Construction of an Experimental Tetrahedral Ambisonic Microphone

Dan T. Hemingson
The University of Texas at Austin
Austin, Texas 78712, USA
dhemingson@mail.utexas.edu

PLEASE READ ALL OF THESE INSTRUCTIONS BEFORE BEGINNING.

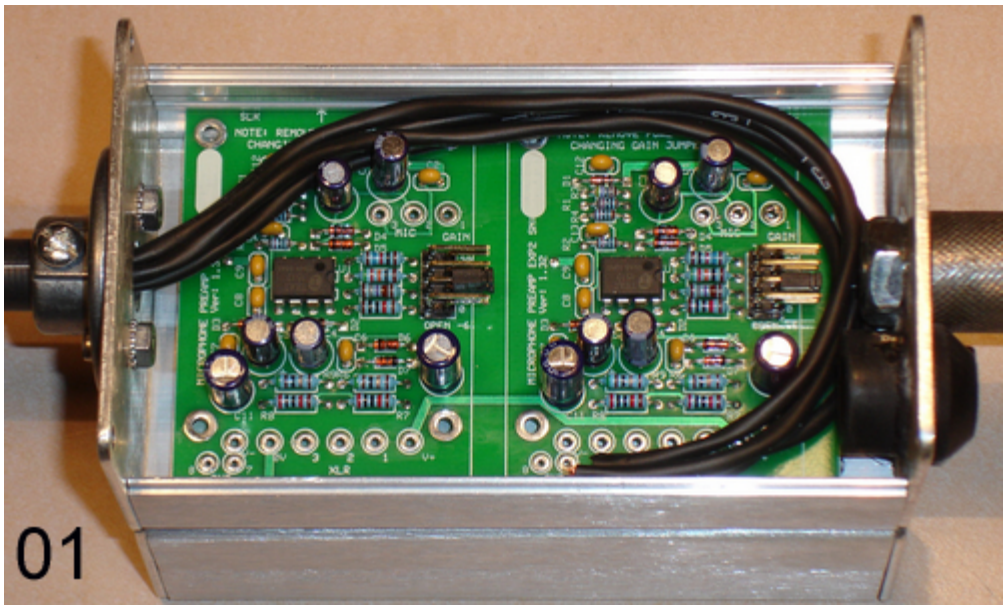
Microphone final construction:

Parts list:
1 Board, 2.5x 3.5-inches FR-4 copper clad
1 Capacitor, .047uF ceramic
2 Holders, 9-volt battery
1 LED, yellow, 3mm
8 Nuts, 2-56 stainless steel
2 PC boards, stuffed
1 Resistor, 10K 1/4w (brown-black-black-red for 1% resistor)
8 Screws, 2-56x1/4 round head stainless steel
Shrinkable tubing, 1/8-inch
Shrinkable tubing, 3/8-inch
Shrinkable tubing, ½-inch
Plastic tubing, ¼" OD, 1/8" ID x 4-inches
16 Washers, 2-56 internal lock
4 XLR connector boot inserts
Microphone cable, Mogami W2931 quad-pair or equivalent
2 Batteries, 9-volt
4 Connectors, male XLR cable

Tools and materials needed:
Drill with 1/16" bit
Fine felt-tipped pen
Pliers or 3/8" hex wrench
Pliers, needle-nose
Screwdriver, small flat blade
Screwdriver, small Phillips (that you can keep in your recording kit)
Shrinkable tubing heat gun (optional)
Soldering iron, pencil type
Solder
Superglue (fresh)
X-Acto knife or equivalent

Process with pictures:
Note: Some things are better described in pictures. I tried to do that as much as possible; at times I used the timer on my camera to show things that required my two hands. There are times that the length of the timer was too short to get things in front of the lens, and I will describe those in text! The numbers of each step match up with the picture numbers. Picture numbers are 2-characters wide since most computer programs, even photo software, look at alpha-numeric increments rather than numeric ones.

CAUTION! You will be dealing with HOT wires and MOLTEN solder. All of it can burn you if you do not let it cool before touching. This includes the tools that are often used both to hold parts in place and as heatsinks to keep from destroying the component.



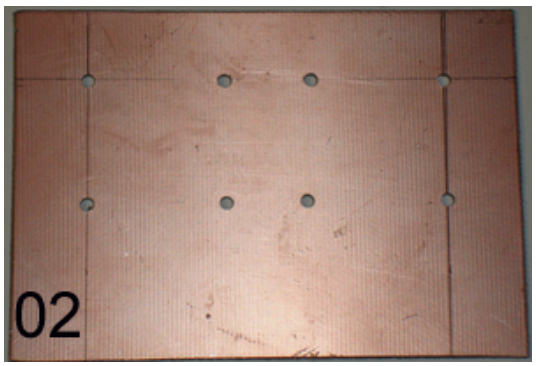
01. The enclosure which houses the preamp pc boards will be called the electronics box. The enclosure which houses the batteries will be called the battery box.

You possibly admired your work at the end of the last installment and attached the tetrahedral to the clamshell pair and slid a pc board in as well. Yes? Hopefully you have taken some pictures along the way.

If so, remove both the tetrahedral end plate and the mic stand adapter plate from the clamshell pair. Do not misplace the screws. The blank end plate may be left attached to the center clamshell pair. Be careful to not scratch the clamshells. Use a cloth or paper towel to keep them safe.

First is the construction of the battery mounting plate:

If you purchased a 3” x 5” sheet of FR-4 board, carefully mark and cut it in half with a shear or tin snips. The final size is 2.5” x 3”. Confirm that it fits into the bottom board slot of one of the clamshells. You may need to sand or file the cut edge (just like you may have done with the PC boards) so it will slide into the slot.



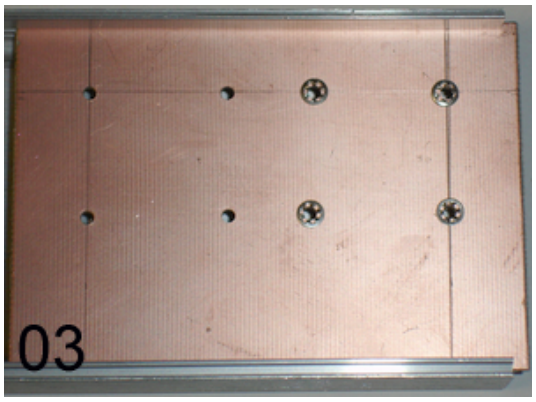
02. Mark a line ½-inch from one long edge of the plate. Call this line the top line and orient the board so the top line is at the top. Mark a second line perpendicular to the top line at ½-inch from the right edge and a third line ½-inch from the left edge.

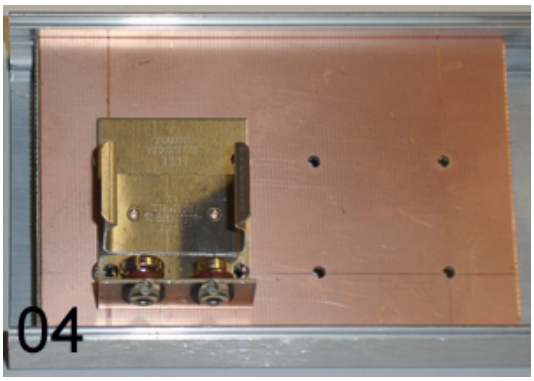
Place a battery holder (connectors at the top) with the upper right mounting hole centered over the upper right crossing marks and with the lower right mounting hole centered over the right edge line.

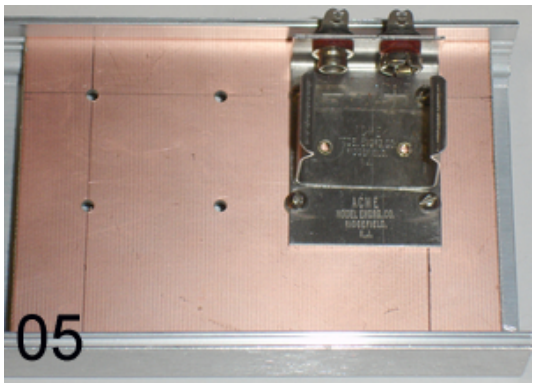
Keep the holder in place while you mark the 4 mounting holes with a pencil. Repeat the process with the left battery holder, left edge line, and the left mounting holes.

Drill the plate at the 8 marks with a 3/32-inch drill.

There are 2 methods described to mount the battery holders to the plate. Use whichever one works best for you. First is steps 03-05. Second is steps 06-07.



