

X-Altra MC/MM Phono Preamplifier Build Instructions.

Important note: An errata list is maintained on the first page of the Excel BOM

(last update: 6th May 2021)

This is a project for advanced DIY'ers and will require very good soldering skills. It is recommended you read through these instructions fully before starting.

Tools and materials required

- Very fine tipped soldering iron
- Fine tipped tweezers for mounting SMD components
- Precision side cutters
- Roll of electrical insulation tape
- DVM with DC full scale range of at least 200 mV or preferably lower
- 0.5mm diameter solder for the SMD components and 1-2mm diameter solder for the through hole components
- A printout of the BOM list and a marker

Attention: under no circumstances use a PCB cleaner on the board after mounting the 12 way DIP switch or the MC/MM push button select switch as it will damage them.

You will not need a component overlay to assemble the board since every schematic reference number and value is silkscreened onto the PCB (top and underside)

Begin by sorting all the parts into SMD resistors, SMD capacitors and finally through hole capacitors and the remaining through hole components – transformer, switches, diodes, LED's etc. Sort the opamps into a separate pile – they will be mounted last after initial testing.

The best order to mount the components is simply to take a pack of SMD resistors and mount all of that value on the PCB, referring to the BOM list to make sure the correct quantity are mounted before crossing them off on the BOM list and proceeding to the next pack.

Board Assembly

1. Do not mount any of the through hole devices until all the SMD devices are placed
2. Do not mount any of the IC's except U9 and U10 at this stage – the remaining IC's will only be mounted after initial testing.
3. Do not mount any of three indicator LED's except D10
4. Begin by mounting all the SMD components on both sides of the board. Mount U20 and U21 (LSK389B devices). Carefully note the orientation of the bridge rectifiers D4 and D5 (underside of PCB adjacent to the power transformer).
5. Once the SMD devices are mounted, proceed with the through hole components, mounting the power transformer last.
6. Note carefully: C9 and C25 have the wrong orientation on the silkscreen – flip the orientation so that it is the opposite of what it shown. (If you do not do this, you will measure very large offsets at the MC input due to capacitor leakage).
7. Ensure the blue 2.2uF film capacitors (C3, C4, C75, C90) on the underside are mounted flat on their sides. If you stand them up, the PCB will not slot into the housing. These must be the last through hole components you mount.
8. Next, on the underside of the PCB, flash closed the pads U12, U13 and U14 according to your mains supply as follows:-
 - For 230 VAC flash U12 and leave the other two open
 - For 115 VAC, flash U13 and U14 and leave U12 open
9. Once completed, wire a mains cable and suitable plug for your country to the PCB – See Fig 2 of this document for details on how to wire the IEC receptacle.
10. Before plugging into the mains and applying power, use the electrical tape to completely cover the mains areas of the PCB both on top and on the bottom.

Exercise extreme caution!

Mains voltages will be present on the board in the next steps!

Make sure NO mains carrying tracks or exposed component leads are exposed!

11. Connect to the mains with an appropriately terminated IEC mains cable. This will entail soldering the mains directly to the appropriate LIVE and NEUTRAL pads on the PCB (these are located near the transformer) and apply power.
12. Refer to Fig. 1 of this document for the location of the test voltages. Use the meter to check that the +-15V supply is within +-200mV
13. Next to C45, check that the raw supply measures c. 25V +-3V and next to C56 +10V +-30mV
14. If the supply voltages are not to specification, you will need to debug the PSU section. If any of the electrolytic PSU decoupling capacitors are the wrong way around, this will result in the voltages being lower than the specified +-15V and the regulators running warm to hot. Note: the +-5V and +10V regulator voltages will not be present on the board at this stage.
15. Only if the voltages in step 11 and 12 measure ok, you can proceed to the next step.
16. Remove power and ensure the power supply is fully discharged.
17. Mount all of the remaining IC's U3, U4, U7, U19, U17, U18 and U26. Note, if you have elected to use NE5534A devices for U7, U17, U18 and U27 make sure you have mounted the associated 33 pF compensation capacitors C5, C6, C95 and C96). If you are using OPA1641 devices, you must not mount these capacitors.

