HST-CAA001

DIY Hi-Fi Class A Amplifier PCB

For John Laurence Linsley-Hood’s Classic Circuit Design

Project Guide

A trading name of W.E.B.Fox

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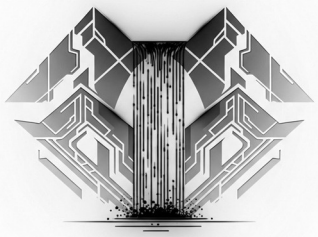

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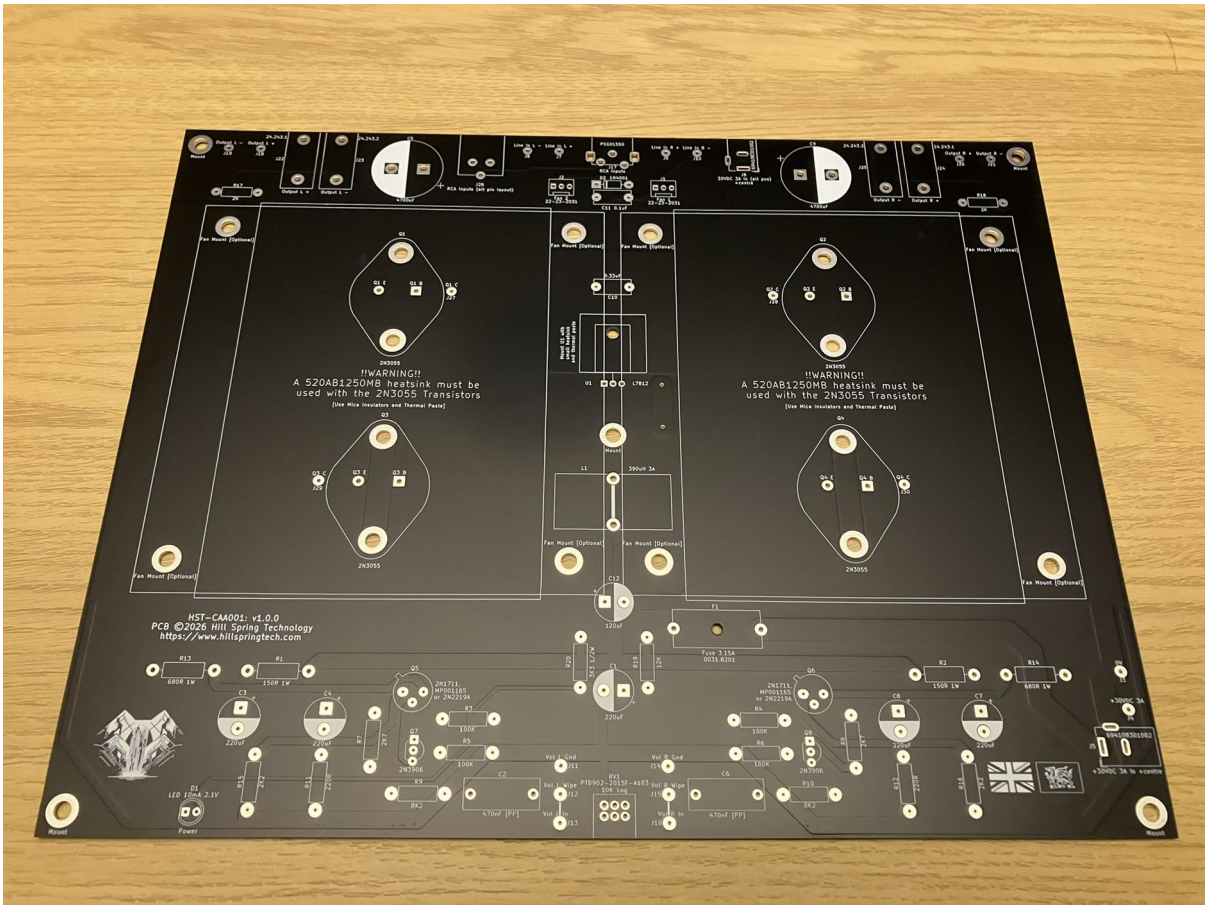
1.0	27/02/2026	W.E.B. Fox	First Version
1.1	27/04/2026	W.E.B. Fox	Minor corrections


!!WARNING!!
A 520AB1250MB heatsink must be used with the 2N3055 Transistors
[Use Mica Insulators and Thermal Paste]
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Introduction

John Laurence Linsley-Hood's Class A amplifier design, which first appeared in the April 1969 edition of 'Wireless World' magazine, has become somewhat legendary amongst DIY audio enthusiasts. I first came across this circuit when I was an obsessive 'Audiophile' teenager, far too many years ago than I would like to admit, and I was blown away by the clarity of the sound it produced.

The quality of the sound reproduced by Hi-Fi audio equipment can be highly subjective, but when constructed correctly and paired with a suitable power supply, I think this circuit provides an amazing listening experience. And, the low component count means you get all of this at a fraction of the price of similar quality Hi-Fi power amplifiers available on the market today, even ones considered 'Audiophile' or 'Reference'.

My early builds of the circuit involved either stripboard or hand-drawn, home etched PCBs, as these were the only real options to an audio DIYer at the time. In more recent times I decided to revisit the design and build a much more up to date take on the circuit, using computer aided design and a professionally made PCB. This was initially just a personal project, but as I'm really happy with the results, it made sense to make more batches of the PCB so that others can have a neat and practical way to construct a modern, stereo version of this amazing circuit.

