JLAudiophile-1200D V1

Features

- Based on IRAUDAMP9 Class D Amplifier by International Rectifier
- Adjustable Oscillating Frequency
- Shutdown pin for standby mode and external protection circuits.
- Easy to Assemble Through-Hole Components

Specifications

Topology	Half bridge configuration	
Minimum Load Impedance	2Ω	
Self Oscillating Frequency	250 kHz to 280 kHz	No input signal, adjustable
Input Sensitivity	1.4V RMS (line level)	
Gain Setting	30x of input voltage	
Recommended Power Supply	±75VDC, 1500W	Operational ±65VDC to ±80VDC
DC Offset	±12mV ±100%	Typical
Auxiliary Power Supply	15V AC 1A transformer, or 15V DC 500mA SMPS	**WARNING**: Needs an "Independent Winding" transformer, floating supply, or supply referenced to VN (negative rail)
PCB Dimensions	2.9" (W) x 6" (D)	
Rated Output Power	1200W at 2Ω	< 1% THD, 10 seconds, cold start
Idle Power Consumption	~ 7W	at ±80VDC

Inductor Specification

Core: T157-2, Micrometals
Wire: 17 AWG, magnet wire or Litz Wire equivalent
Turns: 39
Length: 230 cm
Finish: Varnished
Inductance: 22 uh

Absolute maximum ratings

Correct operation of the amplifier at these limits is not guaranteed.
Operation beyond these limits may result in irreversible damage.

Max Rail Voltage:	±85 VDC	
Max Switching Frequency	300 kHz ± 25 kHz	Given above voltage
Max Ambient Air Temp	< 50 deg celsius	Given above osc freq and voltage Air temp inside amp case
Max Aux Supply Voltage:	18V AC or 18V DC	1A transformer or 500mA SMPS

Recommended Operating Conditions

Rail Voltage	±75 VDC	Rated 1500W
Switching Frequency	300 kHz ± 25 kHz	
Ambient Air Temperature	< 60 deg celsius	Air temp inside amplifier case
Aux Supply Voltage	15 V AC or 15V DC	Floating 1A transformer or 500mA SMPS Referenced to VNN

Returns

14 Days after the buyer receives the item. The buyer is responsible for return postage costs.

Warranty

The product carries warranty out for all provable material and manufacturing defects.
All damage caused by wrong or inappropriate operation voids the warranty.

Disclaimer

This product uses potentially lethal voltages. Incorrect wiring may result in death or serious injury. The builder accepts all the risks and takes full responsibility for proper installation and use of this device. The product designer will in no way be held responsible for an accident resulting in injury or death caused by the device and the information provided in this document.

All information stated is provided 'as-is' and without warranty of any kind.

Operating guidelines to ensure rock solid operation of the amplifier modules.

Recommended Power Supply

- Not more than ±80VDC (1500W or higher)
- Driver supply: 15V AC (1A) or 15V DC (500mA) floating, or referenced to VN (negative rail)

WARNING

- Do not connect/disconnect any terminals, probes, or the IRS2092 IC when there's still power to the main supply. **Wait for the supply to fully discharge** before removing the faston tab connector for rail supply. Measure +/- power supply voltages before touching the amp, it should be 0V.

- The 12V driver supply is referenced to negative rail (VN). Use a floating supply if a VN referenced supply is not available. Instant failure to driver supply will result if this is not followed, beware of exploding capacitors.

- The module should be fully isolated from the heatsink, the resistance should be higher than what you can measure with the highest resistance setting of your DMM (ideally infinite resistance).

- Check the idle oscillating frequency, value should be between 3250kHz to 280kHz.

- Do not feed the input of the amp with frequencies > 20khz. Large LC resonance will occur and will damage the antiparallel diodes on the output.