18. Ensure again that the parts of the PCB with mains voltages are fully covered with no exposed areas before applying power to conduct the next set of tests
19. Confirm that the + and – 5V MC amplifier regulator voltages are present along with the +10V regulators for the MM front end. Note there are 2 locations each for the +5 and -5 rails and two locations for the +10V rails. If any of these voltages are not within 50 mV, you will need to debug the board before proceeding.
20. Once all the voltages are confirmed correct, do the following checks:-
 - Measure the voltages across R82 and R61 with should be 3 V \pm 1V
 - Measure the voltage wrt 0V at U26 and U19 pin 7 – should be $< \pm$ 100mV
 - Measure the voltage on pin 6 on IC's U7, U17, U18 and U27 – all must measure 0V \pm 25mV
 - Measure the collector voltages of Q1 to Q4. They should all be between 2 and 3 volts of 0V
21. Finally, set your meter to its lowest FSR which should be 200 mV or better and measure the voltage between the input and ground of the MC inputs right at the input connector. The reading should be less than \pm 30 mV but typically \pm 5 to \pm 15 mV
22. If you notice large offsets (30mV or more), check that C9 and C25 have been flipped – the orientation on the PCB is the wrong way around. I
23. Power the board down and ensure the PSU is fully discharged.
24. Flash U28 and U29 (AZL and AZR) closed and then power the board up again
25. Repeat the measurement in step 20. You should read 0 mV. If not, you have a problem in the auto zero circuit around U1 (OPA2188) or with the MC amplifier stage.
26. Solder the screened cable L to L and R to R connections under the board. Route the cables under the right-hand side of the board about 15 mm from the edge looking from the front edge of the PCB and cement in place with a few drops of super glue. The screen must be connected both ends to the pads shown with a circle around them.

This completes the electrical assembly of the board except for the indicator LED's which will be done a bit later. Remove the temporary power cable and the associated electrical tape insulation.

Final assembly, mains wiring and the indicator LED mounting.

1. Do not attempt to screw the rear panel on before inserting the board into the housing as any misalignment will create problems.
2. Fit the 11 mm stand-off to the bottom of the PCB. This prevents the PCB from flexing excessively.
3. Mount the mains inlet receptable, the turntable grounding screw and the switches on the rear panel. The 4-way double throw switch is used in the rumble filter position and the Single pole single throw switch in the ground lifter position
4. Slide the main PCB assembly into the housing
5. Mount the rear panel to the chassis making sure it is firmly screwed in place on the four corners
6. Next, screw the input and output connectors to the rear plate using the Philips 2.9 x 13mm self-tapping screws. Do NOT push hard on the screws as you will rip the connectors off the PCB – just screw them in carefully allowing the connectors to pull up securely against the rear panel whilst pressing on the rear of the connectors to make sure they don't bend backwards during the operation.

Wiring the main board to the rear panel

1. Wire the live(hot) and neutral to the power inlet receptacle. Ensure each connection is made off with heat shrink *so that no connections are exposed* (See Fig. 2 of this document)
2. Run the earth(ground) connection from the IEC inlet to the inlet mounting screw (LHS looking from the rear) and secure it tightly with a serrated washer on both sides of the closed solder lug
3. Solder a second earth(ground) connection from the IEC onto to the pad on the main PCB marked 'Earth' located to the LHS of the ground lifter diodes D7 and D8
4. Next, wire up the rumble switch per the diagram below; IMPORTANT: make sure the wires to the switch are all *twisted tightly together* and are run along the right-hand side of the PCB in the chassis side panel slots (looking from the front). This part of the circuit is prone to noise pickup, so cable dressing is important.
5. Connect the pads marked 'GL' on the main PCB adjacent to D7 and D8 to the Ground Lifter switch on the rear panel. Make sure the wires are twisted together or cable tied together.
6. Finally, ensure that there is a short soldered connection from the pad next to C92 to the exposed pad on rear panel located about 1 cm (c. 1/2") above it.
7. Next, solder the indicator LED's in position. The best way to do this is to slide the LED's from the rear into the holes in the front panel so they are *flush with the front of it*, and then to cut the leads to the length required for the ends to be located over the middle of their associated pads. Make sure the polarity orientation is correct and then solder them in position, making sure the tops of the LED's remain flush with the front plate outside surface

This completes the wiring of the unit

Final safety checks.

