



DCX2496 active output mod by



Construction Guide.

Introduction. To transform your DCX2496 Ultra Drive Pro into a flexible 'pre-amp' type unit, several steps need to be performed. You have to remove the existing output board at the back panel. You have to mount a new replacement board at the back panel. You have to mount a small display- and control board at the front panel. Lastly, you have to make a few flat-cable assemblies and interconnect the boards with each other and the DCX DSP board using the new cables. (If you want to keep the serial port for the PC interface there is an additional small board and connector in the kit to mount on the back panel).

The rest of this document will give step-by-step guidance on assembling the unit. It is not a guide of the variety: "Take the screw driver in the right hand, hold the kit in the left hand, and carefully turn the screwdriver clockwise thereby taking care not to slip out of the screw slot"... This kit assumes that you have done some electronic assembly, soldering and such. You have to use your own brain and common sense as well!

That said, all of this is not hard or requires a particular technical prowess. You have to be able to locate, place and solder components on the boards. You have to drill two small countersunk holes in the underside of the DCX front panel. You have to cut and split standard flat-cable and to cleanly press the cables on the connectors. In other words, you must be able to work logically and accurately. If you have a simple multimeter to measure DC volts and resistances, that's good but not absolutely required. (On the other hand, this may be a good opportunity to buy that meter!). You must be aware that fast work is often inaccurate and failure prone. Take your time, run through the steps a few time before heating up the old iron, and success will be inevitable!

I had a lot of fun developing this, documenting it and, above all, using it daily when listening to music. I'm sure you will enjoy it as well! Comments invited!

Jan Didden (jan@linearaudio.nl)
Linear Audio (www.linearaudio.nl)

Note: This kit contains a pre-programmed microcontroller to decode the remote control commands, to drive the displays and to command the level settings. I know that DIY-ers are by nature curious, but please do NOT attempt to read out the program from the controller. This will clear the program memory and make the controller inoperative.

Preparation of the battlefield ;-)

Before you start: check at my website for any last-minute changes or updates that didn't make it into this Guide!

First remove the power cord (and any other cabling, of course). Then start dismantling your DCX2496 by removing the top cover. Be sure to save all screws that you remove because you will need most of them again later to reassemble your unit.

Disconnect all flat cables between the DSP (main) board and the output board at the back panel. You may need to remove some glue that sits on the connectors; pull it off with a set of tweezers.

Next, remove the back panel board by removing all screws from the back panel that hold the various connectors. Take out the back panel board and set it aside, and save the screws.

Next we will remove the front panel assembly. Remove (and save) the three screws that fix the bottom plate to the front panel. Also, remove the rack mount bracket on the RIGHT side (where the power switch is) by removing the two screws that hold the bracket to the enclosure. Disconnect the flat cable that runs from the front panel assembly to the main DSP board. Now, carefully remove the entire front panel assembly by swinging its right side a bit outward and then taking it out towards the right. Set it aside.

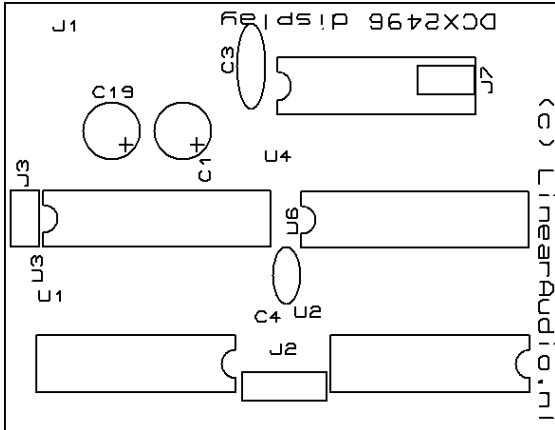
Now, there is a plastic card guide on the main circuit board that normally sits behind the card guide slot. It isn't fixed to anything, and may already have fallen out. If not, take it out.

When you're done, your unit should look similar to the pic below (we will remove the front panel card slot bezel later though).



There are replacement XLR connectors in the kit for the digital and analog inputs. Mount these now, (without wiring) using the original screws. When we get to the testing part, you need these inputs to get some signal into the unit.

