

Repeater Noise Reduction Modification



The following modification reduces output noise in the Electrix Repeater by more than 25dB, allowing the product to be used in a studio or other critical setting without adding appreciably to the noise floor. In the Repeater, the digital and analog circuitry share a common ground, and this is the source of nearly all the various noises that the machine suffers from. The modifications address this problem as well as the “tick-tick” sound that is present when playing back off the CF card.

This is not a project for the faint of heart. Quality tools are required as some of the work involved is not possible with cheaper gear. Additionally, a good amount of experience with electronics is required. There is a lot of information missing from these pages, information regarding common electronics practices that would be too voluminous to include here. The bottom line is, if you have any doubt as to your skills and abilities, take these instructions to a qualified tech person and have them do it for you. The instructions are pretty straightforward here, but a qualified tech can correct his mistakes while the more clueless of us are left scratching our heads.

Peter Toms and Terry Robb of Condor Electronics came up with these modifications and I applied them to my own Repeater, documenting the process and revising some of the notes that Peter gave me. As I fall somewhere in the gray category between qualified and clueless, I thought it would be a good test of how possible these mods would be for someone of my skill set and tool collection. As it was, it almost got the best of me. I was totally stumped at one point and had to bring the unit in to Peter (who immediately located the problem...). I can say that I'm extremely happy with the results. The increase in quality of sound is very perceivable to my ear, both with and without the use of the CF card.

The most important tool needed is a high quality soldering iron, supplied with a fine point tip in good shape. A variable heat soldering station is also a good idea. Very sharp wire cutters/dikes with fine tips are needed, as well as dental probes, various screwdrivers, socket sets, allen wrenches, and solder removal tools, either a suction type tool or a solder wick. Extra wire for extending the ground, 22 or 24 AWG is good. You can also use the solid copper wire found in telephone wire cable. Magnification, good light source, and a set of alligator clips on a stand all come in handy.

With all the caveats taken in stride, let's rock...

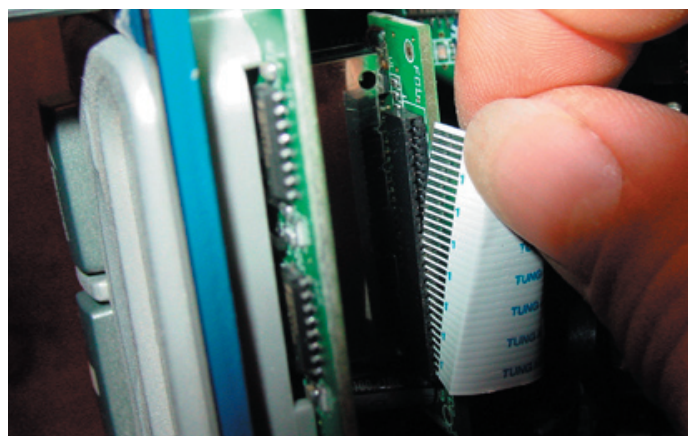
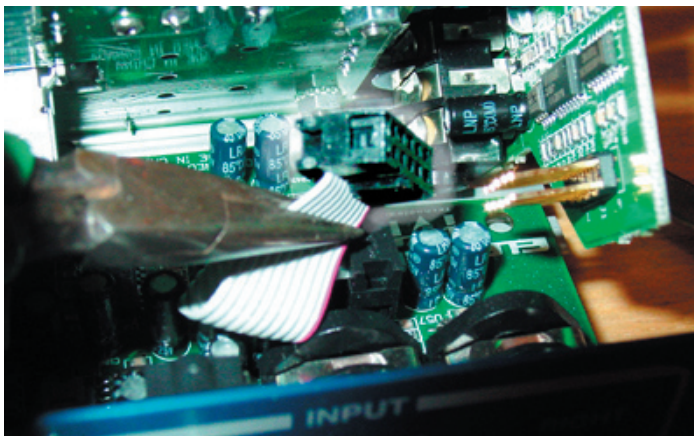
Stephen

Noise Mod for Repeater MK I

There are two types of noise in the product. The first and loudest is the CFC tick when playing off the card. The second is the singing hum that is a result of the power-hungry front panel LED's polluting ground for the audio. These taken together result in a -50 dB or so noise floor with all faders maxed, very objectionable. The mods bring the total noise floor to -75dB with all faders and input level maxed, very quiet, and creates a studio quality recording tool.

There are 5 mods that all involve separating audio ground from digital ground, mostly on the front panel, which is the source of almost all the noise in this product. It's somewhat involved, and takes a delicate soldering iron as well as removing, disassembling the front panel, and then re-assembling it. Anyone who has some tech skills should be able to do this in an hour or three. If you don't want to do the mod yourself, you can send it me and I will do it for \$95.