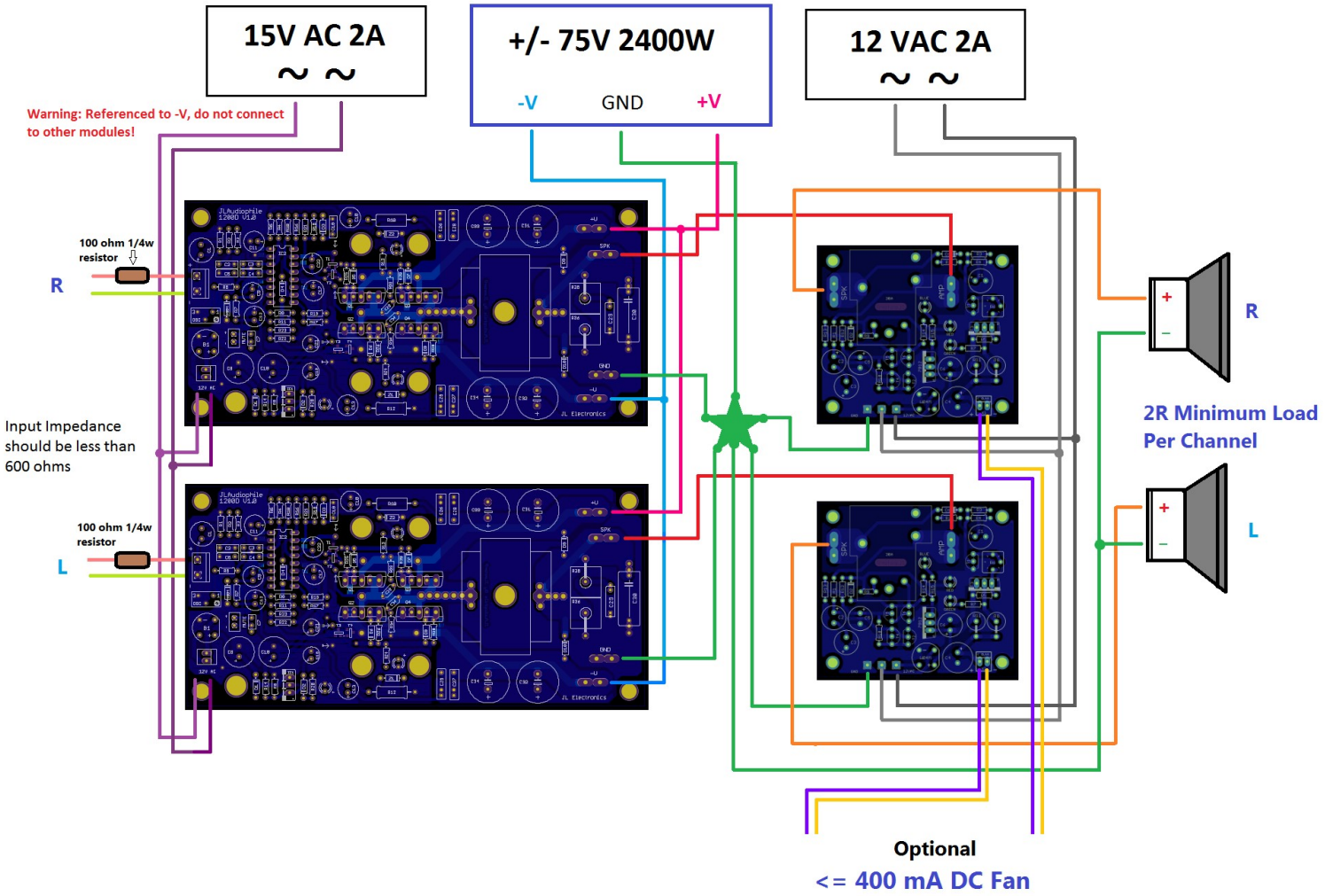
- Maintain the temperature inside the amplifier casing to acceptable values (below 60 deg, celsius) to prolong the life of the amplifier.

- Use speaker protection at all times. Speaker protection is mandatory specially when using a high powered amplifier.

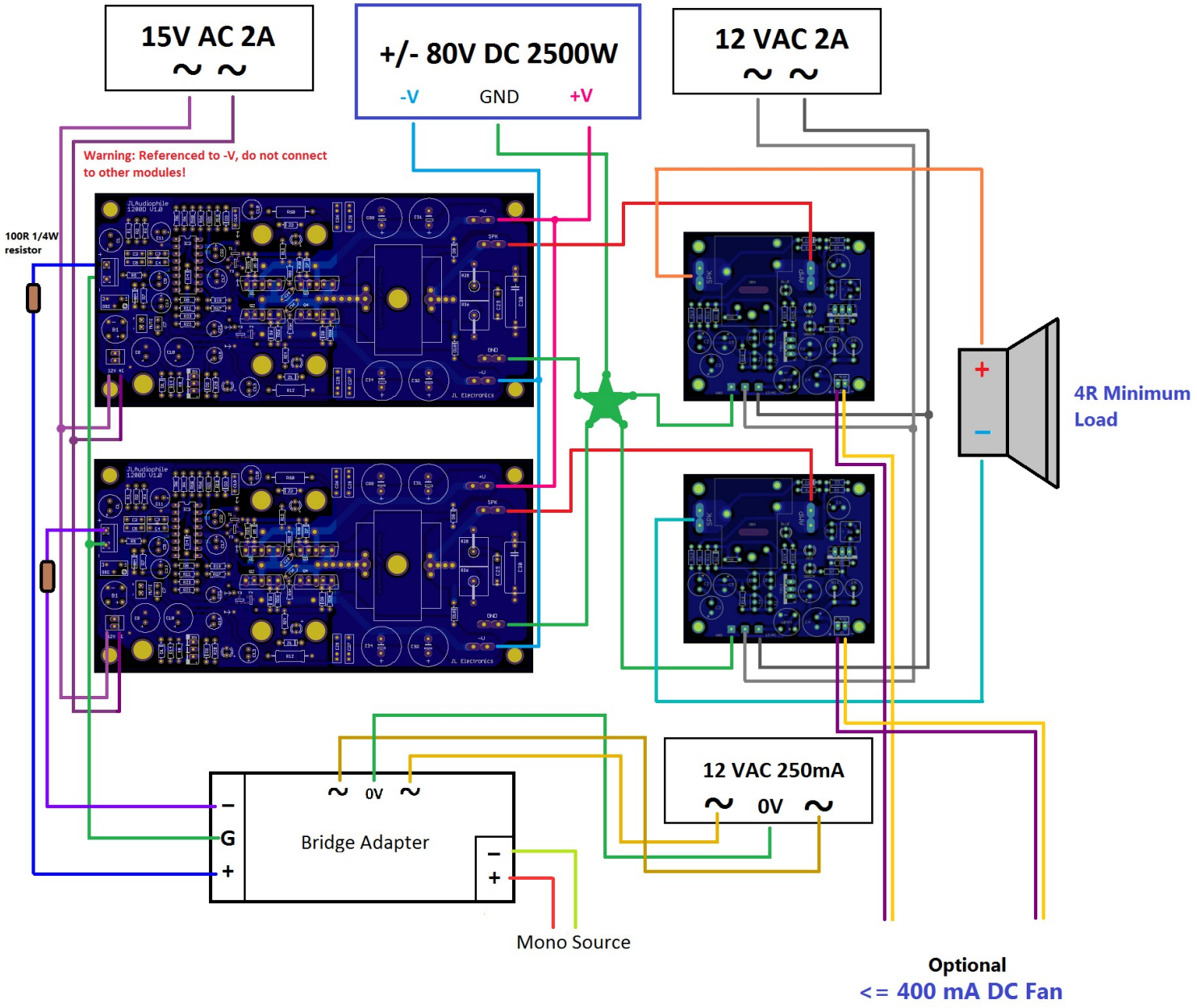
- The input impedance of the module is low (4K ohms). Use a buffer or a preamp with an output impedance of less than 600 ohms.