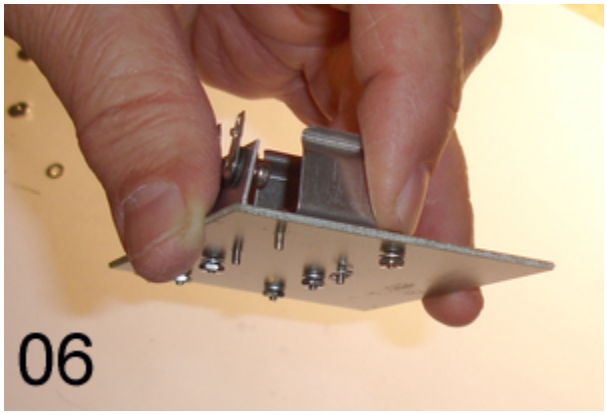




03-05. Use one of the clamshells to hold the board. (Be careful to not scratch the outside surface of the clamshell.) Slide the drilled board into the *top* groove of the clamshell.

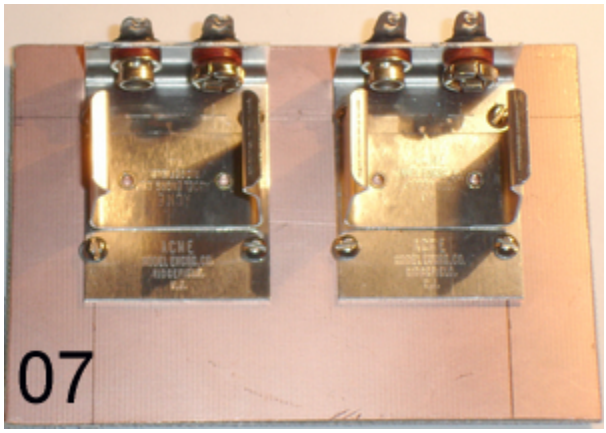
Put a 2-56 lock washer over each of the 4 holes of one of the holders. Hold one of the holders in mid-air (Figure 6) and put a 2-56 screw into each mounting hole. Once in place, slide the plate out so the bottom of the outside screws are accessible, place a 2-56 lock washer and a 2-56 nut on each screw. You will have to put a finger on each screw head to keep it in place. Do not tighten the screws yet. Repeat this with the second set of screws. Repeat for the other battery holder.

Visually align the two battery holders on the plate and tighten all 8 screws. Rotate the wiring tabs on the end of each mount with pliers as shown in Figure 08. Go to step 08.

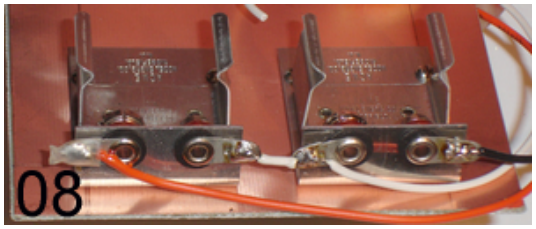


06-07. Alternative method not using the clamshell: Put a 2-56 screw into each of the 2 top holes of one of the battery holders. Hold the battery holder in mid-air with your thumb and third finger holding the screws in place with your index and middle fingers. Turn it over so the battery holder is upside down. Put a 2-56 lock washer on each screw.

Now put the screws into the appropriate mounting holes of the board. Keep the board upside down and place another 2-56 lock washer and a 2-56 nut on each screw. Do not tighten the screws yet. Turn the board right side up. Slide two 2-56 lock washers between the bottom pair of holes of the holder and the board. Now repeat the process to place the washer and nut on the bottom of the board for each screw. Now repeat this entire act with second battery holder.



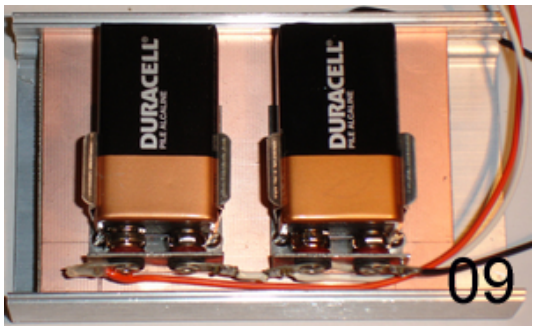
Visually align the two battery holders on the plate and tighten all 8 screws. Rotate the wiring tabs on the end of each mount with pliers as shown in Figure 08.



08. Strip the end of an orange wire and solder it to the left hand (+) tab of the left hand holder as shown in the picture. Cut a small length of 1/8-inch shrink tube and place it over the end of the tab. Shrink it and cut off excessive tubing while the tubing is still hot.

Strip the end of a white wire and put it into the tab of the minus (-) terminal on the left-hand holder (from the perspective of Figure 8). Solder it. Mark and strip the same wire so the end will fit through the tab of the right (+) side of the right holder. Push it in place but do not solder. Strip the end of the remaining piece of white wire and push it into the tab with the previous white wire. Solder both wires to the tab. There is no space for shrink tube to be used here.

Strip the end of a black wire and solder it to the right (-) terminal of the right battery holder. Solder it. No shrink tubing needs to be used here.

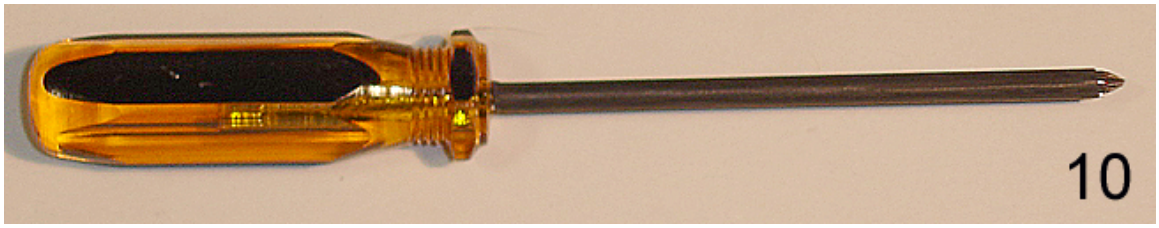


09. Slide the board into the bottom slot of a clamshell. Check that none of the bare wires or tabs make contact with the frame of the battery holders nor make contact with the edge of the clamshell.

Install a 9-volt battery into each holder. Align the terminals of each battery with the terminals of the holder. Press each battery downward into the springs, then move the battery toward the terminals and snap them in place.

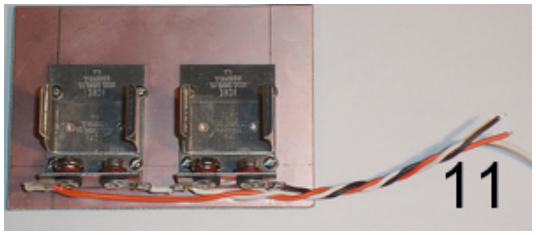
The purpose of this test is to confirm that the battery holders are positioned on the plate correctly. Although it is difficult to tell from the angle of the picture, there should be ample space at the bottom of each battery to easily remove it from the battery holder terminals. Now is the time to make any necessary adjustments.

If you have a voltmeter, check that there are about 18 volts from the orange to black wires.

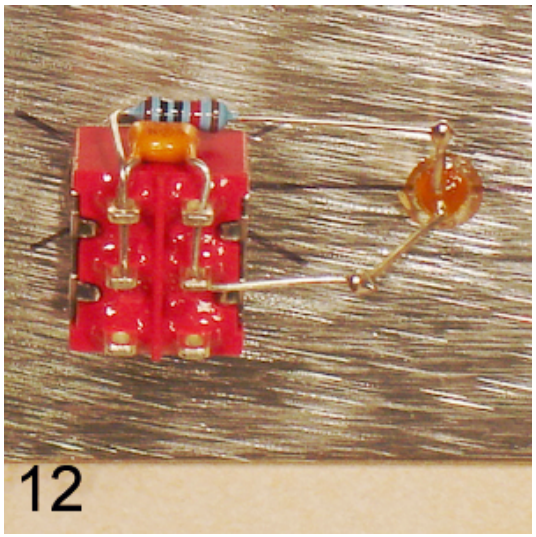


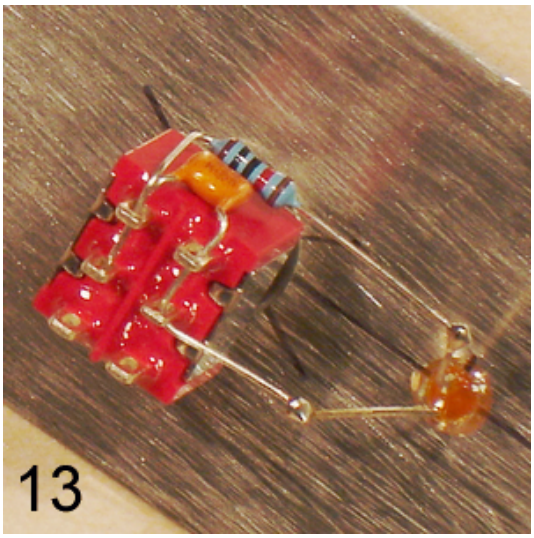
10. Shrink a piece of shrink tube over the shaft of a small Phillips screwdriver. Leave just the tapered end uncovered. This screwdriver will be a necessity in your recording kit. Use it for removing and replacing screws when changing gain jumpers or replacing batteries and for prying batteries from the connectors.

