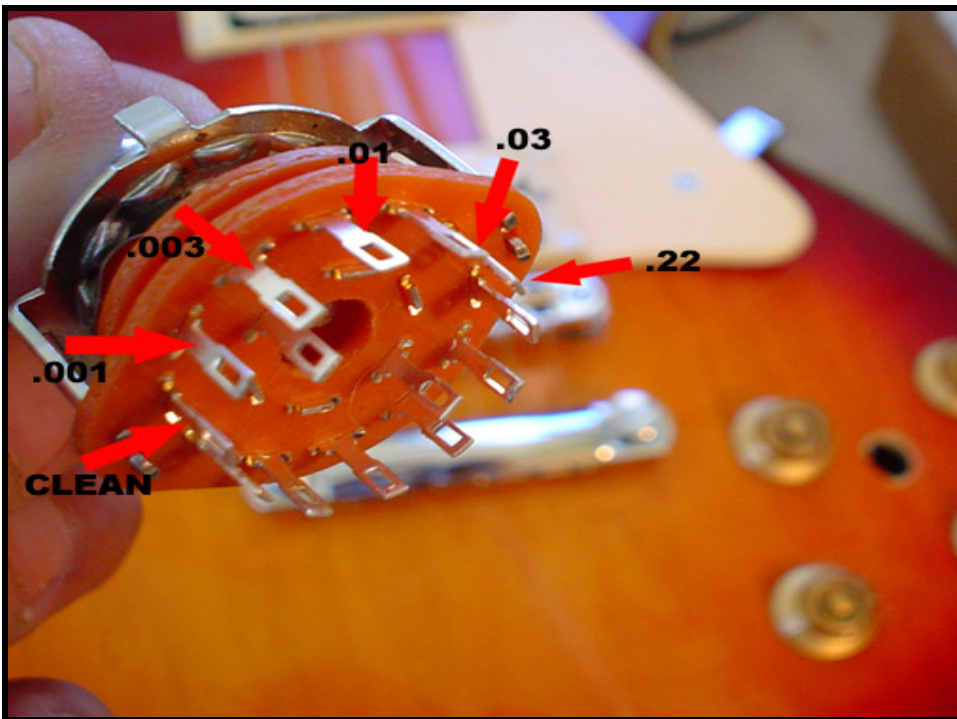
LUG 6 - 0.22  $\mu$ F  
LUG 5 - 0.03  $\mu$ F  
LUG 4 - 0.01  $\mu$ F  
LUG 3 - 0.003  $\mu$ F  
LUG 2 - 0.001  $\mu$ F  
LUG 1 - no capacitor (clean sound)

Here is how you install a Varitone in a Les Paul style guitar. First, drill a hole in the body. Then install the Varitone switch. Mark on the switch the lugs that you will be using. When you look at the side of the switch, you can see which lug is in use. This particular switch has 12 lugs which can be used for additional functions. We will only be soldering capacitors to 5 of these lugs, so turn the switch through all 6 positions, and notice which lug is completing the circuit at each setting. Then you will know which 5 lugs need to have capacitors soldered to them. One out of those 6 settings is left open, so it gets a clean, unaltered sound.

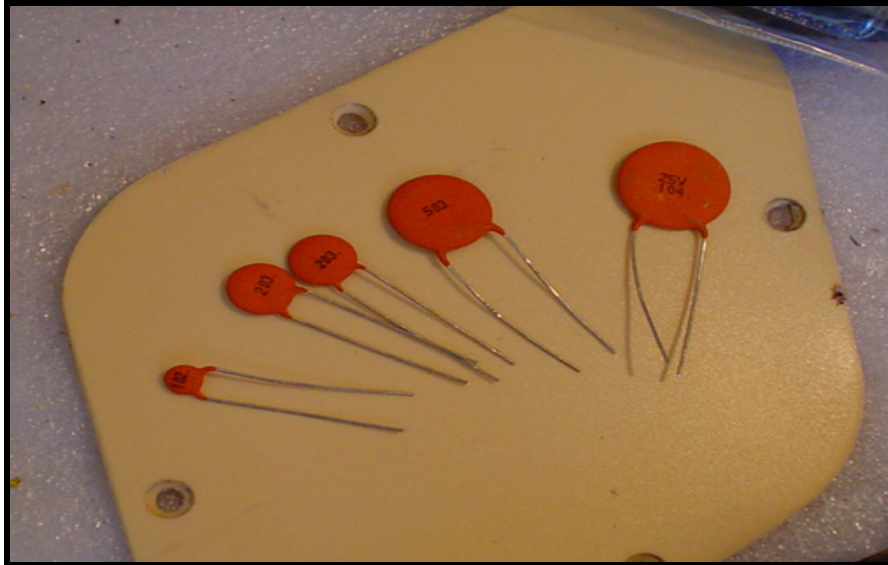




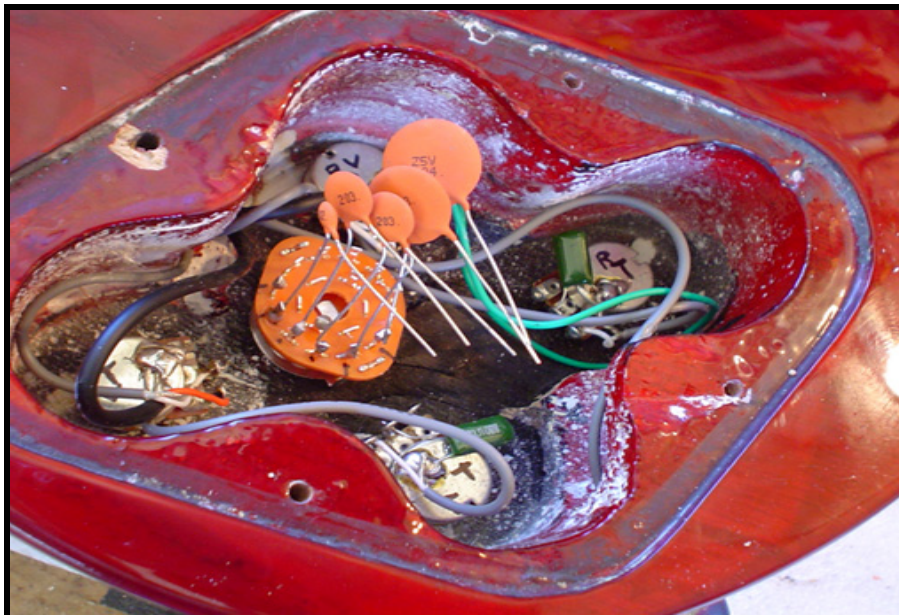
Here are the lugs that we will be using.



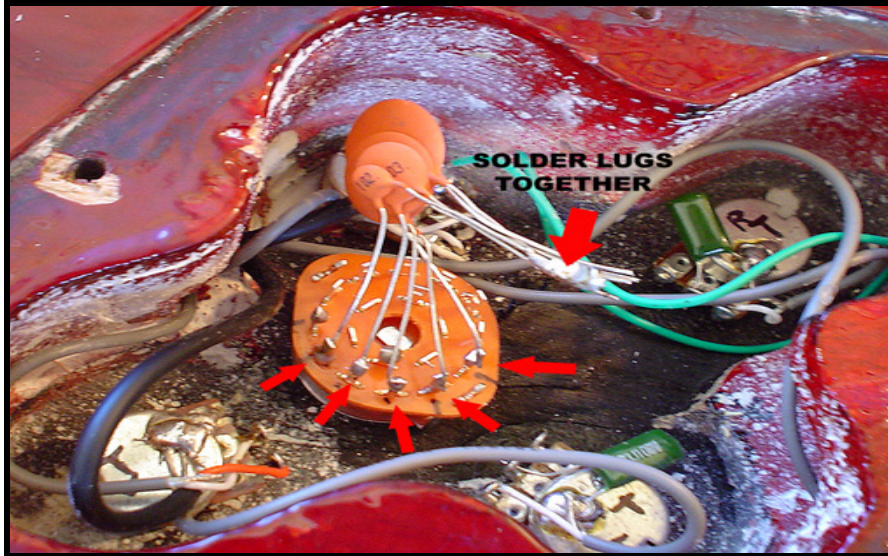
Here are the capacitors that I chose for this project. They are bigger than the standard Lucille capacitors for more bass tones.



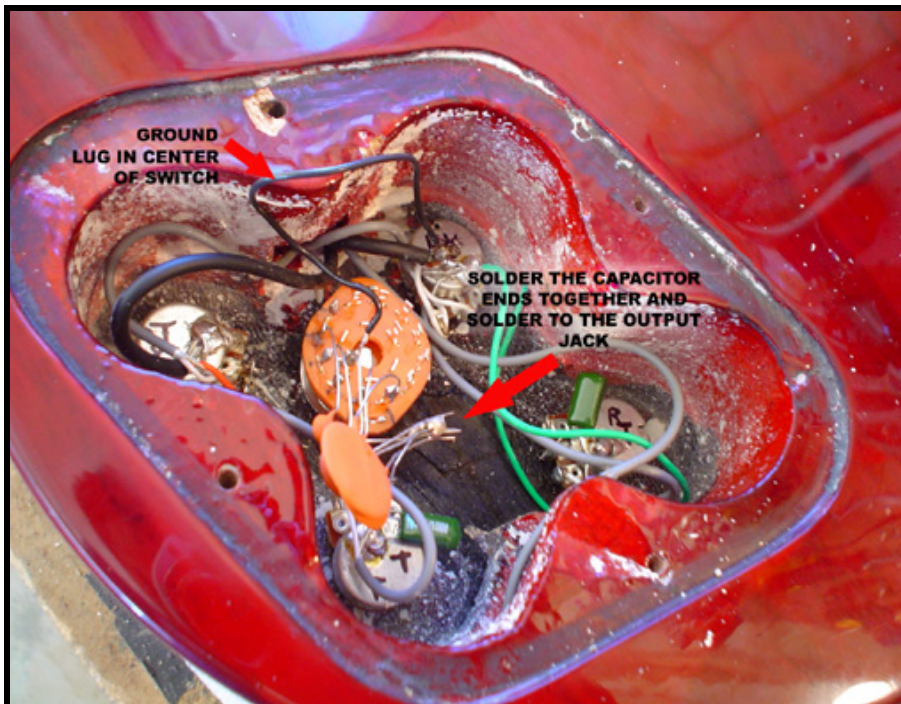
Now solder one end of each capacitor to one of the lugs on the Varitone switch. Solder them in ascending order.

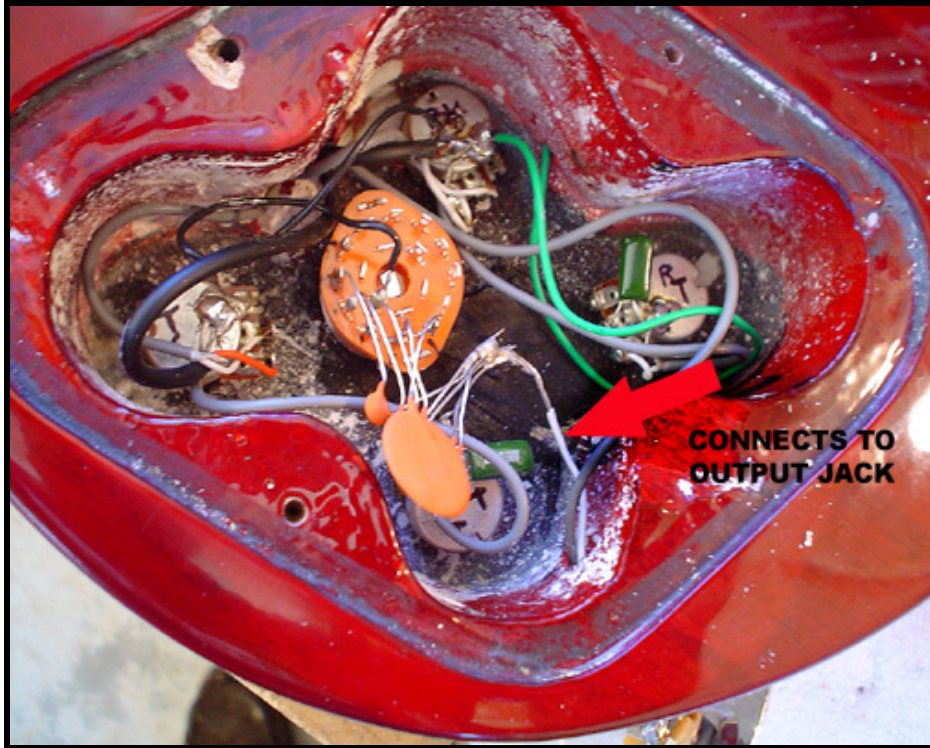


Now solder all of the open ends of the capacitors together. These will be soldered to a wire that connects to the hot lug on the output jack.

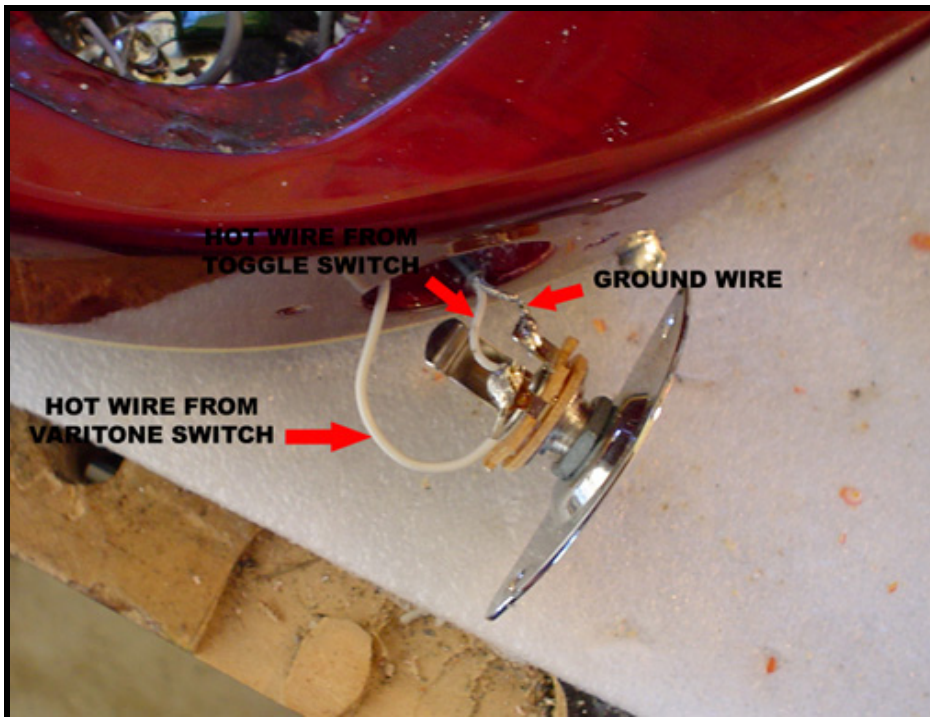


Solder the ground wire. It attaches to the common lug for that pole, which is in the middle of the Varitone switch, closest to the lugs that you just soldered. From there, it gets soldered to the volume or tone pot case and goes to ground.



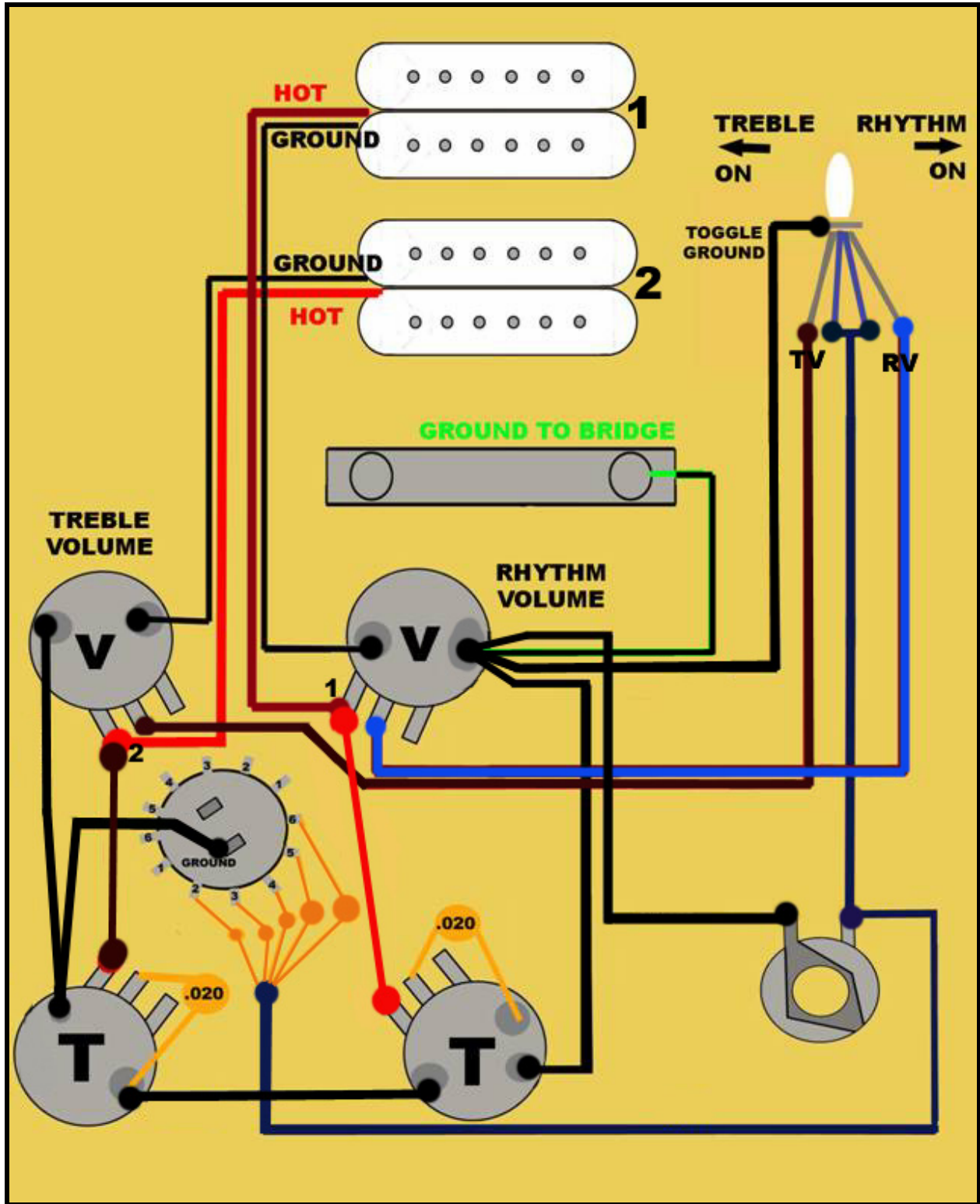


Here is the output jack with two wires connected to the hot lug.

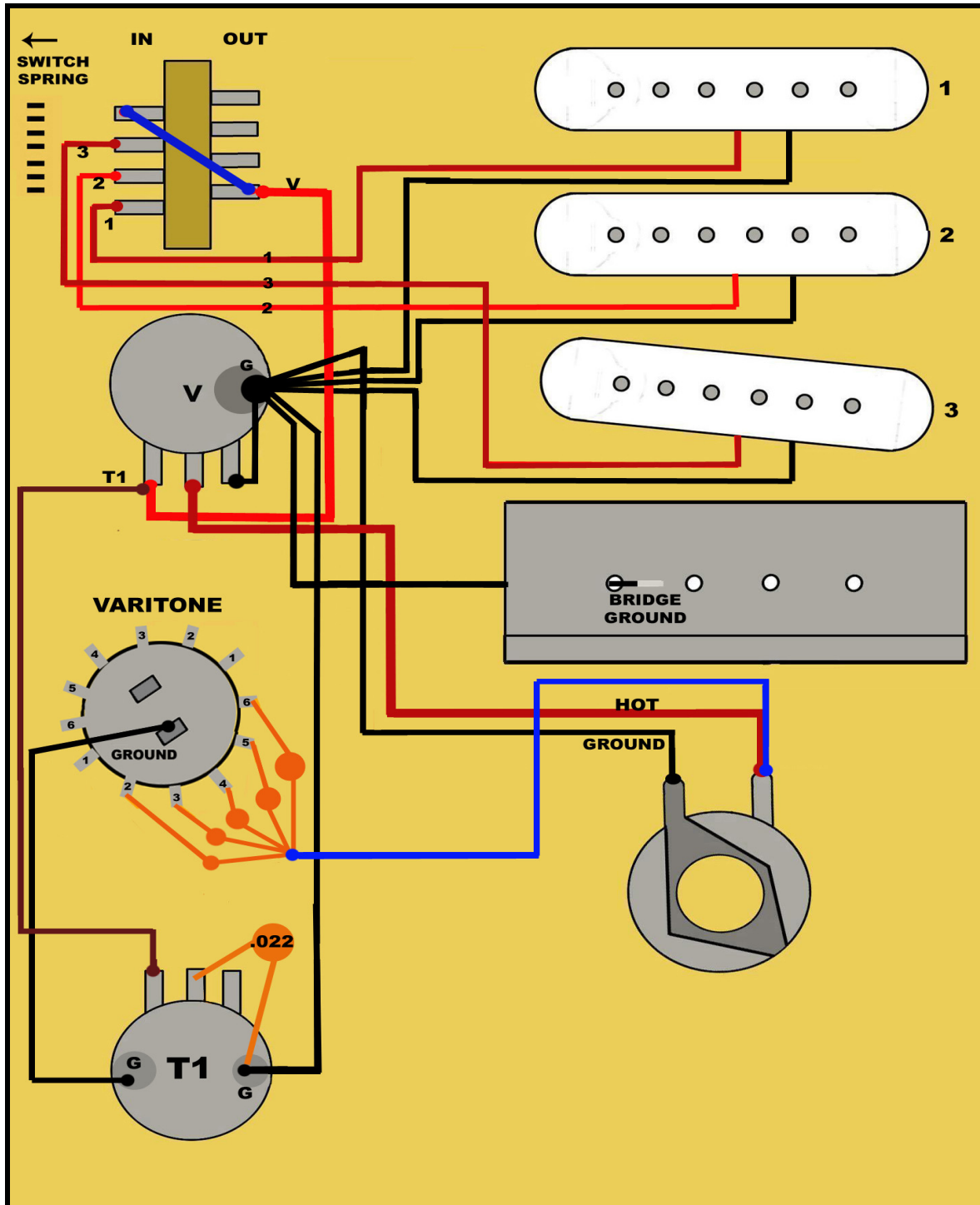




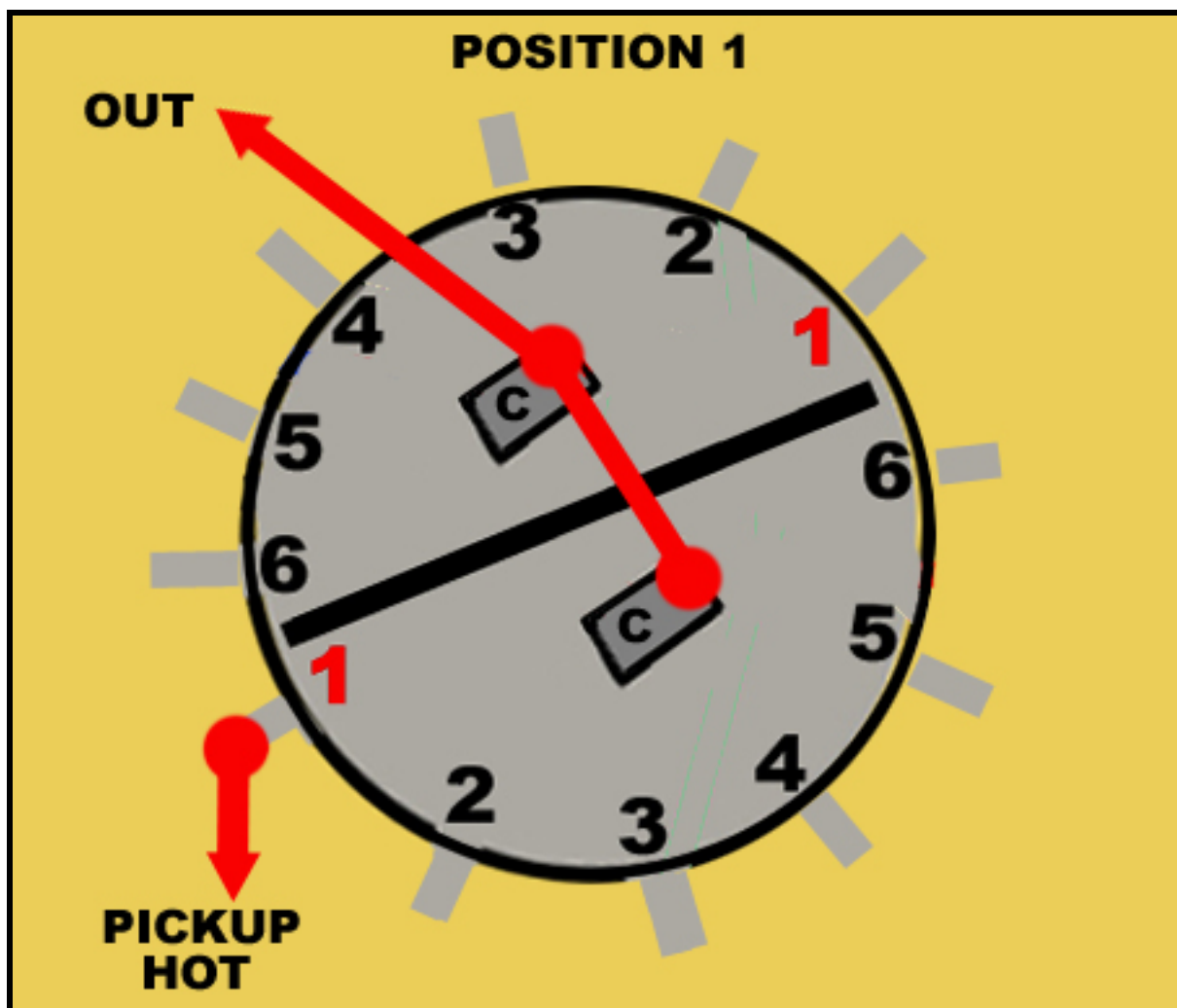
Here is the finished wiring on a Les Paul style guitar.

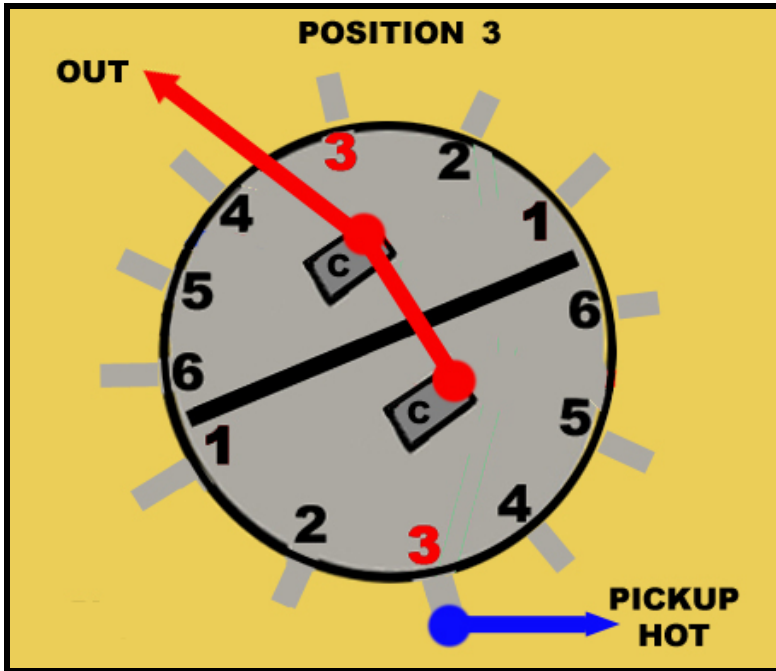
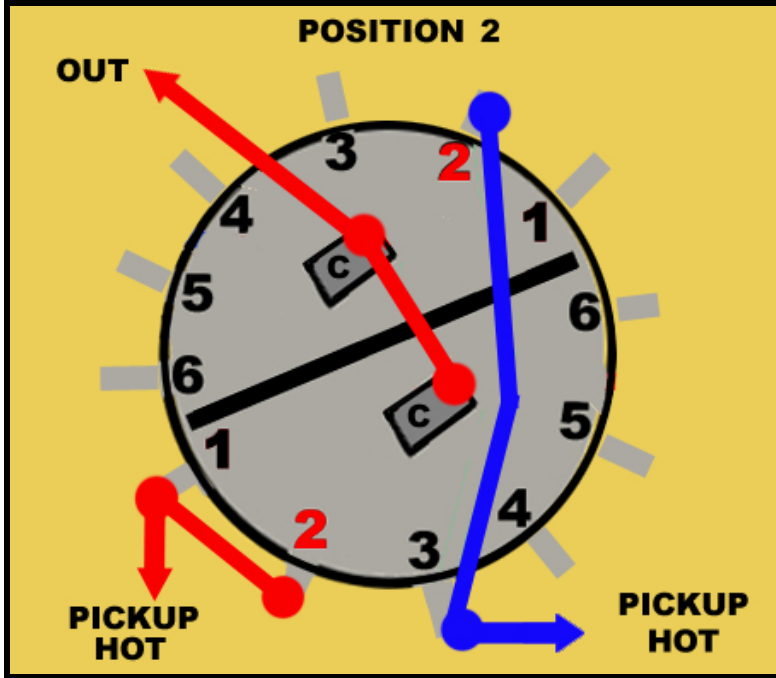


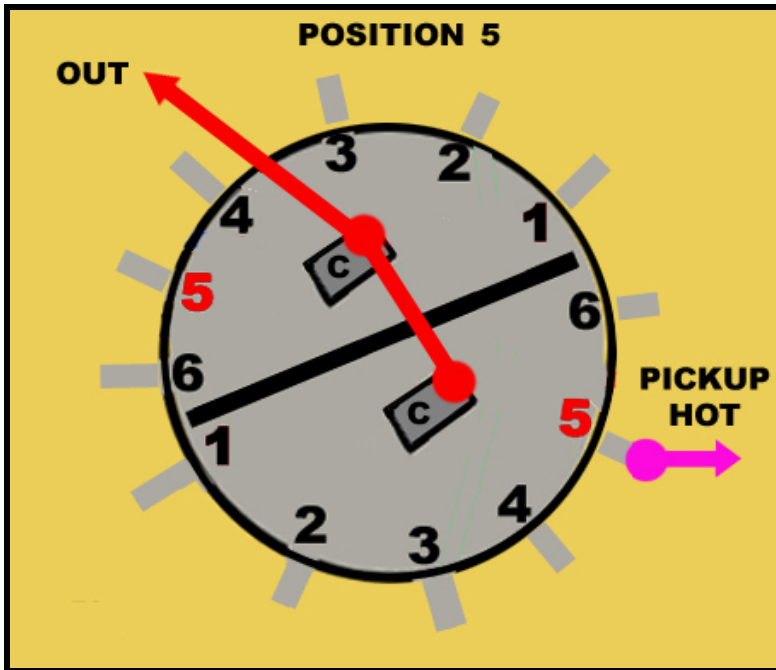
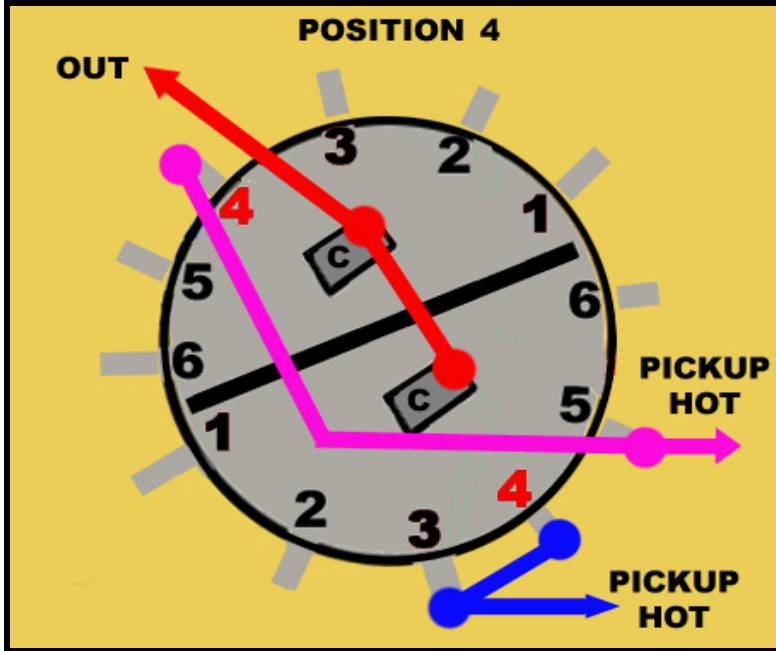
Here is the Varitone wiring on a strat. The tone knob closest to the volume control is the Varitone switch. The second tone knob is a separate master tone control for fine tuning your guitar's tone.

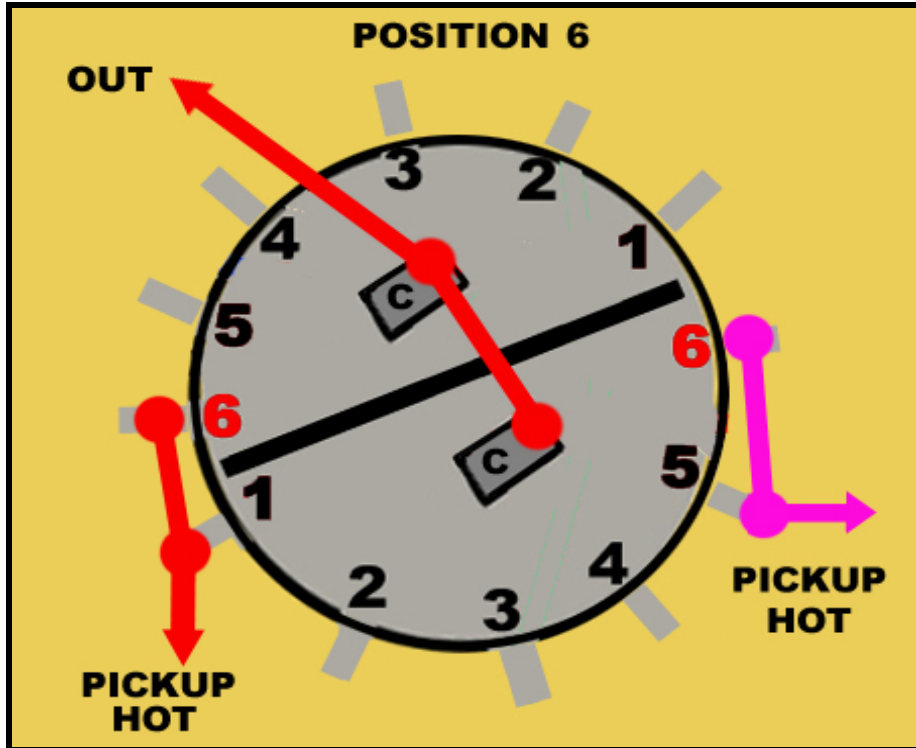


You could also use the Varitone switch to replace your existing 3 or 5-way switch. Rotary switches, like the Varitone, are very similar to lever switches. However, each side, or pole, only turns on one lug at a time. Some of the selections on 5-way switches turn on several lugs. In the diagram below, the switch is in position one. If you look closely at the Varitone switch, you can see which lugs are engaged in each setting. So the number one lug from the top pole and bottom pole will be active when the switch is in the first position. However, the top half sends the signal out only through the top common lug, marked with a "c". The bottom half sends the signal out through the lower common lug marked with a "c". A jumper is often added to link the two sides together for turning on multiple pickups. The diagrams below show how a Varitone works in each position.









The next page shows a wiring diagram for a strat using a 6-way rotary switch instead of a lever switch. Notice you get six different positions with this switch.

position 1 = neck

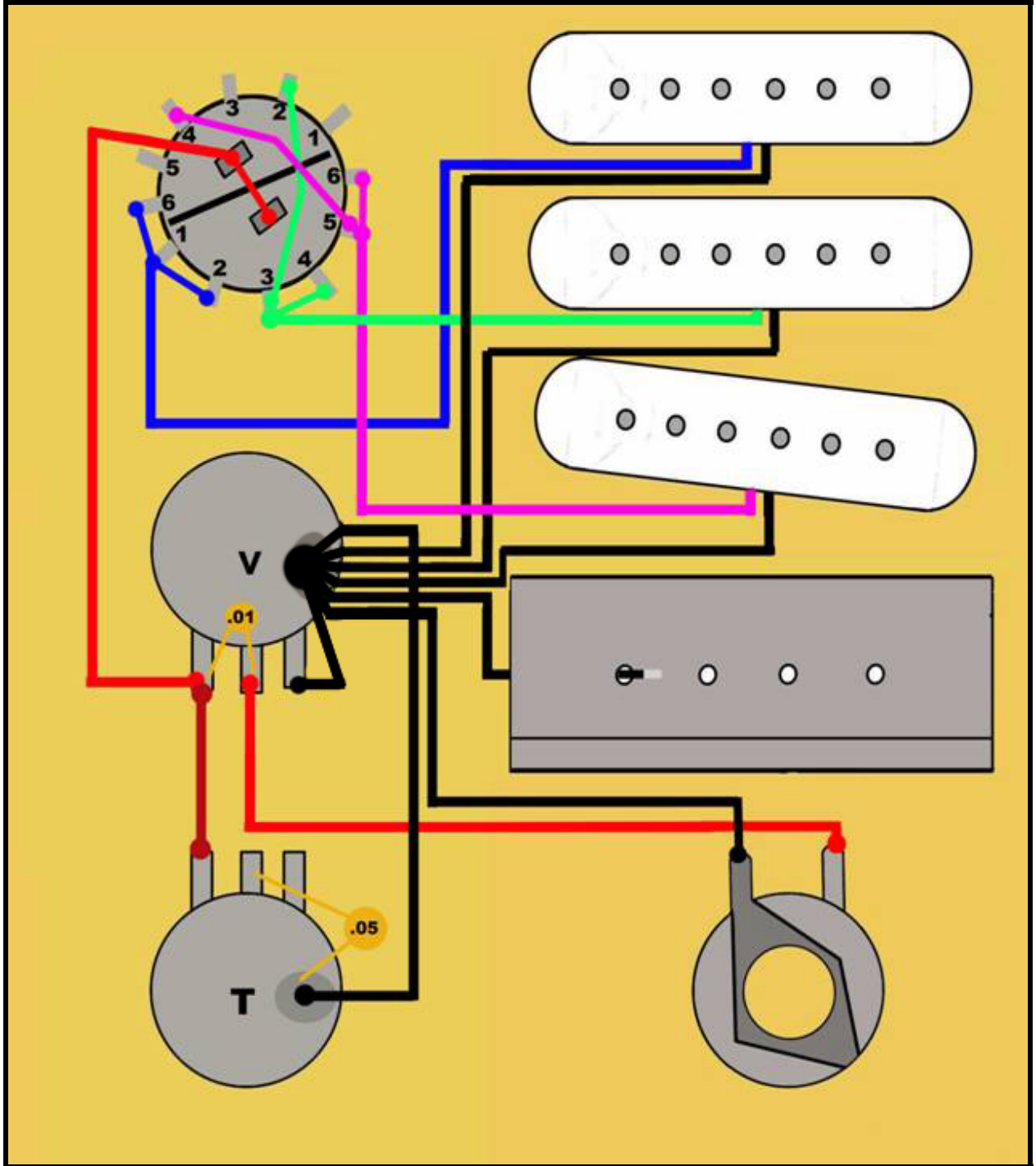
position 2 = neck and middle

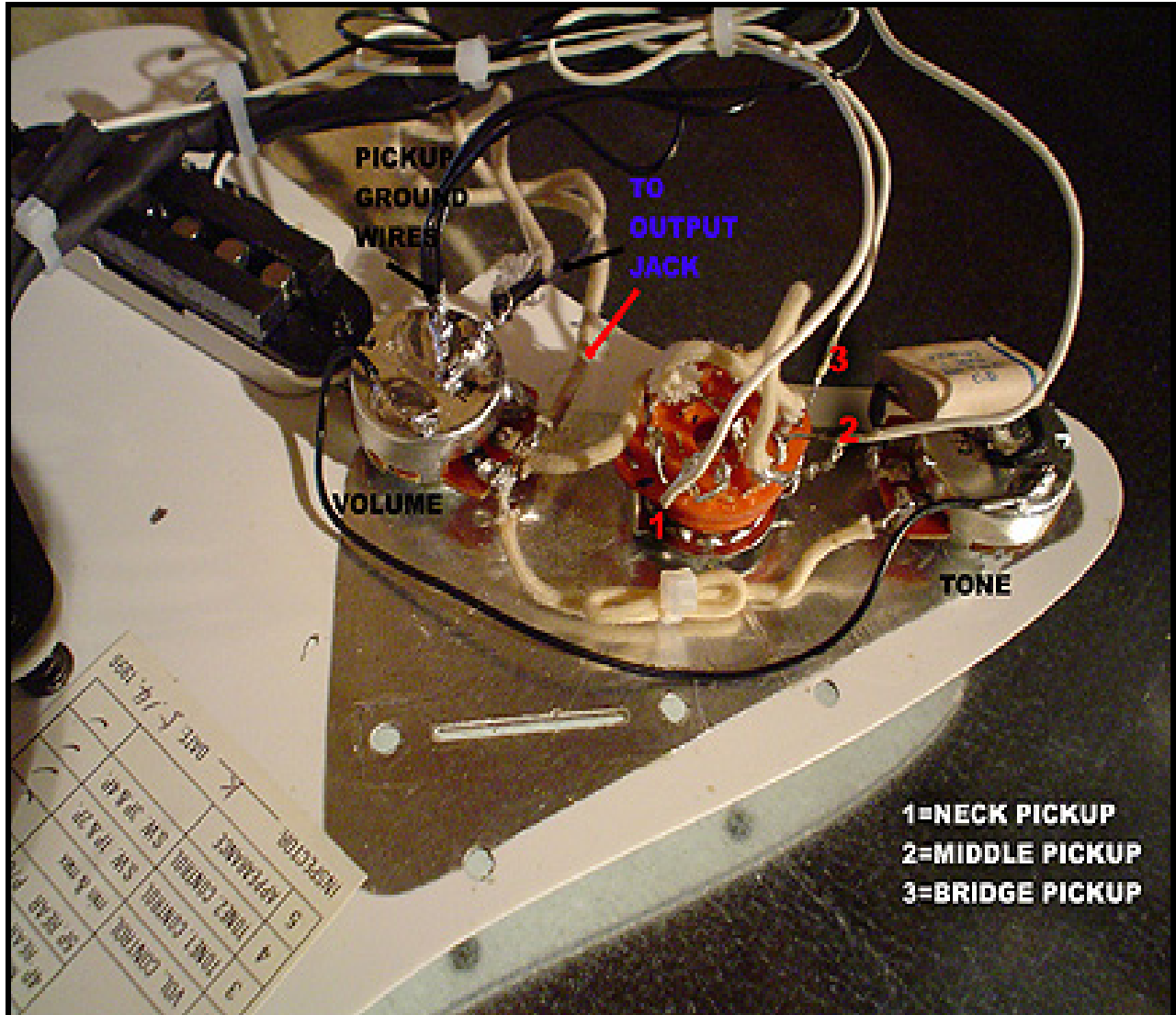
position 3 = middle

position 4 = middle and bridge

position 5 = bridge

position 6 = neck and bridge





Above is a strat wired with the 6-way rotary switch. The rotary is in the middle position in this example. Also notice the vintage style capacitor.

**Question: How do you wire a PRS style strat?** The PRS wiring with two 4-wire humbuckers will yield some useful series/parallel/coil cut sounds. The 6-way rotary switch has a top half (A) and a bottom half (B) that are shown in the diagram. Here is what you can expect with this setup:

Position 1 = neck humbucking

Position 2 = neck and bridge outer coils in parallel



Position 3 = neck and bridge outer coils in series

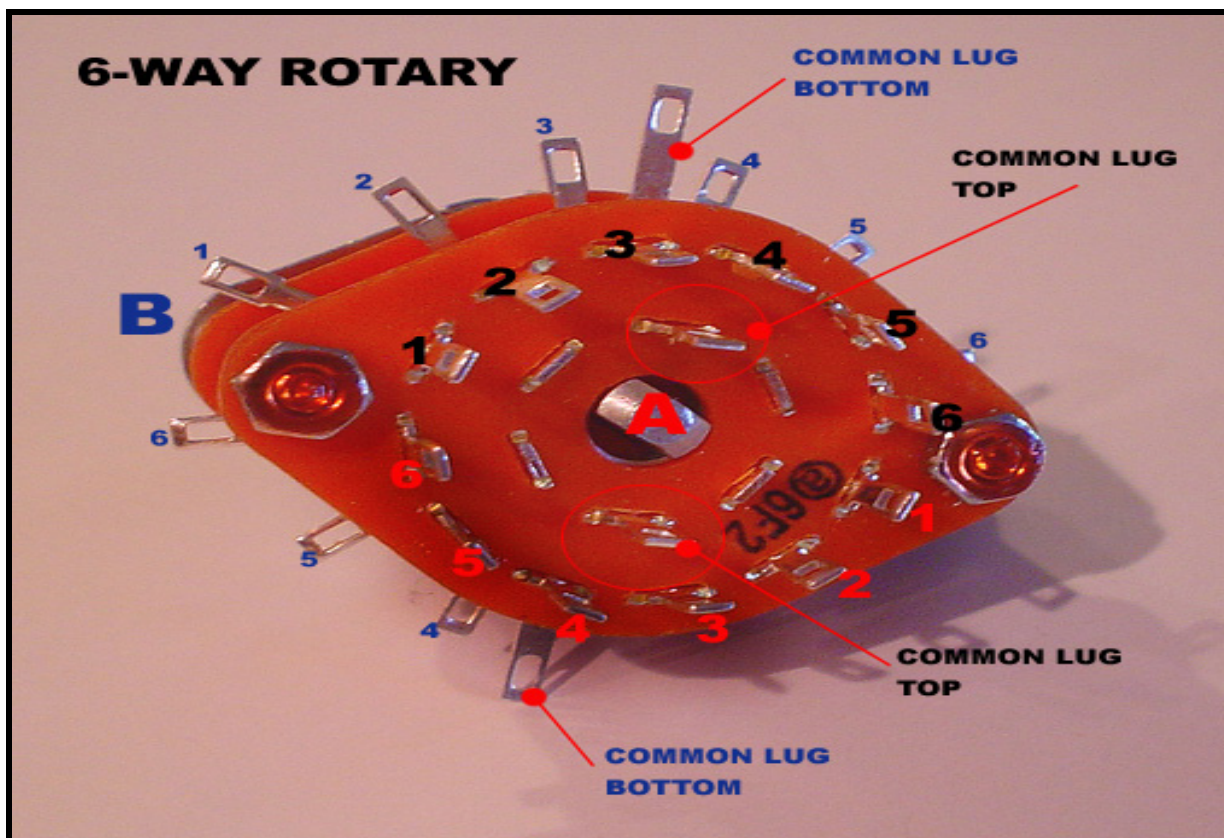
Position 4 = neck and bridge inner coils in parallel

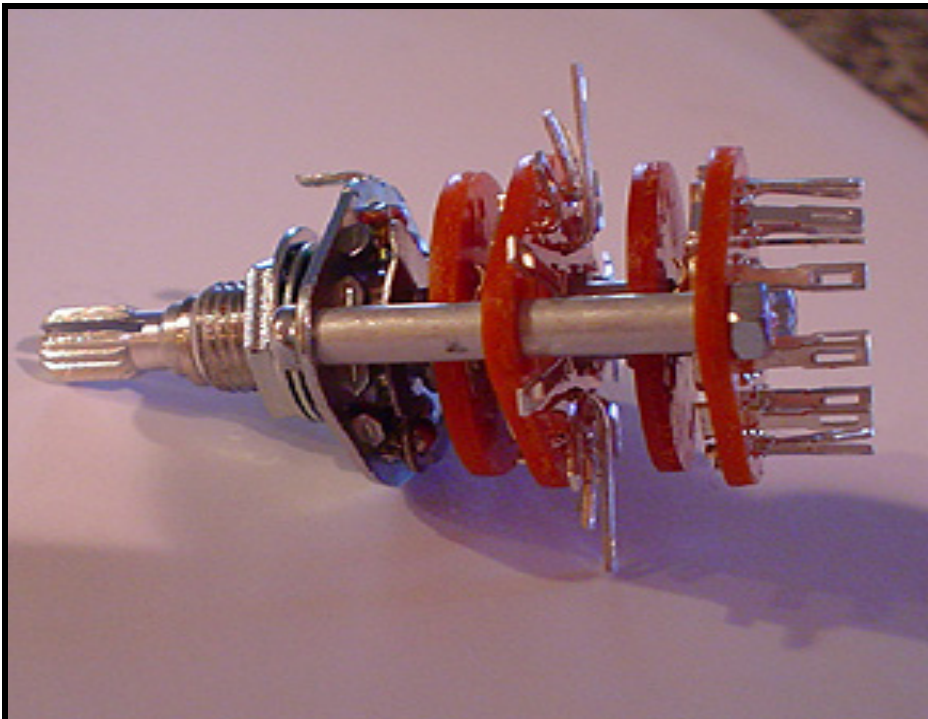
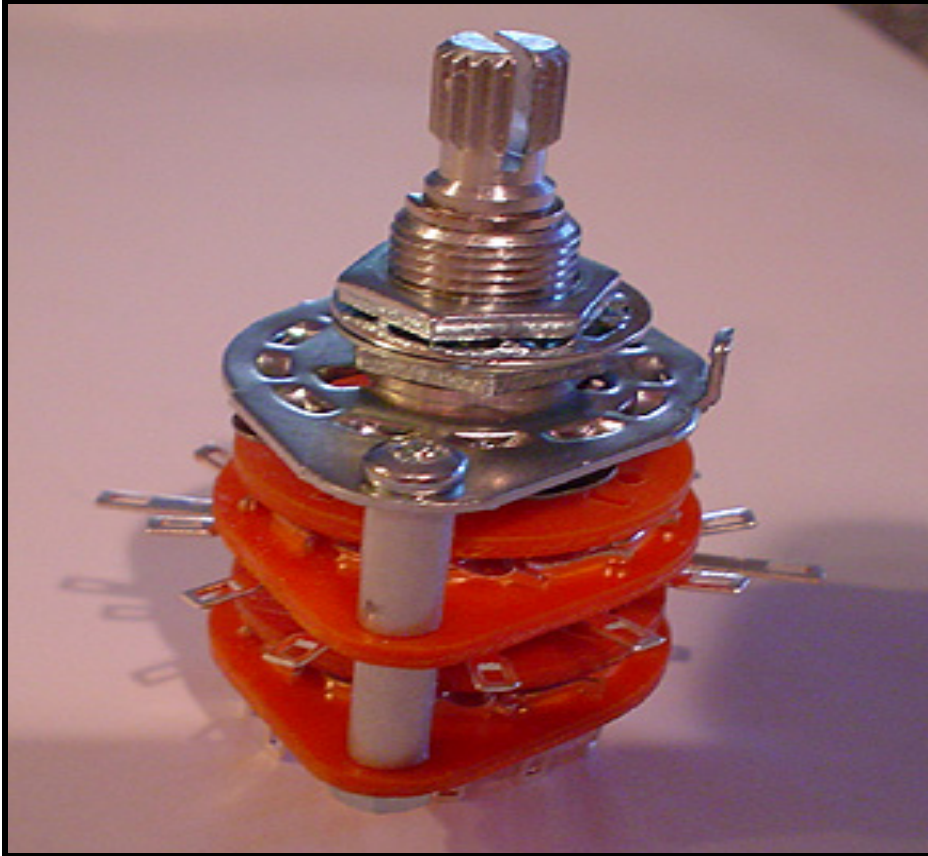
Position 5 = bridge humbucking

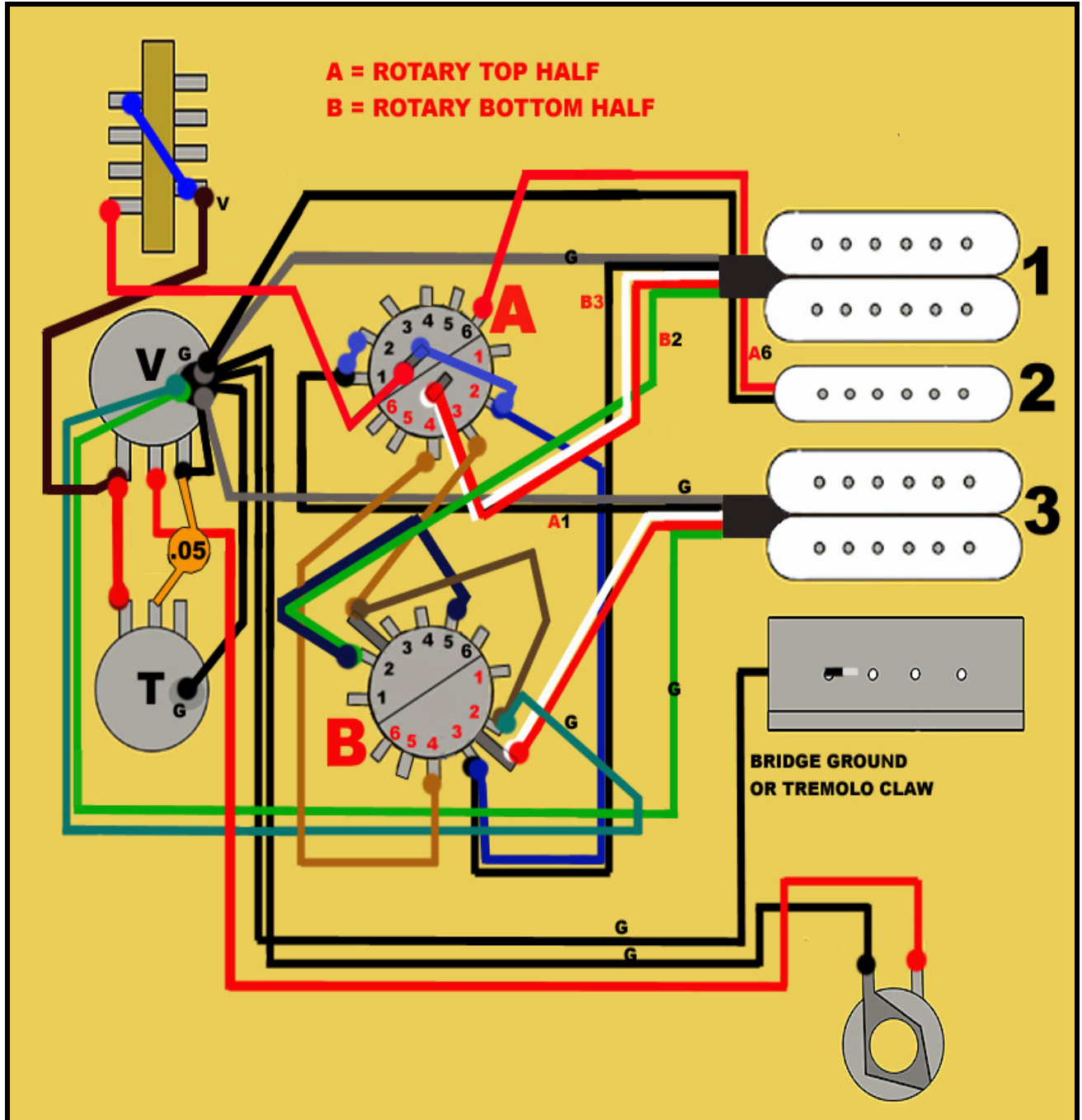
Position 6 = middle pickup

You will also notice the addition of a single coil pickup and the 5-way selector switch. The single coil pickup can be moved to any location...neck, middle, or bridge. It can be a humbucker, or single coil. It just connects to lug 6 on the rotary switch. The 5-way switch acts as an on/off switch now since you have the rotary to change between pickups. In position 1 & 2 on the 5-way switch, the guitar is on. In the other positions, the guitar is turned off. There is also a master tone and master volume control for all of the pickups. The nice thing about this setup is that you do not have to alter your pickguard at all if you are using blade or rail humbuckers that fit into standard strat pickguards.

In the diagram, "A" is the top half of the rotary switch when looking at it upside down, and "B" is the bottom half. In "A", the common lugs are inside of the main lugs. In "B", the common lugs stick out pretty far from the main lugs. If you are going to try this wiring, make sure to print out a color copy from the ebook version. Below is a picture of the top of the 6-way rotary switch.





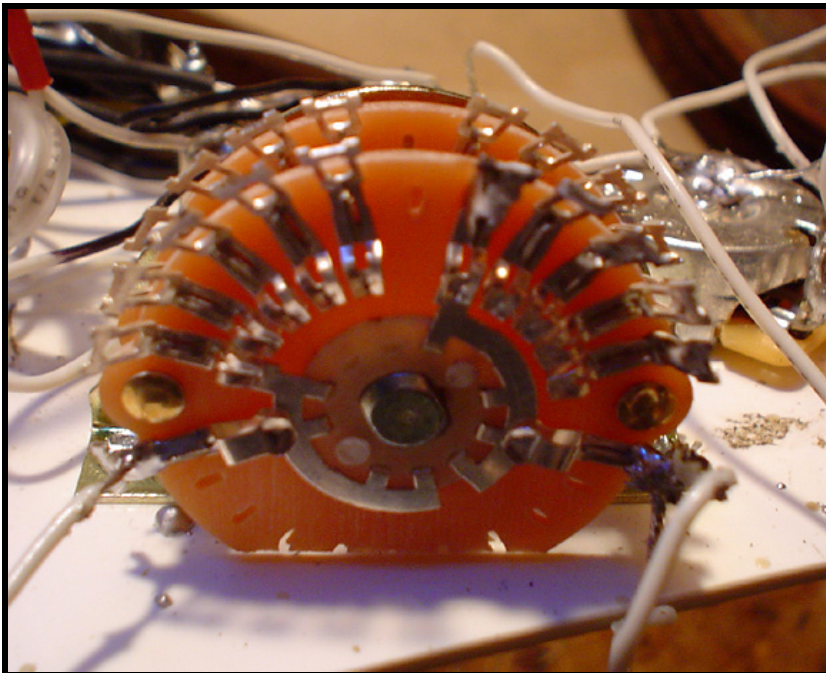


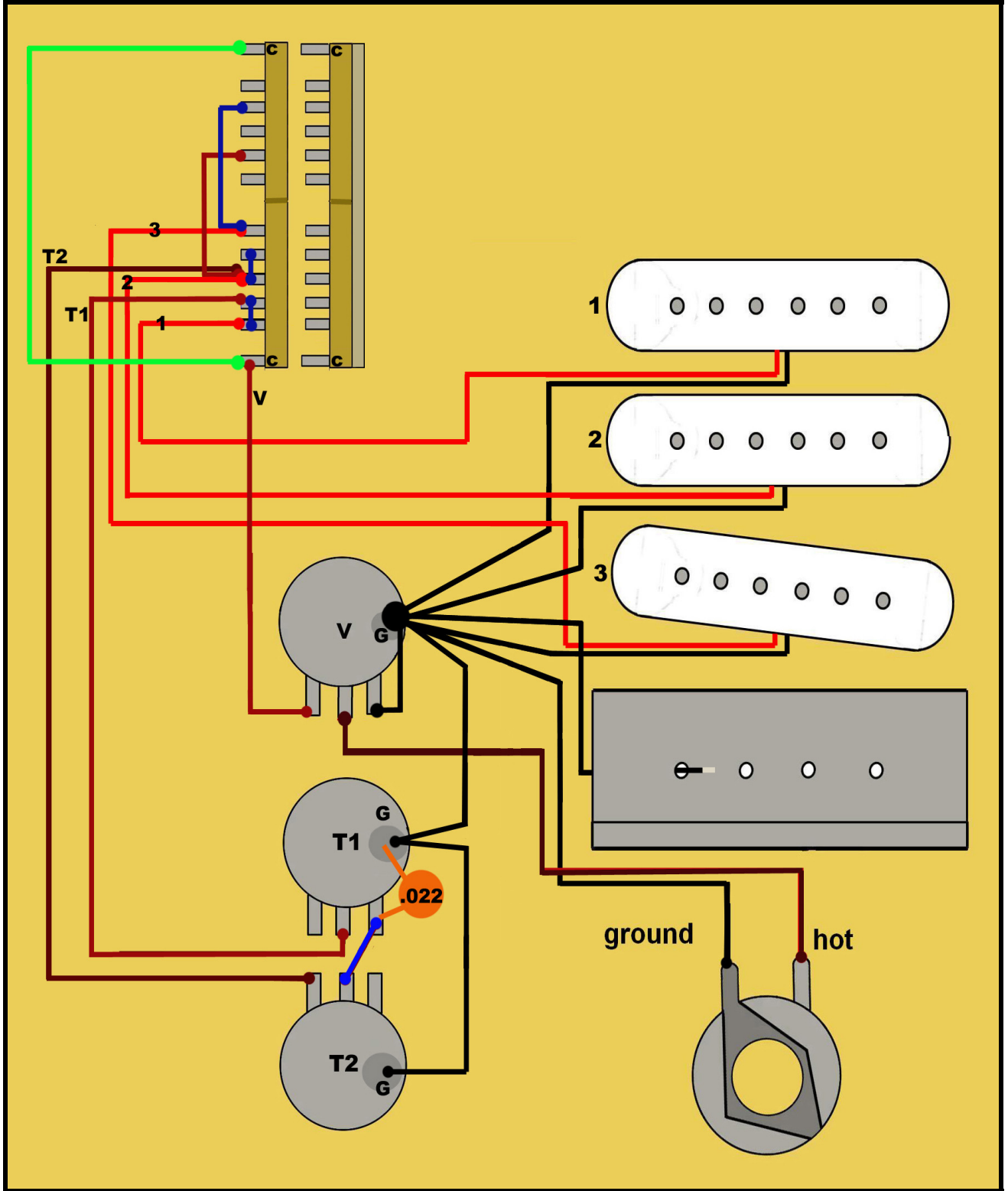
Click here for a larger version of the diagram above.