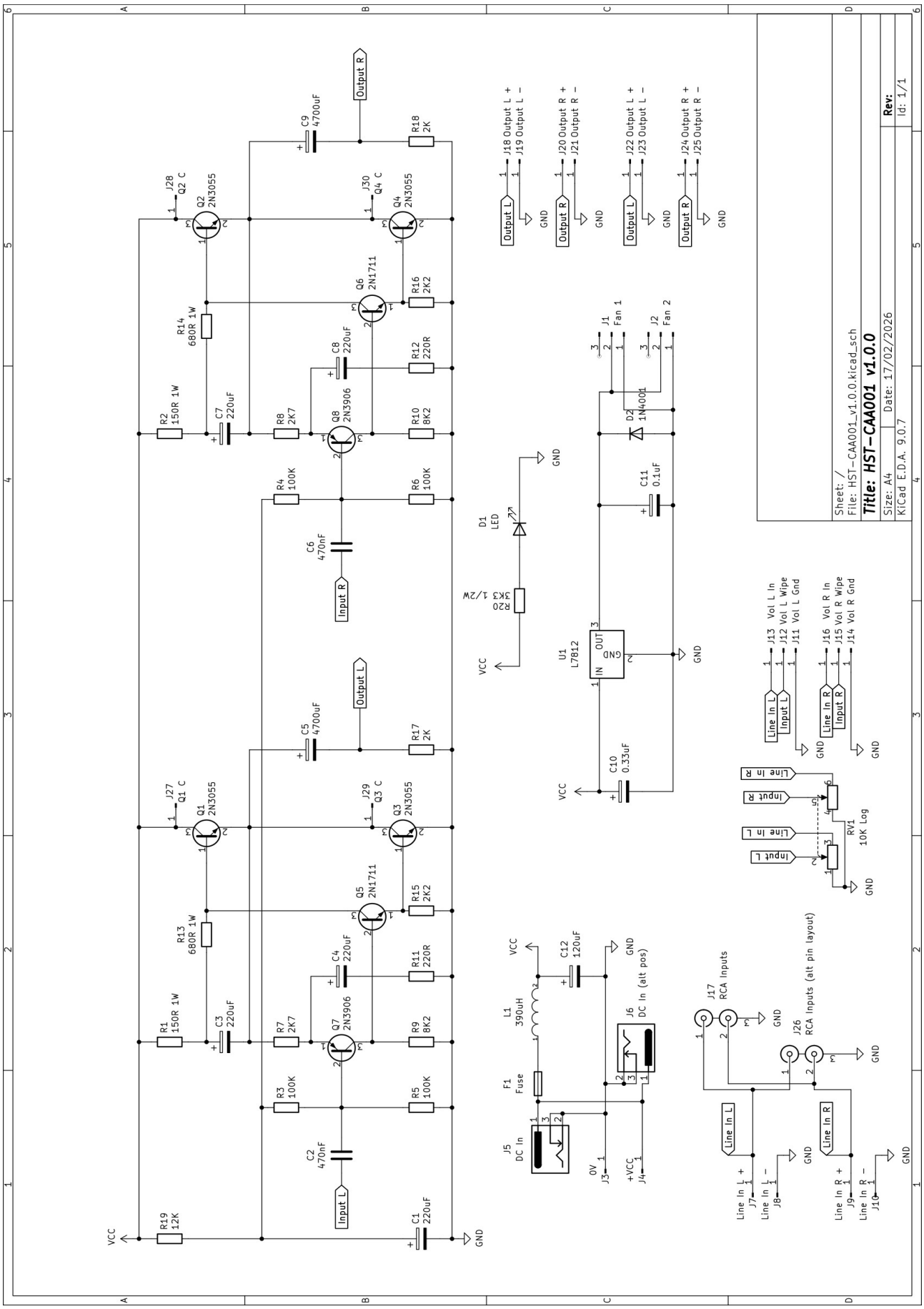
The PCB has been carefully designed to make the amplifier easy to construct, using components that are both through-hole only, and readily available to electronics hobbyists in 2026. There are no fiddly surface mount components to deal with, and no hunting the dark corners of the web for anything rare, exotic or discontinued.

The PCB design has also added flexibility to the circuit, with provision for mounting components in different ways to suit requirements. It also adds optional active cooling and power supply noise suppression.

The circuit's been tuned to work best with 8Ω speakers, but will give good results through 6Ω and 4Ω as well, provided you drive volume levels a little less – this is reflected in the listed output power specifications. If you want the very best performance out of lower impedance speakers, alterations can be made to the circuit as detailed in the **Getting More Power – A Circuit Hack** section of this guide.

Specifications

Power Output (peak):	35W into 8 Ω (17.5W per channel) 25W into 6 Ω (12.5W per channel) 20W into 4 Ω (10W per channel)
Power Output (RMS):	25W into 8 Ω (12.5W per channel) 18W into 6 Ω (9W per channel) 14W into 4 Ω (7W per channel)
Supply Voltage:	≃30V DC
Normal Operating Current:	<3A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Output L
Input R
Input L
VCC
GND
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Q2 2N3055
Q3 2N3055
Q4 2N3055
Q5 2N1711
Q6 2N1711
Q7 2N3906
Q8 2N3906
R1 150R 1W
R2 150R 1W
R3 100K
R4 100K
R5 100K
R6 100K
R7 2K7
R8 2K7
R9 8K2
R10 8K2
R11 220R
R12 220R
R13 680R 1W
R14 680R 1W
R15 2K2
R16 2K2
R17 2K
R18 2K
R19 12K
R20 3K3 1/2W
C1 220uF
C2 470nF
C3 220uF
C4 220uF
C5 4700uF
C6 470nF
C7 220uF
C8 220uF
C9 4700uF
C10 0.33uF
C11 0.1uF
C12 120uF
D1 LED
D2 1N4001
U1 L7812
F1 Fuse
L1 390uH
J1 Fan 1
J2 Fan 2
J5 DC In
J6 DC In (alt pos)
J17 RCA Inputs
J26 RCA Inputs (alt pin layout)
RV1 10K Log
Line In L
Line In R
Vol L In
Vol L Wipe
Vol L Gnd
Vol R In
Vol R Wipe
Vol R Gnd

Optional Components

The **HST-CAA001** PCB has provision for a number of optional components, dependent on your project requirements:

Power Connectors

Connecting a +30V DC 3A power supply to the board can be done in a number of ways. If you plan to place the power supply within the same enclosure/case as the amplifier, you can wire it up directly to connector pins J3 and J4.

Alternatively, there are two separate location options on the board for a standard barrel jack socket (5.5 x 2.5mm), allowing an external power supply to be plugged in.

Input Connectors

If you are planning to mount the line-in connectors to the enclosure/case, connector pins J7–J10 can be utilised.

Alternatively, if you want to plug RCA cables directly into the board, there are two options:

- J17 provides the facility to solder in a Pro-signal PSG01550 or PSG01548 type stereo RCA socket.
- J26 provides a footprint for a more generic stereo RCA socket.

Output Connectors

If you are planning to mount speaker output connectors to the enclosure/case, the connector pins J18–J21 can be utilised.

Alternatively, if you want to connect banana plugs directly into the board, you can solder in 24.243.1 type red banana sockets into J22 and J24, and 24.243.2 type black banana sockets into J23 and J25.

Volume Controls

If you want to mount volume potentiometers to the enclosure/case, connector pins J11-J13 can be utilised for the left channel, and J14-J16 for the right channel.

Alternatively, RV1 gives you the provision to mount a dual-gang potentiometer (a 10K logarithmic Bourns PTD902-2015F-A103) directly to the PCB.

IMPORTANT: If you do not wish to have any volume controls on the amplifier, for instance if you are controlling the volume from elsewhere on your Hi-Fi, you must solder in a wire link between J12 and J13, and a separate wire link between J15 and J16. If you don’t do this, then you’ll get no sound.

Active Cooling

The **HST-CAA001** PCB has provision for active cooling of the power transistors. If you are building the circuit 'as-is', using the recommended heatsinks and a well ventilated enclosure (see **Enclosure Considerations** section), passive cooling should be more than adequate. However, if you choose to adjust the amplifier output current, as described in the **Getting More Power – A Circuit Hack** section of this guide, have issues with ventilation, or simply live in a hot climate, you may find that things start to get too hot. As a rule of thumb, if you find that the heatsink temperatures rise to over 90ºC (194ºF) after prolonged use, it would be recommended to implement Active Cooling.

Optional Components C10, U1, C11, D2, J1 and J2 provide a regulated 12V power supply to run a pair of standard 120mm PC cooling fans. These mount over the top of the large heatsinks for the amplifier's power transistors, drawing hot air up and away whilst pulling cool air in from the sides. Obviously, your music listening pleasure does not want to be spoilt by noisy fans buzzing away in the background, but thankfully there are plenty of quiet/silent PC fans available on the market. One example is the Arctic F12 Silent, but there are other models available from various manufacturers.