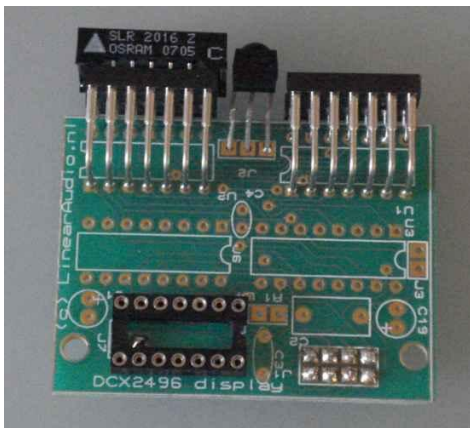
Stuffing the control and display board.



Using the BOM (Bill of Materials) locate the components for the display and control board. The stuffing guide at the left shows where each component goes. Most components mount on the component side, identified by the layout print. BUT there are TWO parts that mount on the back (solder) side:

- The jumper at J7;
- The header at J1.

You MUST solder the jumper J7 at the backside BEFORE putting on the socket for the processor at U4, because once the socket is mounted, you can't get at J7 anymore. So, to be sure, put in J7 and J1 first.



The pic at the left shows the partially completed board. Review the forming of the leads of the IR receiver at J2, between the displays: the idea is to mount it with the lens flush with the displays so that the receiver gets as close as possible to the window.

Note also the solder at the pins of J7 (inside the socket for U4) and J1 which have been mounted on the underside.

Header J3 is for possible future use.

Set the display- control board aside.

Mounting the red Plexiglass window.

Remove (and take your time for that) the bezel on the front panel where you would insert the memory card. Use a small sharp knife to cut around the edges without damaging the metal front panel. It's not difficult but there is some glue you need to slice through. You can sacrifice the bezel unless you want to be able to restore your unit to stock condition sometime in the future.

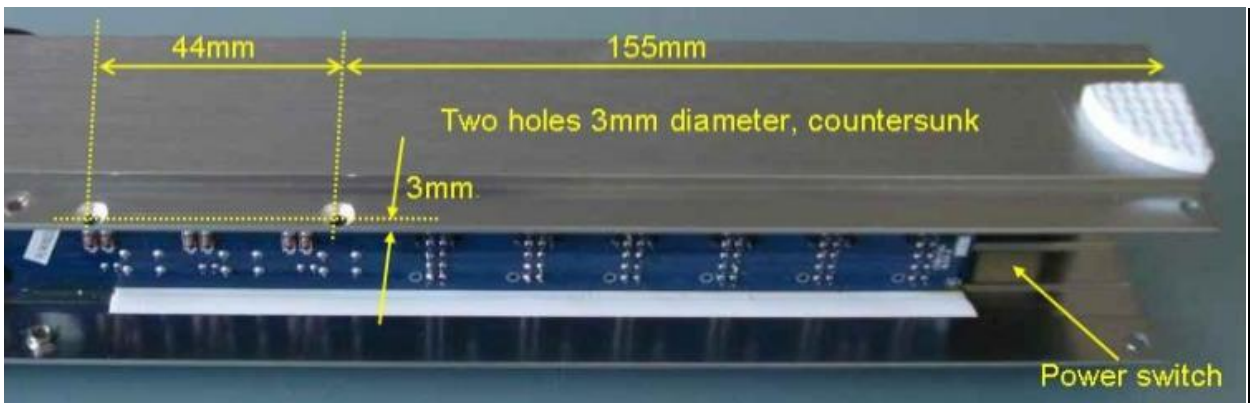


Now check the front panel from the inside to where the bezel has been and where the red Plexiglass window needs to go. If there is still some remaining glue around the edges, use a pair of tweezers and/or a small knife to clean that up. The pic on the left shows the DCX front panel assembly with the card slot bezel removed and the small red Plexiglass window to be mounted on the inside, which is included in the kit.

Carefully run A LITTLE general-purpose glue around the edges of the Plexiglass window and, again, carefully position it on the inside of the front panel where the bezel was sitting before. In fact, this part of the mod is the trickiest one. Use VERY LITTLE glue, the Plexiglass is very light, and you don't want the glue to be visible from the outside. You may want to try to find the best way to position it before applying the glue so you get the hang of it. In my prototype I actually only used glue on the two short sides of the Plexiglass because there is more overlap with the metal than on the long sides.

