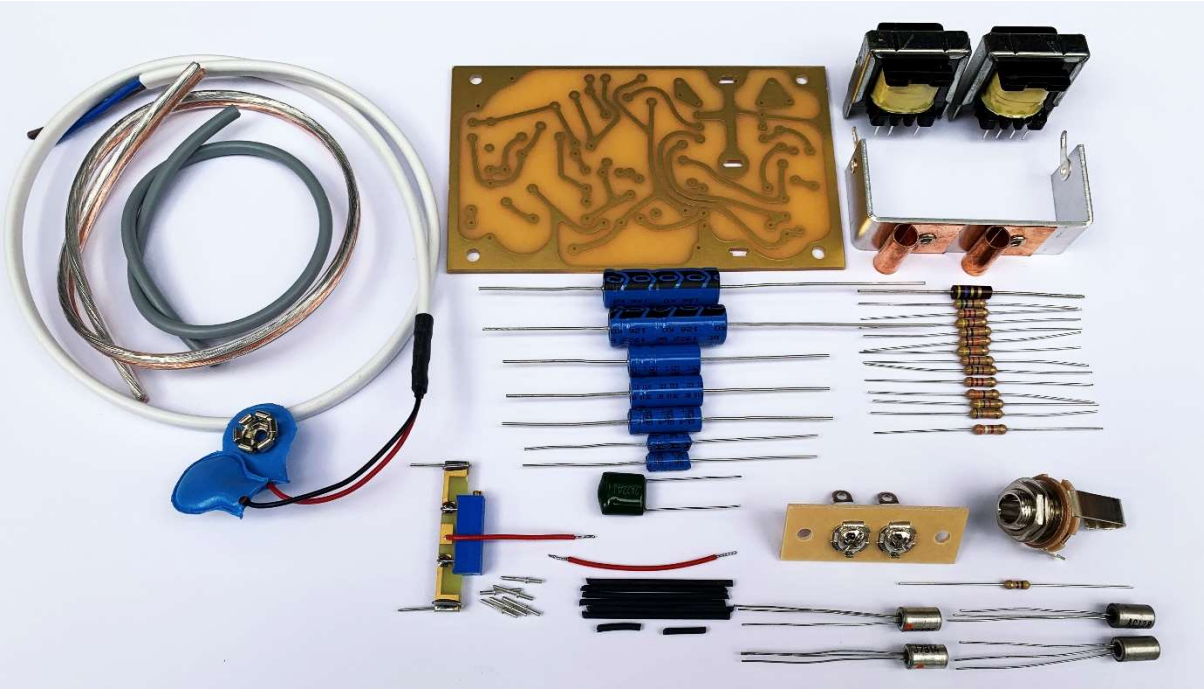
Knight Audio Technologies

KAT – KIT Series

Deacy Amplifier Board Kit



Instructions for assembly and test.
Please read before un-boxing kit.

KAT-KIT Deacy Amp Board assembly details.

Firstly, congratulations on buying this Deacy Amplifier Board kit. It has been many years in the making! It has everything you need to build a highly accurate Deacy Amp board to the same specification as the one residing in Brian's Legendary Deacy Amp. Even the transformers are exactly the same specification as Brian's. We have tried our best to make this amplifier relatively easy to build, so, if you can solder, you can build this kit. Items that require specialist tools to assemble have been pre-made and assembled, so you won't need bespoke riveting presses for the heatsink, or hot air guns to shrink the sleeving on the battery leads. It's all been done for you.

And finally, we have even included the very rare and exceedingly hard to find vintage TO1-large can transistors that have all been individually tested and matched to ensure the amplifier performs perfectly.

So, what else do you need to build this iconic amplifier? Well, not a lot actually but, here's a quick check list so you can pull everything together ready for the build:

- Soldering Iron (25 – 40W is more than adequate)
- Solder (would suggest Multicore 60/40 0.7mm solder)
- Wire cutters
- Snipe-nosed pliers
- New 9V PP9 battery (or KAT DABS unit)
- Multi-meter
- Sharp knife or scalpel
- Small flat-blade screwdriver

Everything else is included in the kit. So, here's a quick check list to make sure you have all the parts to hand ready for the build. I would suggest you empty the bag of miscellaneous parts onto a large white sheet of flat paper as there are many small parts that could easily get lost:

- Printed Circuit Board
- Heat Sink Assembly
- Interstage Transformer
- Output Transformer
- Bias Trimmer Pot Assembly
- 15 No. Resistors
- 7 No. Electrolytic Capacitors
- 1 No. Mylar Film Capacitor (Green Block)
- 1 No. AC125 (TO-1 Can)
- 1 No. AC126 (TO-1 Can)
- 2 No. AC128 (TO-1 Can)
- PCB Pins (6)
- Transistor Lead Sleeving (6 long, 2 short)
- Red jumper wire
- ¼" Jack Socket (For Speaker Cabinet)
- 2 Terminal Speaker Connection Strip (For Speaker Cabinet)
- Battery Lead Assembly with Blue Connectors
- Screened cable for Jack
- Two core speaker cable (Copper/Tinned)
- Internal power connecting wires (Yellow/Grey)

The resistors used are detailed in the following schedule. We have visually represented and described the colour codes to aid their identification, but if you suffer from impaired vision or colour blindness, the values can easily be determined using a suitable multi-meter that will give a digital reading.

KAT-KIT DEACY RESISTOR COLOUR CODES

R1 = 12K (Brown/Red/Orange - Gold)

R2 = 47K (Yellow/Violet/Orange - Gold)

R3 = 2K2 (Red/Red/Red - Gold)

R4 = 3K9 (Orange/White/Red - Gold)

R5 = 330R (Orange/Orange/Brown - Gold)

R6 = 2K2 (Red/Red/Red - Gold)

R7 = 1K (Brown/Black/Red - Gold)

R8 = 10K (Brown/Black/Orange - Gold)

R9 = 68K (Blue/Grey/Orange - Gold)

R10 = 560R (Green/Blue/Brown - Gold)

R11 = 4K7 (Yellow/Violet/Red - Gold)

R12 = 4K7 (Yellow/Violet/Red - Gold)

R13 = 4R7 (Yellow/Violet/Gold - Gold)

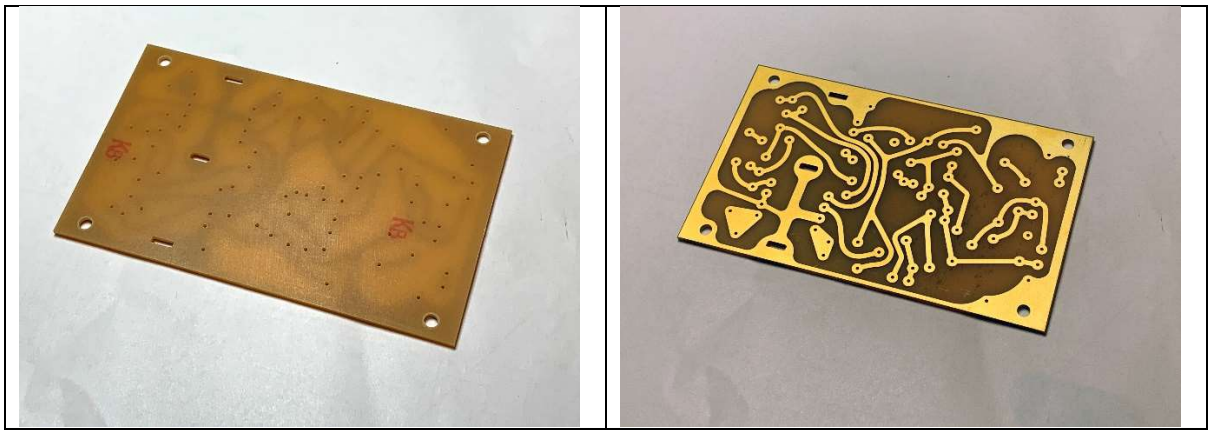
R14 = 120R (Brown/Red/Brown - Gold)

R-Test = 470R (Yellow/Violet/Brown - Gold)

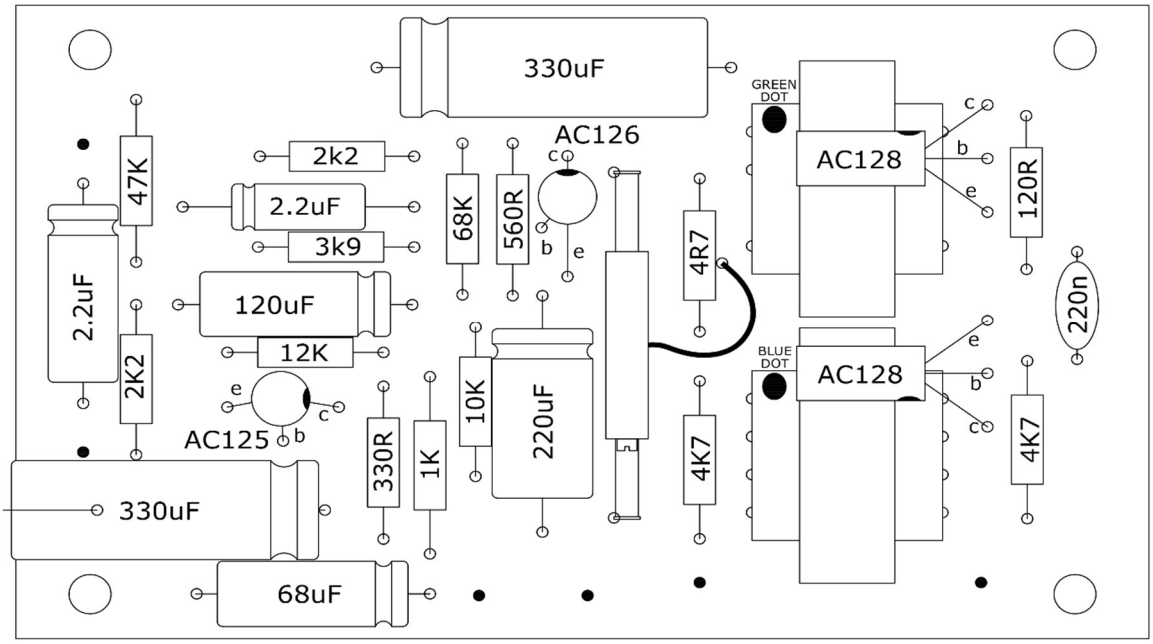
So, where to begin.