- Do not run the amp without load. To prevent problems when there is no load or to avoid stress to the amp when speaker is disconnected, put a > 5W 100Ω resistor in parallel with the speaker output. Overtemp sensor (if there is any) should also monitor this resistor. This resistor will overheat if there is no load and there's full volume on the input of the amplifier.

Stereo Connection Diagram



Bridged Connection Diagram



Note: +/-88V Supply is ok because there will be no bus pumping phenomena.

Tools and Materials Required

- 40W or higher Soldering Iron
- 0.8mm Soldering lead 60/40 Rosin Core or better
- Liquid flux for SMD parts, WD40 or flux cleaner
- Kapton Tape
- Tweezers, Long nose pliers, Side Cutting Pliers
- Screw driver
- Scissors
- Hot melt glue
- Female faston tab connector
- Heat shrinking tube
- Power Supply for testing
- Digital Multimeter
- Oscilloscope or frequency counter (optional)

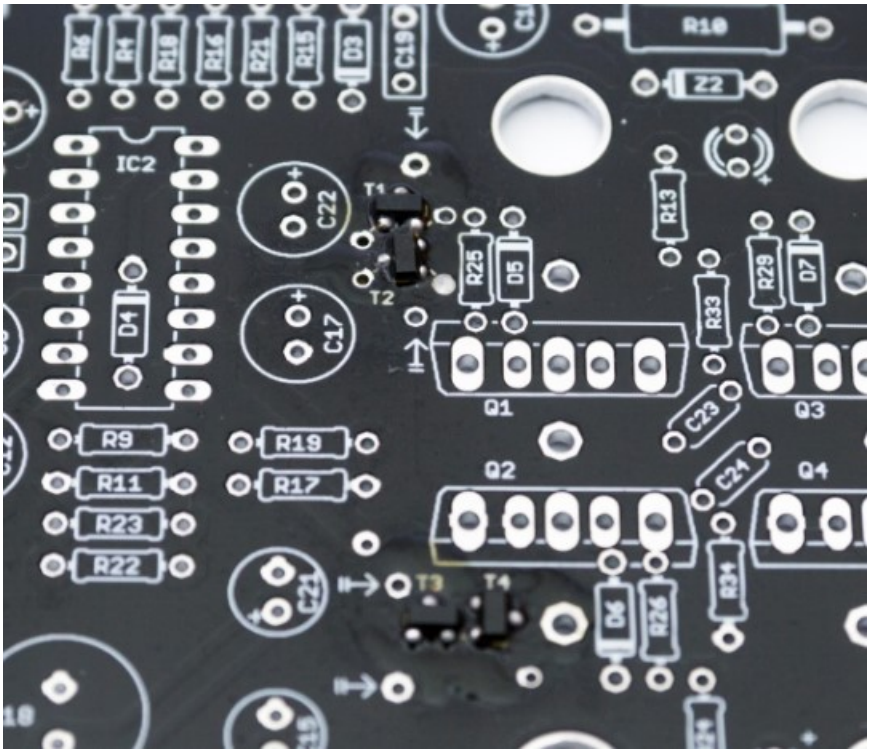
Winding the toroid

Make 39 turns of 17 AWG solid wire in T157-2 iron powder core. Dip it in electrical varnish afterwards so that the wires will not move due to vibration.