SMPS Noise Suppression

Using a linear power supply is considered the gold standard in audio equipment. However, it is possible to use a switch mode power supply (SMPS) instead, as these are much more efficient, and easily available off the shelf. However, it is true that some switch mode power supplies can introduce high frequency noise into the power supply line. Although the noise itself is often above any frequencies we can hear, it can potentially cause distortion within the audio signal, and this distortion *can* be heard.

If you are planning to use a switch mode power supply, the optional L1 and C12 components can be added to help suppress this noise. These form a low-pass filter on the supply rail, cleaning out any signals above approximately 700Hz. Note that the load for the whole circuit passes through L1, so it has to be able to handle at least 3A.

If you are planning to use a linear power supply, L1 and C12 are not required. However, you will instead need to add a wire link between the two pads of L1.

Please read the **Power Supply Considerations** section of this guide for more details, including a suitable linear power supply circuit.

Enclosure Considerations

I personally think the completed project looks rather smart when it is out on display, simply attached to a decorative board:

However, although the voltages are low (the power supply, with its mains transformer, should be safely placed within a separate, earthed metal case), there are still hazards for small fingers. If using passive cooling, those heatsinks get quite hot. If using active cooling, there are spinning fans to consider, although that can be mitigated with finger guards. And, of course, it's all a bit of a dust trap.

So, you may well want to place everything in a case/enclosure. There is no set recommendations for which enclosure you can use, except to ensure that there must be adequate air flow over the heatsinks, so that the power transistors stay reasonably cool.

A good idea might be to have a grill or wire mesh on the top of the enclosure, above the heatsinks/fans, along with vents in the sides and base. This will allow cool air to be drawn in from the bottom and sides, to be vented out of the top. It would also be a good idea not to place anything on top of the amplifier.

Bill of Materials

Below is a complete Bill of Materials (BoM), listing all the components and hardware required to complete the project.

For items marked [OPTIONAL], please see the **Optional Components** section of this guide for details.

Electronic Components

	R1 , R2	150R 1W		
	R3 – R6	100K 500mW		
	R7 , R8	2K7 500mW		
	R9 , R10	8K2 500mW		
	R11 , R12	220R 500mW		
	R13 , R14	680R 1W		
	R15 , R16	2K2 500mW		
	R17 , R18	2K 500mW		
	R19	12K 500mW		
	R20	3K3 500mW		
	C1 , C3 , C4 , C7 , C8	220-250µF >=50V Electrolytic	Lead spacing 5mm	
	C2 , C6	0.47µF Polypropylene (PP)	Lead spacing 15mm	
	C5 , C9	4700 µF >=50V Electrolytic	Lead spacing 10mm	
[OPTIONAL]	C10	0.33 µF >=50V Polypropylene (PP)	Lead spacing 10mm	Active Cooling
[OPTIONAL]	C11	0.1 µF >=50V Polyethylene Terephthalate (PET)	Lead spacing 10mm	Active Cooling
[OPTIONAL]	C12	120 µF >=50V Electrolytic	Lead spacing 15mm	SMPS Noise Suppression
	Q1 - Q4	2N3055		
	Q5 , Q6	2N1711 or MP001165 or 2N2219A		
	Q7 , Q8	2N3906		
[OPTIONAL]	J1 , J2	Molex 22-23-2031 3-pin fan connectors		Active Cooling
[OPTIONAL]	J5 or J6	Würth Elektronik 694108301002 Jack Socket		Power Connectors
[OPTIONAL]	J17	Pro-signal PSG01550 stereo RCA socket		Input Connectors
[OPTIONAL]	RV1	Bourns PTD902-2015F-A103 dual 10k A Pot		Volume Controls
	D1	5mm Green LED 10mA 2.1V		
[OPTIONAL]	D2	1N4001		Active Cooling
	F1	Schurter 0031.8201Fuseholder + 3.15 A 5mm x 20mm fast-blow fuse		
[OPTIONAL]	L1	390 µH >=3A Toroidal Inductor		SMPS Noise Suppression
[OPTIONAL]	U1	L7812		Active Cooling
[OPTIONAL]	J22, J24	24.243.1 type red banana sockets		Output Connectors
[OPTIONAL]	J23, J25	24.243.2 type black banana sockets		Output Connectors
[OPTIONAL]	J3-J4,J7-J10,J11-J16,J18-J21	1mm PCB solder pins		Various input and output options

Heatsinks

Power Transistors:

The PCB is designed to have 2 x 520AB1250MB type heatsinks mounted directly to the board to cool the 2N3055 power transistors. You will also need 4 x TO-3 Mica Insulators

with 8 x Insulator Bushes, along with some thermal paste. See **Construction Guide** section for more details.

If you prefer to mount the 2N3055 power transistors separately from the board, say on a case mounted heatsink, additional pin connectors J27-J30 have been provided to make it easier to remote wire the collector of each transistor (Q1-Q4). Note, though, that if you go down this route, the heat sink(s) you use must have the same or better thermal resistance than the 520AB1250MB (1.2 °C/W)

U1 12V Regulator [OPTIONAL]:

If you are including the optional active cooling circuit, U1 (L7812) needs a small PCB mounted heat sink with a thermal resistance of <= 24 °C/W. See **Construction Guide** section for more details.

Mounting Hardware

PCB:

The PCB has 5 x M4 mounting holes (one in each corner, plus one in the centre of the board). A suitable set of M4 PCB standoffs can be used to mount it to your case/enclosure.

Power Transistors

To attach the 2N3055 power transistors, along with their 520AB1250MB heatsinks, you will need 8 x M3 x 20mm bolts, with nuts and washers. Also required is a set of 8 x 2mm thick by 20mm diameter self adhesive silicone pads. These are supplied with the PCB and already attached to the board. See **Construction Guide** section for more details.

U1 12V Regulator [OPTIONAL]:

To attach U1 (L7812), along with its heatsink, you will need an M3 x 10mm bolt, with nut and washers.

Fan Mountings [OPTIONAL]:

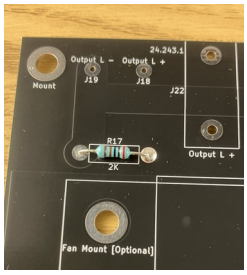
- 8 x M4 x 40mm Standoff Spacers
- 8 x M4 x 80mm bolts. If you can’t find M4 bolts this long, then M4 threaded rods cut to 80mm lengths will work instead.
- 8 x M4 nuts (or 16 if you are using threaded rods)
- 16 x M4 washers

Construction Guide

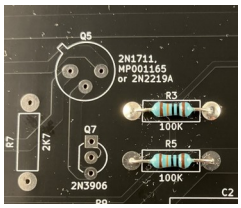
Assembly of main PCB:

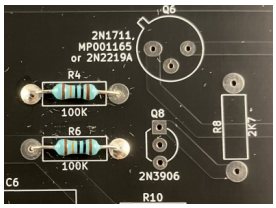
Note that a number of steps are marked [OPTIONAL], depending on your requirements.