Drilling the display and control board mounting holes.

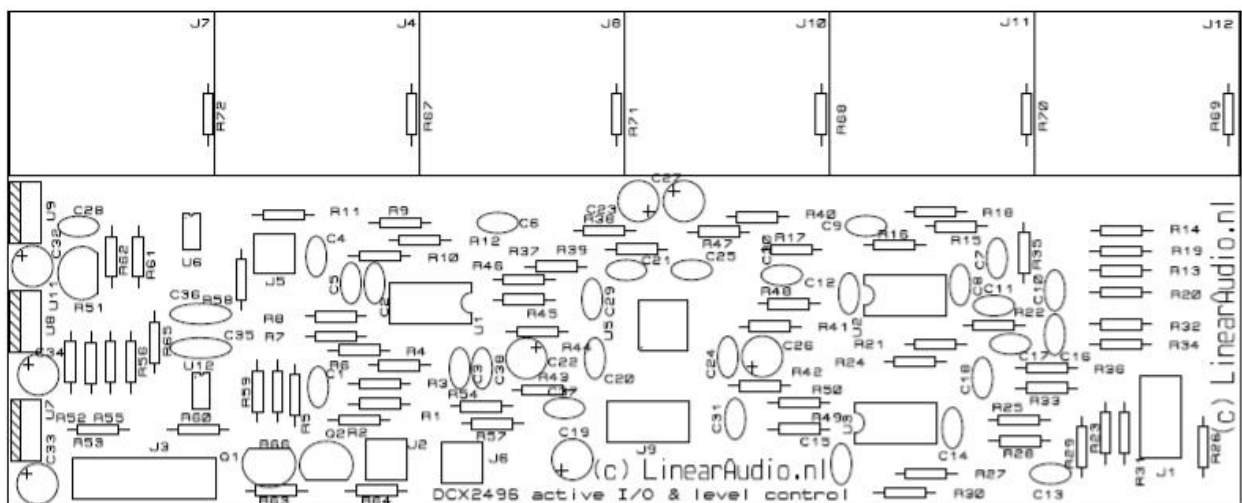
With the pic below as guide, carefully mark the two required holes. Using a sharp pin or something similar to put a small pit at the marked location so that the drill will not 'wander' across the surface. Use a drill press if you can, or else fix the front panel assembly so it can not move. Carefully drill and countersink the two holes and deburr on the inside. Check with the display board visually if everything fits, but don't mount the board yet. Set the front panel assembly aside.



Preparing the main circuit board.

We will now partially stuff the main board to prepare it for the initial test. The idea is to test the power supply and the display- and control board before continuing the assembly. If there would be an error, we can find and fix it quicker.

Note: There is a large, colored version of the Stuffing Guide available at my web site!



Locate and mount the power supply components and socket listed to the right.

Make sure you orient all IC's and the U2 socket as shown on the layout. Watch the polarity of the electrolytics. DO NOT insert the opamp for U2 at this time!

Also mount the headers as listed at the right.

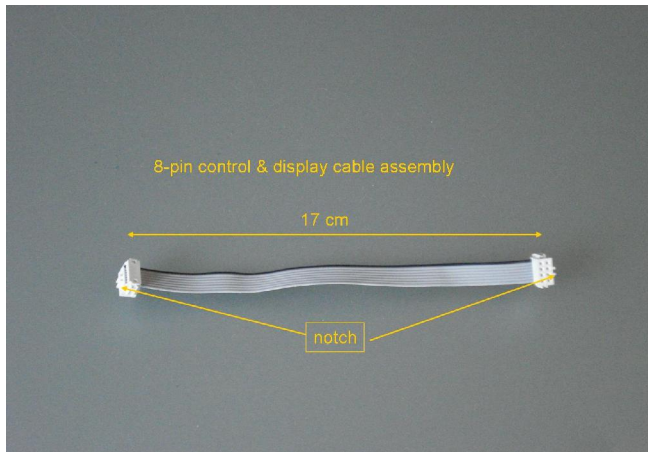
To facilitate the initial test, you need to temporarily mount the board in the new position so that the flat cables can be connected later.