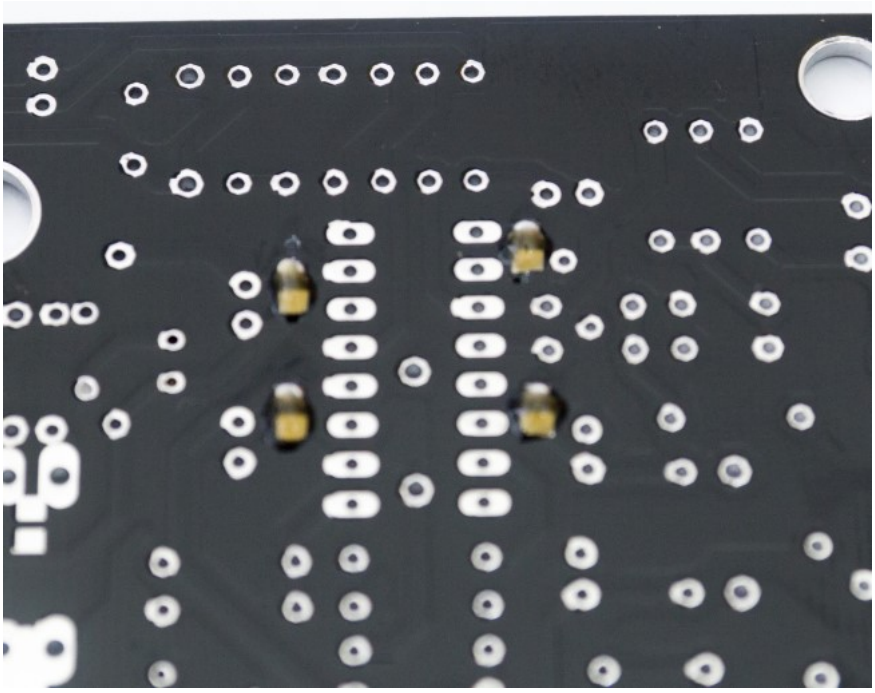
http://www.kitsandparts.com/howtowindtoroidswithoutpain.php

Assembly Steps

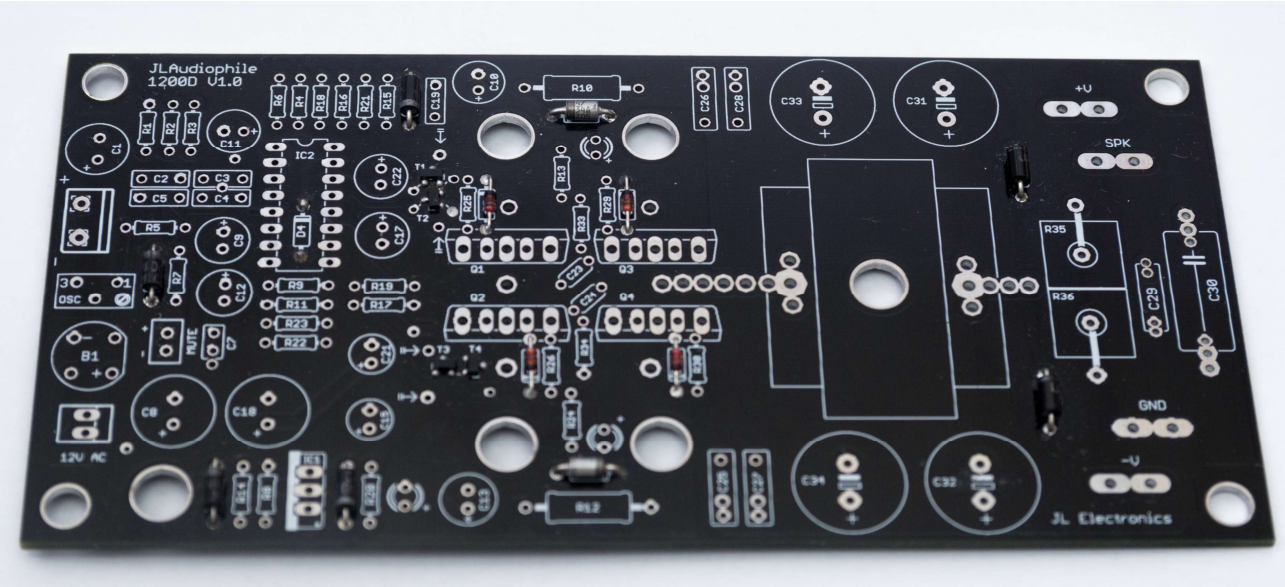
1. Solder the SMD totem pole transistors. Solder PNP first (T2, T4), then NPN(T1, T3). Put solder in one of the pads and apply liquid flux on all pads. (Watch youtube video tutorials on how to solder SMD using ordinary soldering iron).