1. Solder the resistors to the board in the following order:
   a. R17 and R18 [2K 500mW]:

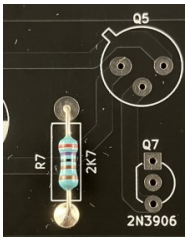


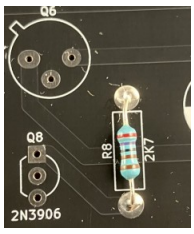
   b. R3, R4, R5 and R6 [100K 500mW]:





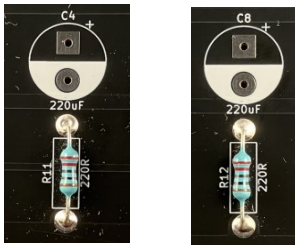
   c. R7 and R8 [2K7 500mW]:



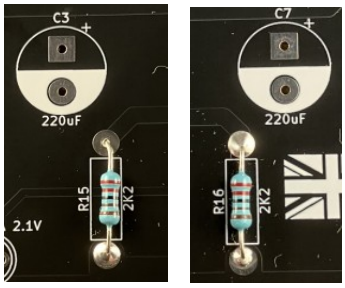


   d. R9 and R10 [8K2 500mW]:

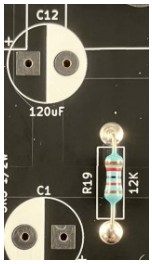
   e. R11 and R12 [220R 500mW]:



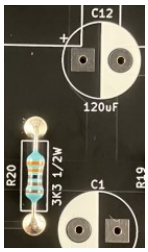
f. R15 and R16 [2k2 500mW]:



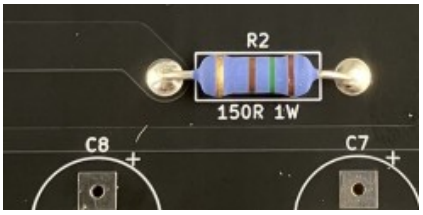
g. R19 [12K 500mW]:



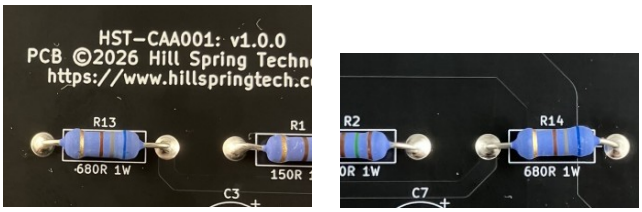
h. R20 [3K3 500mW]:



i. R1 and R2 [150R 1W]:

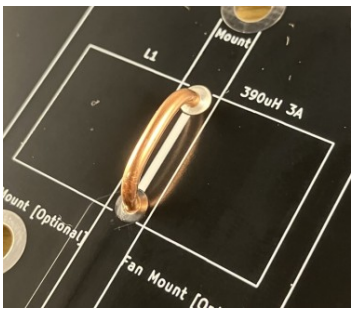


j. R13 and R14 [680R 1W]:



2. [OPTIONAL] If you are using the Active Cooling circuit, solder in diode D2 [1N4001], taking care to match the silver line on the diode [cathode] with the white line on the PCB silkscreen and the square solder pad:

3. If you are **NOT** going to use the SMPS noise suppression circuit, then solder a 1.6mm (16 SWG) thickness link wire between the terminals of L1:



If you *are* going to use the noise suppression, then skip this step.

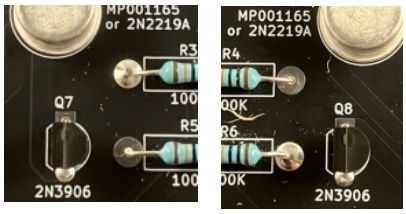
4. [OPTIONAL] If you are **NOT** going to add a volume control to the amplifier, then solder in two wire links, one between J12 and J13 and the other between J15 and J16:

If you are going to add a volume control, either with RV1, or chassis mounted potentiometers attached to J11-J16, then skip this step.

5. [OPTIONAL] If you are using the Active Cooling circuit, solder in capacitor C11 [0.1uF]:

6. Solder in transistors Q5 and Q6 [2N1711, MP001165 or 2N2219A], taking care to line up the small tab on the case with the one on the silkscreen silhouette:

7. Solder in transistors Q7 and Q8 [2N3906], taking care to match the flat side of the case, to the flat side on the silkscreen silhouette:

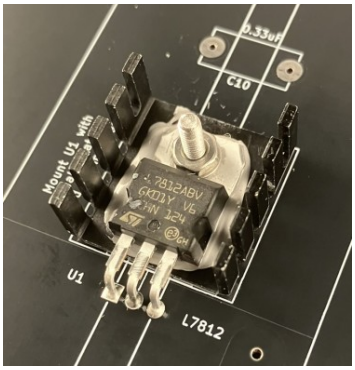


8. [OPTIONAL] Solder in any of the 1mm PCB connector pins that you require:
   a. J3 and J4: 30VDC 3A wired power supply input (if not using PCB mounted Barrel Jack sockets)
   b. J11, J12, J13, J14, J15 and J16 for chassis mounted volume controls (if not using PCB mounted RV1, or wire links as detailed in step 4).
   c. J7, J8, J9 and J10 for wired line inputs (if not using PCB mounted RCA sockets)
   d. J18, J19, J20 and J21 for wired speaker outputs (if not using PCB mounted banana plug sockets)

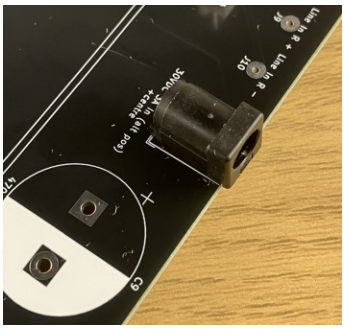
9. Solder in LED D1, taking care to line up the flat part of the case with the flat side on the silkscreen silhouette. The longer lead of the LED (anode) should go through the round pad, and the shorter lead (cathode) should go through the square pad:

Note: You may wish to wire this LED remotely, if you want to mount it on the enclosure/case instead of the PCB.

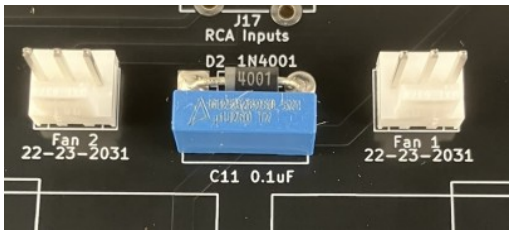
10. [OPTIONAL] If you are using the Active Cooling circuit, mount voltage regulator U1 [L7812] to the board, along with its heatsink. Use an M3 x 10mm bolt with a nut and washers to secure it to the heatsink and board, ensuring that there is some thermal paste between the IC and the heatsink. Tighten the bolt before soldering the pins:



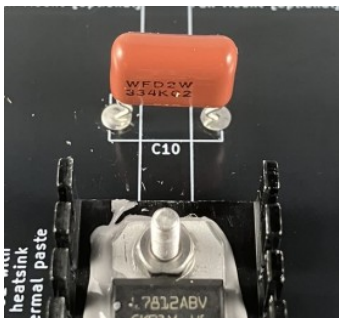
11. [OPTIONAL] Solder Barrel Jack sockets for 30VDC 3A power supply input to J5 and/or J6:



12. [OPTIONAL] If you are using the Active Cooling circuit, solder in the fan headers J1 and J2, taking care to ensure that the plastic tabs line up with the silkscreen silhouette:



13. [OPTIONAL] If you are using the Active Cooling circuit, solder in capacitor C10 [0.33 µF]:

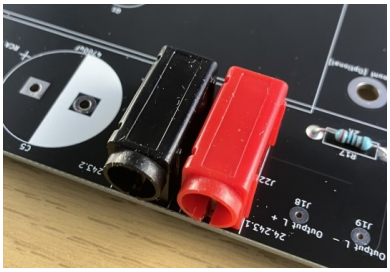


14. [OPTIONAL] If you want to have a PCB mounted volume control, solder in RV1 [Dual Gang 10K Log]:

15. Solder in Fuse Holder F1, and populate it with a 3.15 A 5mm x 20mm fast-blow fuse:

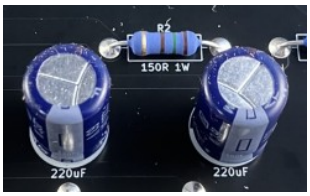
16. Solder in C2 and C6 [470nF]:

17. [OPTIONAL] If required, solder in the PCB mount banana plug sockets. Black sockets in J23 and J25, Red in J22 and J24:

18. [OPTIONAL] If you are using the SMPS noise suppression circuit, solder in capacitor C12 [120uF] taking care that the polarity is correct :

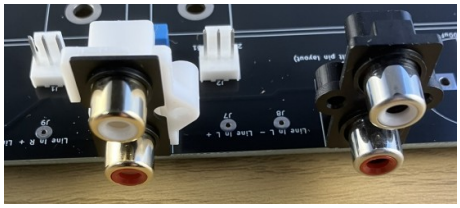
19. Solder in capacitors C1, C3, C4, C7 and C8 [220uF Electrolytic] taking care that the polarity is correct. The negative side (indicated by a shorter lead and a stripe of – signs down the side of the can) should go to the round solder pad within the white semi-circle on the silkscreen. The positive side, with the longer lead, should go to the square solder pad with a + sign next to it:



20. [OPTIONAL] If you are using the SMPS noise suppression circuit, solder in inductor L1:

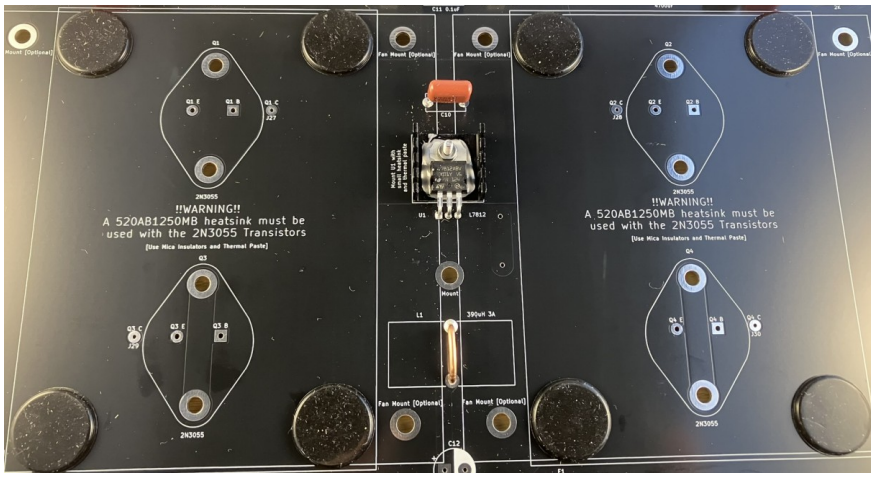
Note that if you are not using this component, then you must have performed step 3 instead

21. [OPTIONAL] If you want RCA sockets on the PCB, solder in either the PSG01550 to J17, or a generic stereo socket to J26:

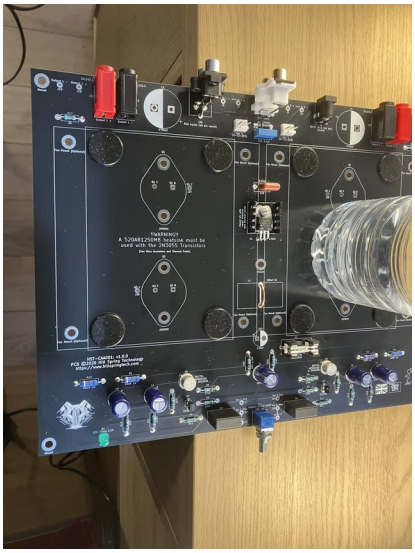


22. It's now time to mount the four power transistors [2N3055]:

    a. Ensure that there are eight silicone pads attached to the PCB (four for each of the two 520AB1250MB heatsinks):

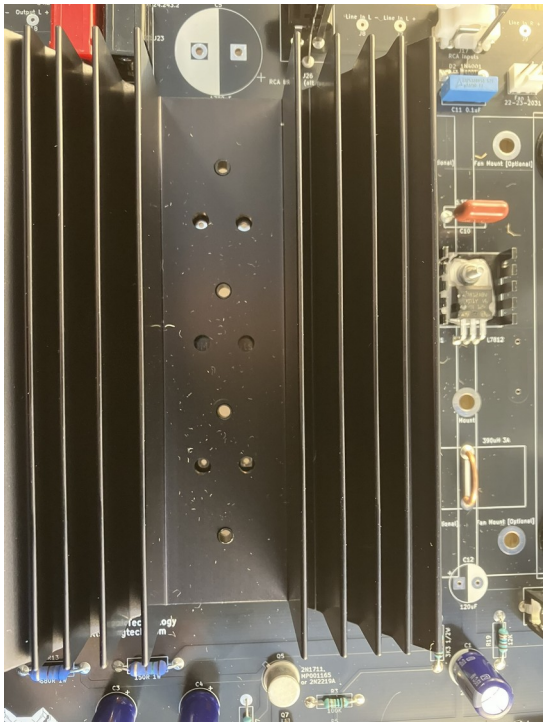


    b. Start with the left-hand channel [Q1 and Q3]. Place the PCB over the edge of your workbench, just enough that you can see daylight through the solder pads and mounting holes for Q1 and Q3, then place a heavy weight on the other side of the board so that it doesn't fall off:



c. Take four bushes from the TO-3 mica insulator kits and line them up carefully over the transistor mounting holes, the wider side down:

d. Now carefully place a 520AB1250MB heatsink onto the board, making sure the bushes fit through their corresponding holes on the heatsink, and that the solder pads line up with the other holes:



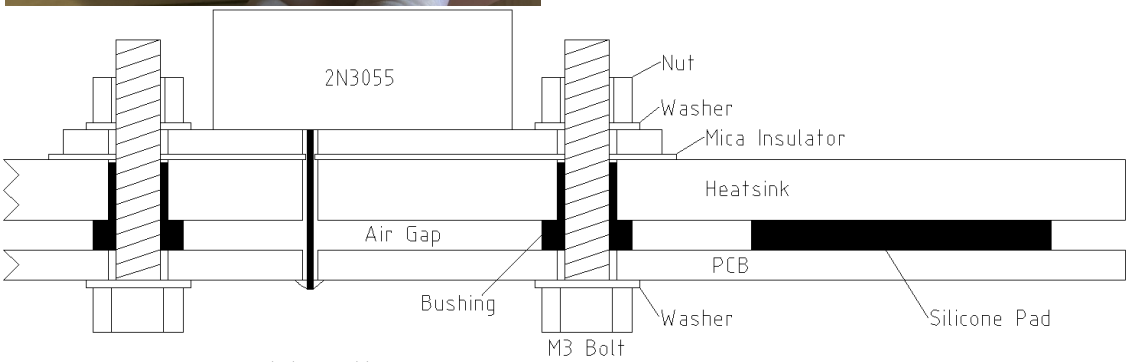
e. Take two of the 2N3055 transistors and apply thermal paste to their underneath:

f. Carefully add the mica insulators to the transistors:

g. And then apply another layer of thermal paste to the mica insulators:

h. Whilst the board is still sitting over the edge of the workbench, very carefully place the transistors onto the heatsink, taking care to fit the leads through their corresponding holes on the PCB:

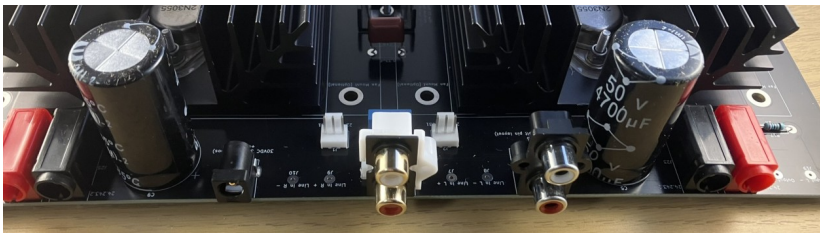
i. With the board still over the edge, bolt the transistors down using the M3 x 20mm bolts, nuts and washers, feeding the bolts up from below:



j. Now repeat steps (b) to (i) for the right-hand side:

k. Solder the pins of Q1, Q2, Q3 and Q4 onto the board. You can also put a blob of solder between the bolt heads and the mount hole solder pads to ensure electrical connection, but this is not essential.

23. Solder in output capacitors C5 and C9 [4700uF Electrolytic] taking care that the polarity is correct. The negative side (indicated by a shorter lead and a stripe of – signs down the side of the can) should go to round solder pad within the white semi-circle on the silkscreen. The positive side, with the longer lead, should go to the square solder pad with a + sign next to it:

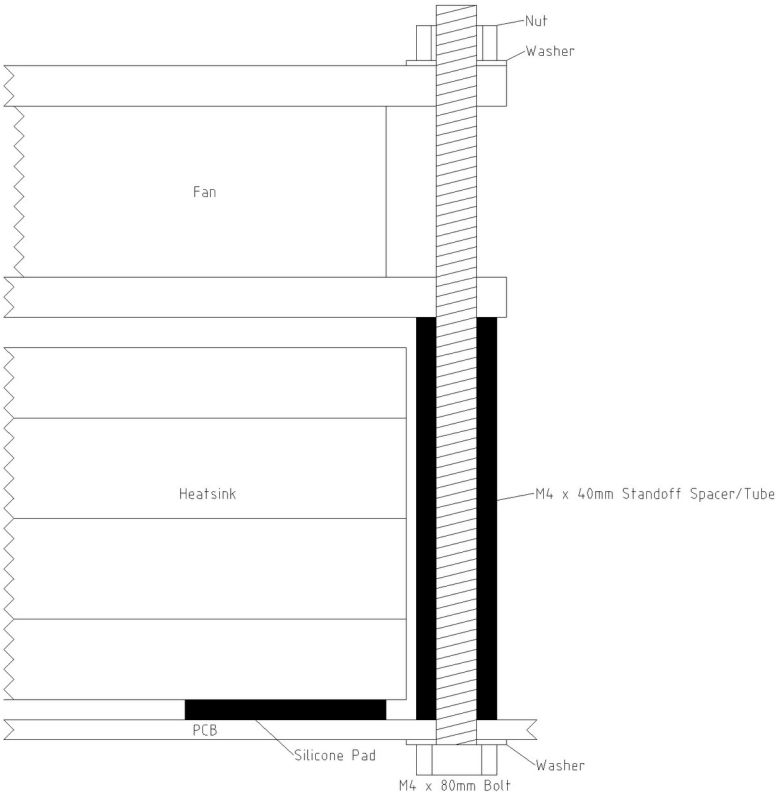


[Optional] Mounting Cooling Fans

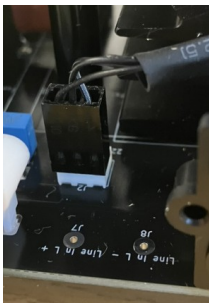
1. First, identify the direction of airflow for your fans. This should be indicated with an arrow on the fan case:

When you mount the fans, you need to ensure that the fans are drawing air upwards, away from the heatsink, rather than blowing downwards.

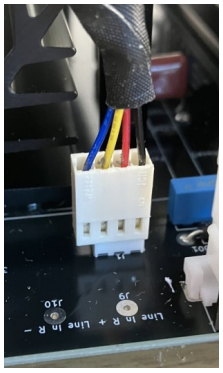
2. Using the M4 x 80mm bolts or threaded rods, attach the fans to the board, using the 40mm standoff spaces/tubes to ensure the fans don't touch the heatsinks:



3. Now plug the fan cables into fan headers J1 and J2:



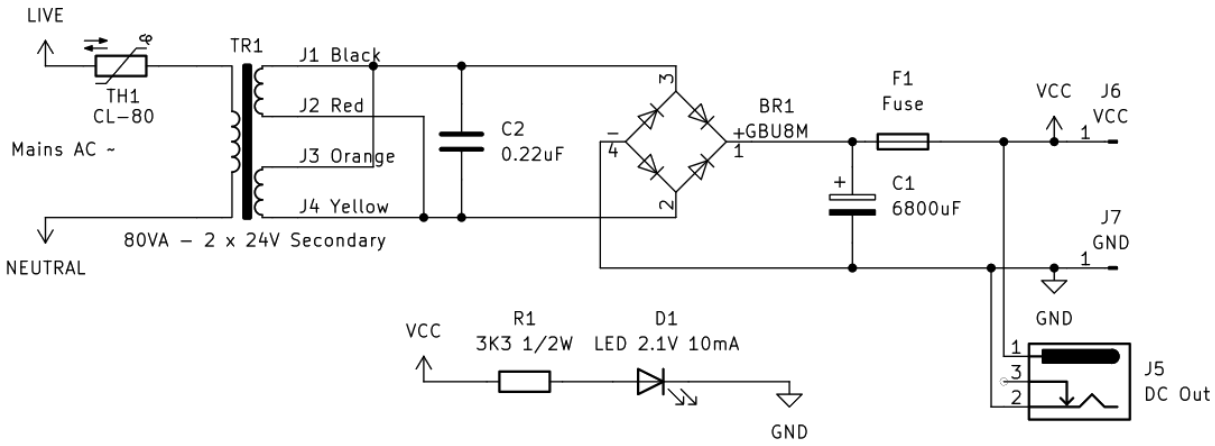
4. Note, if your fans have a 4-pin connector, you can still plug them into the 3-pin header, as the plastic lug will enure the correct orientation (the non-connected pin is just for RPM readings, which we don't need in this application):



Power Supply Considerations

The circuit requires a power supply that can provide 30V DC at 3A. Under normal operation, the current draw will be between 1.5A and 2A, however when powering on, the inrush current can be well over 2A. It is also a good idea to have some headroom so that the power supply is not maxed out all the time, hence the 3A requirement.