<http://tinyurl.com/2KHAPT>

## SUPER SWITCHES

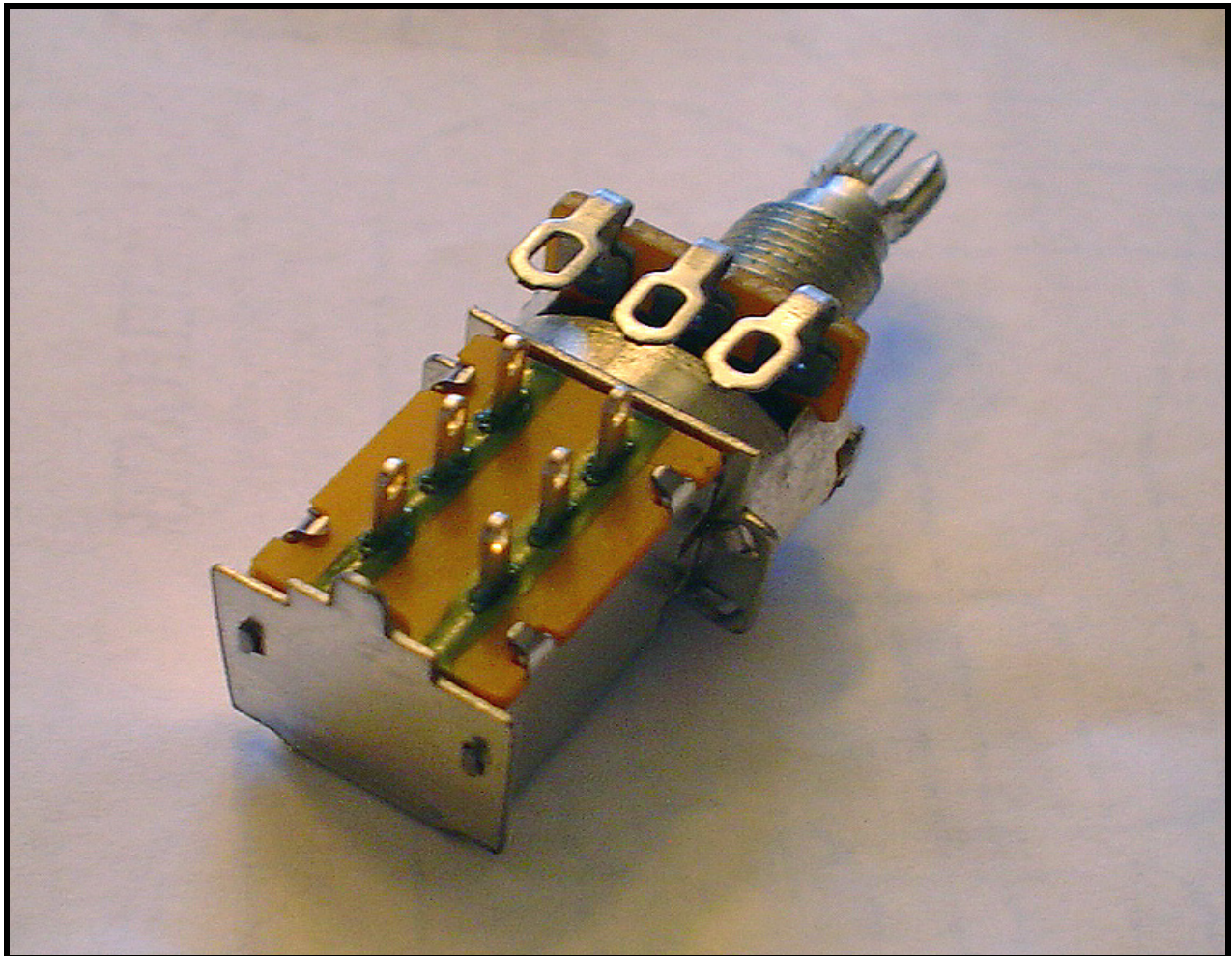
One of the more complicated switches on the market is called a super switch. It has 4 different poles, or channels. And each pole has 5 lugs and a 6<sup>th</sup> common lug that sends the signal to the output, or to the other poles. This allows for an unlimited number of wiring designs. The diagram on the next page shows one way to wire a strat using only two of the poles. Notice each setting touches only one lug per pole. On standard 5-way switches, some settings touch several lugs, causing you to use less jumper wires.





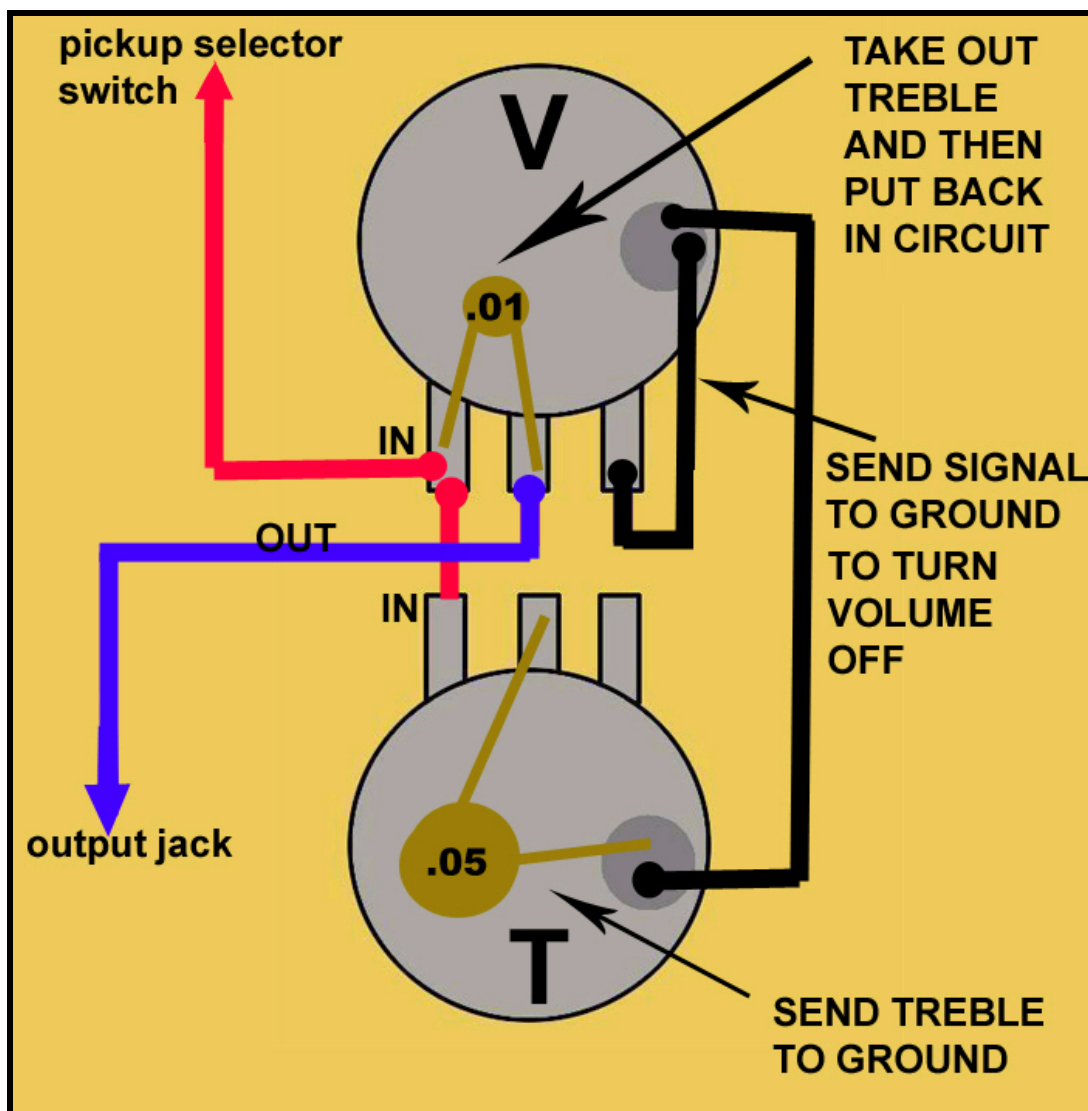
## UNDERSTANDING POTENTIOMETERS

A potentiometer, commonly referred to as a pot, is a variable DC resistor. Basically, it decreases the signal that is going through it. As you decrease the signal in your volume or tone pot, you increase the signal that gets sent to ground. So if you have your volume set at 0, 100% of the signal will be sent to ground. Normally 250K Ohm pots are used with single coil pickups to add warmth to the sound, and 500K Ohm pots are used with humbucking pickups to add more highs to the sound. A 1 Meg pot will give you an even brighter sound. Part of the signal will always leak out to ground in any potentiometer, even when the volume is turned all the way up. A 1 Meg pot will leak the least amount of signal to ground, and a 250K pot will leak the most amount of signal to ground. In the case of the tone potentiometer, a capacitor is added to the circuit, which only allows the highest frequencies to pass to ground, leaving a sound with more midrange and bass.



## VOLUME AND TONE POTENTIOMETERS

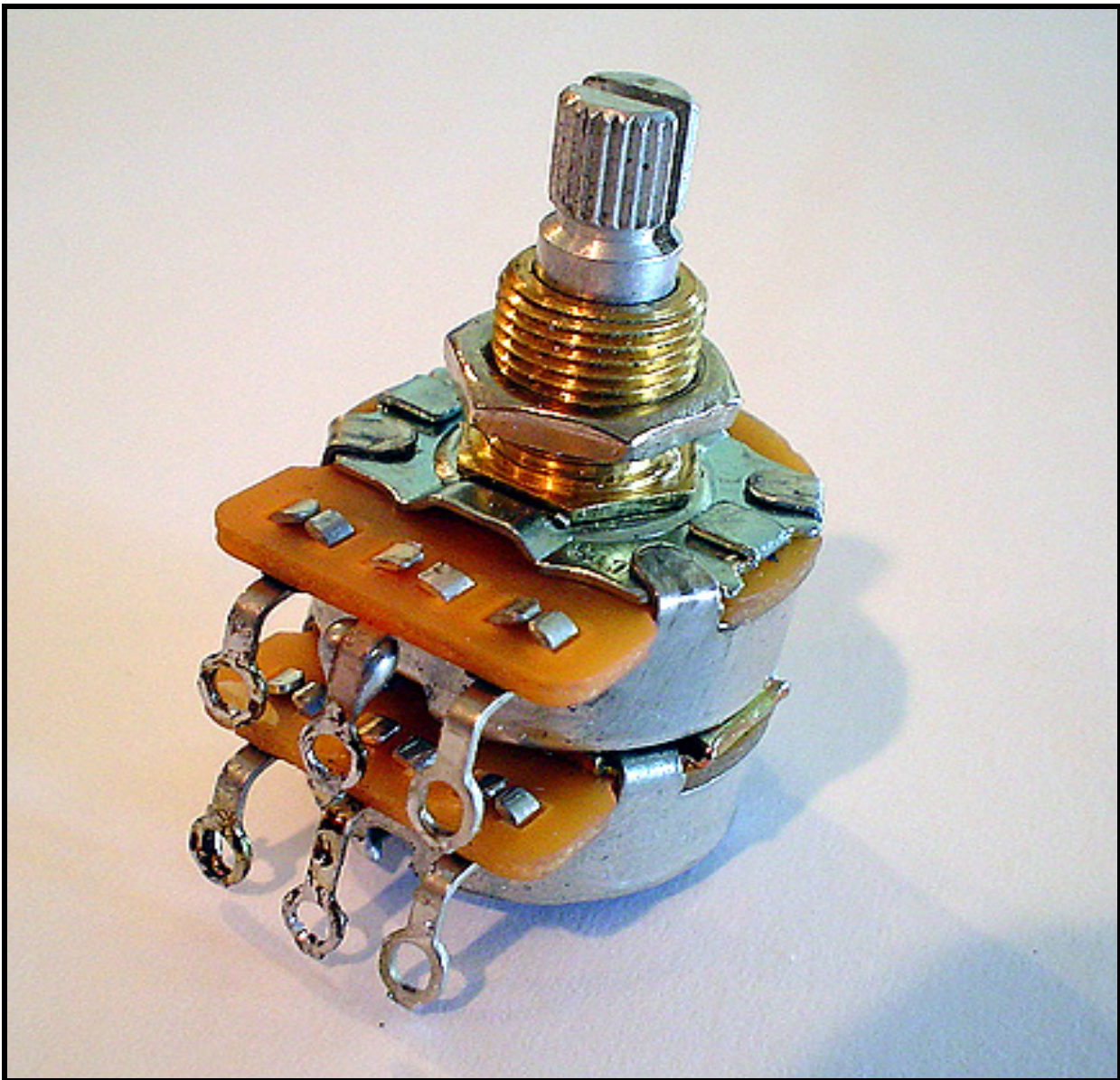
The volume pot receives the signal from the pickup selector switch. It then sends the signal to the output jack, and can also send it to the tone pot if you want a master tone control. The tone pot receives the signal from the volume pot, and then sends the high frequencies out to ground via a capacitor. The telecaster is a perfect example of how you can wire any guitar with one master volume and one master tone control. The wiring on the pickup selector switch is the only thing that will change, depending on the number of pickups you have installed on your guitar. I think having one tone and one volume for all of your pickups is a lot less confusing. Plus, if you have a strat, it also allows you to have a tone control for the bridge pickup. (Most strats don't have a tone control wired to the bridge pickup.) The diagram below shows how a volume pot and tone pot work together in a telecaster.



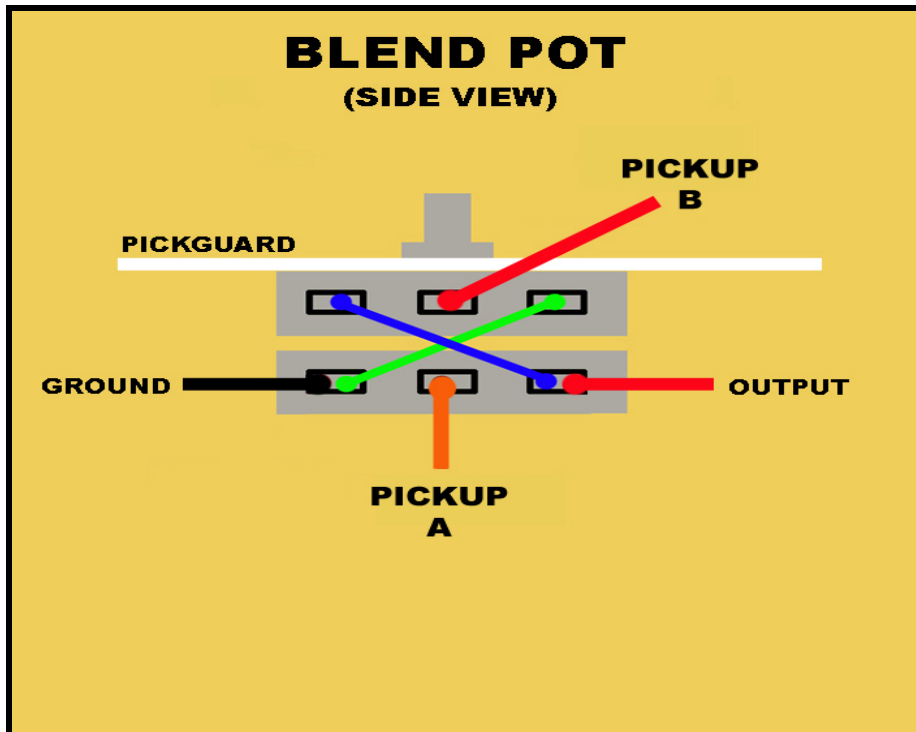
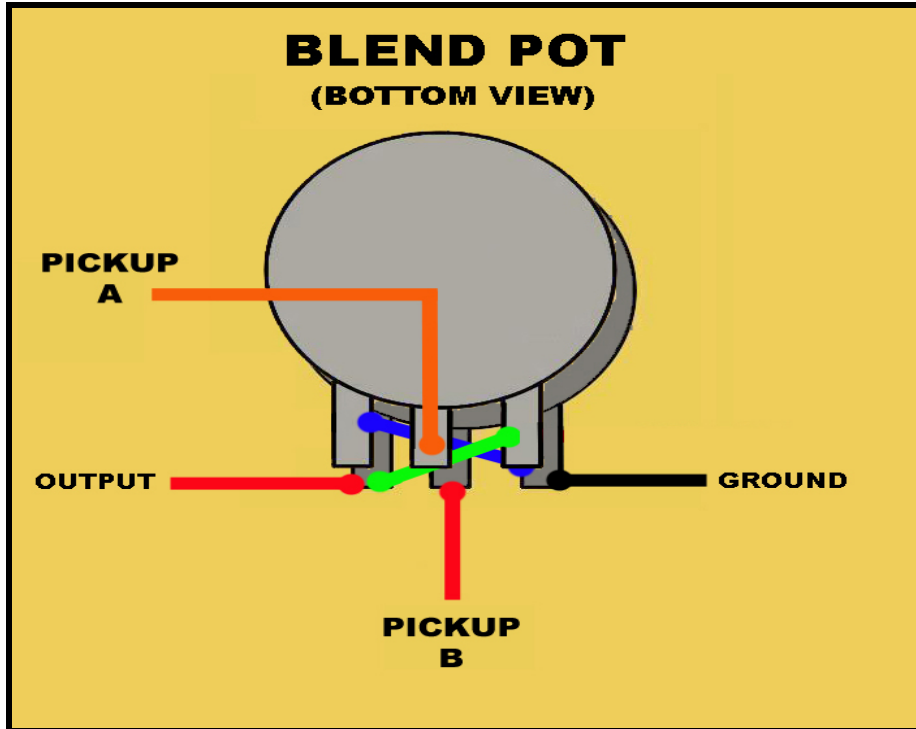
## BLEND POTENTIOMETERS

A blend pot is a potentiometer that controls two pickups. It's a unique substitute for a pickup selector switch. However, it doesn't just turn on a pickup like a lever switch does. It can turn on a percentage of a pickup's volume. Basically, one direction increases the volume of pickup A, while decreasing the volume of pickup B. Turn the knob in the opposite direction, and it increases the volume of pickup B, and decreases the volume of pickup A. In the middle position, both pickups are at 100% volume. A mini toggle switch can be added to turn on the bridge pickup when wired in a strat.

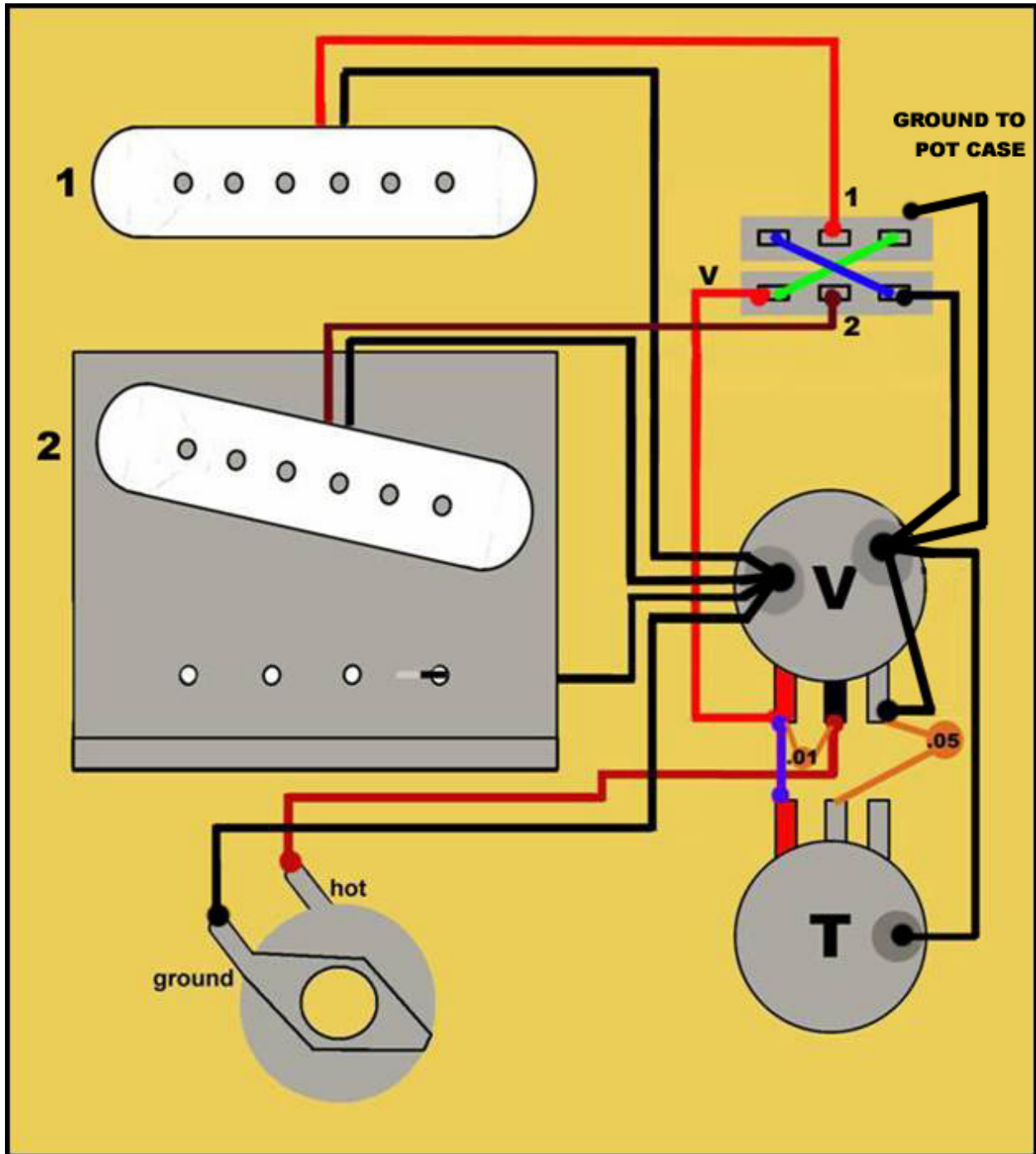
*Note: The shaft controls both potentiometers in a stacked pot. So the pots are not independent of one another. That's why jumper wires are needed to make the blending work.*





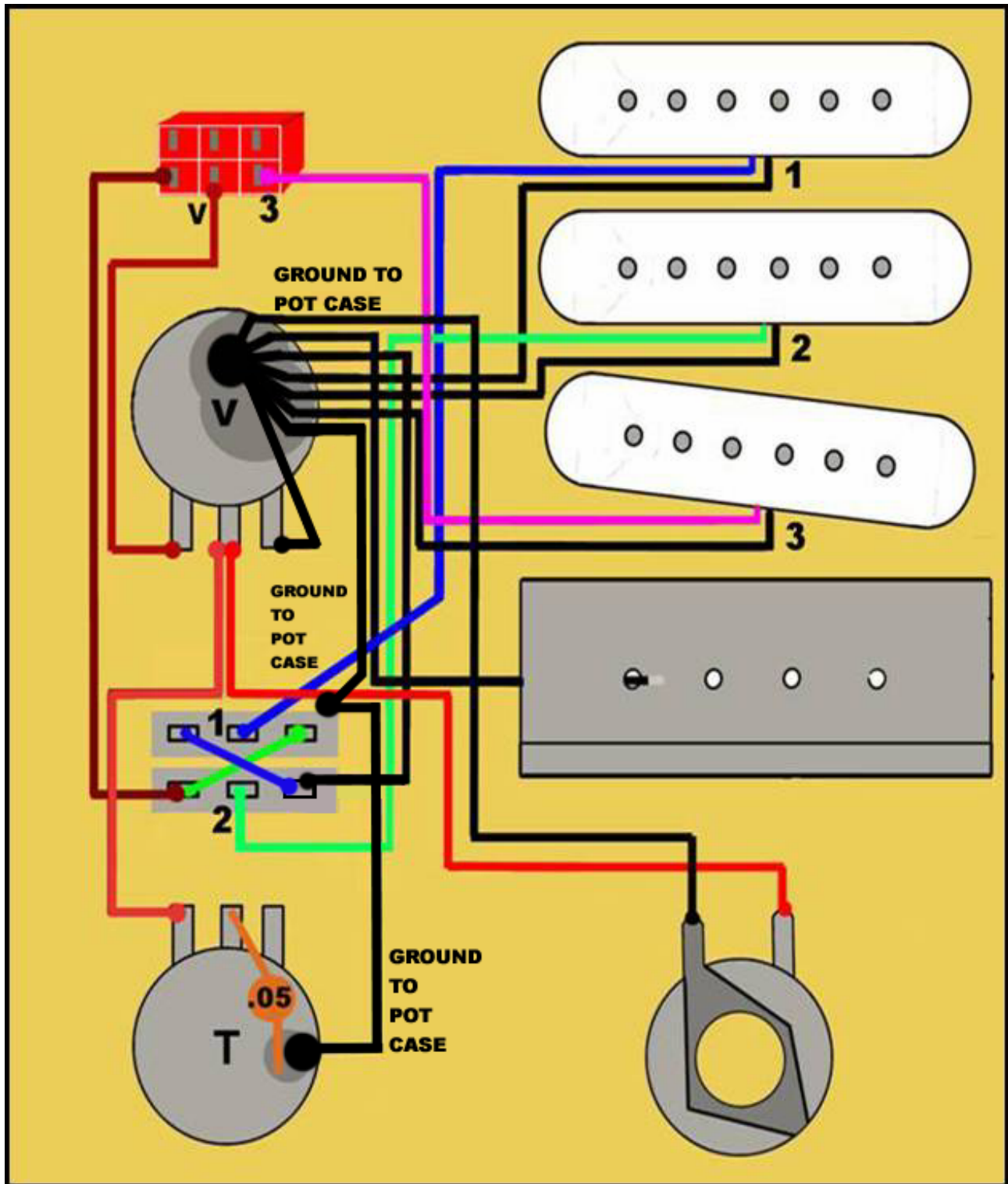


Here is a 2 pickup guitar with a blend pot.



Here is a strat style wiring. There is one master volume and master tone for all three pickups. The toggle switch turns on the neck and middle pickups together, or just the bridge pickup by itself. The blend pot controls the signal coming from the neck and middle pickups. This is a great wiring technique for strat players that mainly play with the neck and middle pickups on. That tone is often

referred to as the strat's sweet sound. So you can control the percentage of the neck and middle pickups, or use the mini toggle switch to turn on the bridge pickup by itself.



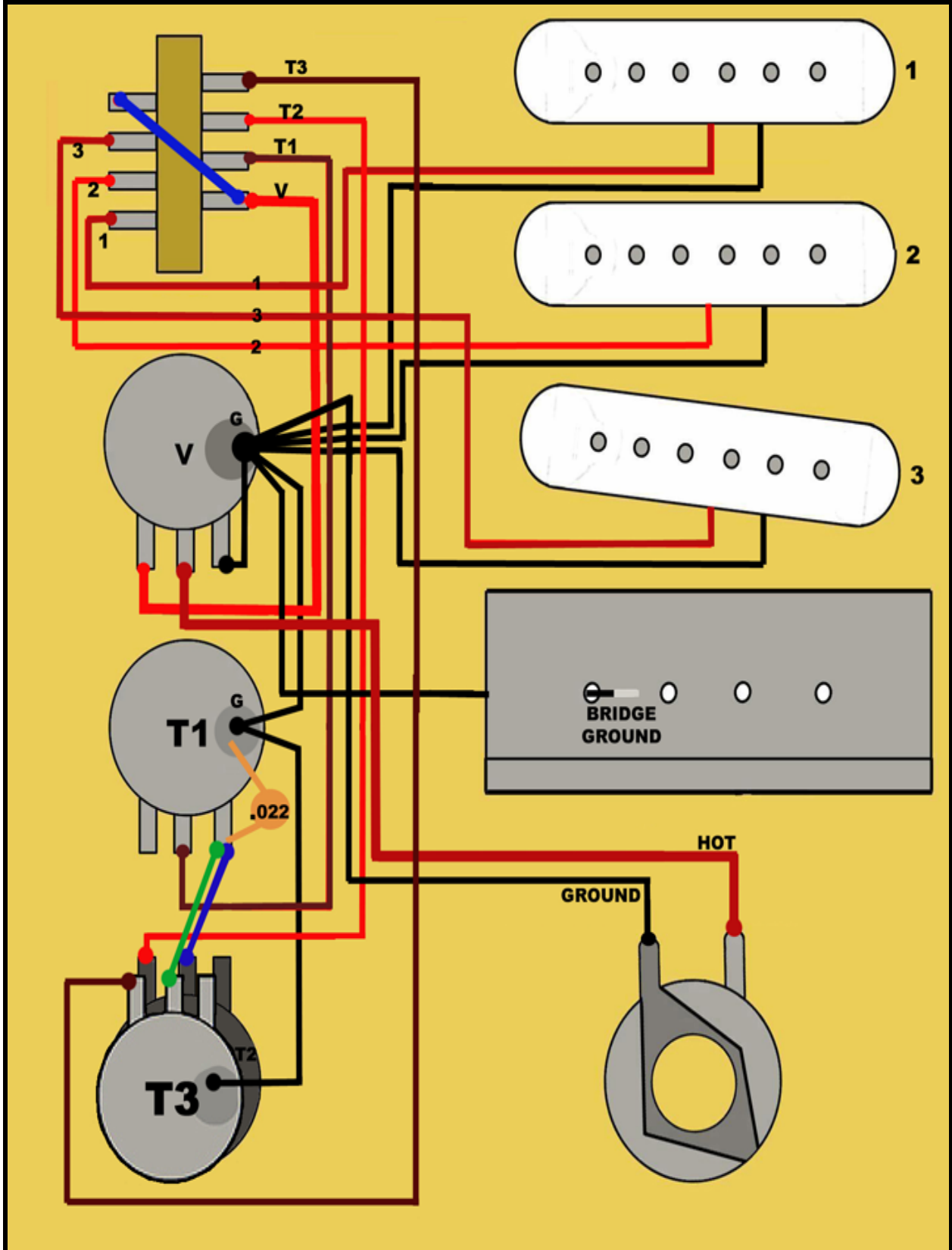
## STACKED CONCENTRIC POTENTIOMETERS

Another type of potentiometer used in basses a lot is a stacked concentric pot. This is basically two potentiometers attached on top of one another, and controlled by two separate shafts (a thick one and a thin one), so unlike a blend pot, each pot is independent of one another. This allows you to pack in two potentiometers in the space of only one potentiometer. A special type of knob is used for this setup, one that has two moving sections for each shaft. You can find stacked concentric pots and knobs online at the ALLPARTS website.

<http://www.allparts.com>

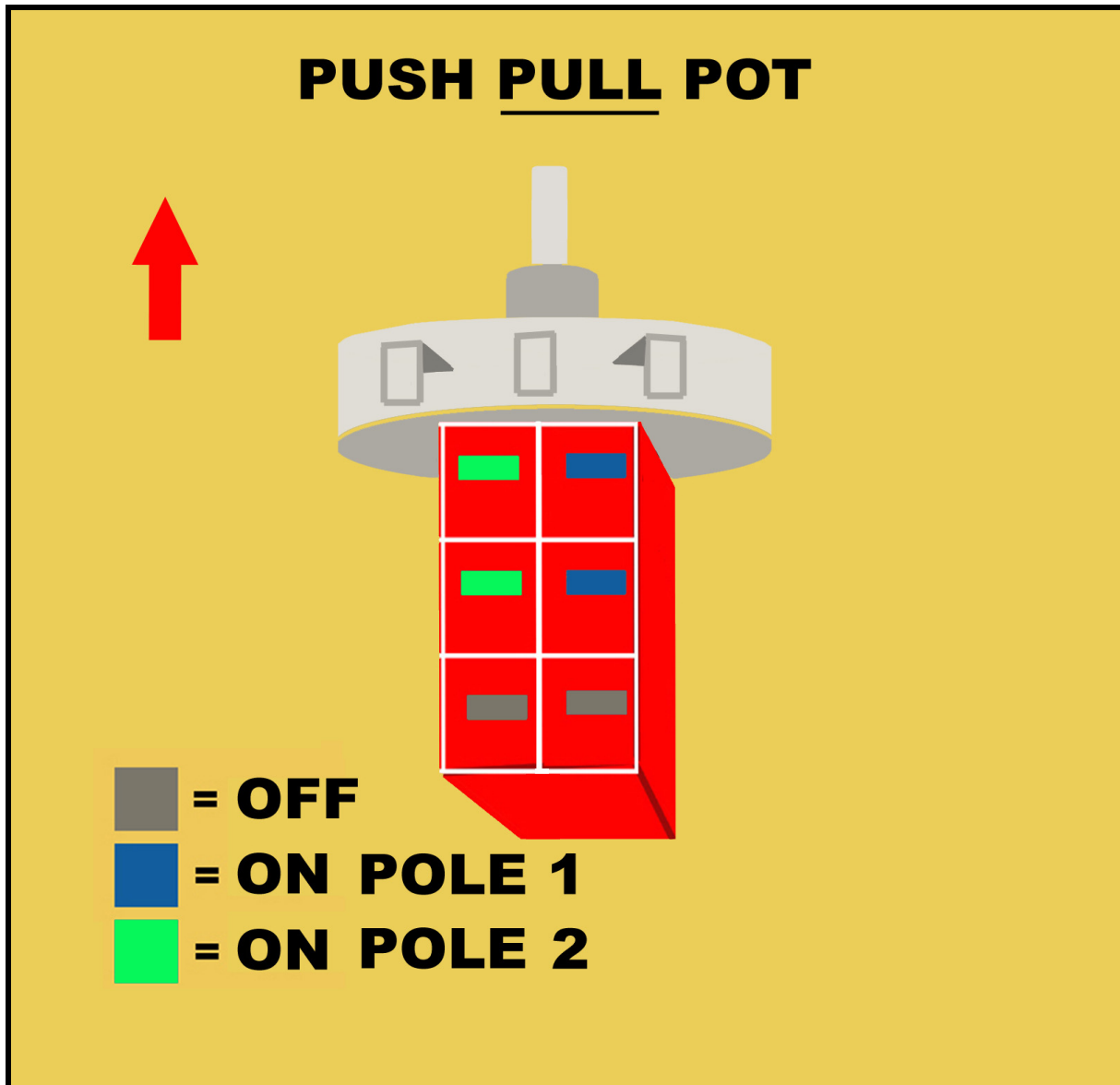


The diagram on the next page shows a strat with a concentric stacked pot being used as a tone control for the middle and bridge pickups.

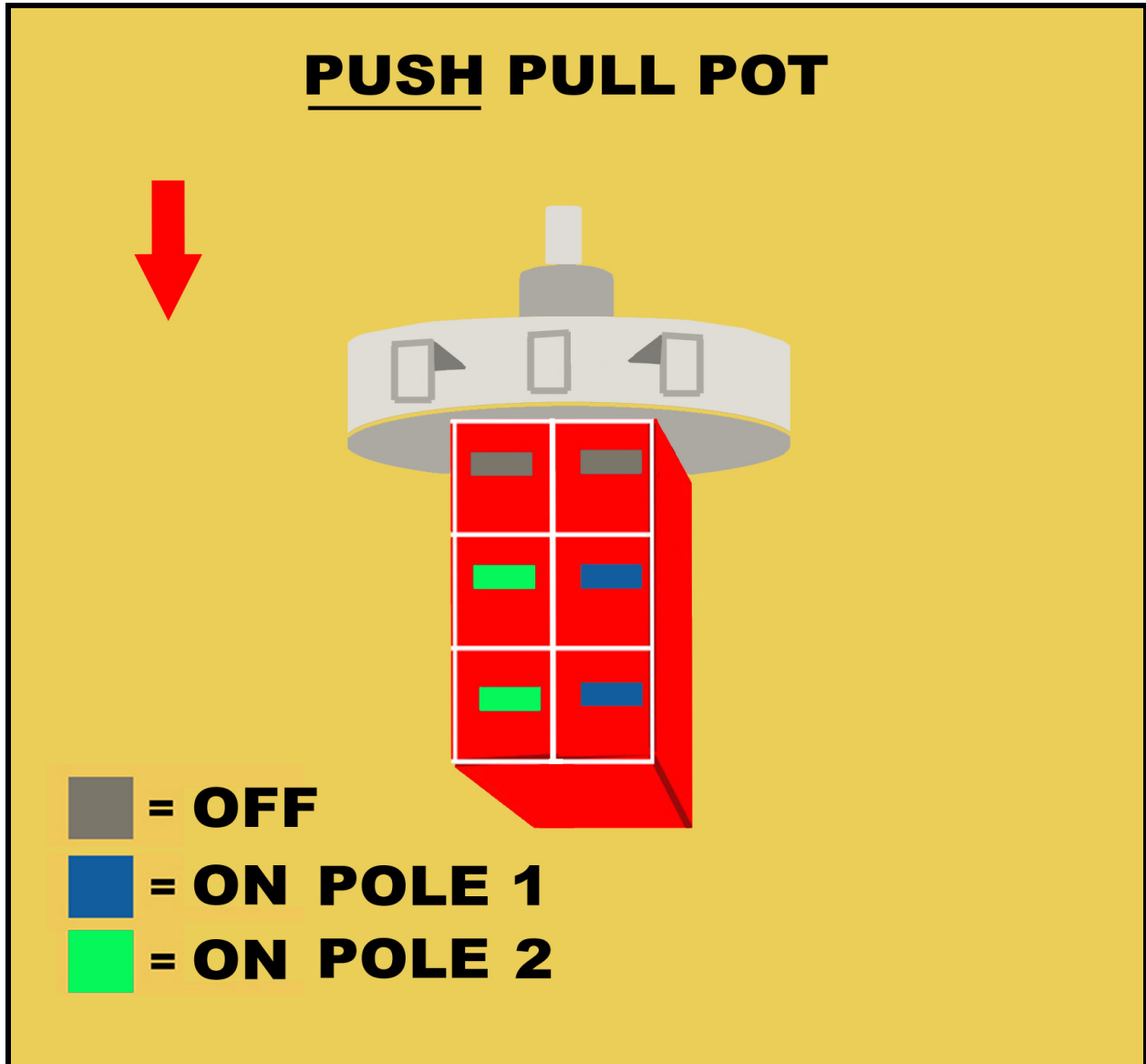


## PUSH PULL POTENTIOMETERS

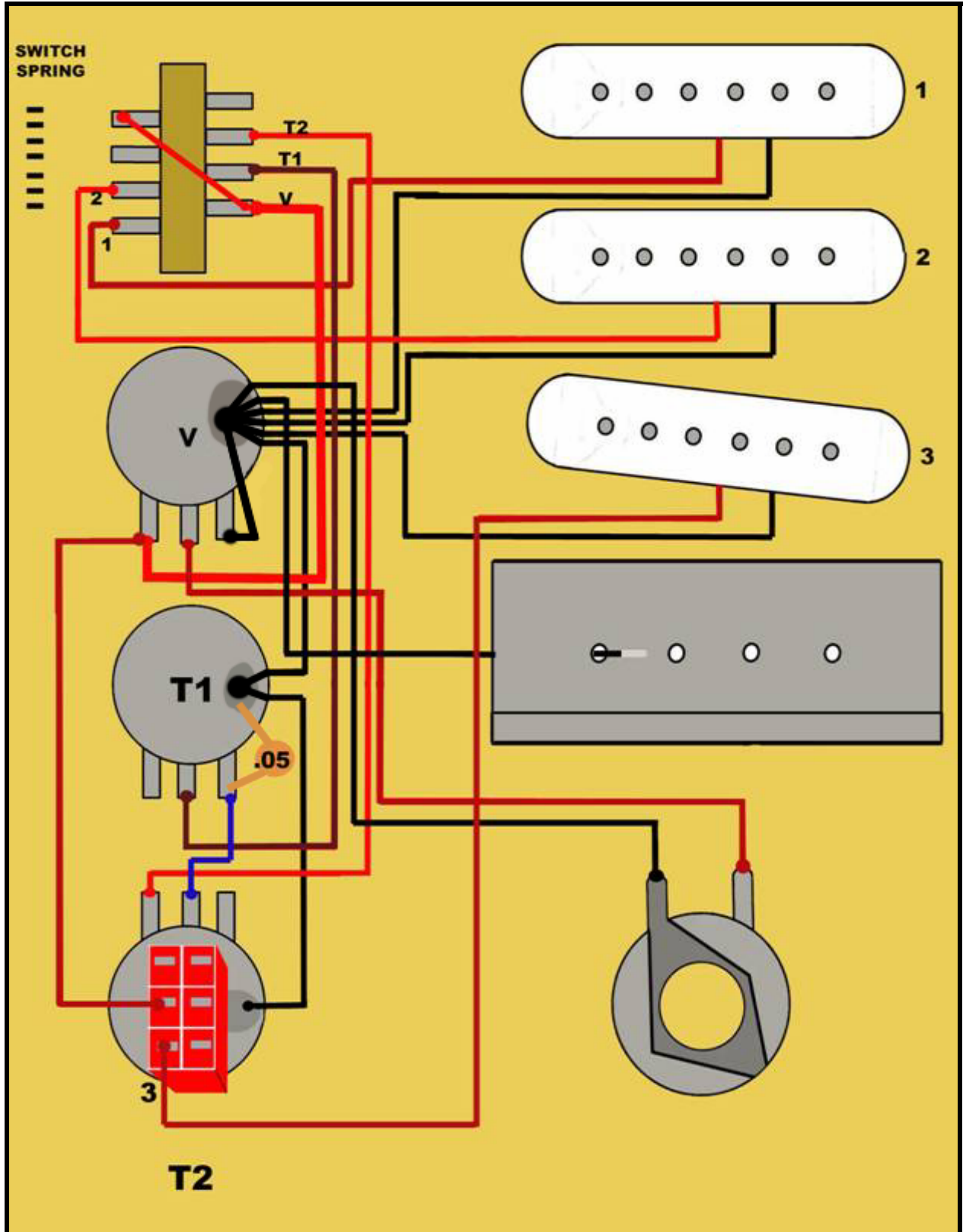
A push pull potentiometer is basically a combination of a DPDT on-on mini toggle switch and a regular potentiometer. This type of pot is designed to conserve space inside your guitar. Otherwise, you would need to drill a hole in your pickguard to add the mini toggle switch. Think of it like a separate potentiometer, and a separate DPDT mini toggle switch stuck together. When the knob is in the up position, it turns on the top 4 lugs. Note: there are two poles, or channels in each push pull pot switch. So the green lugs and the blue lugs are on, but they are not connected to each other. The grey lugs are off. For more info on DPDT switches, check out the section on switches.



When the knob is in the down position, it turns on the bottom 4 lugs.



Next is an example of a push pull pot being used as a **bridge-on switch**. This will allow you to add 2 more tones to your strat: all three pickups on, and the neck and bridge pickups on. To add separate switching for one pickup, just add an on/on mini toggle switch, or a push pull pot to your guitar. Then send the signal to the volume pot. Check out the diagram below, or read the section on switches for more info.





## UNDERSTANDING CAPACITORS

Probably one of the easiest ways to change your guitar's sound is to change the tone capacitor. I am not just talking about adding more or less bass to the sound, but actually changing your guitar's character. For this task, you are not going to need just any capacitor, but a vintage style one. The vintage capacitors are considered to be less harsh sounding than the new caps on the market today, and are getting a lot of attention as of late. Luckily, there are companies that make replica capacitors, and they are just like the ones from the 50's and 60's.

First a little history. The .047 Bumble Bee capacitors, painted like a bee, are the holy grail of caps. They sound smooth and creamy, partly do to their oil content. These were used in guitars, TVs, and even stereos. You can also look for the Black Beauty Spragues, which were never installed in Fenders as stock, but they so work well in most strats.

Fender used Cornell-Dubilier brand .05/150v and .1/150v wax coated caps in all of the premier instruments from 1950 to 1961 (Tele, Strat, Jazz, Precision and Jazzmaster {.02 and .03}). The student models used the cheaper Astron Type AM capacitors in a 200v size from the amplifier assembly line. In 1961 they switched all lines to lower voltage ceramic caps from a variety of manufacturers.

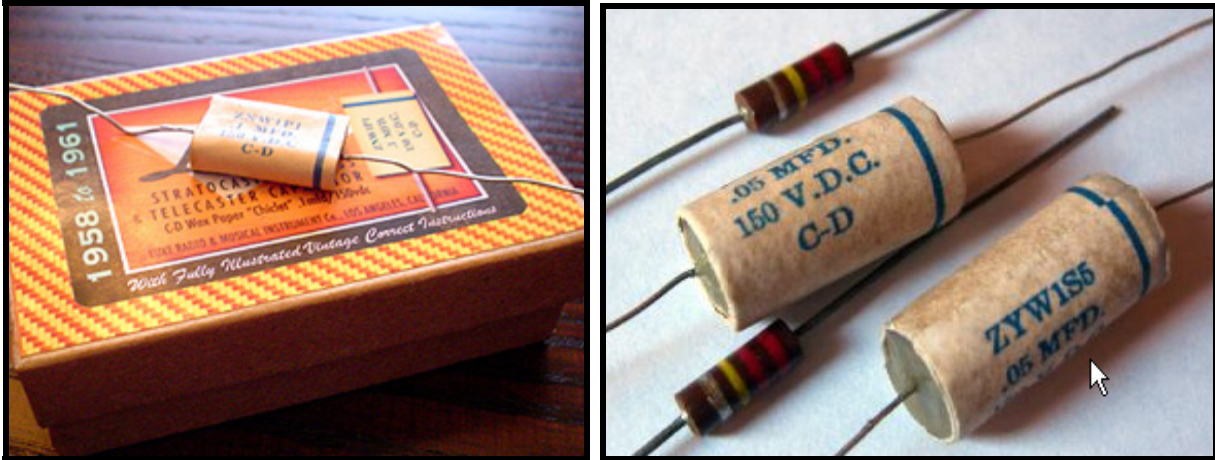
Gibson used Cornell-Dubilier brand .02/400v Grey Tiger caps from the late '40s until 1956, when they switched over to the Sprague made .022/400v Bumblebee Telecaps. These were replaced in 1960 with the Sprague .02/50v ceramic discs. Although the Sprague .022/400v Black Beauty Telecaps do turn up in some high end models, they were used exclusively in the re-launched Les Paul in '68 and '69.

Many people, especially Ebay sellers, will try to sell other kinds of capacitors as genuine, but they are simply taking advantage of the gullible, or un-educated. The original equipment manufacturers of the day ordered parts in large quantities to save money, so the types of capacitors used are fairly easy to keep track of over the course of the years. Genuine vintage caps are hard to find.

The Bumblebee sound comes from the minutely slower response caused by the combination of large plates and the oil-soaked dielectric paper. They are a dry cap, unlike the Vitamin Q type caps, which have a very warm and creamy sound due in part to the foil and dielectric floating in a bath of oil inside the metal canister.

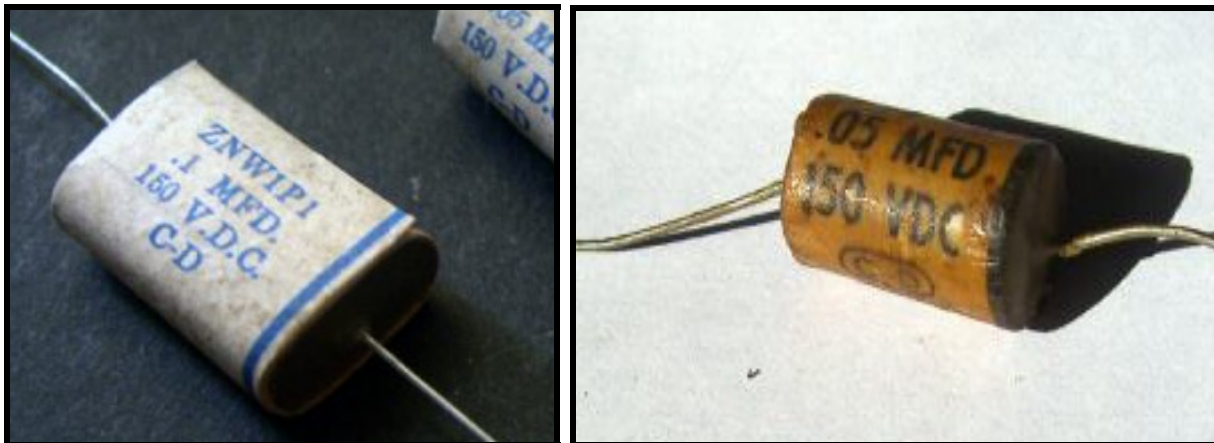
If you are looking for some good replica capacitors that are pretty much the same as the ones used on the strats, teles, and les pauls from the 1950's and 1960's, then you want to checkout **Luxe Radio & Musical Instrument Co**. They have the best selection of reproduction capacitors and resistors.

<http://stores.ebay.com/Luxe-Guitars>



Here is some info from Luxe on their vintage caps:

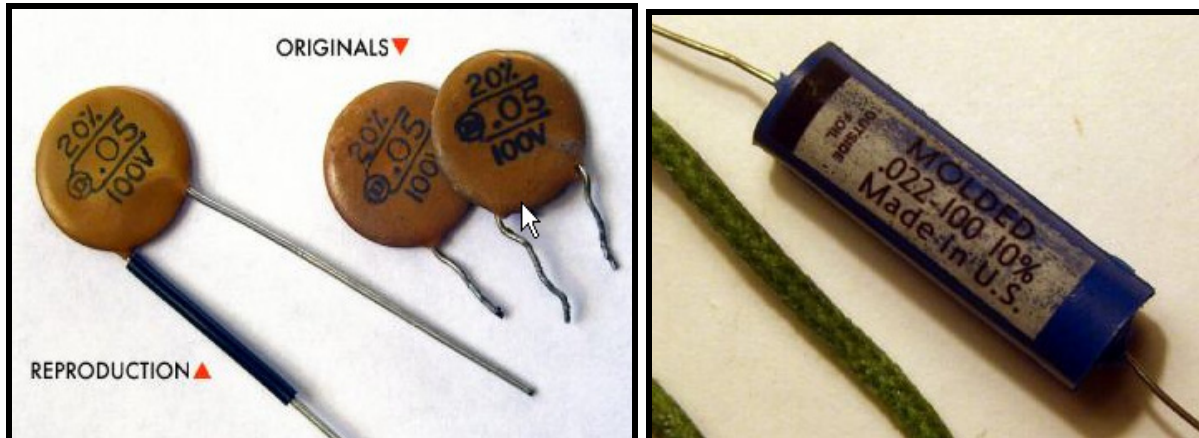
Each of my reproduction wax capacitors is made with the same materials and methods as the original. The only difference is that instead of a foil and paper “slug” at the core, I use a NOS Vitamin Q type paper and oil capacitor. These were manufactured from the 1950s through the 1980s by various companies, like Sprague, for military and aerospace use. Unlike other types of capacitors, the dielectric and foil in these are sealed in a metal and glass tube, making them impervious to heat and moisture. They do not degrade with time and they do not drift in value. They have the added bonus of having an oil-soaked paper as the dielectric, which (and this is a popular topic for discussion) has a more “musical” quality than any other dielectric. I confess that I do not understand how this can be, it’s only electricity, and electricity doesn’t care, but just like a record sounds better than a cd, and a ’55 Champ sounds better than a Peavey. PIO caps just sound better.



I do not use Dykanol or any other chemicals in my capacitors. Most capacitors made before 1956 were coated with a blend of pitch and petroleum jelly. This is the

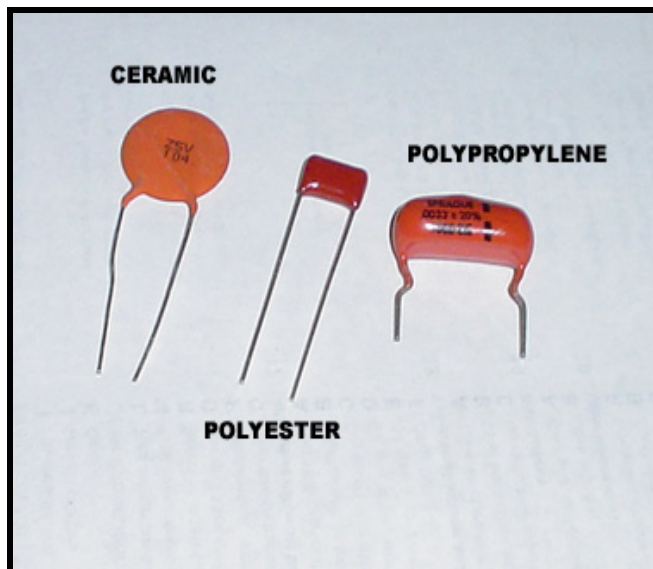
nasty sticky stuff that radio guys hate. I make this coating with pitch and beeswax. It looks the same, but it doesn't get all over the place.

Each of these caps is handmade, to the original factory specifications.

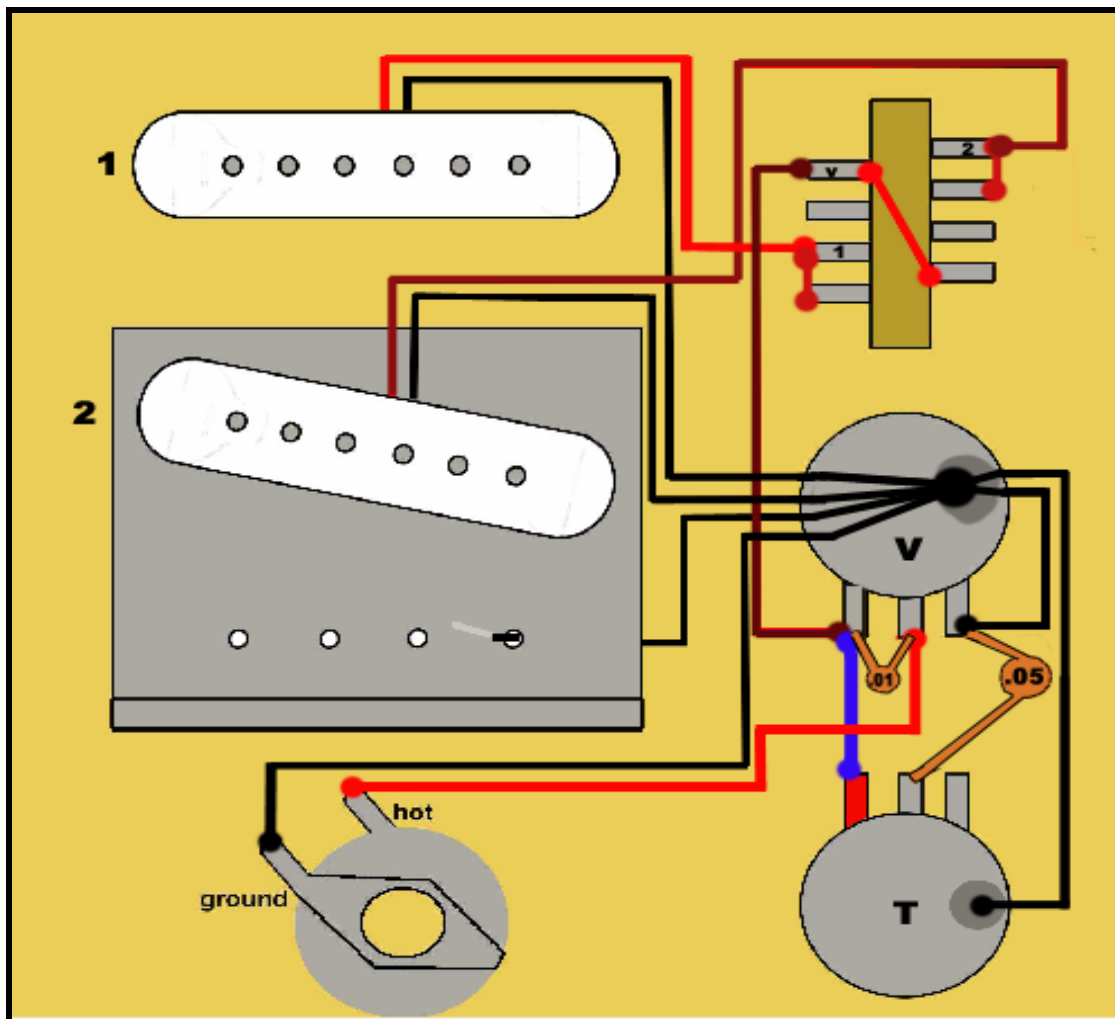
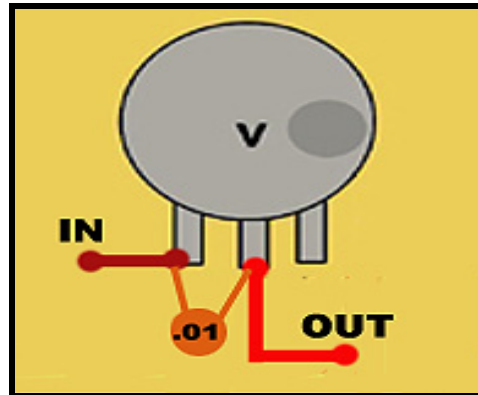
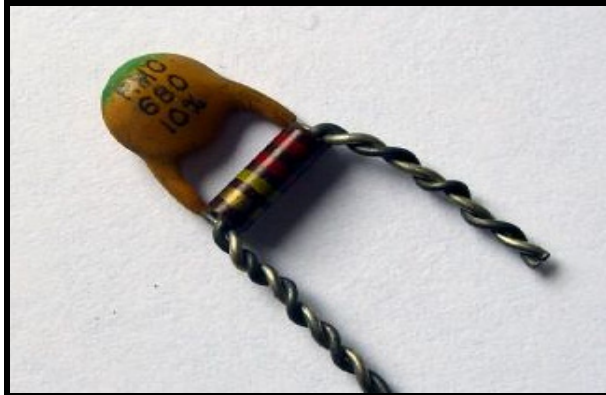


### What types of capacitors are used in most guitars today?

Most guitars will either have ceramic disc caps, polyester caps, or polypropylene caps in them. The bright orange drop capacitors with the hockey stick leads are good examples of polypropylene caps that have a nice, warm, rich tone. These caps also have a higher tolerance than the polyester caps, which are very inexpensive. You can see the polyester capacitors in a lot of import guitars. The ceramic disc caps work pretty well, and can be used for higher frequencies. They are known to be pretty dependable.