Remove each battery by sliding the insulated screwdriver between the battery terminals. Pry the battery away from the terminals then remove it from the springs. Avoid shorting the battery terminals. Remove the battery assembly from the clamshell.



11. Twist the orange and white wires only a couple of times close to the white tab of the second holder. Add the black wire and twist all 3 for about 2½ inches. Cut, strip, and tin the ends of the orange and black wires. Do not cut the white wire yet.





12-13. If the end plate with the switch is attached to a clamshell, remove it. Orient the end plate such that the LED is on your right. The longer lead of the LED should be on the bottom. Bend the long lead to about 45-degrees toward the center set of terminals of the switch. Bend the short lead about 45-degrees upward toward the long edge of the end plate.

Bend the leads of C14 (the small orange .047uF capacitor, marked “473”) to the width of the terminals of SW1. Bend the leads to a right angle so the leads can slide into all 3 terminals and the capacitor can lay flat against the top side of the switch. This is a ceramic capacitor and polarity is not an issue. It is good practice, however, to put the markings where they may be seen for troubleshooting purposes.

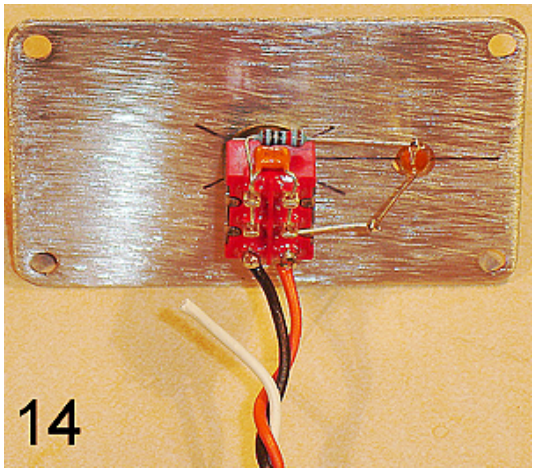
Insert the leads of the capacitor far enough so the ends of the leads are between the center and bottom terminals. Slightly bend the end of the right lead so it will go to the outside of the bottom terminal. Continue inserting the capacitor until it is flat against the top of the switch and the right lead is on the *outside* of the bottom switch terminal. Do not solder anything on the switch yet.

Bend the right capacitor lead sharply from the right center terminal toward the long lead of the LED. Make a small hook on the long LED lead with needle-nosed pliers and hook it to the lead from the capacitor. Close the hook over the capacitor lead and solder the joint. Cut off any excess wire from the capacitor past the joint.

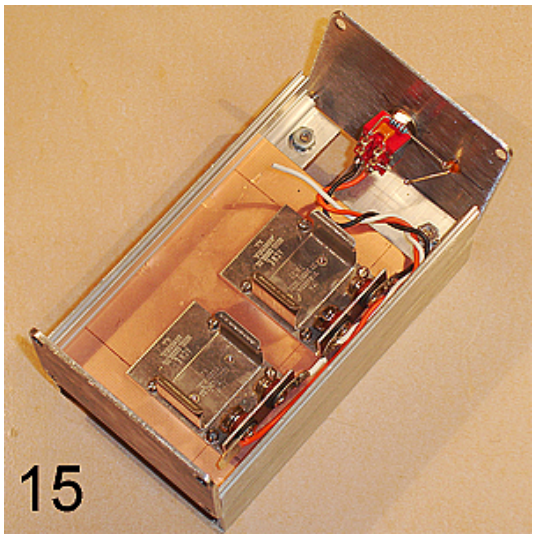
Make a small hook in the shorter LED lead.

Bend one end of a 10K-ohm ¼-watt resistor (brown-black-black-red if a 1% resistor or brown-black-orange if the resistor has a higher tolerance) so it will hug C14 as shown. The other end of the resistor should be aimed toward the hook in the LED lead. Make a right-angle bend in the resistor lead and insert it into the top left terminal switch terminal and through the center and lower terminals.

Bend the LED lead to line up with the resistor lead and close the loop. Solder the joint. Cut off any wire that extends from the resistor past the joint. Do not solder any switch terminals yet. Cut the capacitor leads that extend below the left center terminal.



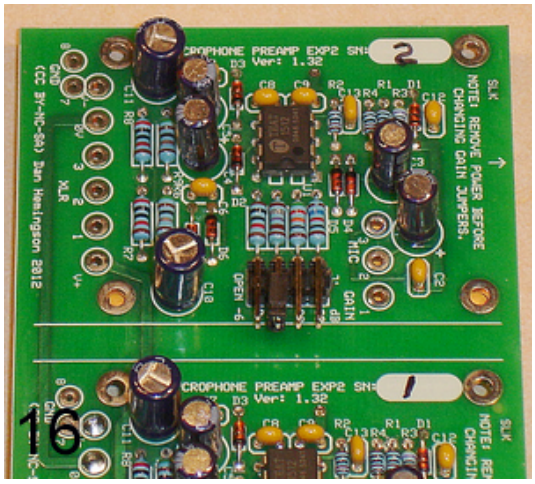
14. Bend the white wire from the battery board away from the tinned ends of the black and orange wires. Solder the black wire from the battery board to the bottom left terminal of the switch. Solder the orange wire to the bottom right terminal. Cut any excess wire between the bottom and center terminals of the switch.



15. If the blank end plate has already been attached to the clamshell pair, slide the battery board assembly into the bottom card slots of the battery box. (Remember, the battery box has the nuts of the 4 machine screws that hold the clamshell pair together.) Slide the board all the way to the end plate.

If the blank end plate has not been attached to the clamshell pair, attach it to the battery box with 2 screws. (Remember about first turning the screws counter-clockwise to find the thread groove if the screws have been inserted previously, then screw them in.) Now insert the battery board into the bottom card slot and slide it all the way to the blank end plate.

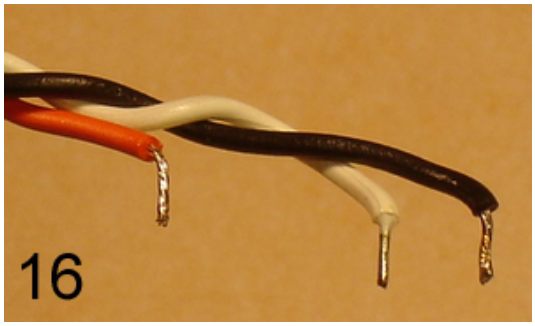
Now would be a good time to fix the battery plate in place. Confirm that the battery plate is against the blank end plate. Put a small drop of superglue on the battery plate where it meets the clamshell groove at the vertical lines used to place the battery holders. There are 4 locations. A small drop of superglue on a toothpick may help get to the right place under the battery holder tabs. Use a minimum amount of glue in case there is a need to remove the board at a later date. Set this assembly aside to dry.



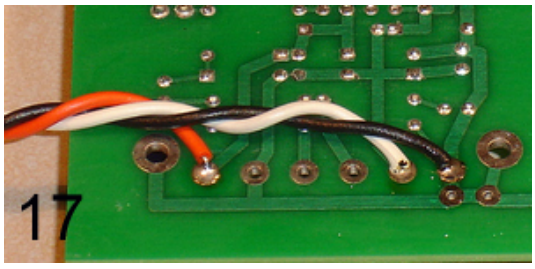
16. Mark the preamp *number* on each silkscreen next to "SN:" with a fine felt-tip pen:
2 – Preamp shown in this picture, the preamp closest to the tetrahedral (the gain block faces the mic stand adapter).
1 – Preamp closest to the mic stand adapter end of the clamshell.
4 – Preamp on the second PC board which will be closest to the tetrahedral.
3 – Preamp on the second PC board which will be closest to the mic stand adapter.