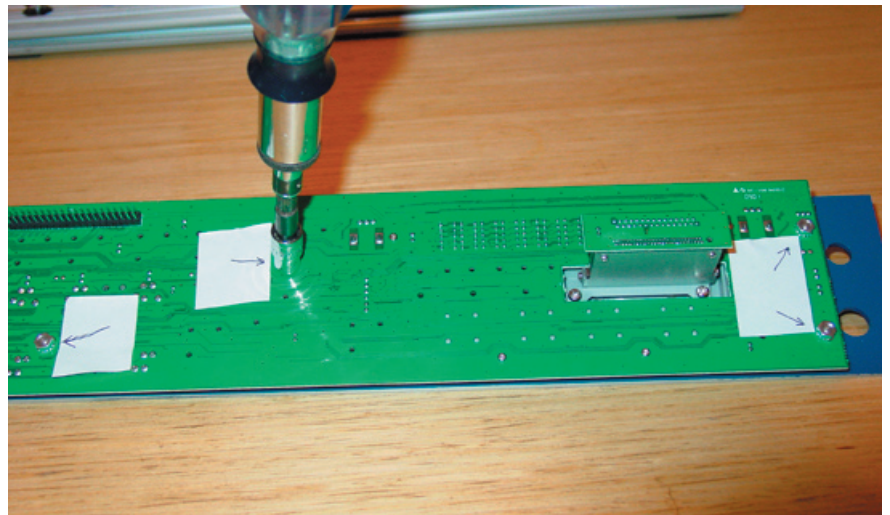
Disassembly: To begin, remove the top aluminum panel from the Repeater (7/64" allen wrench) exposing the two large PC boards and two auxiliary PC boards. Remove the large gray 40-pin ribbon cable from the front panel and the smaller gray 10-pin ribbon going to the input jack on the front panel. Remember how this cable goes on!!! Mark it so you don't forget. Pull out the white plastic 30-pin flat ribbon from the CFC reader, leaving it still attached to the Main or lower PCB.



Lift out the front panel as an assembly. Take off the headphone level knob, the four fader knobs, and the input level knob. These simply pull off. Take off the Headphone jack nut (12 mm) and remove the assembly. Take off the Input level nut (1/2" deep socket) and jack nut (12 mm) and remove the assembly. Remove the 3-pin connector from the main PC board.

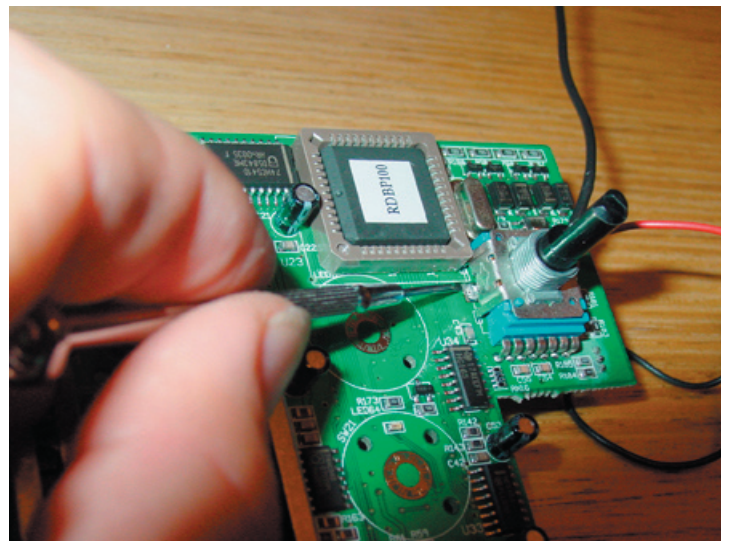
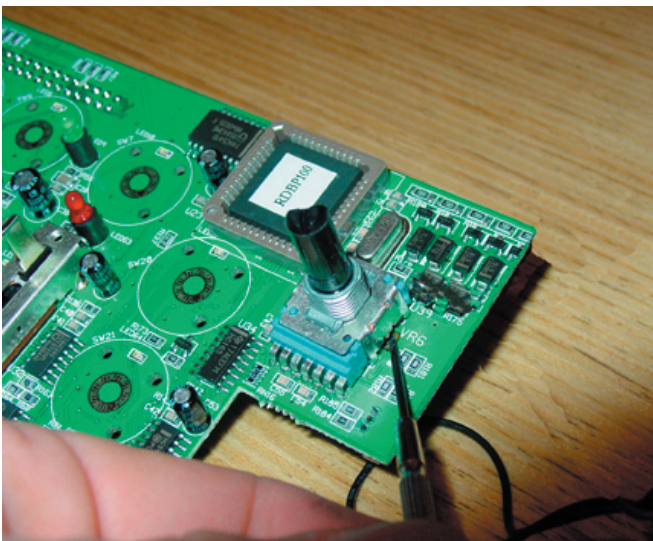


Unscrew the nut on the Headphone level pot (1/2" deep socket) and 4 hex nuts (1/4") on the back of the front panel PCB. Turn the panel face up and lift off the metal panel separating the assembly. Make sure the four white plastic standoffs remain with the metal panel. All the clear plastic actuators are loose and will fall off as soon as you tip the PCB over. Try not to touch the gold plating under the actuators, or the black contacts on the underside of the actuators themselves.



