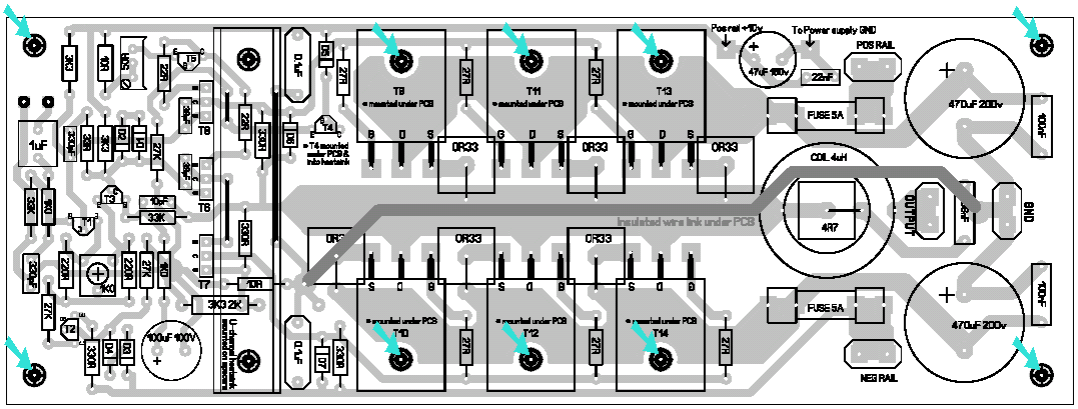
Construction Guide – Actrk400 & 600 power amp modules

The following is a guide only and is not intended to cover all variations of construction that may be employed by other hobbyists. It assumes that the constructor has sufficient knowledge of electronics, and the skills to assemble a moderately complex PCB. The guide begins with an un-drilled but otherwise finished blank PCB.

The PCB

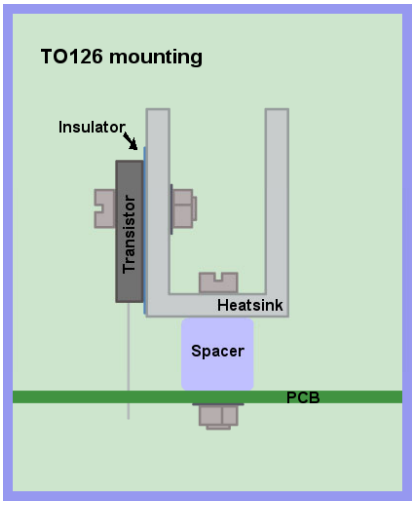
All holes of the PCB should be pre-drilled with a 0.8mm bit. Many of these holes will be drilled again later to accommodate the various component lead sizes. When this is complete rub the track side of the board gently with some fine steel wool to de-burr the holes.

Before re-drilling and placing any components you need to use the PCB as a template to mark the heatsink for drilling. This is done by placing the PCB, tracks down onto the heatsink and securing firmly with clamps or strong tape. Use the PCB to mark the drilling holes for the power FET screw holes and the PCB mounts (shown with blue arrows). I used the same 0.8mm bit to provide a "drill" centre for future drilling. Also mark the hole for T4 the "heat sense" transistor.



~~Remove the board and re-drill the holes that will take the larger components. I.e. the FETs, larger capacitors, fuse holders and 5 watt resistors etc. All holes should be correctly drilled before you begin to load the PCB with components. The PCB bolt holes required for the FETs should be the same diameter as the FET mounting hole.~~

~~For the small heatsink I used a piece of U-channel aluminium measuring 66mm x 12mm. Using the board again as a guide mark the small heatsink for the 3 TO126 transistor mounting holes plus the small heatsink mounting holes.~~

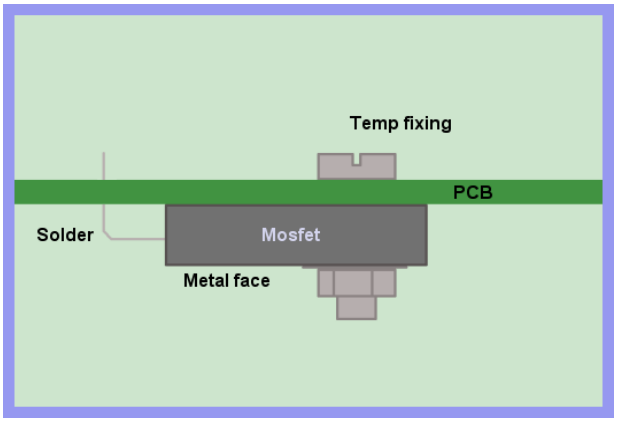


~~Before components are placed onto the PCB, the tracks should be cleaned well using a small amount of detergent and some fine steel wool (or other abrasive cleaner) then rinsed.~~

~~Assemble the PCB starting with the wire links, the small resistors, the fuse holders and all the PCB connectors. Then mount the 2 trimmer resistors, all the capacitors and the relay. Then mount all the TO92 transistors except T4.~~

~~Assemble the 3 TO126 transistors to the small heatsink being mindful of their locations on the PCB. Use the drawing as a guide. Carefully mount the assembly onto the PCB using spacers to raise the heatsink about 6mm. Note there are components underneath that should not be in contact with this heatsink. Once the transistor leads are passed through the PCB tighten all the screws. Before you solder check that there are no shorts between the heatsink and the collector of each transistor. If there is, disassemble and check the insulating pads and heatsink for burrs or damage. Finally solder all the transistor leads~~

The next job is to mount the power FETs. These mount underneath the PCB and involve the use of temporary nuts and bolts to align and secure them prior to soldering. Failure to do this correctly could cause a FET to fracture when PCB is secured to the heatsink. The temporary screws need to be a snug fit so that the FET holes align well with the PCB holes.