Well, I always start with the smallest components, the resistors in this case. So find a suitable piece of board that you can use as a work space without causing damage to the antique dining table underneath. Place the soldering Iron stand next to you so that it is in easy reach and make sure it is plugged in to a socket that is away from the work board. Use an extension lead if you need to but, by doing this, you ensure that the soldering iron mains lead doesn't keep dragging across your carefully laid out parts!
Now, only place on the work board the parts you are going to use at each stage, so in this case, the PCB and the resistors.

So to the PCB. Whilst it has the same track layout of the original, we have decided to have the tracks gold-plated rather than tinned. The problem with vintage FR2 boards is the tracks can easily lift with too much heat, so rather than risk lifting tracks with the tinning process, we plated instead. That said, if you are intent on achieving the true vintage feel of the original, you can tin the tracks with solder. I would advise doing this once it is up and running as the on-board components and solder joints will help sink heat away from the tracks.



As with the original, this PCB has no markings or component identifiers, so we have included the pictorial board with all the values added below.

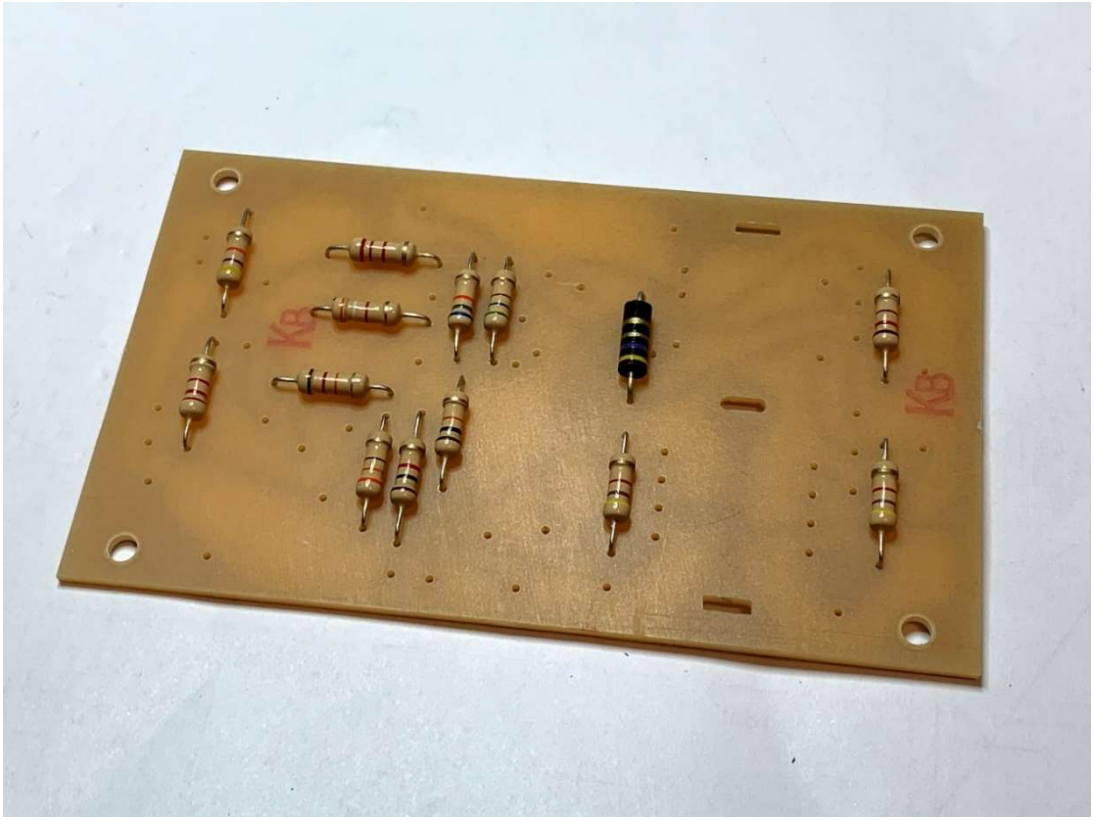


So, let’s begin with R1. This is a 12K resistor (12,000 Ohms). The 12K resistor sits midway up the board on the left-hand side. The spacing between the mounting holes is approximately 16mm for most of the resistors, so, that is the spacing you need to pre-bend the resistor legs to.
Locate the 12K resistor and carefully bend the legs downwards both in the same direction so that there is a nice uniform radius at each bend approximately 4mm from each end of the resistor body. I tend to use a thumb nail to bend the leads over. The resistor should now simply drop into the position with the leads protruding through the holes to the other side. It is generally accepted practice to load the bulk of the components such that their values can be read from left to right, or from the bottom to the top, so, in the case of the resistors, that would place the gold tolerance band either on the right or the top. Obviously, this rule of thumb cannot be used for all components as some, like the electrolytic capacitors are polarity-conscious, and must be installed as required by the circuit rather than board aesthetics.
Once the resistor is inserted and sitting flat to the board, turn the board over and rest the resistor on the work surface. Apply the soldering iron to the solder pad and resistor wire at the same time and feed in a little solder. Do not hold the iron on the joint for more than 3 seconds as this will lift the solder pad and may damage the component. Do not feed in too much solder. Your aim is not to produce a solder mound on top of the pad with a nice concave fillet around the wire (Think of a volcano shape). Once the joint is cool, clip off any excess wire with the cutters. Now do the same for the other wire.

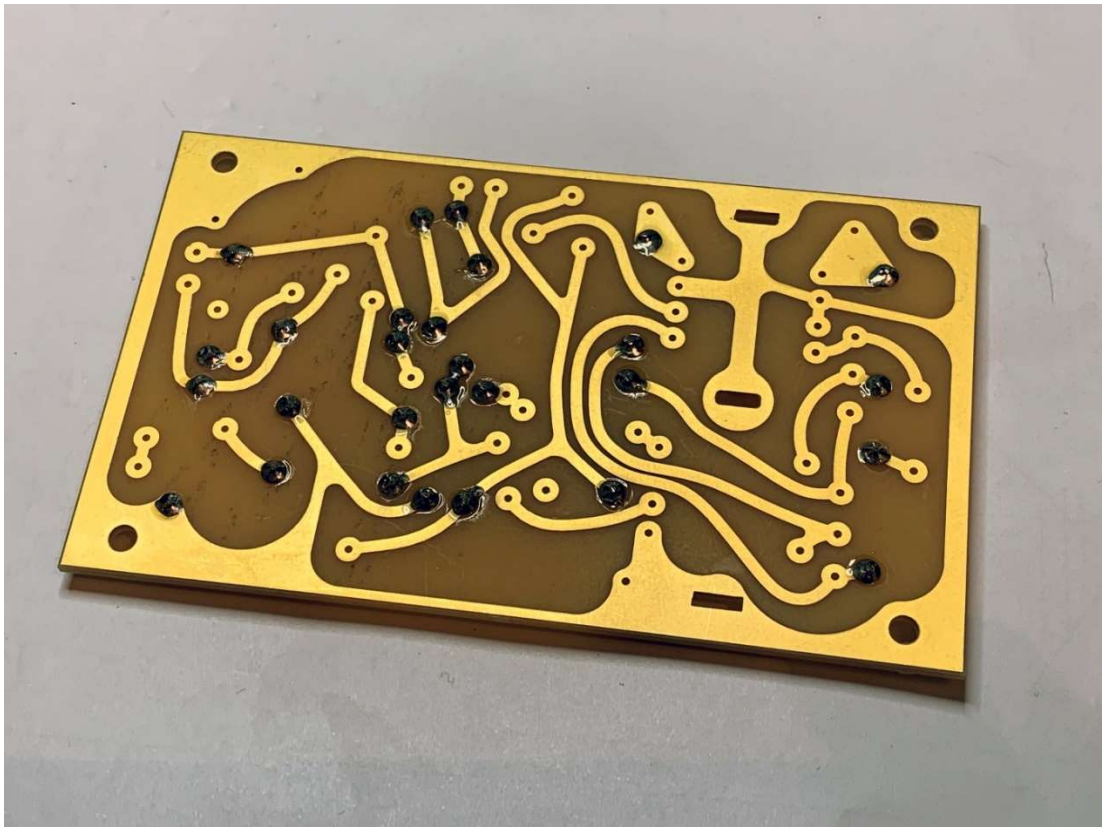
Invert the PCB again so that the component side is at the top and select R2. This is a 47K (or 47,000 ohms) resistor.

As for R1, bend the leads and insert and solder as before. Continue with this process until all the resistors are installed.

Your board should now look remarkably similar to this: -



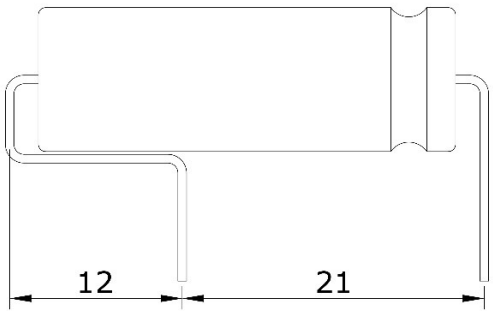
And, if all has gone well, the underside should look like this!



