How to Improve Reliability

with tips for working on PCB amps

Getting Started

It's strongly recommended that you read this page before trying any mods or fixes. You may even want to print out a copy for quick reference.

Plastic Jacks

The input jacks have gained a sort of infamy for being "cheap." The truth is the plastic jacks are used to comply to safety regulations so the amp can be sold all over the world. There are only so many jacks being made that can be mounted to the PCB. Due to how they're mounted the jacks are particularly vulnerable to external abuse. If someone walks by and trips over your instrument cable, or if you're holding your guitar and try to walk 7 feet (2.1m) with a 6 foot (1.6m) cable, stress will be asserted onto the jacks. After a finite amount of abuse trouble will likely appear and the jacks will need to be replaced. There are a few very easy tricks you should implement to greatly reduce the likelyhood of being forced to perform the input jack fix. (It may also be a good idea to use this technique with the footswitch.)

1. **Wrap it up!** After you plug your cable into your guitar, take the other end. Instead of sticking it straight into the jack pull it through the carrying handle. Now pull the other end around and back towards you. Reinsert the cable through the carrying handle and plug into the jack of choice. Pull it tight around the handle and leave some slack between the handle and the inputs. In the case that your instrument cable is sharply pulled it will simply tighten around the carrying handle, and no stress will be absorbed by the jacks. Note that the cable must make one full 360° rotation around the handle before plugging into the input. This will decouple any pressure between your guitar and jacks.

2. **Easy on those nuts!** If you do any mods or repairs be sure to leave some slack when retightening the nuts on the control panel. If you tighten the jacks too firmly to the chassis you're going to put a lot of pressure on the inner lugs of the jacks. After so many mods and repairs you'll end up replacing them—this is what happened to me. If you do *not* tighten the jacks enough, and you fail to wrap your cables around the handle, a trip or tug on a loose jack will cause even *more* damage than normal.

Since metal jacks mount directly on the chassis, any jerks will be absorbed by the chassis itself and not the PCB. In the case that you find the jacks cutting in and out, or not working at all, you will need to replace them. I've written a tutorial explaining the process located here.

Prerequisites & Essential Tools Check List

- **Electronics Safety Knowledge.** A good understanding of draining filter caps, and general power supply safety. This understanding is absolutely vital to your safety. You can read more on soldering safety here.

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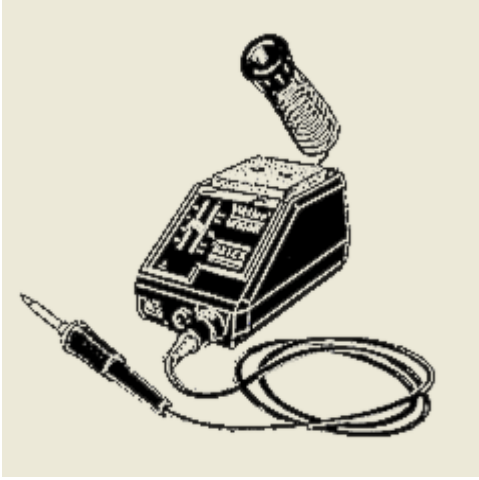
  Eye Protection, such as goggles or glasses. Molten hot solder "spits." *Always* protect your eyes, you've only got one pair! To the right is a pair of typical safety googles, but there are much cooler looking ones available for a little more cash.

- 

  Soldering Iron/Workstation. Lower wattage (25W) soldering irons should be used for PCBs, and I found that they don't cut it with other stuff like guitar work and point-to-point wired amps. In this case that we're simply touching up joints, a 40W iron may be used. If your iron is of a lower wattage try using a bigger tip, which will make heat transferal easier and quicker. The hotter the iron, or the bigger the tip, the quicker you must solder. So if you're inexperienced always use a lower wattage iron. If you can afford it a nice Weller workstation with adjustable wattage is the way to go. A good one costs around $150 to $200. I still can't afford the one I want, as I'm in college, so I just have a couple cheap Lenk irons I'll use until then. I can not emphasis keeping the tip of the iron clean with a wet sponge enough. Afterwards, be sure to clean the joint with the sponge.