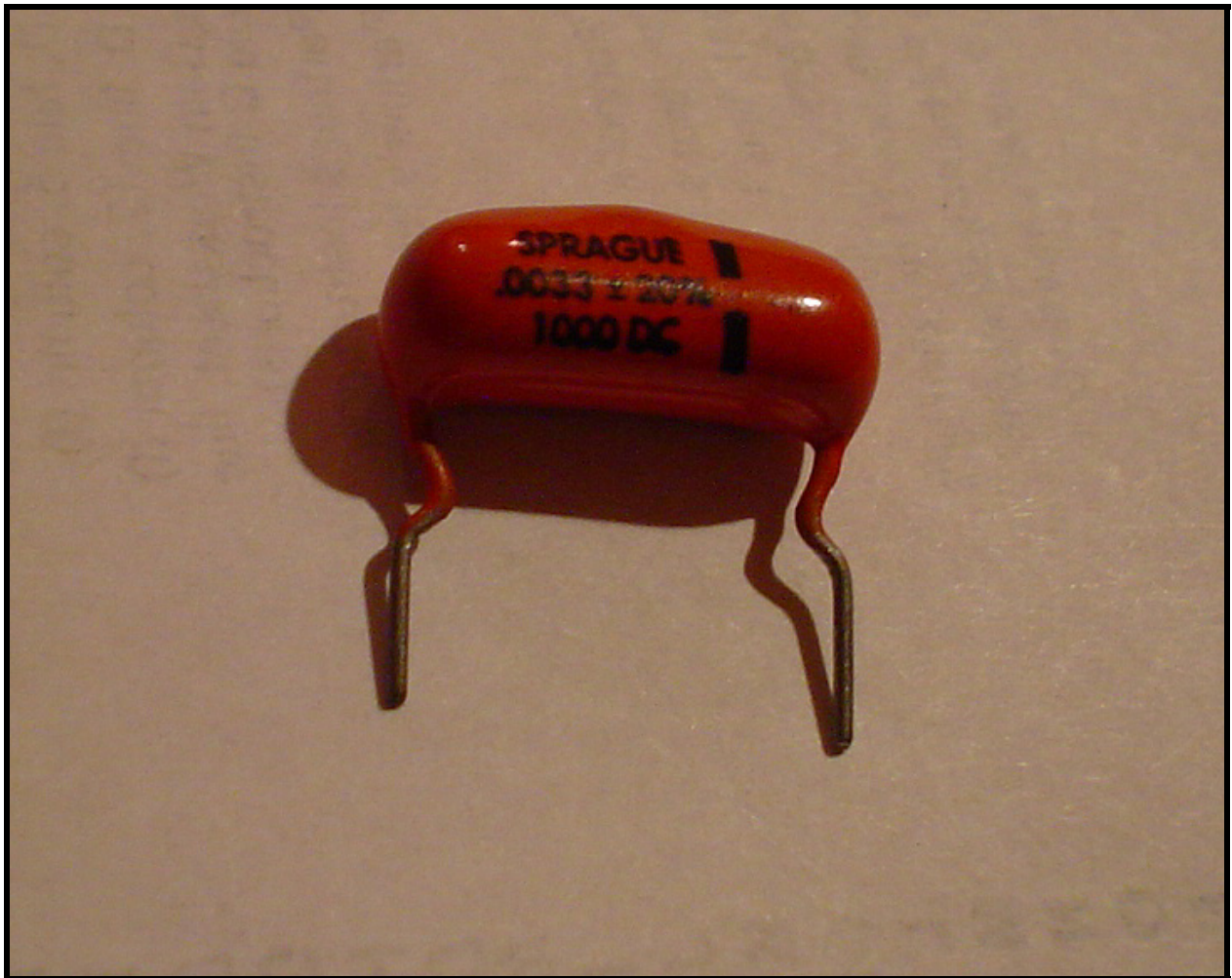


**What does a treble bleed kit do?** Capacitors only let the higher frequencies pass through them. So the treble bleed kit is going to take the high tones out of the circuit at the volume pot, and then throw them back in the circuit as the signal leaves the volume pot. This prevents the treble from naturally bleeding out of the system as you turn down the volume. This is often seen in telecaster wiring. Some of the vintage treble bleeds also add a resistor to the capacitor, as shown in the example below.



**Does the capacitor voltage matter?** A guitar circuit is only a few volts, so a small capacitor is all that is required. And the voltage does make a tone difference. The higher the voltage, the higher the “ceiling” of a tone cap. Gibson engineers preferred the 400 volt caps, never using the cheaper 200 volt versions, while Fender always used the lowest voltage available from their suppliers. A larger cap of 600 volts, or more, can also give the impression of increased capacitance, swallowing up more signal than you want it to.

**Do some capacitors have polarity?** All paper-in-oil, wax paper, mica, ceramic, film, polyester and polypropylene capacitors have no polarity. Old capacitors of these types are marked with an outside foil band which is meant to be wired to ground, but that is only for noise reduction in radios and amplifiers, and makes no difference in the metallized film capacitors of today. Only electrolytic caps have a specific polarity, and they should never be used in a guitar anyway.

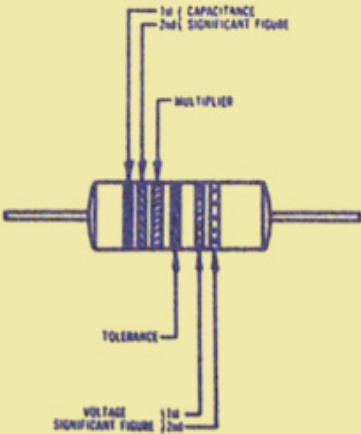


**What do the colors on a Bumblebee capacitor mean?** Here is an old Sprague chart. This chart is in micro-microfarads, so you have to move the decimal point 6 places to the left to get the regular mfd number. A classic Gibson style bumblebee is labelled: Red-Red-Orange-Gray-Yellow so it translates out to 22 times 1000 (22000 micro-microfarads {mmF or pF}) which is .022mF, and the grey band is actually black, standing for 20% tolerance, and the yellow marks a 400 volt rating. Check out the Sprague chart below.

# SPRAGUE

## "QUICK AS A WINK" CHART for CAPACITORS

### MOLDED PAPER CAPACITORS CAPACITANCE IN MICROMICROFARADS



Color	Significant Figure	Decimal Multiplier	Tolerance ± %
Black	0	1	20
Brown	1	10	—
Red	2	100	—
Orange	3	1000	30
Yellow	4	10000	40
Green	5	10 <sup>5</sup>	5
Blue	6	10 <sup>6</sup>	—
Violet	7	—	—
Gray	8	—	—
White	9	—	10
Gold	—	0.1	—

**NOTE:** Voltage rating is identified by a single digit number for ratings up to 900 volts; a two digit number above 900 volts. Two zeros follow the voltage figure.

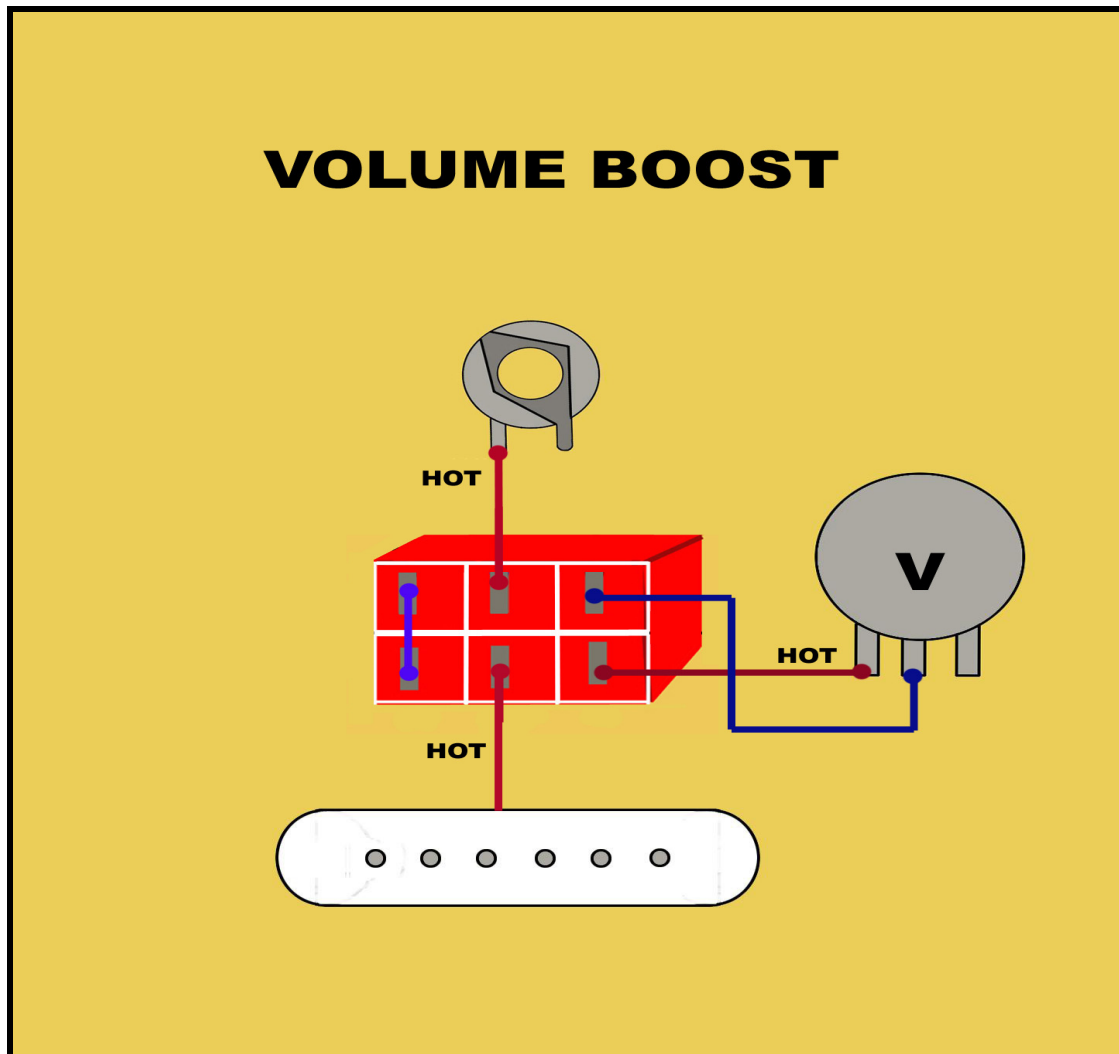


## HOT ROD TECHNIQUES

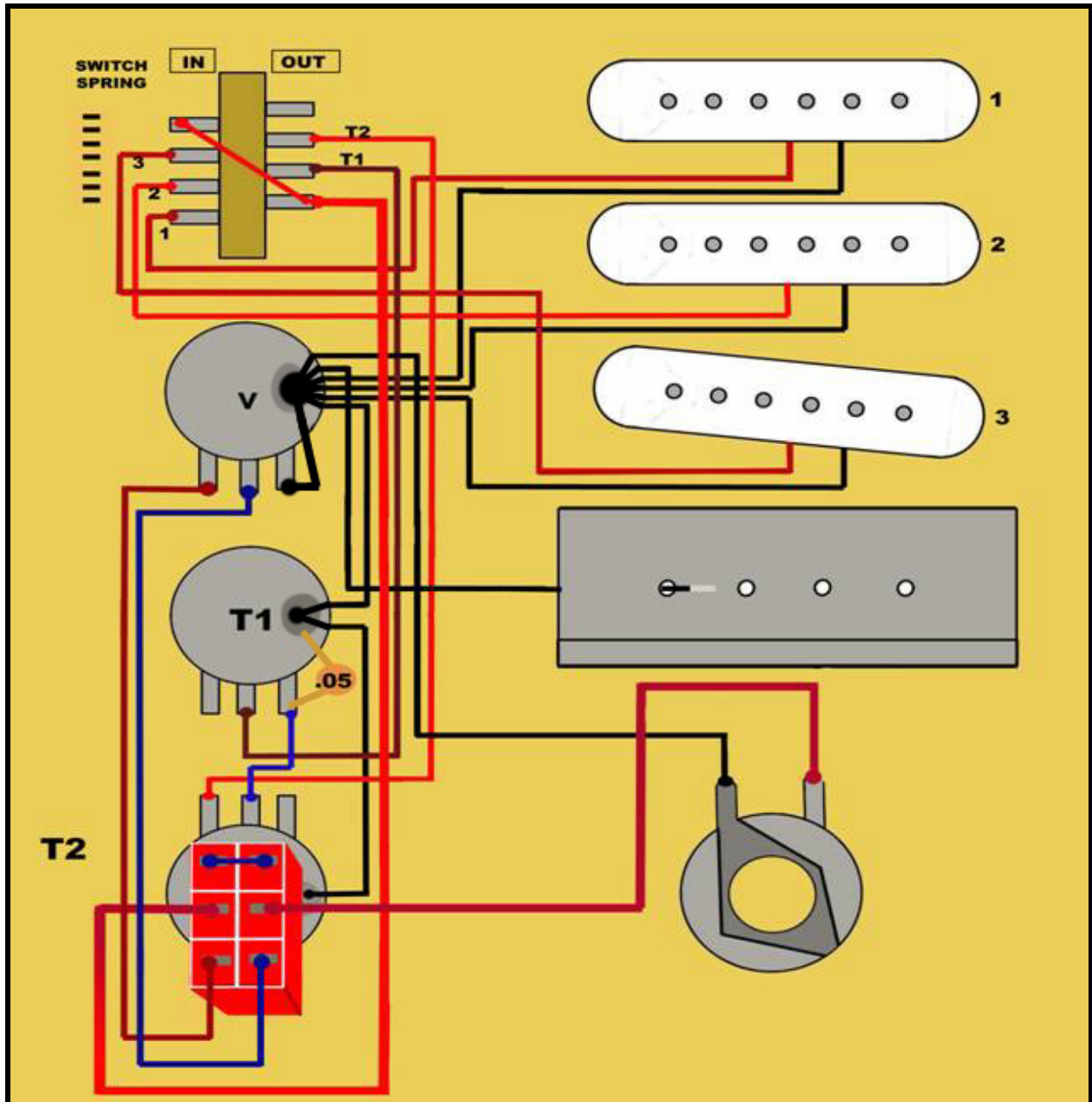
The pros rarely play stock guitars like you or me. They usually incorporate some type of modification to their guitar to get out more useable sounds. I am going to show you some of the more useful hot rod techniques that are both inexpensive and easy to do.

### VOLUME BOOST/BYPASS SWITCH

The volume boost switch is often called a bypass switch, or treble boost switch. It works by bypassing the tone and volume potentiometers, and sending the signal straight to the output jack. This reduces resistance in the circuit, and increases the output of the high tones. You can use a **push pull pot** with an **on/on switch** to activate this bypass. When you pull up on the switch, the signal goes straight to the output jack. When you push down on the switch, the signal goes to the volume and tone controls.



The example below shows the volume boost switch on a strat with a push pull pot.

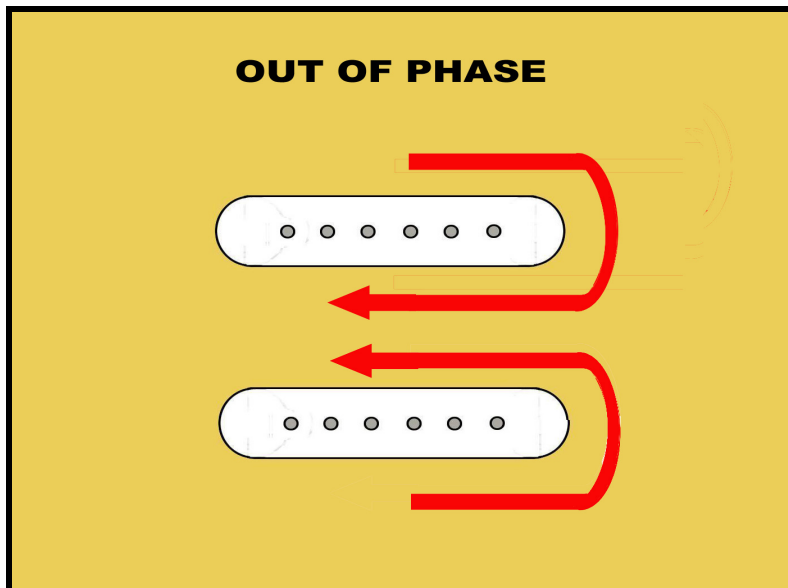
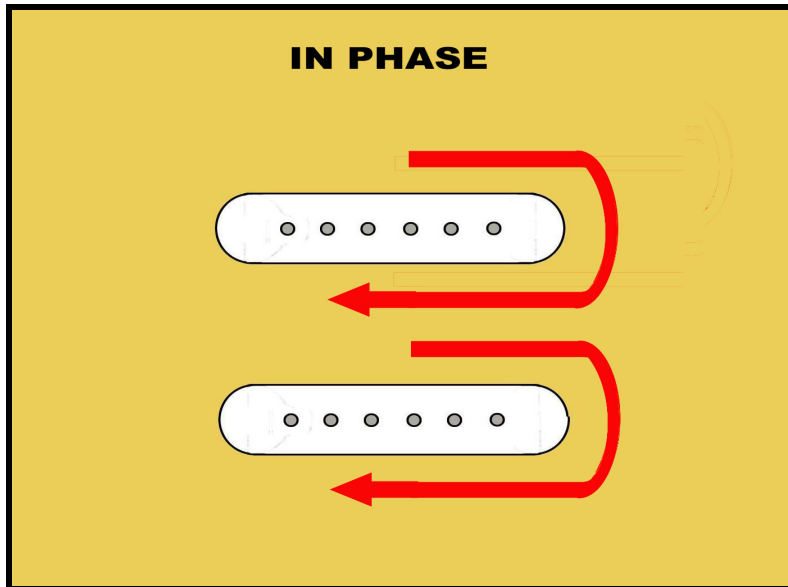


## PHASE REVERSAL SWITCHES

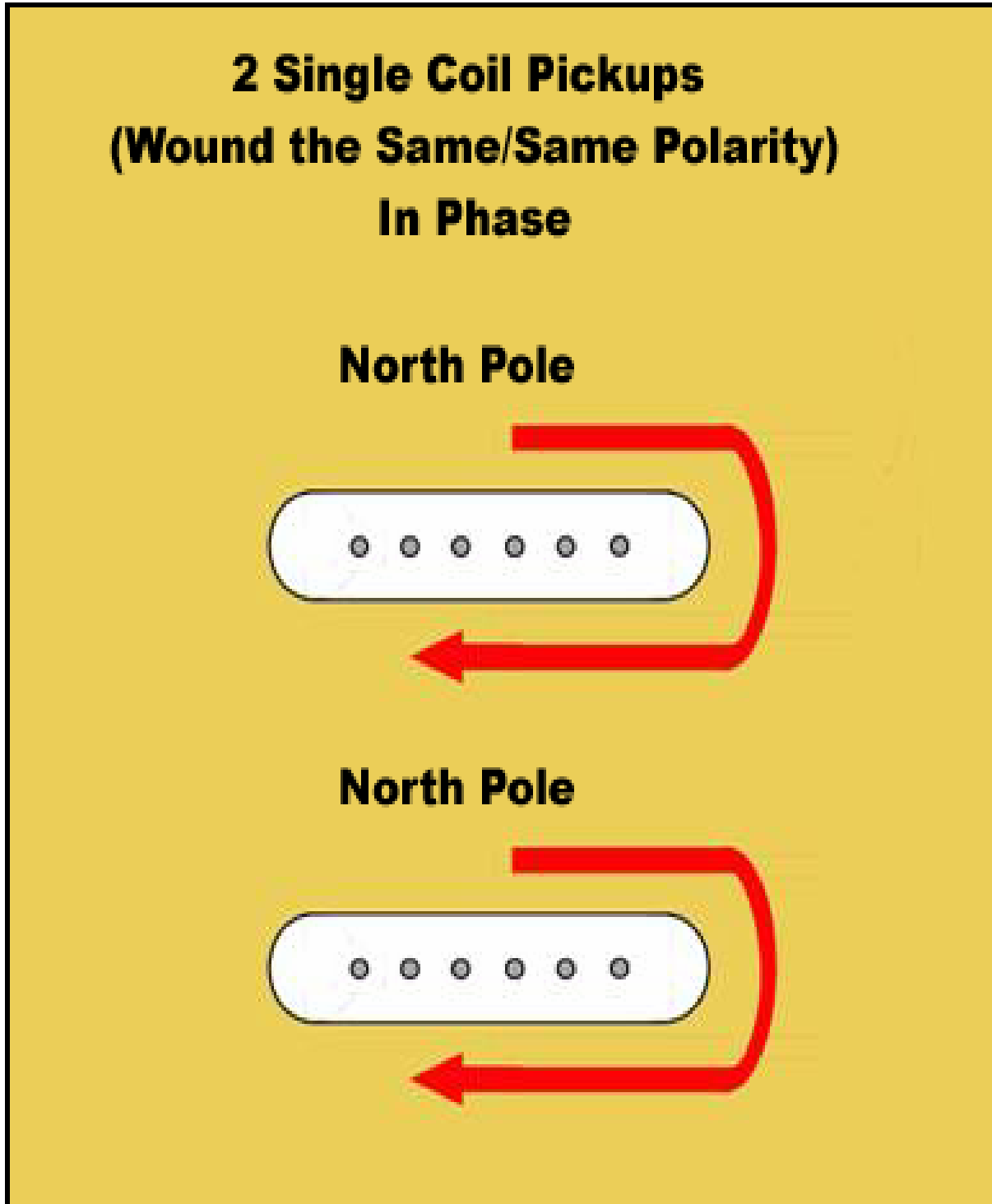
Another way to utilize mini toggle switches involves phase switching. When you change the phase of a pickup, you are changing the direction of the electrical current flowing through the copper wires. Most pickups are wired to be in-phase with each other, and their signals usually move in the same direction. If a pickup is out of phase with itself, or another pickup, the signal will be moving in different directions in each coil, or each pickup. So at least two coils or pickups are needed to get a thinner, out of phase sound. The out of phase sound also has a lower output.



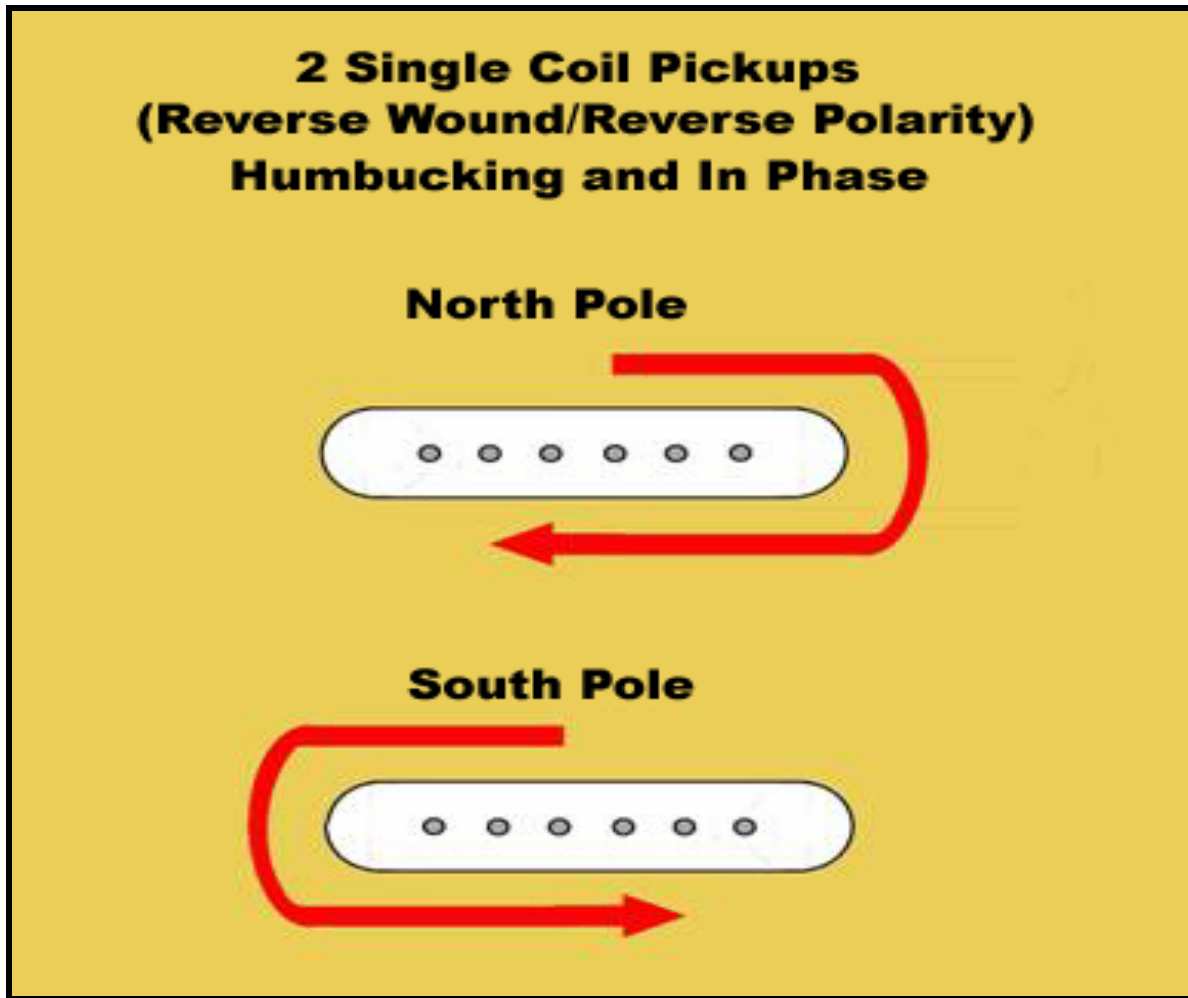
Keep in mind that out of phase single coil pickups can sometimes produce an unwanted noise, or hum. Also note that on most guitars, the poles will be the same for all of the single coil pickups on a guitar. So they will be all north, or all south. But, on some strats, the middle pickup will have an opposite polarity, and it will be wound out of phase with the neck and bridge pickups. In other words, if the neck and bridge pickup wires were spun clockwise around the bobbins, then the middle pickup would be spun counterclockwise around the bobbin. So by being wired out of phase AND having a reverse polarity, you have created a humbucking pickup when the neck and middle pickups are on, or when the middle and bridge pickups are on.



Here are two single coils wired to be in phase. This is typical for most single coils.



Here are two single coils wound to be in phase and humbucking.



Type this address in your web browser to hear two coils in phase and humbucking due to the reverse wound/reverse polarity of the middle pickup. Think of the neck and middle, or the middle and bridge pickups like a humbucker that has been wired in parallel and in phase.

**CLEAN TONE:** [HTTP://WWW.TINYURL.COM/3Y5LA3](http://www.tinyurl.com/3Y5LA3)

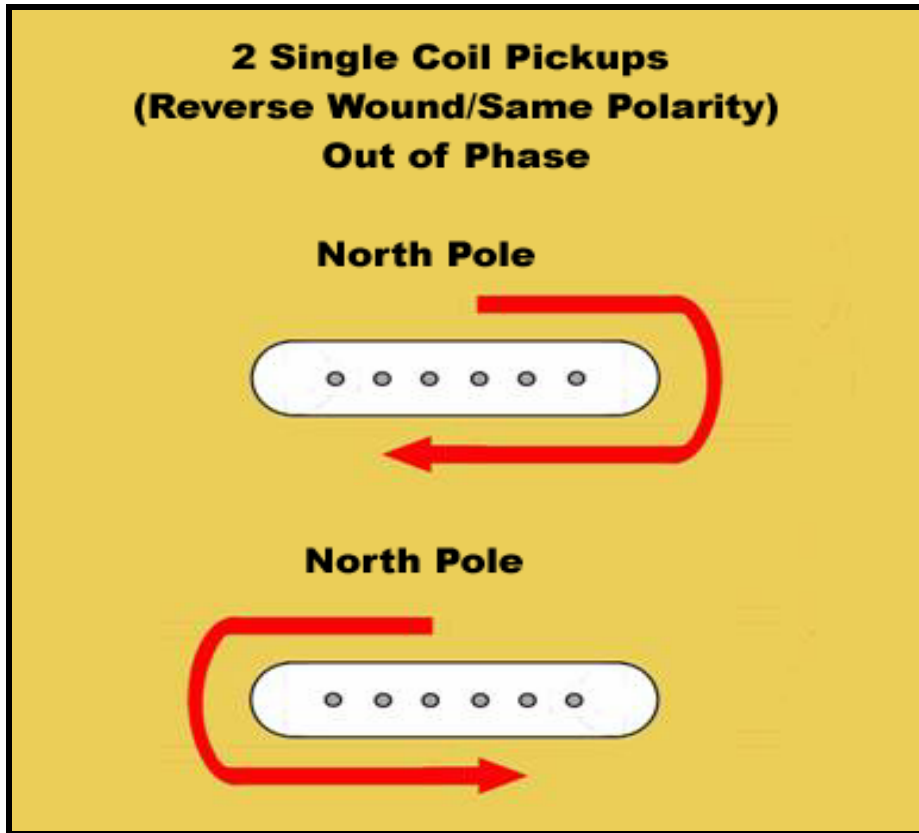
Here are some pictures of the polarity being tested on a strat with reverse wound/reverse polarity pickups. The polarity tester can be purchased from [stewmac.com](http://stewmac.com) for a few bucks. The white side up on the neck pickup means north polarity.



The black side up on the middle pickup means south polarity.



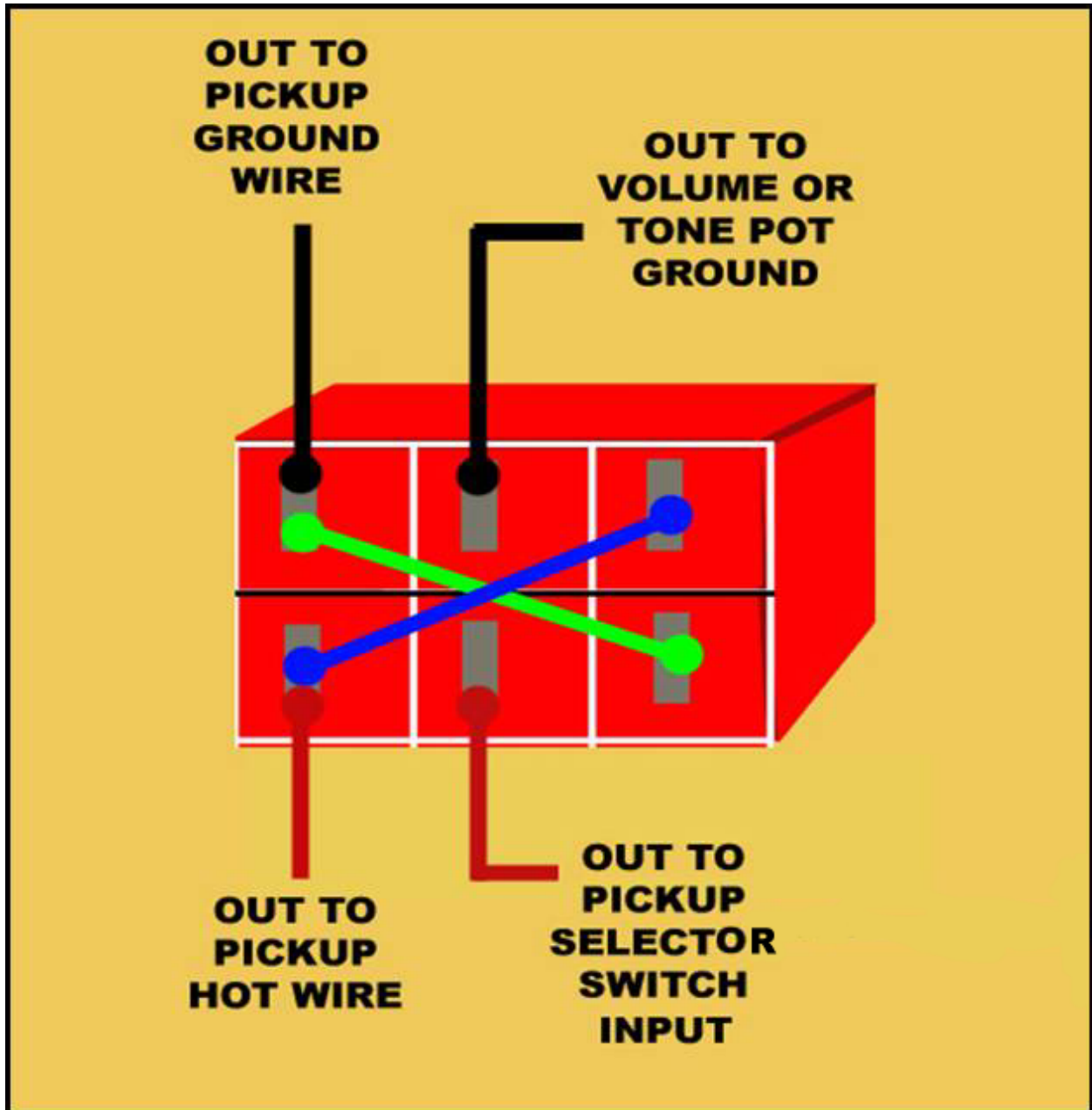
Here are two single coils wound to be out of phase.



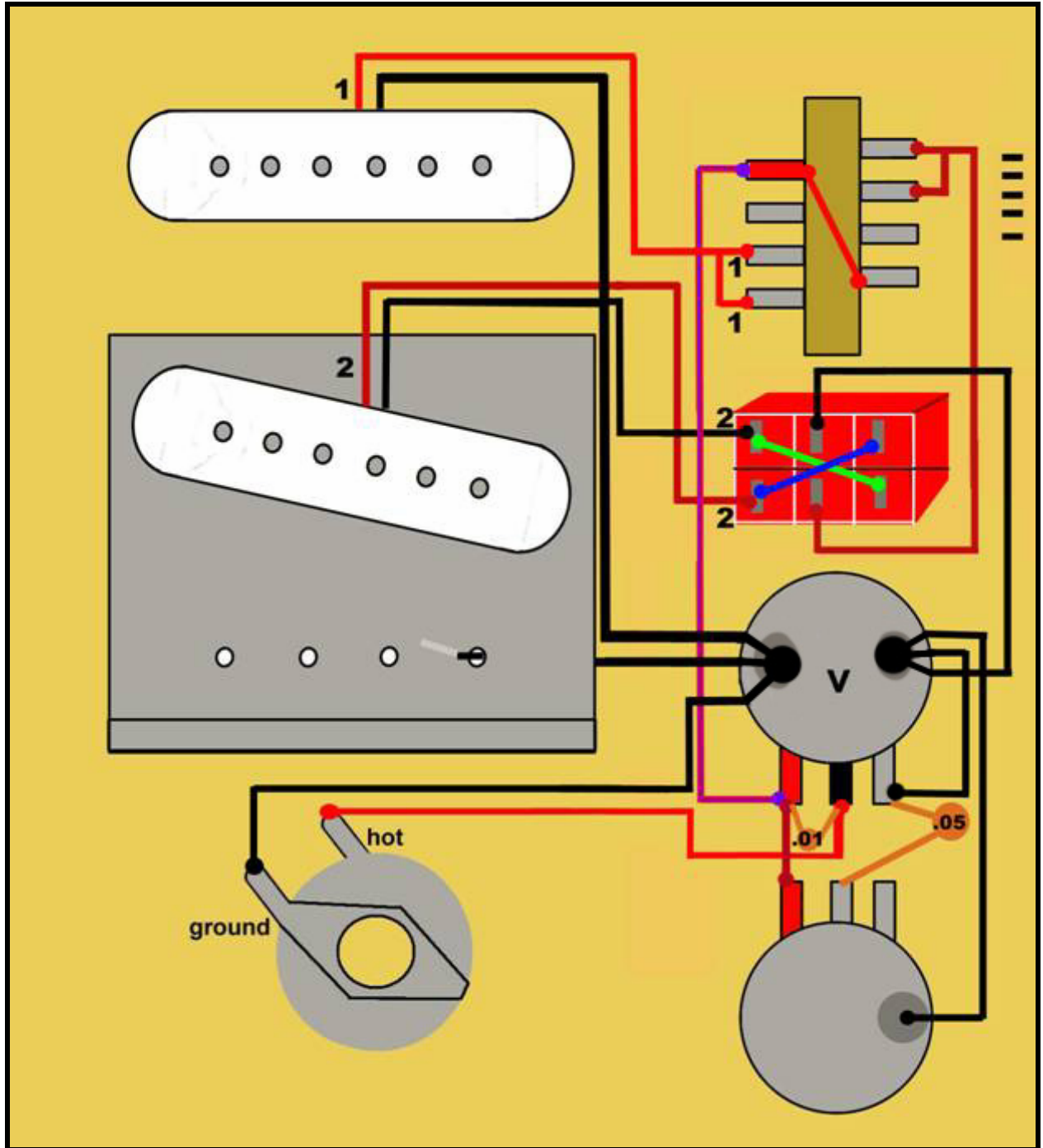
Type this address in your web browser to hear two coils out of phase with each other due to one of the coils being reverse wound, yet both having the same polarity.

**CLEAN TONE:** [HTTP://WWW.TINYURL.COM/24NLCD](http://www.tinyurl.com/24NLCD)

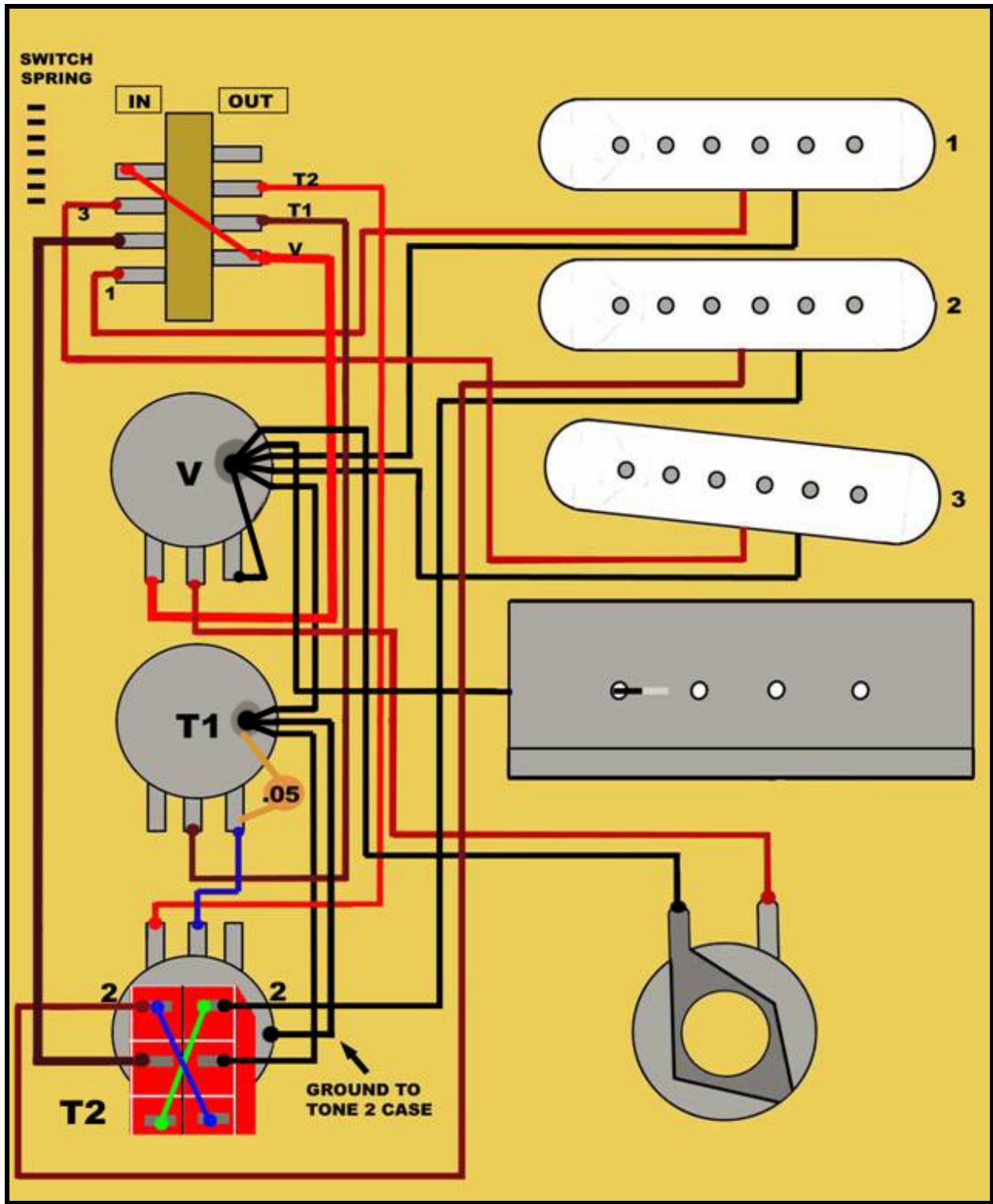
The next example shows how to change the phase of one pickup using a DPDT on-on toggle switch. Just send the signal to the mini toggle before it enters the pickup selector switch, and also throw in some diagonal jumper wires. You only need to change the phase of one pickup to throw it out of phase with another pickup. It would be useless to change the phase of both pickups, since it would just put them back in phase with each other.



Here is an on/on phase reversal switch on a 2 pickup guitar.

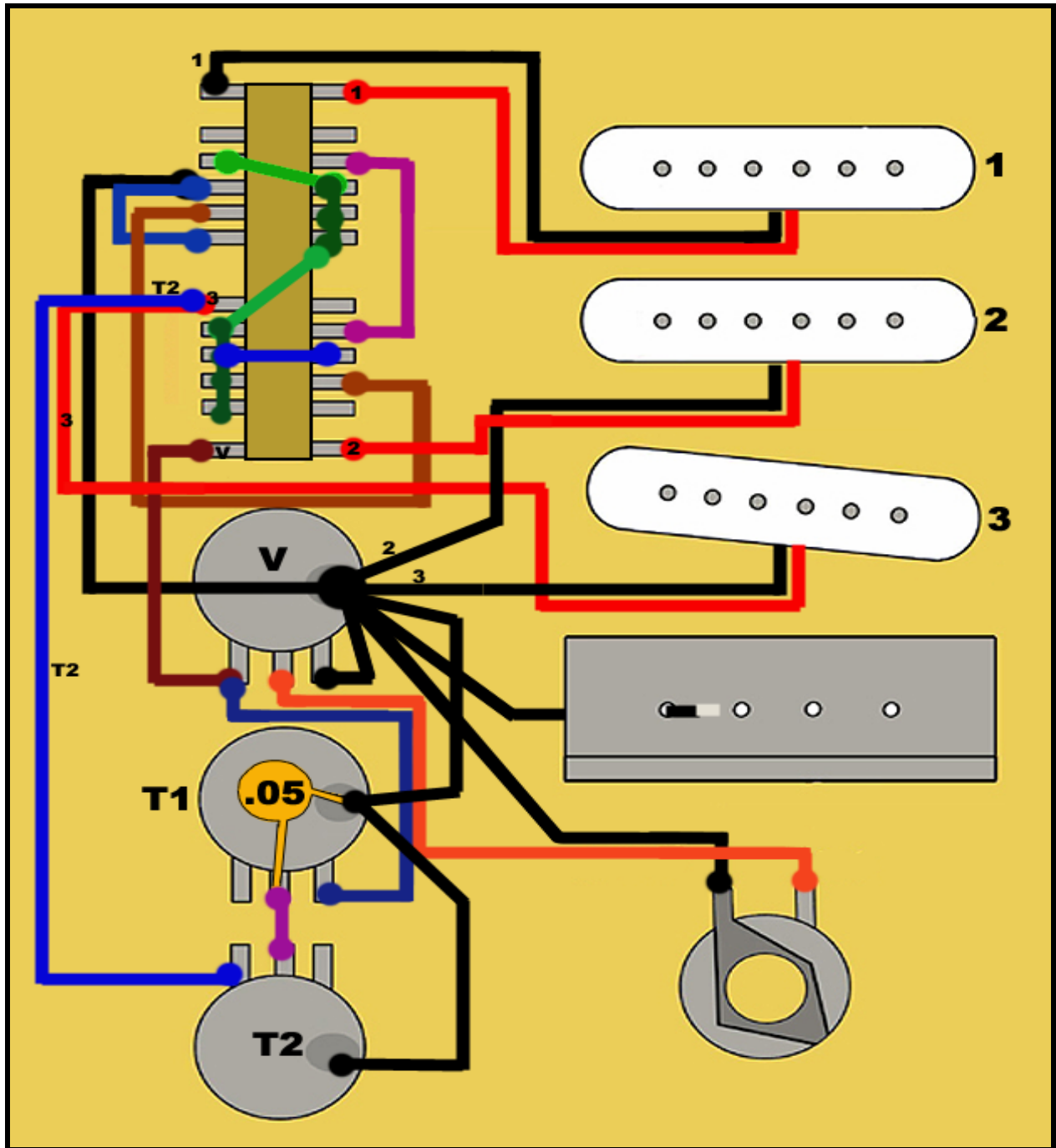


If you want the middle pickup to go in or out of phase with the neck or bridge pickup in your strat, then you can wire the guitar like this with an on/on switch. Remember, two pickups have to be on in order for the signal to be out of phase.

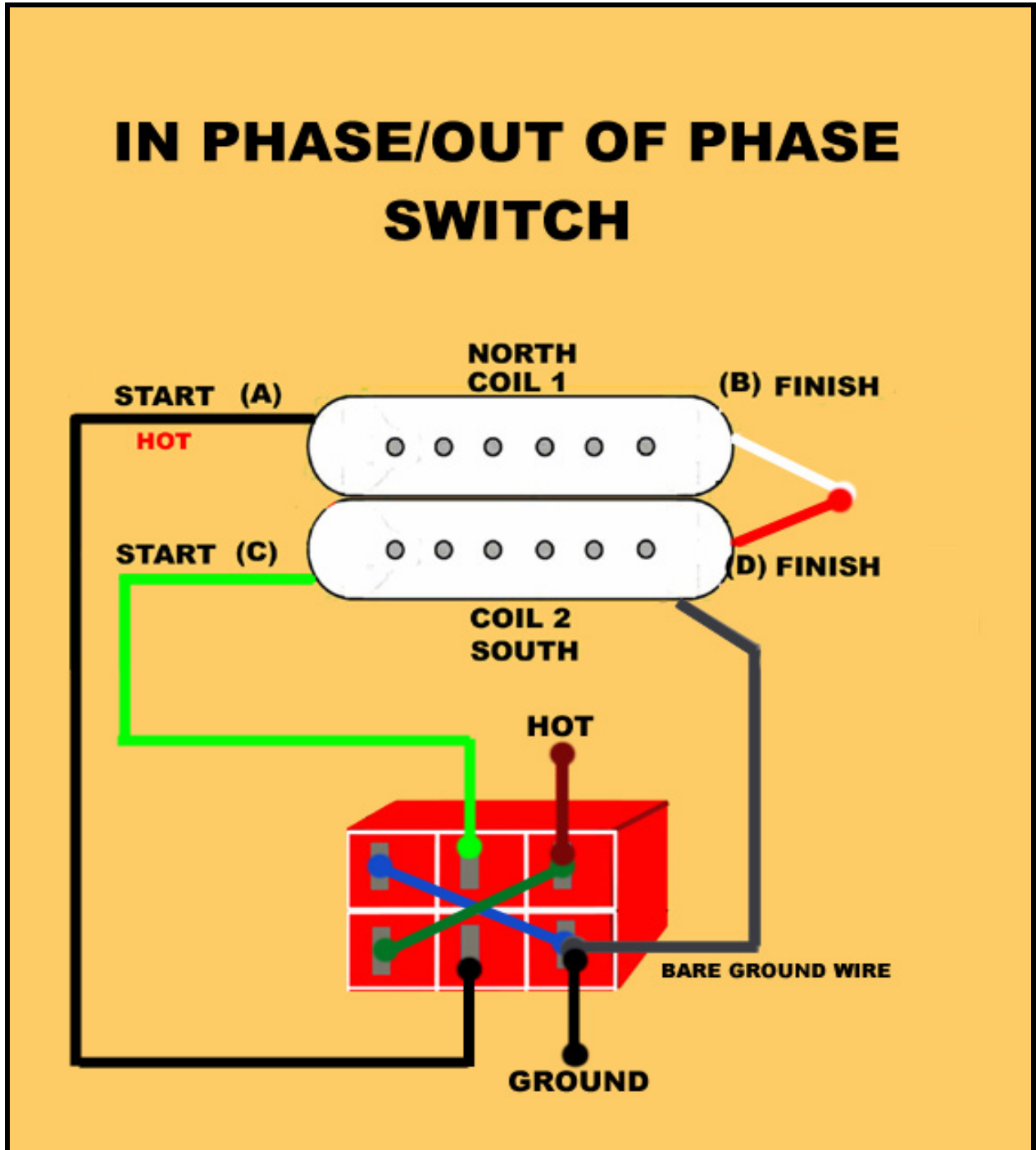




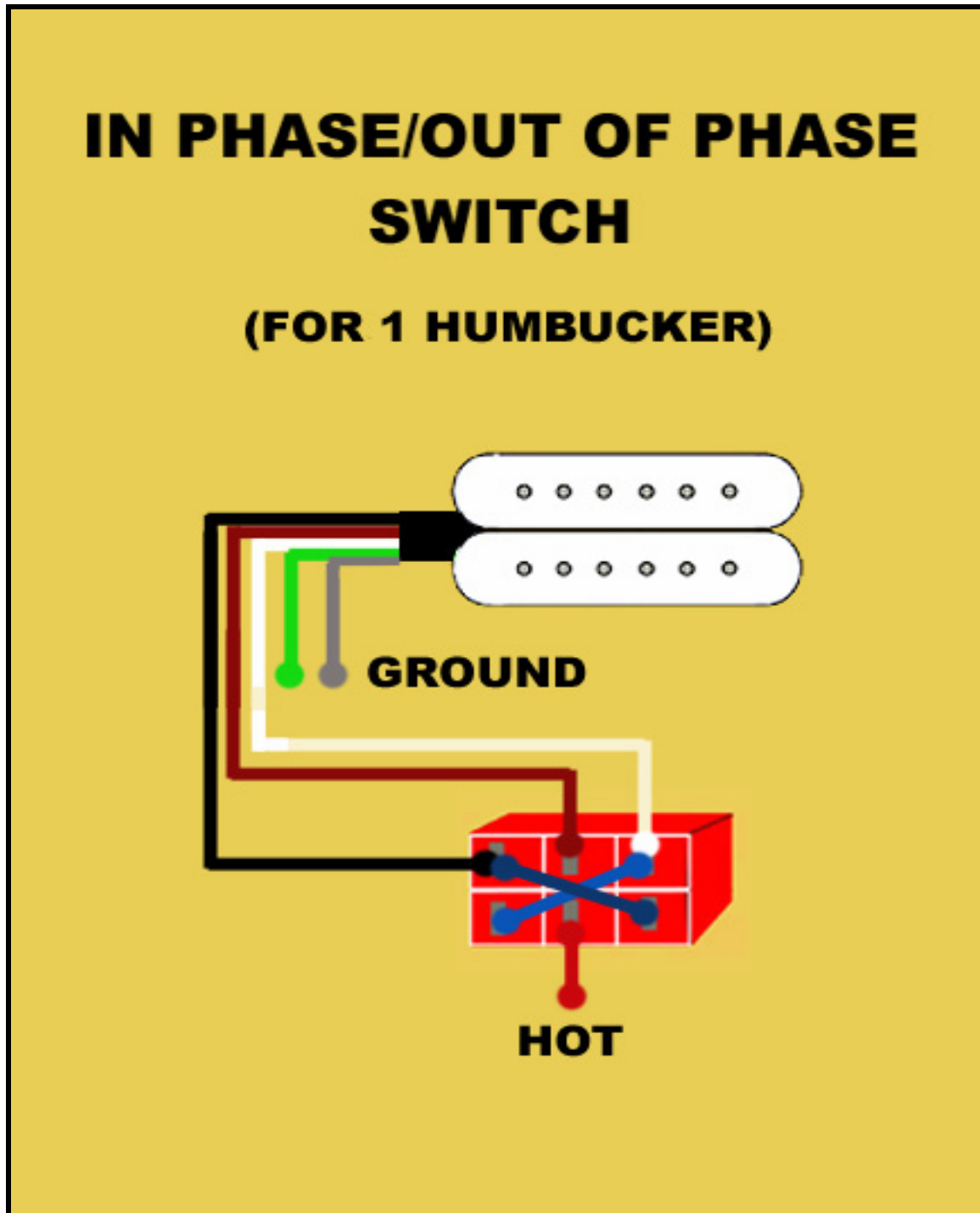
This next diagram is for someone like me who hardly ever uses the bridge pickup. It uses a 4 pole super switch. Be sure to take your time wiring this one. Position 1 turns on the neck pickup, positions 2 and 3 turn on the neck and middle pickups, position 4 turns on the neck and middle pickups out of phase with each other, and position 5 turns on the bridge pickup. The first tone knob (T1) is a master tone control, and the second tone knob (T2) is a separate tone control for the bridge pickup only.



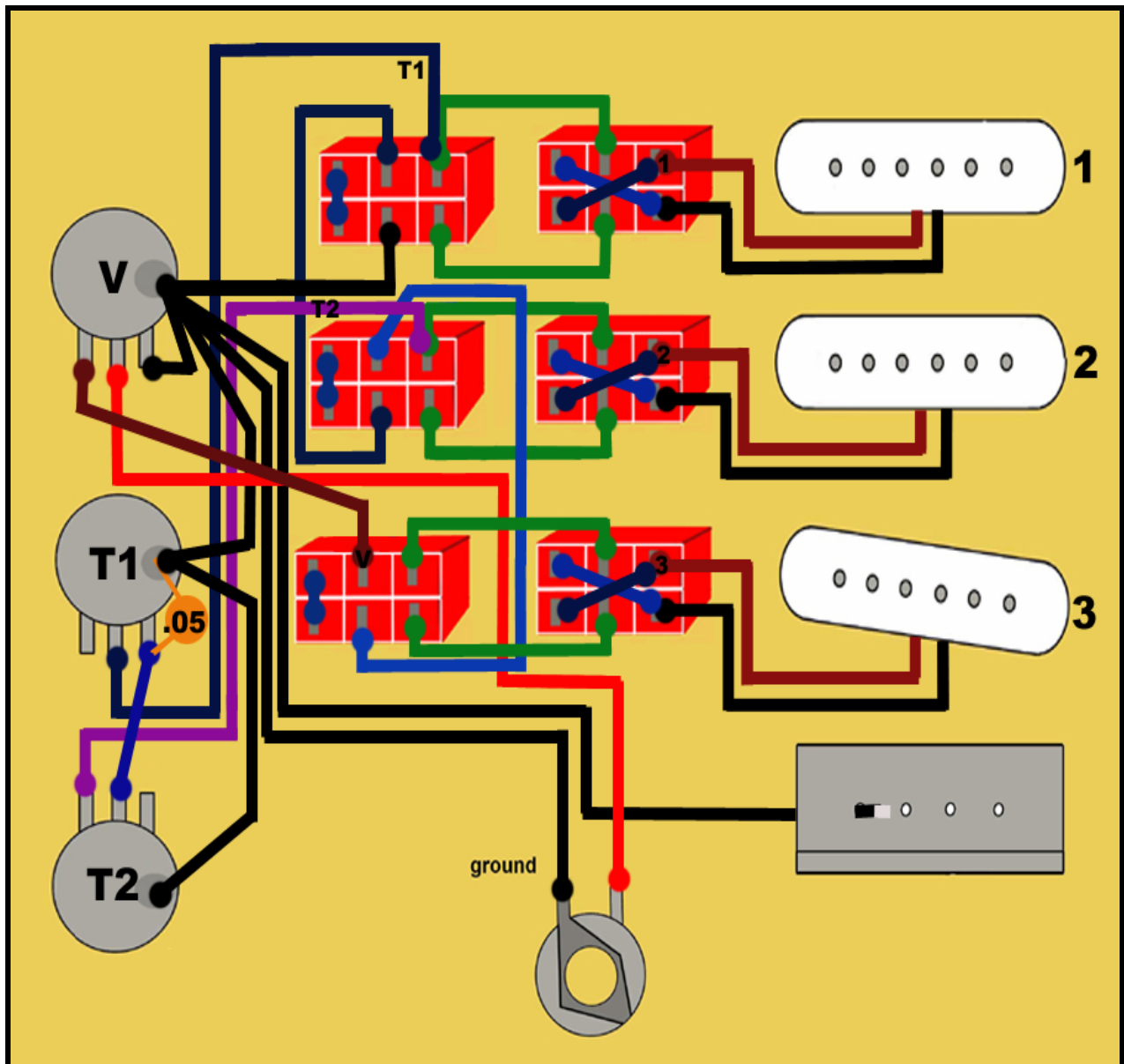
Here is the in phase/out of phase wiring on a 4-wire humbucker. Another pickup will need to be on at the same time in order to get the out of phase tones between two pickups. A simple on/on mini toggle switch is all you need. This diagram uses the same color codes as Seymour Duncan pickups. Black is hot, green goes to ground, and red and white form the series link.



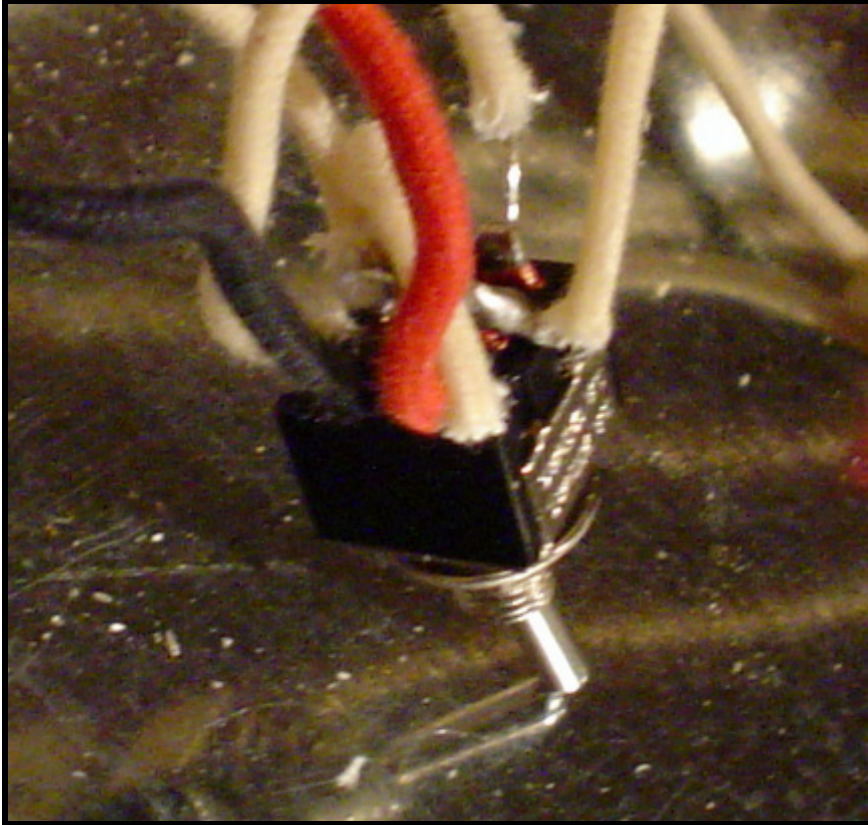
If you have a 4-wire humbucker, and want each coil to go in and out of phase with itself, then the on/on switch wiring would look like this. The unshielded grey wire and the green wire both go to ground. The hot wire goes to the pickup selector switch, just like a normal 2-wire pickup. This diagram uses the same color codes as Seymour Duncan pickups.



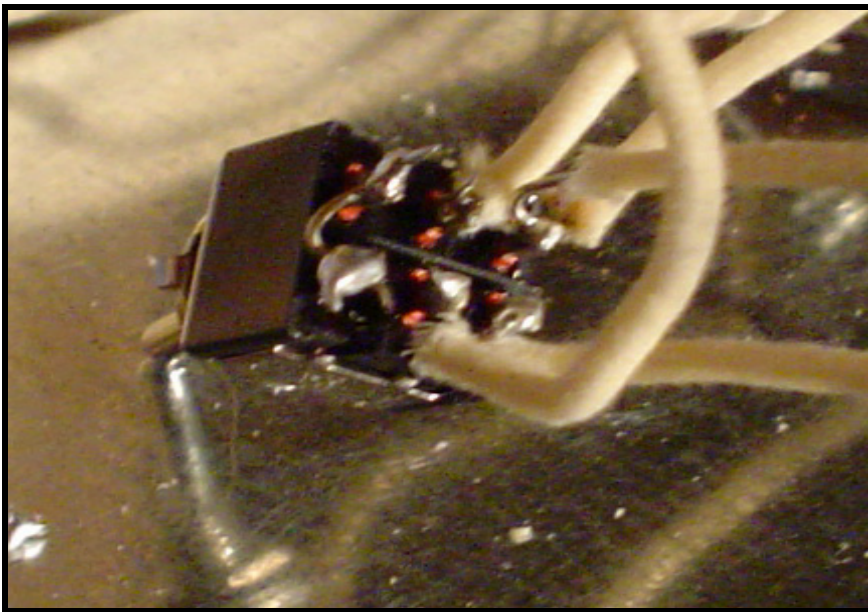
Here is a wiring diagram with 6 dpdt on/on mini toggle switches. The switches on the left turn on and off each pickup, and the switches on the right change the phase of each pickup. The interesting thing about this wiring scheme is that the single coil pickups are wired in series, giving you a fatter sound. This makes the thin out of phase tone much more useable than the weaker parallel out of phase sound. Pickups 1 and 2 have their own tone controls, just like the normal strat wiring.