Next step then, the capacitors. Unlike the TB Plush which uses predominantly radial format capacitors (both leads protruding from one end), the Deacy Amp uses axial format capacitors on all electrolytics. Axials were pretty standard in the 60's as radials back then were too large and bulky and generally only used for larger filter types. The one exception is the 220nF mylar film capacitor (that forms half of the Zobel network across the output transformer primary). The famous green cap that once had its leg hanging out of the board.

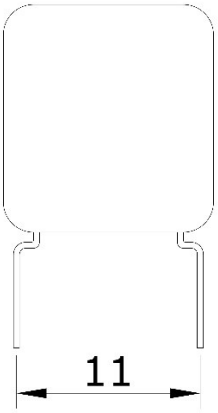
The capacitors then need to be installed starting with the smallest, the 2.2uF units. On these axial caps, the polarity is identified via two methods, just to make sure! Firstly, there is a ring-indent around the outside at one end which also has an insulating material around the point the lead enters the can. This is the positive or '+' end of the cap. On the case, there is also a band of printed arrows with minus '-' signs in them pointing to the opposite end. The negative end.. IT IS IMPERETIVE THAT THESE CAPACITORS ARE INSTALLED THE CORRECT WAY ROUND. PLEASE DOUBLE CHECK BEFORE SOLDERING.

So, in order of installation, I would advise the following: 2.2uF, 2.2uF, 68uF, 120uF, 220uF. Once those are in and soldered, you are now left with the green Mylar cap and the two large 330uF caps. The first of the two 330uF caps simply drops-in at the top of the board. The second requires its negative lead to be bent back underneath for approximately 12mm before being bent downwards again.



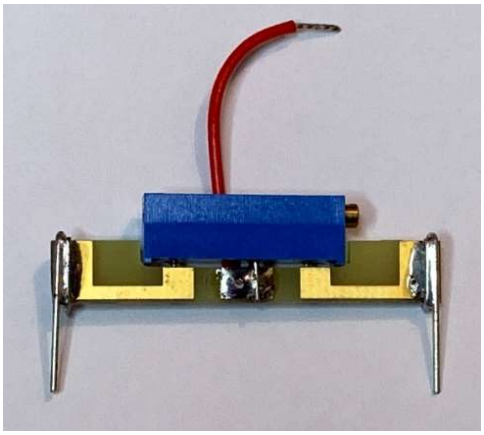
I advise bending these with pliers to get a nice tight bend in the wire, otherwise the cap sits high and looks a little precarious as it hangs its bottom over the edge of the board. Not a great design, but we are not here to question the thinking that went into this amplifier's development. We are here to replicate it. To continue then, with the leads bent downwards at a spacing of 21mm, the cap can be carefully lowered into the board and soldered in place.

This now just leaves us with the little green Mylar capacitor. This cap is a modern-day version of the original and as such, has modern-day lead spacing of 7.5mm. The holes in the board are set at 11mm, tad wider, so you will need to bend the wires outwards a little then downwards before the unit can be fitted. When you insert this cap into the board, do not force it all the way down. It won't go all the way and will try to split the leads away from its body. So, insert it to the point it feels happy and solder it in there.



The Bias Pot Assembly.

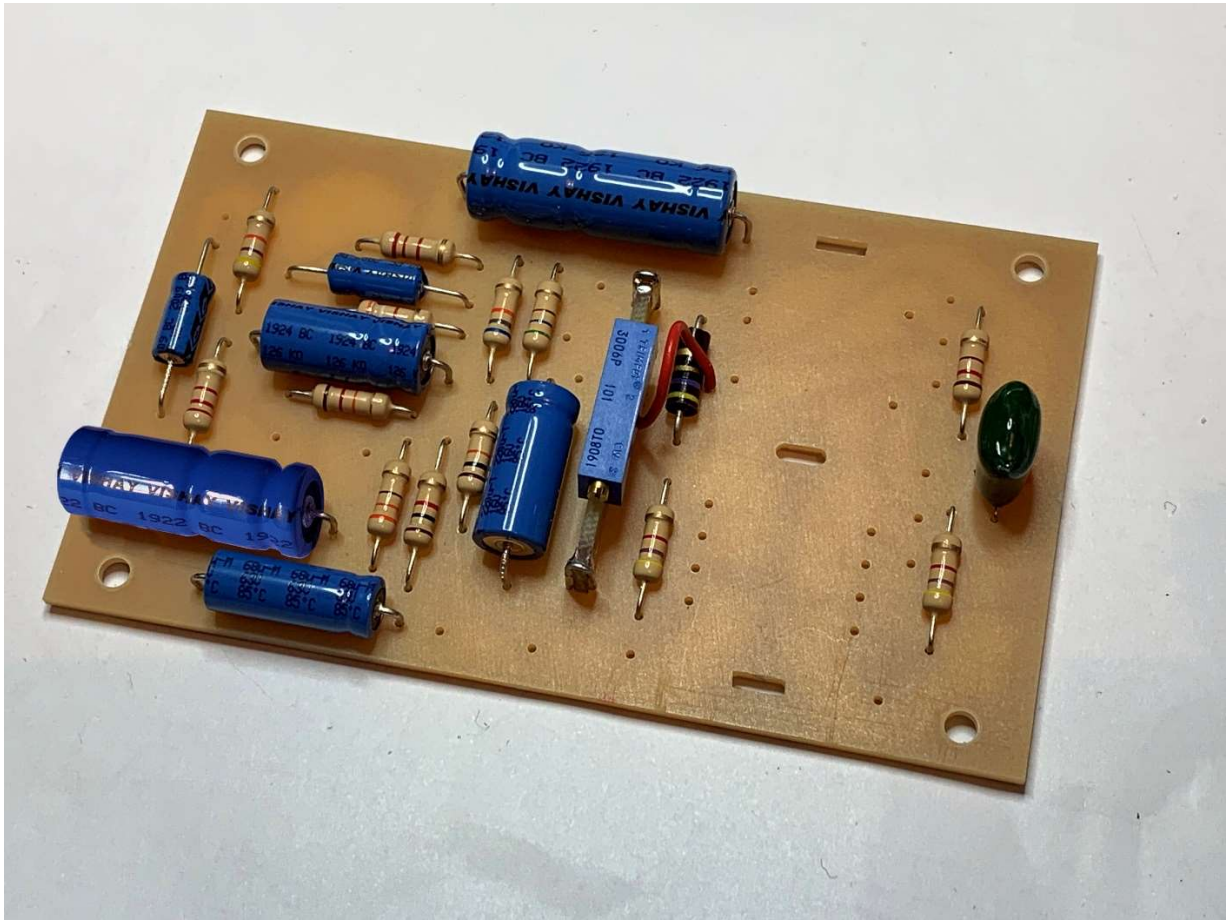
The original bias pot was constructed by wrapping resistance wire around a former that was then riveted to a second board. A metal slider with a spring contact was then added that could move up and down the length of the wire-wound former to set the resistance. These old 'trimmers' are long out of production and whilst one may be able to source NOS versions for the occasional build, trying to procure 100 or so would be impossible, so, we built our own version. Now, we could have just re-configured the printed circuit board to accommodate a modern-day trimmer, but then it just wouldn't look right and moreover, we'd all miss the little red connecting wire that jumps between the slider tab and the interstage transformer. So, we built tiny little PCB's and saddled a modern trim pot on top complete with the little red connecting wire. This, we felt provided a number of options to the builder. Firstly, you could install this unit, set the bias and the amp would perform beautifully from there onwards. Secondly, you could source an original style trimmer pot and fit that. (The holes are set at the correct footprint to accept the original unit), or, thirdly, you could build your own trim-pot and fit that.



Fitting the Bias Pot Assembly.

The assembly is pre-built and simply needs to be inserted into the board and soldered. The assembly needs to be oriented such that the adjuster screw head is pointing towards the bottom edge of the PCB. If you fitted it the other way round, the large 330uF cap will get in the way and restrict screwdriver access to the pot. Once the assembly has been soldered into place, you can poke the red wire (pre-stripped and tinned) into the hole just to the right of the 4R7 (brown bodied) resistor and solder that into place.

Your Deacy board should now look like this!



You now have all the small components installed, so, time to move on to the larger items. The Transformers!

Deacy Amp Transformers.

There has been a degree of speculation and discussion about the transformers fitted to Brian's Deacy Amp. We now know from research that the board comes from a Supersonic radio. We have original circuit diagrams available on the internet showing the circuit of the Supersonic amplifier and these clearly show the output transformer being in an autotransformer configuration. One of the idiosyncrasies of Brian's amplifier is that the output transformer is not configured as an autotransformer. It is configured with isolated windings. Whether this is by accident or maybe part of an earlier trial, we just don't know. The transformers look original, so we have to assume they are. We have a second back-up Supersonic amplifier board, just in case, and that is fitted with an autotransformer, so I'm sure this discussion will rage forevermore. To conclude then, the transformers in this kit are wound to the exact same specifications as Brian's originals and those fitted in the KAT Deacy Amp replica.