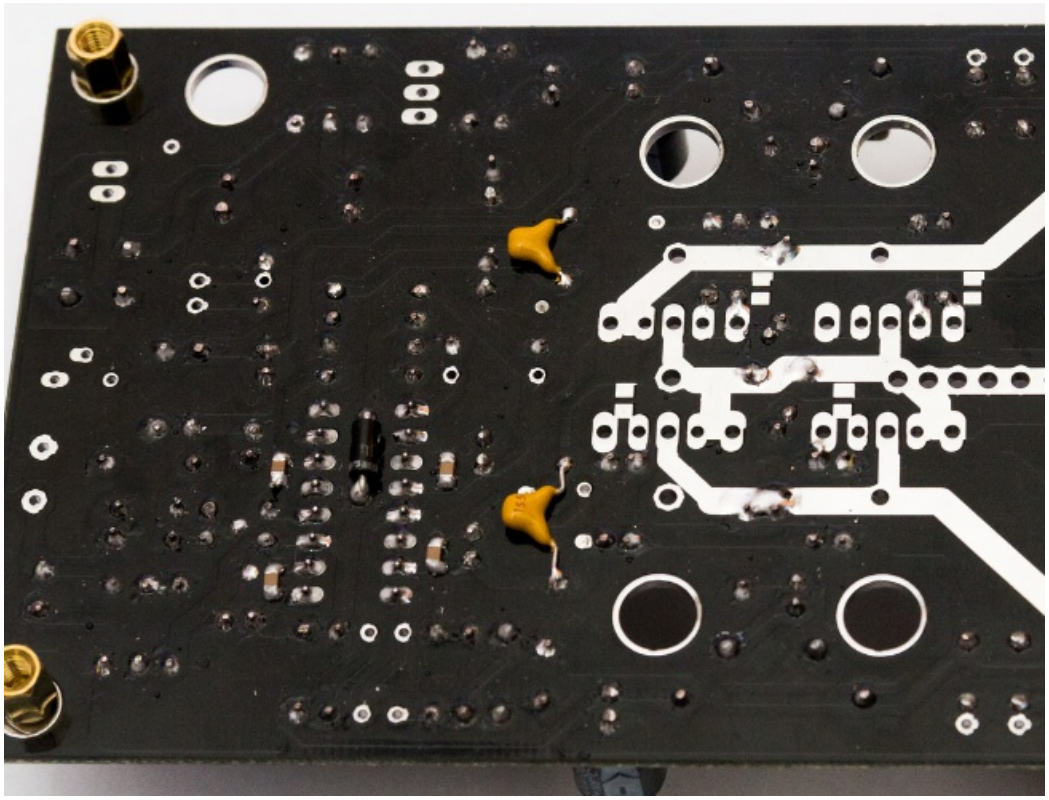
2. Solder SMD decoupling caps under the PCB near the IC, then solder 10k resistor SMD near the mosfets.



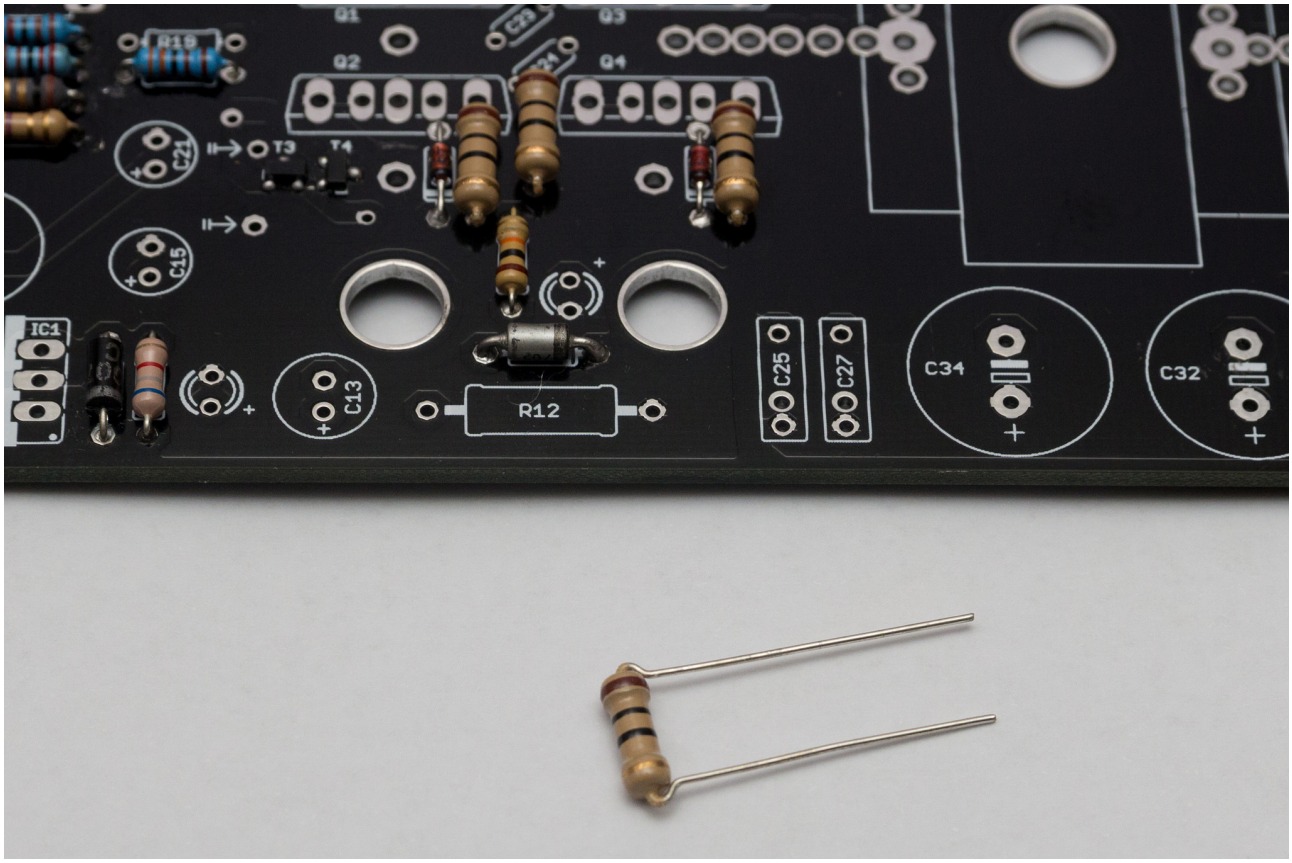
3. Solder all diodes, **D4 should be soldered** under the PCB so that the IC socket for IRS2092 can be fitted correctly. (see pic below)