Next step: wiring power to the PC boards.

Smoothly twist together about a 15-inch length of the 3 24-guage wires: orange, black, and white. Cut it in half.



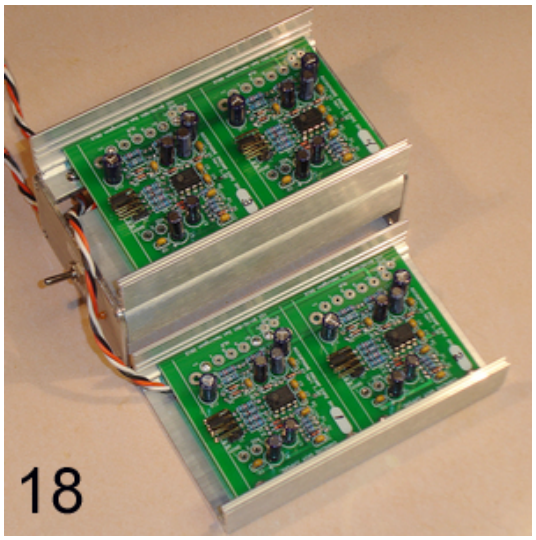
16. Strip the end of each wire and space the ends according to the distance from terminal to terminal: orange to V+, white to OV, and black to V-. Tin the bare ends and bend the ends 90-degrees to fit into the power terminals on the PC board. Only one power connection is required for both preamplifiers on a board.



17. Note the routing of the black and white wires leaves ample clearance for the XLR output wires to the soldered in from the top.

Use the power terminals on the odd-numbered preamplifier of each pc board. That is the closest preamplifier to the switch end of the enclosure. Place the wires in the appropriate terminal hole from the back of the pc boards and solder them in place. Trim the excess

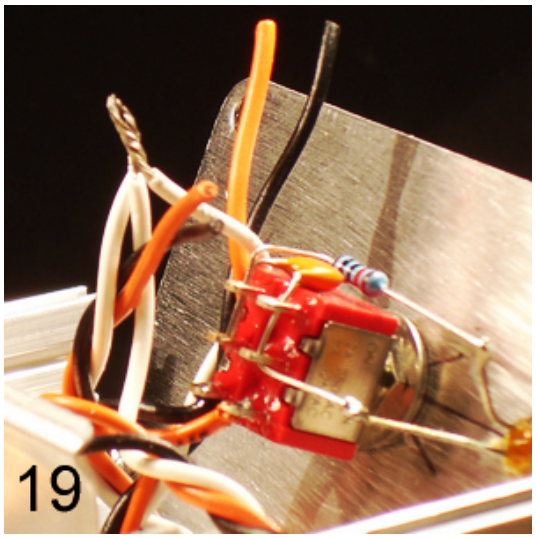
wire sticking through the topside. Route the black and white wires so they do not cover the XLR terminal holes which will be wired from the top of the pc boards. Dress the wires so the twist is neat. Using a cotton swab and a dab of alcohol, clean the residual rosin from the back of the board around the power wire solder joints.



18. Cut the length of the power wires for preamplifiers 1 and 2 to about 7 inches. This measurement is from the point where the black wire is soldered to the PC board. Similarly, cut the power wires for preamplifiers 3 and 4 to a length of about 4 inches.

Slide the PC board with preamps 1 and 2 into the bottom groove of one of the remaining clamshells. Be sure to orient the clamshell such that it will mate with the clamshell pair.

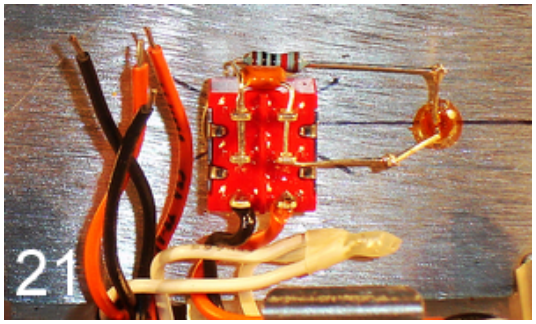
Route the twisted power wires to the battery box through the slot in the clamshell pair. The PC board with preamps 3 and 4 slides into the clamshell pair. These power wires also route through the clamshell pair slot. The card edges should be about even with the top edge of the electronics box. They will be fixed in place soon.



19. It will be easier for the next few steps to loosen the screws that hold the switch endplate; loosen them just enough to the plate will tilt outward.

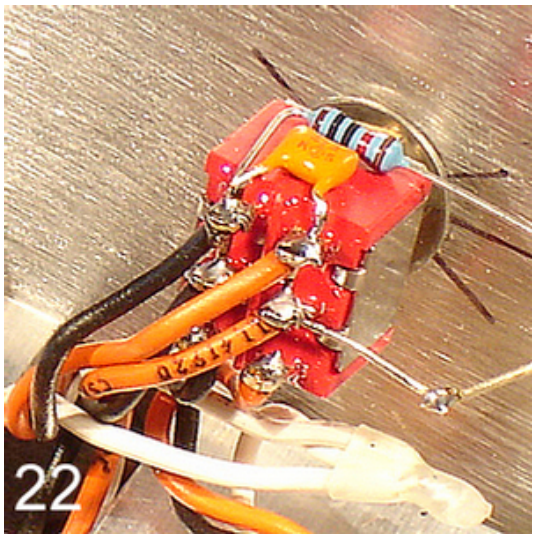
Separate the 3 white wires from the twists (including the wire from the battery holders) about one twist. Strip about ¼" of insulation from the white wires. Align the white wires so the ends of the insulation are even. Twist the stripped ends tightly. Solder the splice and cut the tip end of the joint flat.

20. Cut a piece of shrink tubing that is large enough to slip over the 3 twisted wires and long enough to cover the splice. Shrink the tubing. Cut the excess shrink tubing while the tubing is hot.



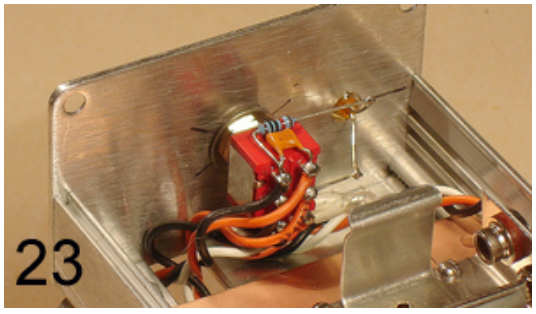
21. Tuck the white wires and splice below the switch. You may need to untwist the orange and black wires one more time.

Strip the ends of the orange and the black wires from the preamplifiers, about 1/8-inch. Tin each end.



22. Insert the black wire from one of the preamps into the left center terminal of the switch. Enter from the bottom and left side of the terminal. Be certain that all of the strands of wire and the resistor and capacitor leads go through the eye of the left center terminal. Solder the left center terminal. Repeat with the orange wire from the same preamp, now going to the right center terminal.

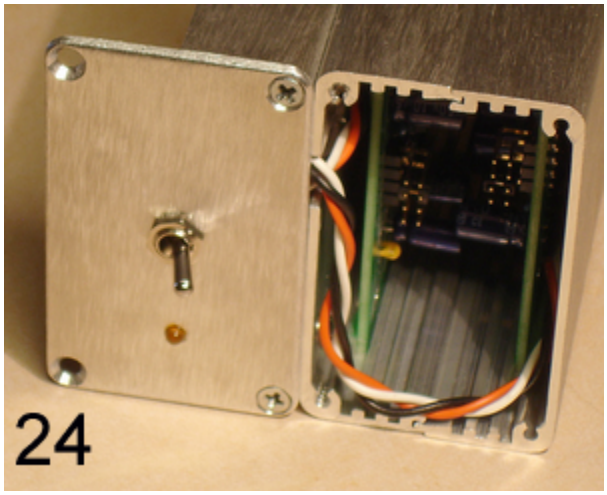
Repeat with the wires from the other preamp, using the upper terminals. Again check for stray strands of wire. Be careful not to cut the wires between the upper and center terminals.



23. Secure the switch plate to the battery box with 2 self-tapping screws. Press the power wires going to the electronics box into the space between the switch and the edge of the clamshell as you move the switch end plate up to the center clamshell.