The Deacy Amp Transformers

	
T1 Interstage Transformer – Green Dot – 5 Pins	**T2 Output Transformer – Blue Dot – 8 Pins**

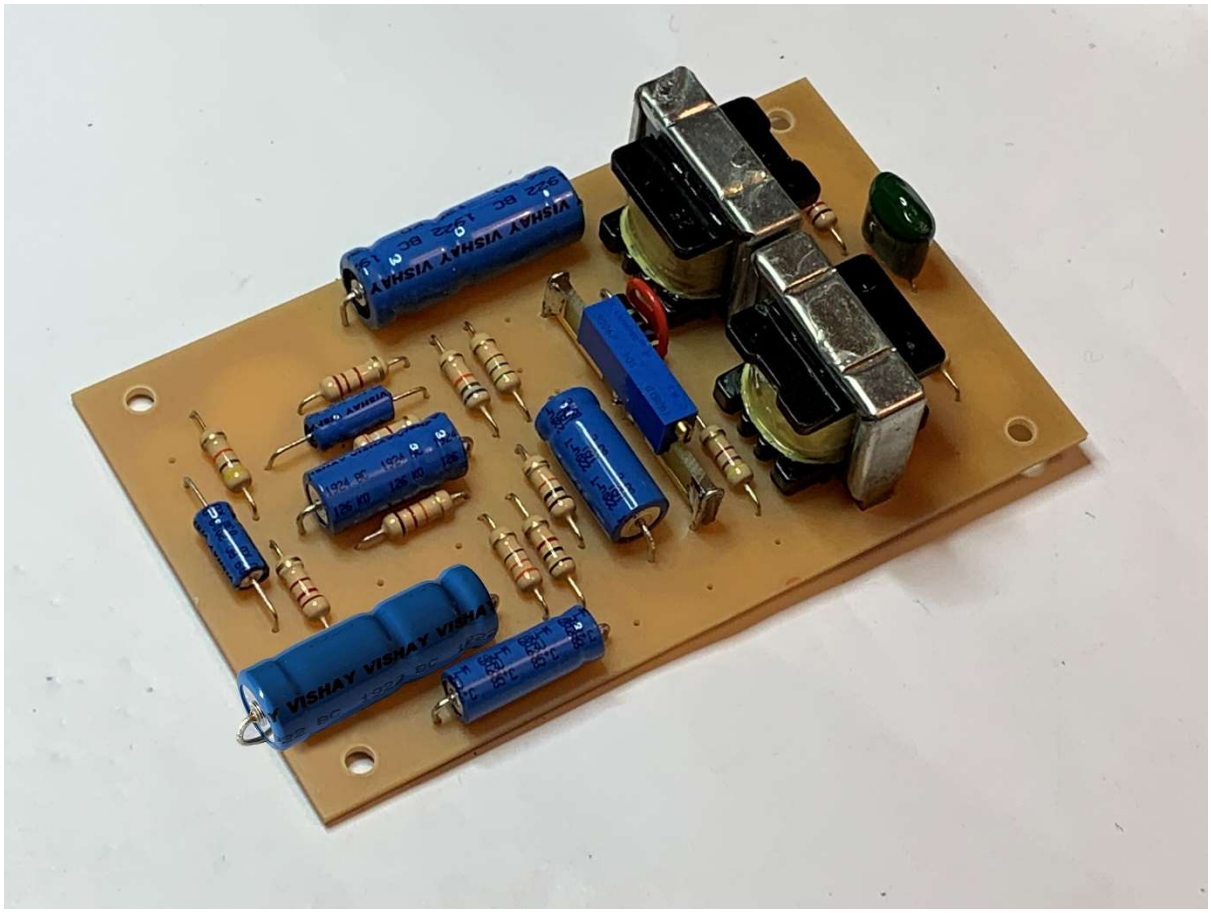
The Transformers are shipped in their own box and in separate poly bags clearly marked T1 and T2. Whilst it's almost impossible to get the wrong transformer in the wrong position, it is possible to wrongly orientate the output transformer, so please check the layout drawing shown at the beginning of these instructions as it clearly shows where to place the units based on the coloured dot.

To load the transformers, carefully line-up the legs with the holes in the board and gently 'wiggle' the transformer into place. Do not force these in as you can easily damage the pins. With both transformers inserted, invert the board and apply some downward pressure with two fingers one directly above each transformer.

With a small flat-blade screwdriver (NOT A KNIFE), gently insert the blade between the two case tabs in the middle of the board and wiggle the screwdriver from side to side in order to splay the tabs apart a little. No more than 45 degrees is required to firmly hold these in place. Now, with a pair of snipe-nose pliers, bend the outer two tabs inwards, again, at around 45

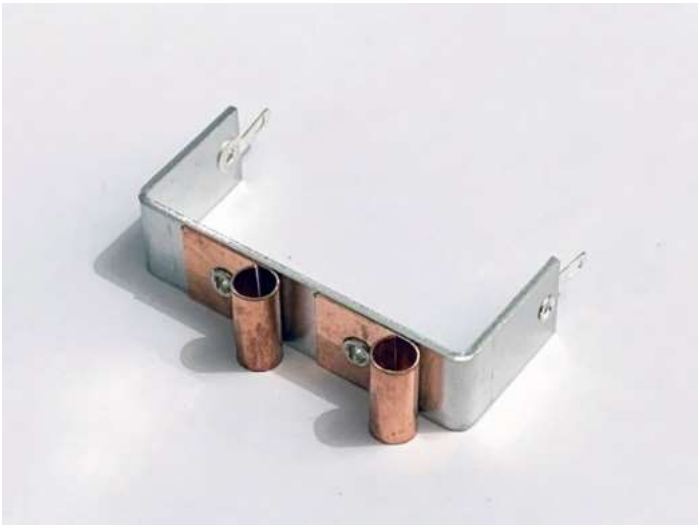
degrees. Do not bend them outwards as we still have the heatsink to mount and that uses the same holes. Once the transformers are in and flat to the board, carefully solder the pins. Again, the three second rule applies here.

Your board should now look like this.



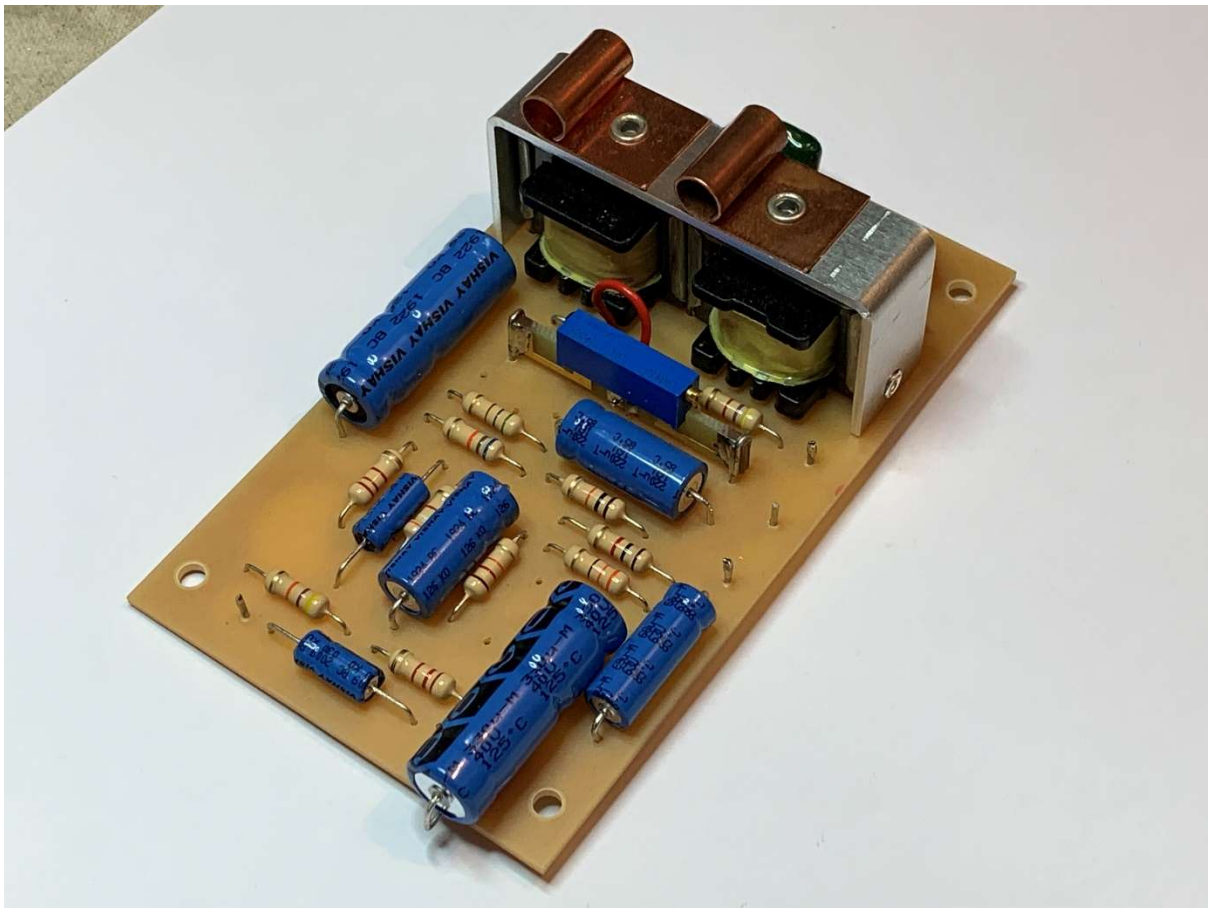
Time to add the afore mentioned heatsink, but first a quick word about it. We decided to use copper transistor clips rather than the originals. We just figured that the transistors used in this kit were exceptionally valuable and scarce, so required a little more protection especially during the initial powering-up phase when things can inadvertently run a little warm. Better safe than sorry then in my books!

The Heatsink Assembly.



To mount the heatsink assembly, simply locate the two tab-legs and gently ease them into the outer transformer tab holes. The main bodies of the transistor clips should be uppermost and the eyelets underneath. The heatsink assembly should push all the way into the board and sit flat and level on the top.