  Recommendation: Variable 5W-40W Weller Station

- **Solder** for electronics. Pick up some 63/37 *Rosin-Core* Solder, and NOT Acid-Core. The 63/37 melts faster, flows better, and is more re-workable than the 60/40. I personally always buy the solder with the largest diameter possible, as the thinner solder easily bends all over the place, takes longer to use, and is generally harder to use in my opinion. I prefer my solder to be *at least* .050mm in diameter, and preferably much larger. In some instances a larger diameter solder may deliver too much when we only need a little. In this case you may want to keep around a roll of solder that's smaller.

  Recommendation: Kester "44" 0.05mm 63/37 Rosin Core Solder

- **Soldering Flux**. Flux cleans metal and aids in heat transference. If you find that solder won't stick to the component, or that a joint looks dirty and dull, then we need to apply a *very small* amount of flux before soldering. Seriously, use a *tiny* amount, as ideally you don't want to leave any behind. Using too much flux will look sloppy and can cause corrosion in the long run. When flux is heated it'll let off some smoke/fumes, avoid breathing this in.

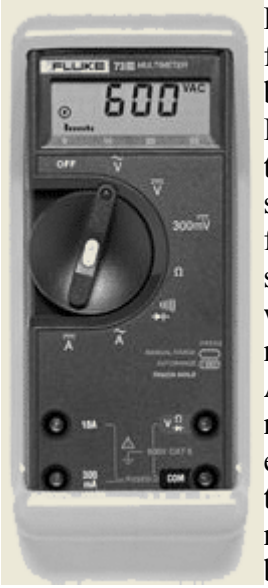
  Recommendation: Low Residue Flux Pen

- **Desoldering Braid**. Forget solder suckers. This stuff makes an easy job of cleanly removing components. Basically, we just stick this braid between the solder joint and our iron, and as the joint is heated the solder will melt and be absorbed by braid. When the braid is lifted we will have a clean, solder-free, joint to work with. With this stuff even sloppy DIYers can make a job look somewhat professional. The stuff is instrumental if you want to minimize any damage done to the fragile PCB soldering pads. I wish I knew about this stuff when I first started out!

  Recommendation: Tech-Spray Pro-Wick

- **Wire Clippers/Strippers**. We need something to cut those leads after we solder a component to the PCB. You may also need to strip some wires or remove some nuts with the strippers.

- **Screwdrivers.** You'll need a mini flat-head screw driver to remove the chickenhead knobs, and a medium sized philips for removing all other screws. I prefer to use a short, stubby philips to remove the back panel.

- 

Digital Multimeter, sometimes called a VOM or DMM. Used for a variety of stuff, from checking the values of components before soldering them in, to helping isolating problems. Isolating a problem without a multimeter or oscilloscope is next to impossible. As I've mentioned many times the proper way to set the range of your meter is by selecting the highest range first, then lowering the ranges one by one until you can clearly see a reading. If you set your range too low, or too high, you won't get any reading at all. Some of the more expensive models have "auto-ranging," which is a very nice feature. Analog meters require a lot more skill to use, so it's recommended that you stick with the digital ones. The higher end Radioshack meters are good for general use, but you'll find the best deal at AES—search for part S-Z3220. This is the one recommended by a few professional tube amp techs as the best bang-for-buck.

Tips for working on PCB amps

Printed Circuit Boards (PCBs) are used by anyone and everyone who mass produces instrument amplfiers. Another form of circuit layout is called "Point-to-Point" (PTP). PTP amps need their circuit constructed and soldered by hand, so they are very labor intensive and expensive to build. Therefore, PTP amps usually cost twice as much as similar PCB amps. Because of the craftmanship involved in their production, PTP amps are almost always more reliable. PCBs may or may not sound any better or worse than PTP amps. I have heard more than one testament from people who've installed Hoffman PTP boards in their Bassman Reissues and found no difference in tone. I have also heard people say it makes a big difference. It's completely subjective, and it's important to not get caught up in hype.

If we plan on improving circuit reliability, we must first know how to replace components without inflicting more damage to the amp. For a while it seemed like every time I opened my amp to fix something I broke something on the way out. This was very frustrating and annoying. Luckily, I've picked up a few good techniques which I'll gladly share with you.