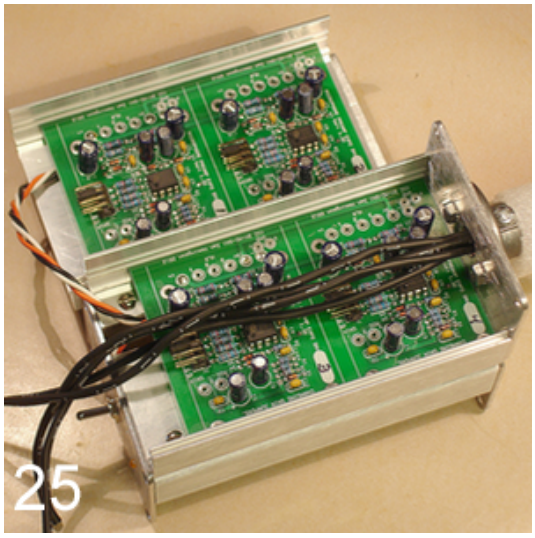
Confirm that the lead going to the LED from the center switch terminal did not get bent into the metal case of the switch. Adjust it if necessary.

Turn the clamshell pair over and slide both preamplifier PC boards to the tetrahedral end of their half of the electronics box. Mate the clamshell to the pair. They should easily mate. If not, confirm that the PC boards are directly over each other then press the electronics box together. It will snap into place.

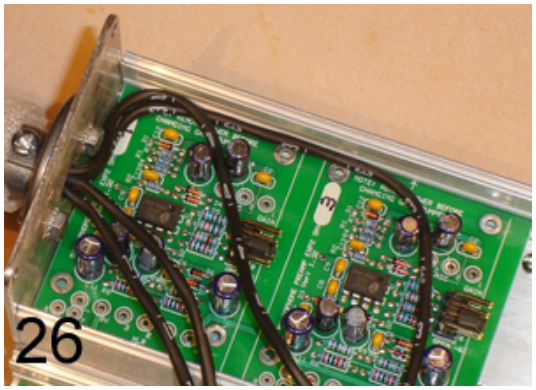


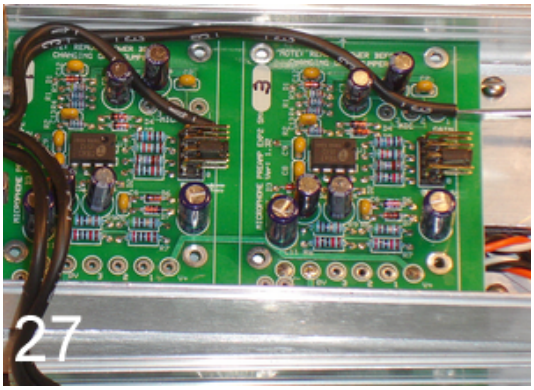
24. Lay the boxes on their side and bend the power wires to the outside PC board (preamps 1 and 2) as shown. If yours has too much wire or too little wire, fix it now. Some excess wire could be pushed into the battery box and stored next to the switch. Yours should look very close to this picture.

Next is to wire the capsule pairs to the PC board.



25. To protect the microphone capsules during this next sections, I suggest that you wrap the tetrahedral in some thin shipping foam or bubble wrap and use a small rubber band to hold it in place. Separate the clamshell and the clamshell pair. Mount the tetrahedral to the electronics box side of the clamshell pair. The screw in the adapter flange should be facing up. Use 2 self-tapping screws to secure it.

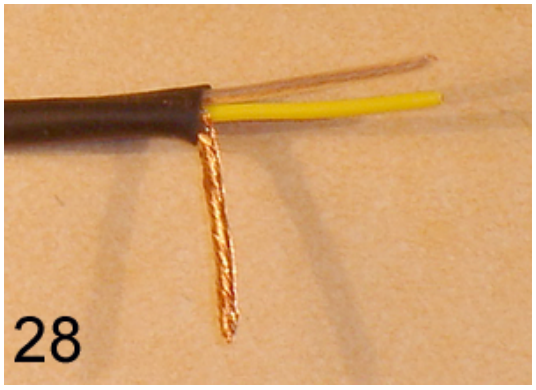




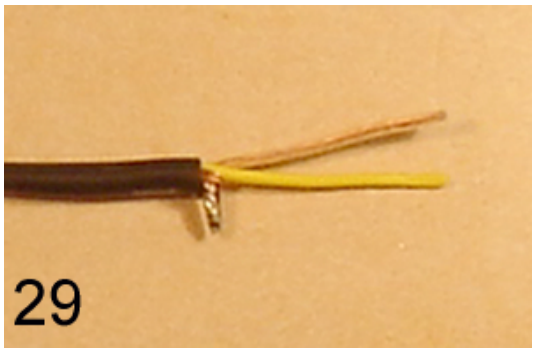
26. Route the capsule wires 3 and 4 along the edge of the clamshell wall. Bring pair 3 down to preamp 3 and run the wires between C1 and C3. Route pair 4 between C1 and C3 of preamp 4. Note in Figure 26 how the routing takes place.

27. Be sure to route both cables as shown in Figures 26 and 27 before cutting either cable. Referring to Figure 27, straighten each pair so it passes over the 3 MIC terminals (as shown being held in place with the end of a screwdriver). Cut capsule cable 3 where the cable crosses the white line near right edge of the board. Likewise cut capsule cable 4 where the cable crosses the white line at the right edge of preamp 4.

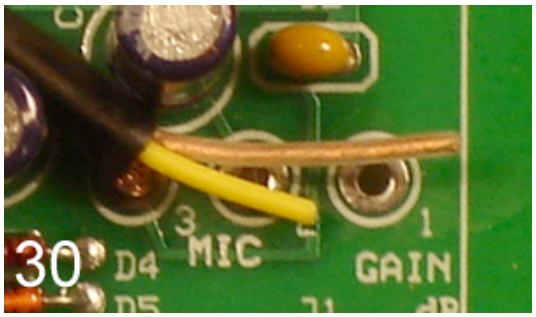
Now prepare the ends of the cable to connect to preamplifiers 3 and 4. Begin with the cable for preamp 4. Figures 28-34 with the yellow wire are actually from capsule 4.



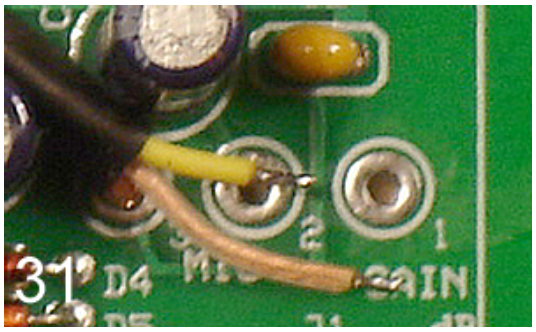
28. Try not to cut any of the shield wire strands as you cut about ¾-inch of the outer insulation from the pair. Carefully move all of the copper and tinned wires to one side of the pair. Straighten them out at a right angle. Start the twist at the inner end of the wires and move outward. The result should similar to Figure 28. Note the lay of the wires and the smoothness of the end result.



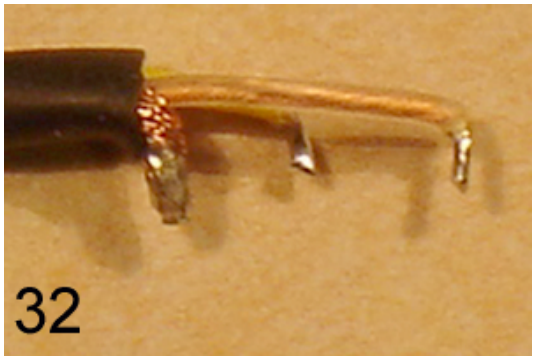
29. Cut the shield wires, leaving a length of about 1/8-inch. Re-twist the end, smooth but not tight. Heat the end of the shield wires with a soldering iron and put a minimum amount of solder on only the *very end* of the twist. No blobs allowed! This has to go through one of the holes on the PC board. If there are blobs, reheat and let the solder be absorbed into the wires or flick it off. This is molten solder; be careful where you flick!



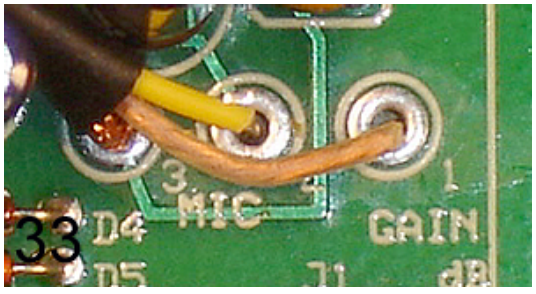
30. Insert the shield into the hole MIC 3. It is OK if it fits like a peg in a board. Do not solder yet. Cut the ends of the colored and clear wires as shown in the figure.