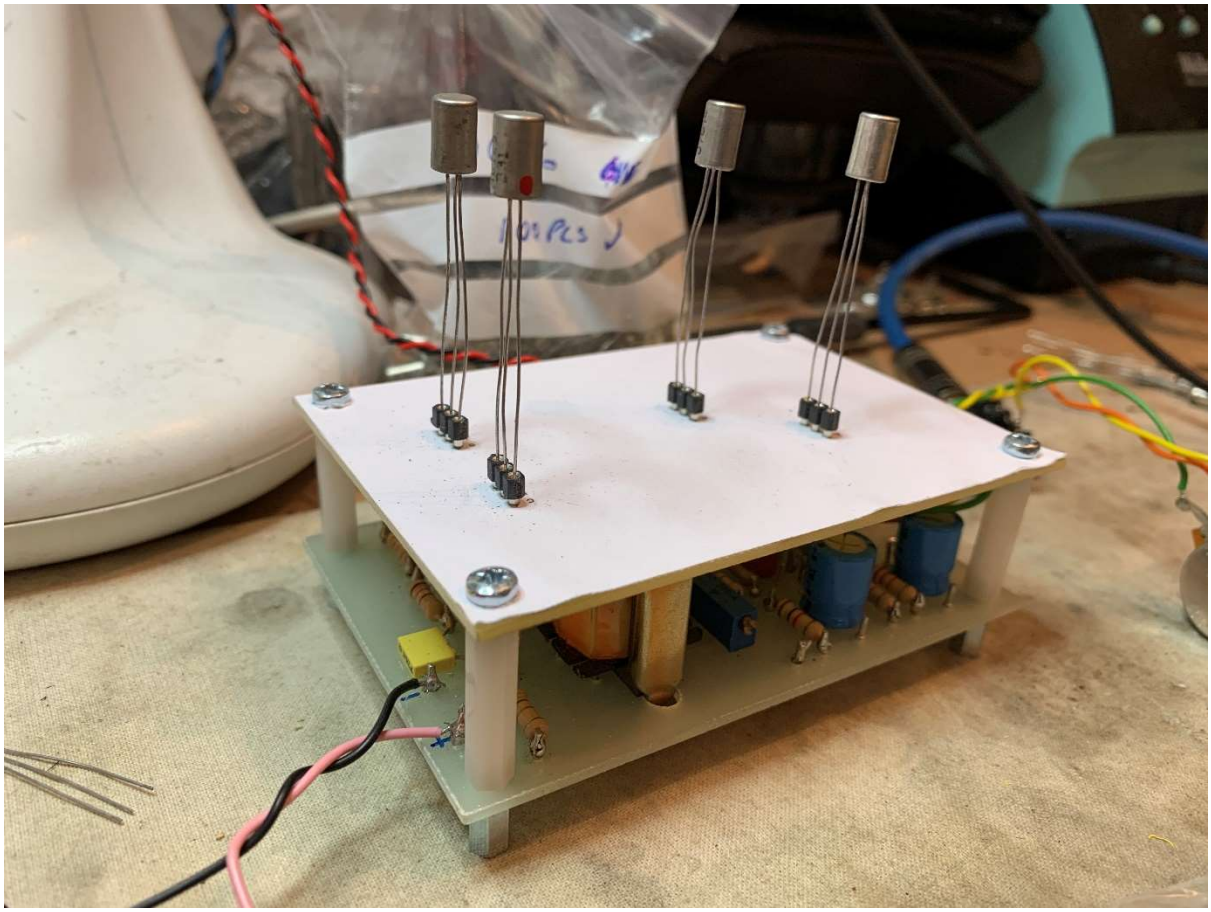
A quick check to see if your board now looks like this:



If it does, you can now bend-over the heatsink solder tabs outwards. And solder them to the board, trimming the excess tab off flush with the board as you go. Now to the really delicate part!

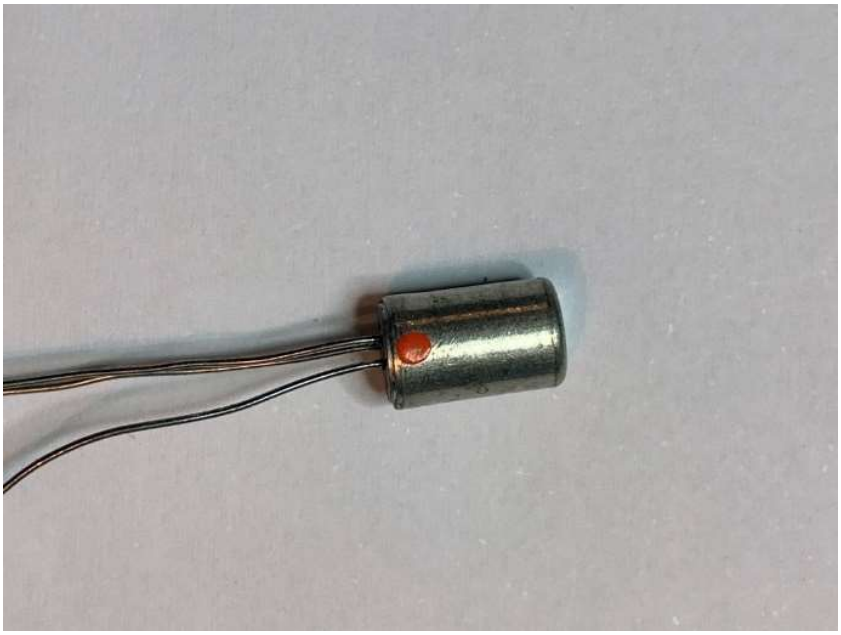
The Transistors.

Original large-can TO-1 AC128 transistors are quite rare. TO-1 AC125's even rarer. TO-1 AC126's are heading in the same direction as the 'Dodo' and 'Rocking-Horse doodoo'! We have been slowly collecting these rarities over the last three years. That is how long this project has been in the making! Not just collecting them but testing them and only keeping the units that were in-specification. The result of the three years' work is 100 full sets of original vintage TO-1 transistors tested and fully matched in sets using an identical amplifier test unit.

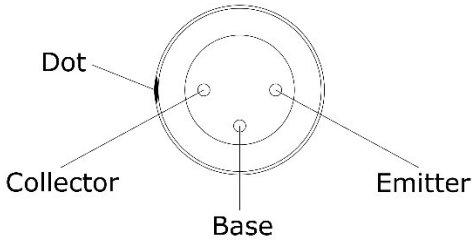


Now, the upside to this is that these sets are very close in specification to the originals, the downside is that they are very delicate and sensitive to heat, so please be warned!

The pin-out of the TO-1 transistor is denoted by a small paint dot on the side of the can. Normally either black or red. This dot is placed right next to the collector lead. So, the dotted lead is the collector, the next along is the base and the final lead, the emitter. *These should not be confused with the later smaller TO-18 can transistors that have a metal tab on the bottom rim, as this tag denotes the emitter!*



In some instances, and due to their age, the paint dot may have become faint, or worn away completely. This is not a problem as the pin-out can still be determined by the orientation of the wires protruding from the bottom of the transistor. If you turn the transistor upside down, so that the wires are pointing towards you, here is the pin-out.

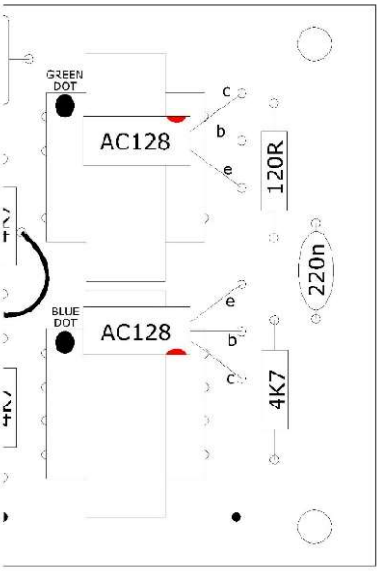


Transistor viewed from underneath

Fitting the transistors.

Let's start with the AC128's. These are each supplied with three pre-cut black sleeves. Slide the sleeves onto the leads of the transistors and find out which lead is the collector. Remember this is the one closest to the dot. The collectors of the AC128 output transistors sit furthest away from each other, so one is at the top of the board, the other at the bottom. Look at the bottom of the transistor and make sure the leads aren't crossed or twisted. Flatten the three leads between your fingers so you know the leads are sat in the order of: collector-base-emitter and slide on the three long black sleeves supplied. Then insert the top transistor in first (collector dot facing towards the top edge of the board. Carefully invert the board and solder the base (centre lead) first. **(3 second rule or less applies here!!!).** Turn the board back over and check that the sleeving is sat nicely on the board and not squashed. Now gently insert the transistor into its heatsink clip and push it in until the bottom of the transistor is flush with the clip. Loading the transistor into its clip will help protect it from further applications of heat. Now you can solder the emitter lead. Let that cool for a few seconds, then solder the collector lead. Don't try and solder all the leads at once. You will get a build-up of heat at the transistor junction inside, and that's never a good thing especially when you are pushing 60 years of age!

Now do the same for the second AC128. Remember to rotate it with the dot facing south and the collector lead nearest to the bottom edge of the board.