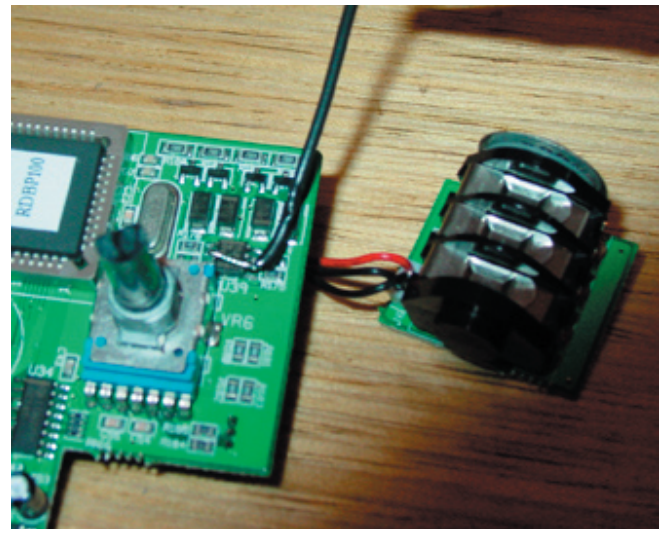
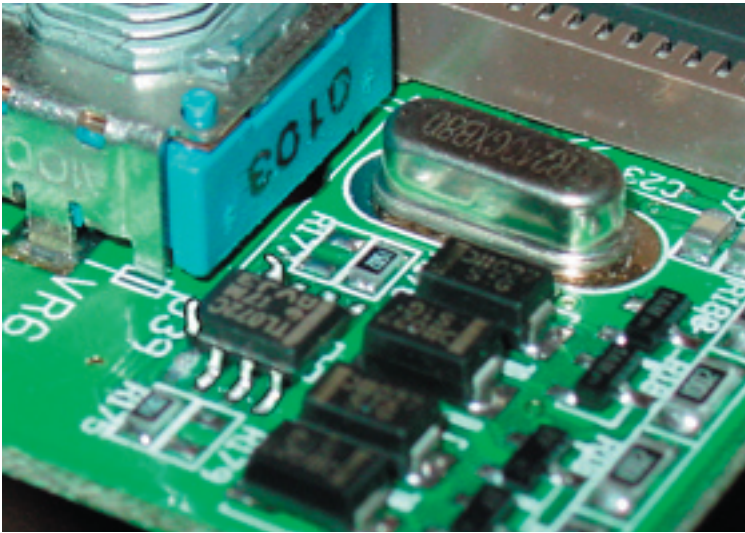
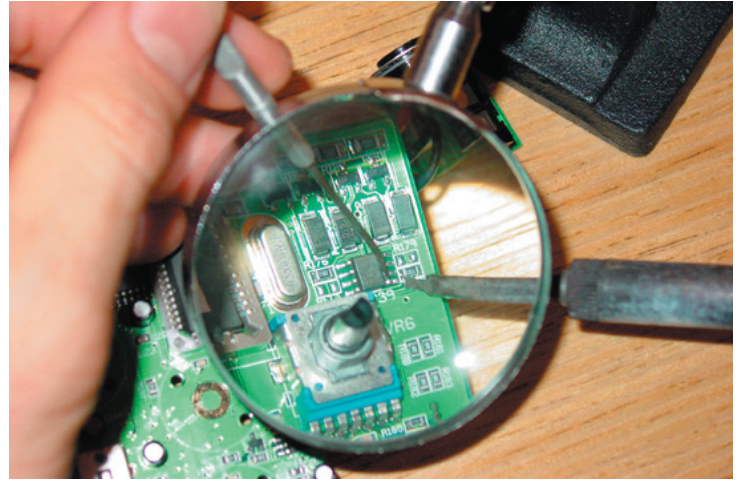
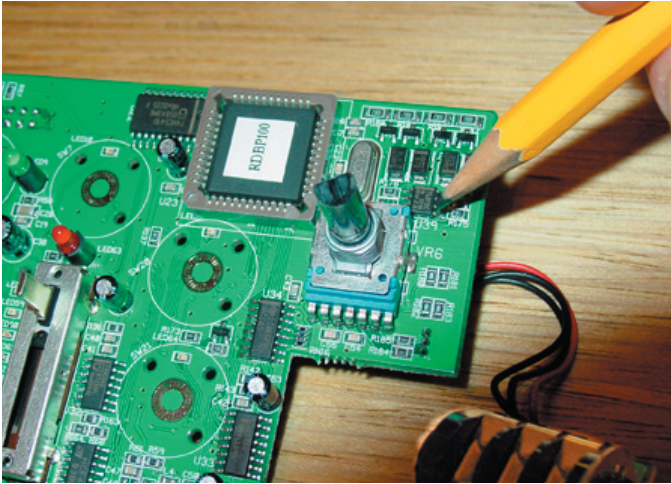
Observe that one of the actuators is larger and note where it goes, Tap Tempo. Observe also that each actuator has three plastic tits on the bottom rim, the Tap Tempo has four tits. These must be properly aligned when replacing the actuators during reassembly.

Mod #1: Locate the headphone level pot on the PCB and observe that it has seven signal pins and a threaded metal body shell that connects it, along with the seven signal pins, to the PCB. The shell stands on four metal corner legs and two middle legs which extend down through the PCB. Using the cutter, clip away the two legs of the shell that connect it to the PCB. Remove the legs from underneath. You can bend the pot up on its seven remaining pins slightly out of the way once the legs have been clipped to facilitate removal of the two ground pins. The other four standoff legs are ok; simply leave them as they are.

