AUDIO PROBE EXPLAINED

An Audio Probe is an essential tool for the DIY pedal builder. This along with a test box, are tools you should have at your disposal for easier debugging when things go wrong!

They are both very simple tools to make

THE AUDIO PROBE:
Put simply, it allows the cable connected to your amplifier to be used to probe for a signal by touching circuit components with a probe end.

The guitar signal is carried from your guitar via a cable to the IN of your circuit via the INPUT jack through the effects circuit and back OUT via your output jack and a cable to your amplifier.

A guitar cable has 2 wires, the hot wire that carries the signal and the ground wire.

An audio probe simply separates these 2 wires adding a clip to the ground wire and a probe to the hot wire that carries the signal.

It is most definitely the quickest way for a DIY'er to debug problem builds.

This document explains how to build it, how you use it and the basics of tracing the audio path.

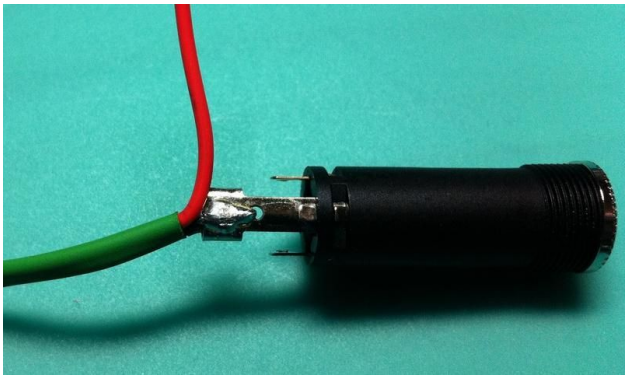
AUDIO PROBE COMPONENTS
Photo essay courtesy of Bruce Robertson (Pedalpartsandkits.com)

1. 100nF (.1uF) Capacitor preferably ceramic disc type. Smaller size is preferred. 16-100V rating is fine.
2. A few feet of stranded wire, preferably 2 colours such as red and black or red and green. Gauge is not critical, but we'll say in the 18-24 gauge range is fine.
3. A female 1/4 inch diameter Audio jack that is designed to be soldered onto the end of a wire; not the type that mounts into an enclosure.
4. An alligator clip or similar type device to attach the ground wire onto a circuit's ground point.
5. A paper clip or piece of solid core wire. Something to use as the probe tip which won't bend very easily. If you have an old multimeter test lead, that would be perfect and it already has the wire attached. In this document, a straightened large paper clip is used.
6. Some heat shrink tubing. Not necessarily required, but will help prevent a short and will provide wire stress relief.

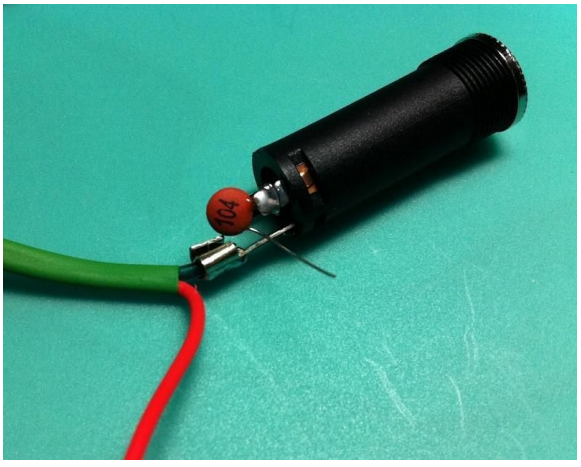
These parts are seen below:

CONSTRUCTION

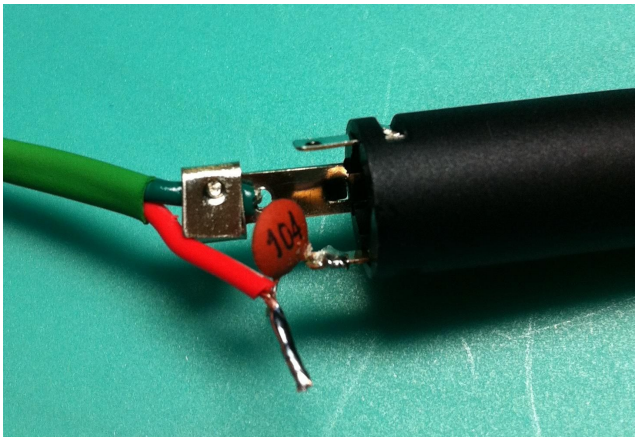
The female audio jack unscrews, to reveal the terminals. Mine is a stereo jack, so it has 3 lugs. We will only use 2 of those. Solder the ground wire to the lug for the sleeve, as seen below. You will notice in this picture that I put some green shrink tubing on the 2 wires, which I actually ended up removing a few steps later, so for now, ignore the heat shrink tubing, and just note that the ground wire is now soldered directly to the sleeve lug of the jack.