Here is the phase reversal switch with vintage style cloth wires.

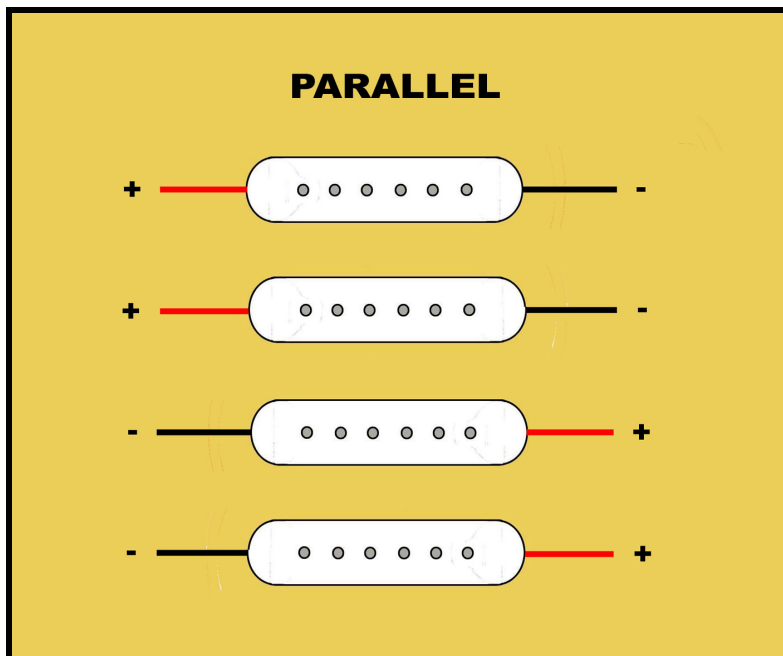
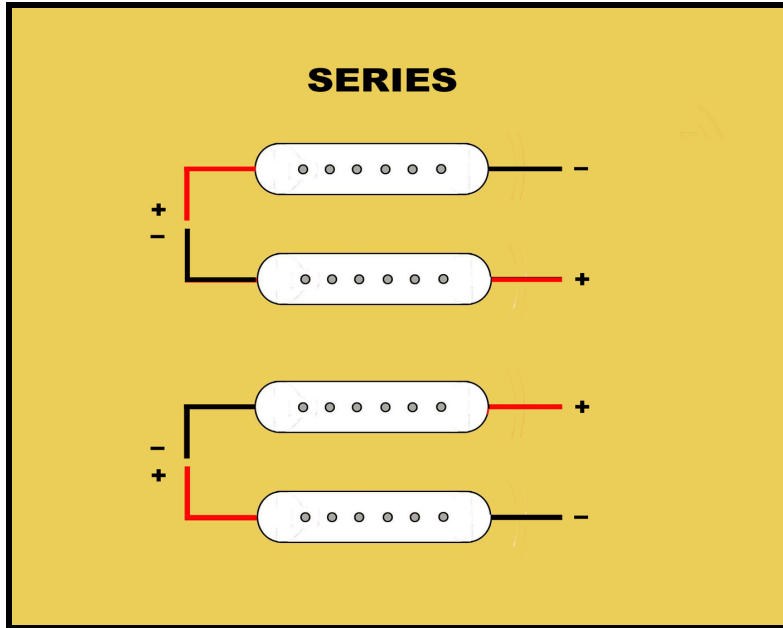


Here is the pickup on/off switch.

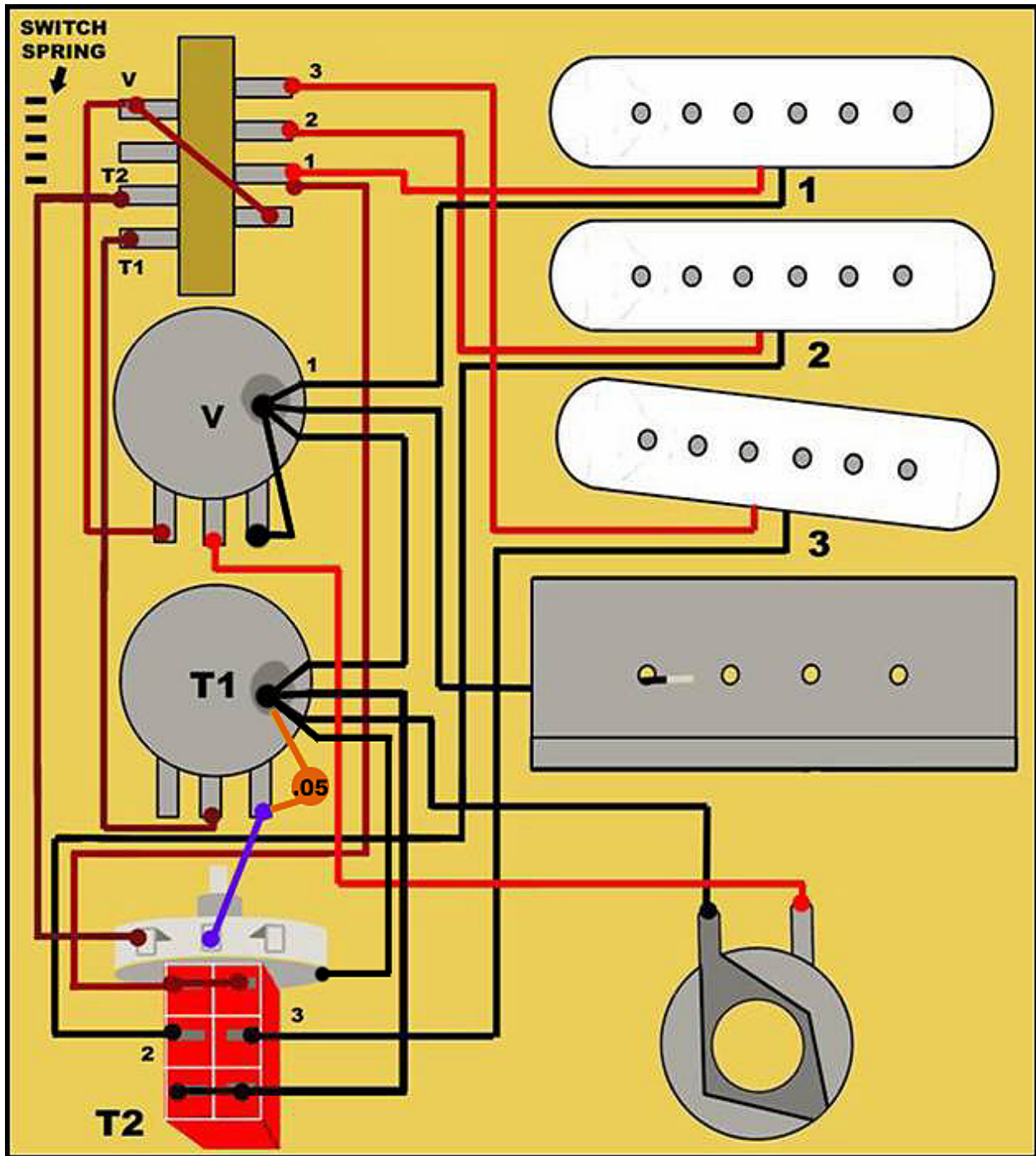


## SERIES/PARALLEL WIRING

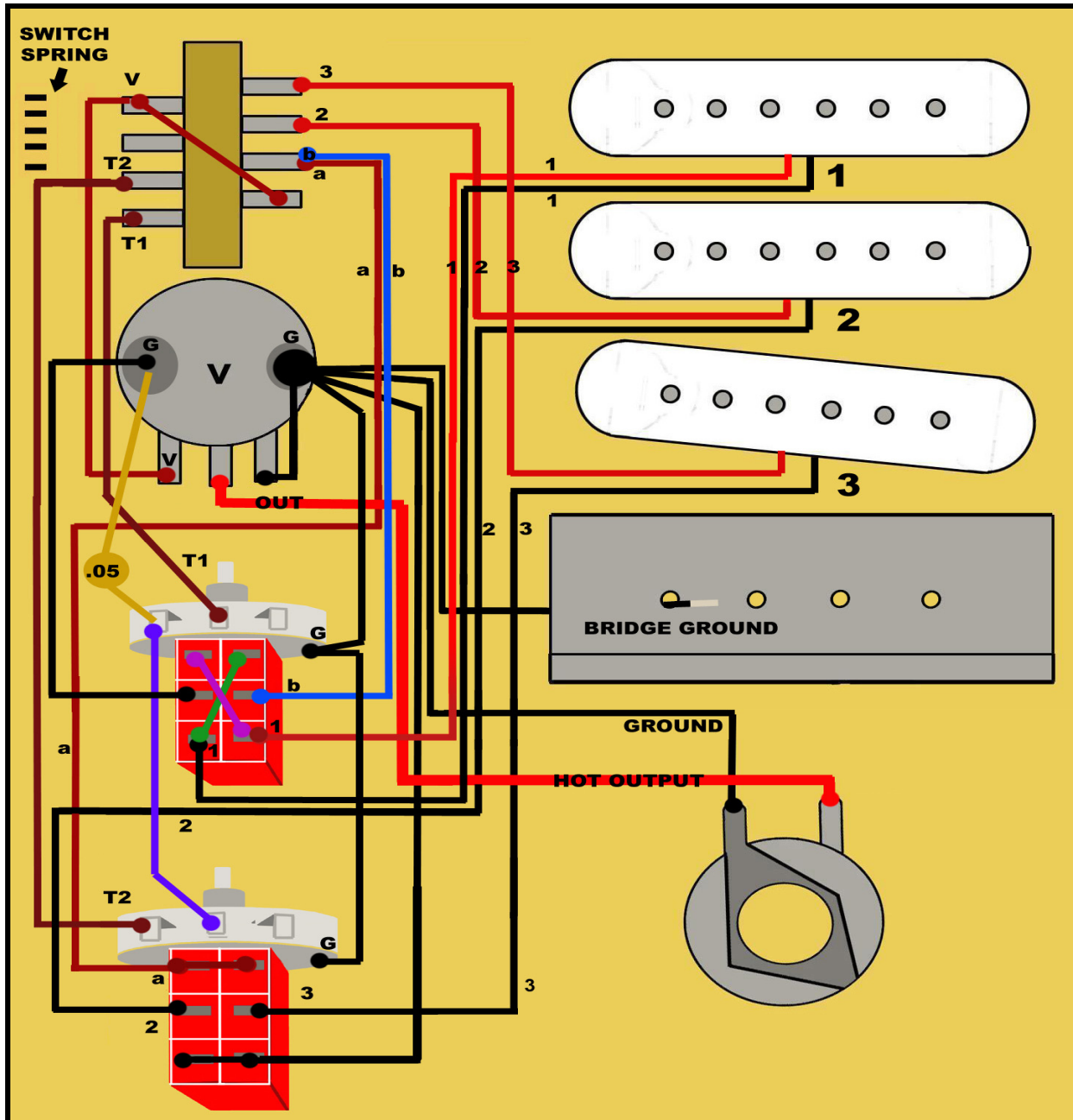
If you are looking to get more volume and midrange out of your pickups, you might want to try adding an on/on series/parallel switch to your setup. Parallel wiring between two pickups is probably what you are used to by now. It's used in most guitars to add clarity to the sound. Series wiring is a little different. It produces a longer path with more resistance. This additional resistance adds volume and prevents the higher tones from getting through the circuit, and allows more low/midrange tones to get through. In series wiring, the output of one pickup goes into the input of another pickup. In parallel wiring, each pickup takes its own path to the output.



Now take a look at this strat style guitar with an on/on series/parallel switch. It has 8 different sounds. When you pull out the push pull pot, you will have the neck and middle pickups in series in position 3, the bridge and middle pickups in parallel with each other, and also in series with the neck pickup in position 4, and the bridge and neck pickups in series in position 5. The series wiring will be louder and have more lows and midrange than the parallel wiring.

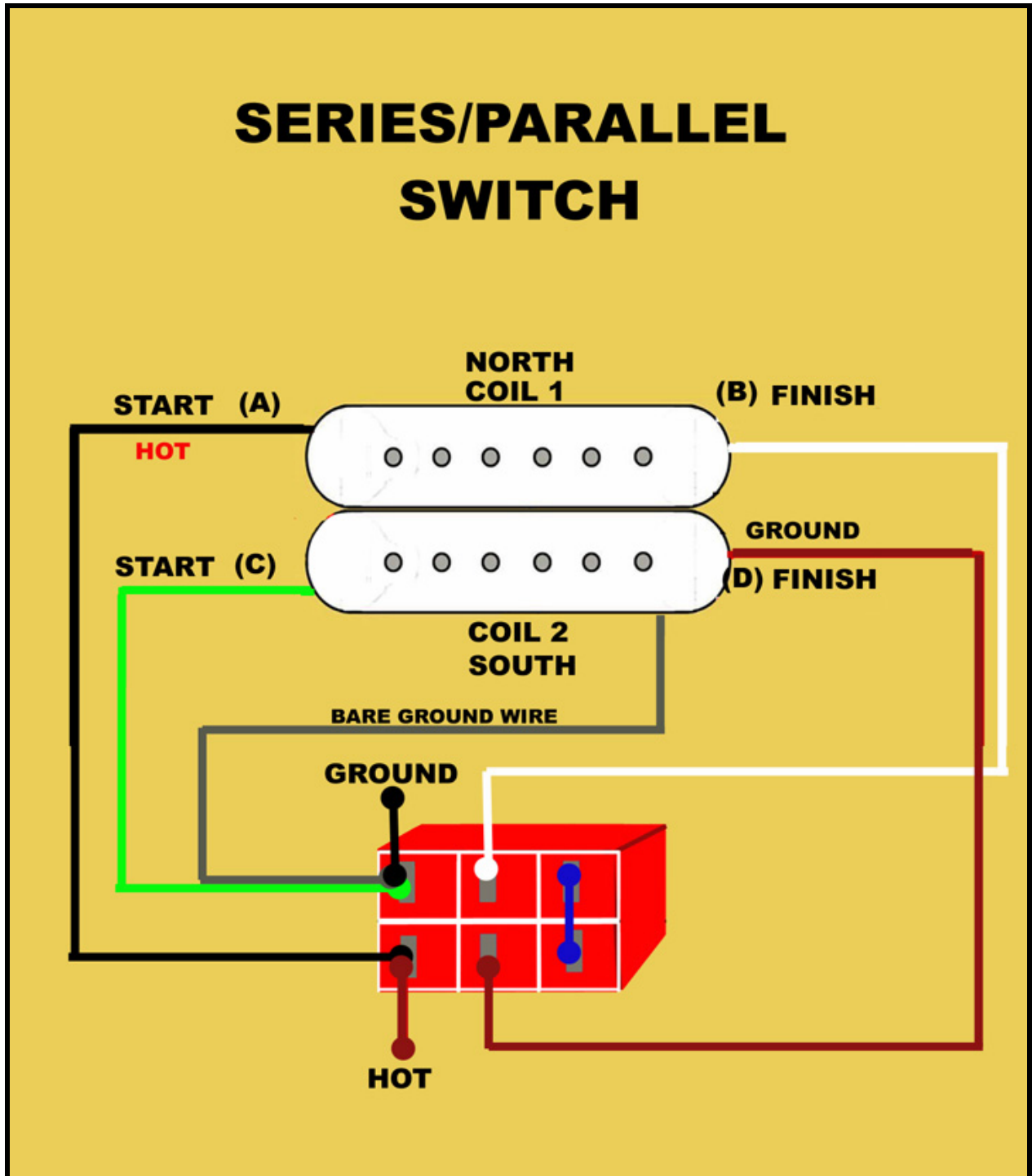


Let's put a few on/on switch mods together. Here is a strat with a series/parallel push pull pot (tone 2) and a phase reversal push pull pot (tone 1). When the tone 2 knob is pushed down (t2), the wiring is in parallel. When you pull up on the knob, the wiring is in series. The phase reversal push pull pot (t1) will give you some interesting tones when the 5-way switch is in positions 2. When the tone 2 knob is pulled up (series), the phase switch (t1) will give you some good tones when the 5-way switch is in positions 4 and 5. To be clear, position 1 is the neck pickup on, 2 is the neck and middle, 3 is the middle, 4 is the middle and bridge, and position 5 is the bridge pickup on. Note: the capacitor connected to the tone 1 control can be soldered to any ground point nearby.

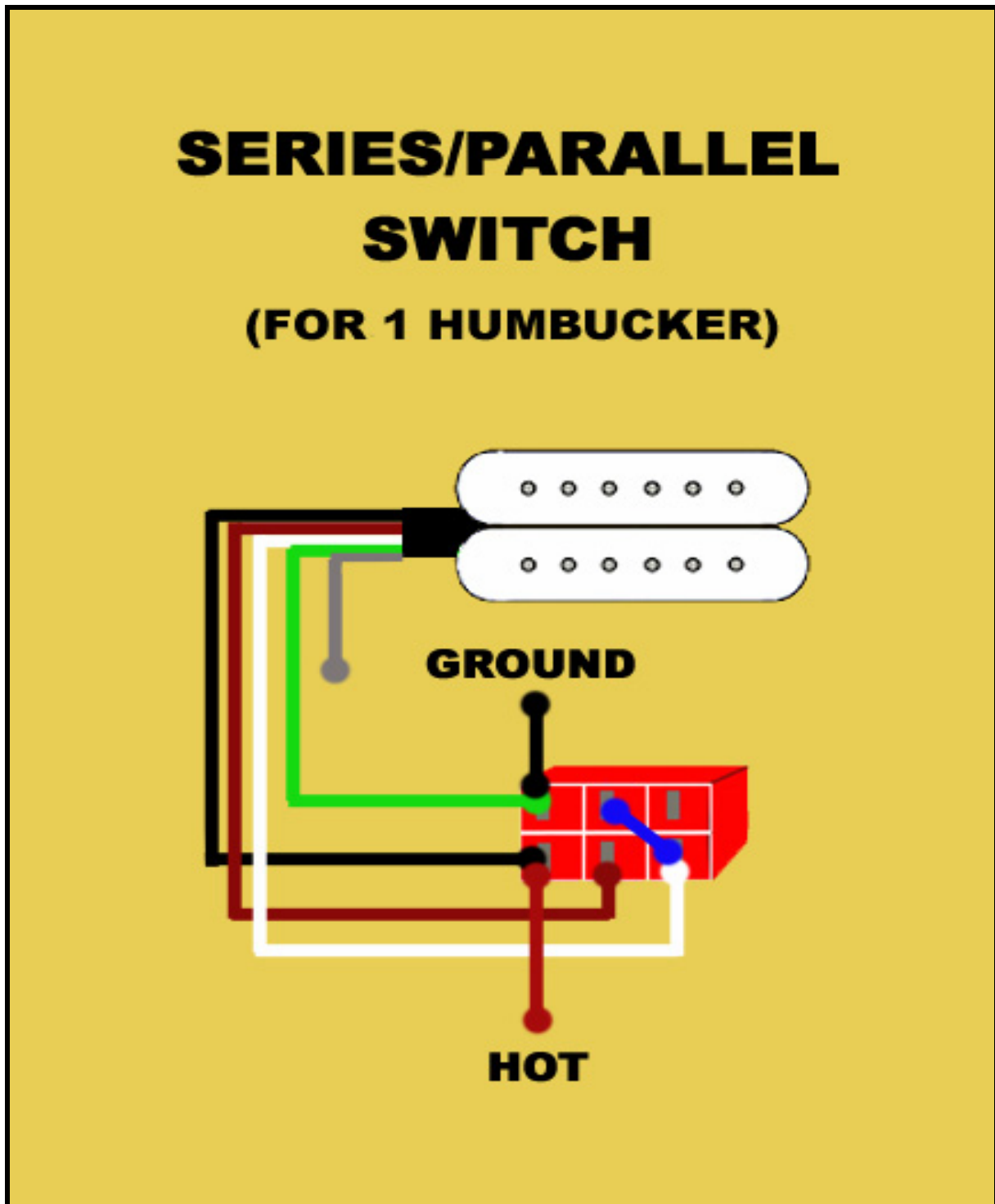




If you have a 4-wire humbucker on your strat, then you can add a series/parallel on/on mini toggle switch like this. Another pickup needs to be on in order to get the series wiring between the two pickups to work. The hot wire goes to the pickup selector switch, just like a normal 2-wire pickup.

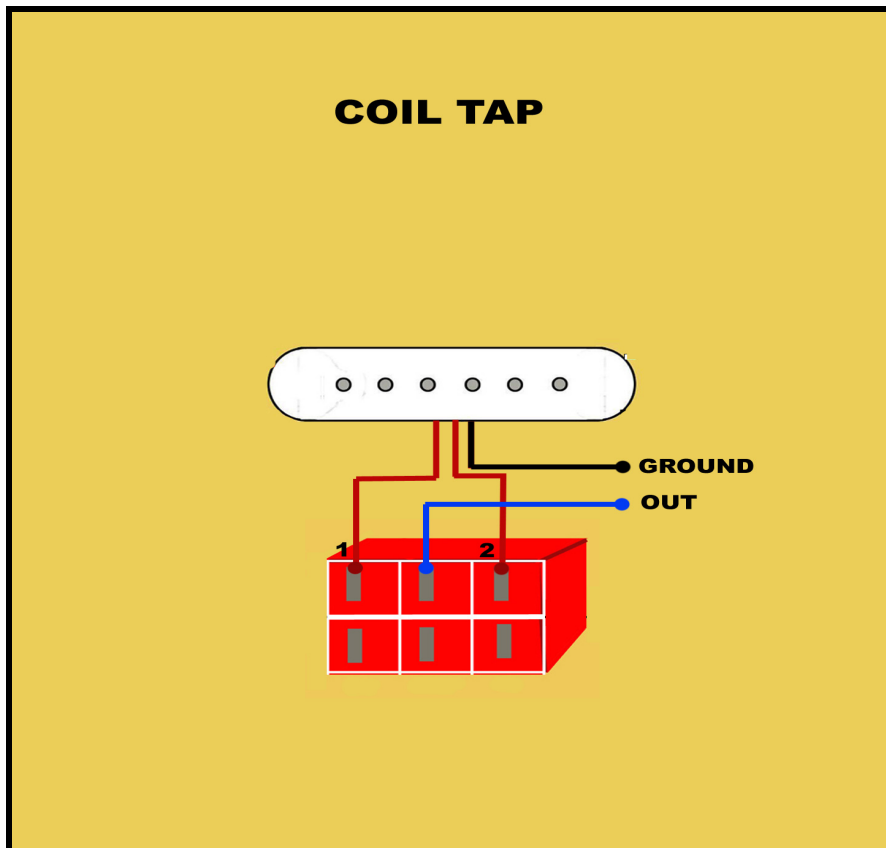


If you want each coil in the humbucker to switch from a series connection to a parallel connection, then the wiring would look like this. The unshielded grey wire goes to ground. This also uses an on/on DPDT switch.



## COIL TAP/COIL CUT

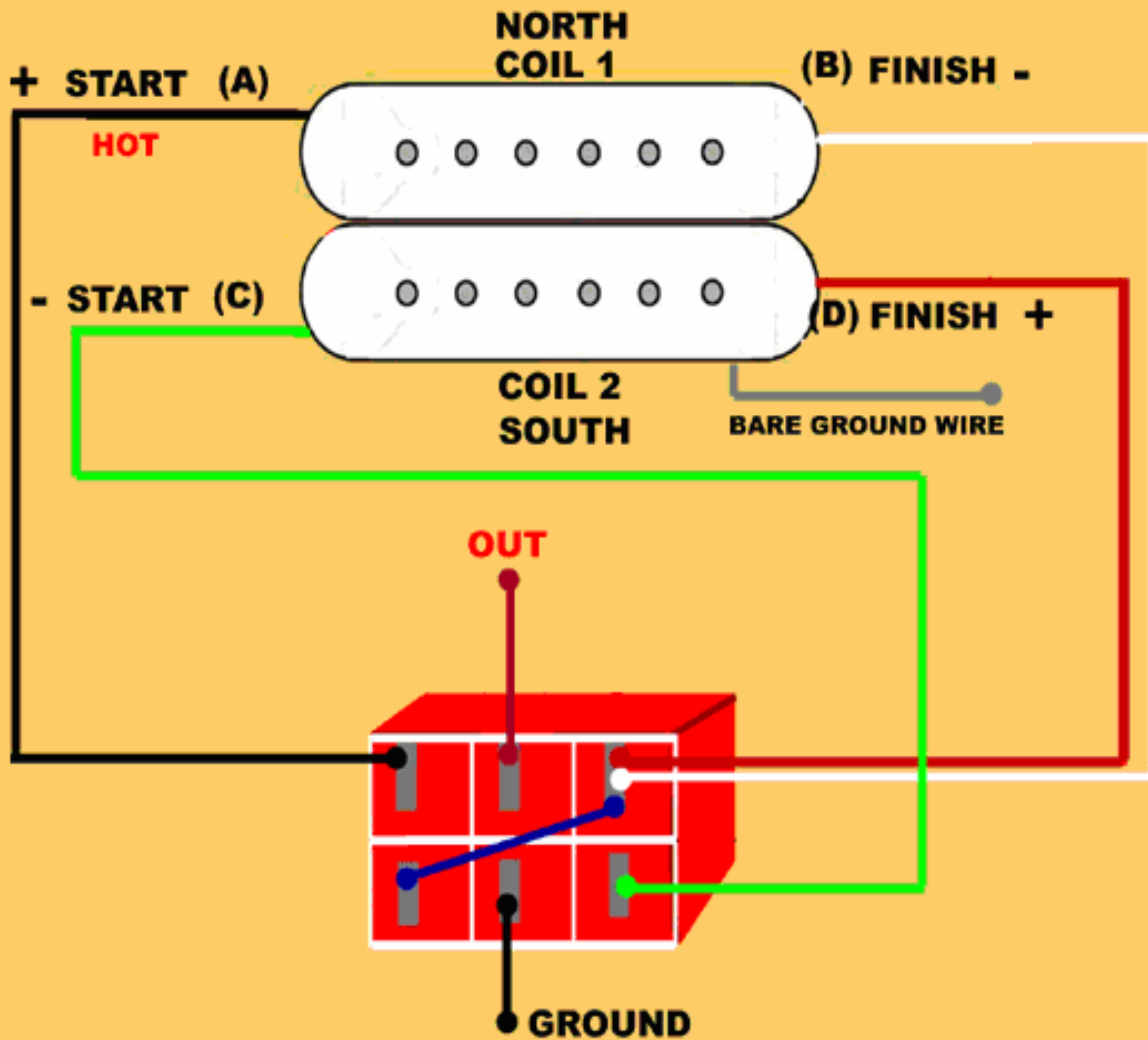
By far the most useful guitar hot rod technique is **coil cutting**. It gives you the benefits of both worlds. With a 4-wire pickup you can create a strat sound and a les paul sound at the flick of a switch. Note: coil cutting is often referred to as **coil tapping**. Coil tapping, however, involves single coil pickups that have 2 leads and a ground wire. Basically, the coil tapped pickup is wound halfway, and a lead is added. Then it is wound the rest of the way, and another lead is added. Below is a diagram of a coil tapped pickup hooked up to an on/on switch. These pickups are harder to find online, especially since most sellers use the term "coil tapped pickups" to describe "coil cut pickups."



## COIL CUTTING

Coil Cutting is fairly easy to do with an **on/on/on switch** and a 4-wire humbucker. This setup will yield three different tones: north coil on, both coils on, and south coil on. Only two wires exit the on/on/on switch: a hot lead, and a ground lead. So it can be wired just like any 2 wire pickup once the signal leaves the switch. The hot out wire goes to the pickup selector switch, just like a normal 2-wire pickup. **This is probably one of the best hot rods that you can do to increase the different tones that are hidden inside a guitar. Note: if you have a strat, buy a blade, or rail humbucker that will fit into your existing single coil pickguard.**

# COIL CUT IN PHASE

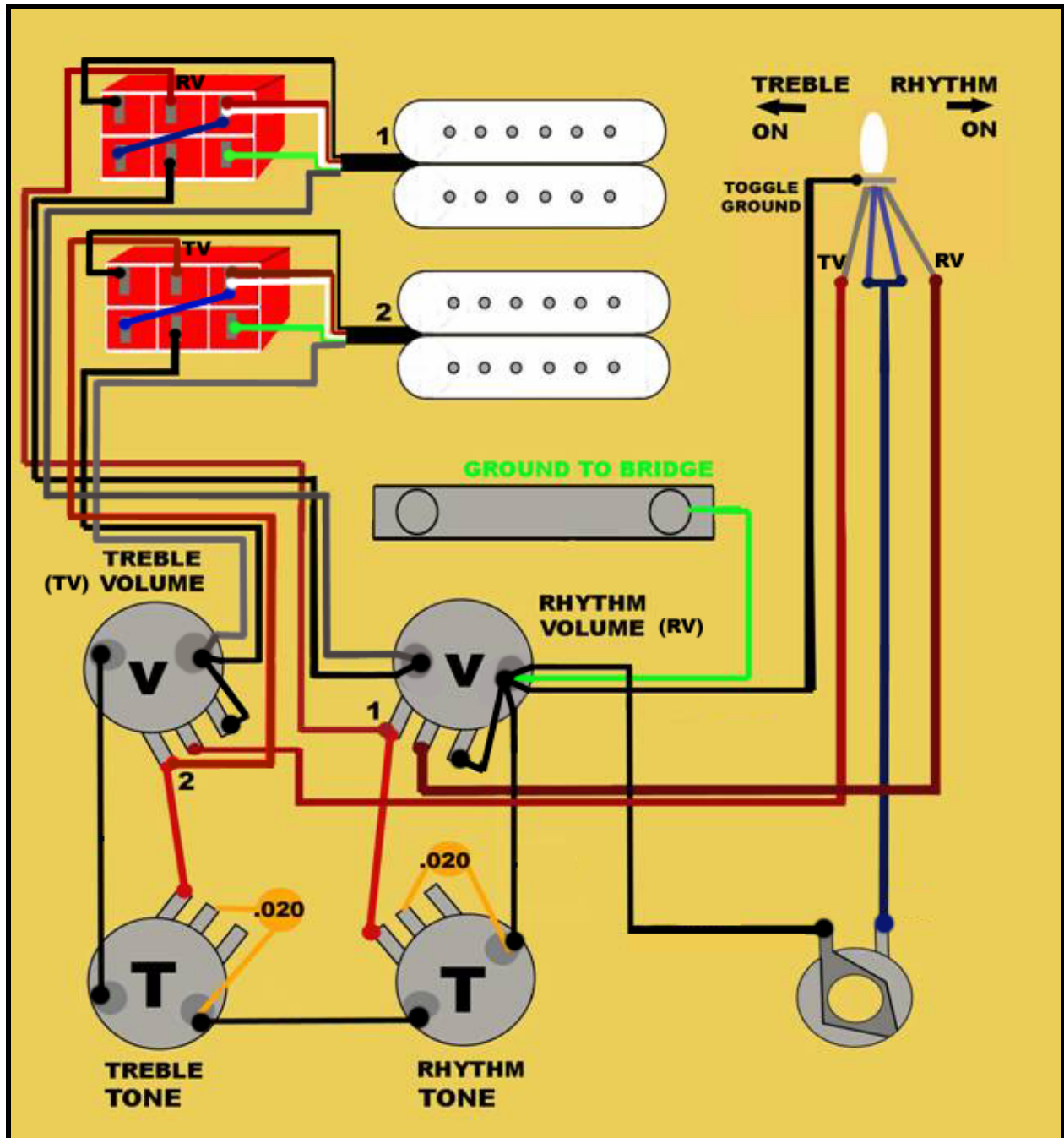




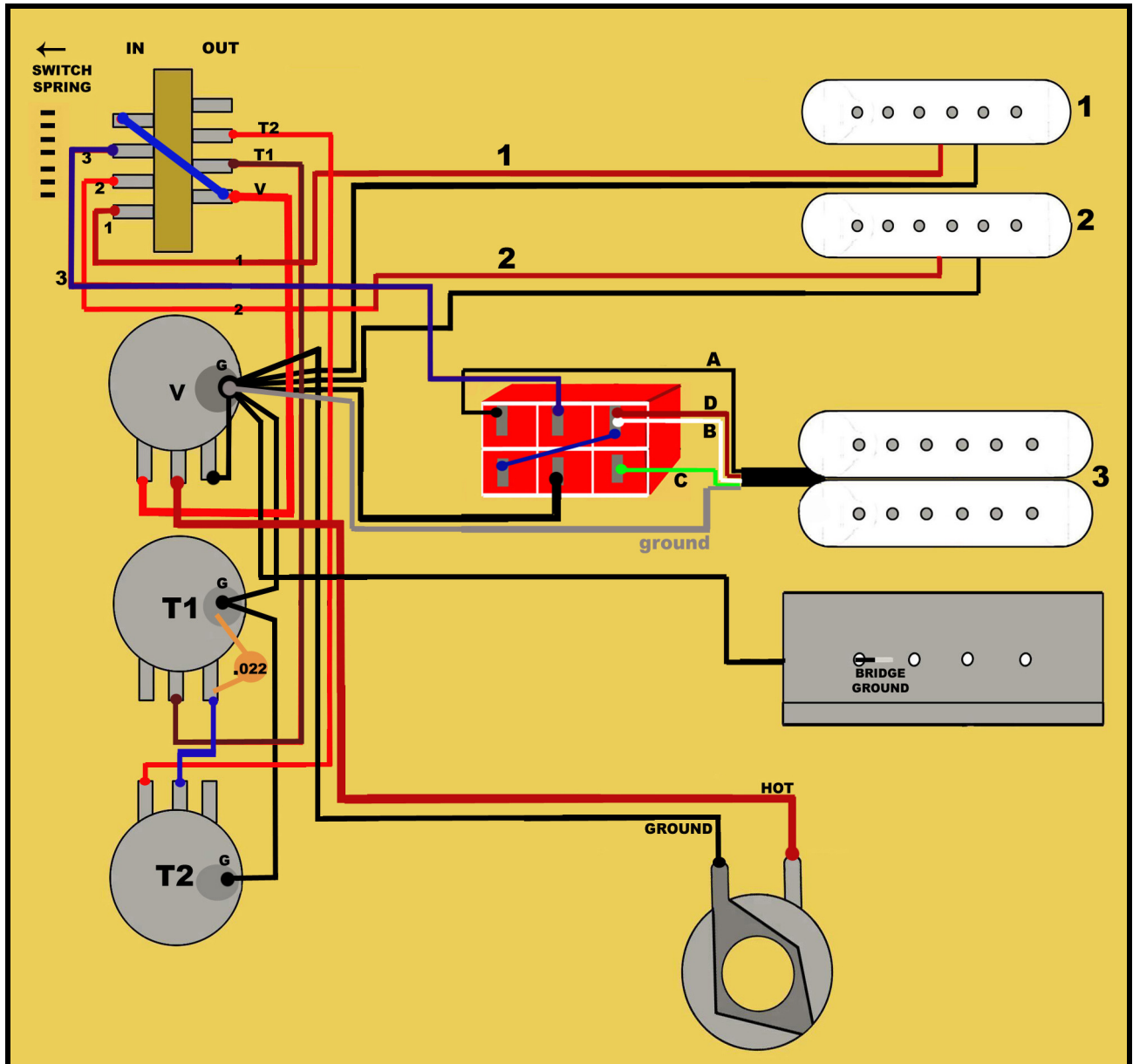
Type this address in your web browser to hear this coil cut humbucking pickup. The first tone is the north coil on, the second tone is both coils on, and the third tone is the south coil on. The north coil is closest to the neck in this pickup.

**CLEAN TONE:** [HTTP://WWW.TINYURL.COM/2M82NZ](http://www.tinyurl.com/2M82NZ)

Here is a Les Paul style guitar wired with two on/on/on coil cut switches. The color codes for the humbucking pickups are based on a Seymour Duncan pickup. The north coil has a black start wire and a white finish wire. The south coil has a green start and red finish. The grey bare wire always goes to ground. So black is hot, green is ground, and red and white form the series link. Each humbucker will be wired in series and in phase when both of its coils are switched on.



Next is a fat strat with a 4-wire bridge humbucker. The color codes for this humbucker are based on a Seymour Duncan pickup. The north coil has a black start wire and a white finish wire. The south coil has a green start and red finish. The grey bare wire always goes to ground. This humbucker will be wired in series and in phase when both of its coils are switched on. An on/on/on mini toggle switch is used for this modification.



On the next page is the transformation of a regular strat into a fat strat with a coil cut humbucker. The import switch was also changed out for a lever switch. If you don't know

which wires are the start or finish on your 4-wire humbucker, then check out the questions and answers section at the end of this book for a detailed explanation.







Check out the next page. Add a lever switch, 4-wire humbucker, an on/on/on mini toggle switch and this is what you end up with.



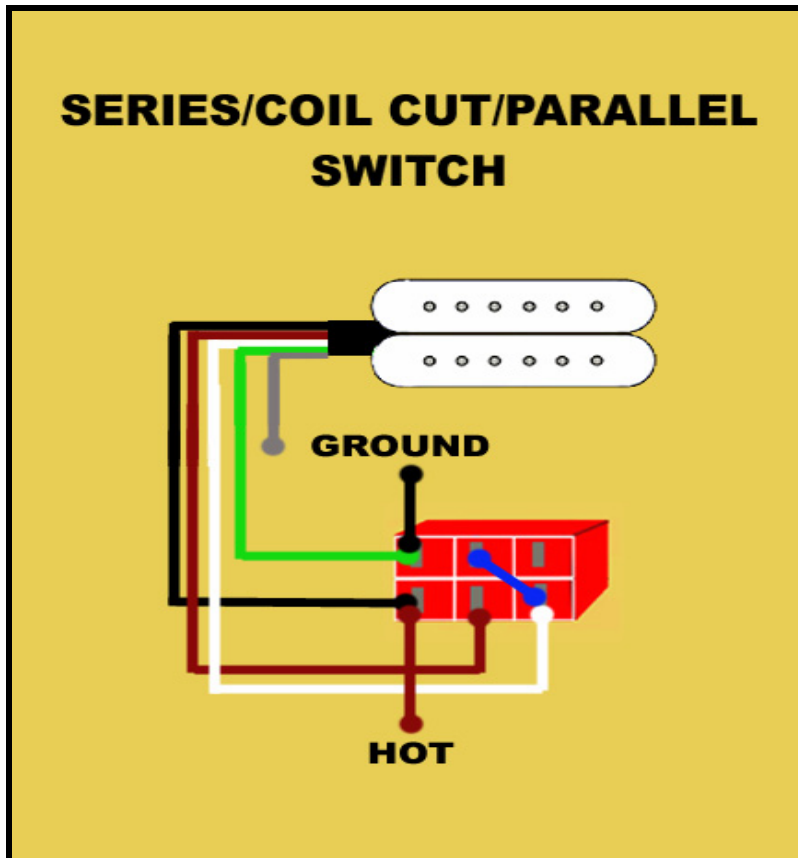


Type this address in your web browser to hear this guitar:

[HTTP://TINYURL.COM/35WYKE](http://tinyurl.com/35wyke)

Note: the background guitar track is a strat wired in parallel and out of phase. Notice how it sounds similar to an acoustic guitar.

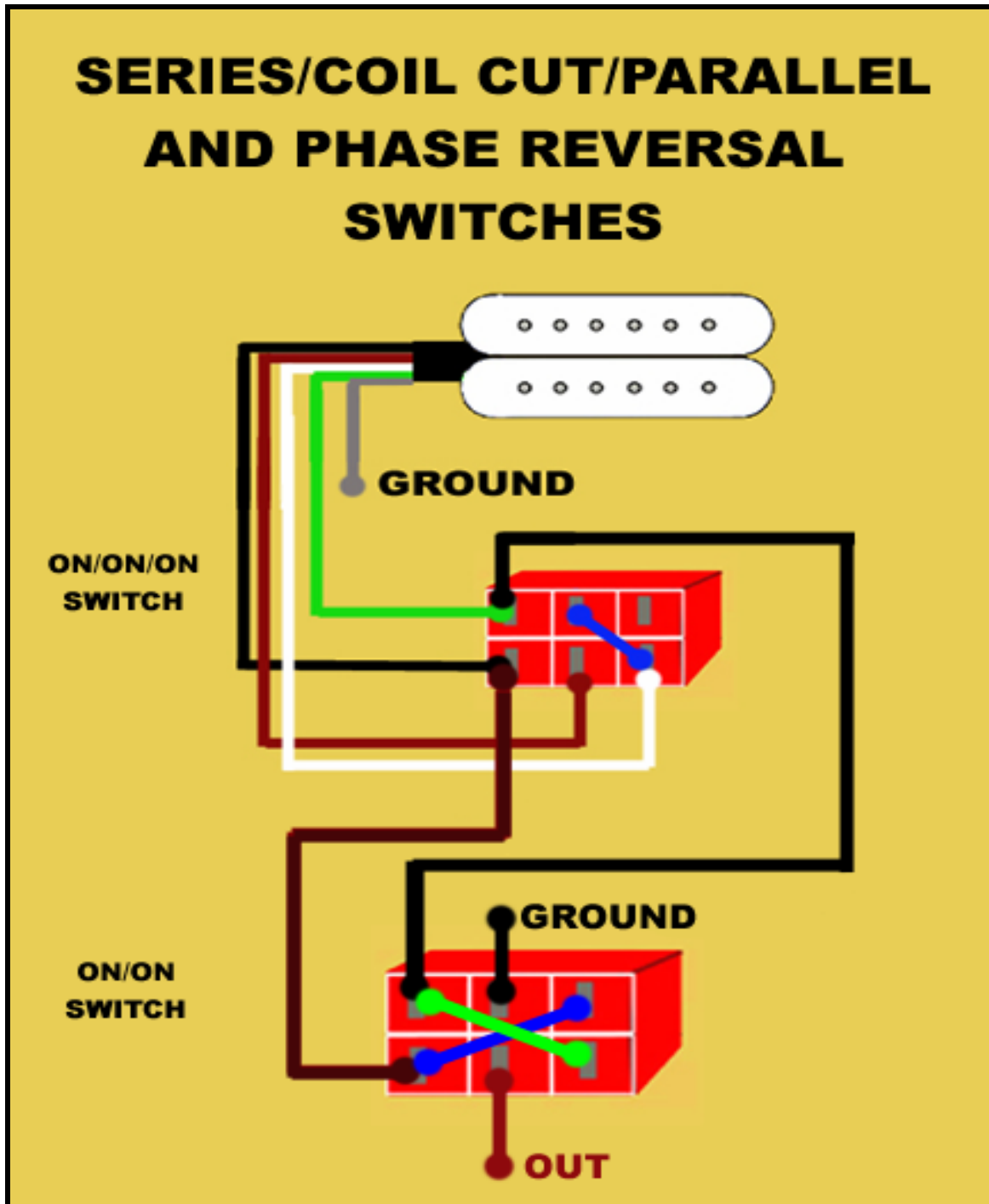
If you want to throw a few mods together on a 4-wire humbucker, try this. It's an on/on/on switch that switches between series wiring, coil cutting, and parallel wiring. The bare grey wire and the black wire go to ground. The hot wire goes to the pickup selector switch, just like a normal 2-wire pickup. The color codes are the same as a Seymour Duncan humbucker pickup. The black wire from the pickup is hot, green is ground, and the red and white wires form the series link.



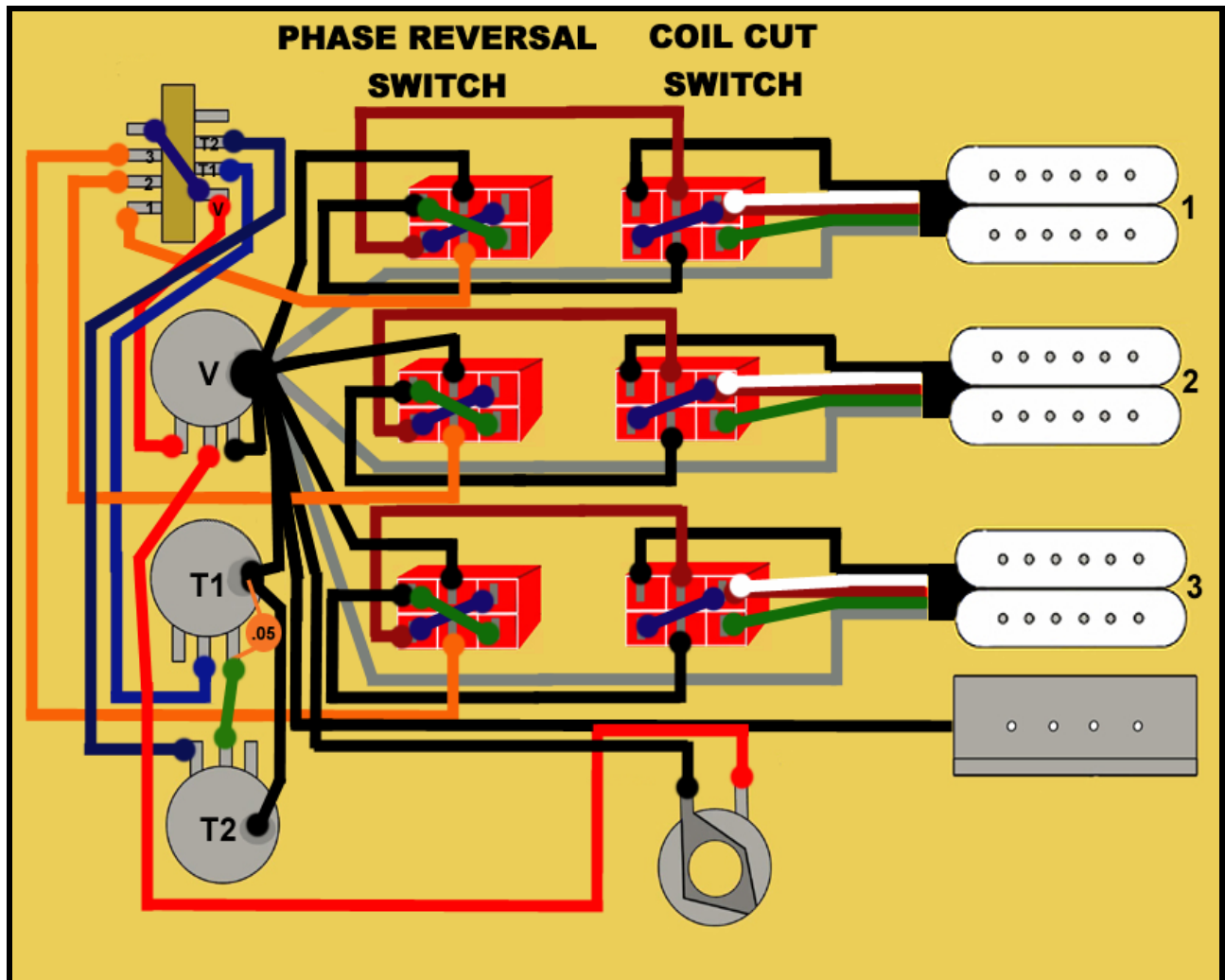
Type this address in your web browser to hear this coil cut humbucker pickup. The first tone is the humbucker in series, the second tone is the pickup with one coil on, and the third tone is the humbucker in parallel.

**CLEAN TONE:** [HTTP://WWW.TINYURL.COM/385TTY](http://www.tinyurl.com/385TTY)

Add a phase reversal switch to the mix, and the wiring looks like this. The top mini toggle switch is an on/on/on series/coil cut/parallel switch. The bottom toggle is an on/on phase reversal switch. You need two pickups on in order for the bottom switch to change to out of phase. The bare grey wire goes to ground. The hot out wire goes to the pickup selector switch, just like any normal 2-wire pickup. This pickup uses the same color codes as a Seymour Duncan pickup.



Here is a mod that combines coil cut switches with phase reversal switches. It can generate a ton of different sounds and give you a les paul tone or a strat tone. It has 6 mini toggle switches. To the left of the pickups are the on/on/on mini toggles that coil cut the 4-wire humbucking pickups. This will give you three sounds per pickup (north coil, both coils, or south coil). Then to the left of those are the on/on mini toggle switches that change the phase of each pickup. The humbuckers in this diagram use the same color codes as Seymour Duncan pickups (black=hot, green=ground, red + white= series link). Remember you can buy humbuckers that fit into stock Stratocaster pickguards, so why not increase your sound options?

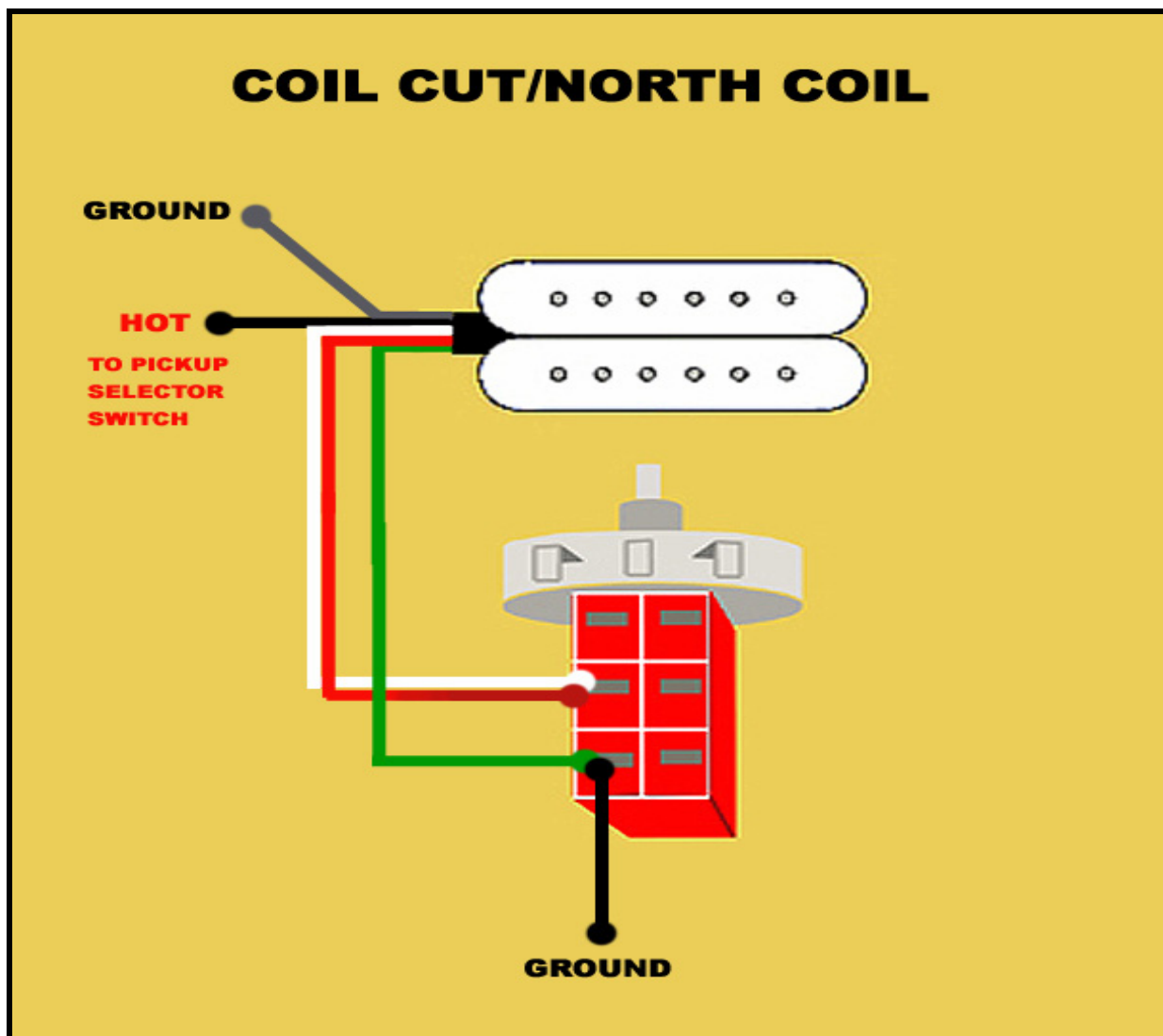


Click here for a larger version of this diagram.

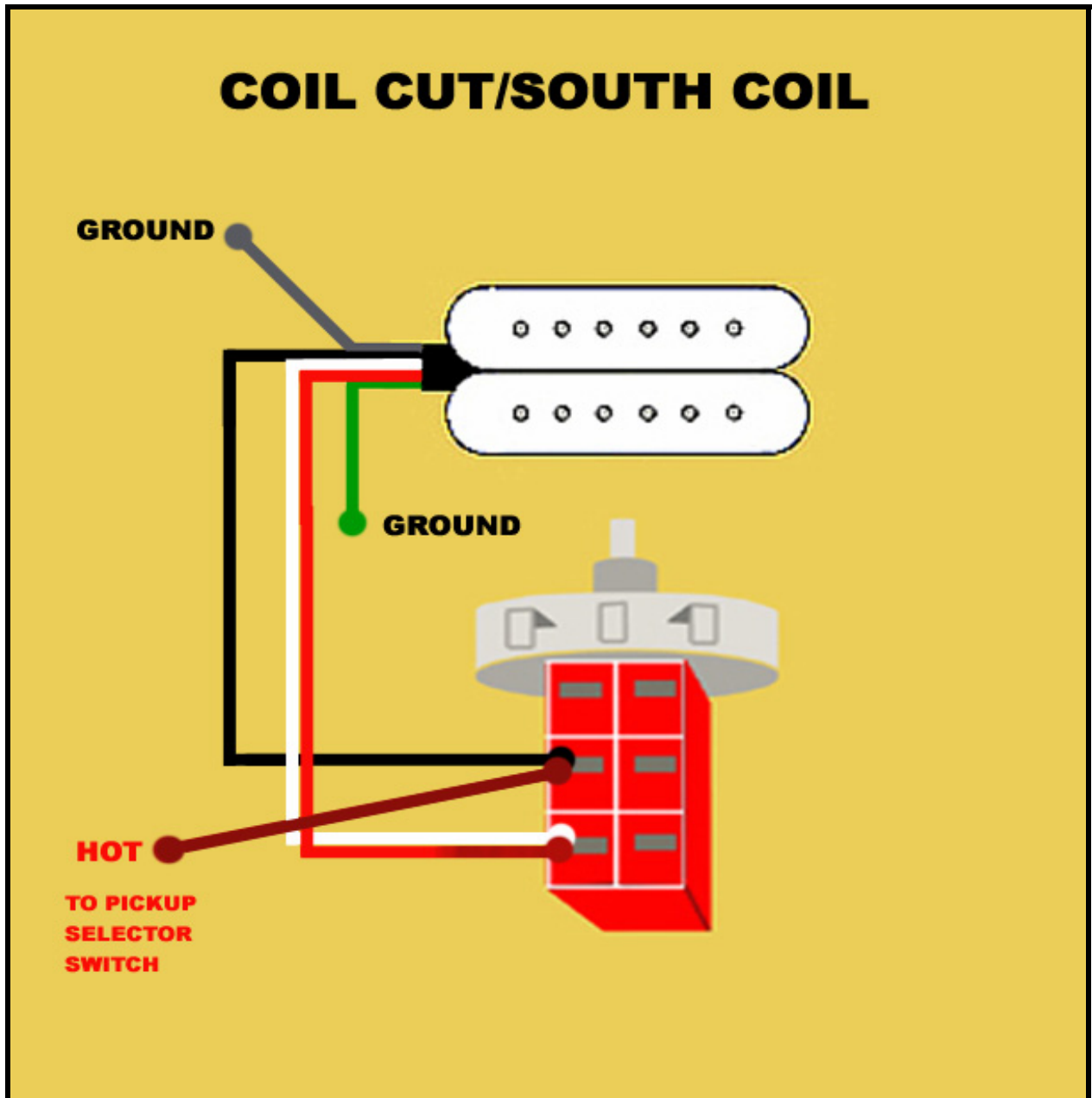
<http://tinyurl.com/3878FE>

## COIL CUTTING WITH A PUSH/PULL POTENTIOMETER

If you want to cut the coils on your humbucking pickup, but don't want to alter the appearance of your guitar, you can use a push/pull pot instead of a mini toggle switch to change from a humbucking pickup to a single coil pickup. The push pull pot is basically an on/on switch connected to a potentiometer, so you get only two selections with this setup (humbucking or single coil). The diagram below uses the same color codes as a Seymour Duncan pickup. Black is the hot wire, green is the ground wire, the red and white wires form the series link, and the bare grey wire goes to ground. You are left with one wire exiting the push pull potentiometer that also goes to ground. The top part of the push pull pot, or the actual potentiometer, can be connected just like any volume or tone potentiometer. Note: if you don't know which coil is the north coil, then you can buy a polarity tester from [stewmac.com](http://stewmac.com) to find out which coil is north and which is south.

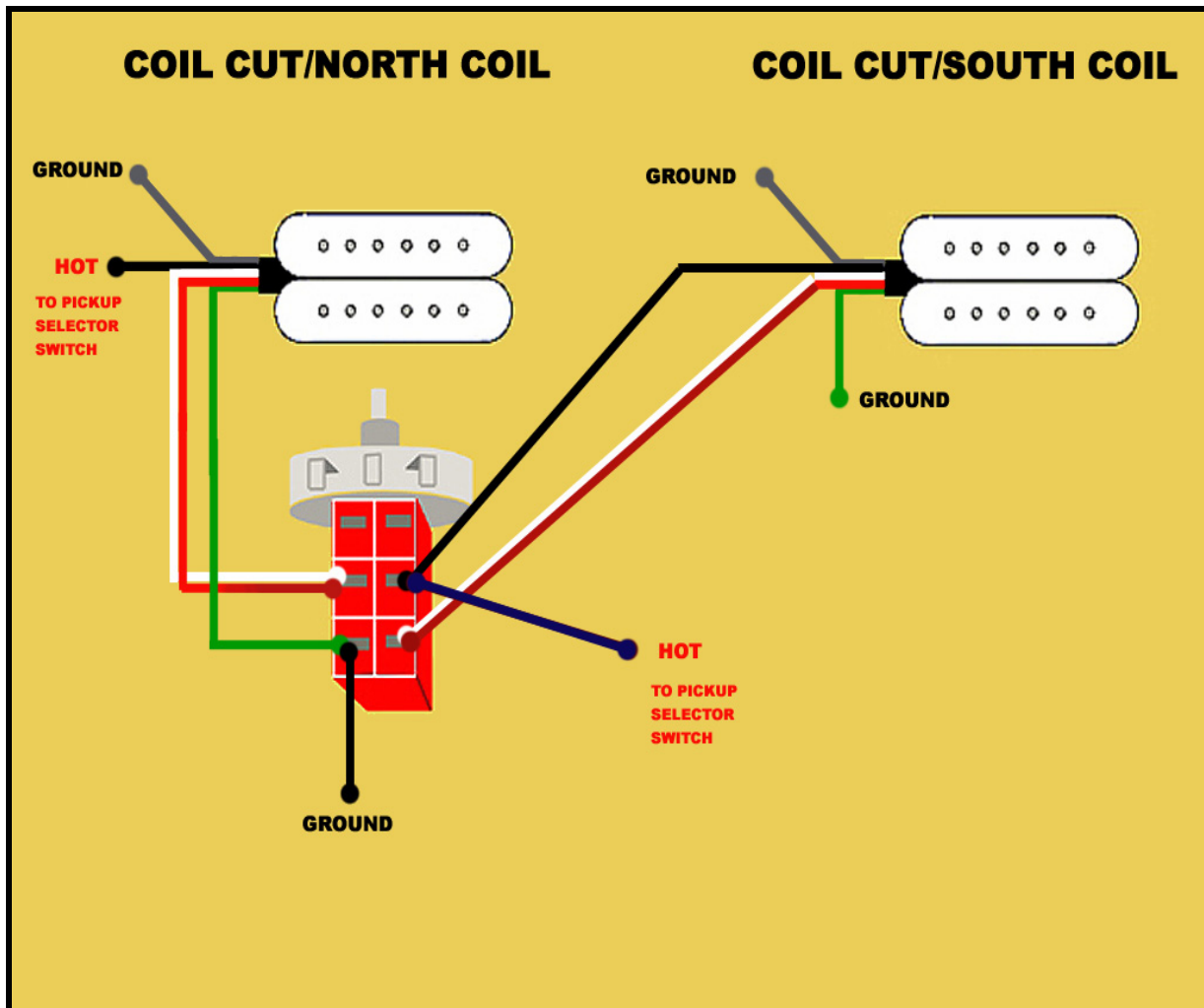


The wiring is a little different if you want to go from both coils on, to the south coil on. The hot wire from the pickup (black in this case) goes to the middle lug on the switch section of the push pull pot. Another wire connects to that same location and goes out to the pickup selector switch, where that pickup would normally be connected to. The diagram below uses the same color codes as a Seymour Duncan pickup. Black is the hot wire, green is the ground wire, the red and white wires form the series link, and the bare grey wire also goes to ground.