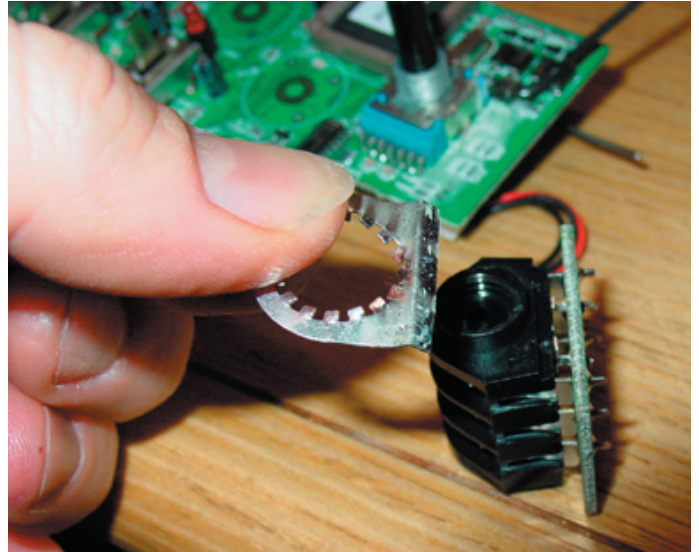
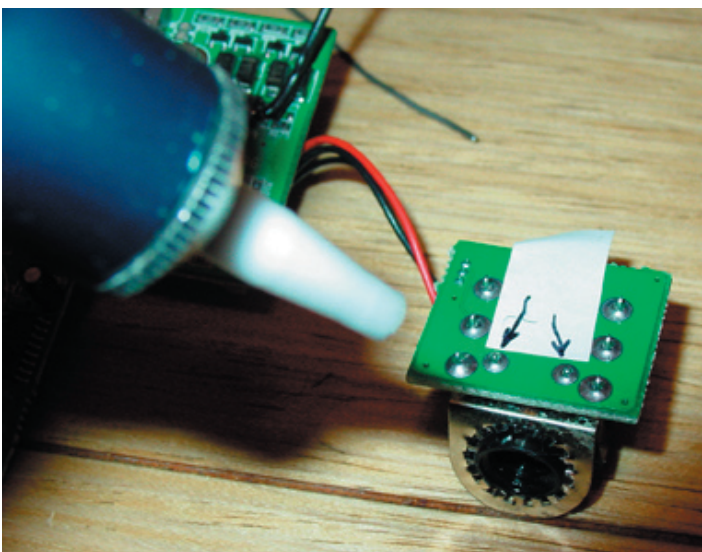


Locate the IC U39 directly above the headphone level pot. Observing the upper left as pin 1 count counterclockwise to upper right pin 8. Using a fine point soldering iron and a dental pick, GENTLY lift pins 3 and 5. This is crucial. Don't do this unless you can do it right. Bend the pins up and over the top of the IC, resting on the back of the IC. Don't break them off or you'll have no headphone output. Take 8 inches or so

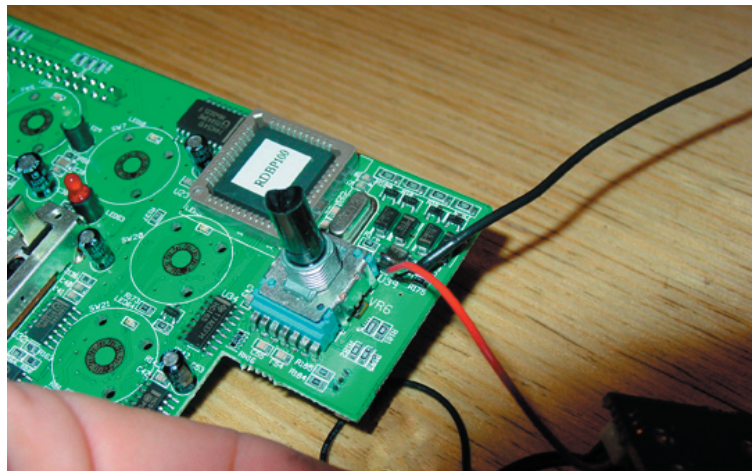
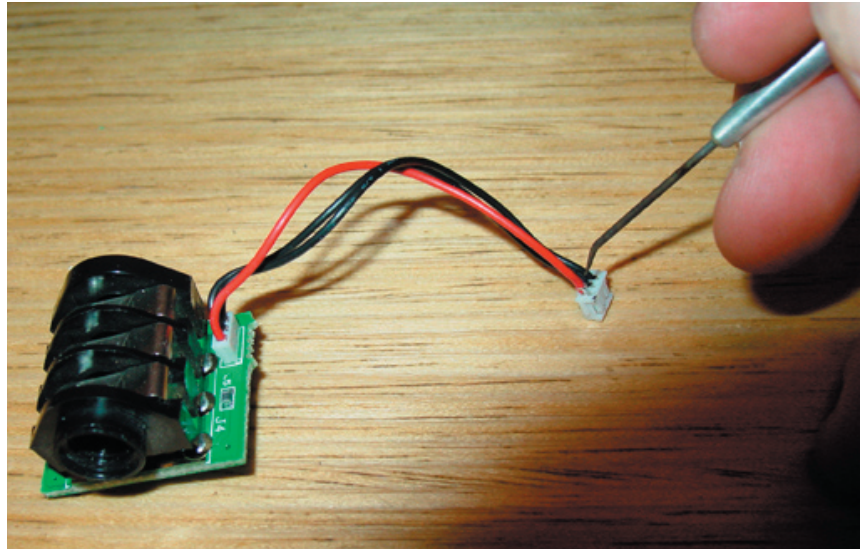
of insulated wire, strip one end and solder that to the bent up pins, connecting them to each other. This is audio ground. Make sure not to splash solder around. This is delicate work! Leave the other end hanging for later.