You can mount the first and last XLR ONLY at this time so you can fix the board temporarily to the back panel. DO NOT forget to tape a sheet of plastic isolation to the chassis beneath the board to avoid shorting something on the board to the metal.

Using the original screws, temporarily mount the output board at the rear panel with the two XLR connectors on the board. (And the plastic isolation sheet taped beneath it!).

Preparing the flat cables.

In order to test the power supplies and the display- and control board we need to prepare the replacement flat cables. There are 5 cables to make: The signal connection cable from the DCX DSP board to the new output board; the power supply cable between the same boards, the display cable that will run between the new output board and the display- and control board and the cable to connect the analog inputs to the new output board. Again, this is not something that is particularly difficult but it has to be done with care and accuracy.



If you have a multimeter, it's a good idea to check for continuity between like pins and the absence of shorts between different pins.

Power supply components:

U7, U8, U9, U11;

C16, C19 thru C27;
C28, C32, C33, C34, C35, C36;

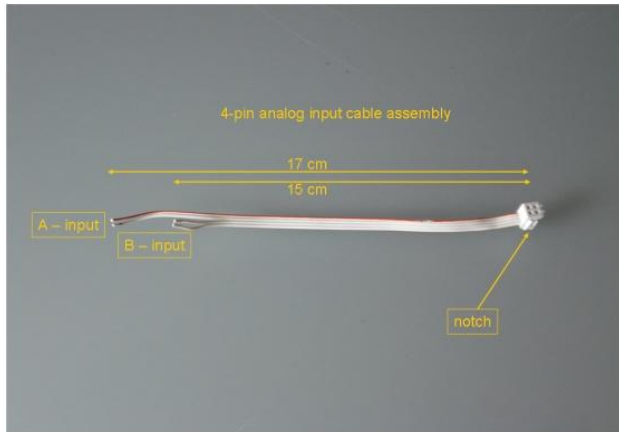
R51, R52, R53, R55, R56, R66;

Socket for U2;

J1, 2, 3, 9.

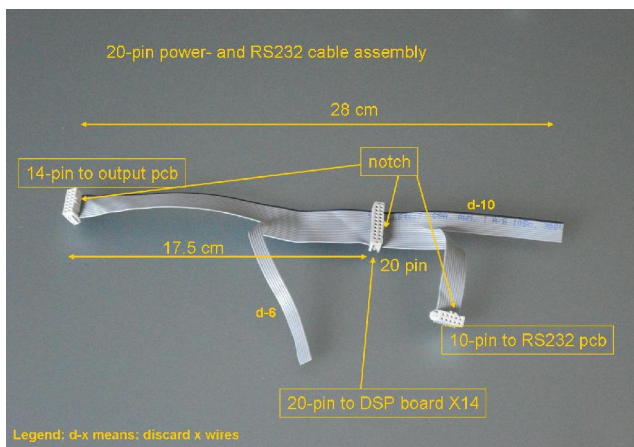
We will start with the easiest one, the display cable. Locate and cut the required piece of the ribbon flat cable. Separate 8 wires from one end; be sure to have the color coded wire included. Locate two 2*4 pin flat cable connectors. Check how the cable feeds into them, check how they align with the internal indents. Make sure the cable is at a right angle to the connector body. VERY IMPORTANT: on the pic to the left, verify the color coded wire position against the notch on the connector. If you get that wrong, you may damage parts!

Using a vise, carefully press the connector top onto the body. Then double check the connection visually for a tight fit and again check the cable and connector notch orientation.



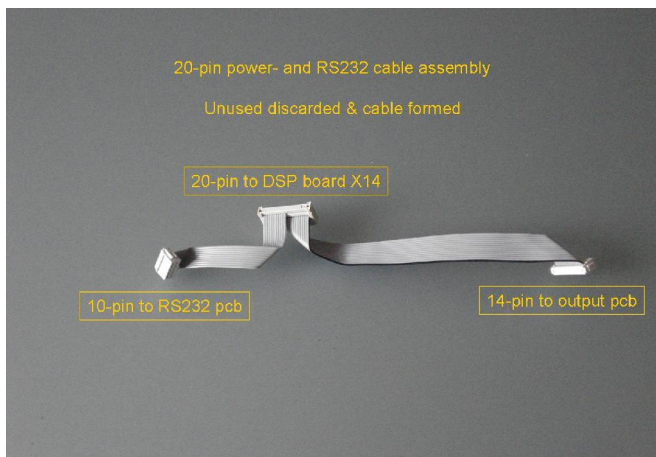
Next we'll build a small 4-wire cable we will need for the analog inputs. This cable has flying leads on one side which will be soldered to the input XLR's later.