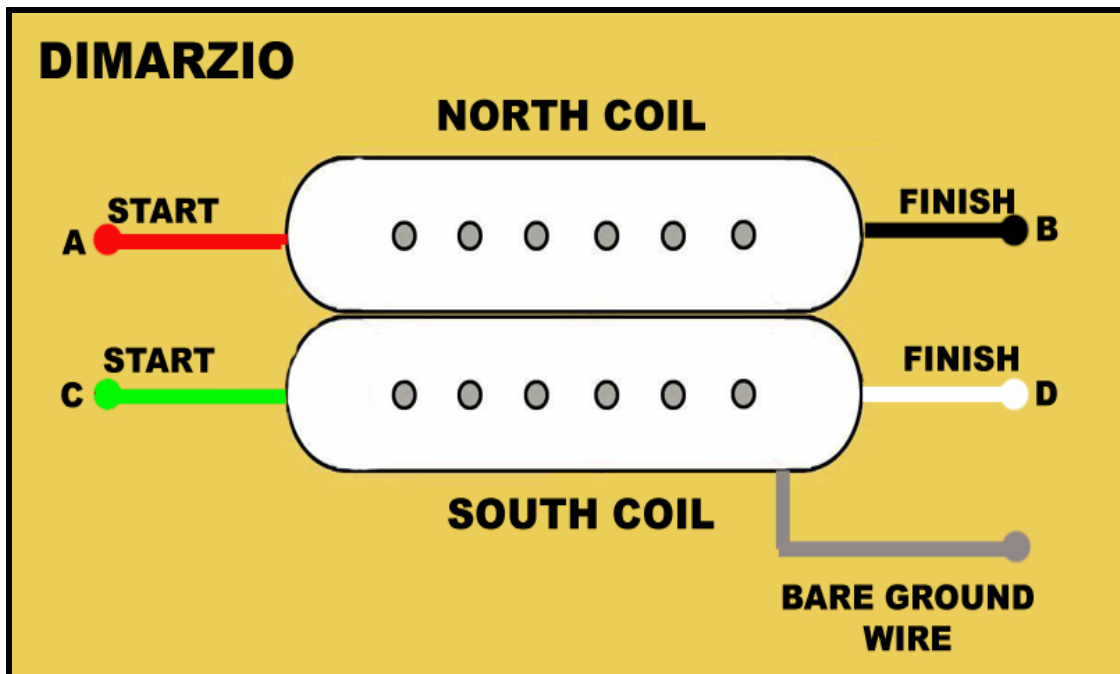
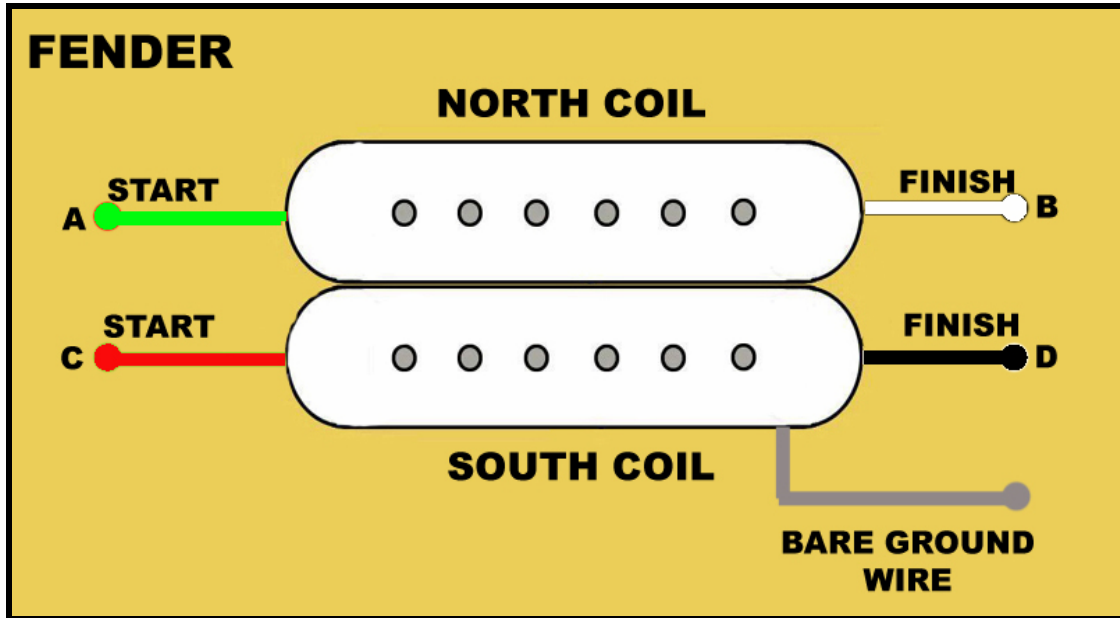


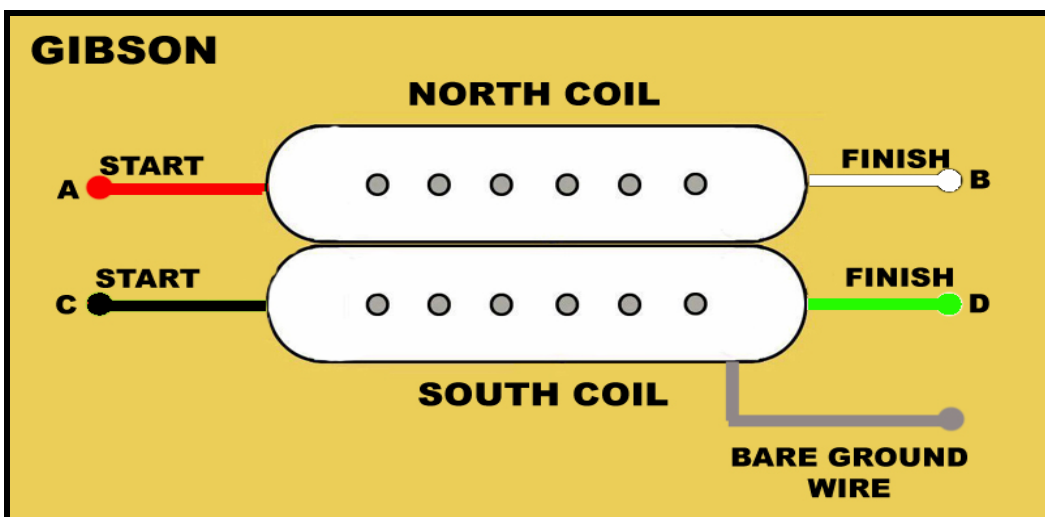
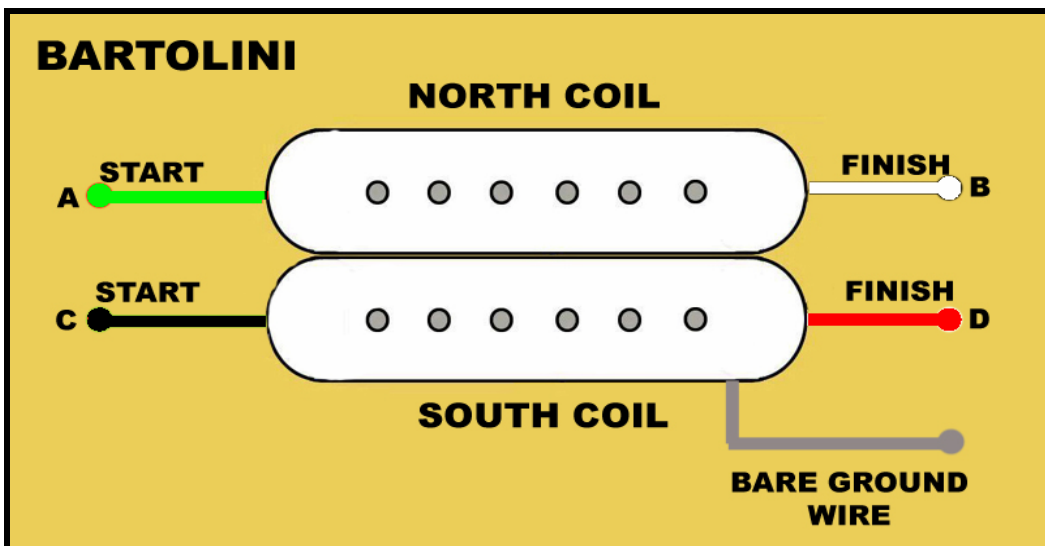
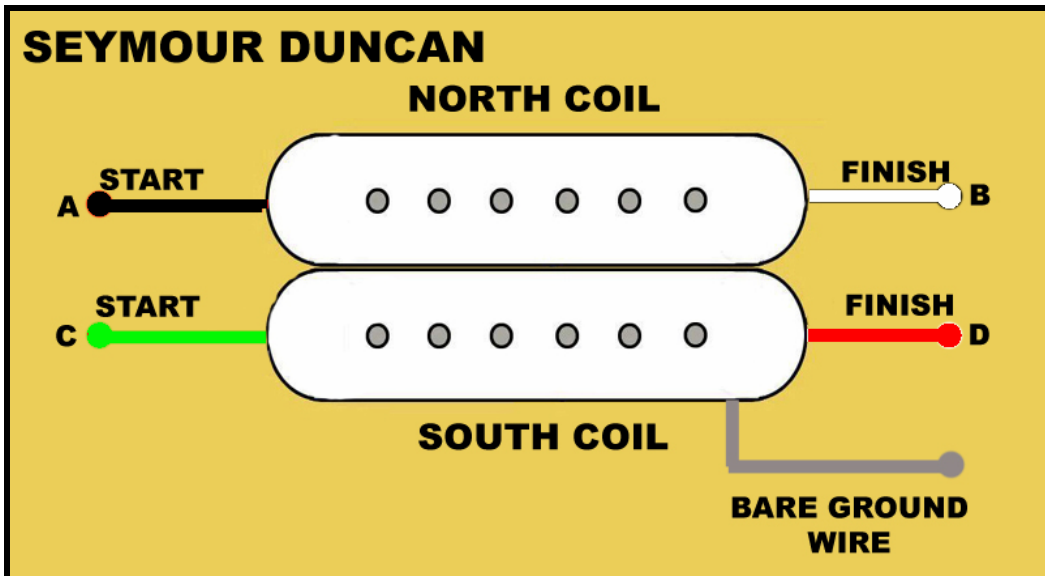
Next we are going to connect two 4-wire humbuckers to one push pull potentiometer. The on/on dpdt switch section of this potentiometer has two poles, one on the left, and one on the right, so it is easy to solder one pickup's connections to one pole, and the other pickup's connections to the other pole. In the example below, when the coil cut switch is turned on, the north coil will be on in the pickup on the left, and the south coil will be on in the pickup on the right. If you wanted the north coil to be on in both pickups in the cut position, then each pole would have the same connections, just from two different pickups. By knowing which poles are north and south, you can arrange the coil cut switch to turn on any combination of coils (outside coils on, inside coils on, north coils on, or south coils on). Also you can easily mix pickups from different brands and cut them how you want. Notice that the pickup on the left has a hot wire that goes out to the lug on the pickup selector switch for that pickup, and the hot wire for the pickup on the right will exit out of the middle lug on the switch and go to its appropriate lug on the pickup selector switch. The ground wires will go to the volume pot case. The diagram below uses the same color codes as a Seymour Duncan pickup. Black is the hot wire, green is the ground wire, the red and white wires form the series link, and the bare grey wire goes to ground.

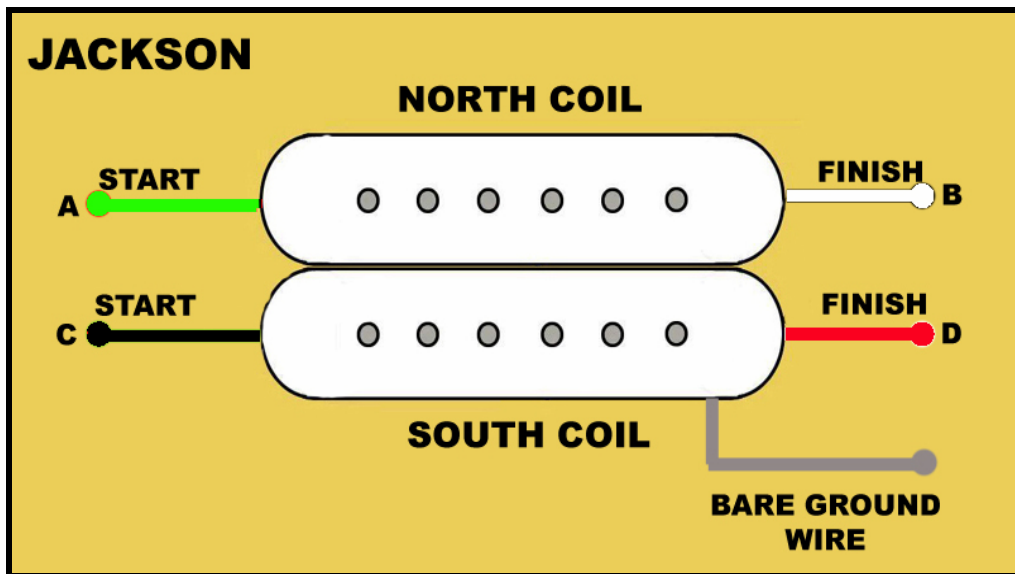
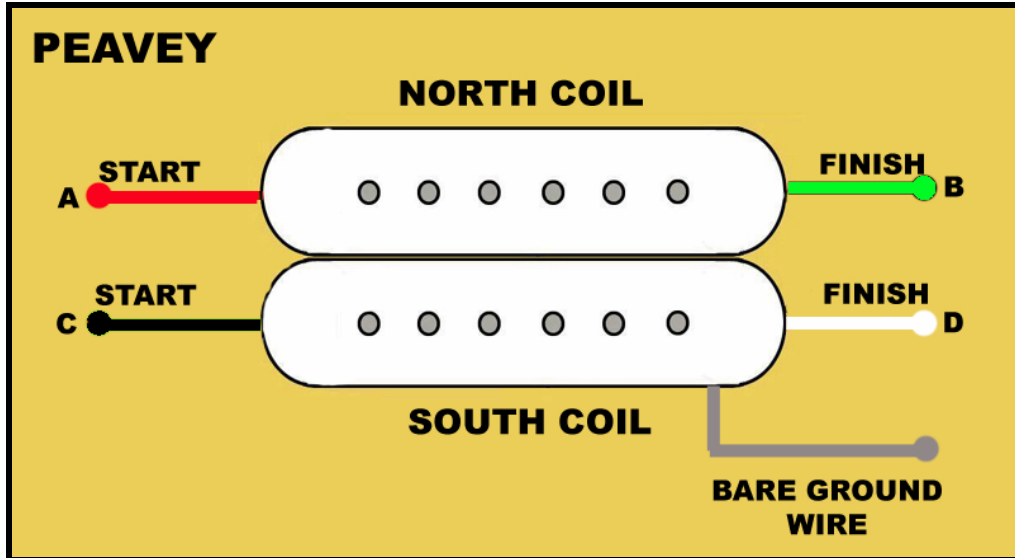


## PICKUP COLOR CODES

Here are some of the common 4-wire humbuckers. Check out the questions and answers section for more info on how to wire them.



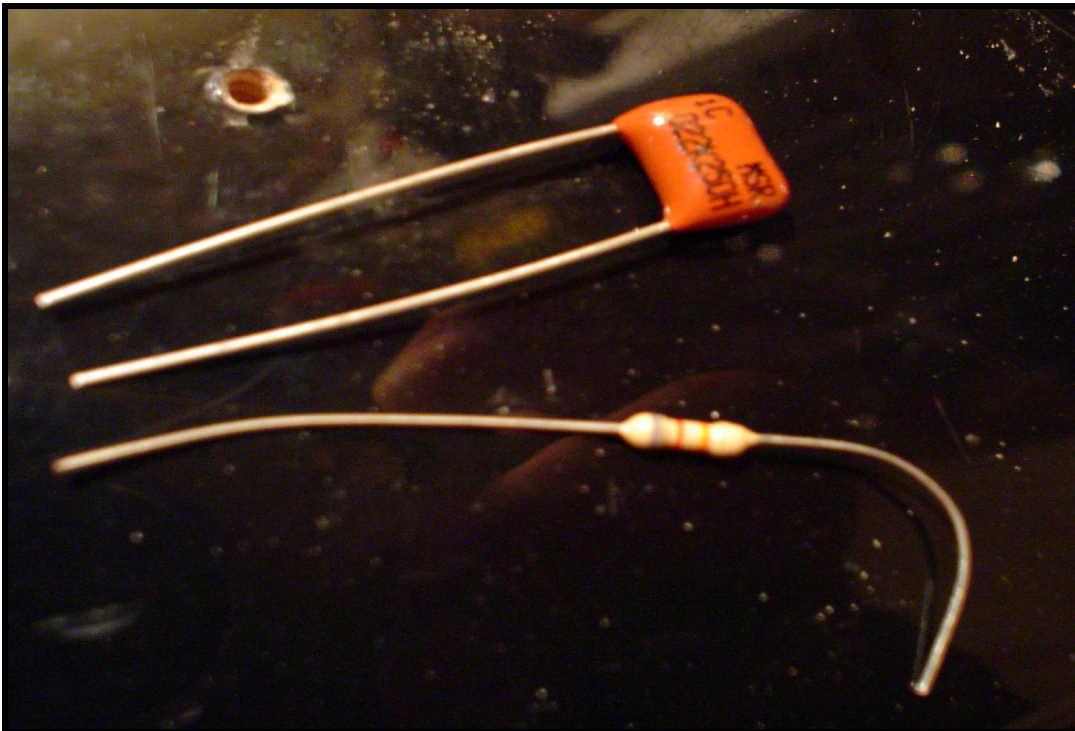
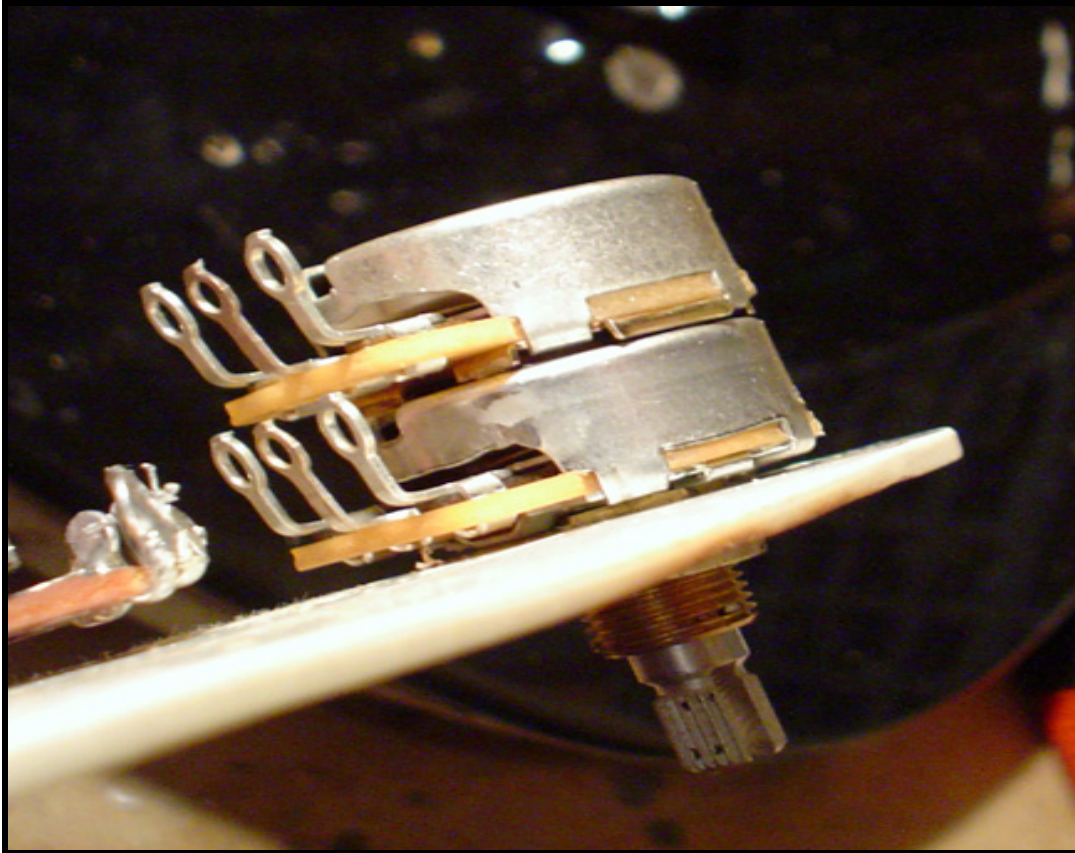


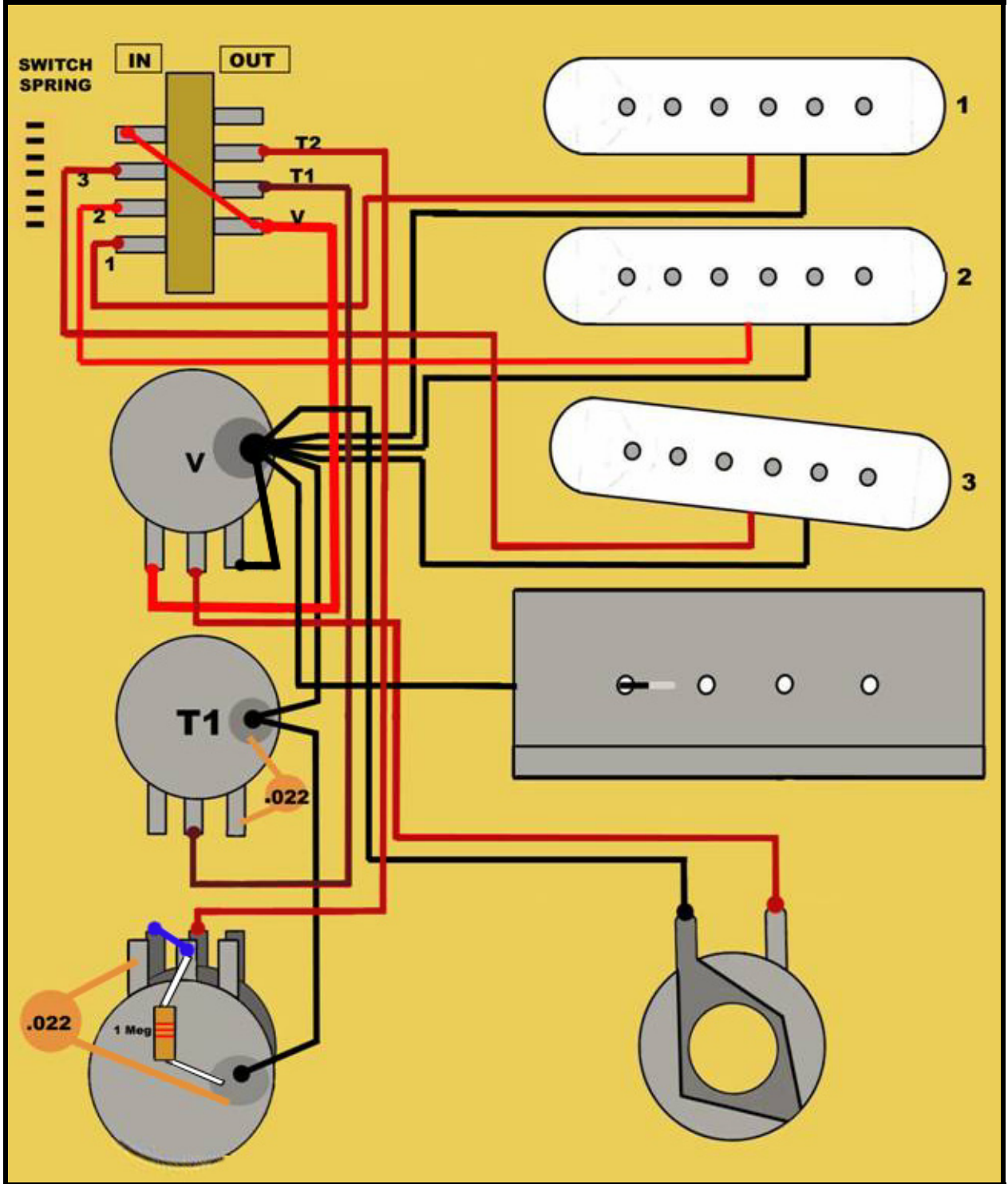


## TBX TONE CONTROL

Some might think of the TBX tone control as a treble boost, but its not. The TBX control is actually a stacked pot, resistor, and capacitor that cuts the bass and the treble out of a circuit, depending on which way you turn the knob. This can add some new dimensions to your soloing, especially if you are going for those bright, crystal clear, Jeff beck tones.

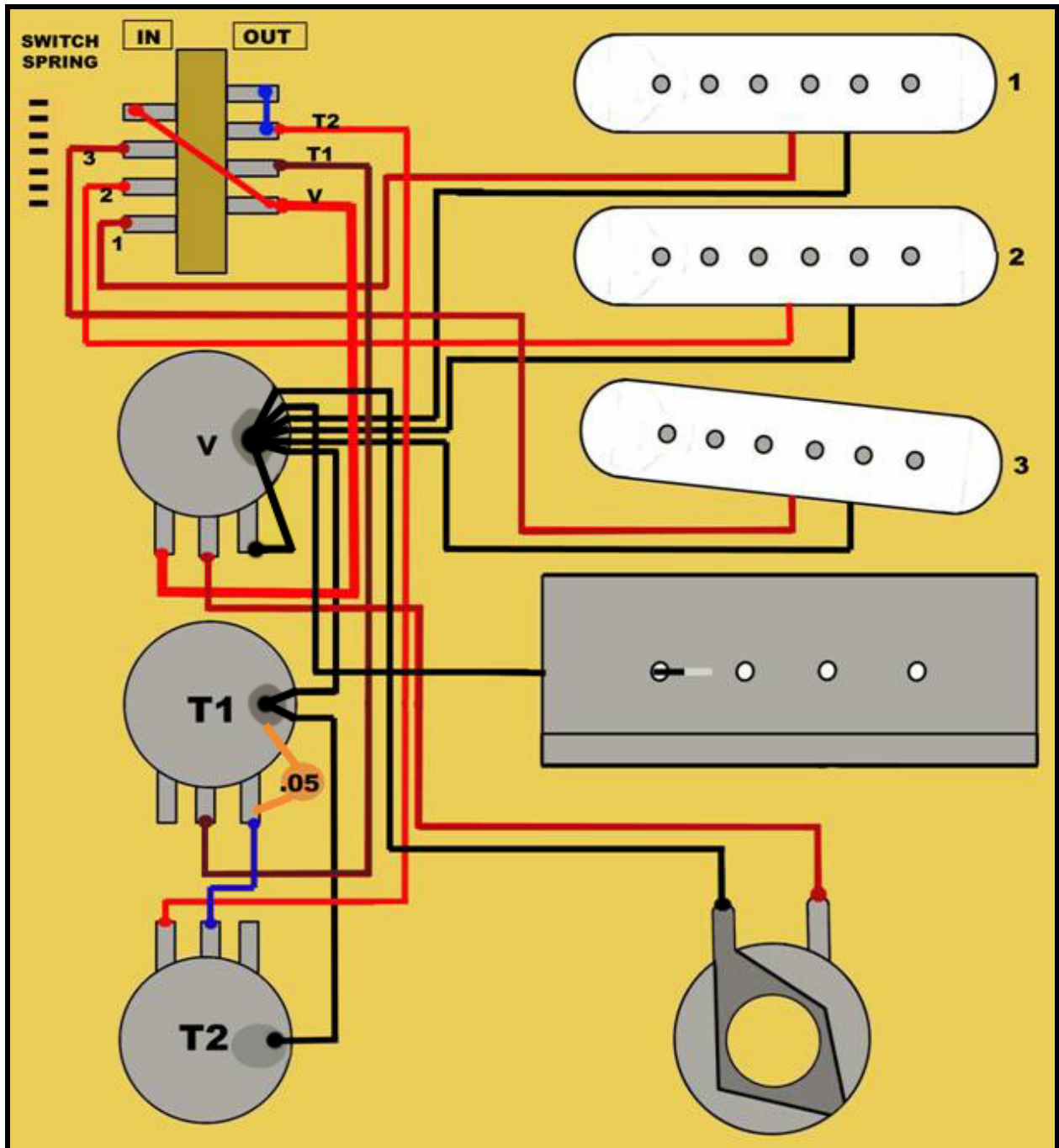
The diagram on the next page shows how to wire the TBX on your strat. In this case, the TBX control receives the signal coming from the middle pickup. However, you could wire it to be the tone control for any pickup, or be a master tone for all 3 pickups. Notice that the resistor and capacitor get soldered to ground on the TBX case.





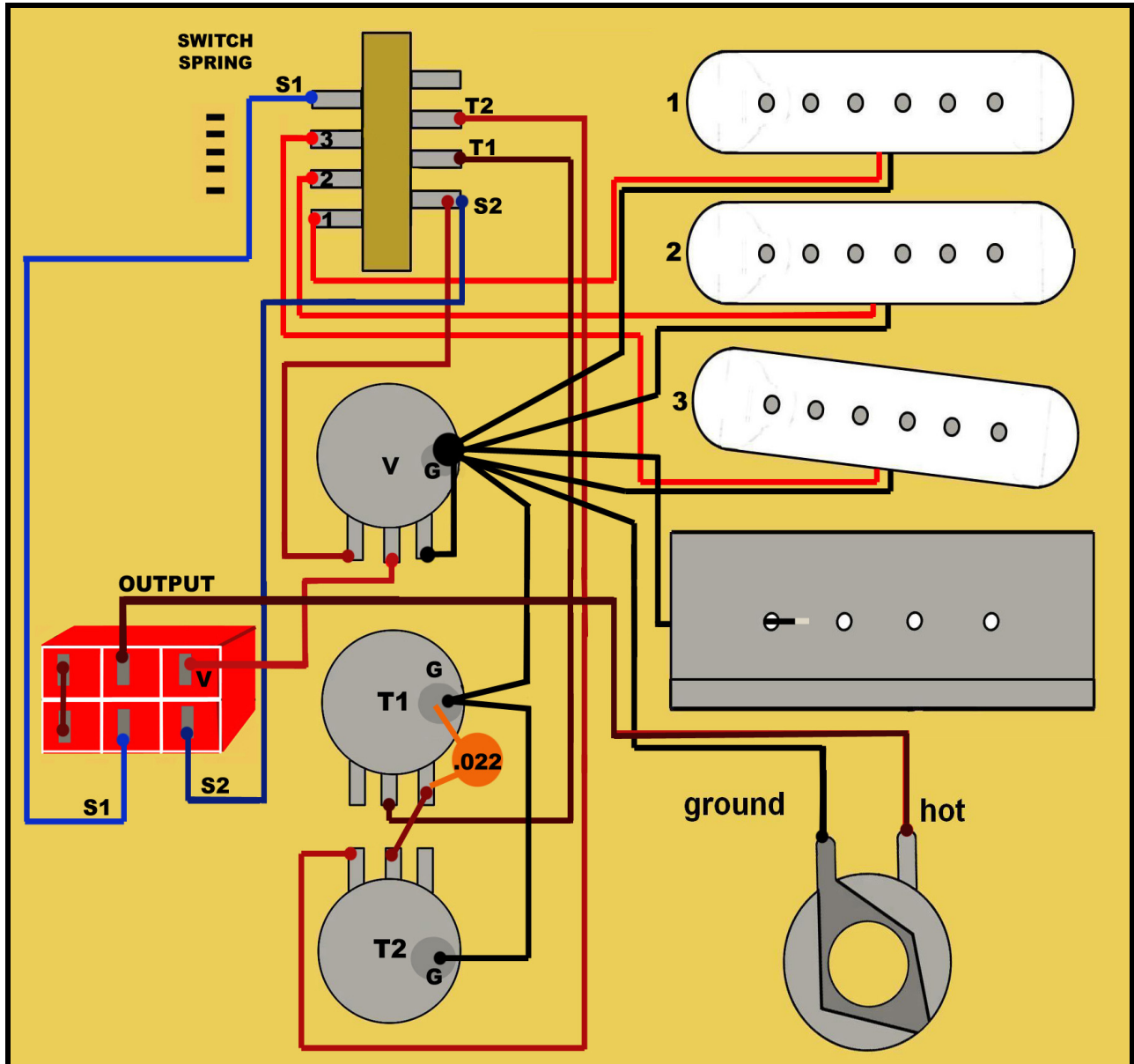
## BRIDGE TONE CONTROL

This modification is one of the easiest to do, yet very useful for toning down those screeching solos. This mod will make your middle pickup tone control work for the middle and bridge pickups. All you have to do is add a small jumper wire from the 5-way switch middle pickup lug (T2) to the lug directly above it.



## TREBLE BOOST/ SOLO SWITCH

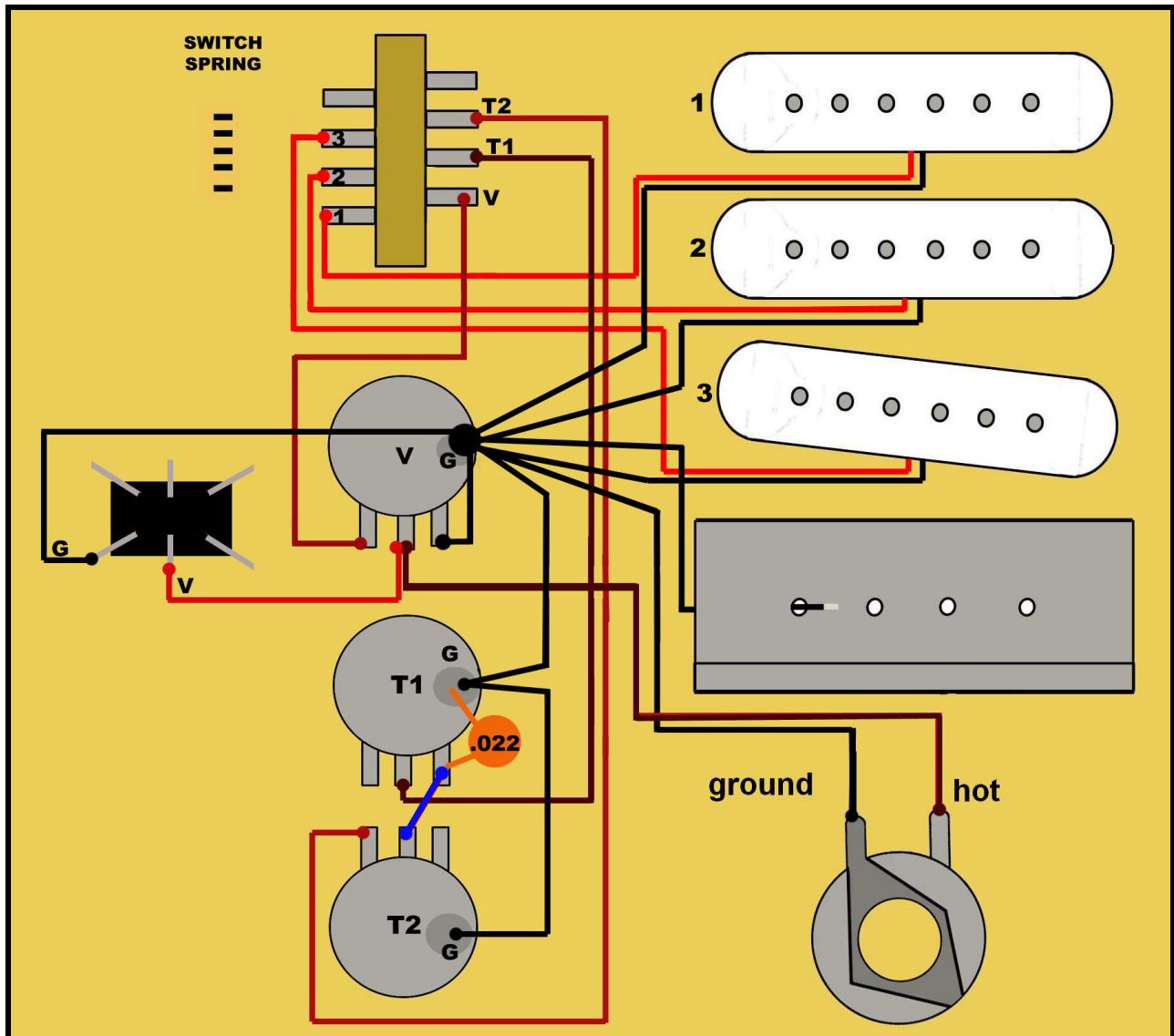
One of the more useful hot rods that you can do to your guitar is to add a solo switch to it. This modification involves a DPDT on/on mini toggle switch used to bypass the 5-way selector switch. It doesn't matter what position your 5-way selector switch or tone knobs are in, when activated, the solo switch will only turn on the bridge pickup. When switched off, you will go back to your original 5-way switch setting.

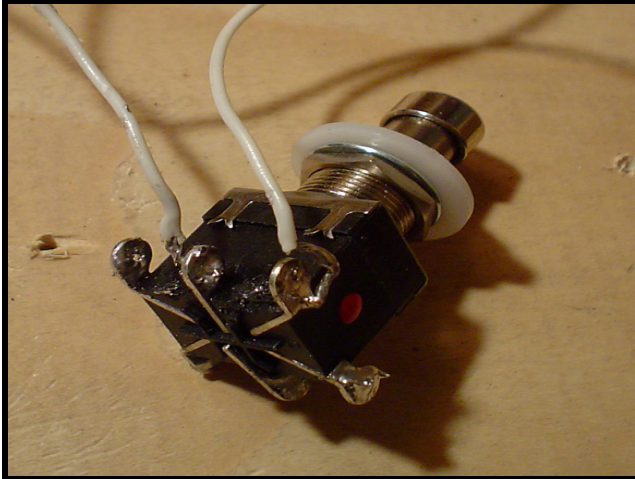




## MOMENTARY KILL SWITCH

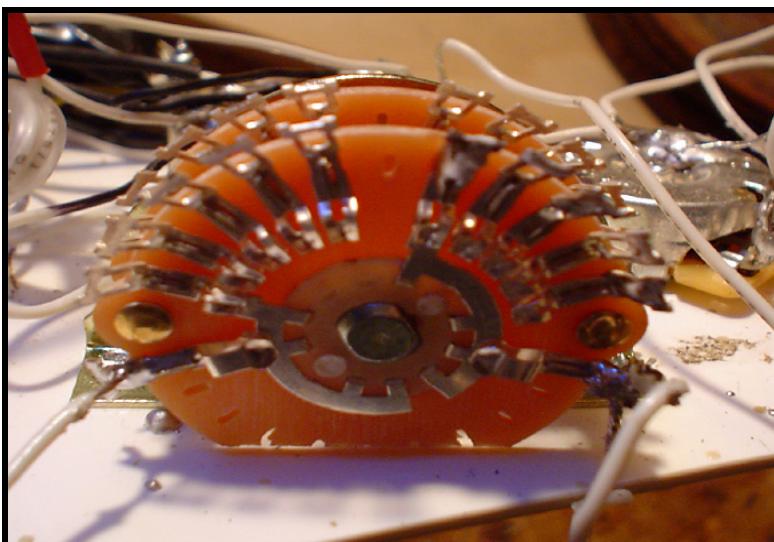
A momentary, or non-latching switch, is a special type of on/off button. When you push it in, the power is on. When you release, the power goes back to the off position. Although this switch is not very practical as an on/off switch, it is useful for achieving a special type of effect made popular by the guitarist, Buckethead. This effect is achieved by pressing the button rather quickly while playing around on the neck with your other hand. If you search around on youtube.com, you will find a bunch of Buckethead solos, demonstrating this interesting technique.

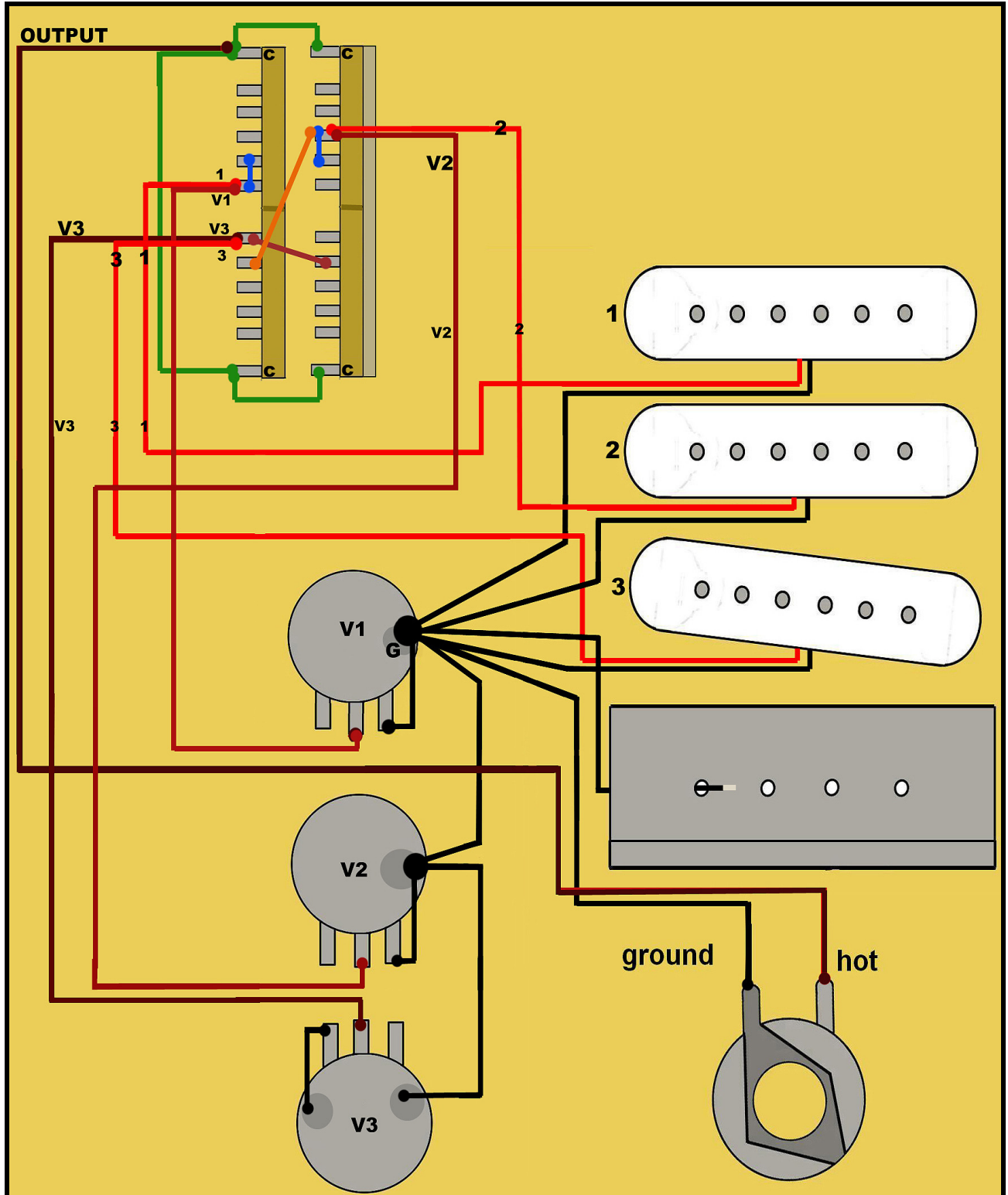




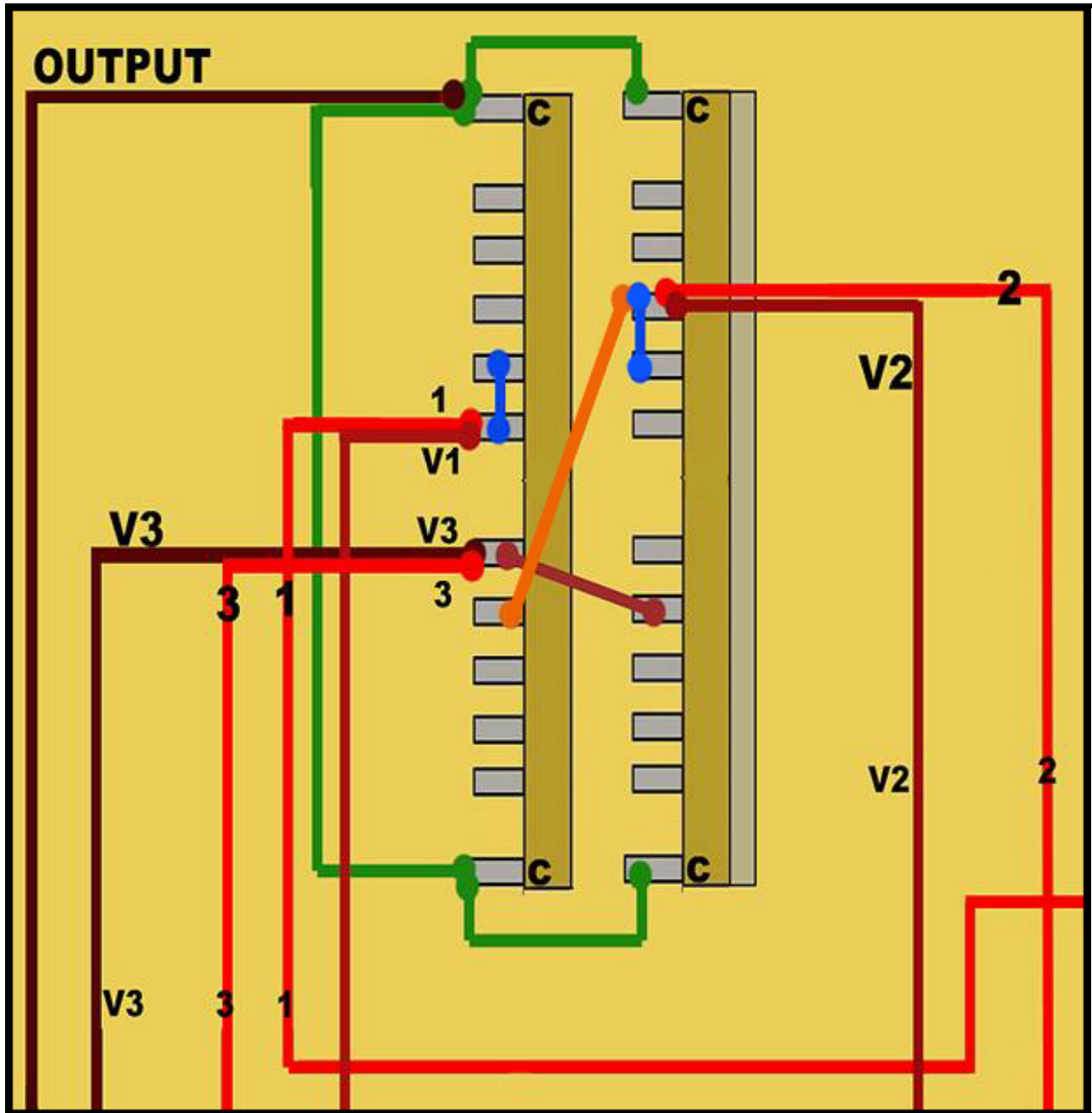
### 3-VOLUME STRAT

If you are a perfectionist when it comes to adjusting and readjusting your volume control to find the perfect tone, then this is a hot rod technique for you. It works great for me because I like to play with lots of pedals, but never at 100% volume. The solution is simple, add more volume controls. The 3-volume strat wiring basically allows each pickup to have a separate volume control. So you can go from a 50% rhythm volume on the neck pickup, to a 90% solo volume on the bridge pickup, and then back to a 60% middle pickup chorus volume. Note: if you use positions two and four on the 5-way selector switch, then each volume potentiometer will become master volume control. So each volume pot will control both pickups. You will need a super switch for this mod, or a switch with 4 poles, and 6 lugs per pole. The lugs marked with a "c" are common lugs and send the signal out of the switch from each pole.



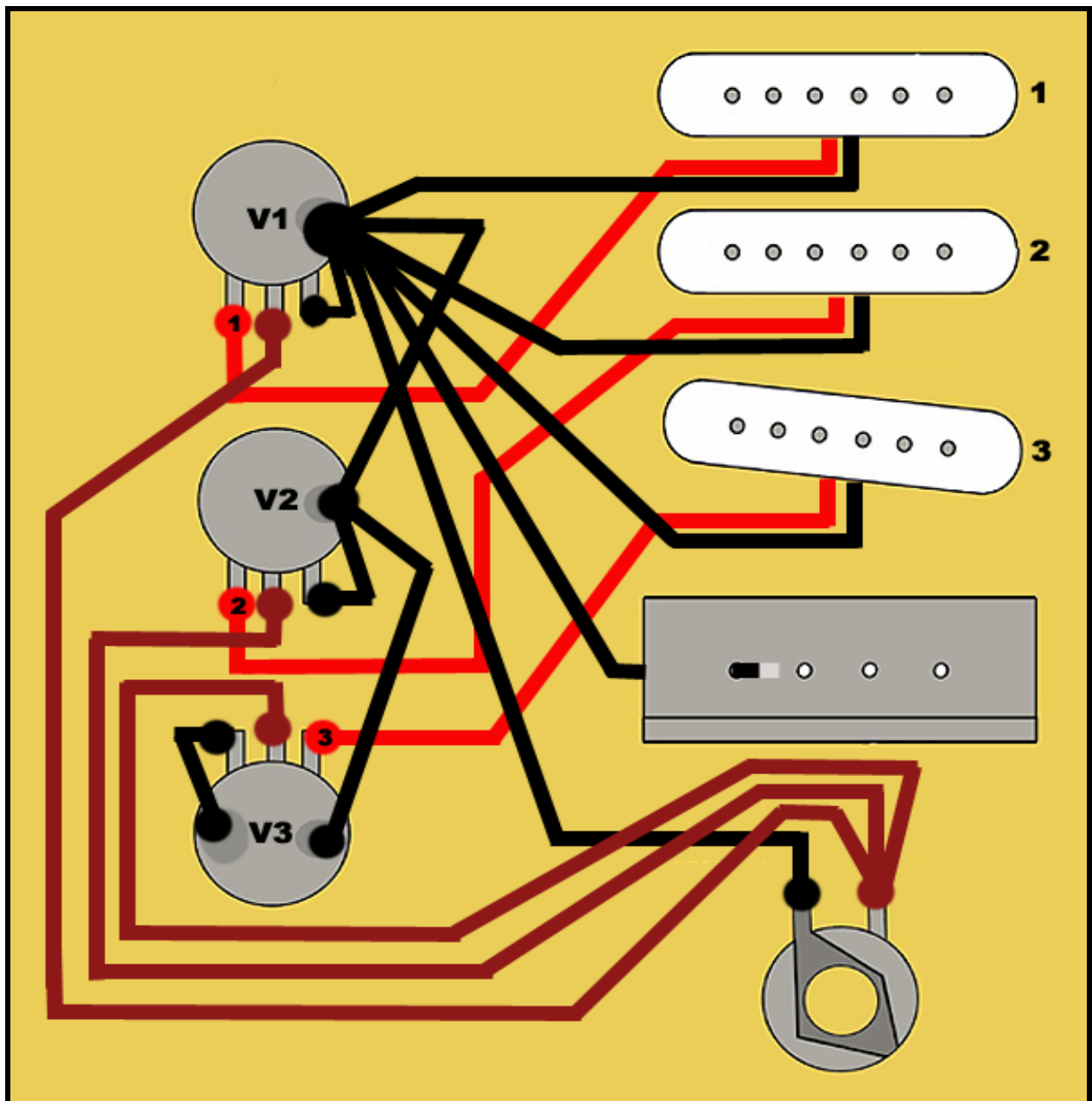


Here is a close up of the super switch. Each group of 6 lugs represents a different pole.



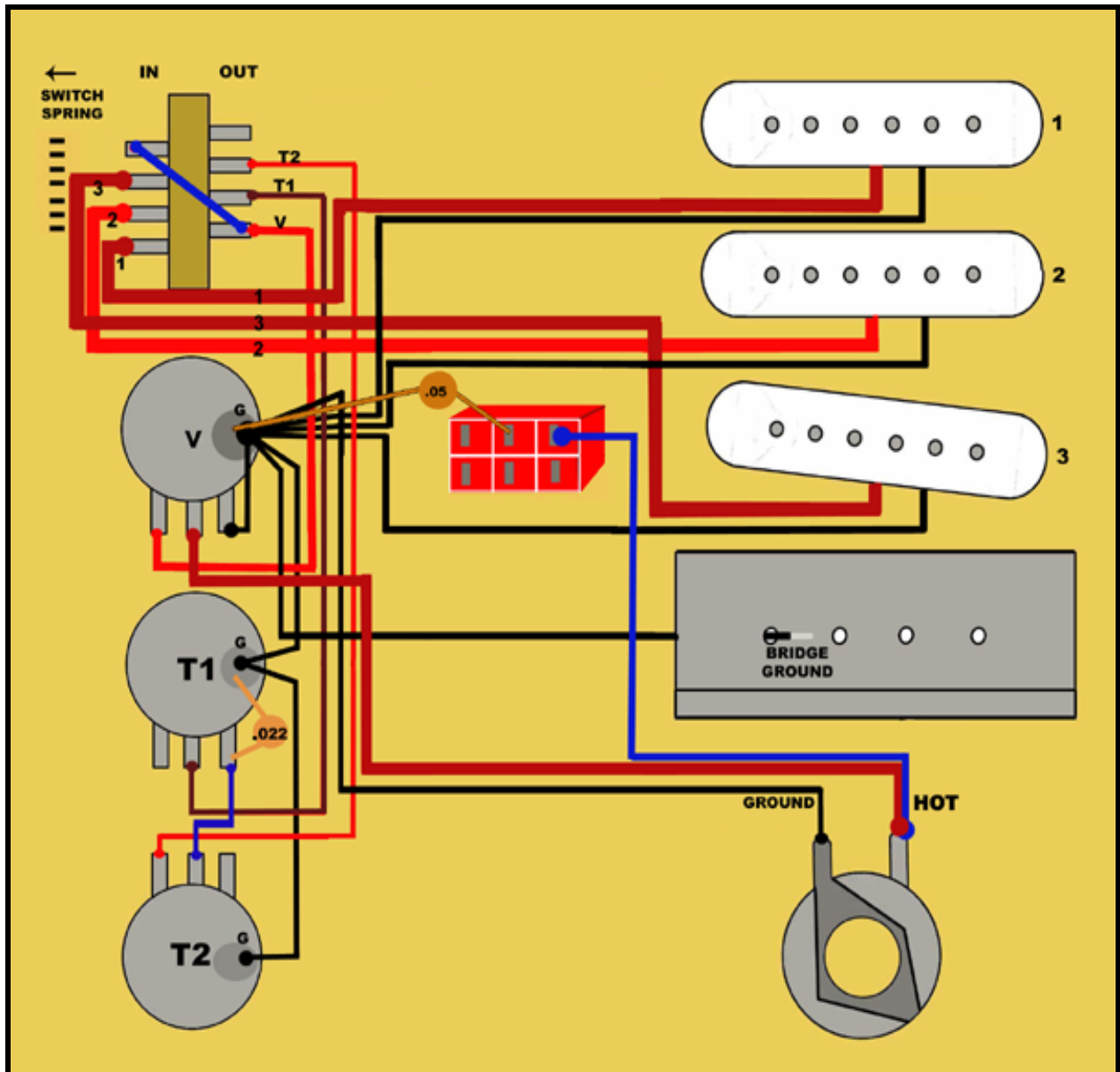
### 3-VOLUME BLEND SRAT

This modification is also for a 3-volume strat, however, in this case, each pickup is always on. So if you want to turn on or off each pickup, you have to adjust each pickup's volume control. The cool thing about this mod is that you can blend in all of the pickups for some unique sounds. So you could play with 90% of the neck pickup, 70% of the middle pickup, and 10% of the bridge pickup all on at the same time if you wanted to.



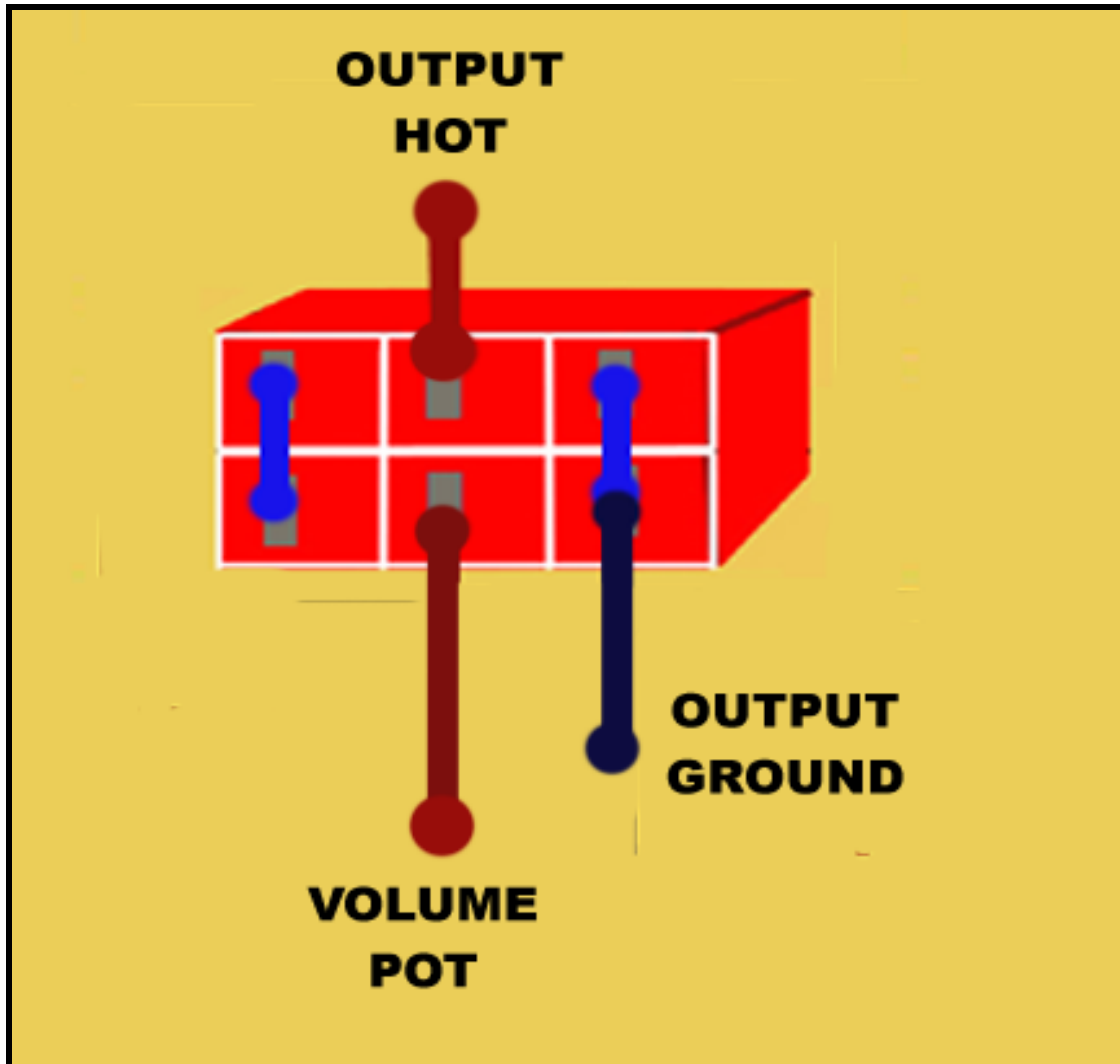
## BASS SWITCH

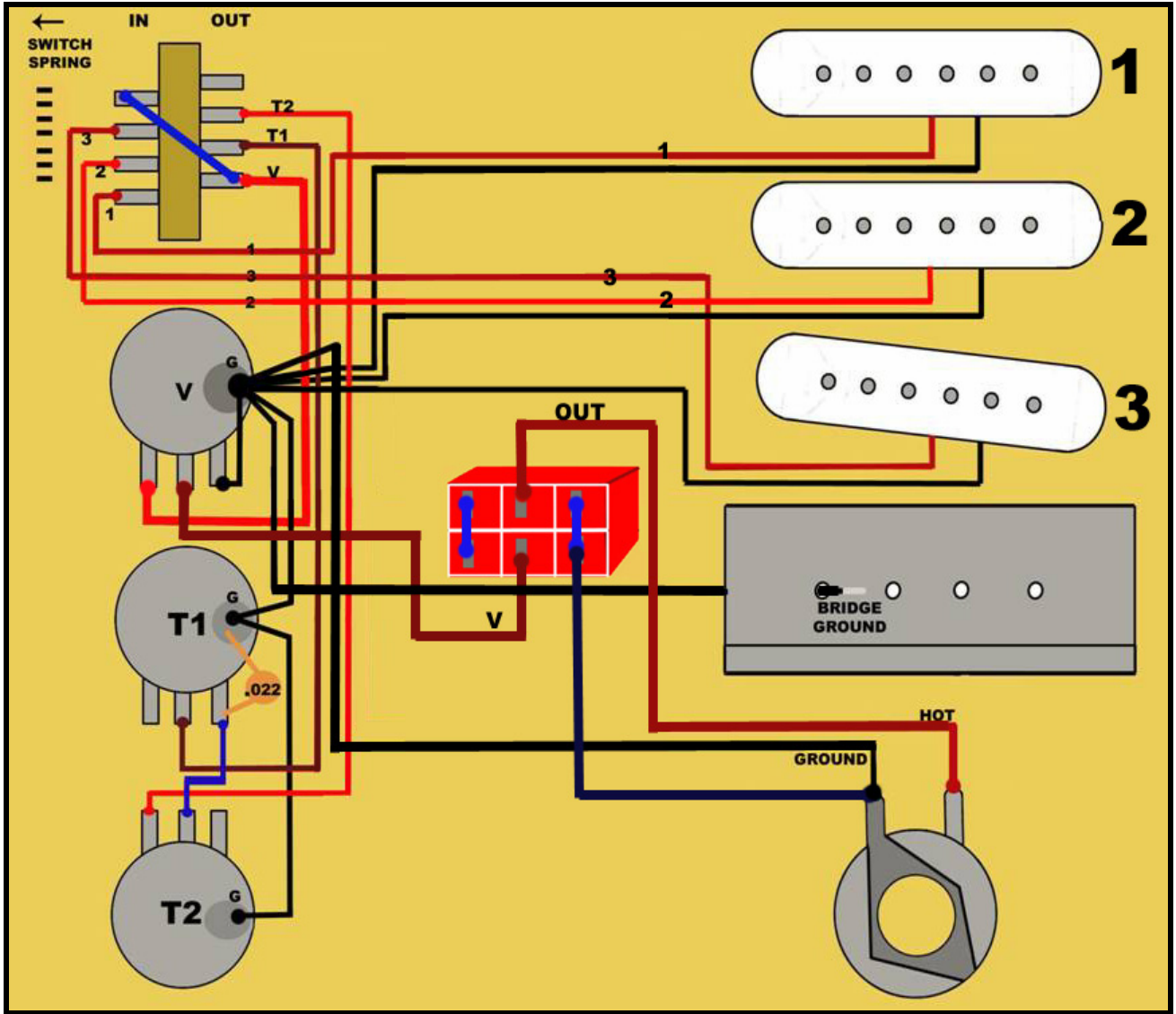
Have you ever wanted to quickly add a few bass tones to your solos, without messing with your tone knobs? This bass switch can solve your problem. It uses a simple on/on toggle switch to add a stronger capacitor to the circuit, which then sends the highs to ground. Think of it as a slimmed down version of the Varitone rotary switch.