- Over-ordering - If a part is inexpensive it's a good idea to order more than the absolute minimum. For example, if you order a resistor there's a chance that Mouser may accidently send you a faulty one. Mouser has millions of parts and they simply do not have the time or money to test every 10¢ component that comes through their door. Secondly, you never known when you'll need a similar part. I've been saved a few times because I had ordered extra parts. If I hadn't I would've had to reorder.

- Securely store nuts & washers - If you don't already have one, run to the grocery store and buy a little tupperware bowl with a lid or use a zip-lock bag. Use it to store the nuts and washers that you've removed from the control panel. Be sure to seal it or you may accidently bump it and spill parts all over the floor. Yes, I've done it.

- Getting under the PCB - I don't understand why some techs charge extra for repairing these amps. Getting under the PCB really isn't all that hard, and over-charging for it is shear laziness on the tech's part. If a tech tells you he'll have to "charge you extra" for working on this amp never go back there again. He'll only make you pay the "regular" price on jobs so easy that a monkey could do them. As always, and for your own personal safety, the filter caps must be drained before touching **anything** inside the amp.
    1. Main PCB - Remove the chicken head knobs and nuts and washers. Remove back panel. There are six black screws we must remove that secure the PCB. Look for them, and be sure to store them safely. Since the PCB is partially stablized by the control panel, we will have to pull the PCB back and up in order to get underneath it. Your first try won't be "easy," but be patient and push it back softly yet firmly, it will come out. NOTE: It's in your best interest to remove the green ground wire that's near the input jacks to make access easier. Just be sure it's screwed back

into the chasis before you turn the amp on or may not get any sound. If you have to remove any other wires (as you do in the Blues Deluxe/Deville) be sure to write down where they went--or take a picture with a digital camera.

2. Vacuum Tube PCB - The easiest way to remove this one is by removing the tubes, then removing the black screws which hold the sockets to the chasis. If you're wanting a headache try removing the silver screws which hold the sockets to the PCB. Trust me, you'll never do it again. You may also want to remove the really small PCB which supports V1. I used to leave it in, because I was lazy, but one of the two tiny green heater wires bridging the two tube PCBs broke, and it wasn't easy to immediately spot.

- Checking Component Integrity - It's a good habit to check a component with proper equipment before installing it into your amp. Never assume proper functionality of an electronic component. Since you'll need a multimeter for most work always test the resistance of your resistors before putting them into your amp—it's easy to misread those color codes. If you don't own a capacitance meter you'll simply have to assume the capacitance is correct. You can always check for shorts by checking the resistance of the cap. Since your meter uses DC current to compute resistance, and caps theoretically have infinite resistance to DC, you ideally should not get any reading. If you get close to zero ohms the cap is shorted and is no good. If you get a high resistance the cap's leaky, which can be tolerated.

- Prepping Components - "Prepping" refers to how we prepare a component before installing it into our amp. Often times you may find your component's leads dirty. Dirt and solder simply do not mix. Any metal that has impurities between itself and the solder will not have a strong connection, and often no connection at all. So for dirty leads we must use a tiny bit of flux to clean them. Flux and solder will flow towards heat, so draw the flux away from the component with your soldering iron. After the flux has flowed, solder will immediately stick to the lead. This is often refered to as "tinning," or adding a little solder to the leads before installation. You do not want excess flux, but if you draw it further away from the component this will not be a problem as the leads will eventually be shortened.

  Leads should never be bent right at the point where they come out of the body. This puts stress on the inside of the component and can cause it to crack. Properly prepped leads should come straight out of the component, bend at a 90° angle somewhere on the lead, and then be soldered into place. This is rarely an issue in point-to-point amps, though if space was poorly laid out during circuit designed this can be an annoying problem in PCB amps. An example of this is the 5W resistors we'll learn about later. Caps, specifically polypropylene types like the Sprague/Vishay Orange Drop, should be carefully prepped so that we do not crack of the epoxy seal around the lead entry points. This can allow moisture into the capacitor, which may lead to drifting and potential failure.