1. Make sure the unit is NOT plugged into the mains.
2. Fit the IEC inlet receptacle with a 50 mA slow blow (also known as a 'T') fuse
3. Set your meter to Ω s (NOT Diode Test mode!) and check that from the IEC earth(ground) pin, the resistance to every single part of the housing (rear panel, front panel, sides and bottom) is 0 Ω s. If not, you will need to debug the connections to make sure they are all shorted together. This is important for safety reasons and you may not proceed further until this is resolved!
4. Next, making sure the power switch is in the ON position **BUT THE UNIT IS NOT PLUGGED INTO THE MAINS**, measure the resistance across the live(hot) and neutral pins on the connector. For 230 VAC operation it should read about 1.3 k Ω s and for 115 VAC operation about 650 Ω s.
5. Next, measure the resistance between the live(hot) and earth(ground). It should measure open circuit.
6. Measure from neutral to Earth – should also measure open circuit.
7. Measure from the circuit board 0V to the chassis. It should read open circuit with the Ground Lifter switch in the UP position (i.e. GL enabled). In the down position, it should read open circuit.
8. Next, switch your meter to the Diode Test mode. Switch the GL to the 'Lift' position and check that you read 1 diode drop (approx. 0.4 to 0.6V) measuring between the PCB 0V and the chassis. Swap the meter leads around and repeat the measurement and again you should read between 0.4 to 0.6 V. If you read open circuit or a figure much below 0.4V in either direction, you have a fault and will need to resolve it before proceeding.

This completes assembly of the X-Altra MC/MM Phono Preamplifier. It is now ready for use.