## KILL SWITCH

Here is a simple kill switch. It will allow you to turn off your guitar quickly without messing with the volume control. It uses an on/on mini toggle switch that connects the volume pot to the output jack.

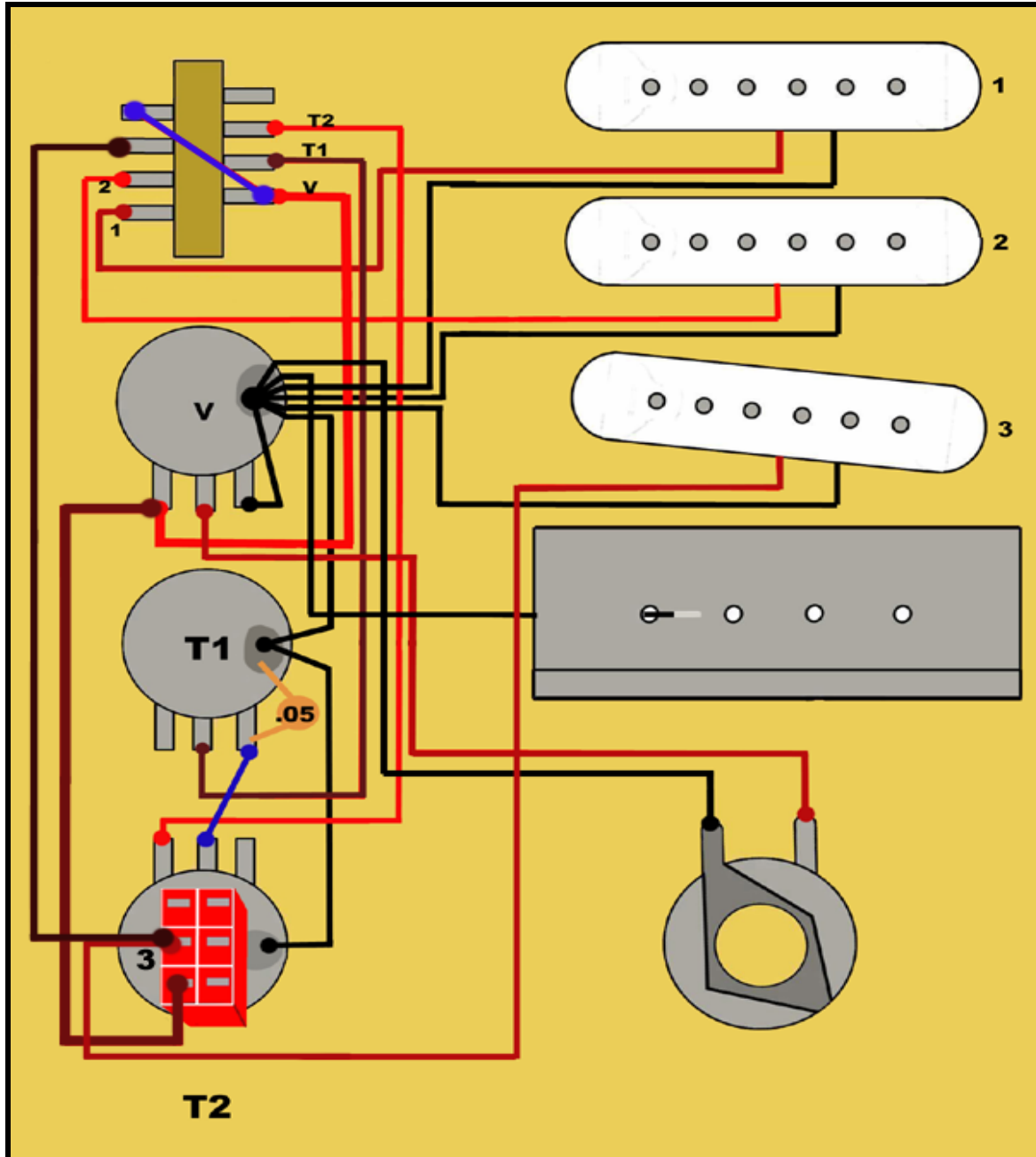




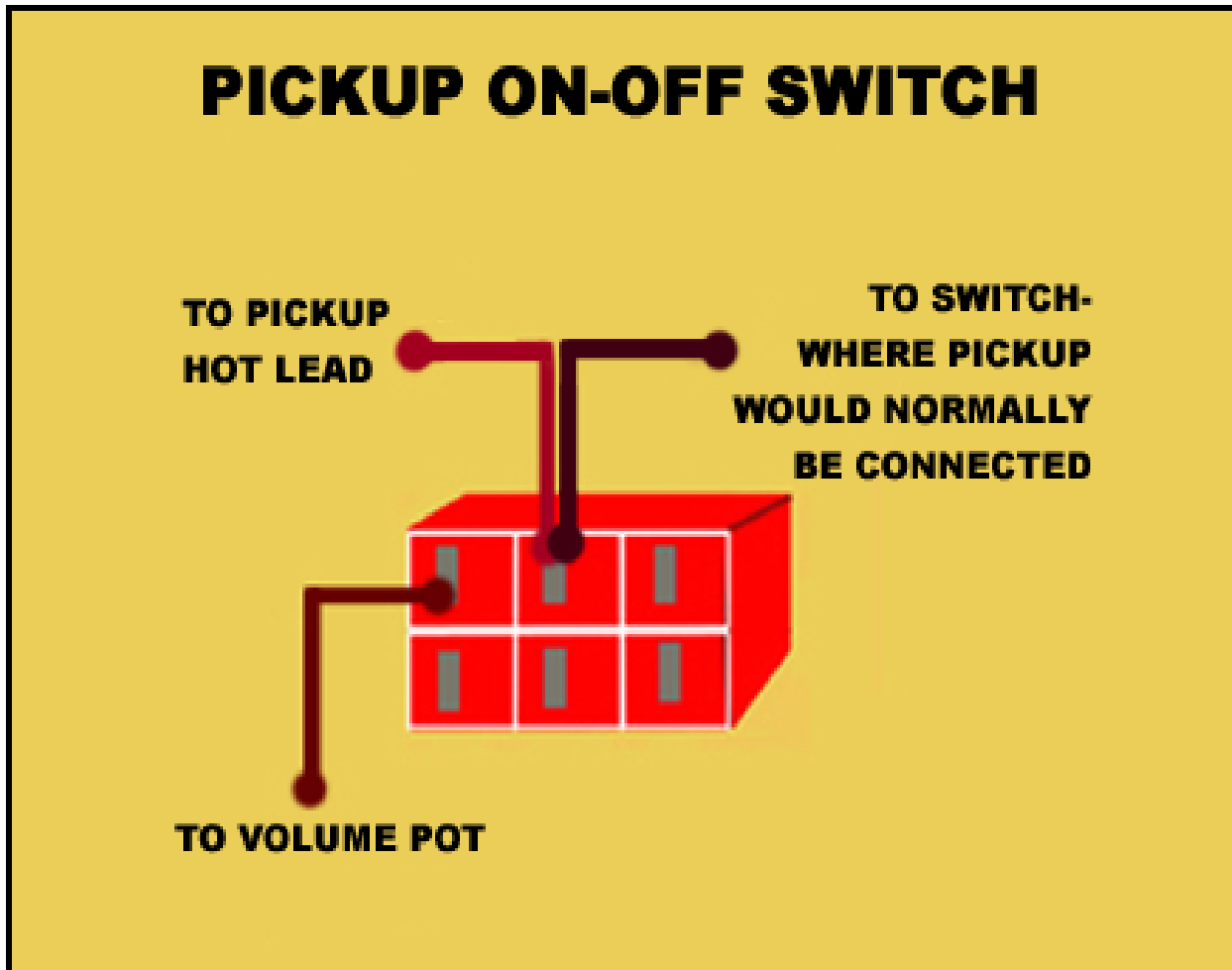


## BRIDGE-ON SWITCH

This will allow you to add 2 more tones to your strat: all three pickups on at the same time, and the neck and bridge pickups on at the same time. To add this switching to one of your pickups, just add an on/on mini toggle switch, or a push pull pot to your guitar. Then send the signal to the volume pot. Check out the diagram below for more info.

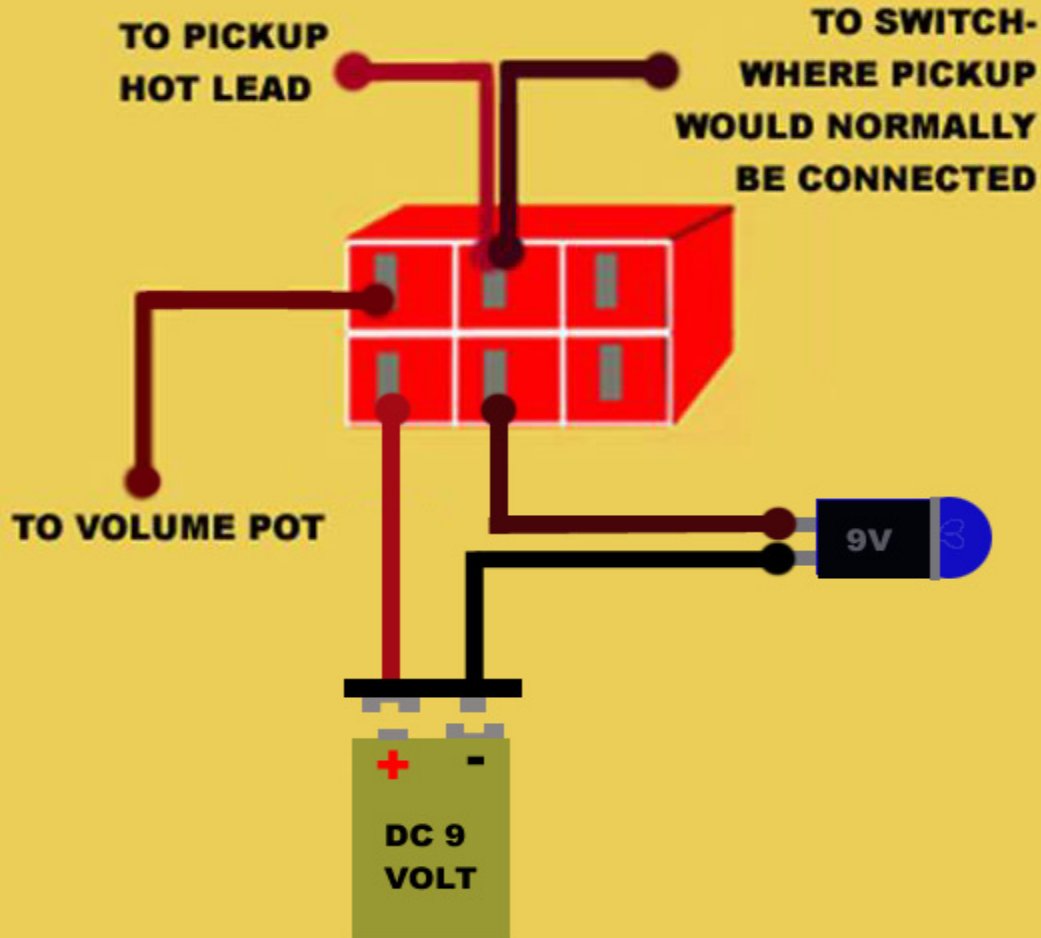


Here is a close-up of the switch. It can be connected to any pickup as an additional on-off switch, regardless of what position the pickup selector switch is in. You can use a push pull pot, or an on-on mini toggle switch for this function.



If you want to add a little flair to your solos, you can easily add a small 9 Volt light to this on/on switch. When the mini toggle is flipped, and the pickup is turned on, a light will also be turned on. All you need is a 9 Volt battery connector, a 9 Volt light, and a 9 Volt battery. All of these items can easily be found online. The light I used is actually for a tube amp, but any 9 Volt light will work. A guitar circuit is only 1 Volt or less, that's why you need an additional 9 Volt battery to power the light bulb.

# PICKUP ON-OFF SWITCH PLUS LIGHT



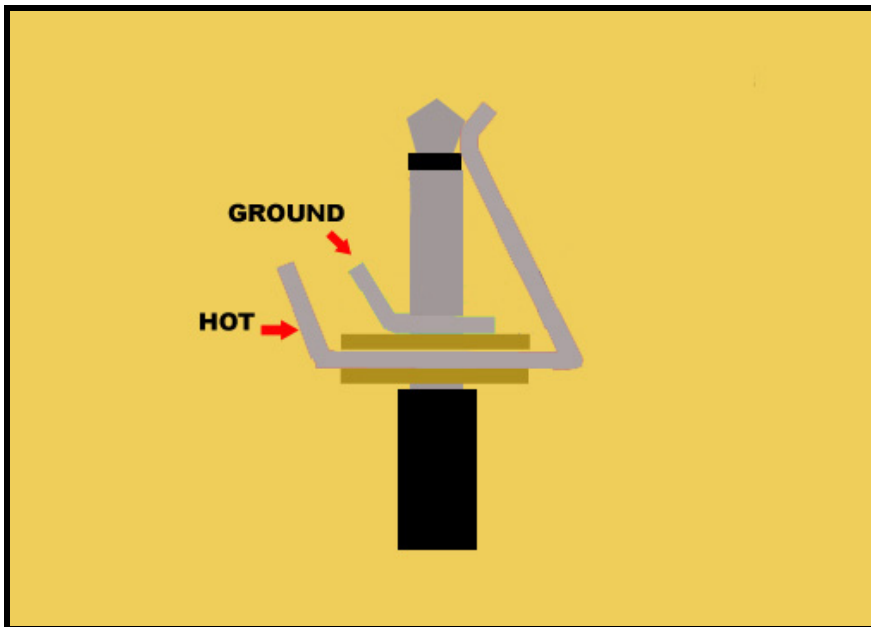
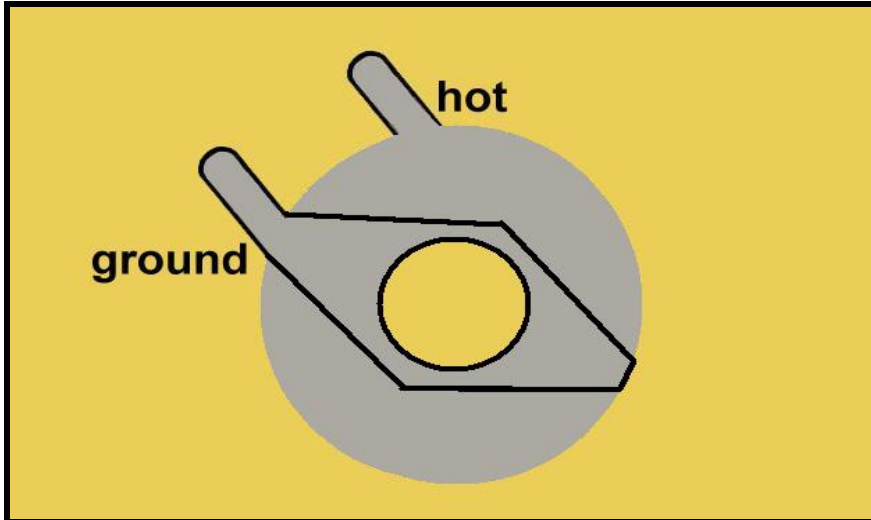
Here it is in action. If you wanted to use a big light like this, then you would have to take out the second tone potentiometer, and just go for a master volume, and master tone control. If you use a smaller LED, then you can place it almost anywhere and keep your second tone control.



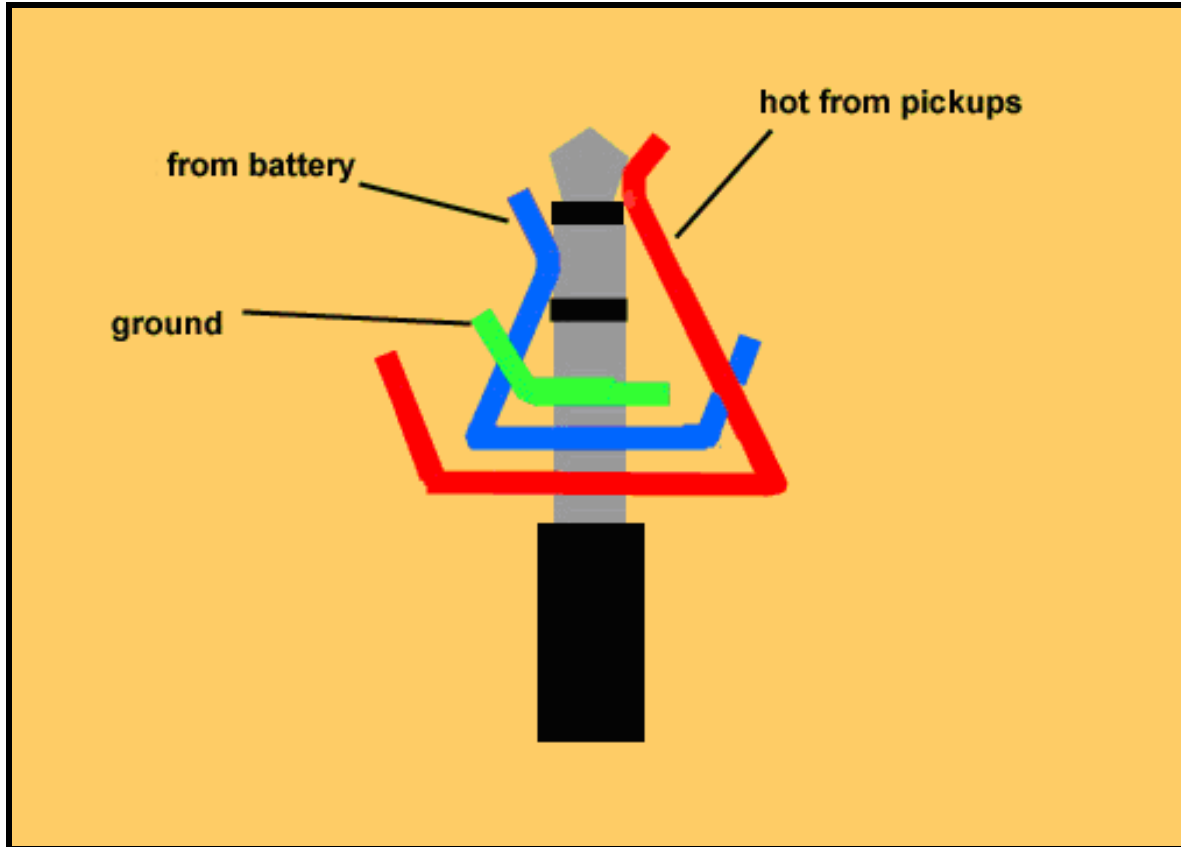
## QUESTIONS AND ANSWERS

**Question: Which lug on the output jack is hot, and which lug is a ground?**

There are two lugs on the jack. One of them is attached to the prong. That one is hot. Sometimes the hot lug has a different shape, and is notched.



If you are using active pickups, or a preamp inside your guitar, then you will probably need to use a stereo output jack. It has one additional lug that receives the signal from a 9 volt battery.

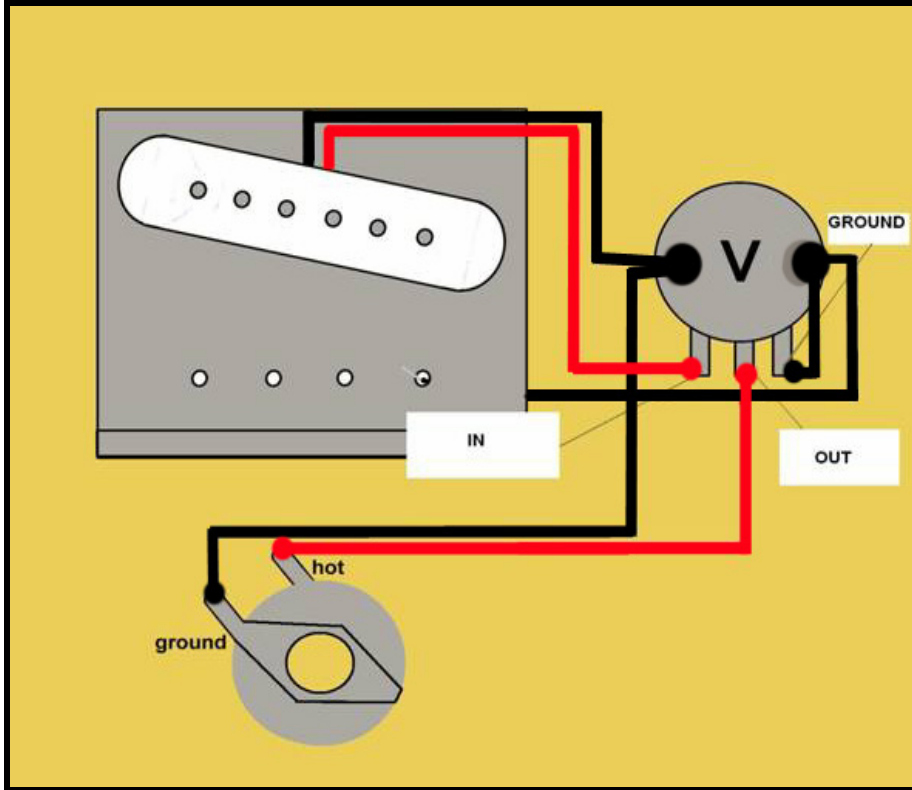


**Question: What do the colors on the wires mean?**

You have probably noticed by now that most hot wires on a guitar are colored, like white, red, or yellow, and most ground wires are black. Although most pickup companies do not use the same color codes, most ground wires will be black. You should check with the manufacturer to see what color codes your pickup wires use.

**Question: How do pickups work?**

Basically, pickups are magnets wrapped in copper wire. They pick up magnetic signals given off by vibrating strings. The signal gets carried through a volume potentiometer, which can send the signal to ground to decrease the volume if desired. Then the signal goes through a tone potentiometer connected to a capacitor. The capacitor sends only the high tones to ground as you turn the tone knob. Then the signal goes to the output jack and into the amp. In order to complete the circuit, you need to ground all parts with electricity flowing through them. The 3-way or 5-way switch turns different pickups off and on. The next picture shows a basic wiring diagram with one pickup and one volume control.



**Question: Why do some pickups have staggered pole pieces?**

Staggering the magnet poles increases or decreases the magnetic output of each string. So strings that naturally have a higher output should have lower magnets to give the guitar a balanced volume. For example, one of my strats has a higher output on the B and E strings, so to compensate for that, the pickups have lower poles on the B and E strings.

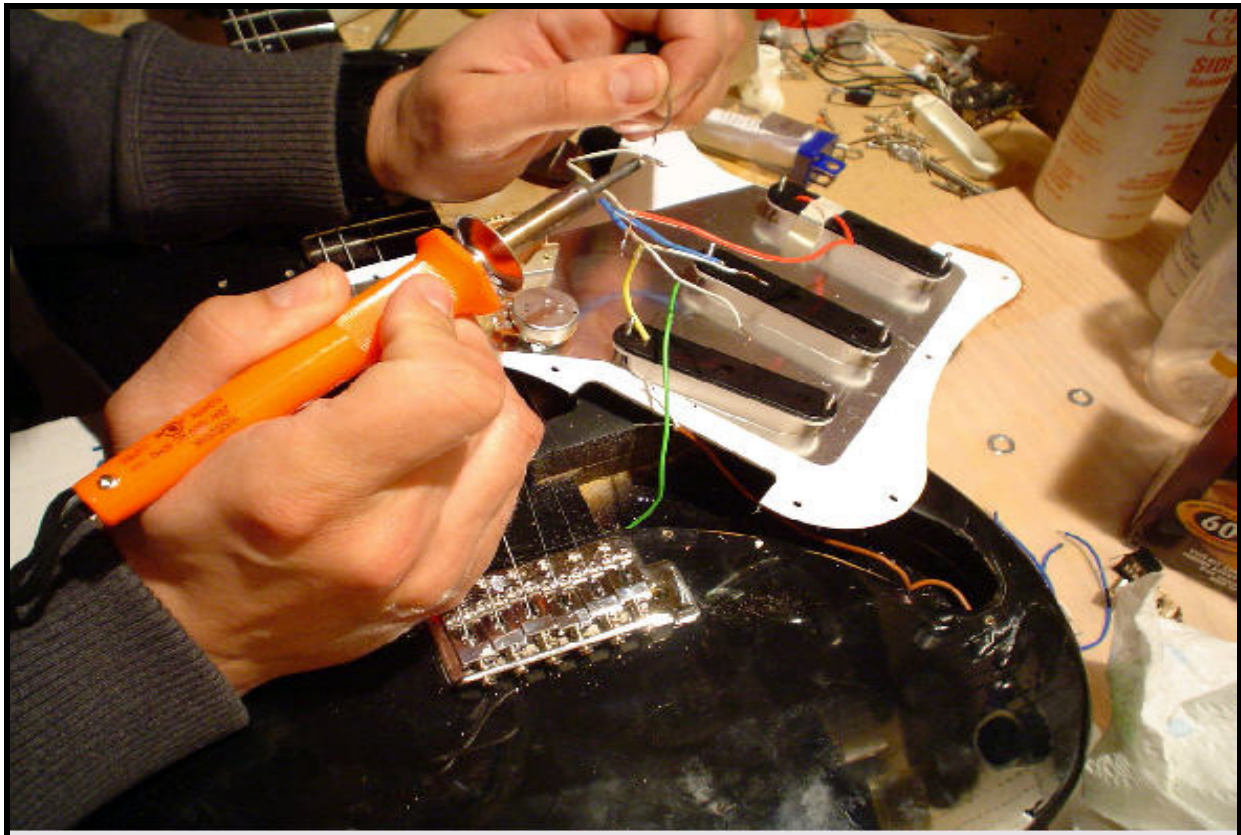


**Question: Which pickups have more unwanted noise, single coil, or double coil?**

This problem, called 60 cycle hum, is common among single coil pickups. It occurs when the pickup basically picks up interference from an alternating current electrical supply that is nearby. Proper grounding and proper wire shielding can reduce this unwanted noise. Double coil pickups have less noise, due to the in phase in series wiring, but also have less treble. Many guitarists prefer single coils for their vintage guitar sound, and humbuckers for their powerful southern rock sound.

**Question: Do you have any soldering tips?**

If you are using the twisted strand of wire, before you get started you will need to add solder to the ends of all lugs and wires. This will make the soldering job go much quicker. Don't take too long to solder a connection, or you can damage a potentiometer or capacitor. After you solder a wire to a lug, do not move it for at least 3 seconds. Any movement can cause a cold, or bad joint. If you re using the stiffer vintage style wire covered in cloth, just pull back on the cloth to expose the wire, put the wire in the lug hole, and touch the soldering iron and solder to the connection. Most switch and potentiometer lugs have holes in them that the wires can fit into.

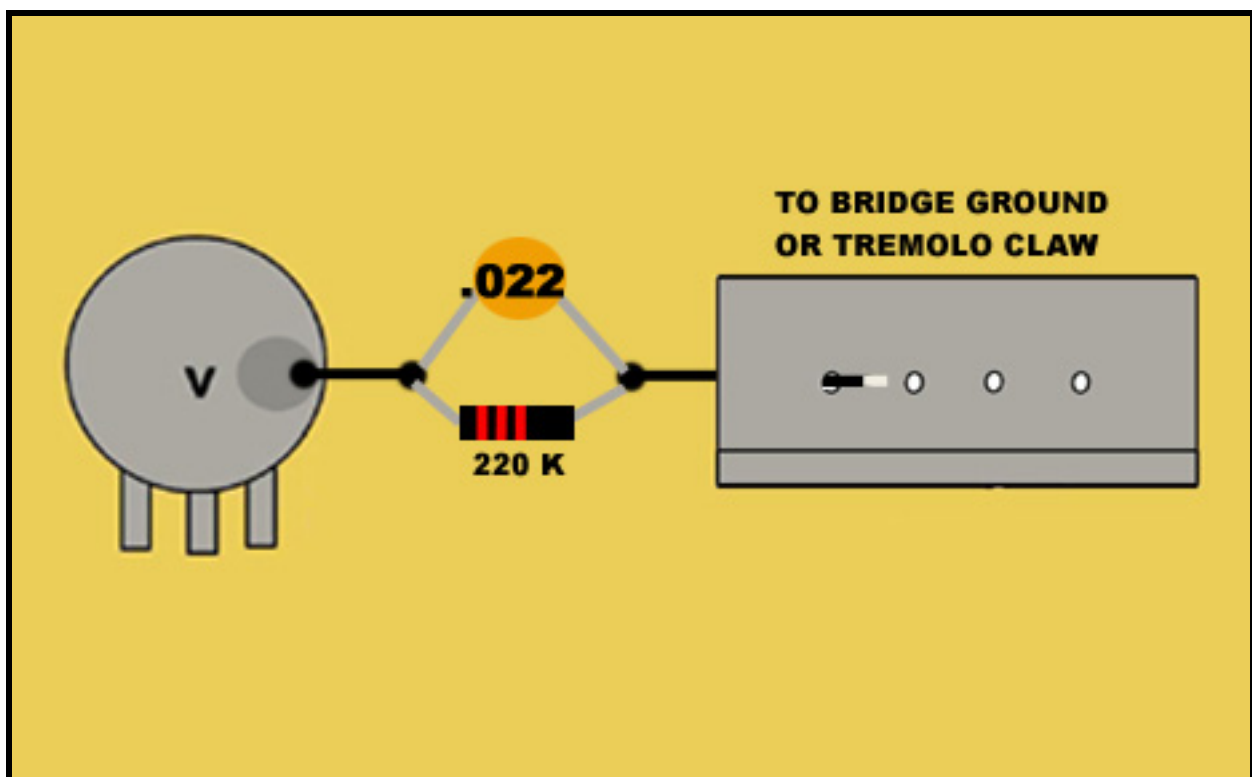




**Question: What is one way to prevent electrical shock?**

Often, getting shocked while playing guitar is the result of faulty wiring, not necessarily in your guitar, but in the outlets that your equipment is plugged into. Faulty wiring has been a problem at some clubs. It all depends on who does the wiring, and if they know what they are doing. One way to protect yourself is to get an AEMC Outlet Tester. It can detect faulty wiring in three-wire receptacles, open grounds & neutrals, and reversed hot/ground connections. You can get one at Amazon.com. You can also get a wireless system for your guitar to increase your protection.

Or you can add a .022 capacitor and a 220K Ohms resistor in between the bridge ground and volume pot case to reduce the DC current. Check out the diagram below.

**Question: What is the cheapest way to change the sound of my guitar?**

Change the pickup height. The closer the pickups are to the strings, the stronger the signal. The farther away they are, the weaker the signal. If your pickups are too close to the strings, they can sound too thick and distorted. Or you can just change the strings on your guitar. The thicker the strings will give you a warmer sound. Or change the potentiometers. Higher value pots like a 500K or 1 Meg will give you a brighter sound. Most strats currently use 250K pots. Last but not least, change the capacitor on your tone control. A stronger capacitor will give you a muddier sound with more bass.

**Question: What effect do magnets have on a pickup?**

Basically, the stronger the magnet, the stronger the pull is on the strings. The stronger magnetic field will slow down the string vibrations and give your pickups a warmer sound. Weaker magnets will pull less, and give you a brighter sound. To test this out, raise your neck pickup so it almost touches the strings. Notice how the sound is muddier than usual?

**Question: What is impedance?**

Impedance is the resistance in a circuit, and can affect the tone qualities of a guitar pickup. Adding more resistance in a circuit will cause a boost in volume, midrange, and bass levels. This is why humbuckers, which are wired in series, have a fat, powerful sound.

**Question: What is an active pickup?**

It is a pickup that has its own preamp to boost the gain and volume, while reducing unwanted noise. Emg 85 pickups, which are played by the heavy metal band Metallica, are a good example of some popular active pickups. Active pickups also have their own power source, like a 9 volt battery.

**Question: What type of wire is used in guitar electronics?**

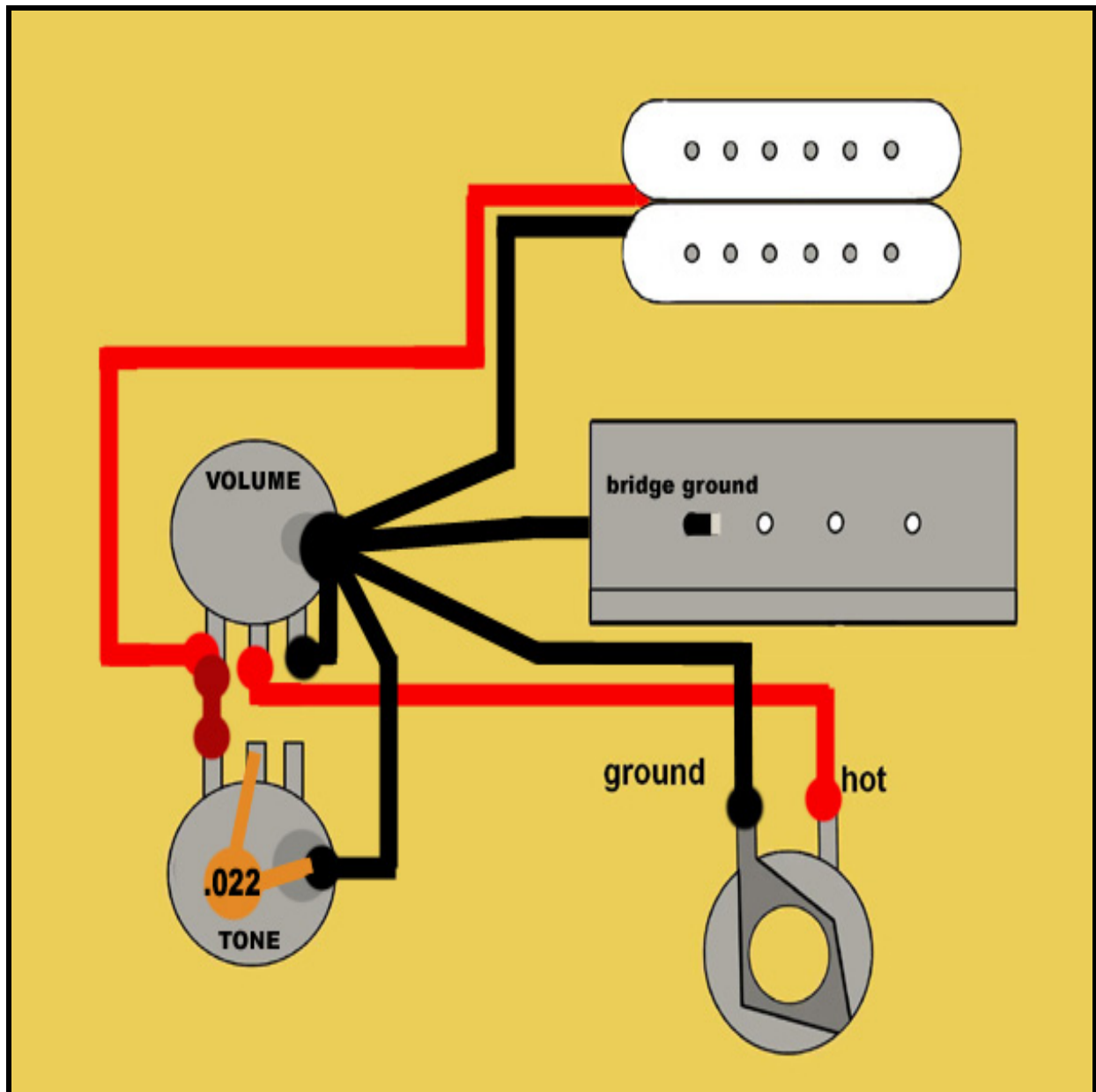
Most guitars use a 22 AWG wire with a braided, or teflon shield.

**Question: Why does a telecaster have such a bright, twangy sound compared to a strat?**

There are many reasons, but some of the main ones revolve around the electronics and the body. The tele guitar body is pretty solid. The strat body has more open space in the body cavity, which changes the sound. The telecaster also uses a copper plated steel bridge, which helps to increase the strength of the bridge pickup's magnetic field. This gives the tele a bright, twangy sound. Plus, the tele neck pickup uses 43 AWG copper wire, which has a smaller diameter than the 42 AWG wire that is found in a strat's pickups.

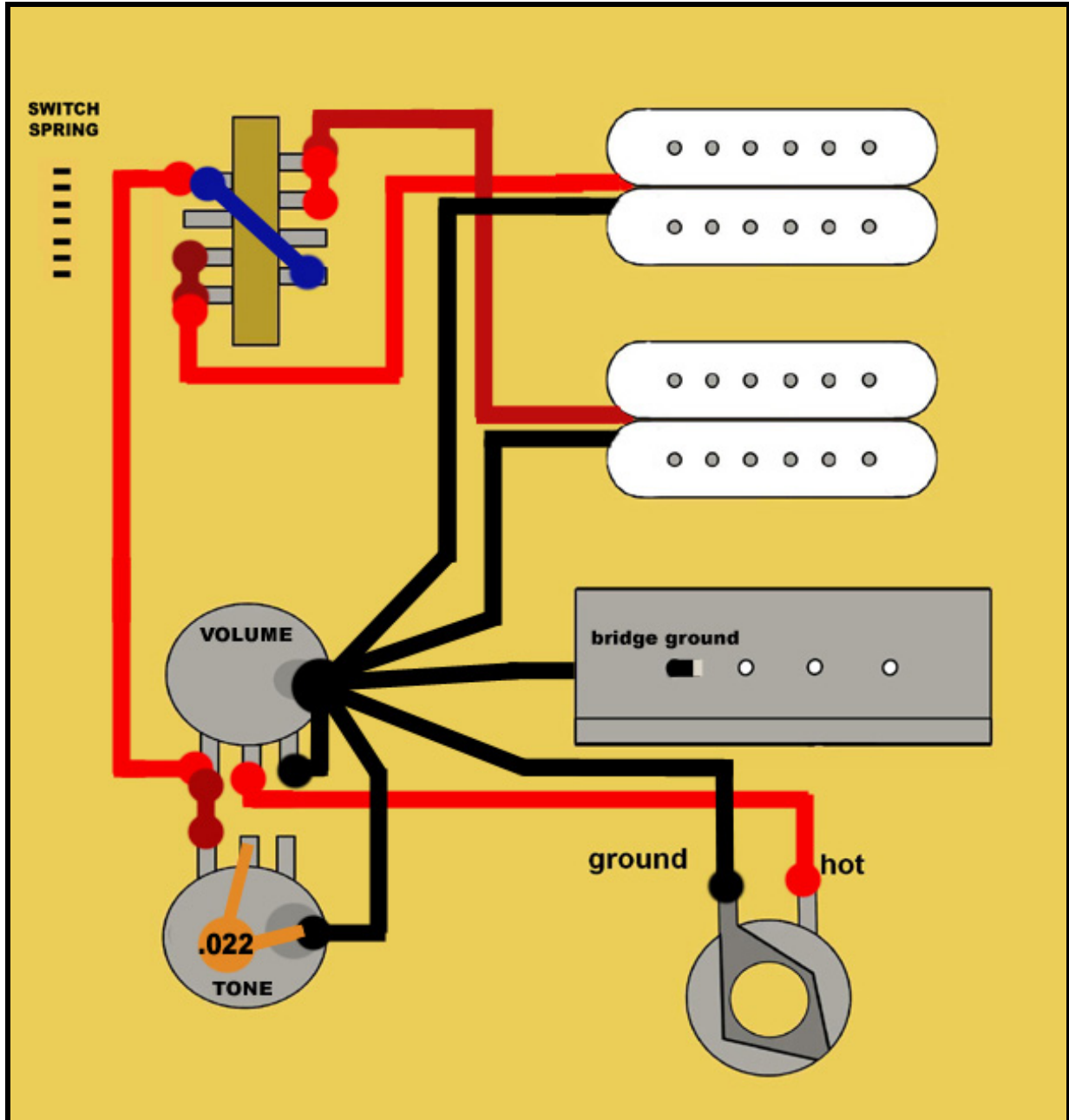
**Question: How do you wire guitar that has only one humbucking pickup?**

Below is a basic wiring diagram using one humbucker. You can use this with either the bridge or neck pickup. The pickup will have a volume and tone control. You can get plenty of good sounds out of this setup. If you want to play around with the tone, you can use a stronger or weaker capacitor. Adding a stronger capacitor sends more treble to the ground, and gives you more bass tones.

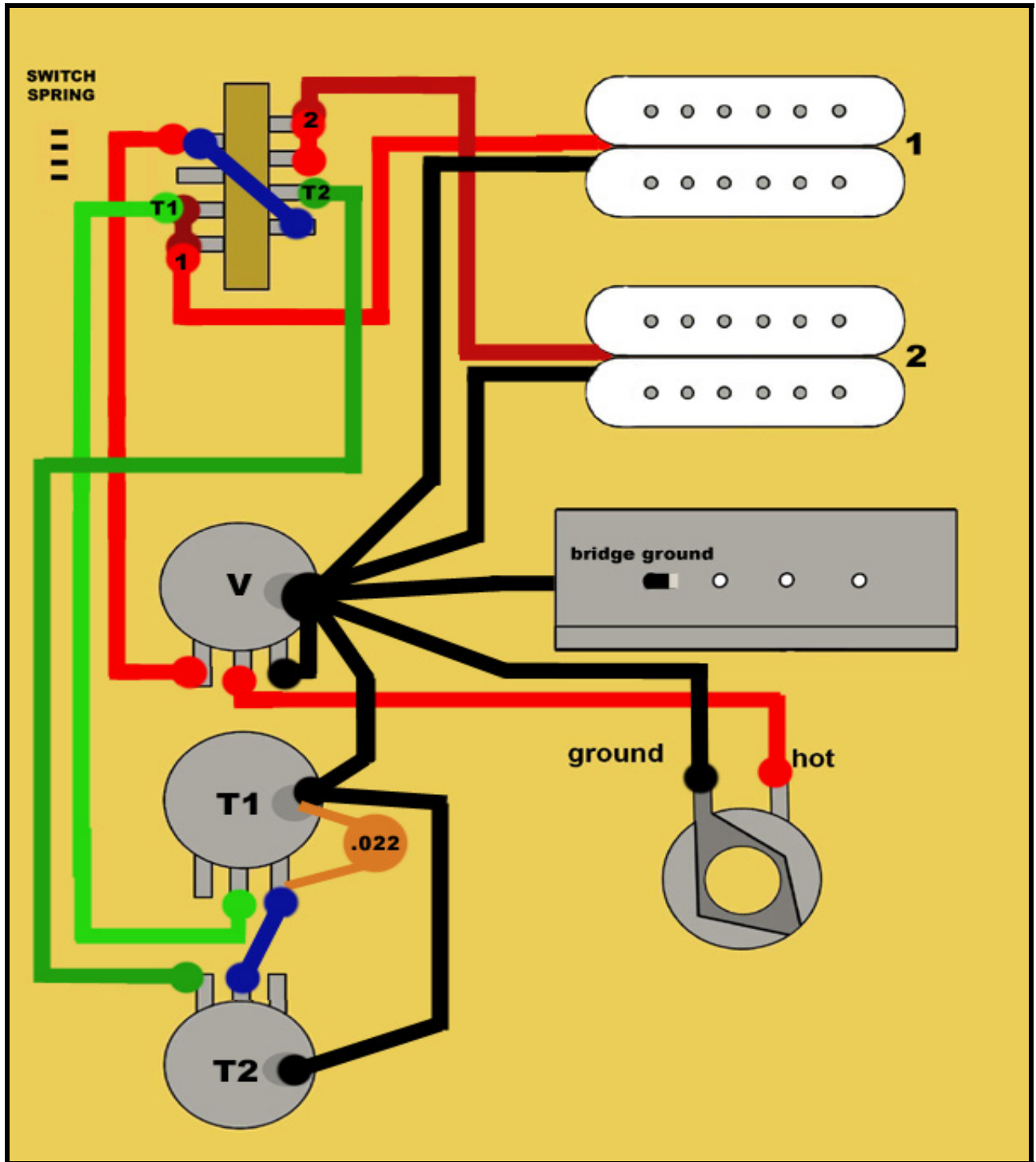


**Question: How do you wire a guitar that has two 2-wire humbuckers?**

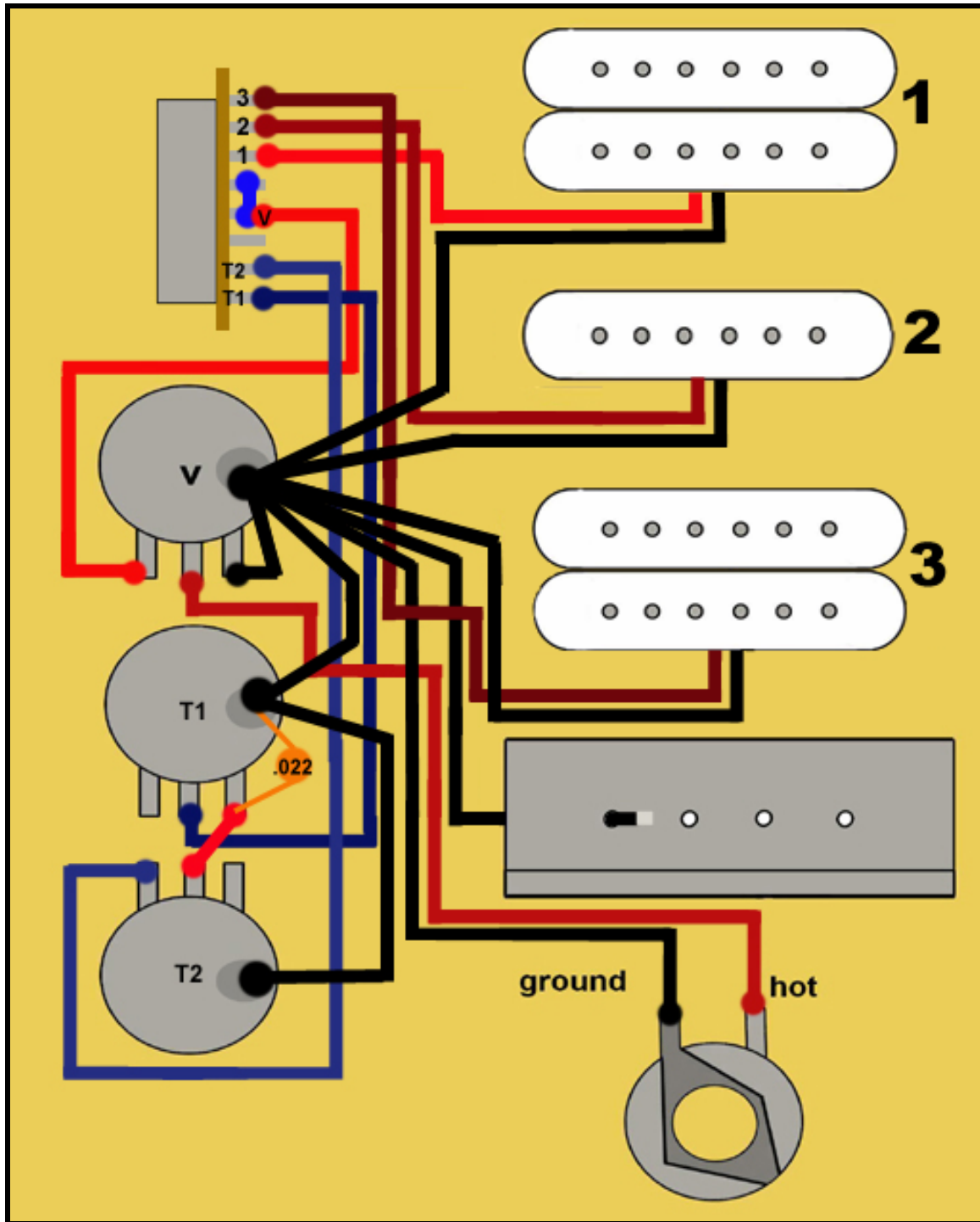
Here is an example using a 3-way switch and a master volume and master tone control. You can turn on either the neck pickup, both pickups, or the bridge pickup.



If you wanted a separate tone control for each pickup, then it would look like this.



If you have a humbucker, single coil, humbucker setup, then the wiring would look like this. It is basically the same as a Stratocaster with an import switch. If the humbuckers are 4-wire conductors, then just add coil cut switches to them.



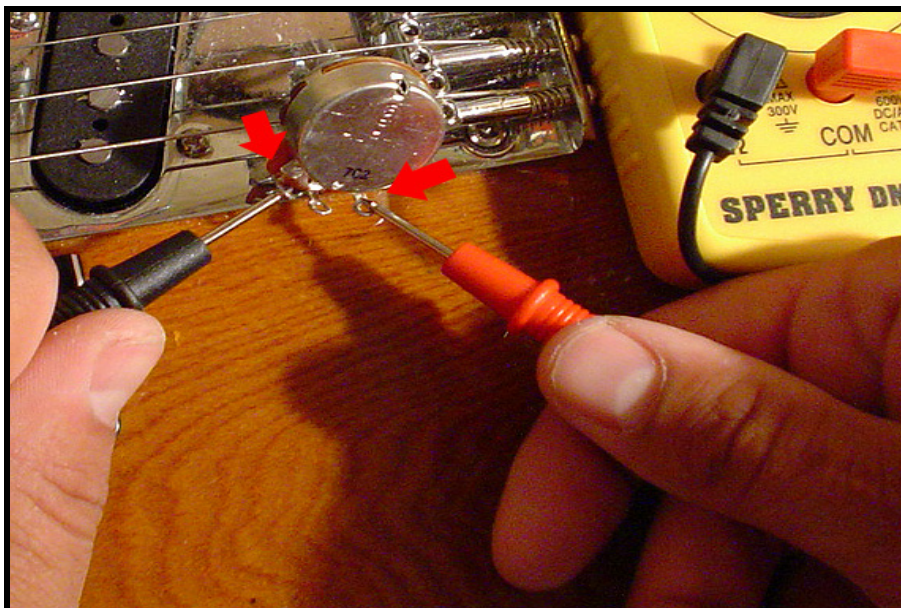
**Question: How do you use a multimeter?**

Multimeters can be used to check the resistance of pickups, potentiometers, leads, and speakers. If you need to know how "hot" a pickup is, then just connect each multimeter lead to the hot and ground pickup wire, and take a reading. Make sure the multimeter is set to the 20K Ohms setting. The pickup shown below came in at around 5.76K Ohms. If you don't get a reading, then the pickup needs repair. Hot pickups are usually 10-15K Ohms. The hotter a pickup is, the more volume, bass, and midrange it will have. Lower impedance pickups will have a broader range, and more sparkle, but a lower volume.





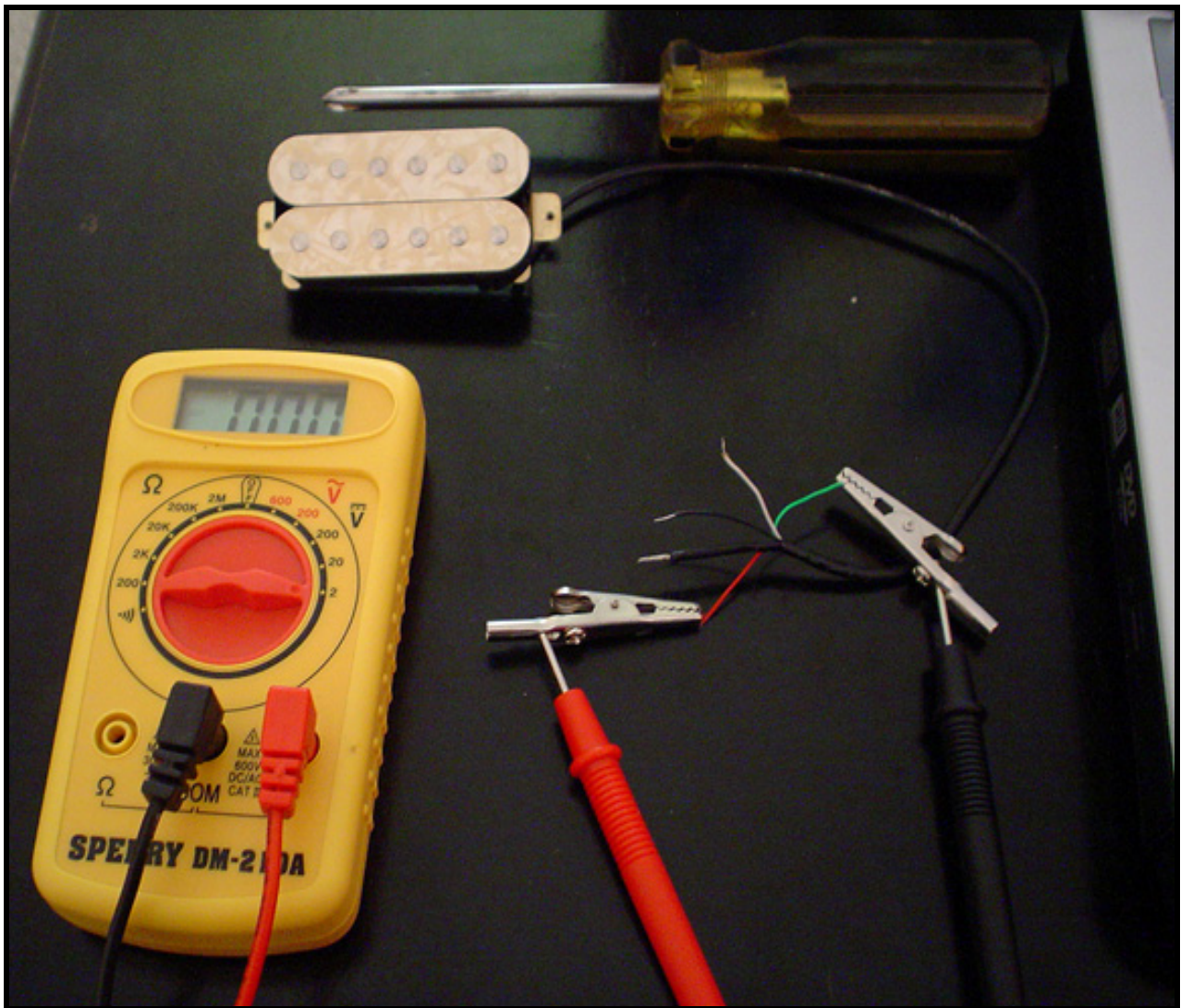
Is your tone or volume pot working? Check it out by placing a multimeter lead on the two end lugs. If you have a 250K pot, then you can expect a reading around 230K - 260K.





**Question: How do you figure out the color codes on a 4-wire pickup?**

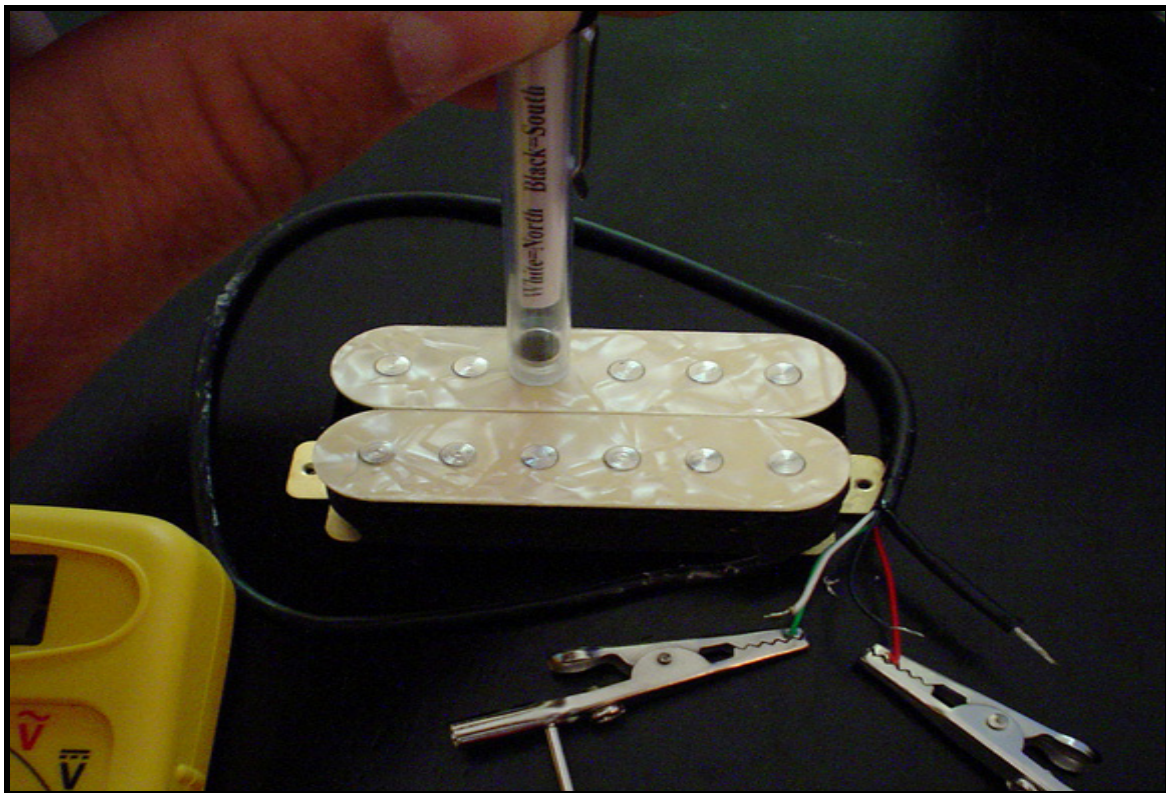
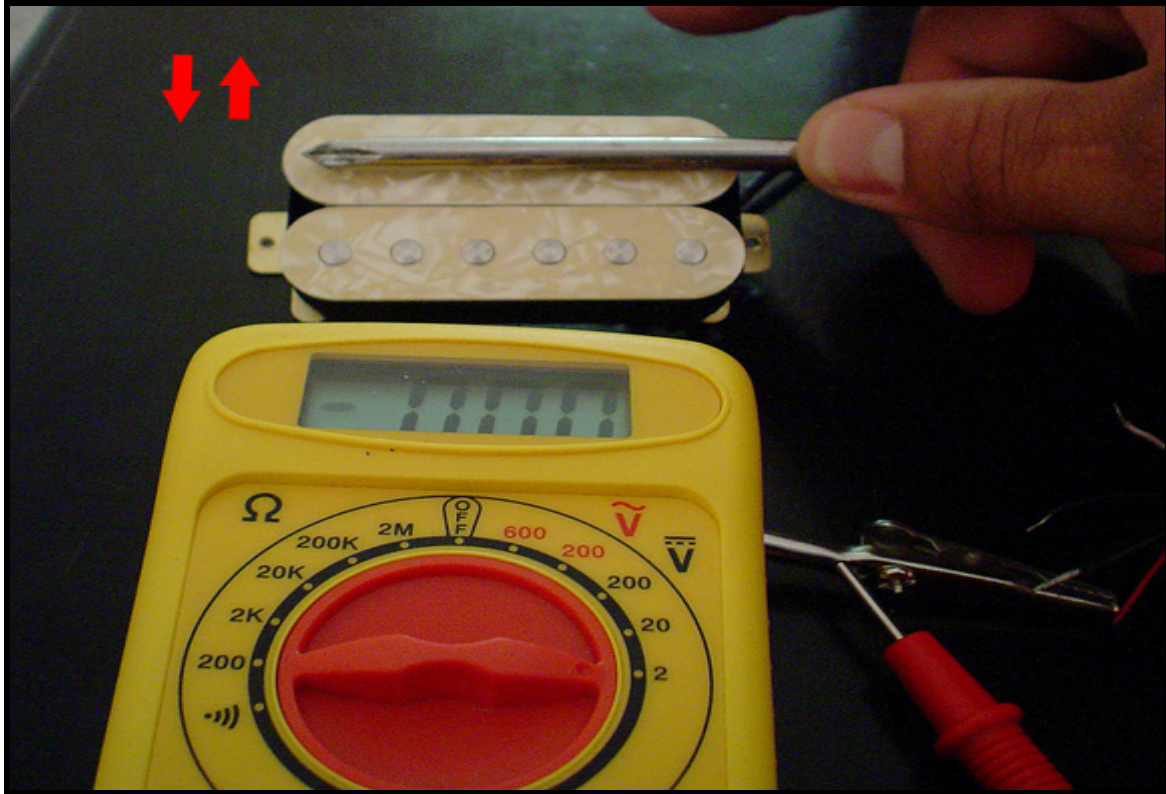
You can use a multimeter to figure out which pickup wires belong to which coil. Switch the multimeter to the 20K Ohms setting. This will give you a reading up to 20,000 Ohms. Pick out one of the 4 shielded pickup wires, and then touch it to the red multimeter lead. Now touch the black multimeter lead to every other remaining wire. Out of those remaining wires, only one wire will give a reading on the multimeter. The two wires that give a reading belong to the same coil. The two wires that are left will also give a reading, and will belong to the other coil. The 5th bare wire always goes to ground. After doing this, I have determined that the black and white wires belong to one coil, and the green and red wires belong to the other coil.