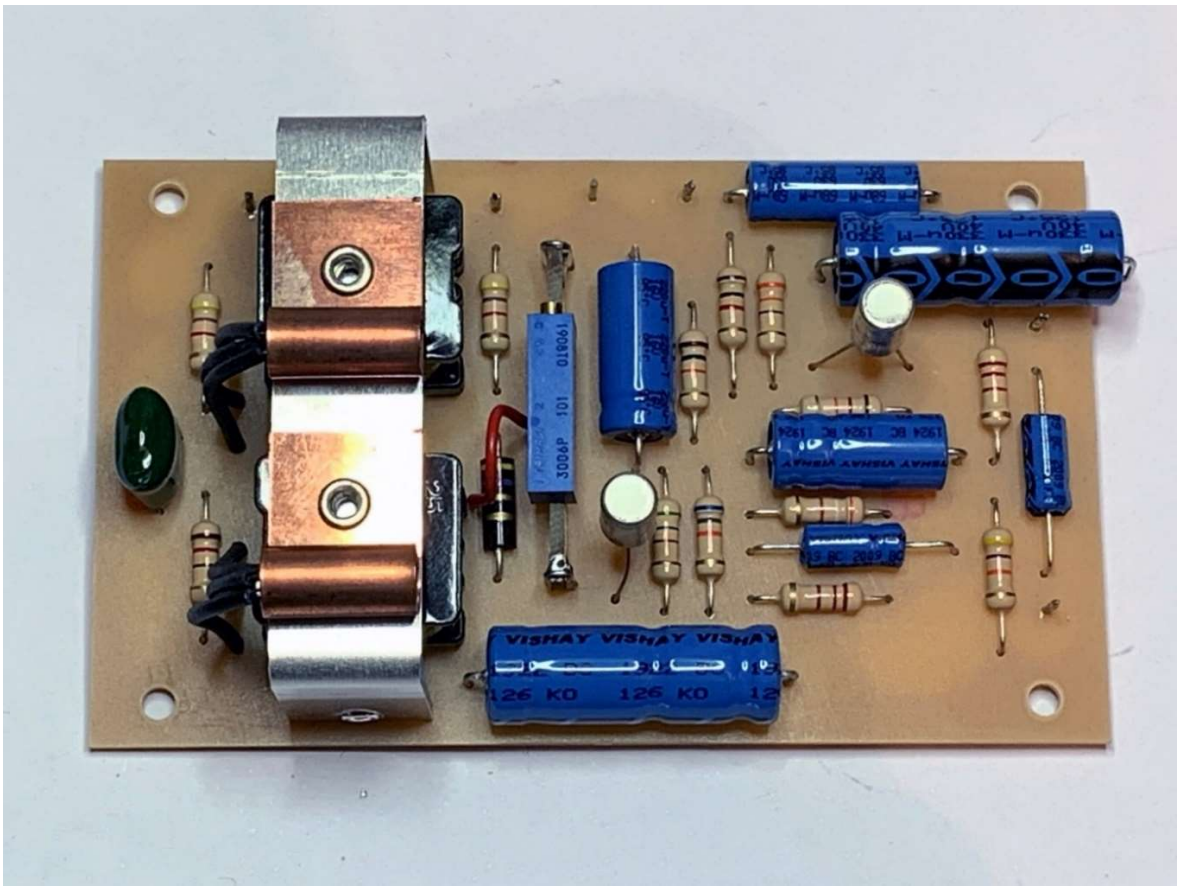


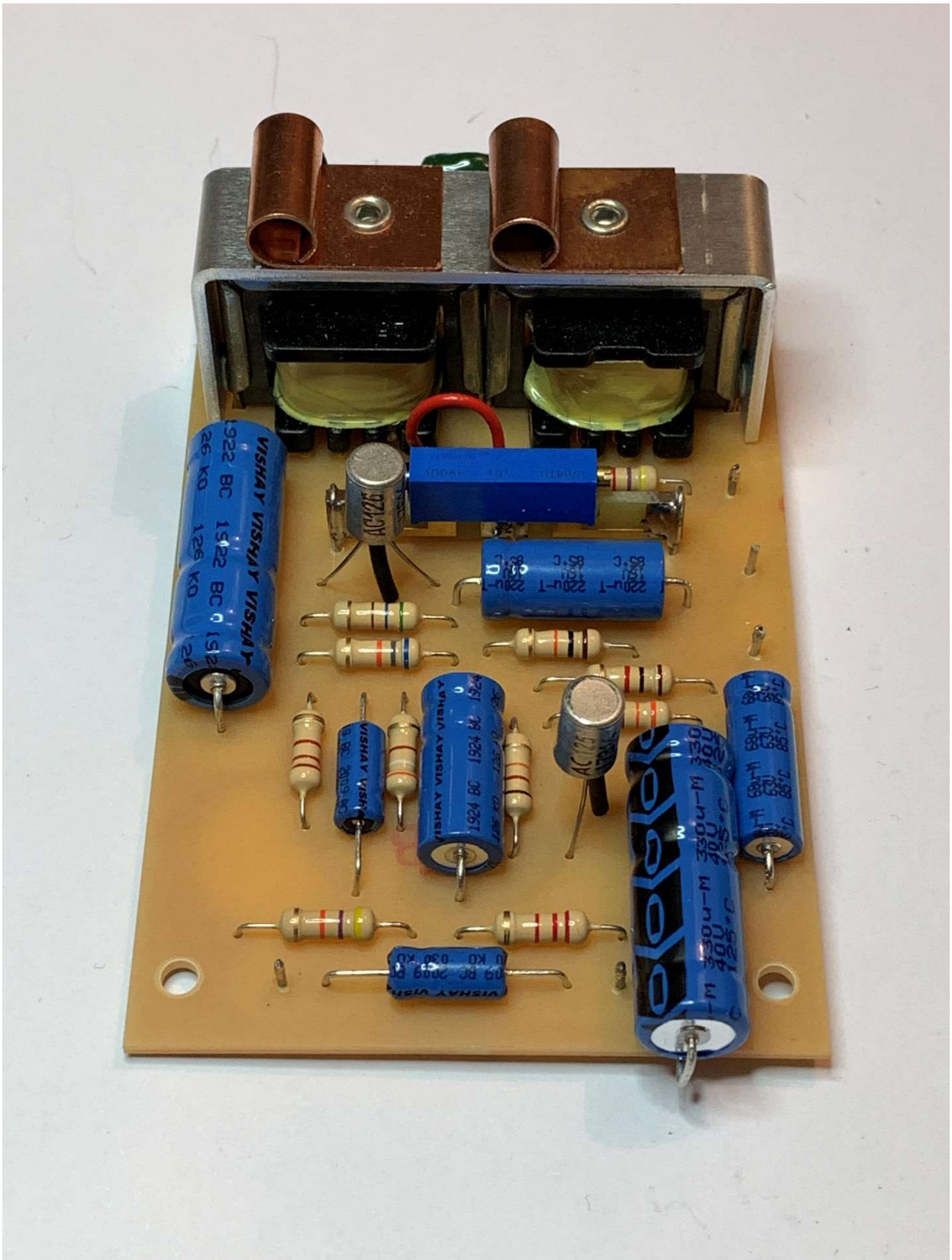
With the output pair in place, it’s time for the AC126. Both the AC126 and 125 transistors are supplied with only a single short pre-cut length of sleeving as it serves two purposes: firstly, to insulate the base lead and stop it shorting to those either side and secondly, to set the height of the transistor above the board (lead length).

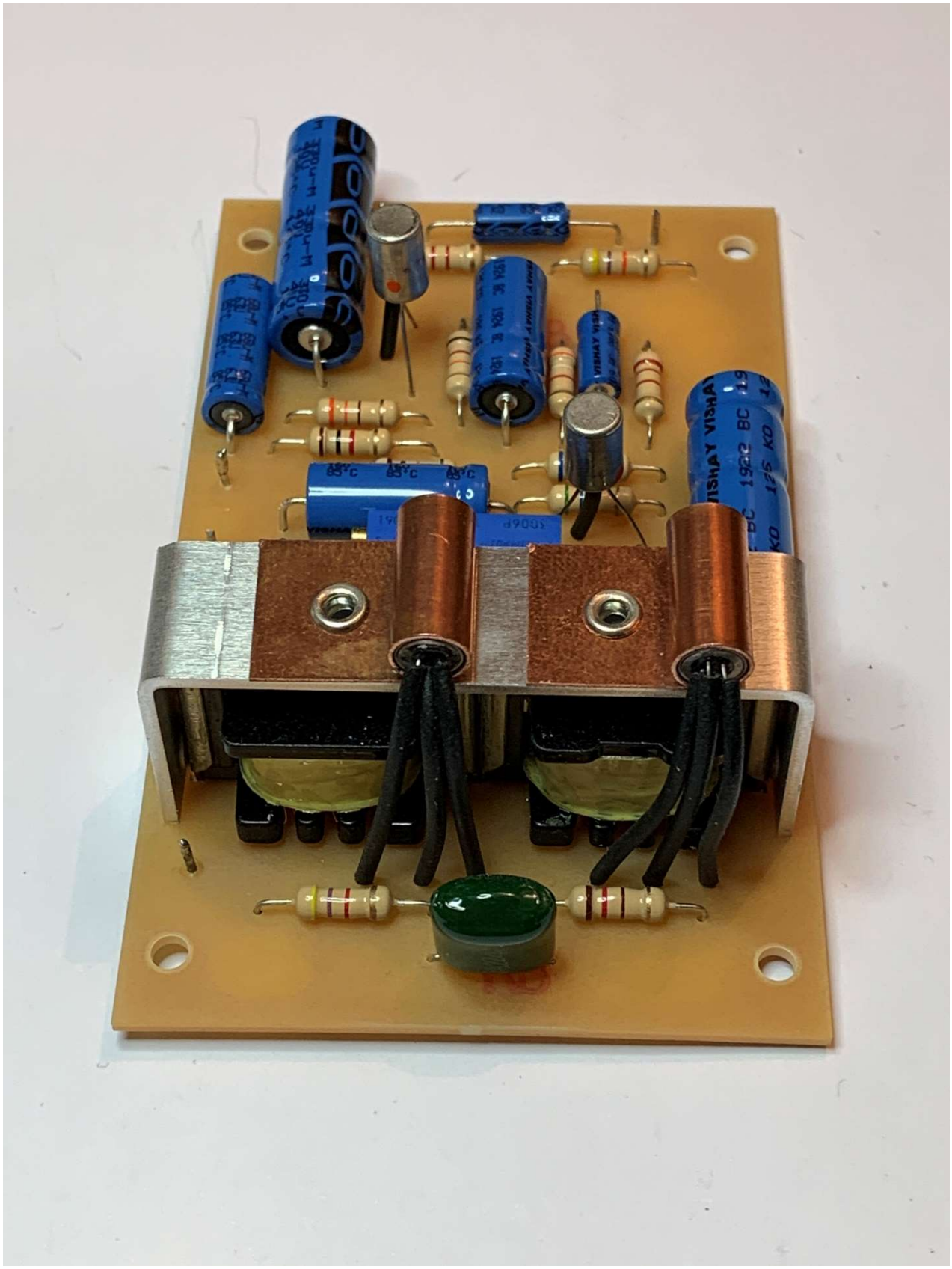
With the AC126 fitted with its sleeve on the base leg, insert it into the board as shown on the layout diagram. The AC126 is the driver transistor and is located next to the bias pot on the board. Take care to make sure the leads are going into the correct holes and that none of the leads are twisted. Invert the board, push the transistor in till the sleeve just touches the board and solder the base connection. You can now invert the board again and straighten the transistor, so it sits upright. Then, invert the board again and solder first the emitter, let it cool, then the collector.