Important note: If you have a Rev 2 pcb, see the picture of the routing of this cable and the connections at the end of this Guide!

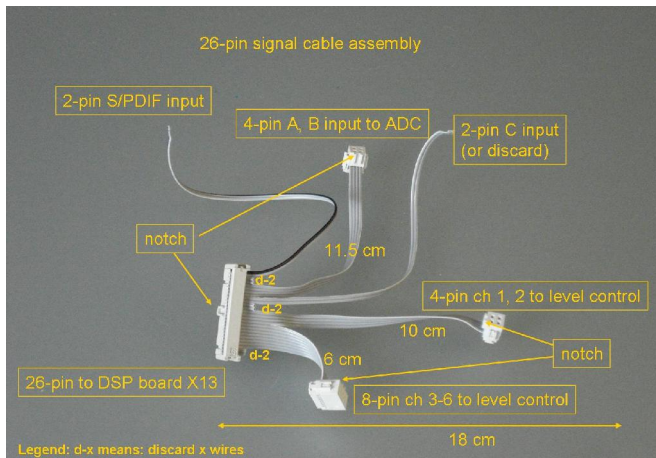


Next one is the power supply cable. This is a bit more complex but still not difficult.

Same procedure: locate and cut the indicated cable length. Probably the best way is to put on the 2*10 pin connector at the 17.5cm point first. Watch the notch position on the connector; it should point to the short end. Verify the position of the color coded wire 1. Next, separate the 2*7 wires at the long end, including the color coded one. Mount the 14-pin connector as shown with its notch position. Then separate the 2*5 wires from the short end but this time DO NOT include the color coded wire, see pic! Mount the 10 pin connector as shown, and visually inspect the completed cable.



Now fold the short end over the middle connector and put on the cable clamp as shown in the pic at left. This completes the power supply cable.



If you have a multimeter, it's a good idea to check for continuity between like pins and the absence of shorts between different pins.

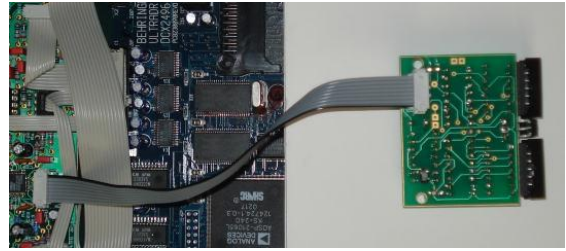
And finally, the signal cable. This IS a bit involved as there are several connectors on the cable, and several wires have to be skipped and discarded. The best way is to start with the main 2*13 pin connector, mounted with the notch as shown.

Next, start at the color coded side. First separate two wires. These will be left flying and will be connected to the digital input. Next separate but don't cut at this time, two unused wires. Next, separate 4 wires, cut to the indicated length and mount a 4-pin connector oriented as shown.

Work your way down all wires. When done, again do a careful visual inspection. Re-count all wires and if you are satisfied, discard those indicated as 'd-x'. If you are not planning to use the C-input you can also discard those wires, or fold them down neatly and fix with a tie-wrap.

Initial test.

Now it gets interesting. You should now have completed the display- and control board with all IC's and the displays in it, all flat cables, and the main board should have the power supply parts, the CS3318 and the socket only for opamp U2.



Connect both the power supply cable AND the display- and control cable as shown. Watch the color reference wire on the display cable! Pay attention to the plug orientation (the notch). Take some time and go back to the cable pics and verify that the notch is at the correct position. There is an overall view of the cable runs at the end of this Guide.

Don't mount the display- control board yet, but position it in such a way that it is well clear of any metal parts and that there is no danger of parts or solder joints of it touching other metal points. Put a sheet of paper beneath it if necessary.

If you have a multimeter to check DC voltages, do the steps at the right. Note: it is not absolutely required, but gives you some extra confidence. If you were going to buy a multimeter anyway, now would be a good time.