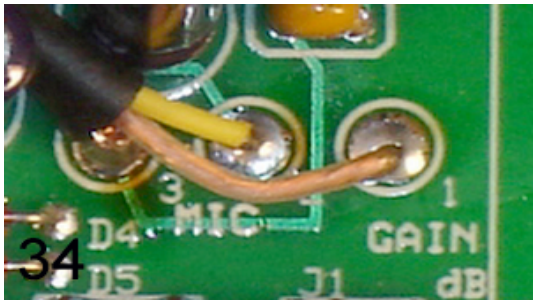
31. Use the holes as a guide. Remove the insulation from each of the wires above MIC 1 and MIC 2 as shown. Tin the end of the wires.



32. Bend the wires to right angles, and tin the colored and clear wires. Cut the bare wires to the approximate thickness of the PC board.



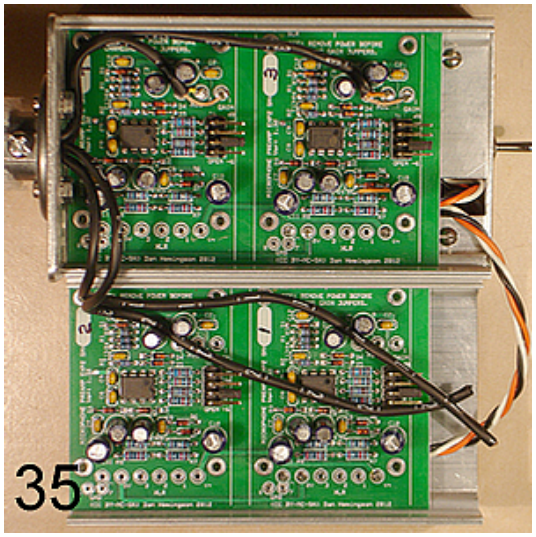
33. Insert the wires into the holes. Be sure that no stray shield wires are reaching out to touch the nearby pad of D4. Also notice how the clear wire is routed around MIC pad 2.



34. Solder holes 1 and 2 from the top side of the board. Now carefully solder the shield in hole 3.

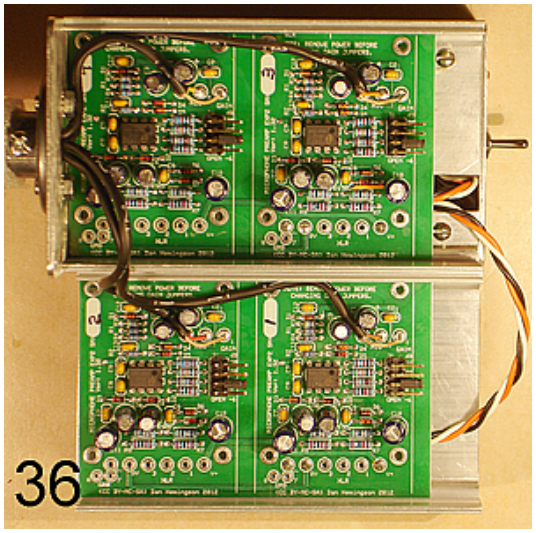
If this is the first time through steps 28-34, repeat the process with capsule pair 3 and preamp 3. If the connection to preamp 3 is complete, tuck the capsule wires 3 and 4 in the corner and alongside the box edge as in Figures 26 and 27.

If all of the capsules are connected to their respective preamps, jump to the installation of the microphone cable. Otherwise, continue to the next step.



35. Route the wire from capsule 1 alongside the bend (routing) of the wire from capsule 2 and along the edge of the clamshell. Cut the capsule 1 wire so the end will be at the white line at the gain block edge of preamp 1. Likewise, cut the capsule 2 wire so the end will be at the white line near the gain block edge of preamp 2.

Repeat steps 28-34 with the wire from capsule 2, then the same for the wire from capsule 1.



36. A view of the electronics box with all 4 capsules wired.

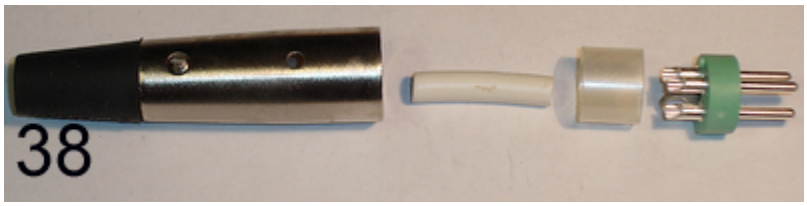
Clean the solder rosin from new solder joints on the top of the board with a cotton swab and alcohol.

Installing the XLR connectors is the next item of construction.

Cut about 10-inches of outside rubber jacket from one end of the quad-pair microphone snake cable. Remove the core threads.

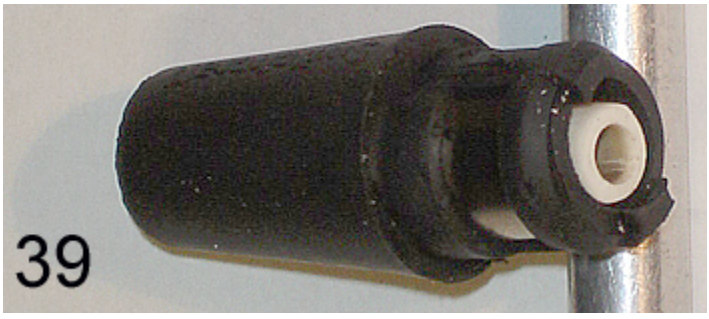
Note: If the interface/preamplifier(s) you will be using need longer lengths of the individual pairs, adjust this length now. Remember to add a few inches for slack, the cable inside the connectors, rework later on, etc. It is always better to have these free pairs a bit longer than required in case you use another interface later.

37. Cut a piece of 3/8-inch shrinkable tubing about 2-inches long. (Use the smallest diameter that will fit over the outer jacket of the cable.) Place it on the cable so its end is overlapping the end of the jacket by about 1/4-inch. Shrink with a heat gun and let it cool. Be sure that the tubing is shrunk all the way around and cools before putting on another layer. Apply a second layer of shrink tube, this time overlapping *both* ends of the first piece. Shrink and cool. (These layers of shrink tubing are to protect the end of the jacket.)



38. Switchcraft connectors, and those similar, have a left-handed screw holding the insert; it turns *counter-clockwise* for the screw to *retract* into the insert. They are usually manufactured with the insert loose in the shell and the screw tight into the retracted position.

Remove the insert with the pins from the shell of an XLR connector. Leave the plastic or paper insert provided by the connector manufacturer shown in Figure 38 inside the shell.



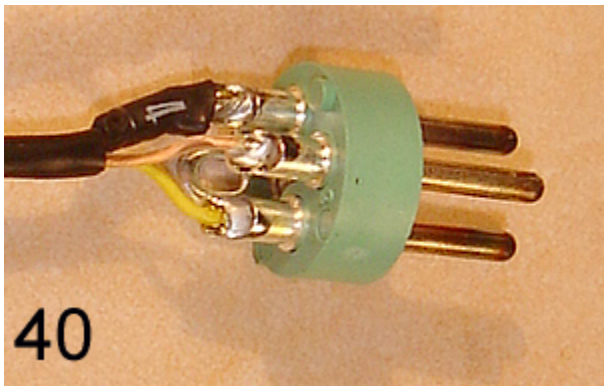
39. The photograph illustrates the proper placement of the boot insert into the rubber boot, shown with the boot removed from the connector. Do not actually remove the boot from the connector shell. It is removed here for illustration purposes only.

Due to the small diameter of the individual pairs, properly clamping the boot to hold the wire is not possible with a normal connector boot; therefore, a small piece of plastic tubing is added to the inside of the boot, facilitating a proper clamp of the pair.

The plastic tubing can be just about any material and any color. It should be about 1/4-inch in outer diameter and 1/8-inch inner diameter. Tygon is a common brand that is available in many hardware and building supply stores. Only about 4-inches are needed for this project. Cut 4 lengths, each 1 inch long.

Loosen the 2 boot set screws (normal screw rotation) if necessary to slide in the boot insert. Slide the boot insert into the rubber boot so the end is about even with the inside end of the clamp. If it does not slide in far enough to look like the photograph, cut the excess amount from the boot insert and try again. If the boot slides in too far, back it out to look like the photograph. When the boot insert is set into position, tighten the set screws just enough to hold the insert in position.