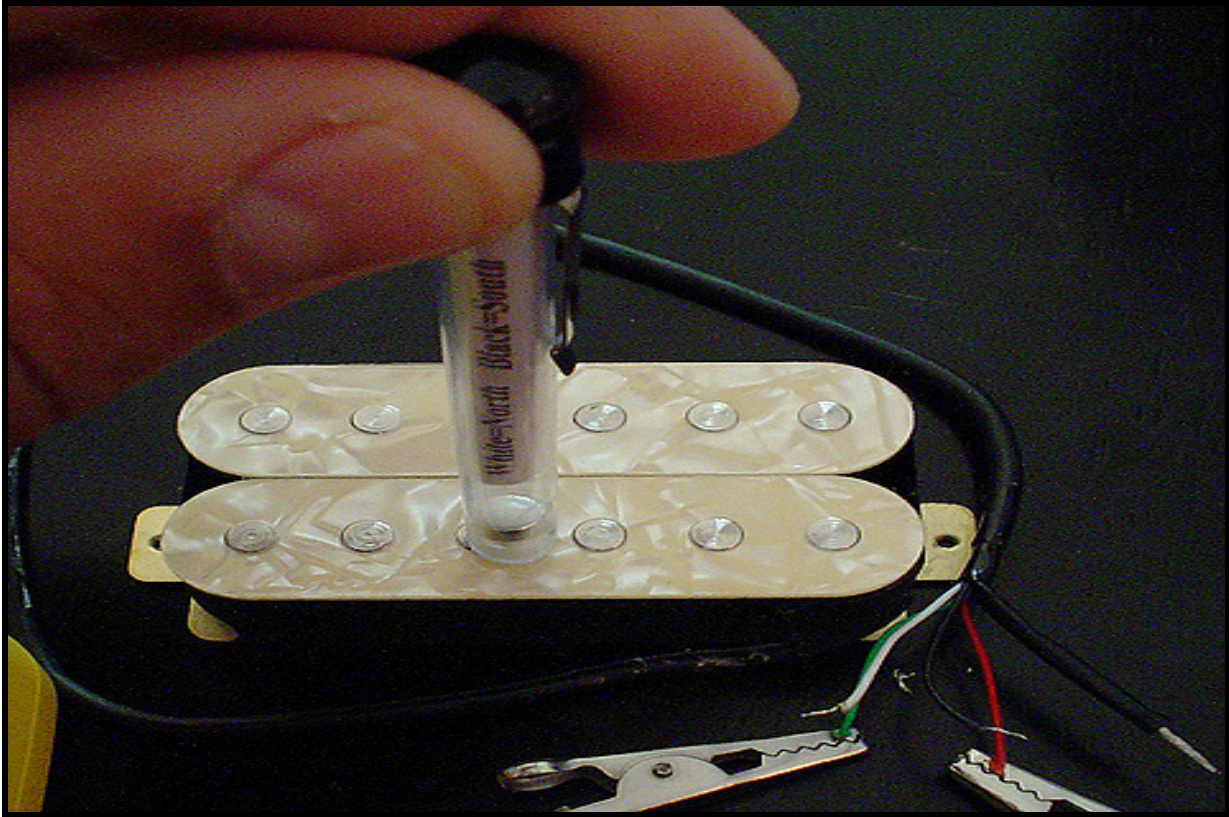


Now set your multimeter to the 2 Volts setting, and also switch the multimeter leads to the Volts input. Connect the leads to the wires which belong to the same coil. In the case below, I connected the white and black wires. The red multimeter lead was connected to the black wire, and the black multimeter lead was connected to the white wire. Now take a screwdriver and tap the poles on one of the pickup coils. Now remove the screwdriver. Notice how the reading on the multimeter goes positive, and then negative, or negative and then positive, and then back to zero? We are looking for the multimeter to give a positive reading first when the screwdriver touches the poles, and then a negative reading when it gets pulled away from the poles. This tells us the wires are in phase on that particular coil. If you are getting a negative first reading, switch the multimeter leads around. I connected the red multimeter lead to the black wire, and the black multimeter lead to the white wire. When the screwdriver taps the coil, it gives a positive reading first, and then a negative reading. So the black wire, which is connected to the red multimeter lead, is the start wire, and when the humbucker is installed in the guitar, this black wire will connect to the positive, or hot lead. Next, let's figure out which coil these wires go to. Do the screwdriver test on the top coil, and then on the bottom coil. You will notice that one coil always gives a stronger reading than the other coil. In this case, it is the top coil. It gets a reading up to .099 before going negative. The bottom coil only goes up to .014, so we now know that the black and white wires belong to the top coil. The black wire will be called the start, and the white wire will be the finish.

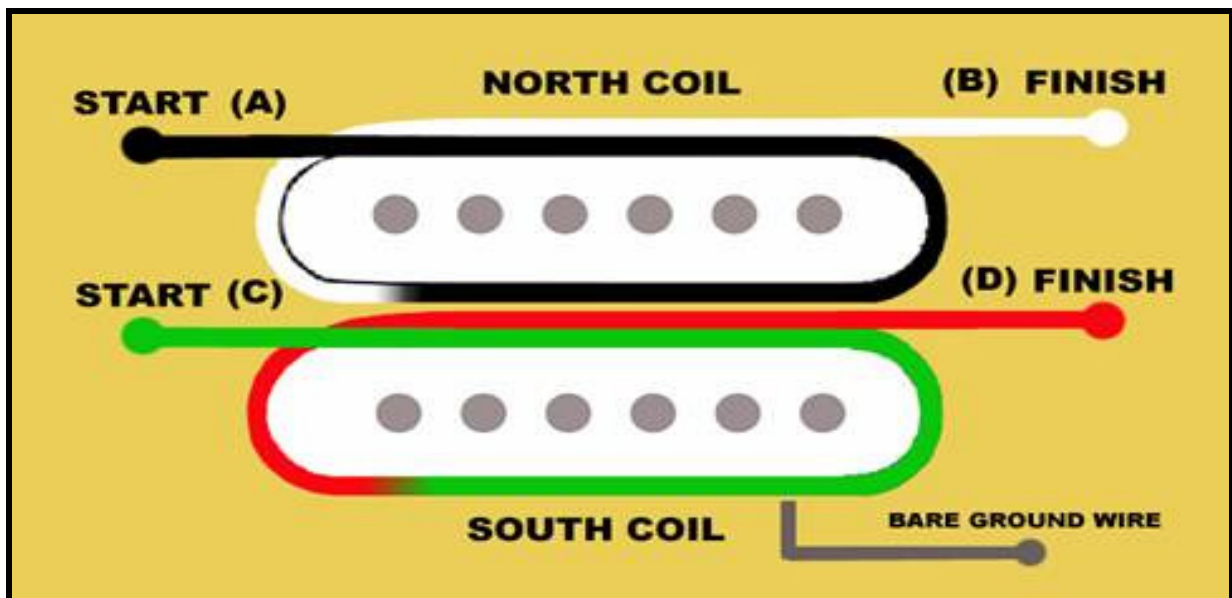
Next, you need to determine if the coil has a north or south polarity. This can easily be done with a magnet polarity tester from [stewmac.com](http://stewmac.com). They cost around \$6. Just touch it to each pickup coil to determine the polarity. In this case, the top coil's polarity is north.

Let's move on to the next set of wires. We are now looking for a negative reading first, because one of the coils on a humbucker has a reverse polarity. I get a negative first reading when I connect the red multimeter lead to the green pickup wire, and the black multimeter lead to the red pickup wire. So the green wire will be the start, and the red wire will be the finish. The bottom coil also gives a stronger reading (up to .135) than the top coil (up to .016), so these wires belong to the bottom coil. Now check the polarity. The polarity tester shows a south polarity. Coil one and two are now done. To summarize, this technique will determine which wires belong to what coil, and which wires are opposing one another. For example, if the black wire is the start of one coil, then the red wire will be the finish of the other coil. Likewise, if the green wire is the start of one coil, then the white wire will be the finish of the other coil.





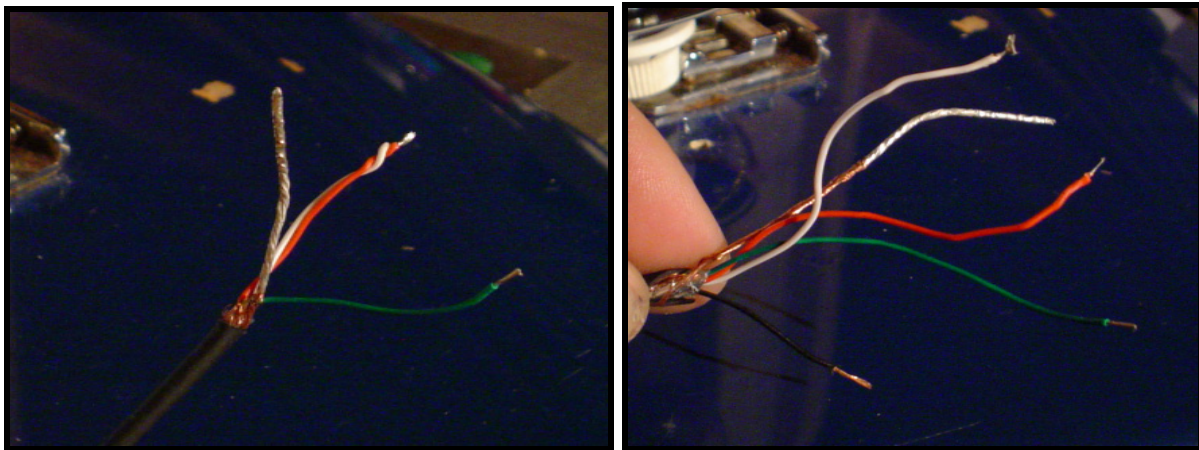
Here is the wiring diagram for this pickup. This pickup uses the same color codes as Seymour Duncan pickups.



**Question: What if I already know what the series link is?**

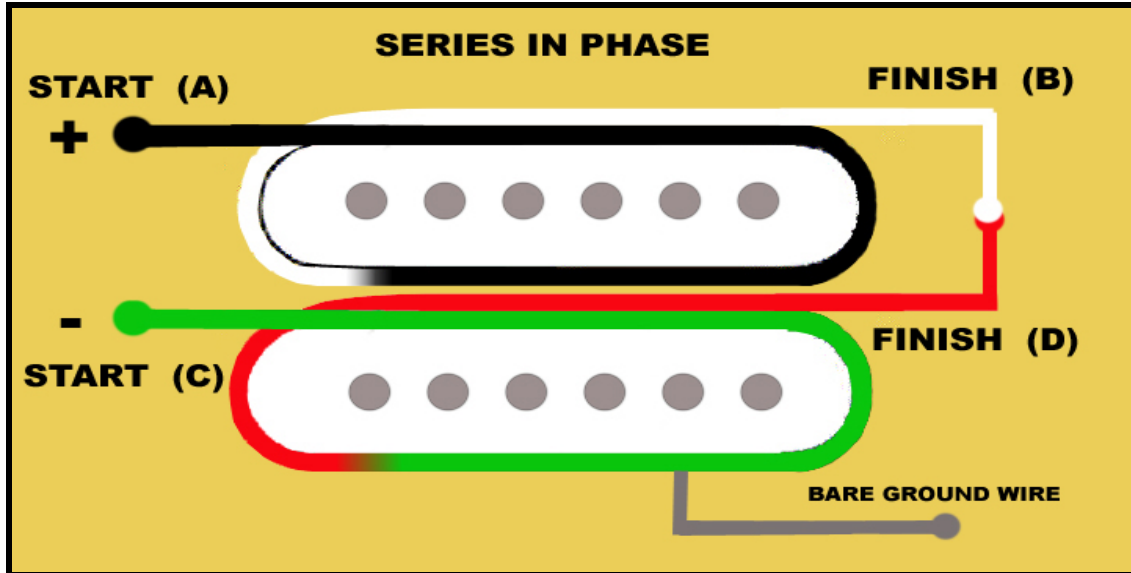
If you purchase an unknown humbucker, and two of the wires are soldered and taped together, then they are the two finish wires that form the series link. This will save you the trouble of trying to figure out which wires belongs to what coil. If you know what the series link is, then you only have two options to chose from. Basically, you need to know which is the hot lead and which is the ground lead.

It does not matter which wire is the hot or ground when only one pickup is on, since the pickup will always be in phase with itself. But when another pickup is on, and the sound is out of phase, then you will need to change the hot and ground leads around. If that does not work, you need to take the pickup apart and flip the magnet over. Below is a pickup that I purchased online. You can see the red and white wires are twisted together. Those are the series link. The black and bare ground wires are twisted together, too. Those go to ground. That leaves a hot green wire to send to the pickup selector switch. This pickup has the same color codes as a GFS Lil Killer pickup and also a Jackson pickup. I separated the wires in the picture on the right.

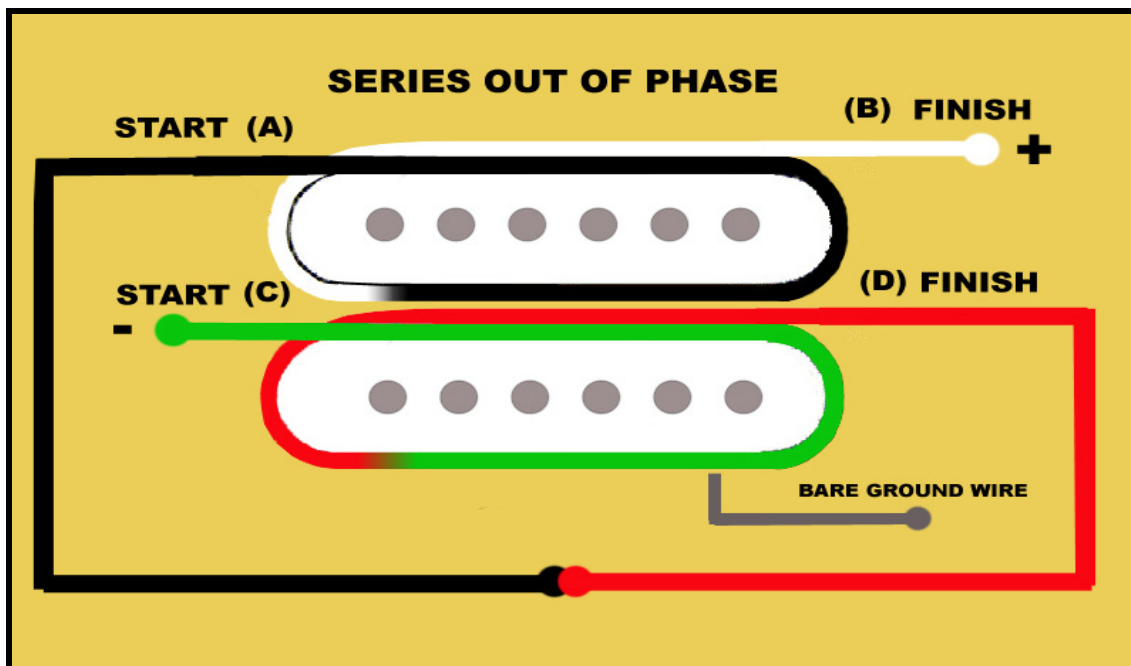
**Question: What are some wiring options for a humbucking pickup?**

I'm going to use the pickup I described earlier as an example (the same color codes as a Seymour Duncan pickup). The next diagram shows the series in phase wiring. The out of phase wiring cancels the hum, and the series link adds a low/midrange boost. There is quite a bit of confusion out there regarding in and out of phase humbucking pickups. While each pickup coil is wired out of phase, the signal is actually put back in phase. The out of phase 60 HZ signal ends up getting cancelled out. And only the in phase signal gets recorded by the magnetic pickups. This is due to the reverse polarity in each coil. To make things less confusing, we will refer to humbuckers as being wired in series and in phase. The white and red wires form the series link. The series link is formed by soldering a positive wire from one coil to the negative wire on another coil. (Wire B is negative and wire D is positive). Often, when you buy a new set of 4-wire humbuckers, two of the wires will be twisted together. Those are usually the negative and positive wires that form the

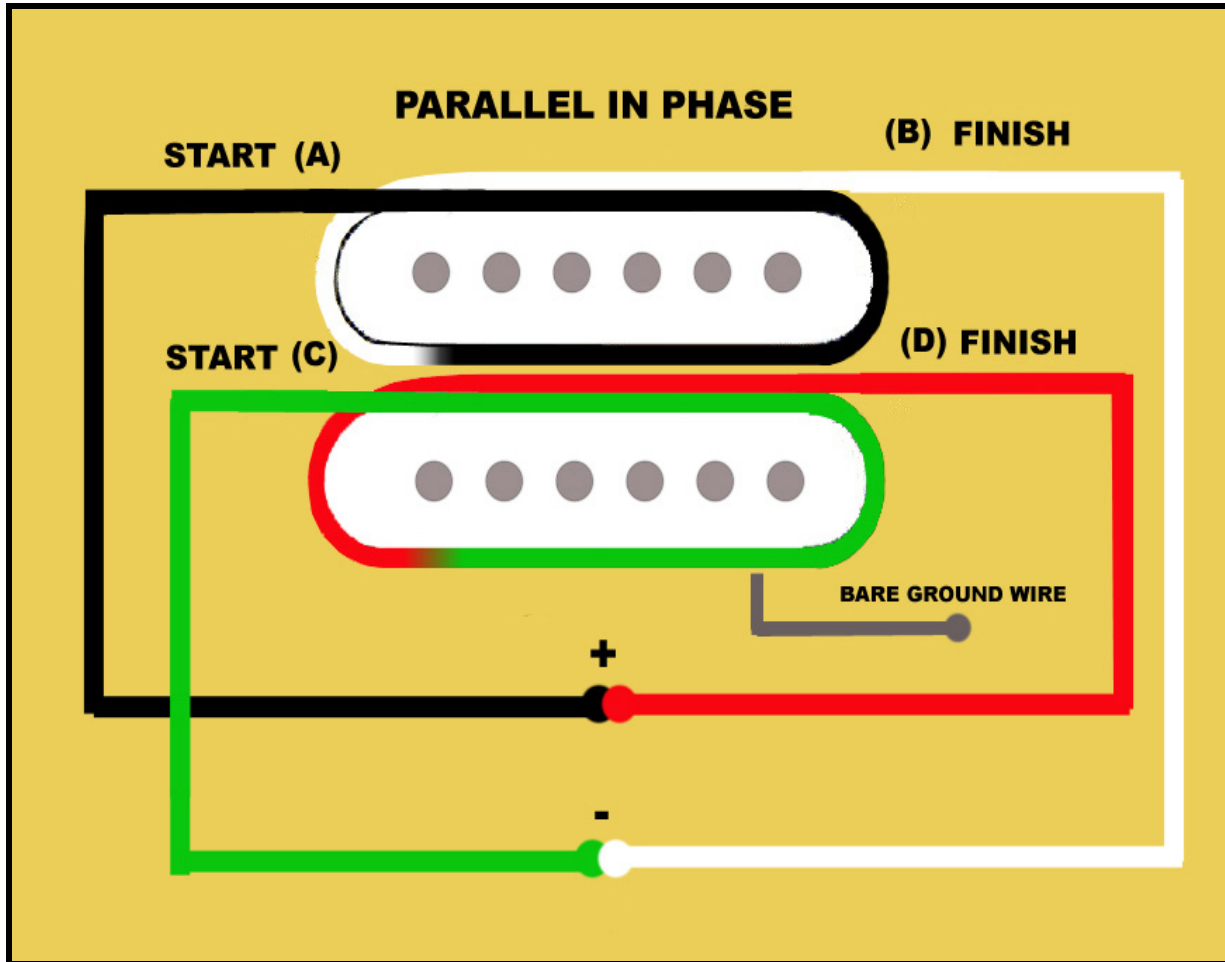
series link. The next diagram shows a typical humbucker, wired in series and in phase. It produces a fat sound with a lot of volume.



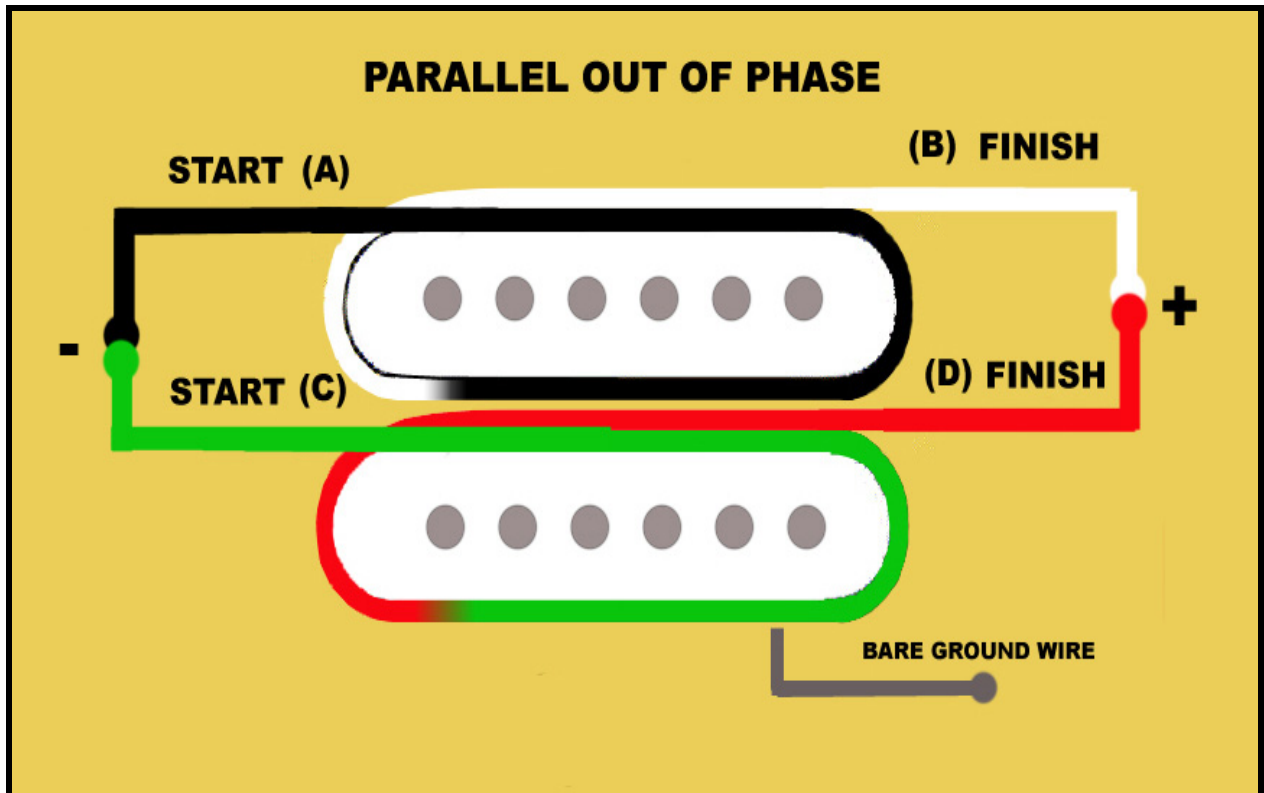
The series out of phase sound is weaker and not hum cancelling. It has more treble tones. This is a popular choice for funk music.



The parallel in phase sound is still humbucking, but with the tone qualities of a single coil pickup. It has more treble than the series in phase sound. If the middle pickup on your current guitar is reverse wound/reverse polarity, then it will yield the parallel in phase sound when the neck and middle, or the middle and bridge pickups are on. The parallel in phase sound is a popular way to wire a strat, especially if you prefer the range of a single coil pickup, but want the hum cancellation.



The parallel out of phase sound is not humbucking and is very weak and thin, sounding almost like an acoustic guitar. This type of wiring can cause 60 cycle hum, or unwanted noise.



Type these addresses in your web browser to hear these pickup wiring options.

**SERIES IN PHASE:** <http://tinyurl.com/25OSQM>

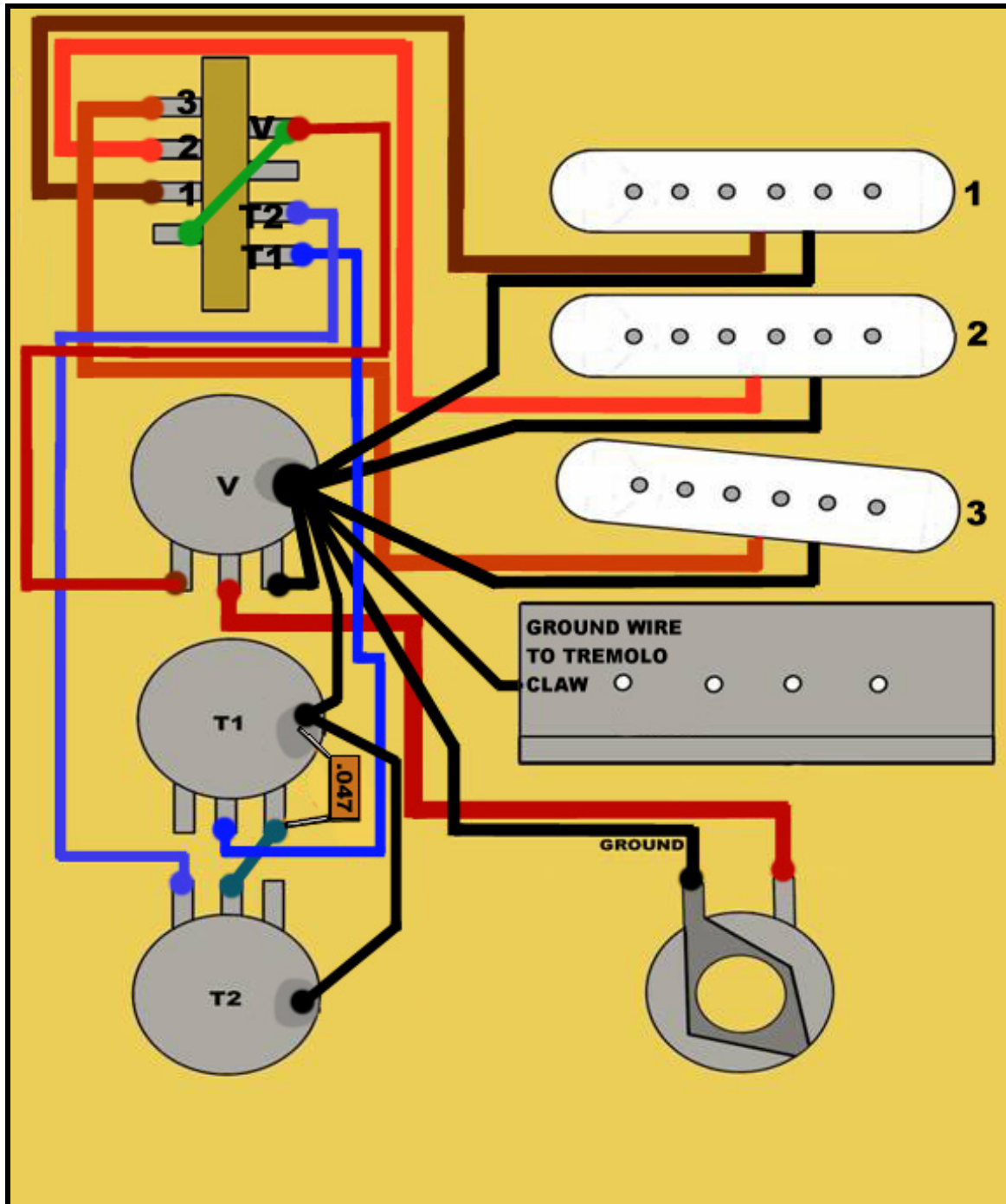
**SERIES OUT OF PHASE:** <http://tinyurl.com/3Y7GHV>

**PARALLEL IN PHASE:** <http://tinyurl.com/3YZYWG>

**PARALLEL OUT OF PHASE:** <http://tinyurl.com/2EDOXM>



**Question: How were the early 1950's stratocasters wired?** If you were trying to replicate the early strats, then you would use Astrons, or Cornell-Dubilier capacitors, 22 gauge cloth wiring, 250K audio taper pots by Stackpole, and a Fender style CRL 1452 3-way switch.



**Question: Where can I get good guitar parts and information?** Here are some great places to find guitar bodies, necks, switches, pots, wires, pickups, and more.

<http://www.smallbearelec.com/home.html> Tons of parts, and cheap prices, too.

<http://www.stewmac.com/> They have pretty much everything for the beginner to advanced luthier.

<http://www.wdmusic.com/> Tons of stuff, even economy parts.

<http://store.guitarfetish.com/> A great source for 4-wire humbuckers, mini humbuckers for strats, preamps you can add inside your guitar, and pretty much everything else you can think of, even electric guitars.

<http://www.guitarpartsusa.com/> The name says it all. They have everything, even screws and pickup winding parts.

<http://www.allparts.com/> Plenty of Fender factory parts and even concentric pots.

<http://www.internationalluthiers.com/electricparts.php> They have some good prices on switches and pickups.

<http://www.warmoth.com/> High quality bodies and necks.

<http://stores.ebay.com/Luxe-Guitars> Incredible vintage style capacitors. They sound amazing.

<http://stores.ebay.com/Classic-Clones-Amplification> They have the vintage style cloth wiring. I love this stuff.

<http://stores.ebay.com/musicpartsplus111> Plenty of parts, potentiometers, switches, knobs, etc.

<http://stores.ebay.com/MMTG-Enterprises> MMTG has tons of parts.

<http://stores.ebay.com/MetalShopMusic-Guitars-Parts-Amps> Amazing necks and bodies, and they also have plenty of parts.

<http://pickguardian.com/> Great source for custom pickguards to fit your favorite pickups. They also have plastic control plates for telecaster guitars.

<http://stores.ebay.com/Jamerson-Guitars> A good source for necks and bodies

<http://www.noahjames.com/books.html> Great book on building guitars and basses from scratch.

[www.stanhinesleypickups.com](http://www.stanhinesleypickups.com) Great sounding hand wound pickups for your strat.

<http://www.paintyourownguitar.com/> Everything you need to know about painting a guitar body.

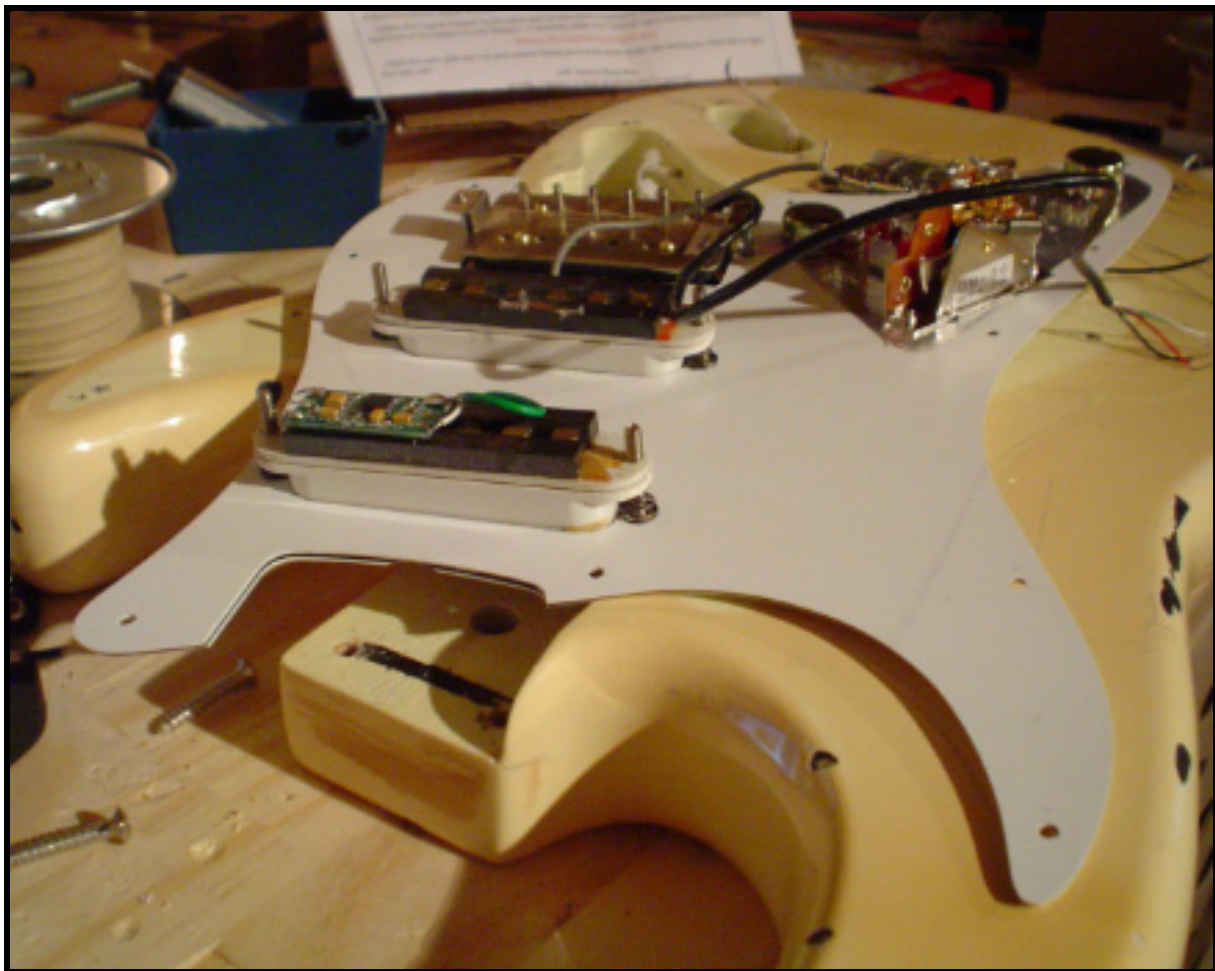
<http://guitartone.net/> Modify your existing pedals, and turn them into boutique pedals.

<http://www.langcaster.com> Great sounding low impedance pickups by Joh Lang.

<http://wamplerpedals.com/> Some great boutique pedals by gear geek, Brian Wampler.

<http://buildyourownclone.com> Build your own boutique pedals with these kits.

<http://www.stratcollector.com/> Learn all about vintage strats.



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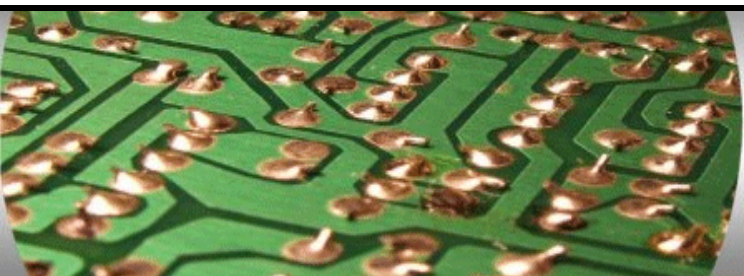
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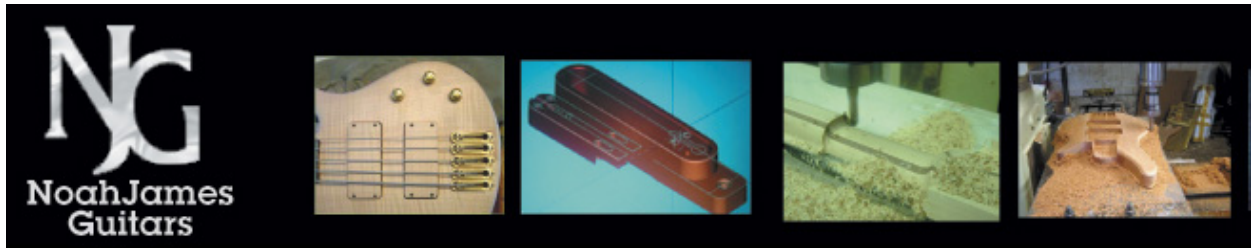
*Langcaster*



*Strat Collector* Buy, Sell, and Learn about collectible Fender Stratocasters

**GuitarTone.net**





**GuuitarFetish**  
.COM



**WORST GUITAR**  
THE GOOD, THE BAD, THE GUITAR  
.COM



**Question: Where can I get hand wound strat pickups?** There is nothing quite like the tone of a hand scatter wound pickup. You just can't reproduce that type of sound with a machine made pickup, no matter how much it cost to make. Stan Hinesley has been doing just this for years. All hand wound in the USA by Stan himself. Here is the Texas LaGrange pickup. It has a smooth Texas blues tone. The LaGrange Set features staggered hand bevelled Alnico 5 magnets. The middle pickup is reverse wound/reverse polarity for hum cancelling in positions 2 and 4. Check out [www.stanhinesleypickups.com](http://www.stanhinesleypickups.com) for more info.



**Question: What are some popular pedals among strat players?** If you play a strat, odds are you have at least one of these pedals in your arsenal: the Boss DS-1 distortion because your amp's distortion just doesn't cut it, the Ibanez TS-9 Tubescreamer if you are into the SRV overdrive, or the Dunlop Fuzz Face for some 1969 Hendrix distortion. Besides that, I would say a good delay pedal is essential. That can make any guitar sound better.

**Question: What are some good low impedance pickups for the strat?** Try a set of Lancaster low impedance pickups. A Low resistance of +/- 100 Ohms means the widest frequency range without the hum. These pickups are loud and clean and you can play them in any Amp or PA. There have 8x magnets in the neck pickup, so no loss of tone when bending the strings. They also have a built in overdrive that gives a sweeter sound than most of the drives available in amps or pedals. They have an earthed copper laminate bobbin. And for better shielding, Lancaster plates them with chrome, and seals them in wax, leaving you with an incredible set of pickups.



**Want a low impedance humbucker?** Lancaster has come up with the answer, a humbucking pickup called the Ultimate Lo. The Ultimate Lo uses a much heavier gauge of wire with only a tenth of the number of turns. This makes the inductance 100th that of a conventional pickup. Self-resonance is as high as 56 KHz - way beyond the range of human hearing. The resistance is a mere 120 ohms because of fewer turns and thicker wire. Guitarists immediately react with favor upon hearing their first chord played on the Ultimate Lo®.

The preamp is designed with discrete transistors, so that an extremely low current is drawn from the battery. Long battery life is assured, so that the battery lasts almost as long as its shelf life. No compromise has been made in the output capability, either. The buffer stage has a capability of driving the volume pot to 2.5 Volts RMS, which is hardly ever likely to be required in normal playing. All Lancaster pickups are wax sealed and use a copper/chrome plated pickup cover. There is no loss of power caused by this cover, which happens often with high impedance pickups.

How can Lancaster use a pickup with so few turns? We have seen active pickup preamplifiers powered by 9 Volt batteries for many years now. Lancaster developed their own low noise preamplifier, matching the pickups to the guitar amplifier, and eliminating impedance from even the longest guitar cable. By designing a tone control that works independently of pickup parameters, a consistent and smooth working range can be obtained. Loading and resonance can be selected and controlled to achieve a response that is just stunning.

**More about the Joh Lang.** Joh from Lancaster is an innovator, and inventor. So he knew the drawbacks of high impedance pickups, even his own, having a signal and frequency loss because of the guitar cable and winding capacitance. He also noted that most guitarists used stomp boxes in order to obtain their overdrive sound. Last year Mr. Lang decided to develop a solution for both problems. Signal losses from guitar cables can be minimized with a low impedance buffer amplifier in the guitar. A transformer can

do this, too, but there are certain losses in transformers. So Lancaster started at the front end: the pickups. After countless experiments with magnets, wire gauges and techniques, Joh Lang created his Lancaster Ultimate Lo pickups and these are truly revolutionary.

Not only do they have a low resistance of around 100 Ohms, but they can also be made as a completely noiseless humbucking pickup in a single coil housing. Normal coil resistances are around 6,000 ohms. The inductance that those coils have is around 3 Henrys which is a very high impedance, getting higher as the frequency rises. The new pickups have less than a hundredth of the inductance of the high impedance pickups. This extends the range of response, and the self-resonance is in the supersonic range at over 56 KHz. The result is a pure clear, crisp and open sound, with no restriction or muddiness. The use of a 100 mt guitar cable with no loss in treble is no problem.

The next step was the development of an appropriate low noise preamplifier and a natural sounding overdrive circuit that would fit into the guitar cavity. After numerous, painstaking experiments, Joh Lang created an onboard overdrive, the Ultimate Drive, that is fully adjustable with the characteristics of a tube driven amp. This preamp was designed for a maximum dynamic range with an output capability of 2.5 Volts RMS and with a very low current consumption of only 450 microamps for long battery life. For example, a PROCELL Alkaline battery with a capacity of 580mAH should last at least 1000 hours of continuous playing time. The battery is only connected when a jack plug is inserted the output socket.

Lancaster also makes guitars out of 35,000 year old swamp Kauri. These are truly amazing. Check out [www.lancaster.com](http://www.lancaster.com) for more information.





**THIS GUITAR BELONGS TO THE GREAT JAN AKKERMAN.**

**Question: Can you explain the physics involved in pickup design and function?**

**INDUCTANCE:** Inductance 'L' has an impedance which rises with increased frequency ( $Z = 2 \pi f L$ ). This Z is called reactance in electronic terms. Guitar pickups wound in the conventional way may have an inductance of anywhere between 2.5 and 10 Henrys. High output pickups generally have a higher inductance, higher self-capacitance, and therefore a lower self-resonance.

**CAPACITANCE:** A capacitor 'C' has a reactance in the opposite way than an inductor; the impedance falls with increased frequency ( $Z = 1 \div 2 \pi f C$ ). The value of C is in Farads. The coil windings have self-capacitance because the windings are very close to each other. Inductors, being wound layer upon layer, have a winding capacitance which resonates with the inductance at a frequency determined by the formula:  $f_{res} = 1 \div 2\pi\sqrt{LC}$ .

**SELF-RESONANCE:** This self-capacitance of the windings resonates with the coil's inductance. This is known as the coil's self-resonance. In the case of a guitar pickup

coil, the self-capacitance can be anywhere between 50pF and 300pF (pF = picofarads = Farads x  $10^{-15}$ ). Added to this capacitance will be the capacitance of the guitar lead, which may add another 250 to 1000pF. For example, a pickup with an inductance of 8 Henrys, used with a guitar cable at 800pF, and a winding capacitance of 150pf will have a combined resonance of only 1.8 KHz (1,800 Hz). This is sure to sound Ok for some guitarists, but most would feel robbed of tonal quality. Turning up the treble control on the amplifier will do little to help, except increase the hiss.

**Q FACTOR:** High impedance pickups range in self-resonance between 2 KHz to 5 KHz with a loaded Q of 0.8 to 4.0 or more. Q is a quality factor which engineers use to express bandwidth and is calculated with the formula:  $Q = f_0 \div BW$  where BW is the bandwidth of resonance. It is the difference in frequency between the -3dB points of the resonant curve. The  $f_0$  represents the resonant frequency. The Q factor is decreased by the resistance loading the coil (the volume and tone pots), and by the series resistance of the coil itself. A high Q factor gives a peak in the response, which may be quite prominent. The peak may even be as high as +12dB. High peaks can be annoying, as they emphasise only a narrow range of the frequency spectrum, but can add character to a pickup.

**SUMMARY:** All this means that the standard high impedance pickup frequency response will be limited by the self-resonant frequency, which can be as low as 1500 Hz or possibly as high as 5000 Hz, and is affected by the guitar lead capacitance. After peaking at resonance, the output drops rapidly at -12dB / Octave. This is a limit well within the audible range, and well within the range where the quality of sound can be degraded. It is also in the range where the human ear is most sensitive. The self-resonance characterises what a pickup will sound like. Of course, the position of the pickup on the body also determines which harmonics are most prevalent. Higher order harmonics come from the bridge pickup because of the way a string vibrates. Conventional pickup coils are a compromise between output level and tone. There is a need for a pickup that eliminates these compromises, and builds on quality and tone. One that will eliminate the effect of capacitance of guitar leads. It would be good, too, if the pickup sounds clear and precise. It should not sound too muddy or weak. It should make music.

**Question: What are boutique pedals?** Boutique pedals are effects pedals made by small, independent companies like Red Witch, Keeley, Zvex, Fulltone, and Wampler. These pedals tend to sound better, and usually have higher quality parts. If you are looking for the perfect tone, and haven't found it yet with stock pedals, then you might want to give the boutique pedals a try. On the next page is the Brent Mason Overdrive and Distortion pedal by Wampler Pedals. This is the exact pedal that Brent uses. I haven't seen anything else like it. You can find these pedals at:

<http://wamplerpedals.com>

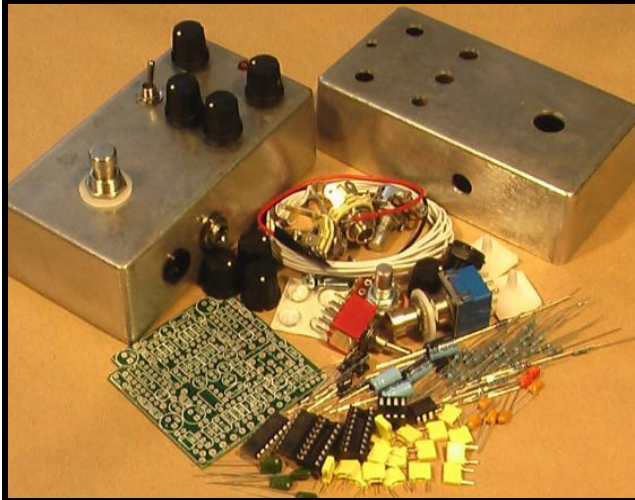


Type this address in your web browser to hear this pedal.

[HTTP://TINYURL.COM/3C7U52](http://tinyurl.com/3c7u52)

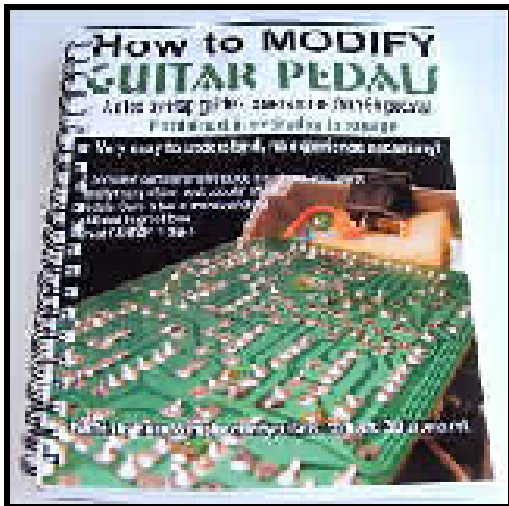
**Question: Can you make your own pedals?** You sure can. You can save some money by buying kits and doing all of the soldering yourself. Build Your Own Clone offers a full line of DIY guitar FX kits that are based on some of the most famous circuits ever, and use top shelf components to provide you with great sounding boutique quality effects. Check them out here.

<http://buildyourownclone.com>

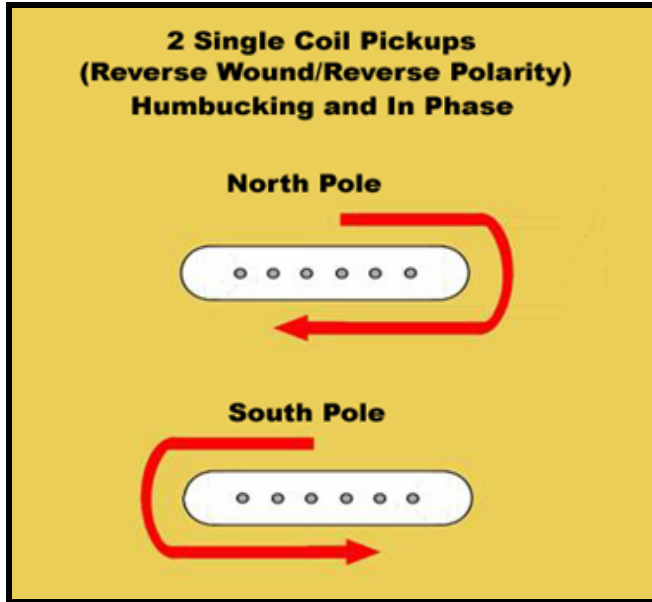


If you are interested in modifying your existing pedals, or even designing your own pedals, be sure to check out the Guitar Tone website. They have some great books that explain everything you've ever wanted to know about guitar effects pedals, and how to make them. Check it out here:

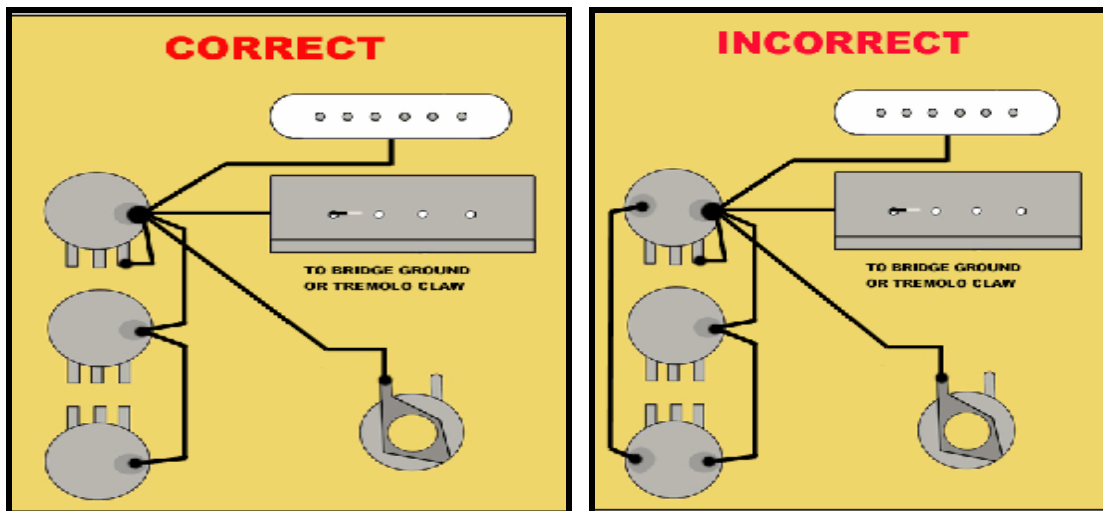
<http://guitartone.net/>



**Question: Why do some guitars have reverse wound pickups?** Many strat style guitars will have a middle pickup that is reverse wound with a reverse polarity. This actually creates a humbucking pickup when the neck and middle pickups are selected, or the middle and bridge pickups are selected. The reverse windings put the pickups out of phase, and the reverse polarity puts the signal back in phase, and eliminates hum. Here is a test. Take any two single coil pickups that are not wired yet, If their faces attract one other, then one of them is reverse wound/ reverse polarity.



**Question: What is a ground loop?** This occurs when you create more than one path to ground for a particular electronic device. Ground loops can cause unwanted AC hum. Notice in the diagram on the left that there is only one path to the output jack. In the diagram on the right, the bottom tone pot can take two paths to the output jack.



**Question: What type of soldering iron do you use?**

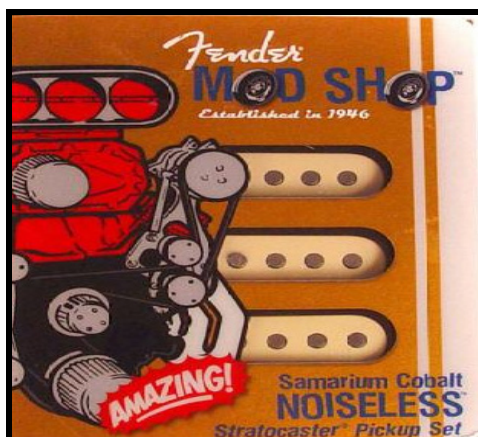
There is only one type of soldering iron that I like to use on my projects, a Weller. In my opinion, everything else is just second rate. I like to use the 100 to 350 watt gun handle versions that can heat up in a few seconds with the push of a button. The good news is

that you can find them on Ebay for around \$20. Type in "weller soldering iron" and see what comes up.



**Question: What is the Fender S-1 switch with the SCN pickups?**

It is similar to a push pull pot, but a little more complicated. This switch is available on some of the more expensive strats, and is not available for sale by itself at this time. So if you want an S-1 switch, you need to buy a strat. The Fender American Series HSS strat is a good example of a guitar with S-1 switching. The S-1 switching changes from parallel to series wiring, giving you some fat strat humbucking sounds. These guitars also come with the Samarium Cobalt Noiseless Pickups designed by Bill Lawrence, which are an improvement on the Fender Vintage Noiseless Pickups. The SCN pickups offer the traditional bell-like tone with the power and quietness of a humbucker. The bridge pickup is rated at 11.6 K Ohms, the middle at 6.5K Ohms, and the neck pickup at 6.5K Ohms. These pickups come with three wires. The white wire is hot, the black wire is ground, and the green wire is an independent ground.



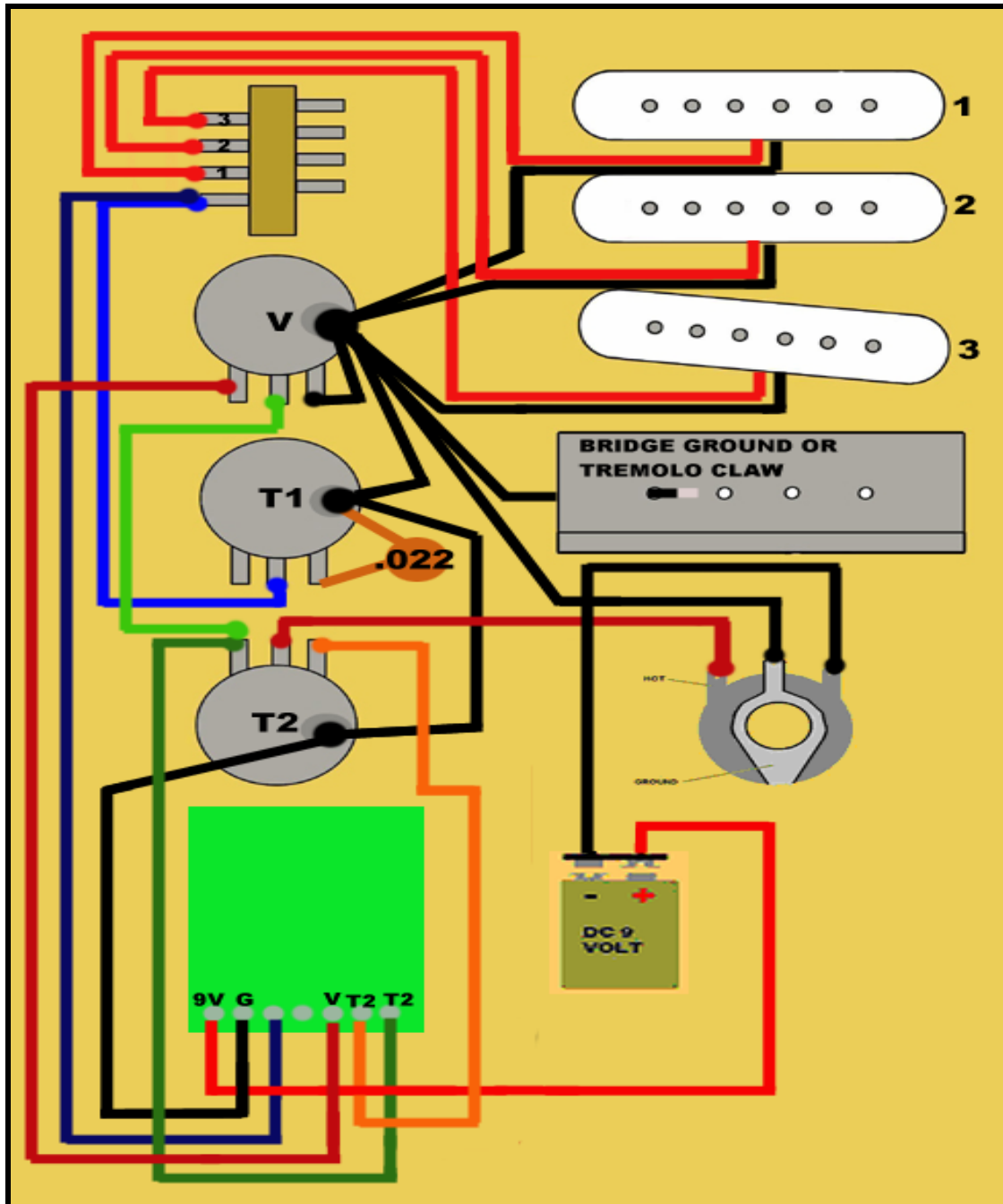
**Question: How do you get the Eric Clapton "woman tone" on a guitar?**

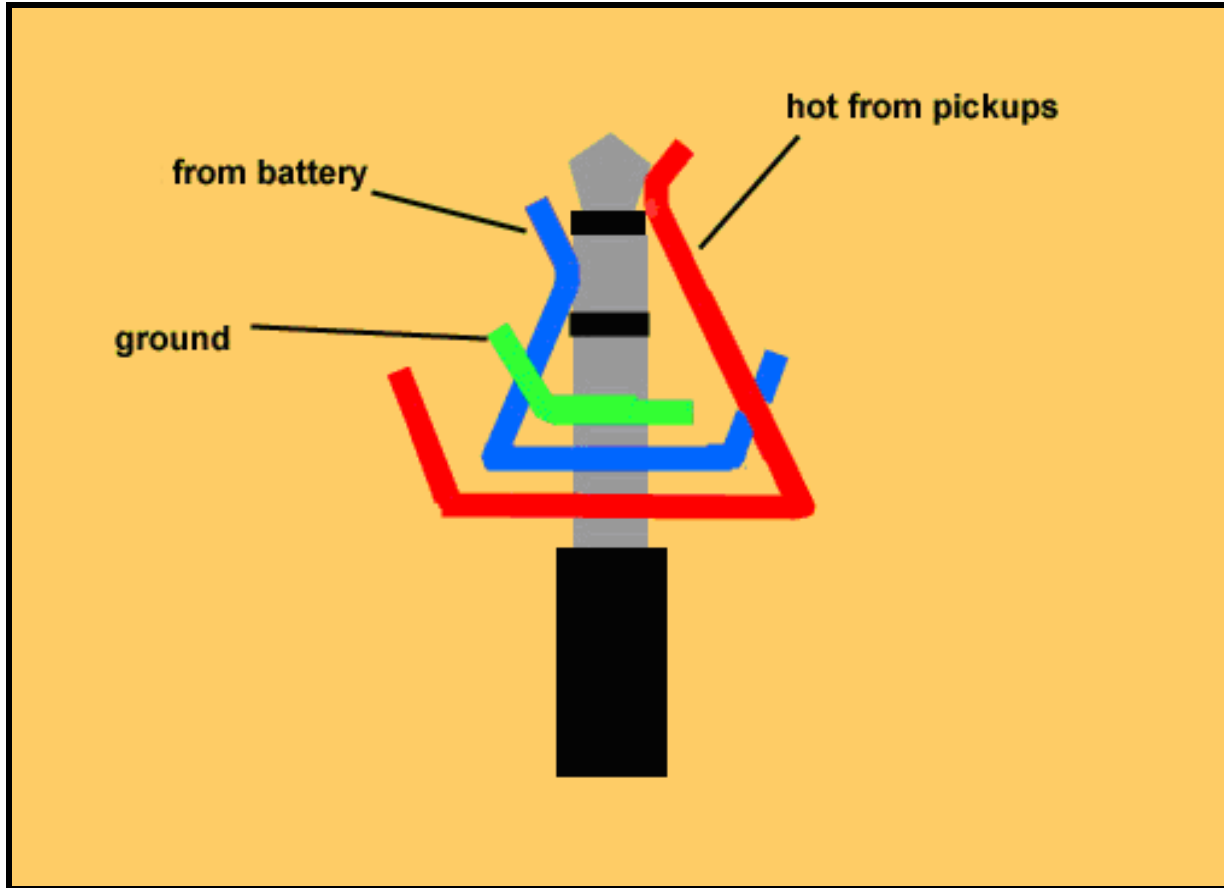
All you need is a small capacitor (.010 - .020 uf) on your tone control, and then just

crank it up all the way for a warmer sound. A set of heavy strings will help, too. Listen to some of the older Cream albums to hear what I'm talking about.