Pick up the headphone jack assembly. Using solder wick, remove the solder from the PC pins connecting the toothed metal washer ring at the front of the jack. Cut away the toothed ring. This metal ring must be completely removed. It's OK to leave a small remnant under the jack attached to the PCB so long as it does not touch the front panel metalwork at all.

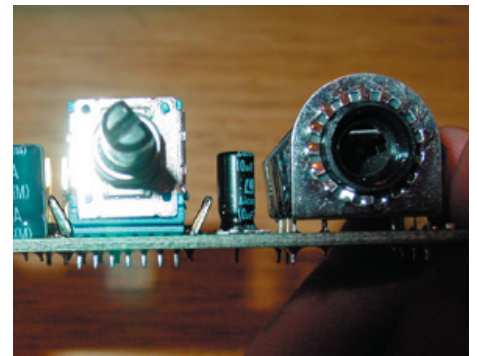


Observe three wires going to the white plastic 3-pin connector. Using the needle probe, remove the red wire from the connector leaving its metal crimp intact. Poke it in from the top to remove. Solder this red wire crimp to the bridge you made between the two pins 3 and 5 on U39. Now the headphone jack is permanently connected to the PCB. Make sure the two pins (3 and 5), the red wire crimp, and the length of wire are all connected on top of U39. Alternately, you can solder this red wire prior to connecting the wire to pins 3 and 5 on U39. OR, just burn away some insulation about 2" up the ground wire you just added to U39, solder the red wire on there (with the crimp removed and the end of the wire stripped), and cover with electrician's tape.



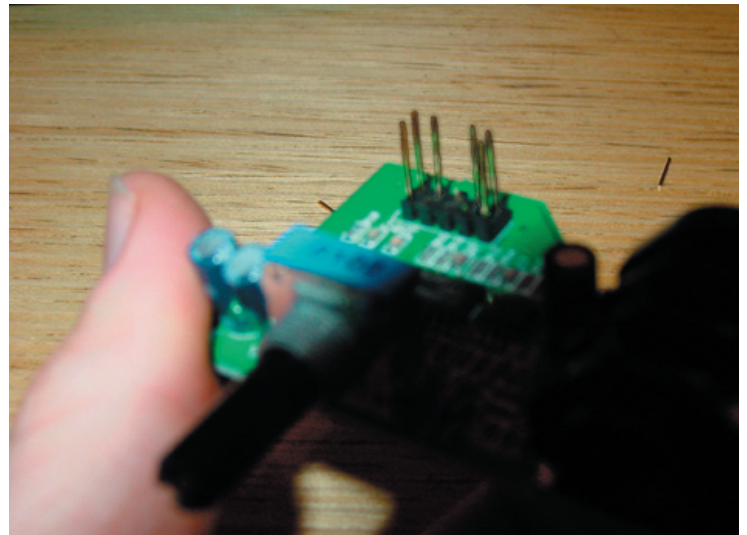
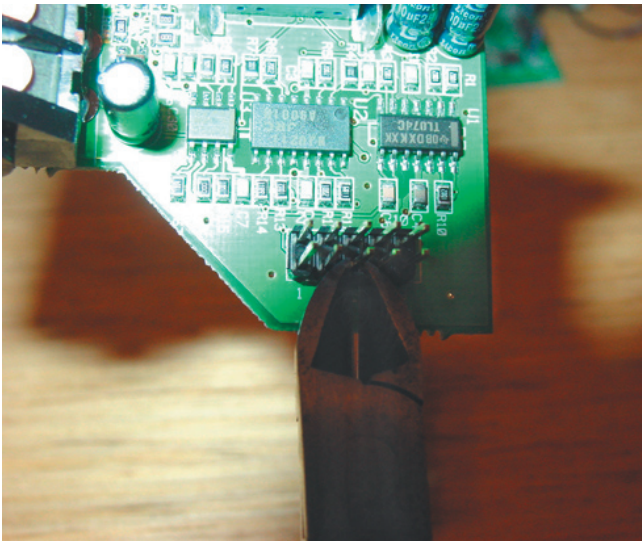
One of the difficulties involved with the whole process, is the delicate nature of wires being connected to IC's like in the previous step. These wires put a delicate strain on the IC, which may break off at some future point, especially during the mod process. Treat these wires with utmost care, don't pull on them, and rout them along the PC board so that they don't get pulled during reassembly. Using solid core telephone wire can help this process as it doesn't put as much strain on the delicate components when it is tugged.

Mod #2: Input level pot. Now move over to the input level assembly. This is located on one of the auxiliary PC boards. The input level pot stands vertically off the board, but also has a metal body shell that frames it, connecting it to the PCB. Observe that the legs have a small outward bend in each one. Clip each leg at this bend. This is tight and rather hard to do as the legs are big, but be bold, just do it and cut them in half and bend the remnants outward slightly so that they do not connect. You don't have to remove them. Leave the frame on the pot and make sure the wrap-around shell is still tight around the pot. Don't damage the capacitors that are next to the legs. The pot should be standing connected only via its signal pins.