If you don't use a multimeter, no problem, but we will skip the test at the right and go straight on below.

With an eye on the display, switch on the DCX. You should see an initial indication on the display of Mute status ('X') and two level values, probably '-25'. If that jives, you've done a great job! Take a break, have a drink, kiss your (girl) friend or whatever rocks you ;-)

If you have a multimeter: Connect the multimeter to the U2 socket to check the power supply voltages: the multimeter + or RED terminal to pin 8, the - or BLACK terminal to pin 4. The easiest to do this is to insert a short piece of wire in the socket pin and clip the meter lead to the wire. Be sure NOT TO TOUCH anything else with the wire and/or meter clip. Set the multimeter to DC volts (scale 20 or 25V, depending on what is available). Double check that no parts or wires on the output board are touching anything, and then switch on the DCX. Verify that the multimeter shows 18V +/- 1volt. In particular check the polarity: pin 8 should be positive with respect to pin 4! You should also see an initial indication on the display of Mute status ('X') and two level values, probably '-25'. If that's OK, you've successfully completed an important step. Take a break, have a drink, kiss your (girl) friend or whatever rocks you ;-)

Mounting the display/control pcb.

Before mounting the display/control board cut a plastic sheet to the size of the board. A plastic separator sheet used in document folders is suitable. Cut holes in the plastic at the position of J1, J7 and the mounting holes. This sheet will be placed on the top of the board to prevent accidental shorting to the DCX front panel board.



Next, carefully mount the display/control board with the included 2.5mm hardware and the 8mm stand-offs. It should look like the pic to the left. The display should just touch the Plexiglass window at the front. Double-check that the board is not bent or anything and that there are no obvious shorts or mechanical problems. Note the plastic sheet and the back-side mounted J1, J7.

When you are done mounting the display- control board, repeat the initial test to make sure all is well and the display works as it should. You can also at this point try out the remote or leave that to later, whatever suits your taste. But then set aside temporarily the front panel assembly because now we will continue the work on the main PCB.

Output channel 3 & 4. Since we have already mounted the socket for U2, we will finish those two channels completely and then do a sound check. After that we do the other channels, step by step. If we then would have problems later, we have already narrowed down the possible cause for no additional effort. (Yes, I'm lazy at heart....). Stuff and solder the components associated with the U2 channel, which are the DCX output channels 3 & 4, as listed at the right column.

R13 thru R24;
C7 thru C12;
R46 thru R49;
C30;
R39, R40, R68, R71;
J8, J10 (XLR);
Insert U2 (watch orientation!)

Now it is time to take out the remote. This unit uses standard Philips RC5 TV codes which are probably the most universally used. Any 'universal' or programmable remote has several sets of those codes build-in; the trick is to find which one. Your universal remote has some kind of procedure to scan for codes the unit reacts to, but there is a shortcut. It is known that the German company Loewe (sometimes 'Loewe-Opta') follows the RC5 standard quite faithfully. On the list of codes for your remote, under 'TV' find the codes that are the same for Philips and Loewe (there will probably be several pairs). Program that code.



Visually inspect for unsoldered wires, bad joints or shorts. Next, connect the two flying wires 1 and 2 from the main signal flat cable to the digital input connector. The color coded wire (#1) should go to the 'hot' pin and the other to the 'cold' pin. (On an XLR the hot pin is pin 2 and the cold pin is pin 3; pin 1 is ground and is connected through the self-tapping mounting screw). Again provisionally mount the output board, connect the flat cables, and connect an input source to the digital input.

Important note: If you have a Rev 2 PCB, the flat cable routing is slightly different; check the pictures at the end of the guide!

We will now mate your remote to the new board, so you need to place the jumper on J7 as shown at the left. Fire up the DCX and verify that the display is active and showing 'Pres Menu'. If you have a multimeter, verify that the DC at the channel 3 & 4 XLR pins 2 & 3 is not more than a few mV, certainly less than 10mV

Follow the sequence on the display and press each button first when asked, then again to confirm. You can use any button on your remote for a particular function, but using Picture-In-Picture for Mute is probably going to get you confused some time in the future...