In a postscript to the original Wireless World article, published in the December 1970, J. J. Linsley Hood provided a circuit for a simple linear power supply. This is what I have always used for the amplifiers I have built, and I can provide a separate PCB for this (see the **Linear Power Supply PCB [HST-LPS001]** section):



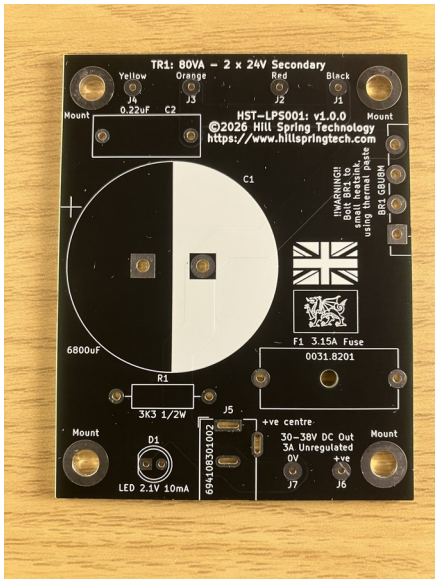
The above circuit is unregulated, so without load the output voltage is 38-40V, but once connected to the amplifier, that drops to 30-32V

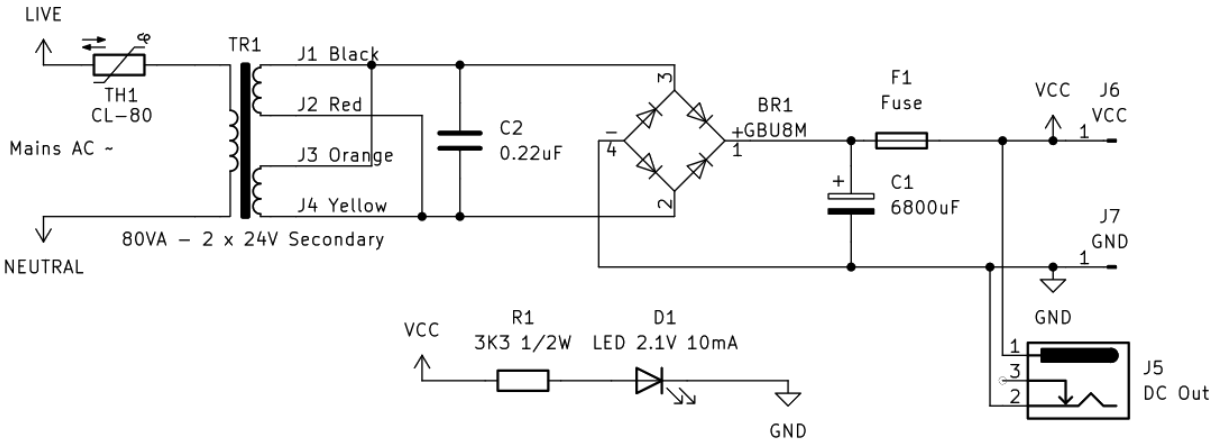
If you use plan to use an off-the-self power supply instead, then I would strongly recommended buying from a reputable supplier, as there are a lot of very suspect switch mode power supplies out there from on-line marketplaces.

If you are going to use a switch mode power supply instead of a linear supply, then it is recommended, although not essential, to include the SMPS noise suppression components (see **Optional Components** section).

Linear Power Supply PCB [HST-LPS001]

For the Linear Power Supply Circuit, as detailed in the **Power Supply Considerations** section, I can supply a separate PCB [HST-LPS001]:





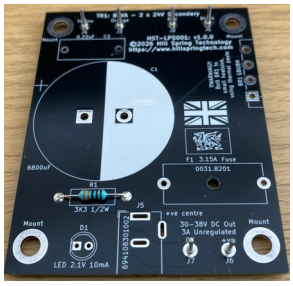
Bill of Materials - Components

	R1	3K3 500mW	
	C1	68000 µF >=50V Electrolytic	
	C2	0.22µF Polypropylene (PP)	Lead spacing 15mm
	BR1	GBU8M	
	F1	Schurter 0031.8201Fuseholder + 3.15 A 5mm x 20mm fast-blow fuse	
	D1	5mm Green LED 10mA 2.1V	
[OPTIONAL]	J5	Würth Elektronik 694108301002 Jack Socket	
	J1, J2, J3, J4 and J6	1mm PCB solder pins	
	TH1	CL-80 NTC Thermistor	
	TR1	80VA toroidal mains transformer with 2 x 24V secondary windings	

Assembly

1. Solder the resistor R1 [3K3 500mW]:

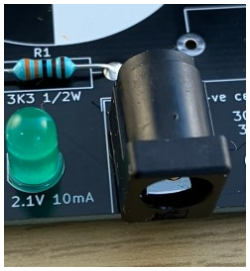
2. Solder in 1mm pin connectors J1, J2, J3, J4 and J6:



3. Solder in LED D1, taking care to line up the flat part of the case with the flat side on the silkscreen silhouette. The longer lead of the LED (anode) should go through the round pad, and the shorter lead (cathode) should go through the square pad:

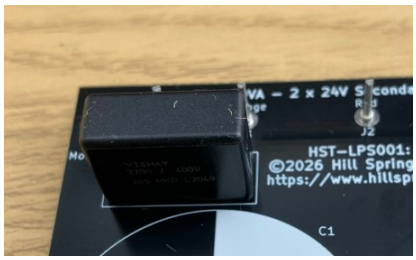
Note: You may wish to wire this LED remotely, if you want to mount it on an enclosure/case instead of the PCB.

4. [OPTIONAL] Solder in Barrel Jack socket J5:

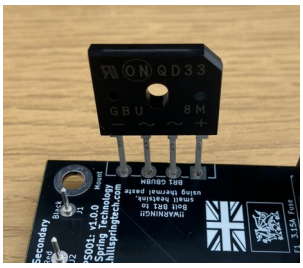


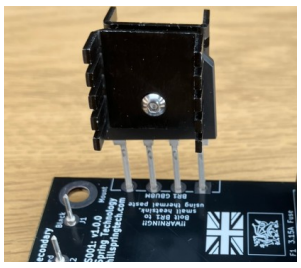
5. Solder in Fuse Holder F1, and populate it with a 3.15 A 5mm x 20mm fast-blow fuse:

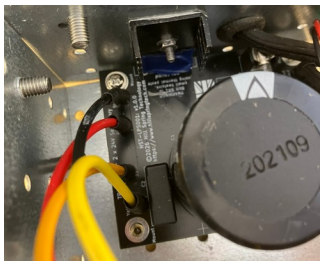
6. Solder in Capacitor C2 [0.22uF]:



7. Now solder in Bridge rectified BR1 [GBU8M]. The + pin, marked both in writing and identified by a notch in the case, should go through the square solder pad. Also note that the GBU8M will get hot in operation, so it should either have a small heat sink attached, or be bolted to the metal case of your power supply:







Always use thermal paste when attaching BR1 to a heatsink or case.