4. Solder the bypass caps for the totem pole buffer, arrows on the top of the PCB indicates the correct mounting holes for the capacitors.



5. Solder all the resistors. Resistors R25, R26, R29, R30, R33, R34, are rated at 1/2W, but the resistor pads in the PCB are only spaced for 1/4W, bend the pins (refer to pic below) so that the resistors will fit in the PCB.

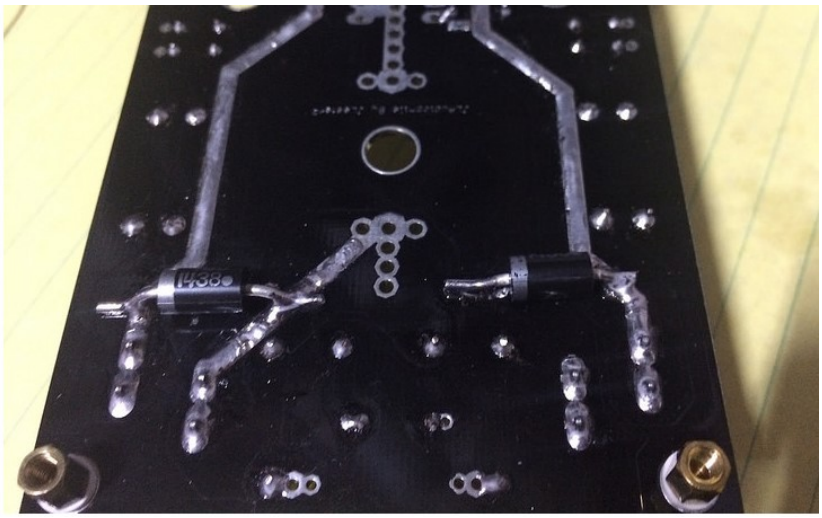


6. On the bottom PCB, fill the high current traces with soldering lead, be careful not to fill holes with lead.

7. Resistor and diode leads are prone to corrosion when flux is left uncleaned, clean the board with flux remover or wash it with detergent soap, let it dry afterwards.

8. Solder the Osc trimpot, set it initially to 0 Ω (Fully Counterclockwise). **Note:** Since pins 3 and 2 of the trimmer are connected. Turning the dial clockwise should increase the resistance and vice versa.

9. Solder MUR460 (D9, D10) under the PCB.



10. Solder the faston tabs. Hold the male faston tab using the female faston tab connector to align it while soldering. Solder the top side of the PCB first.

11. Solder the bottom of faston tabs afterwards.

12. Bridge rectifier will run very hot during operation, elevate it on the PCB for better cooling.

Soldering the mosfets and the VCC regulator

13. Bend the TO-220 mosfet's pin perpendicular to its body. For TO-220 type mosfets, bend the pins about 0.1" **longer** from the thick portion. For TO-247, bend between the thick and the thin part of the pins.

14. Insert the mosfets under the PCB but do not solder them yet. The purpose is to ensure that the mosfets are correctly mounted in the heatsink before soldering. Use only 1 pair of mosfets. Solder the other pair after the amp is verified to be working.