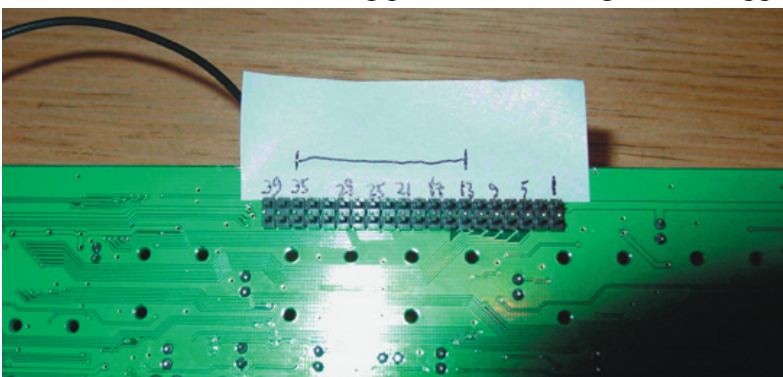
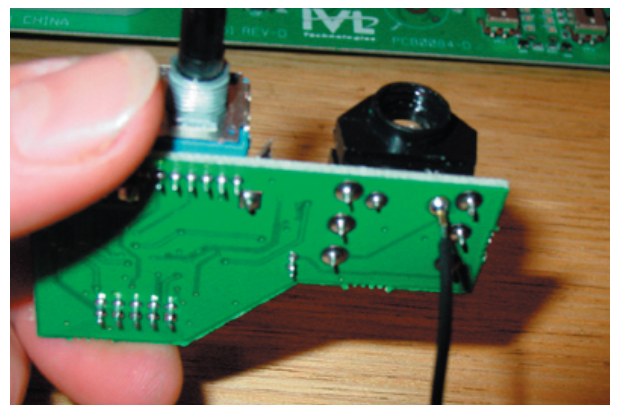
Cut away the toothed ring on the input jack. As before it's OK to leave a small remnant under the jack so long as it does not touch the metal work.

Observe the 10-pin ribbon cable header. Pin 1 is labeled, as is pin 9, odd pins in one row and even pins in the other. You must cut off pins 4, 5, 6, and 8. These are the middle three pins of the even row and the middle pin of the odd row.



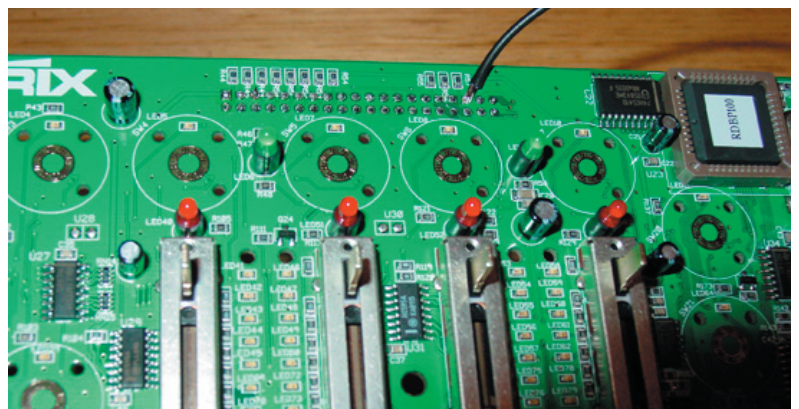
Cut a 16-inch length of wire and solder one end onto one of the holes where you removed the toothed metal ring. This is audio ground for the input level pot.

Mod #3: Front Panel Re-ground. Observe the main 40-pin ribbon cable header J3. The odd pins are in the top row, and the even pins are in the bottom row. Pin one is on the upper right if you are looking at it right side up with the “J3” above the pins. Pin 2 is just below it. Pin 39 is on the upper left. Remove pins 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, and 35. These are 12 ground pins all in the top row, the 7th to the 18th pin in that row, right to left. Be very careful, count and mark the pins before you cut them so as to get it correct. If you cut the wrong pins you will disable your Repeater completely. There should be two remaining pins on the far left, and six remaining pins on the far right in the upper row of pins.

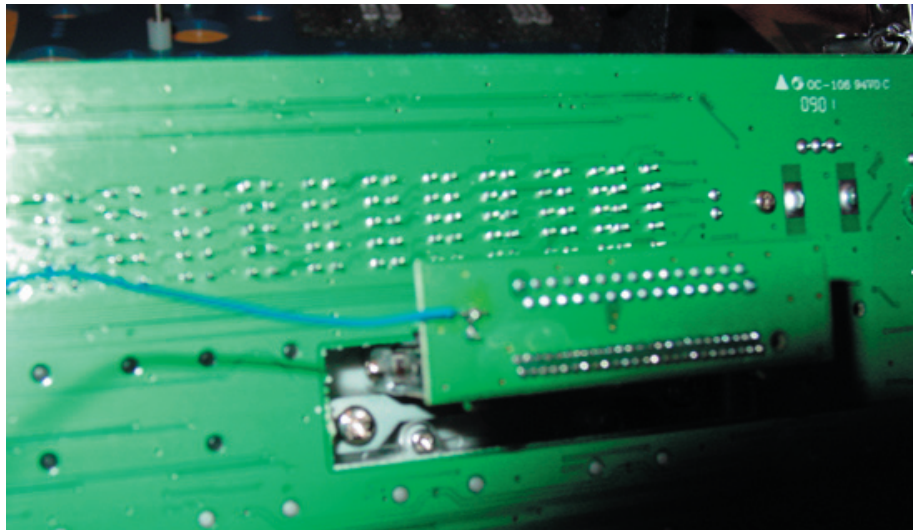


The 40-pin cable can be turned end for end and reinstalled. This just gives you a little extra length to work with though it's not necessary. Do be careful when attaching this cable as it can be reattached with the pins misaligned (ask me how I found this out). Make sure that pin 1 is going into the first hole and not the second one.