At the end, remove the jumper as requested (no need to switch off the DCX if you are careful). Try out the remote to verify operation. Leave the level set to a low value like -20, with Mute on.

Going live. Connect a digital source, and set the DCX controls so that you have a signal at the DCX input LED displays, as well as at the channel 3 & 4 output LED displays. It may be a good idea to set all channels to 'flat' for the testing, so remove all crossover filter settings (set filter type to 'off'). Verify that Mute is on (the display should show 'X').

Connect a power amp to outputs 3 & 4, with a speaker connected, and switch on the amplifiers.

Now using the remote, un-mute the unit and increase the level until you hear the music from your speakers. Another milestone, time for another break!

Output channels 1, 2, 5, and 6. Next, mount all remaining components for the output channels 1, 2, 5, 6 as listed at the right. Put in IC's U1 and U3 and solder the remaining XLR's in position. Then, similarly as described for the testing of channels 3 & 4, test all channels for undistorted sound.

U1, U3;
R1-12, R25-36;
C1-6, C13-18, C29, C31;
R37-38, R41-42, R45-46;
R49-50, R67, R69, R70, R72.

Using the remote, verify that you can increase or decrease the woofer channels (1, 2) and the tweeter channels (5, 6) relative to the main channels. Also check that the balance is working properly.

Analog input A, B. Finally, we will mount the components associated with the analog input channel. The soldering of the two single-ended to balanced IC's OPA1632 is a bit tricky due to their small size. The way I have done it is as follows (but the more experienced among you probably have a better way): First I tin the solder pads just enough, no blobs! Then, taking my time, I position the chip correctly, and keep it in place by pressing on it with a blade screwdriver. Make sure of the correct orientation! Then, with a bit of solder on the iron tip, I heat two diagonal opposite corner pins so they will be connected to their pads. Now I can release the screwdriver and solder the other pads at leisure, and go back to make sure the first two pins that I did are really OK. At the end of this step you should have no more parts left. If you have, check with the layout and put them in.

U6, U12;
R43-44, R54, R57-65;
C35-38;
Q1, Q2;
J5, J6.

Next, solder the analog input flat cable to the A and B inputs. Check the cable assembly pic above. The color coded wire (#1) goes to input A, 'cold' (pin 3), the next wire, # 2, goes to A 'hot', pin 2.

Similarly, wire # 3 goes to input B, 'cold' and wire # 4 to input B, 'hot'.

Pin 1 on the XLR's is ground and is connected through the self-tapping mounting screw.

We will now test the analog input channel. Connect a suitable source like the CD player analog output to the analog inputs. Switch on the DCX and be sure to select analog inputs for inputs A & B. Select the 'An' menu selection on the remote and increase the analog input level to just below input clipping level. Then set the output level to a comfortable value.

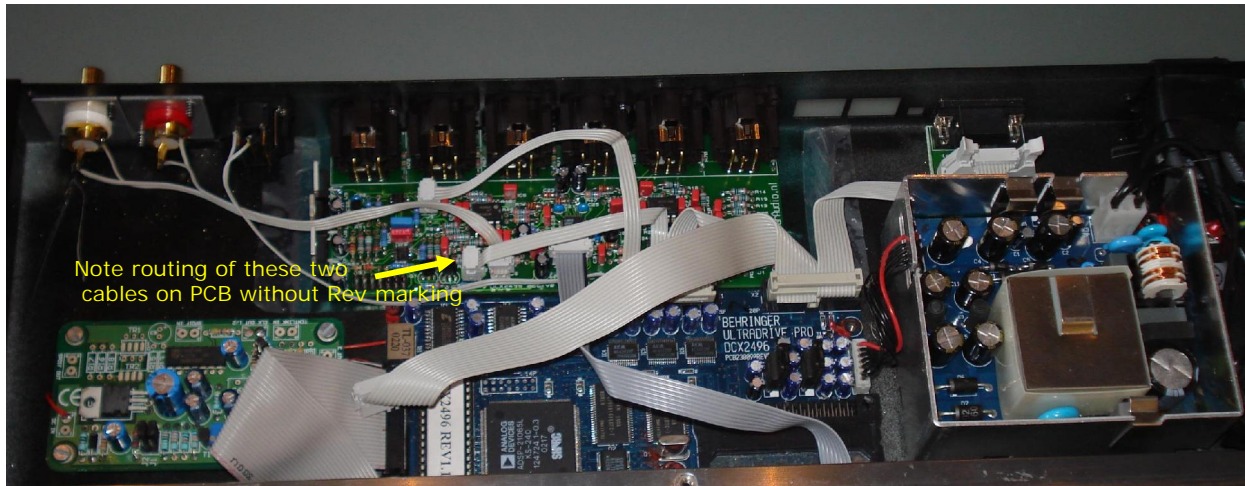
Well, I guess that's it! We're all done, except for some mechanical wrap-up. Make sure the output board and the display- and control board are properly fitted. Verify the seating and routing of the flat cables. Then put the unit together again, the front panel assembly first to the bottom plate, be careful with that power switch. Then attach the rack mount bracket and lastly the top cover.