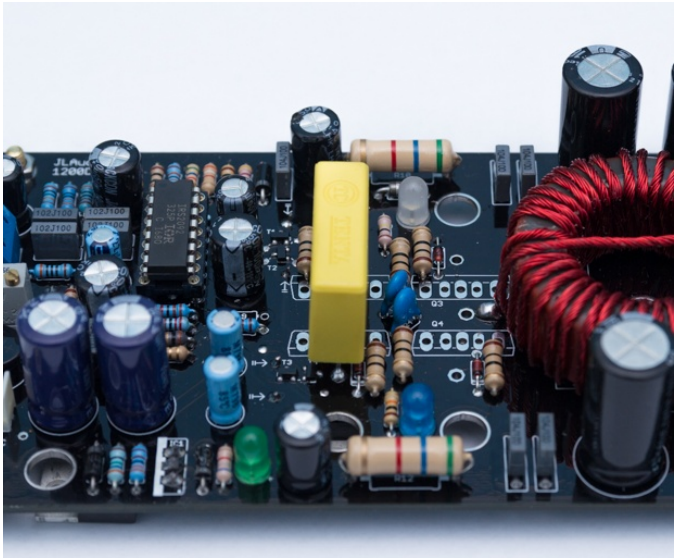
15. Mount the amp module with unsoldered mosfets to the heatsink, tighten screws and ensure that the mosfets are evenly flat and with proper contact with the heatsink.

16. Solder the pin of the mosfets **first** on the top PCB side.

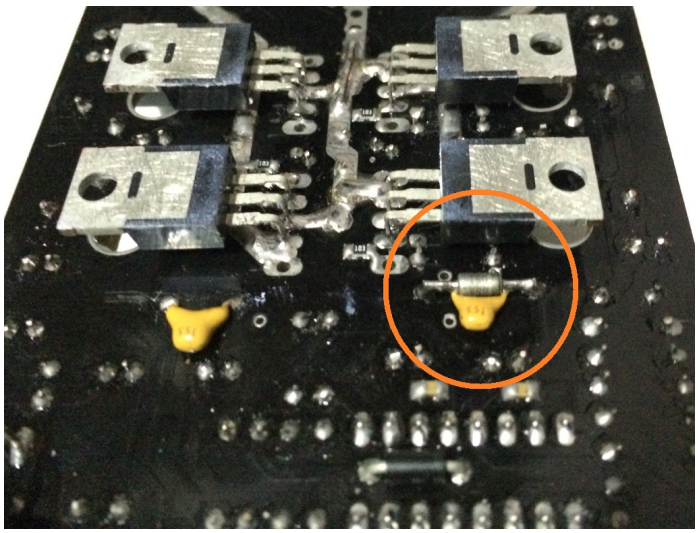
17. After soldering the mosfets on the top side of PCB, unscrew and remove the whole amp module from the heatsink and solder the bottom side of the board for the mosfets.
18. Do the same technique for the VCC regulator LM317.

19. Place kapton tape in the PCB to insulate the inductor from the PCB traces. Solder the inductor afterwards.

20. Insert rail to rail bypass capacitor (see pic below) between the mosfet rails, solder it on top side of the pcb.



21. Solder 14V zener in parallel with buffer capacitor VB-VS, see schematic.



Guidelines before powering up

1. Check if there are shorts in the terminal connectors. In continuity tester, check the terminals V+, V-, SPK and GND. There should be no shorts.

2. The module should be fully isolated from heatsink. In highest megaohm setting of multimeter (200 Mohm), the result should be ideally infinite resistance. (higher than the current setting)

3. Remove IRS2092 IC from the socket.

4. Check if there are shorts on mosfets.

5. Check if the trimmer pot + R5 was set to 250 ohms. Check orientation of diodes and electrolytic capacitors.

Applying Power

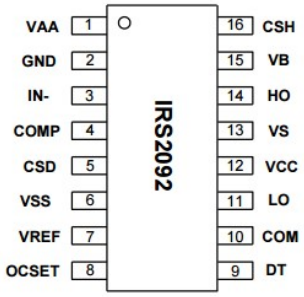
WARNING: The AUX driver supply should be a floating 15VAC or 15V DC supply and should **not** be powering any other amplifier modules (like speaker protect, preamp, etc.) except for this module.

1. Important: Before checking all housekeeping supplies, remove IRS2092 IC from the socket.

2. Apply power to 15V AC terminal (do not connect the main rail power supply to +V, -V and GND yet!), check the LM317 module's voltage regulator's output, connect the negative probe of voltmeter to -V track and positive probe to pin 2 (middle pin) of LM317. Verify that the voltage is in the range of 11.4V DC to 12.9V DC. If ok, proceed to next step.

3. Turn off 15V AC power. Connect +V, GND, -V. Apply power to rails. The white LED should light up.

4. Check the output voltage of +/-5.6V zener regulators directly on IC socket. For +V, check VAA and GND. For –V check VSS and GND.



PDIP16 and SOIC16N

5. If driver supply and 5.6V VAA/VSS supply are ok. Turn off all supply and make sure both power supplies are fully discharged. Measure with voltmeter, reading should be 0V DC. Then put IRS2092 back into the socket.