Next, solder one lead of the capacitor to the tip lug of the female audio jack as seen below:

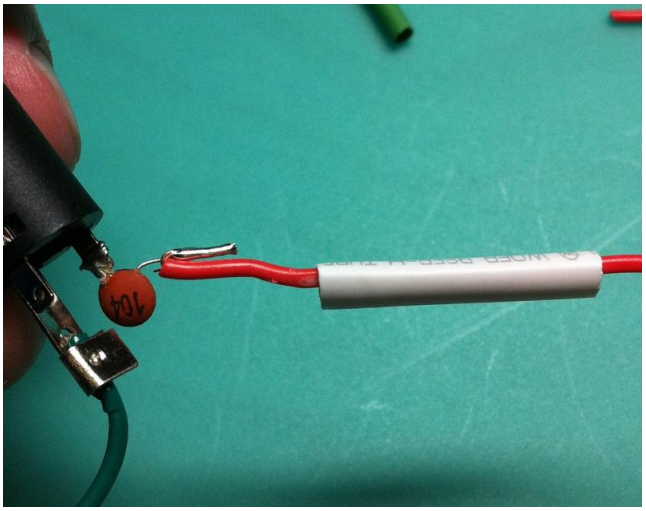


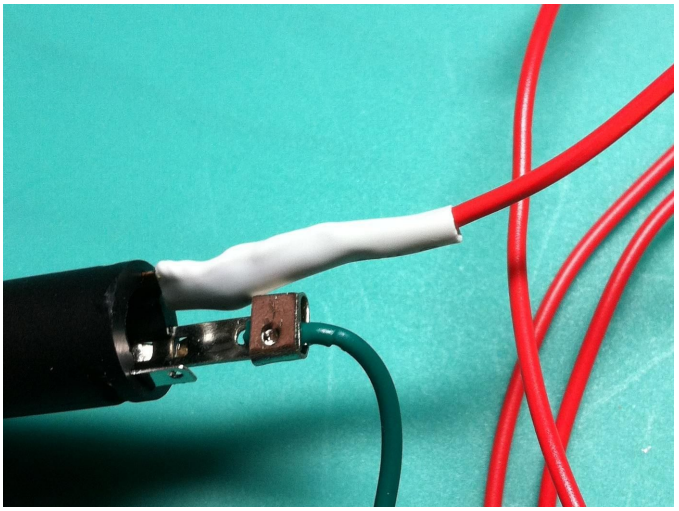
Then solder the probe wire to the other lead of the capacitor:



As I mentioned previously, I removed the green heat shrink. This was so I could take a larger diameter of heat shrink tubing, and use it to cover the solder joints of the capacitor. Here, I am about to slip the white heat shrink over solder joints and capacitor:

After heating the tubing a bit, it shrunk down over the cap and is insulating the solder joint from touching the adjacent ground wire.

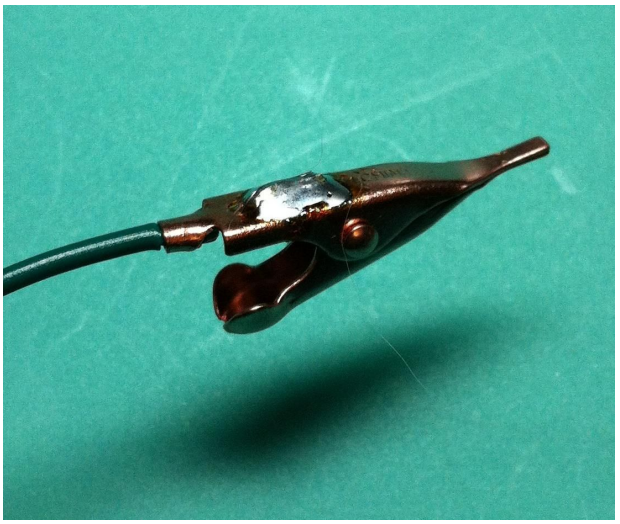




For some stress relief on the wires, I put a couple pieces of heat shrink tubing over both wires before screwing the female. Here's a picture of everything about to be screwed together:

And a picture of this end, assembled:

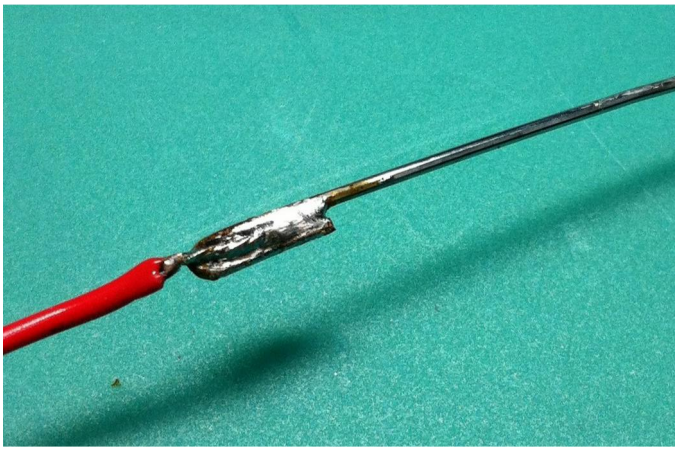
Next, we'll solder the alligator clip to the end of the ground wire. I recommend that you use the alligator clip's clamping clips to grab the insulation of the wire as this will prevent the wire from being stressed right at the solder joint. And here's a picture with that step completed:



If you used a multimeter test lead for the audio probe wire, then you are now done. You can ignore the rest of these instructions with the exception of the last paragraph which provides some guidance for safety. I had a multimeter test lead that I intended to use for my audio probe, but since I could not find it tonight, I decided that I would make my own using a large paper clip and some heat shrink tubing, as described next.

We are adding something rigid to the end of the wire that can be grabbed and aimed rather than trying to probe with something flimsy. I used a straightened paper clip, and bent the last quarter inch back onto itself, and did the same with the stripped wire. I locked them together and then soldered at a higher temperature than I typically use for circuit boards. This is because the large paper clip is fairly thick, and its length tends to pull heat away from the solder joint. We don't want a cold solder joint on our test probe, that's for sure. Don't worry! The paper clip can withstand much more heat than many electronic components. Once you're done, turn that soldering iron back down before you overheat your next circuit board.

Here's a picture with the paper clip and wire soldered together. I didn't worry too much about cleaning up the residual flux, but I suppose you could if you wish.



Next, I used 2 different diameters of heat shrink tubing to cover most of the length of the paper clip. This is to reduce the chances that it will contact other components by accident as I am probing around inside an enclosure, and to increase my ability to grip the probe since the paper clip by itself is pretty skinny and is fairly slippery. The heat shrink tubing may also provide some stress relief to the wire right at the solder joint by adding a little more stiffness.

Here's a picture of the competed Audio Probe.

Obviously, this audio probe is designed to accept a guitar cable. You could also take an old guitar cable, cut off one end, and solder on a clip to the ground lead and the capacitor and probe to the hot signal carrying lead. Then you would plug the 1/4 inch male plug directly into your amp while testing.

Personally, I think the design in the photo essay above is a little nicer, as you don't need to destroy one of your guitar cables, you can hook up any length guitar cable you wish, which is nice if your amp is 25 feet from your soldering iron, and this design takes up almost no space when not in use

USING YOUR PROBE

So you've built your circuit. You plug it in and it doesn't work! You've checked all the obvious possibilities, power to board, off board wiring, correct component values, and all seems good.

The fault lies somewhere in your circuit. So it's time to use the probe.
You will need to feed a signal through the circuit in order to check that audio is flowing through it.

You can use your guitar strumming it as you probe but this isn't the most practical way to send audio through because it leaves you with only one free hand!

You can use a looper pedal to send a recorded loop through the circuit freeing up both of your hands.

Any device that plays music or generates an audible signal will do the job your phone, mp3 player, or signal generating phone app, etc. There are adaptors available on Amazon, eBay etc that connect to your phone and a standard 1/4" guitar jack as well as many free function generator apps.

CDL Micro 0.5 m 50 cm 1 ft 3.5 mm Male Plug to 6.35 mm Female Stereo Socket Adapter Cable

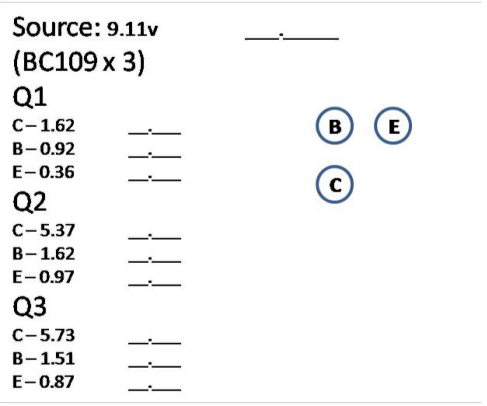
You will need a schematic of your circuit to follow the audio path in a systematic way.