Follow the same procedure for the AC125 Transistor.

Your board should now look like this.

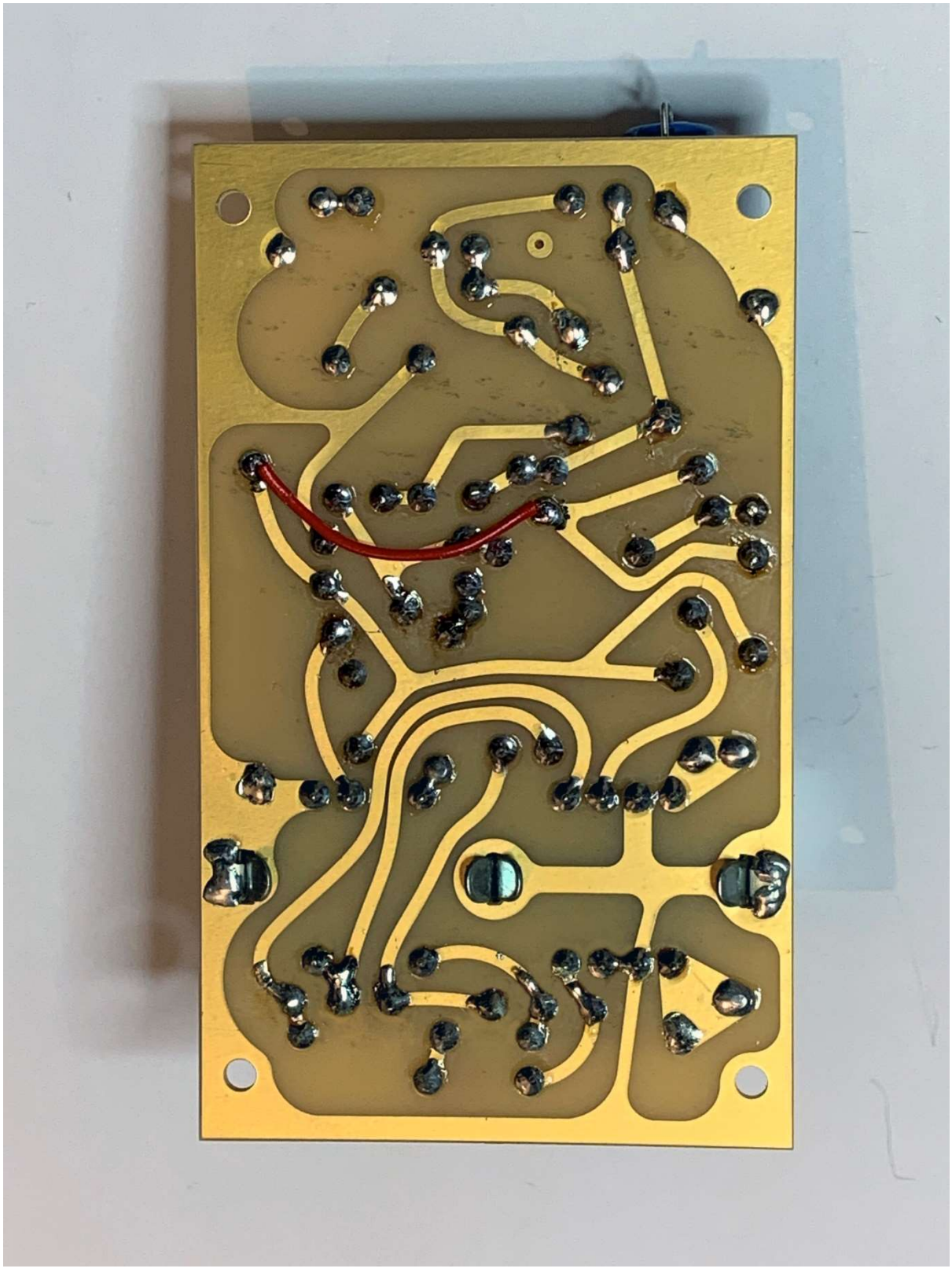



VISHAY
AC126
AC125
220u-T
85°C
330u-M
125°C



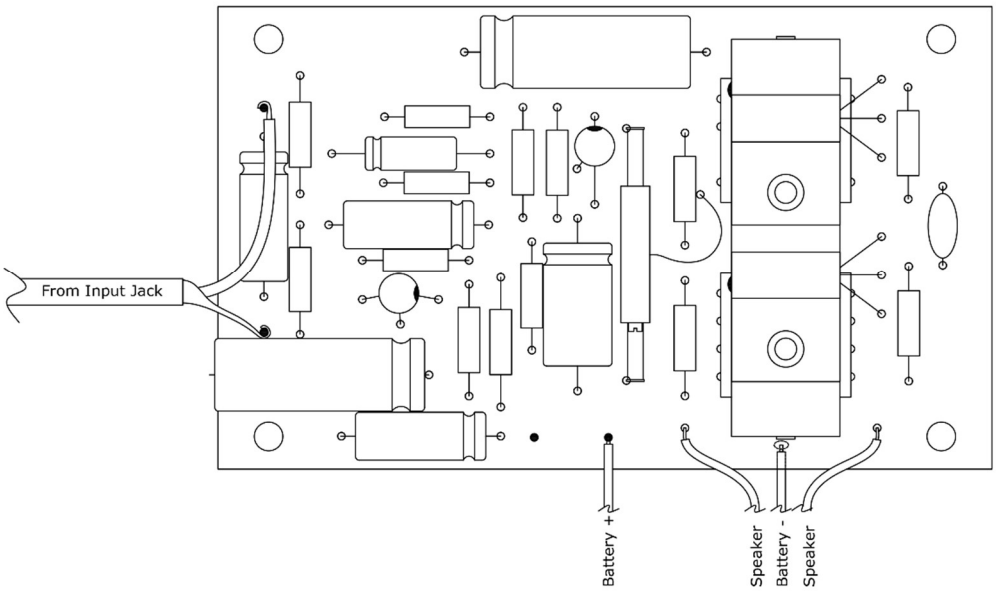
Wiring the board.

First things first, we need to add the power supply link wire underneath the board. The wire has been supplied pre-cut and tinned. You just need to form a small eyelet at each end and solder onto the lead stumps sticking through the pads as per this picture.

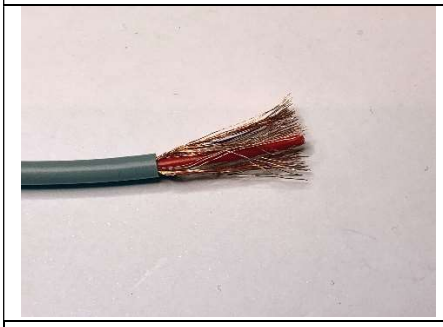
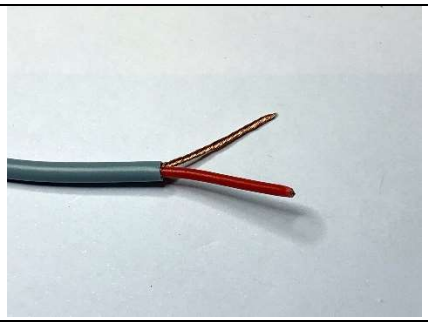


Now for the external connections:

We now need to add the leads that will connect the amplifier board to the input jack, battery and speaker as per the drawing below:



Let's start with the input cable. A length of grey (same as Brian's) single core screened cable has been supplied with the kit. The guide below explains how to prepare the ends of the screened cable. Both ends need to be prepared the same.

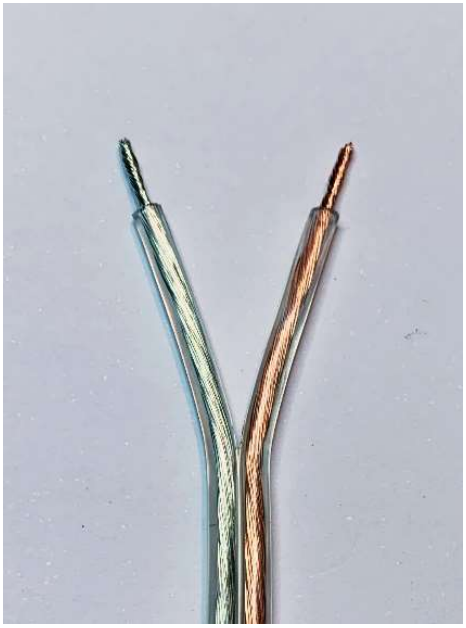
		
Grey Single-core screened	Cut back the outer sleeving 25mm	Un-braid the screen
		
Straighten the strands	Pull behind core and twist	Tin both conductors

Now, you have two options here. You can either solder-in the vero pins supplied and solder the wires to those, or you can solder the wires directly to the board pads. If you decide to insert the pins, it helps if you then bend the ends of the wires into eyelets that slip nicely over the pins.

This will give the solder joint a little added mechanical strength and also help hold the wires in place as you solder. Care should be taken to ensure the correct orientation here as the amp will not work correctly if reversed. So, the red core (signal) of the screened cable must go to the positive '+' side of the 2u2 input cap.