1. Measure and bend the FET leads so that they pass through the PCB solder holes and the FET mounting hole aligns with the PCB hole. Note that the metal side of the FET faces the heatsink with the leads bent in the opposite direction.

2. Secure the FETs using the temporary nuts and bolts and tighten taking care that the FETs remain in position.

3. Check to see that the plastic side of the FET is hard against the PCB then solder all the leads. Remove the nuts and bolts.

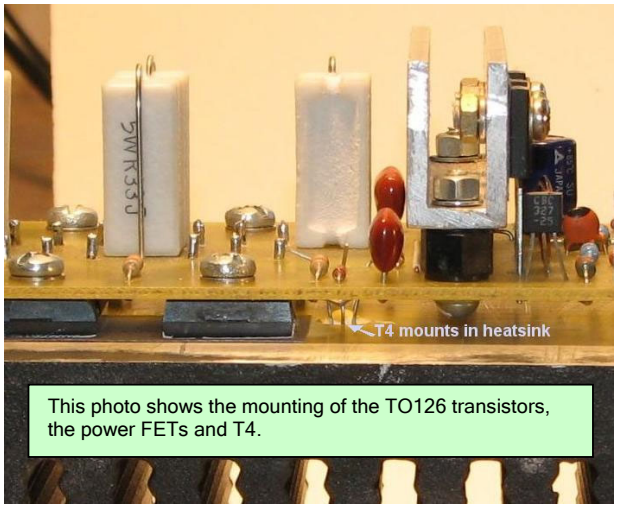
Finally solder the long insulated link connecting the 2 PCB ground points. Solder only at the points shown.

Examine the board looking for errors and the tracks for any unintentional shorts between tracks or poorly soldered joints. Your PCB is finished.

The Heatsink

Using the centre holes marked earlier, drill and tap the heatsink to take whatever mounting bolts you intend to use. Fine threaded self tapping screws can also be used. Completely de-burr all the holes using a countersink bit or larger drill bit. This prevents any metal that de-forms during the threading process from piercing the FET insulating pads.

Drill the hole for T4 so that it is a snug fit and is deep enough to just take the whole transistor body. T4 is mounted under the board (take care of the pin-out orientation) so that it slides into the heatsink hole when the PCB is mounted. This is done by inserting the leads of T4 through the underside of the PCB so that it hangs. Bend the leads a little so that it is retained. Using a few screws and 5mm spacers carefully place the PCB onto the heatsinks so that all the mounting holes line up. Make sure that T4's body goes in the hole and then on the top side of the PCB bend T4's legs down fully. Lift the PCB off without any side movement then carefully solder one leg only of T4. Re-mount the PCB and check T4's alignement. Once you are satisfied lift the PCB again and solder the remaining 2 legs.



This photo shows the mounting of the TO126 transistors, the power FETs and T4.

Put a little thermal grease in T4's mounting hole, place insulating pads in position under the power FETs and permanently mount the board. Use the photograph as a guide. Tighten all the screws then using a multimeter check for shorts by measuring between the heatsink and the FETs drain (centre) lead. You should see an open circuit. If a short is measured lift the PCB and check for burrs or other damage to the pad.

Final Set up And Adjustment

No attempt should be made to set up or test a power amplifier module that is not correctly mounted on a heatsink. Make sure the main power supply is fused and the work area is clear. First check all your work and make sure the output devices are insulated from heatsink. The set up is done without an input or a load connected to the power amplifier.

1. Check the power supply is operating correctly and verify the rail voltages. Switch the power supply off and check with a multimeter that the rail capacitors have discharged.

2. Using a multimeter measure the resistance of VR2 and set it for maximum resistance.

3. Correctly connect the ground lead, the two positive leads plus the negative lead to the power amp module.

4. Remove the PCB fuses and replace with 100 ohm 5 watt resistors. Connect a multimeter that is set to the 20 volt scale across the positive rail 100 ohm resistor.

5. Check that the power supply connections are correct one last time and switch on. If the multimeter reading goes off-scale, turn off immediately and find the problem. Check also the 100 ohm 5 watt resistors; they may have gone open cct.

6. If everything seems ok adjust VR2 to set the output stage bias current, by measuring the voltage across the positive rail resistor. Adjust for a reading of 4 volts per output FET pair. I.e. For a 6 FET board set for a voltage of 12 volts. This equates to a bias current of 40mA per FET pair or 120 mA total. For the 12 FET board set for a voltage of 24 volts.

7. If everything seems ok, check the output offset voltage and adjust VR1 to achieve an offset of less than 10 mV. You will need to wait briefly between adjustments for the offset to settle.

8. All being well switch off, back off the bias control trimmer (VR2) and replace the 100 ohm resistors with 10 ohm 1 watt resistors. Switch on again and re-adjust VR2 to get 0.4 volts per FET pair.

9. Switch off, remove the resistors and put the fuses back in. Switch on, re-check the offset voltage and adjust with VR1 if necessary.

The amp module is ready, connect the input and output and enjoy.