For Canon and other XLR connectors with a wire clamp, adjust the boot for placement in the clamp.



40. Run one of the pairs through the connector's rubber boot, the connector shell, the paper or plastic insert, and the boot insert. Check that the plastic insert is still in position.

Cut off about 5/8-inch of the outer jacket from the end of the pair. Be careful not to cut into the shield wires or the inner conductors. Strip about 1/8-inch of insulation from each of the inner conductors. Twist the shield (copper and tin wires), but not too tight. Tin the end of all 3 wires.

Slip a short piece of shrink tube over the shield wires, leaving about 1/8-inch of wire for the connection. (If the proper size of shrink tube is not available, use the cut off piece of the jacket of the pair as shown in Figure 40. It just won't shrink!)

Secure the 3-pin connector with a pair of pliers similar to the way you secured the microphone capsules with the pliers and a rubber band. Solder the shield to pin 1, the

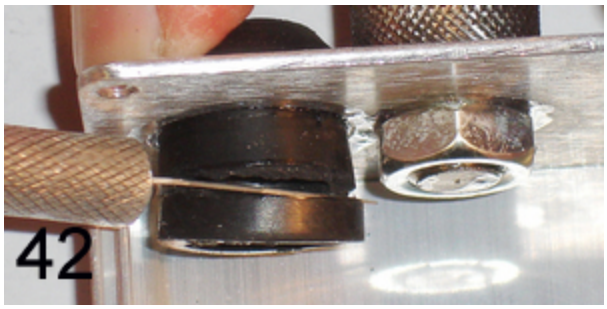
colored wire to pin 2 (180-degrees from pin 1), and the clear wire to pin 3 (the center one). Use the pliers with a rubber band on the handles as a clamp. Careful: The pins stay HOT for a while. Let them cool.

41. Gently pull the wire and rotate the connector insert into the shell until the connector set screw lines up with the hole. For Switchcraft connectors, turn the screw *clockwise* to set the screw.

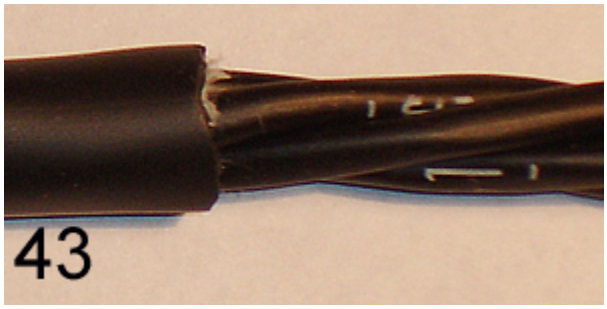
Tighten the boot set screws until they are almost even with the shell. You only want them to hold the wire in place and use the compression as a strain relief. Do not over tighten the boot screws.

Repeat the process for the 3 remaining connectors.

Next is the output cable connection to the stand adapter end plate.



42. Attach the mic stand adapter end plate to the unused clamshell. Cut the inside edge of the grommet with an X-Acto knife to about the same length as the thickness of the 3/8-inch jam nut on the mic stand adapter. Be careful. Do not put your fingers in line with the knife!



43. Cut about 7 inches of the outside rubber jacket from the free end of the quad-pair microphone snake cable. Leave the 4 pairs twisted together, but remove the filler strings within the twists.

44. Cut a piece of 3/8-inch shrink tube about 1 1/2-inches long. Place it on the cable so its end is just past the end of the jacket. Shrink with a heat gun and let it cool. Be sure to heat the tubing all the way around.

There are 2 sizes of the grommet, the outer diameter is the same, but the hole size differs. Test the size by inserting the 4 pairs into the grommet and attempt to insert the end of the outer jacket *with* the single layer of shrinkable tubing. The smaller and more common grommet hole (and the one specified in the parts list) will not allow the cable with a single layer of shrink tube to easily pass through, if at all. If this is the case, you are in luck and jump to step 45.

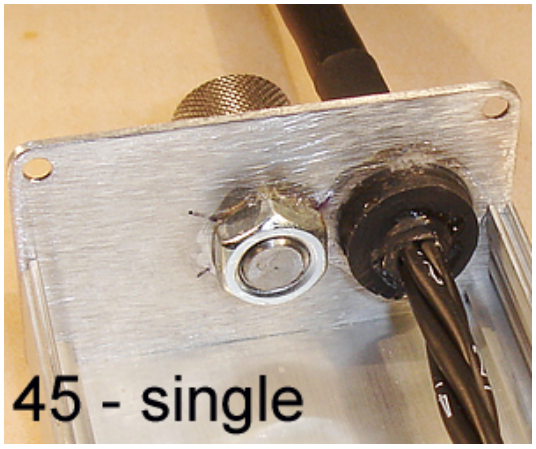
Cut another piece of the same size of tubing but just about an eighth of an inch longer. Place it so the end is also even with the end of the cable jacket. Shrink all the way around and let it cool. Test for a very tight fit into the grommet. Don't try to force it through.

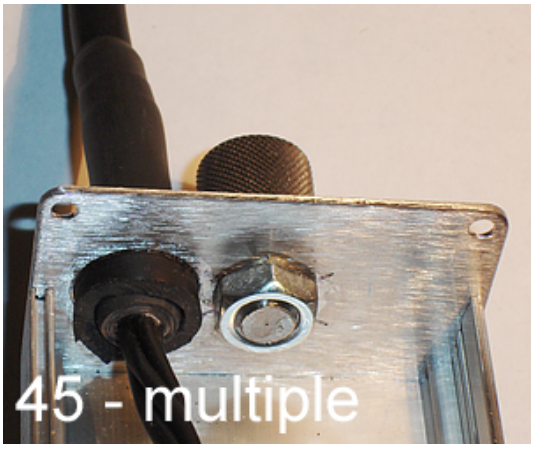
The next larger size of shrink tube will probably be needed next. Repeat the last sequence. After it cools, route the 4 wires through the grommet and see if the shrink tube section fits snug in the grommet. It depends on the grommet, but probably not.

If not, remove the wires from the grommet. Cut another piece of the larger shrink tube, and make it about 1/8-inch longer yet. Place another length of shrink tube over the existing tubes, but leave just a bit over the end where the wires come out. Shrink all of it and let it cool.

Again, check to see if it fits very snugly or, better yet, will not allow passage through the grommet.

Three warnings –
Warning 1 – There is very little opportunity to adjust the position of the cable once it is pushed into the grommet. The glue dries very quickly.
Warning 2 – If you get any superglue on the multiple pairs, immediately untwist the pairs and keep them separated until the glue dries. It is called superglue for a reason!
Warning 3 – Avoid getting superglue on your fingers. You can superglue your fingers together or to anything you touch.
– End of warnings!



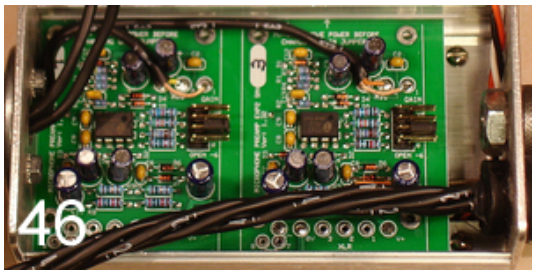


45. This is a time for some planning. When routing the 4 pairs through the grommet, pairs 1 and 2 should emerge on the mic stand adapter side at the point where the pairs exit the jacket and shrinkable tubing. Therefore, pairs 3 and 4 will emerge along the outside edge of the clamshell. It doesn't matter which pairs emerge on top; that will depend on which end of the original piece of wire you started.

With the 4 pairs routed through the grommet, put a light ring of superglue around the circumference of the outer end of the shrink tube. The glue will lubricate the grommet as you quickly push the cable into the grommet until the end of the shrink tube/rubber jacket is even with the inside end of the grommet.

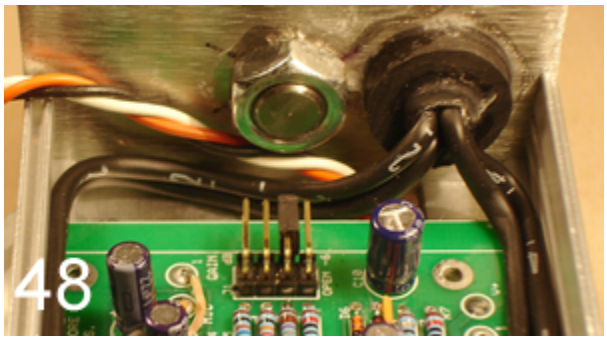
Apply an additional light ring of superglue around the inside end of the grommet and, if there is not a ring of existing superglue, around the outside end of the grommet where the cable exits. Let the glue dry thoroughly.