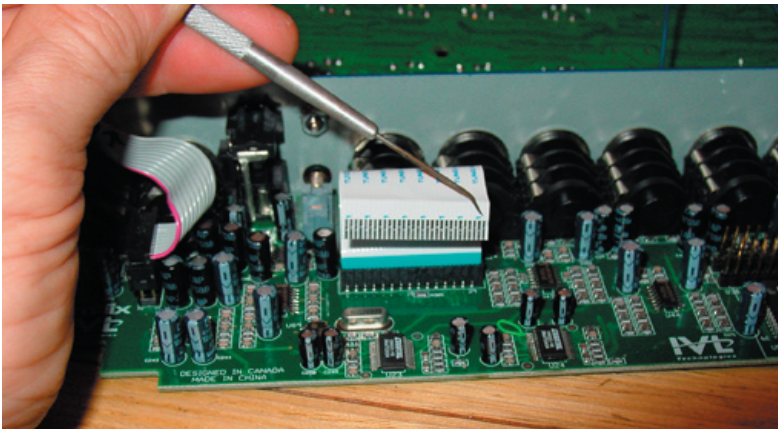
Cut a 10-inch length of wire, strip one end and solder it to the pc end of Pin 35 on the header, on the other side from where you cut off the pins, directly beneath R57. This is digital ground for the entire front panel.



Mod #4: CFC Reground. Observe the CF reader assembly and note the large electrolytic capacitor C3. It has a white stripe on one side indicating that it's a ground pin. Cut a 12-inch length of wire and solder it to this pin, the one away from the metal shell, on the bottom side of the PC. This is CFC digital ground.



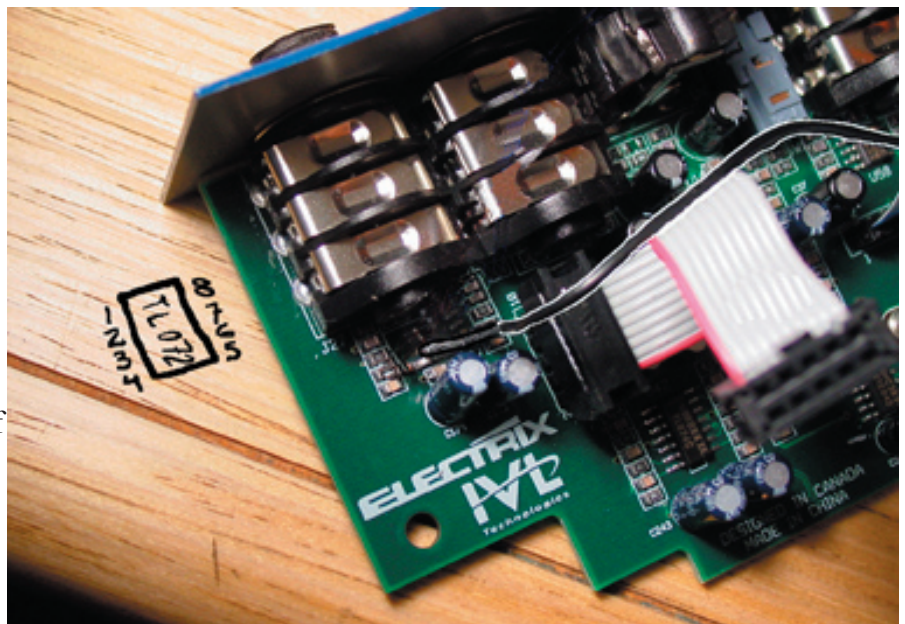
On the main PCB still in the metal chassis, looking from the front, observe the white CFC reader flat cable still attached to the PCB header. There are 30 metal fingers on the loose end of the ribbon. Using your dental pick, remove the right-most pin (pin 30), by simply scratching it off. This takes a bit of doing, be gentle. Be careful not to damage the plastic backing, as you need it to register the cable in the reader header.



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Mod #5: Input Buffer Re-ground. Look at the main PCB still in the metal chassis, and observe U57 right next to the Right Line-In jack. It's an 8-pin TL072 opamp, and pin 1 can be located by observing the orientation of the printing on the IC and looking at the lower left corner. Moving counter-clockwise, the pins

move numerically until you reach pin 8, directly above pin 1. Remove the 10-pin cable from the main PCB before going further. Using the soldering iron and dental pick, GENTLY lift pins 3 and 5 as before and connect them together with one end of a 16-inch length of wire. This is very tight and very hard to do so make sure you have lots of light and magnification. The solder they used is very hard. You sort of have to heat them and gently pry them up. Don't break them off or you will have no rear inputs. Try not to burn the two caps next door, in fact you can remove them prior to working on the IC. Just make sure you remember their polarity orientation before removing them. This is the hardest part of the entire mod procedure.