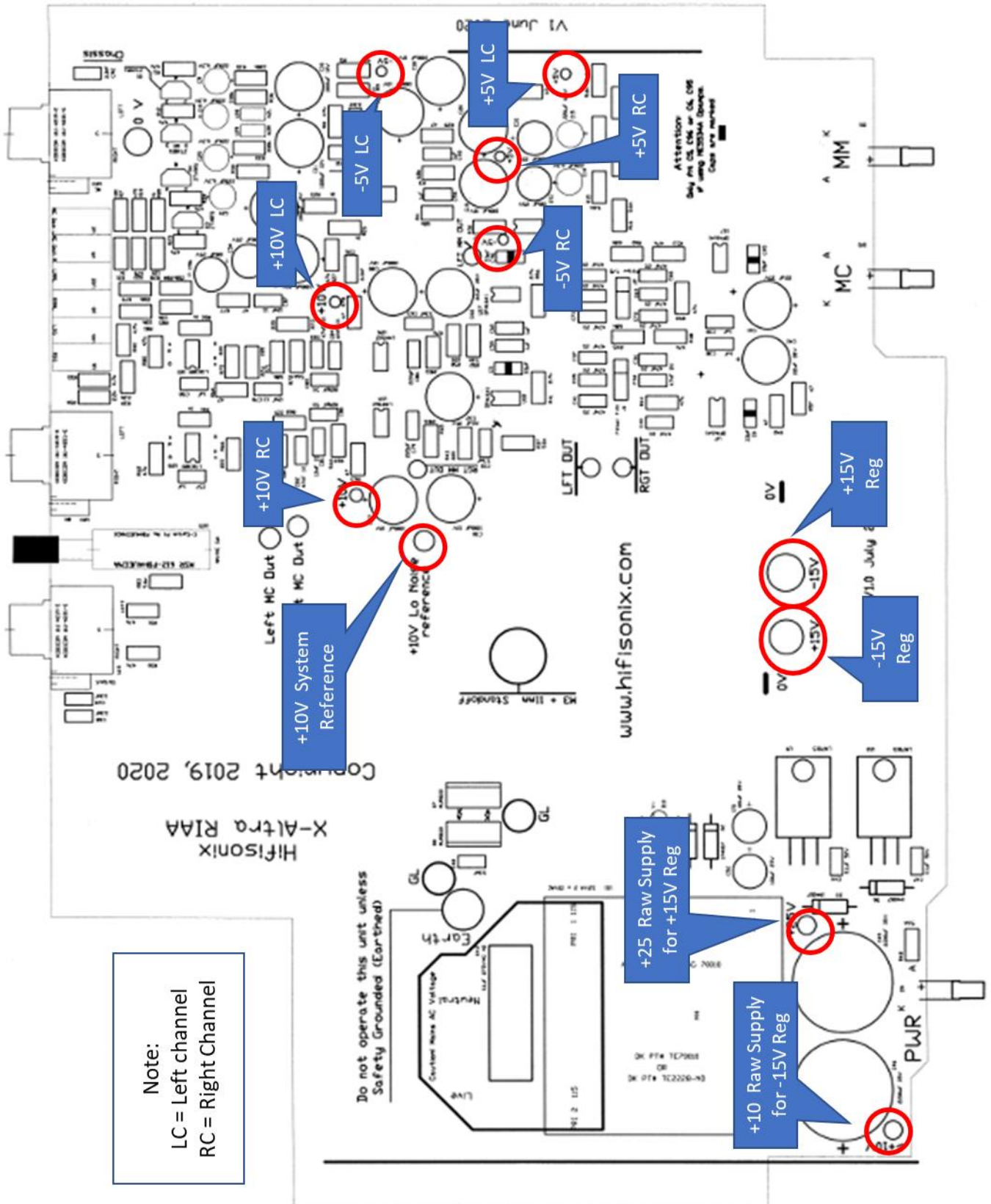


Figure 1 - General Layout Showing Location of Test Points

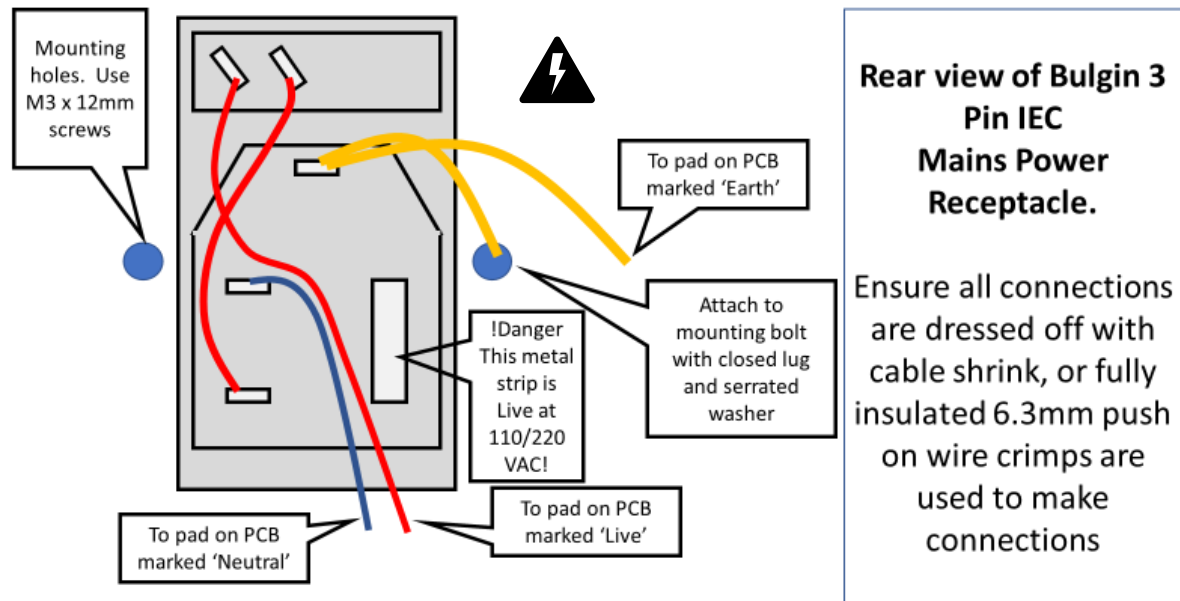


Figure 2 - How to Wire the Bulgin 3 Pin Mains Power Inlet Receptacle