Next is connecting the output pairs to the preamplifiers.



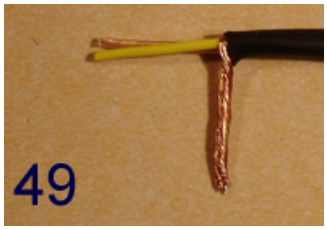
46. Mount the microphone stand adapter end plate to the electronics side of the clamshell pair. Confirm that the power wires to the outside PC board are in the correct place. Use 2 self-tapping screws. The output pairs should be in line with the XLR terminals on the PC board.

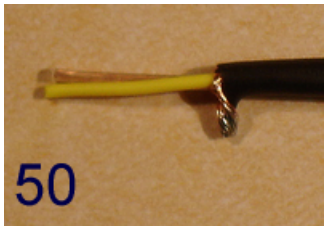
47. View of mounted end plates.

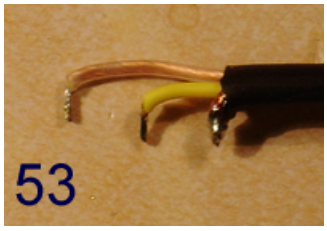


48. Route pairs 1 and 2 along the endplate and then along the left edge of the PC board. Route pairs 3 and 4 along the right side of the board. Note the jog from the grommet to the clamshell edge.

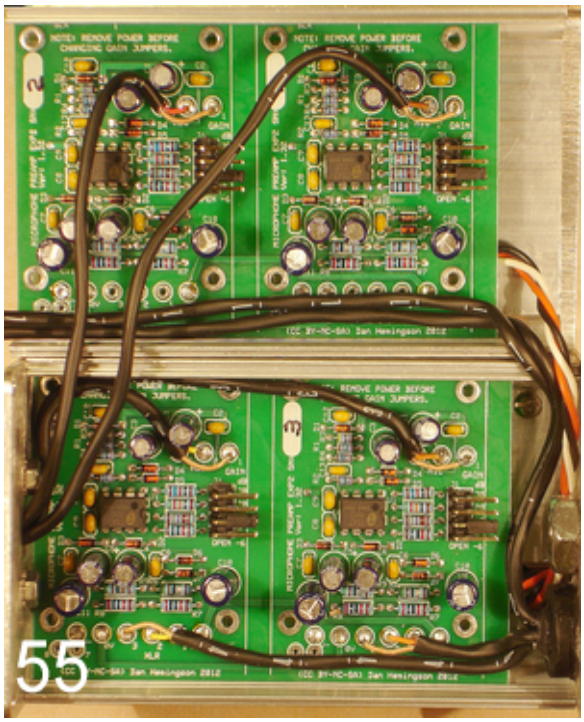
Be aware that the power terminals are not used on preamps 2 and 4. The shield wire of the output pairs must go to XLR terminal 1, not V+. Before wiring the output pairs, fill the V+, 0V, and V- holes with solder on preamps 2 and 4. Do this from the top of the board. It is simply less confusing to only have 3 vacant holes.







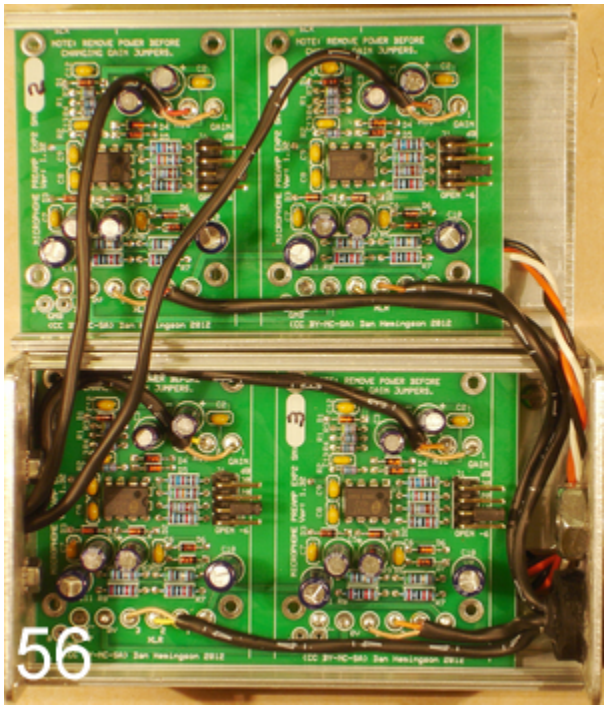
49-54. The process to connect the output pairs to the PC board XLR terminals is almost identical to the connection of the capsule wires. The important difference is the order of the terminals and wires. The shield of the output wire is connected to XLR terminal 1 and the clear wire is connected to output terminal 3.



55. Prepare and solder output lines 3 and 4 to their respective XLR terminals.

Route the output pairs for preamps 1 and 2 along the side of the clamshell. Prepare and solder output lines 1 and 2 to their respective XLR terminals.

Remove any protective foam or bubble wrap around the tetrahedral.



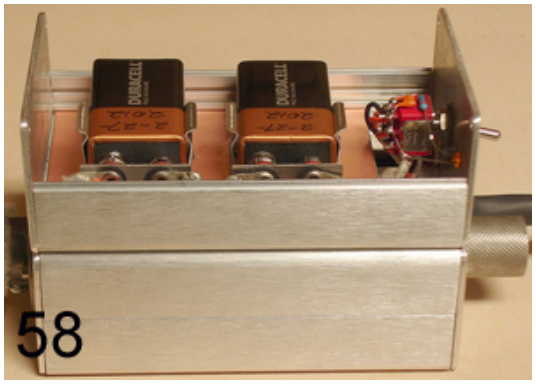
56. Carefully search for any stray wires which may have been cut from the pairs of wire or may be reaching out to touch a nearby component lead. When the electronics box is closed the tetrahedral wires to preamps 1 and 2 fold along the output wires for preamps 3 and 4.

Clean the rosin from the PC board around the newest connections with a cotton swab and alcohol.

The PC boards do not need to be glued in place, but if you really want to secure them use one tiny spot of glue per board.

As you close the electronics box, you may have to move the wires to avoid the tops of the capacitors. Also be careful not to pinch the wires where the edges of the clamshells meet. It may take a little bit of pressure the make the final closure of the box, but the box should stay closed without the final end plate screws in place. If it pops back open, check for pinched wires. Move them to the side of the capacitors and retry.

57. Create some kind of label for “OFF” and “ON” labels and install them on the switch end plate. The switch is wired such that power is on when the handle is toward the outside of the box. This position was chosen because when transporting the microphone, it is easier to accidentally push the switch inward rather than outward. Outward is “on” to help keep from inadvertently running down the batteries.



58. Check that the power switch off. Install the batteries. Put the remaining clamshell on the battery compartment. Do not attach the outside clamshells with screws yet. Reminder: Always have the power switch off when changing the batteries.

Hint: Write the date of install on the batteries to help keep track of their life.

The next step is to test the microphone.

I suggest using headphones to prevent feedback. Put the microphone on a mic stand. Turn on the power switch. The LED should turn on. It is supposed to be dim, first, to reduce current drain on the batteries and, second, it is intended as a power indicator for the operator, not as a homing device in the concert hall.

Plug the output connectors of Exp2 into a preamplifier/mixer/interface (to be called the “interface”). It is great that Mogami labels the wires.

The outputs are the A-format configuration:

1 – LFU (left front up),
2 – RFD (right front down),
3 - LBD (left back down),
4 – RBU (right back up).

With the Exp2 internal gain settings set at +10dB, the output level is that of a typical condenser microphone. Turn on the Exp2 power and the interface power. Do *not* turn on the phantom power from the interface.

Set the interface like you would with any normal microphone. Start with a low input gain setting and set the headphones at a nominal level. Testing one capsule at a time, turn up the gain until you hear ambience. Talk into the appropriate capsule to confirm its operation. Note the gain setting. Turn the gain back down. Repeat for each capsule.

Turn all of the capsules up to the nominal gain setting on the preamp.

Install the 8 remaining screws in the clamshells. Remember to turn the microphone power off when not using it. Typical battery life for alkaline batteries is 7-8 hours.

Rev. 20120227 – extensive editing, updated pictures and order of construction