**Question: What is the Clapton mid boost?**

It is a preamp inside your guitar that will give you more of a Les Paul sound on your strat. You can get a boost of up to 25 db with this kit. Check out the diagram to see how its wired. You can find these kits online for around \$100.





**Question: How hot are vintage sounding pickups?**

If you want the vintage single coil sound, then you will probably want a pickup that is measured at 5K Ohms to 7K Ohms on your Multimeter. This is not a measurement of impedance, but a measurement of DC resistance. But both measurements are related. A low DC resistance will yield a lower impedance pickup. And a pickup with low impedance will give you plenty of treble and sparkle in your tone. The lower resistance is due to less windings of copper wire around the magnets. Now, if you are looking for a hotter pickup with more punch, then you might be looking for a pickup rated at 8K Ohms to 9K Ohms. And if you want a very hot, loud pickup, go with one rated at 10K Ohms to 15K Ohms.

**Question: Where can I get humbuckers that will fit into my strat pickguard?** I like the LiL Killers from [Guitarfetish.com](http://Guitarfetish.com). They are only \$25, and have a great tone. Unlike the "Big Name" version of this pickup, the GFS Lil Killer has a real vintage FIBER BOBBIN. That means that, unlike plastic, they can really heat up the wax and vacuum impregnate the windings. The result? KILLER tone, great output, no noise, and NO MICROPHONICS! They come in 6K Ohms, 10K Ohms, and 15K Ohms. They use the



same pickup color codes as Jackson pickups. You might also want to check online for blade pickups, rail pickups, stacked pickups, and mini humbuckers.



*Note: Guitarfetish, GFS, MODboards, and Xaviere Guitars are all trademarks of GF Sales LLC*

**Question: Where can you get vintage style 22 AWG wire?** Bookmark this site  
<http://stores.ebay.com/Classic-Clones-Amplification>

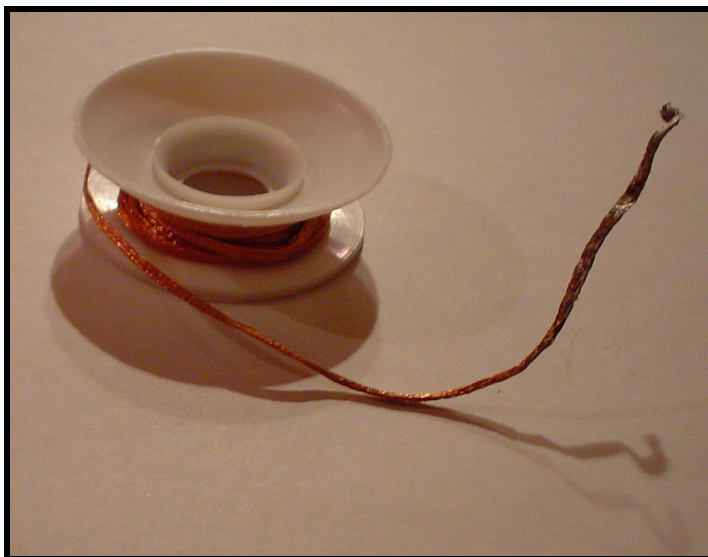
This wire is from the same manufacturer that supplied wire to Fender. It has a double-cloth jacket, waxed cotton outer braid, and a celanese inner braid. I love this stuff. It is stiff and bendable; making it a dream to use. It comes in several colors like red, vintage white, and black so you can keep your grounds all black and your hots all white or red. No need to strip your wires anymore, just pull back on the cloth to expose the wire. And when you are done soldering, just push the cloth back over the wire



**Question: Where can you get a custom made pickguard?** Pickguardian.com will make you a custom acrylic, plexiglass, or tortoise pickguard and control plate for cheap. They offer a bunch of unusual colors, and can even make clear plastic pickguards and covers. Check out the example below. Now you can show off your hard work.



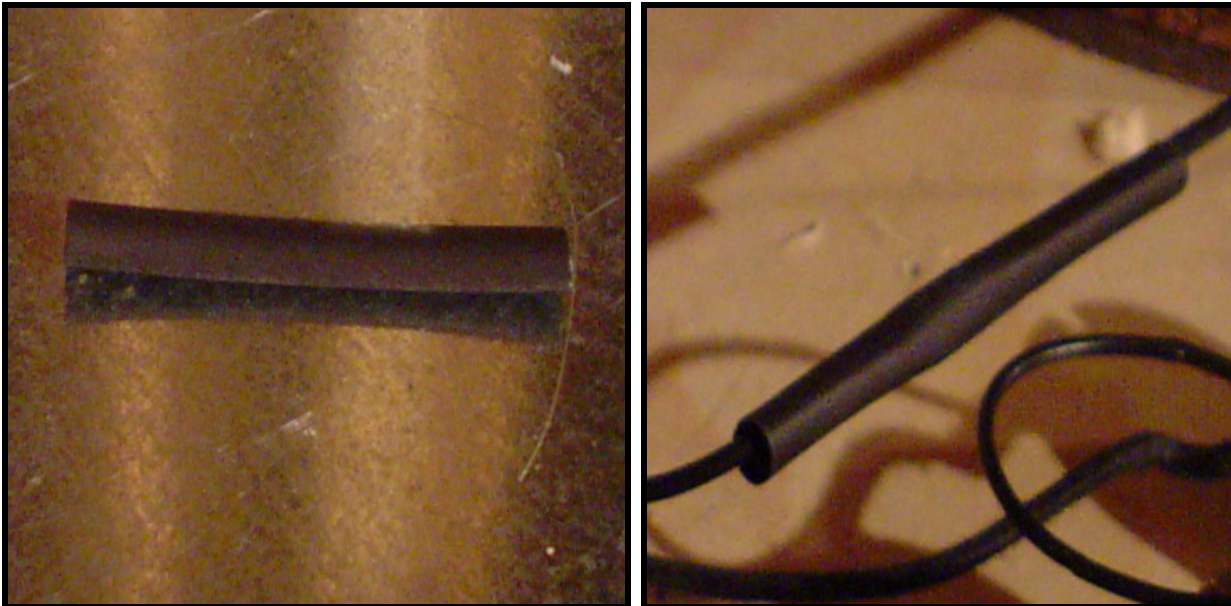
**Question: What is desolder braid?** A desolder braid or wick, when heated, absorbs old solder left on your switches and potentiometers. So if you reuse electronics parts often like I do, this stuff will keep your work neat and clean. Once a portion of the braid has been used to absorb solder, then that part of the braid is used up, and should be cut off and thrown away. Desolder braid can be found everywhere online.



**Question: What is heat shrink tubing?** Heat shrink tubing is a protective sleeve that is used to cover wire connections. So let's say you need to extend the length of your bridge ground, or tremolo claw ground wire. Twist the two wires together and solder them. Then fold back the bare wires.



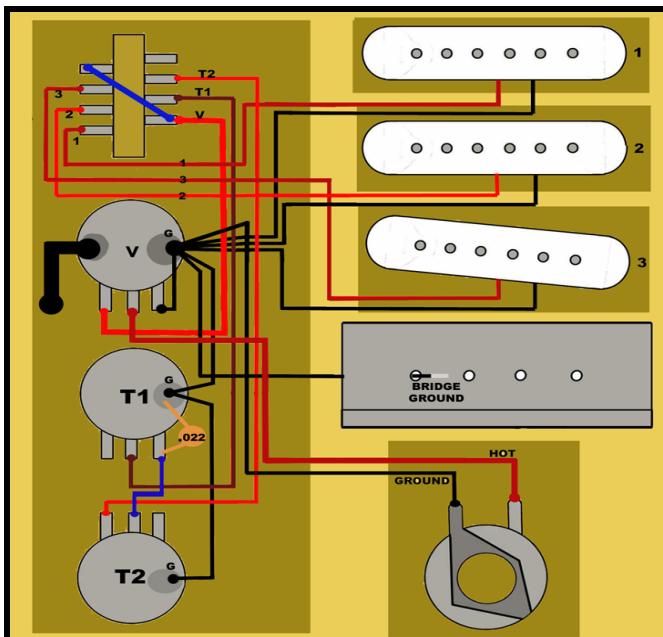
Next, take a piece of heat shrink tubing and place it over the open connection.



Now heat up the heat shrink tubing with a lighter. You will see that the tubing starts shrinking rather quickly. Be careful. Don't hold the lighter over the tubing too long, or you can start a fire.



**Question: Why do some people use shielding in their guitar bodies?** Because they have a problem with unwanted noise. Conductive shielding paint applied inside of the control cavity will help reduce the 60 cycle hum and unwanted noise. If you have a pickguard, you can use the conductive tape to shield it. For the body, you can use the conductive paint. Then solder a ground wire to the dried conductive paint inside the body cavity. If that doesn't work, you can always twist the ground wire around a wood screw, and then screw it into the body cavity. Make sure you paint a little bit above the body cavity hole, so that the pickguard tape touches the conductive paint inside the body. Stewmac.com sells the paint for \$28 a can.



**Question: What type of wood is normally used in strat bodies?** Most of the strats, or strat clones use Alder or Ash in their bodies. These woods provide a rich, warm tone with a good amount of sustain. If these woods are not available to a manufacturer, then Basswood or Poplar is often used, which provides a similar tone. Here is an ash body that is available online at <http://stores.ebay.com/MetalShopMusic-Guitars-Parts-Amps>

Notice the conductive shielding paint applied inside the cavity.



**Question: What are some good strat pickups made by Fender?** Fender has all kinds of pickups, but here are some of the favorites among strat players.

**Texas Special Pickups** – Great SRV blues tone with plenty of punch.

**Tex-Mex Pickups** – Overwound bluesy pickups with a warm tone.

**Custom 54' Pickups** - Vintage sound with some great bell-like tones.

**Hot Noiseless Pickups** – Plenty of power and clarity Jeff Beck style.

**Vintage Noiseless Pickups** – The classic Fender sound without the hum.

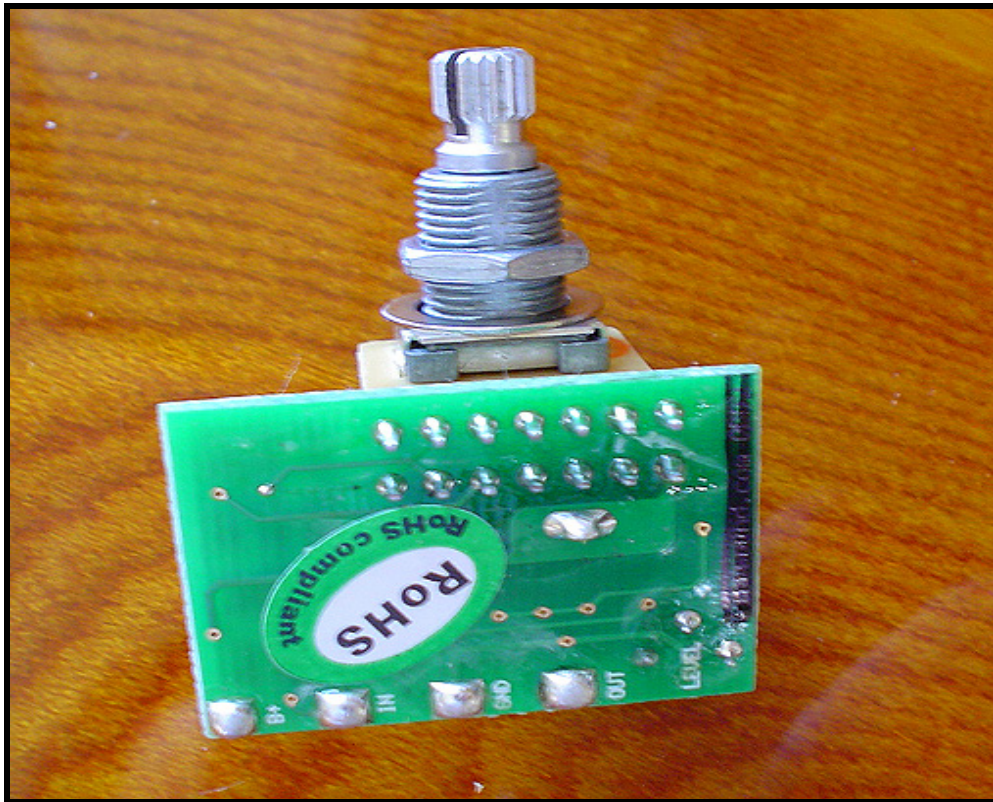
**SCN Pickups** – Samarium Cobalt gives you even more clarity and punch without the hum.



## BONUS SECTION 1 – ADDING A DISTORTION PREAMP TO YOUR TONE CONTROL

Sick of hauling around distortion and overdrive pedals to all of your gigs? Why not just add the distortion directly to your guitar's wiring? Seems pretty logical to me. Yes, you can make your tone knob a distortion pedal.

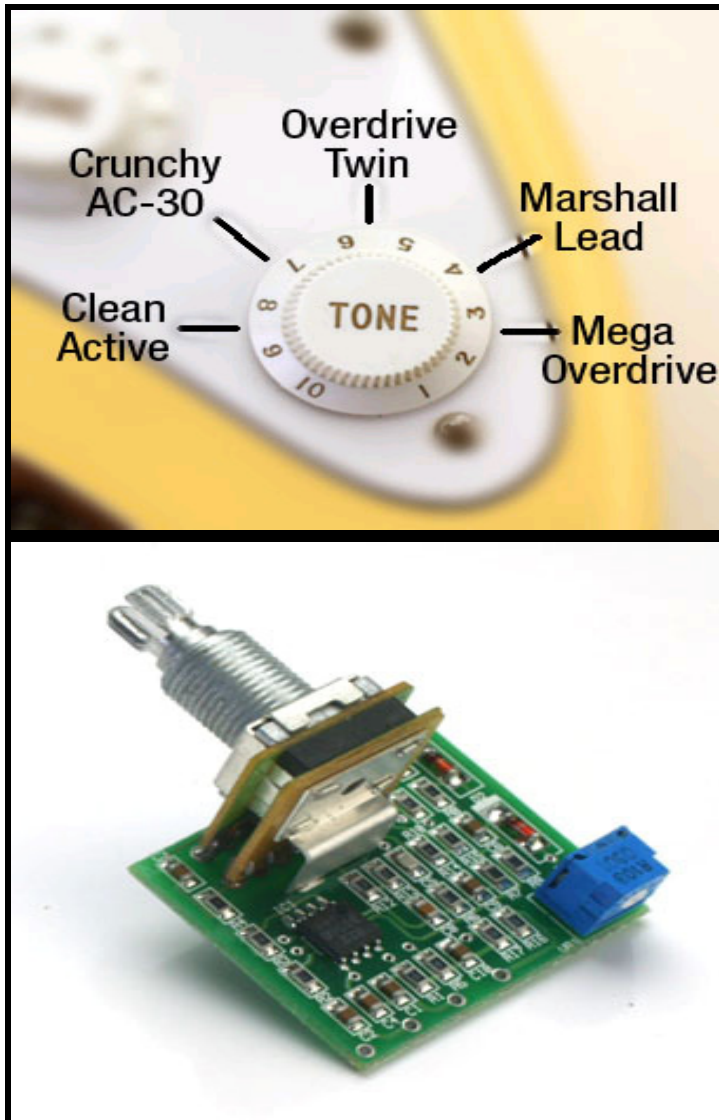
The distortion preamp is an onboard multi-circuit and will take the place of one of your tone knobs. It can be purchased at [www.guitarfetish.com](http://www.guitarfetish.com) for around \$30. It offers 5 killer tones: clean, crunchy, overdrive twin, marshal lead, and mega overdrive. To switch between the tones all you have to do is turn your tone knob. No matter what sound you are looking for, guitarfetish has a mini preamp to add to your guitar.



Here is what the [Guitarfetish.com](http://Guitarfetish.com) website has to say about this preamp:

*"This is the single most versatile distortion effect in the whole world, and it mounts right IN YOUR GUITAR. DO NOT confuse these with similar circuits touted on*

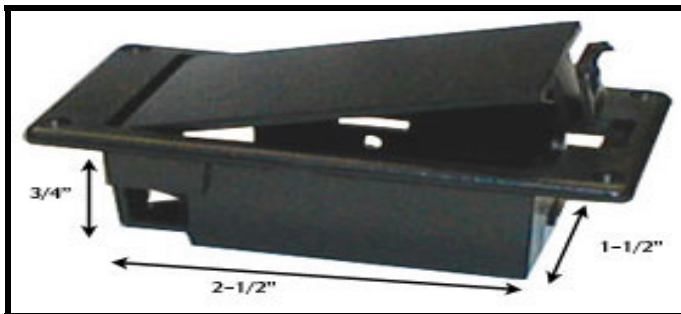
ebay- we have these custom made to our specs. FOUR different distortion effects AND an active boost mode, right at your fingertips- the whole lot instantly swtichable, just turn the knob.. Drill NO holes, make no serious mods to your axe- just install the "Multi Drive Circuit" in place of one of your tone pots, and you're all set. The Multi Drive Circuit runs on a single 9 volt battery. Battery life is excellent, and the entire range of distortion sounds is adjustable via an internal level trimpot. The active mode is unity gain (No Boost) it's the exact sound of your guitar, but now you're Low Impedance! Run a mile of cord- and notice how full and punchy your stock pickups are! There's a small trim pot on the board that allows you to dial in how loud you want the boost effects- so you can either get unity gain distortion or give the distortions a noticeable boost. I like the distortions to have just a slight boost, but sometimes for playing out I'll goose that trim pot a bit to give me more boost for the lead songs."





Installing the preamp is pretty simple. Only a few wires need to be switched around. The hardest part is finding room for the 9 volt battery. This is pretty easy if you have a guitar with a pickguard, you can just put the battery inside the body cavity, underneath the pickguard. You should be able to change the battery by unscrewing a few of the pickguard screws, lift the pickguard partially up, change the battery, push it back inside, and then screw the pickguard back down. Or you can route out space in the back of the guitar and install a battery box to make battery changes even quicker.

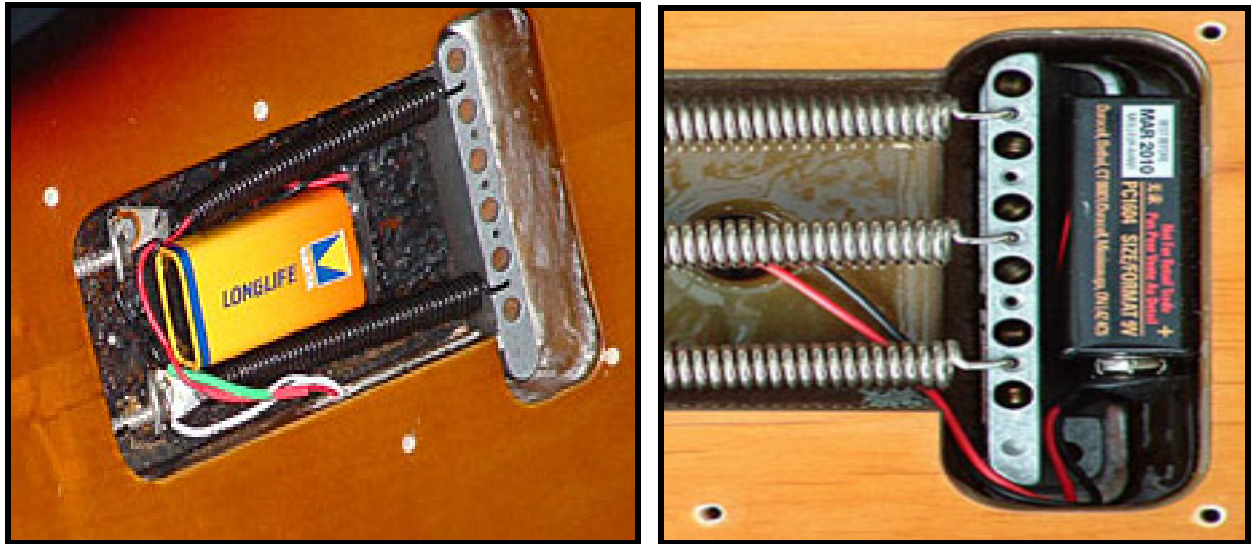
Here is what a battery box looks like. They can be purchased at [www.guitarnucleus.com](http://www.guitarnucleus.com) for around \$10.



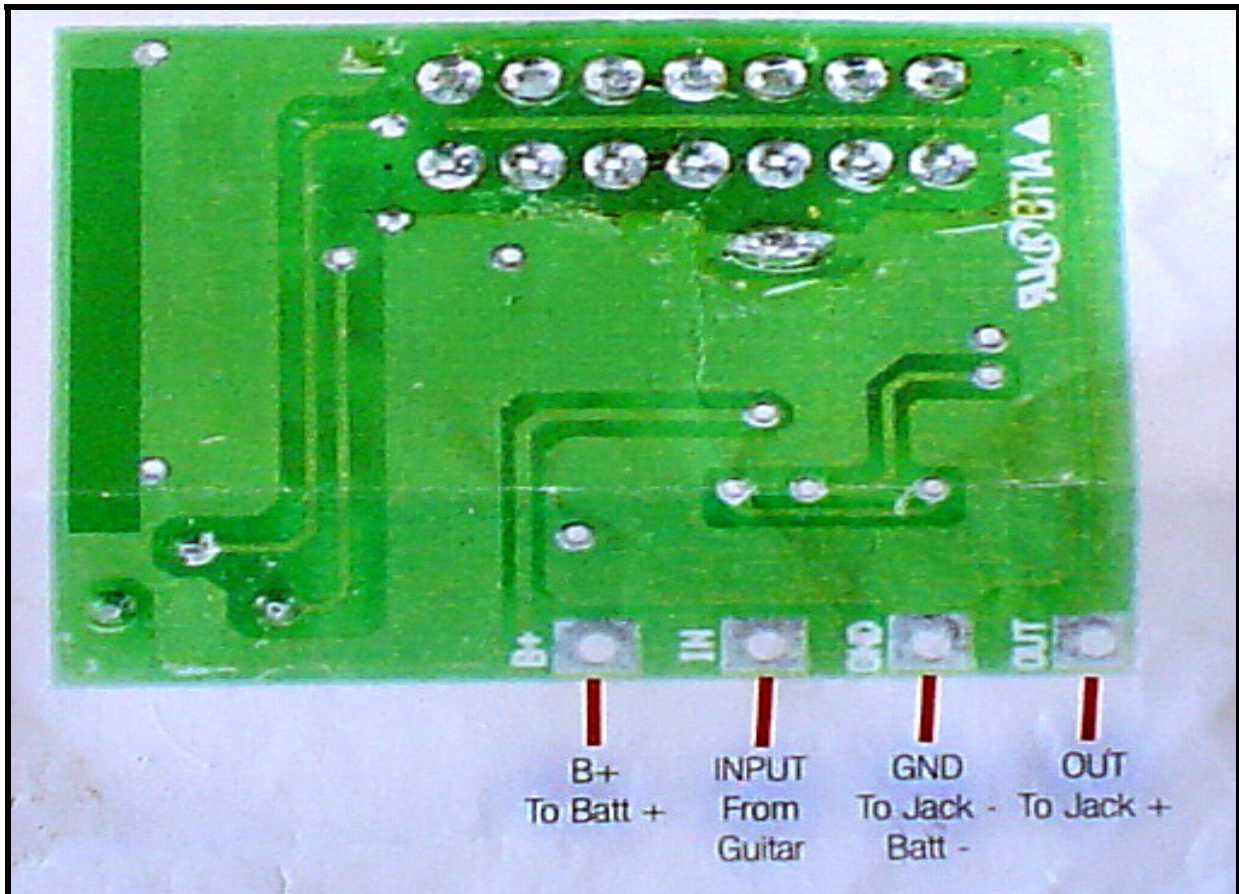
Or you could drill a hole in the back of the guitar, so the body cavity hole extends out to the backside of the guitar. Then place a Les Paul switch cover over the hole. You could also flip the output jack around to make room for the battery inside the guitar. Just unscrew the battery jack when you need to change the battery.

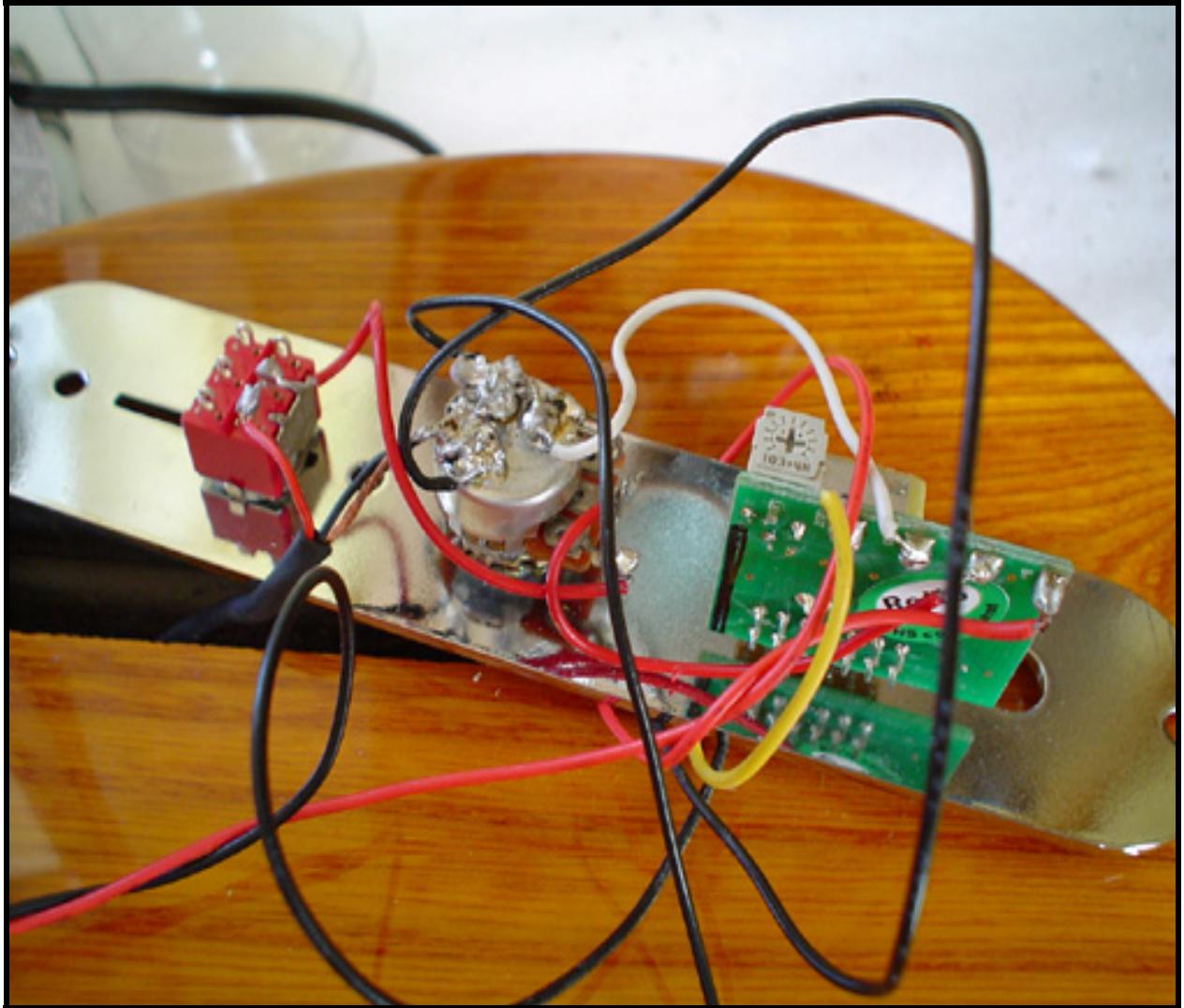


Here are a few more options for hiding the battery.



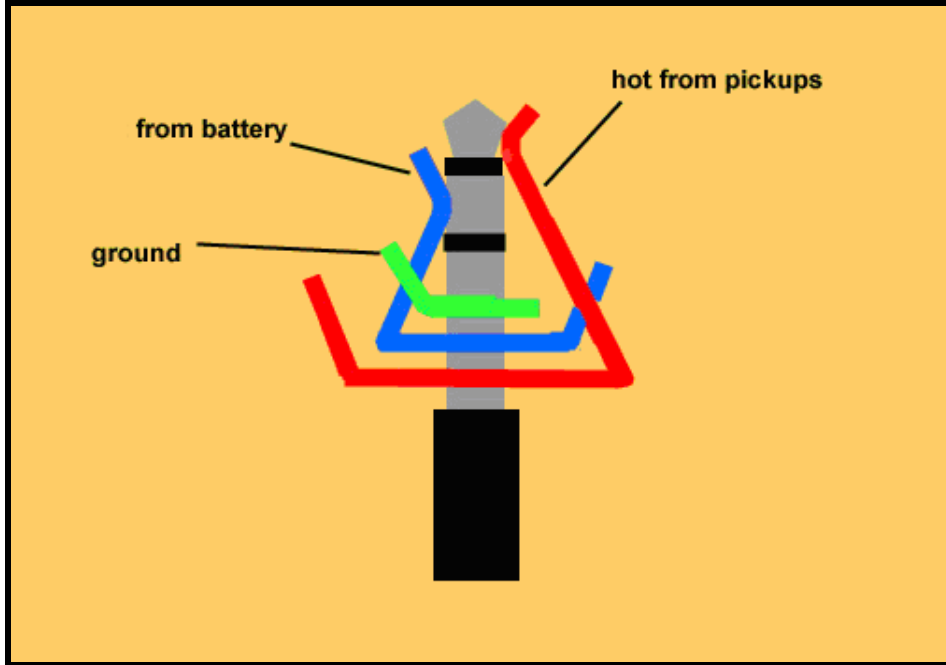
This preamp only needs to be wired in 4 spots.



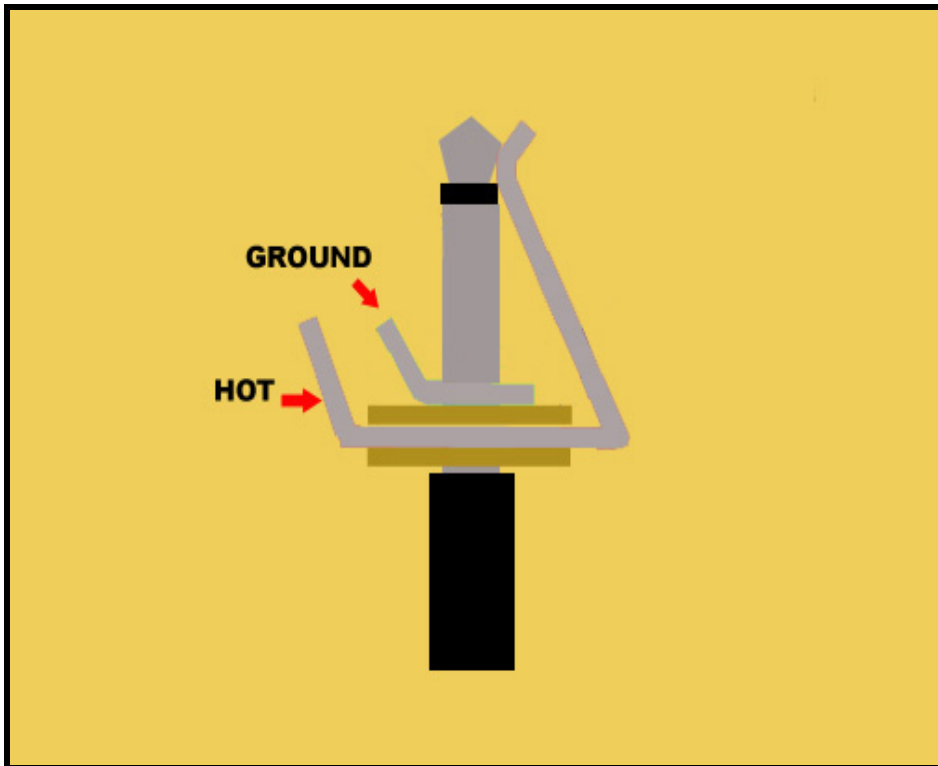


## THE STEREO OUTPUT JACK

You might not be too familiar with a stereo output jack unless you have used active pickups before. The stereo output jack has one extra prong that gets connected to the 9 volt battery. The stereo output jack and 9 volt battery wires are included with the distortion preamp kit from guitarfetish.com. Notice the diagram on the next page. The longest prong gets power from the pickups. The shorter prong gets connected to the 9 volt battery. Note: you don't need a stereo cable for the distortion preamp to work. A mono guitar cable will work with the stereo output jack.

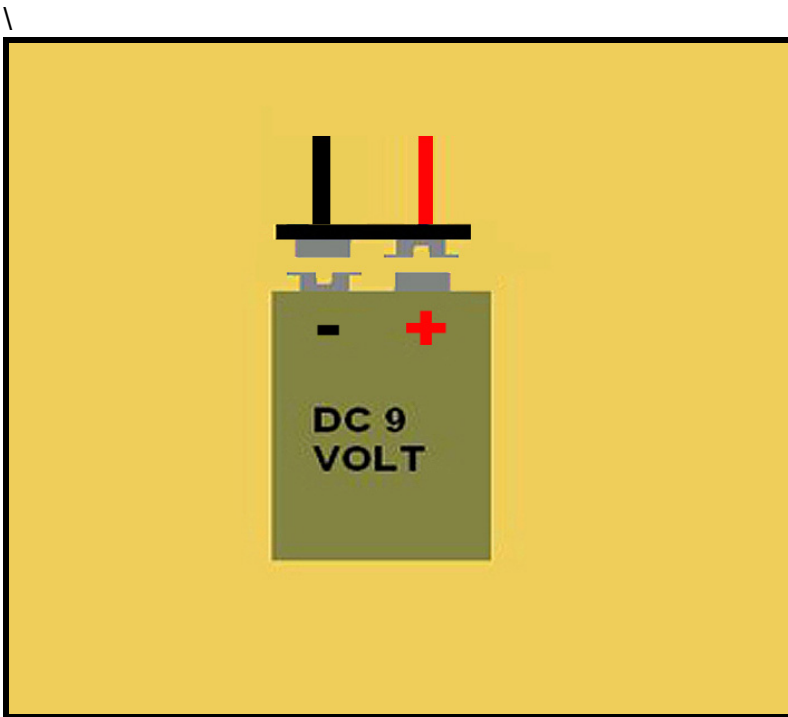


Below is a picture of a mono output jack, and not a stereo jack. Notice the difference.



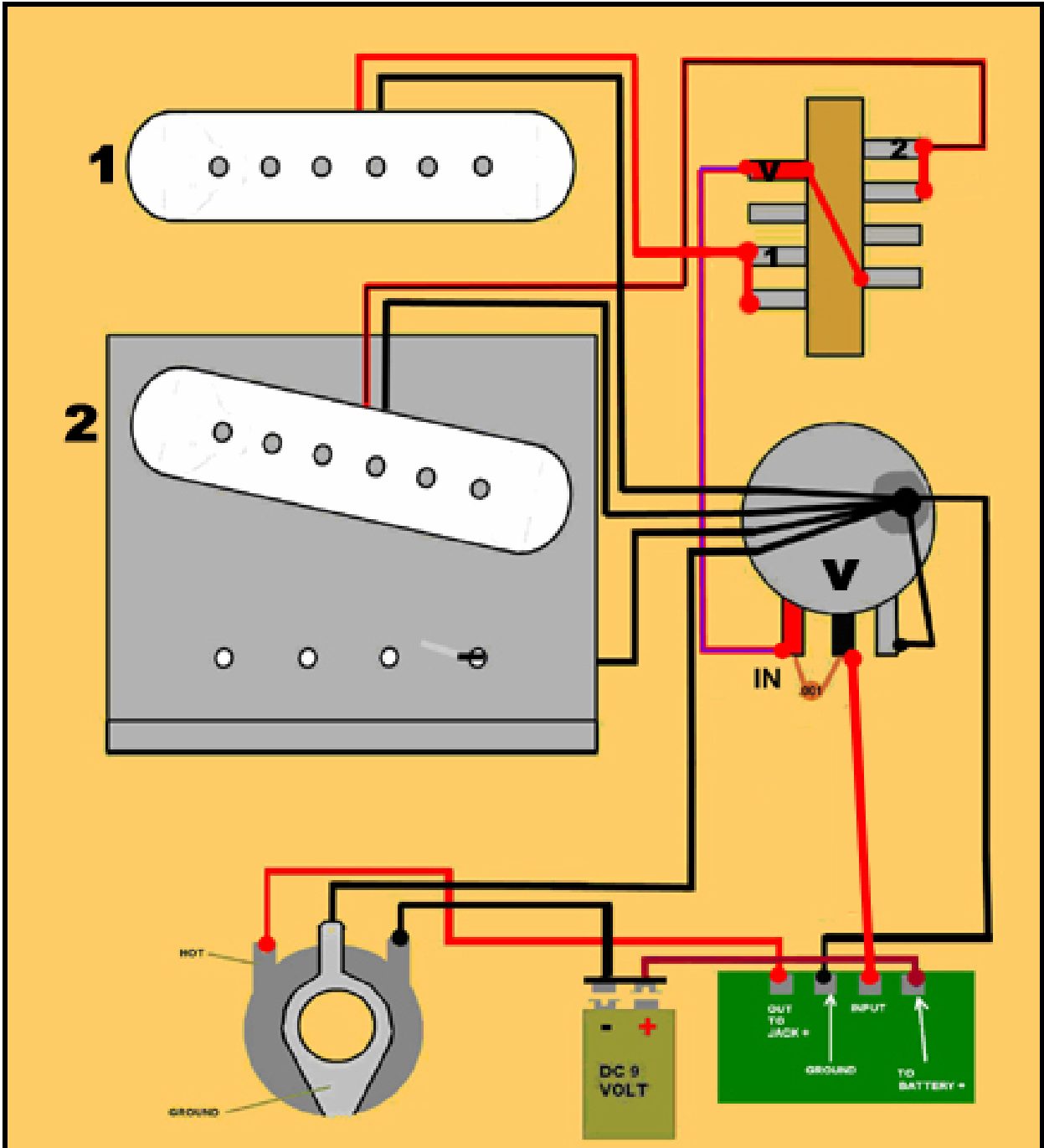


Here is a close up of the battery connection.



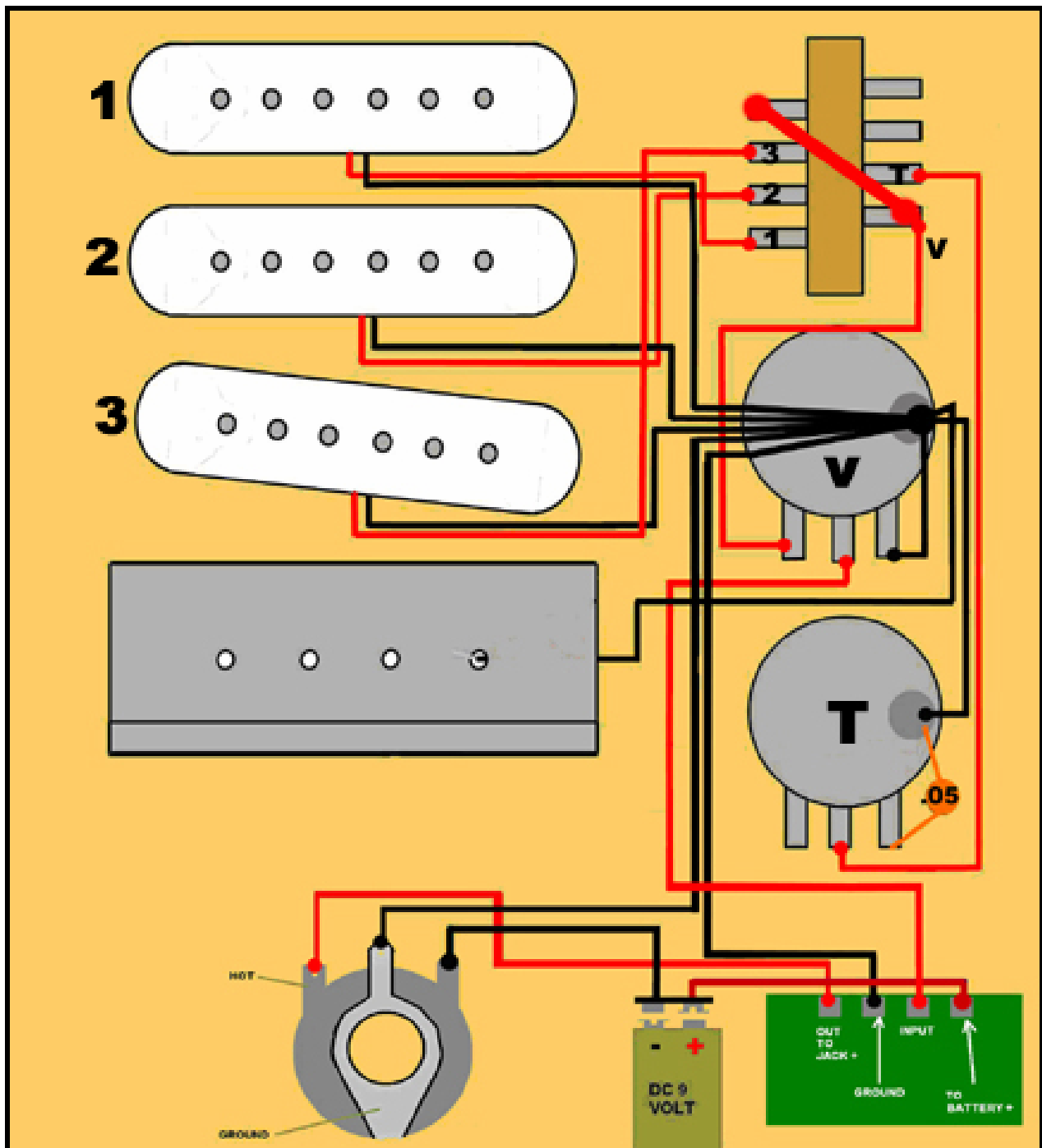
## WIRING A GUITAR WITH TWO PICKUPS

If you have two pickups on your guitar, like a tele, the wiring is simple. The main difference is the removal of the tone control.

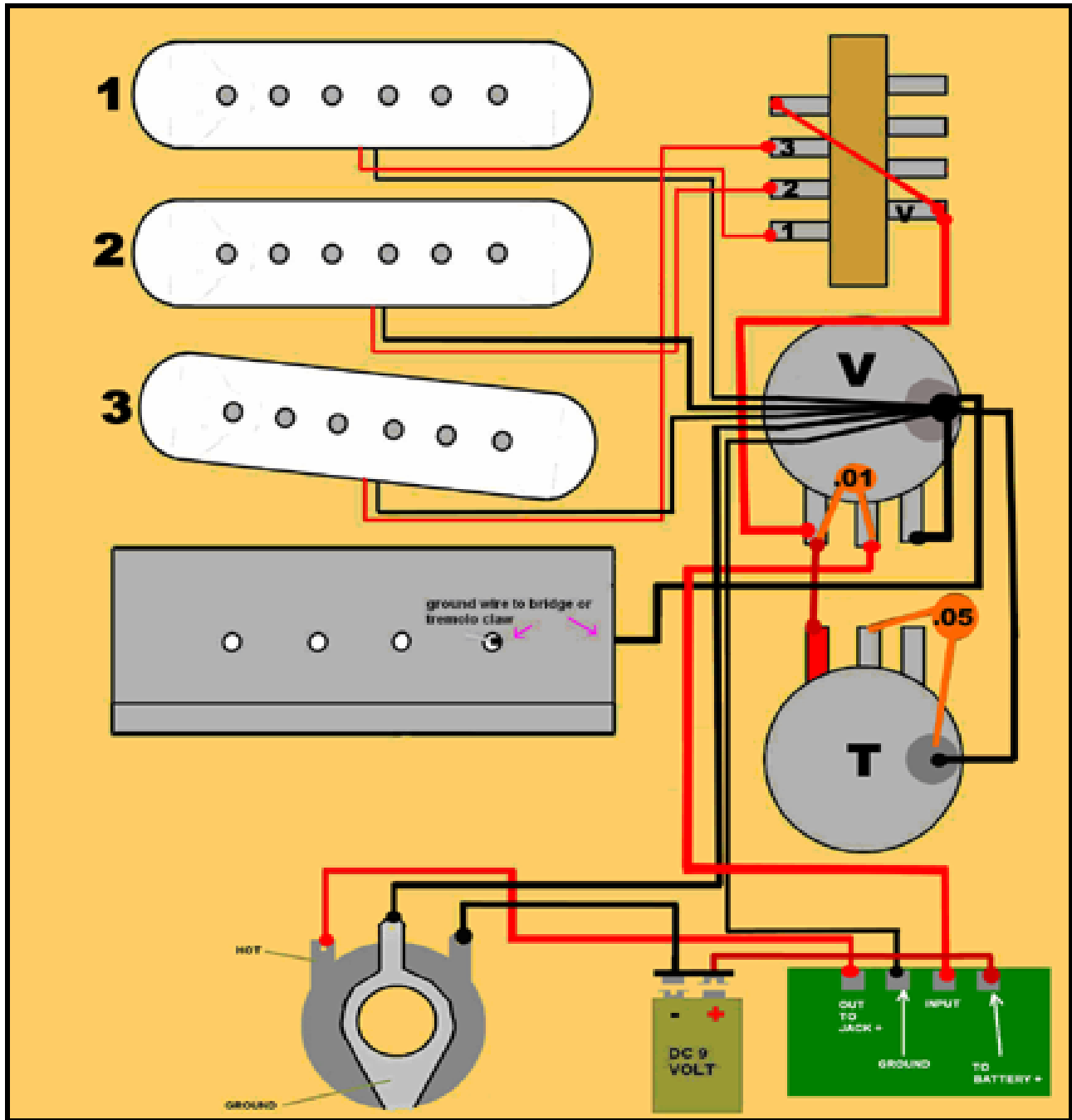


## WIRING A GUITAR WITH THREE PICKUPS

If you have a strat, or 3 pickup guitar, it gets a little more complicated because you have three tone potentiometers, and will be removing one of them and replacing it with a distortion preamp. Therefore, the middle pickup will no longer be sending the signal to a tone pot. That leaves only the neck pickup with its own tone control.



If you wanted to add a master tone control for all of the pickups, you could wire it similar to a telecaster style guitar, where the signal goes into the volume pot, then out to the tone pot and preamp.



Note: Guitarfetish, GFS, MODboards, and Xaviere Guitars are all trademarks of GF Sales LLC.



## BONUS SECTION 2 – HOW TO MODIFY A BOSS DS-1 PEDAL

If you've been in a music store anytime since 1978, you've no doubt seen the ubiquitous orange Boss DS-1 Distortion pedal. Universally recognized as a good, inexpensive distortion pedal, you've probably even owned one or two in the past. Although it houses a simple circuit design, it produces a very good sound, particularly for a mass produced pedal. Let's look a little more closely at the circuit and check out some changes that are available to make this great pedal even better.



The circuit is a buffered bypass circuit with electronic switching, as are all Boss pedals. The circuit comes in through R1, a 1K resistor, and then travels through C1, a .047 microfarad, or  $\mu\text{F}$ , capacitor into the first buffer. This buffer goes out through C2 and then into a JFET (junction gate field-effect transistor), which is part of the switching. If the pedal is off, the signal goes out to the switching circuit and through the output through Q7, which is the other you can increase or decrease in value to adjust gain before the next stage. Increasing the value increases gain, while decreasing it will give you a little less gain overall but will tighten up the DS-1's low-end response, ridding it of

the flubbiness many people dislike. We can also decrease C3 to get this same effect by not allowing as much bass to come through. I like to change its value to either  $.022\mu\text{F}$  or  $.033\mu\text{F}$  if I'm looking for a less flubby tone. To clarify, to me "flubby" means a deeply compressed tonality. C4, which has a value of 250 picofarads (pF) also filters out some highs. Changing this won't do too much, although you may be able to coax a little more brightness by changing it to a 100 pF capacitor.

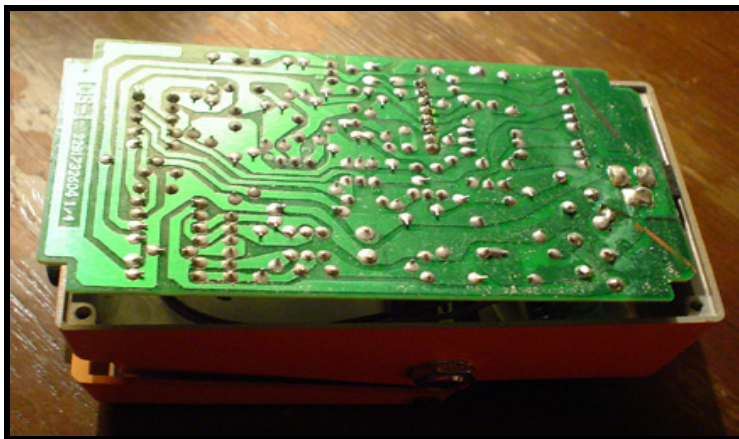


The signal then goes out through C5 into the opamp. This opamp is used in a unique way to clip the signal. R11 controls the gain in combination with the distortion knob, R13 and C8. The gain control is set up this way to enable the clipping of higher frequencies as you turn the distortion up. When it's turned down, it allows lower frequencies in – giving it a muddy sound since the signal is clipped beforehand through the transistor gain circuits, then clipped *again* when the distortion control is turned down. The first stage clipping is still occurring and as a result, the pedal doesn't sound as clear and articulate as many would like. R13 and C8 are part of this "non-inverting" opamp circuit which provides negative feedback to ground. This is important for several reasons. The resistor value of R13 and the capacitor value of C8 basically provide a frequency range where the signal is made to clip. In this case all frequencies above 33hz is being clipped. To contrast, a Tubescreamer only lets frequencies above 728hz clip. This means that none of the lower bass frequencies are being boosted and/or clipped in the Tubescreamer.

The signal goes out through R14, which is a 2.2k resistor, through C9, which is a .47 $\mu$ F capacitor running across two diodes – D4 and D5 – and then to ground. All the usual diode tricks can be done here to allow more asymmetric clipping or different clipping flavors. Here C10 JFET. These JFETs act as a switch, allowing the signal to either go through the distortion circuit or out through the buffers, producing a clean signal.

When the pedal is on, signal travels to Q6, through C3 and into a transistor gain stage. R7 controls the gain of this circuit by changing the voltage bias, consisting of a 470k resistor which is also in parallel with D4 and D5 and is used to filter out highs in conjunction with R14. R14 and C10 form a low pass filter, cutting out high frequencies.

Go to [indyguitarist.com/filter.htm](http://indyguitarist.com/filter.htm) and scroll to the bottom. Plug these values into the corresponding fields to determine which frequencies are being filtered. With the current values you will find it's filtering everything above 7k, which helps to smooth things out a little bit. If it's too bright, replace R14 with a resistor valued at 3.3k, allowing more highs to be filtered out, or try a 4.7k resistor to filter out everything above 3.3kHz.

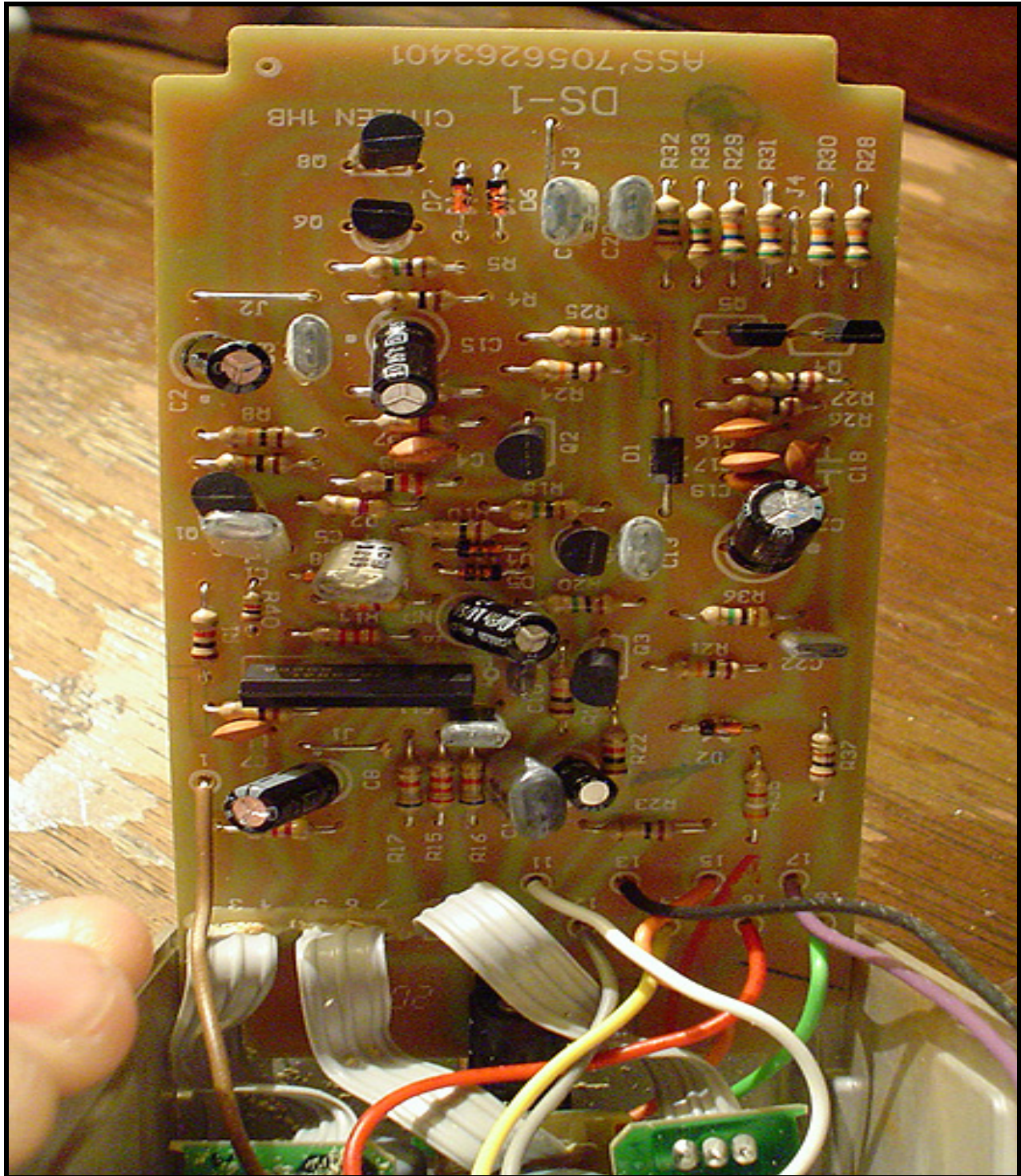


After traveling through the diodes and the capacitor, the signal goes through a Big Muff  $\pi$  inspired tone control. There are many things we can do to manipulate the tone here, and a great resource is the Duncan Tone Stack calculator, available at [duncanamps.com/tsc/](http://duncanamps.com/tsc/). Experiment with different values to find the tone you're looking for. In the stock version of the pedal, the tone is a bit "scooped" meaning that there is little mid frequencies allowed through making the tone a little "thin" sounding. We can change that quite easily however. Check out the suggested changes in the charts below to get a warmer tone, a scooped mid tone or simply less highs.

After the tone control the signal travels through the level control and then out through R18, which is a 10k resistor, and then on to Q7, which is the other side of the JFET switching circuit. In its on state, it goes past Q7, through C13 – which is a .047 $\mu$ F capacitor – through yet another output buffer and then a resistor, a capacitor and finally through the output.

Let's look at some modifications that will have your DS-1 doing your bidding in no time.

**Note:** It's a good idea to buy some desoldering braid to suck up the old solder when dealing with pedals. Then you can use fresh solder for the replacement capacitors and resistors, and will prevent tearing up the traces on the pedal.



**Classic JCM-type Marshall Tones:**

Location	Change to
<b>C3</b>	.033 $\mu$ F
<b>R17</b>	15k
<b>C2</b>	1 $\mu$ F
<b>D4</b>	1N4148 CONNECTED IN SERIES TO ANOTHER 1N4148
<b>D5</b>	1N4001 CONNECTED IN SERIES TO ANOTHER 1N4001
<b>C5,C9</b>	1UF
<b>R13</b>	OPTIONAL – CHANGE TO 1k FOR TONS OF GAIN, IF YOU DO THIS, ALSO CHANGE C8 TO A 1 $\mu$ F

**Modern distortion tones**

Location	Change to
<b>R16</b>	1k
<b>R14</b>	10k
<b>C10</b>	.001 $\mu$ F
<b>C5,C9</b>	1 $\mu$ F
<b>R13</b>	3.3k
<b>D4</b>	LED

**Vintage distortion tones**

Location	Change to
<b>D5</b>	LED
<b>C3</b>	.033 $\mu$ F
<b>R16</b>	1k
<b>C11</b>	.01 $\mu$ F

If you like the general sound of the DS-1 but are looking less highs and more of a tonal range change C10 to a capacitor with a larger value. Stock is .01 $\mu$ F for a frequency roll-off of 7.2kHz.

### Less shrill highs

Location	Change to	FREQUENCY ROLLOFF
C10	.015 $\mu$ F	4.8kHz
C10	.022 $\mu$ F	3.2kHz
C10	.027 $\mu$ F	2.6kHz
C10	.033 $\mu$ F	2.1kHz
C10	.047 $\mu$ F	1.5kHz

To sum it up, the Boss DS-1 Distortion is an inexpensive pedal that can rival many of the best boutique pedals simply by changing the circuitry a little. While this may seem hard, technical, and out of reach, it really is very simple if you know **what** to change and **where** to change it. I hope that I've given you the knowledge and courage necessary to change your pedal from a mouse into a monster. Happy soldering!

You can get resistors, capacitors, and all the parts you need for this type of project right here:

<http://www.smallbearelec.com/home.html>

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## DOWNLOADING THE COLOR EBOOK VERSION

If you have purchased the printed book edition, then you may want to download the color ebook version. This will make the diagrams much easier to understand. The book version was printed in black and white ink to cut down on the production costs, and keep the retail price down. The ebook version is an .exe program file.

You can download the .exe version of Beginner, Intermediate, and Advanced Hot Rod Techniques for Guitar here:

<http://tinyurl.com/2YJOLK>