- Soldering Pad Technique - When installing new components it is very easy to dislodge the soldering pads used in PCB amps. If we attempt to force a component into place before enough solder has been removed we can totally dislodge the solder pad, which is just a thin piece of foil glued to the PCB. If this happens we will have to run jumpers so that the amp will work. What technique should we use to minimize accidental damage.
    1. Using a desoldering braid to absorb the solder, remove the component that you wish to replace.
    2. If necessary, remove any excess solder left on the pad until we've uncovered an unobstructed hole.
    3. Clip the new component's legs and insert into place.
    4. Heat the soldering pad with your iron. Do not melt the solder on the iron.
    5. Add solder to the soldering pads so that the solder flows around the component's legs.
    6. Clip any lengthy leads that protrude from under the PCB so that they do not short on the chassis.
    7. Use a multimeter to check the continuity of the traces that run through the pads we've soldered onto. I call this "ohming out" the circuit. This will keep us from having to take the amp back apart if we plug in and find a new problem. 99% of the post-installation problems I've encountered were caused by damaged soldering pads. Often times it's not visually obvious that a pad has been damaged.

  Correctly following these steps will greatly increase the reliability. If not, you may find yourself running a lot of jumpers from soldering pad to soldering pad. Damaged solder pads will need to be jumpered to the next location in the circuit. If you find you've lost all your volume, and that you can barely hear your guitar through your speaker, then you need to go back to the component(s) you've installed and "ohm out" the circuit. Use your problem solving skills.

- Soldering Technique
    - Read the instructions that come with your soldering iron. Follow them.
    - Avoid breathing in fumes!
    - Wear eye protection! Solder spits, and it will spit right in your eye.
    - Don't solder naked! You'll be sorry.
    - Don't solder in nice clothes! You'll regret the day.
    - Heat the joint, not the solder. If you heat the solder and let it roll off onto the joint it won't be as strong or aid in heat transferrence as heating the joint itself.
    - Piling solder onto a joint does not mean it's a good connection. Using the proper technique will ensure a good connection.
    - Keep the iron's tip "tinned." This means keeping the tip of the soldering iron looking nice and clean and coated with solder. This will transfer heat to the joint much faster.

    - Use a natural sponge. Wet the sponge and use it to keep the tip clean. You'll probably notice a dark substance forming on the iron when its hot. Help keep the tip clean by wiping this off onto the sponge.
    - Solder will flow towards the source of heat. Keep that in mind when working with wires.
    - Be careful not to overheat a fragile component, capacitors immediately popping into mind. In such as case use a heat sink.
    - Use 63/37 Solder. It's easier to use than the standard 60/40.
    - Using a large tip will heat up the joint faster. A little known fact, the size of the tip is more important than the wattage of the iron.

- Never Assume! - Only reconnect the bare necessities before putting everything back together.

Circuit Reliability

- Wave Soldering - Wave soldering, also known as flow soldering, is a method of mass soldering electronics assemblies by passing them, after fluxing, through a wave of molten solder. It's a quick and easy way to mass produce electronics. The Hot Rod Deluxe, as well as all other PCB amps, sometimes suffer side effects from this process. Whether missed joints were caused by poorly engineered machinery, or by the operator letting the solder or flux levels get too low, is unknown by me. It is therefore recommended that, after properly draining the filter caps, that we check for cold and missed solder joints. "Cold" solder joints are characterized by a dry/dull look. A bright fluorescent light and a magnifying glass will be most helpful when closely examining joints. I personally had no problems with my PCB after checking it, but I've heard otherwise from other owners.
- 5W 470Ω Resistors - This problem actually has much more to do with cold solder joints than the resistors themselves, though replacing the resistors may help long term reliability. The 5W resistors affect the 16V power supply used by the reverb, effects loop, and channel switching circuits. To learn how to fix this click here.
- Plate Load Resistors - Also caused by faulty resistors. Symptoms include a loud intermittent crackle or static or, in some cases, a very early and nasty sounding break up in the clean channel. This fix also has its own page located here.

Tube Reliability

Bias modestly. Buy tubes from a reliable source. Use a small personal fan at gigs and blow it into the back of your amp. In the United States these can be found at Walmart for less than US$15.

By Justin Holton