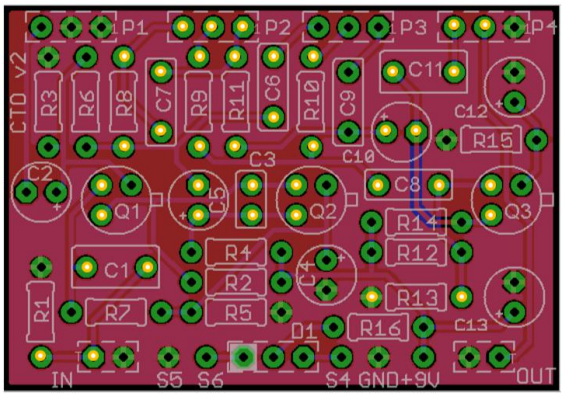
Below is the schematic for the gpcb Colortone Overdrive (CTO) with the audio path traced onto it in green. To begin probing, make sure your volume is set to a suitable level. (You don't want to jump out of your skin with your 1st probe if it's set to max!) Clip your ground to any ground point on the circuit. If it is already in an enclosure, you can clip it to a bare part of the enclosure or ground lug of the jacks etc.

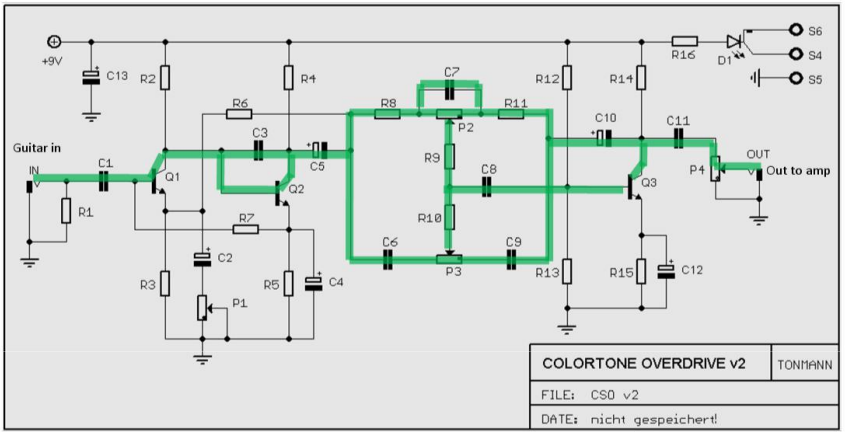
You should use your circuit build documents to identify the components on the pcb in relation to the schematic. Feed your audio signal into the circuit. Now, using the probe end, touch the probe to the IN pad. You should hear clean signal going in here. The next point would be the top of R1 on the CTO path, then through C1 to the base of Q1 and so on. It is worth noting that at each stage, you may hear differences in sound, e.g. through capacitors used for filtering, you may get an increase in treble or more bass etc. and coming out of a transistor used as an amplifier, the signal level will become louder.

You continue to probe **until you come to a point where no audio is present**. For example, on the CTO, you have audio going in at C5, but nothing coming out. You have found your problem area! Hopefully the only one!

The first thing to check would be for cold solder joints. Make sure there are good solid connections between the pad to the component leg. Look for solder bridges that are connecting it to something it shouldn't be. If the problem still exists, the next thing to check would be the capacitor itself. Once you have repaired the suspect fault, always check for audio at the OUT pad or OUT jack tip. This is to ensure that this was the only fault. Don't put away the probe until you are sure there are no more faults!







Tracing the Audio Path – by Tonmann

The audio path is the parts of an effects circuit that your guitar or instruments signal passes through

The audio path goes from the input jack to the output jack

If a component is grounded or goes to a reference voltage (usually designated Vb or Vref), it affects the audio signal but is **not** part of the audio path.

examples on the CTO would be – R3, R5, C4, R13, R15 on the ground side and R2, R4, R12, R14 and R16 on the power side you will sometimes get audio going to one side e.g. R3 top end but it is still not part of the audio path

Transistors - these have three terminals; collector / base / emitter for BJTs (Bipolar Junction Transistors) and drain / gate / source for FETs (Field Effect Transistors).

For 99.99% of the circuits you will see, the base / gate is used as the input and either the collector / drain **or** the emitter /source is used as the output. (The exceptions are usually electronic bypass switching found in some commercial pedals).

There are a few circuits where both collector / drain **and** emitter / source are used as outputs (Q2 of the MorC Compressor), usually only one of these is connected towards the output jack.

Tracing the audio path is very much like "join the dots" in that you have to get from the input jack to the input of the first active component, from the output of the first active component to the input of the second active component and so on until you reach the output jack.

A good exercise to gain practical experience of tracing an Audio Path would be starting with a simple circuit follow the information above, plot the path onto the schematic and then audio probe the circuit to see if it is accurate.

The more you do it the easier it becomes in most cases a basic audio path is all you need to probe and find your fault area. Do remember that audio probing leads you to your problem area and not what is faulty. Further visual and other testing methods may need to be carried out to find and resolve your fault.

Soldering Tutorial on Youtube