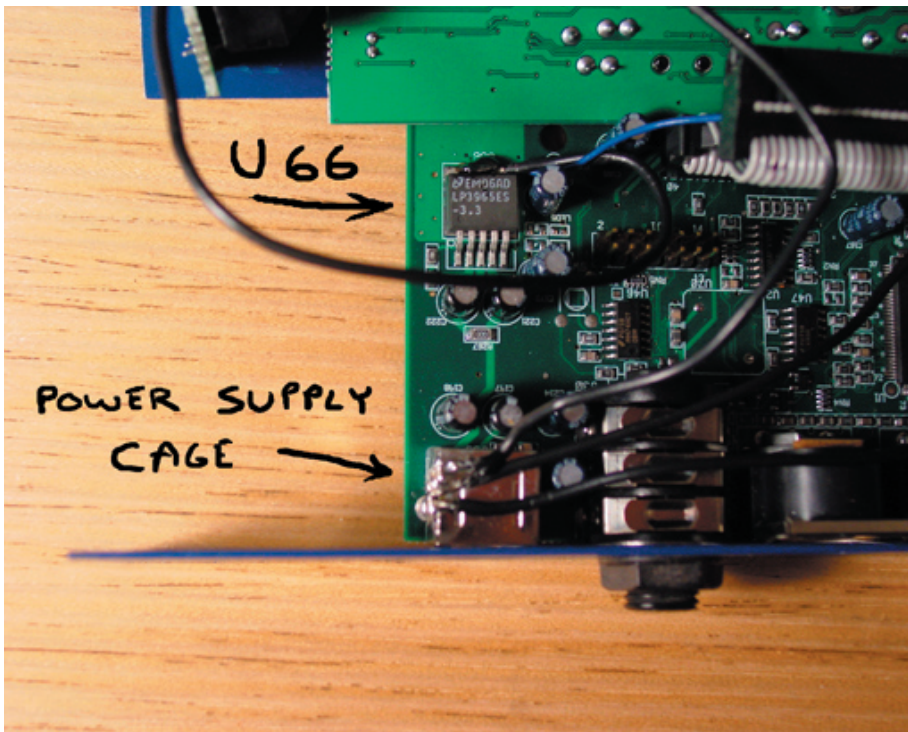
Now replace the gray 10-pin ribbon onto the main PCB with the red wire lined up on Pin 1 towards the front.

Re-assembly. Place the front panel PCB facing upwards and replace all the plastic actuators, fitting their locator pins correctly. Pick up the metal panel, making sure the white standoffs are still in place on the screws, and the clear plastic meter lenses are in place, and slowly lower it down rocking it slightly as it comes in contact with the PCB. Make sure that all the actuators are still located, the lenses are in place, and the standoffs are in place. This is a juggling act. You can ease this by squeezing the standoffs with your pliers to make them stick on the screws better. Now, replace the four nuts and gently tighten them up, checking that the front PCB and the metal panel are parallel and not deforming.

Re-attach the Headphone jack assembly. You will want to add the plastic or fiber washer between the jack and the panel for spacing reasons. This assembly is placed so that the PCB faces outwards and the jack is inside the cut-away.

Re-attach the input jack assembly using the clear plastic washer on the input jack.

At this point, take the ground wire from the input buffer mod, the wire from the input jack assembly, and the wire from the headphone assembly, and solder all three to the metal cage surrounding the power supply input jack on the main PCB. This takes a bit of heat to do correctly. You can also slide the wires into the crack on the side of the cage and solder them there.



Take the remaining two wires from the CF reader and the 40-pin ribbon header, and solder them to the large tab of U66, the 3.3 volt supply regulator near the power supply input jack.

Slide the assembly back into the metal chassis. Re-connect the white flat ribbon to the CF reader. Reconnect the 10-pin ribbon to the input jack assembly, being careful to get the direction correct. The red wire end goes to pin 1 on the jack assembly. If you put it on backwards, it will blow up the input amps and you will have no audio. There are only 6 of the 10 pins, so there's a little juggling to get it on correctly.

Dress the new ground wires into the chassis so they don't get caught, and then put the top back on and install the four hex head screws. You're all done!!!!

Fire the unit up and enjoy the quiet. Best of luck,

Peter Toms
Condor Electronics Inc.
Seattle WA 98103

After words

These mods address the most egregious of the noise problems. There are more. However, the returns lessen dramatically with the amount of work it would take to further address the remaining issues. They seem to all be related to the digital ground polluting the audio ground. We have achieved a -75db noise floor, up from -50db. Don't get greedy.

As the guinea pig in this project, I fell into a few traps that my lack of experience led me into. I ended up purchasing a new Weller soldering iron (\$125) so that I could do some of the trickier work. In the process I was able to document and photograph my work so that others with similar skill and experience could follow in my steps. Once again, I recommend this work only for those with access to high quality tools and with plenty of experience. Peter has expressed to me his concern about putting this mod out for public consumption; I have in turn proved both that it can be done and that it's really pretty tricky. The last thing either of us want to see are people unable to use their Repeater. Don't attempt these mods on your own unless you are comfortable with the thought of sending your unit off to Peter to have it repaired. You may end up spending as much as if you sent it off to him to do all the work in the first place. And if you don't have the proper tools already, it is much cheaper to have an experienced tech do it.

Last thing. Peter is a very busy person, running Condor Electronics and all, and he isn't able to answer a whole bunch of questions related to Repeater modifications. Thus I have offered to act as question buffer. I know somewhat what I'm doing and I've done the process myself. If you have any questions feel free to shoot me an email. Thanks,

Stephen Golovnin Vsyevolod at Yahoo dot com