6. Connect the module according to the diagram and turn on both the supply.

7. Check the output of the amplifier (SPK, GND) for DC output using multimeter. Connect a 5W 10ohm resistor across speaker out and ground. Set the multimeter to 200mv DC. The output of the amplifier should not exceed 200mv DC voltage.

8. When the amplifier is verified working. Turn off power, wait until supply is fully discharged. Disassemble and solder the remaining pair of mosfets. Place the module in the main heatsink.

9. After assembly, recheck if the module is fully isolated from the heatsink.

Potentiometer Adjustments

Frequency Adjust- OSC is a trimpot to adjust the frequency. Higher resistance translates to higher frequency and vice versa. Adjustments have to be done at idling condition with no signal input.

Turning the trimpot clockwise will increase the oscillating frequency. Recommended operating frequency is 300 kHz ± 25 kHz. Do not lower the Osc. Freq. below 250kHz because the inductor will become hot and zobel resistor will heat up due to a larger residual current.

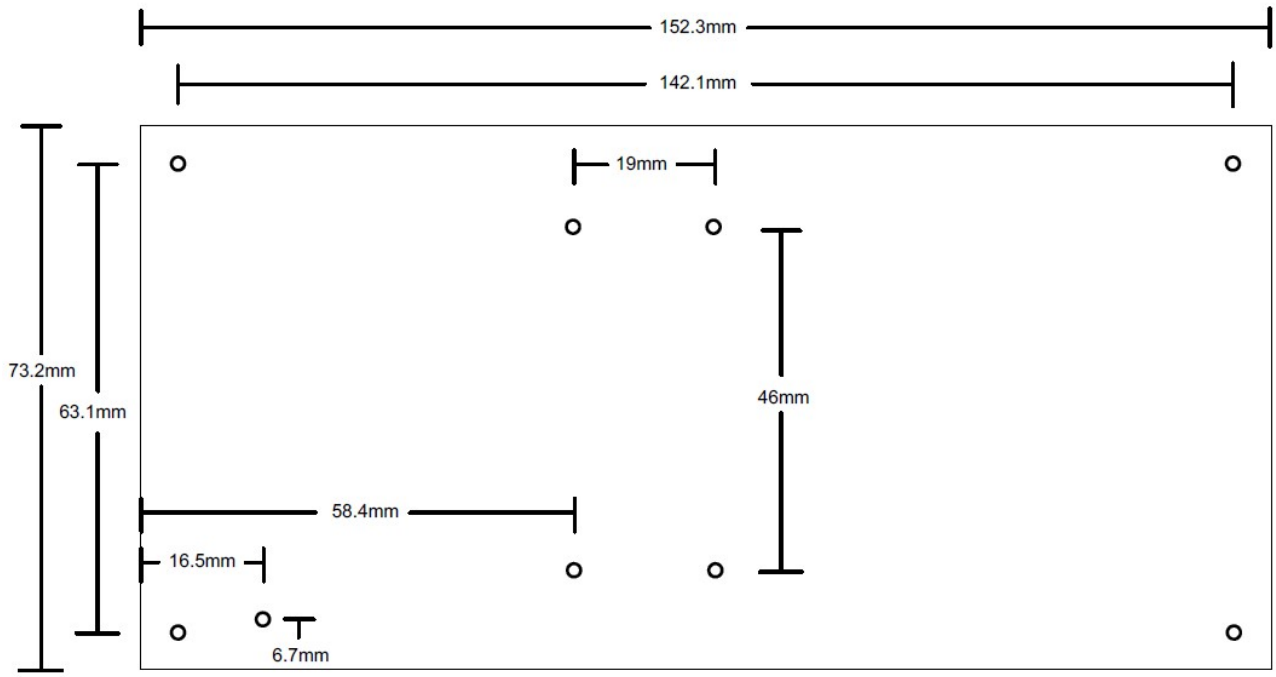
Switching Frequency	OSC trimmer + R5 Total Value
280 kHz	**230 Ω**
300 kHz	240 Ω
320 kHz	260 Ω
330 kHz	370 Ω

Warning

Increasing the switching frequency beyond recommended value might result to irreversible damage to the driver stage due to overheating. Failed driver stage will result to damage of output mosfets.

Decreasing the switching frequency will result in higher idle temperature of the T157-2 Inductor, and the zobel network due to larger ripple current.

PCB Dimension



References

Reference Design

IRAUDAMP9
AN-1138 – IRS2092(S) Functional Description

IR Class D Tutorials

Class D Audio Amplifier Design
Designing Practical High Performance Class D Audio Amplifier

IR Design Tips

AN-1135 - PCB Layout with IR Class D Audio Gate Drivers

IR Application Notes

AN-1071 - Class D Audio Amplifier Basics
AN-1084 - Power MOSFET Basics
AN-978 - HV Floating MOS-Gate Driver ICs
AN-1070 - Class D Audio Amplifier Performance Relationship to MOSFET Parameters