8. Solder in C1 [6800uF Electrolytic] taking care that the polarity is correct. The negative side (indicated by a stripe of – signs down the side of the can) should go to the round solder pad within the white semi-circle on the silkscreen. The positive side, with the longer lead, should go to the square solder pad with a + sign next to it:

Wiring Transformer to PCB:

Pins J1 to J4 are designed to connect to a transformer with two separate 24V secondary windings. Winding 1 should connect to J1 and J2 (Red and Black) and Winding 2 should go to J3 and J4 (Orange and Yellow). If you have a transformer with just a single 24V secondary winding, then you can connect this between J1 (Black) and J2 (Red), leaving J3 and J4 disconnected.

It is also recommended to wire in a thermistor [CL-80] between LIVE and the transformer primary.

Getting More Power – A Circuit Hack

In the original Wireless World article in April 1969, J. J. Linsley Hood left it to the builder to correctly set the current flow through the power transistors. This is determined by the resistor values of R1 and R13 on the left channel, and R2 and R14 on the right channel, but it is also affected by the current gain and collector-base leakage current of Q1 (left channel) and Q2 (right channel). The problem is that the current gain and collector-base leakage current for those transistors is temperature dependant, so the resistor values need to be adjusted to match both the builder's heatsink set up, and the ambient temperature where the amplifier would be operating. And to further complicate matters, the impedance of the speakers being driven, and the supply voltage, will all have a bearing on the current flow.

Getting these resistor values right is quite critical to the performance of the amplifier. If the current flow is too low, the output signal will start to distort at lower power levels. If the current flow is too high, the transistors will get too hot too quickly, coupled with significantly higher current draw on the power supply.

The original magazine article had a small table suggesting different resistor values dependant on load impedance and supply voltage, but it was still left to the builder to decide what to use by trying different values out until they found the right balance. In a postscript to the original article, published in the December 1970, Linsley Hood made a change to the circuit, setting the value of R1 and R2 to 150R, and R13 and R14 to 470R, then adding a 2K5 potentiometer in series with R13 and R14 to allow the builder to tweak the potentiometer until they got the desired result. This was an easier way of doing things, but it still required a complex test set up to get it right.

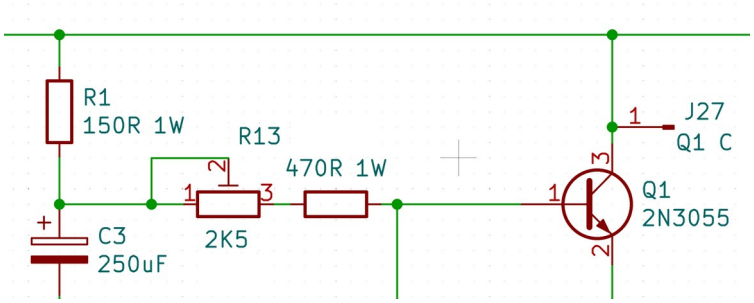
For the HST-CAA001 PCB, because the heatsink performance and supply voltage are known, I wanted to discard the potentiometer and set the value of R13 and R14 to an appropriate, pre-set value (hard-coded if you like), so that any new build of the PCB will just work, without any set up or adjustment. After extensive testing, I settled on 680R. I felt this gave the best balanced performance through 8Ω loads using passive cooling, yet still worked well with 6Ω and 4Ω loads.

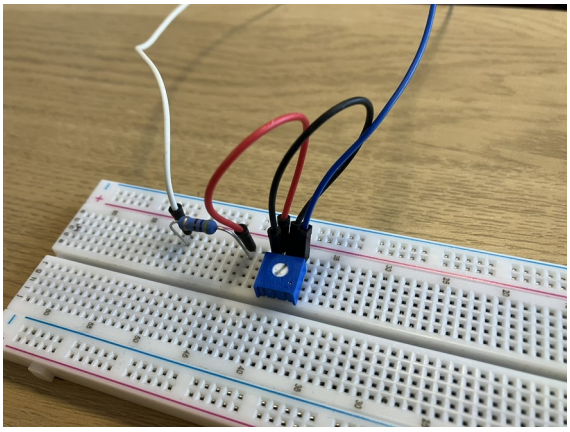
If you are happy with the way the amplifier is performing for you, then this is probably as far as you need to read. However, if you really want to drive the amplifier more, to get a higher power output, especially under 6Ω and 4Ω loads, it is possible to fine-tune the values for R13 and R14 using the following process:

Hacking R13 and R14 values:

1. First and foremost, if you're going to hack these values, I would strongly recommend implementing the active cooling circuit with fan installation first.
2. Next, you will need a signal generator and an oscilloscope.

3. Choose either the left (R13) or right (R14) channel to run the testing.
4. Connect the signal generator to the input, and the connect the output to a load of your chosen impedance.
5. Attached your oscilloscope across the output as well.
6. Temporarily remove R13 or R14 from the board, then replace with a 470R resistor in series with a 2K5 linear potentiometer (you can break out a couple of wires from the resistor solder pads to a breadboard) :





7. Set the 2K5 potentiometer to its highest resistance point, and set your volume control on your amplifier to zero.
8. Connect your bench power supply to the amplifier, setting it to 30V, and limiting the current to 3A (just in case).
9. Now turn everything on and run a 1KHz sine wave (2V peak) from your signal generator through the amplifier.
10. Turn the volume control up until you see the sine wave output on the oscilloscope start to clip/distort. Then, turn the volume down until just past the point you stop seeing the clipping/distortion.
11. Measure the peak voltage of the output sine wave (not peak to peak, just from zero to the highest point of the sine wave). From this, you can calculate the max power output, where V is peak voltage, and R is the load impedance:
    a. $P_{(peak)} = V^2 / R$

b. $P_{(rms)} = P_{(peak)} * 0.7071$

12. Also make a note of the current draw on the power supply.
13. Now you have a base figure, if you start to to adjust the 2K5 potentiometer resistance down, you should see the power supply current rise.
14. If you increase the volume, you should now find that you can drive more power through the amp before you see the sine wave start to clip/distort.
15. Continue adjusting the 2K5 pot down and turning the volume up until you don't see any improvement in output power at the point of clipping/distortion, or that the current draw on the power supply is getting too high (probably don't want it much above 2A, considering that once you change the other channel as well, this will increase even more).
16. IMPORTANT: Keep checking the heatsink temperatures with an infrared/laser thermometer. Don't let them get above 90ºC (194ºF)
17. Also note that as the power transistors get hotter, this will change their characteristics, and therefore the optimum resistor levels, so you may want to re-test once the amp has been running for a while. Again, don't let the heatsinks get above 90ºC (194ºF)!
18. Once happy you have got the most out of the circuit, turn the amp off and remove the 2K5 pot and the 470R resistor from the circuit, being careful not to change the pot's current setting. Once removed, measure and record the pot's resistance.
19. Add this resistance value to 470R and you should have the approximate value for R13 and R14 to replace onto the board.