The other end of the screened cable should have the jack (supplied) soldered to it. Ensure the screen is connected to the sleeve lug on the jack as follows:

Next is the speaker cable. This, as in Brian's original, is a figure of eight, clear covered speaker flex with different coloured cores to aid correct polarity connection. One core is bare copper, the other is tinned copper (silver looking).



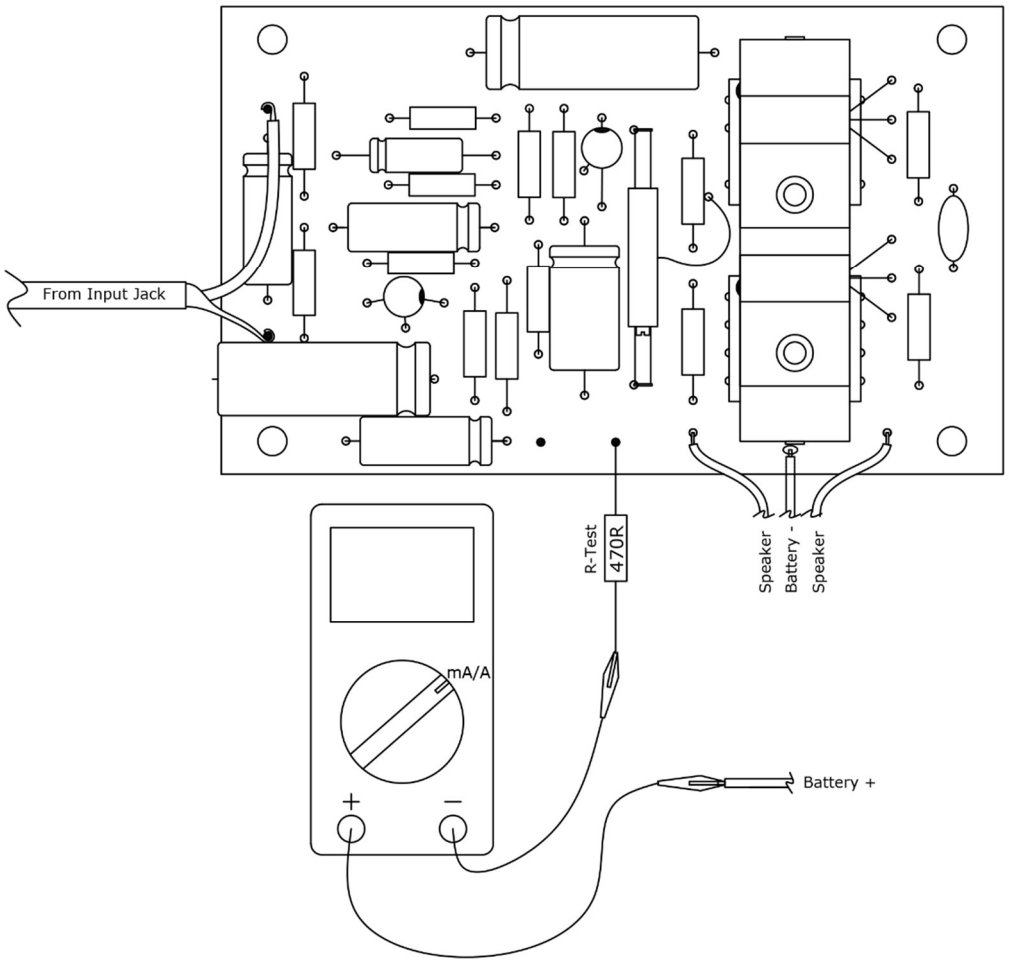
Once again, you can either pre-load the holes with Vero pins and connect to those or, solder directly to the pads underneath. On Brian's Deacy, the tinned copper wire (silver-looking wire) is connected to the speaker pad closest to the Bias trim pot.

The battery leads are last, but we need to power-up the amp and set the bias first and to do that safely, we need to add a series resistor in the battery '+' power-line. There are a number of things that can go wrong when you build amplifier circuits. A transistor can be inserted the wrong way round. There could be a solder splash on the board shorting two tracks. An electrolytic cap can be inserted the wrong way round etc. There is also the danger that the bias trim-pot might be set at a position that pulls too much current and over-heats the transistors… Also, remember, these are expensive vintage transistors, so we want to give them every chance of survival we can! Adding the series resistor will mean any excessive current will get dumped across the resistor rather than the expensive parts on the board.

The negative battery lead '-' should be soldered to the underside track pad on the board at the point where the heatsink tab has also been soldered.

Within the 'miscellaneous bag' there is an additional 470R resistor. R-Test! We are going to insert that in the powerline before we connect the board to the battery. At this point, you will also need a multi-meter that can measure small current (mA). So, let's begin by wiring up the amp as per the diagram below.

It is also a good idea at this point to connect a speaker. Even with the test resistor in-line, you should still hear the amp hiss into life!

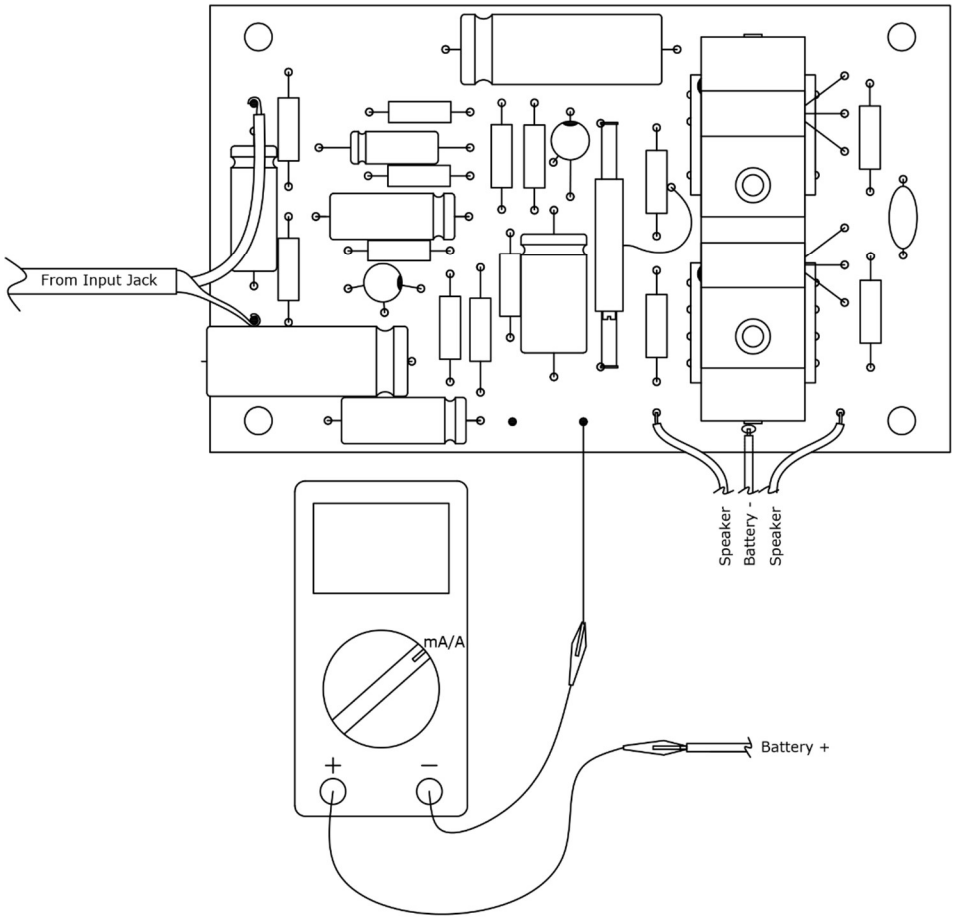


So, with the amp connected as above, switch on the meter, make sure it is set for small current and that the leads are plugged into the sockets marked for current.

Now connect a new 9V battery. NOTE POLARITY!!!!

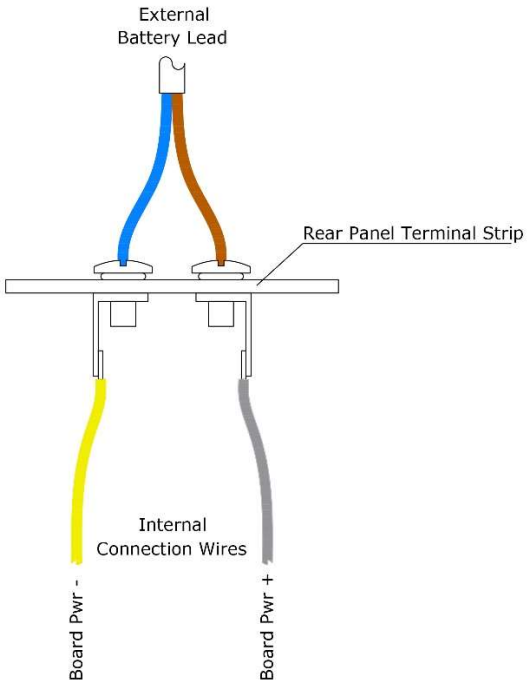
Your amp should start making a quite hum/hiss. Check the current being drawn and with a small screwdriver, adjust the trim pot to give around 5 – 6mA. If you can't hit that, there is a good chance there is an orientation/connection/solder joint issue. Turn the amp off and re-check everything.

Once you have found the problem, rectified it and achieved the 5 – 6mA current draw, you can now disconnect the battery, remove the 470R series resistor and re-wire the board as follows:



Re-connect the battery and now adjust the trim pot to give between 13 – 14mA. That is your bias now set. You can now disconnect the above and connect the final battery leads.

The power leads should be wired as follows:



Congratulations. You now have a Deacy Amplifier board!..