Well done! Now get out some music....

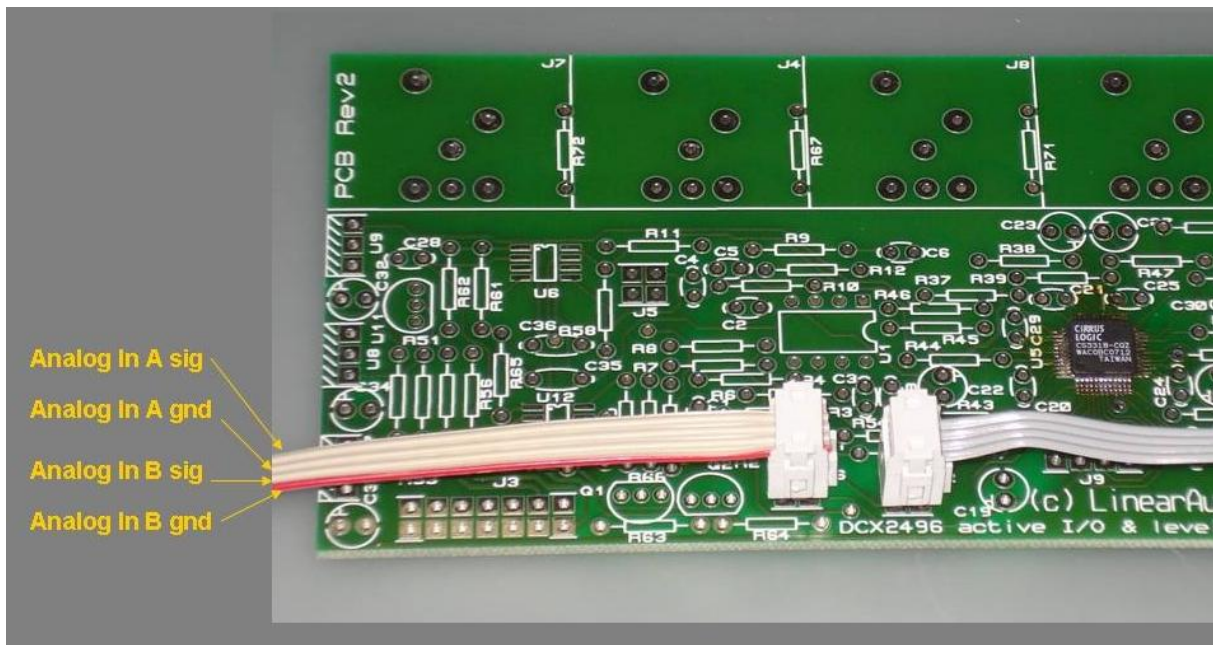
The picture below gives an overall view of the flat cable runs.

Important note: if you have a Rev 2 PCB, the routing of the two cables indicated by the arrow has slightly changed; see the picture below for the Rev 2 PCB.

The power connector at the far left has been temporarily removed to get a better view of the signal cable routings.



Important: If you have a PCB board marked 'PCB Rev2' in the upper left corner, the flat cable routing is slightly different to improve the routing of the signal cables. On the previous board, two cables shown above run around each other. On the Rev 2 board that has been fixed as shown below:



Questions, comments, bugs: please let me know at jan@linearaudio.nl!

But, please, first check at my website for any last-minute changes or updates that didn't make it into this Guide!