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15 YEARS OF ANKITS 2004-2018

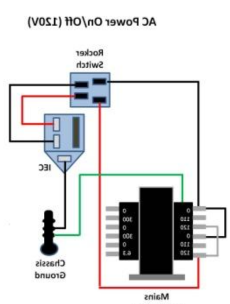
DIY Guide

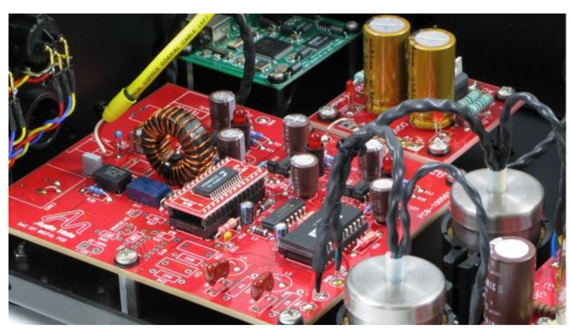
Understanding the basic skills for building an ANK Audio kit and learning a little about our products and the DIY hobby

Version 2.00, July 2019

audionotekits@rogers.com

1-613-822-7188





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Section 1

Introduction

This document is intended to help you understand all the aspects associated with building an ANK Audio kit. It's a great way to prepare — either prior to ordering a kit or just before you start to build one, whether you are embarking on your first kit or are quite experienced.

We hope that this guide will shed some light on a number of topics associated with building our gear. It may also help you understand the skills necessary to build your first kit, whether it be a DAC, pre-amplifier, Phono stage, Single-ended 300B amplifier, or EL34 70W Monoblock.

We hope also that it will provide you with a basic understanding of the electrical aspects and tools required for the kits so that you will have sufficient knowledge to test and debug a unit, if necessary. Good Luck! ...and enjoy the journey into the wonderful world of audio kit building.

Brian discussing ANK Audio kits at a local Audio Show. Welcome to the wonderful world of ANK Audio kits — High End Audio that you build yourself... Enjoy.

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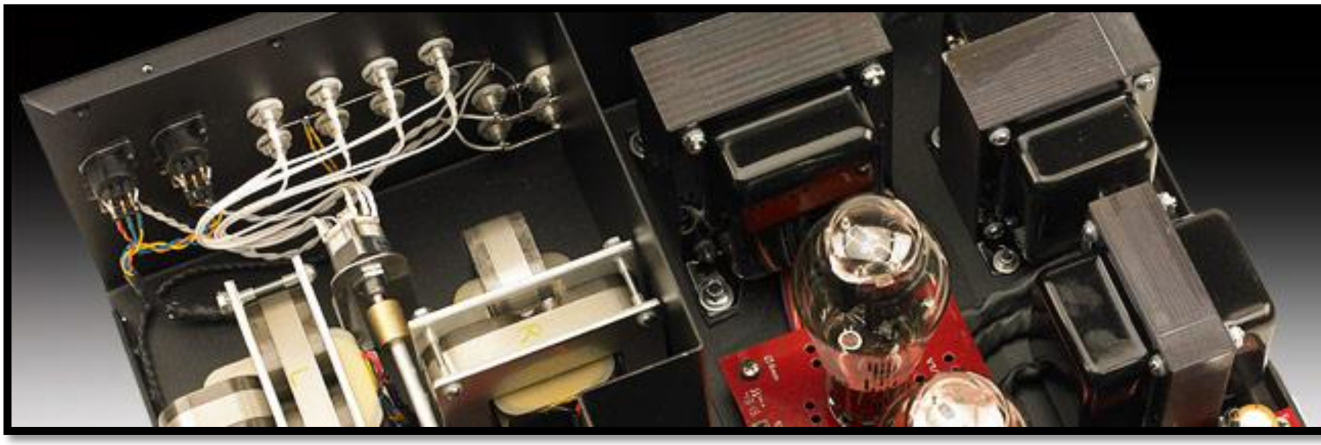
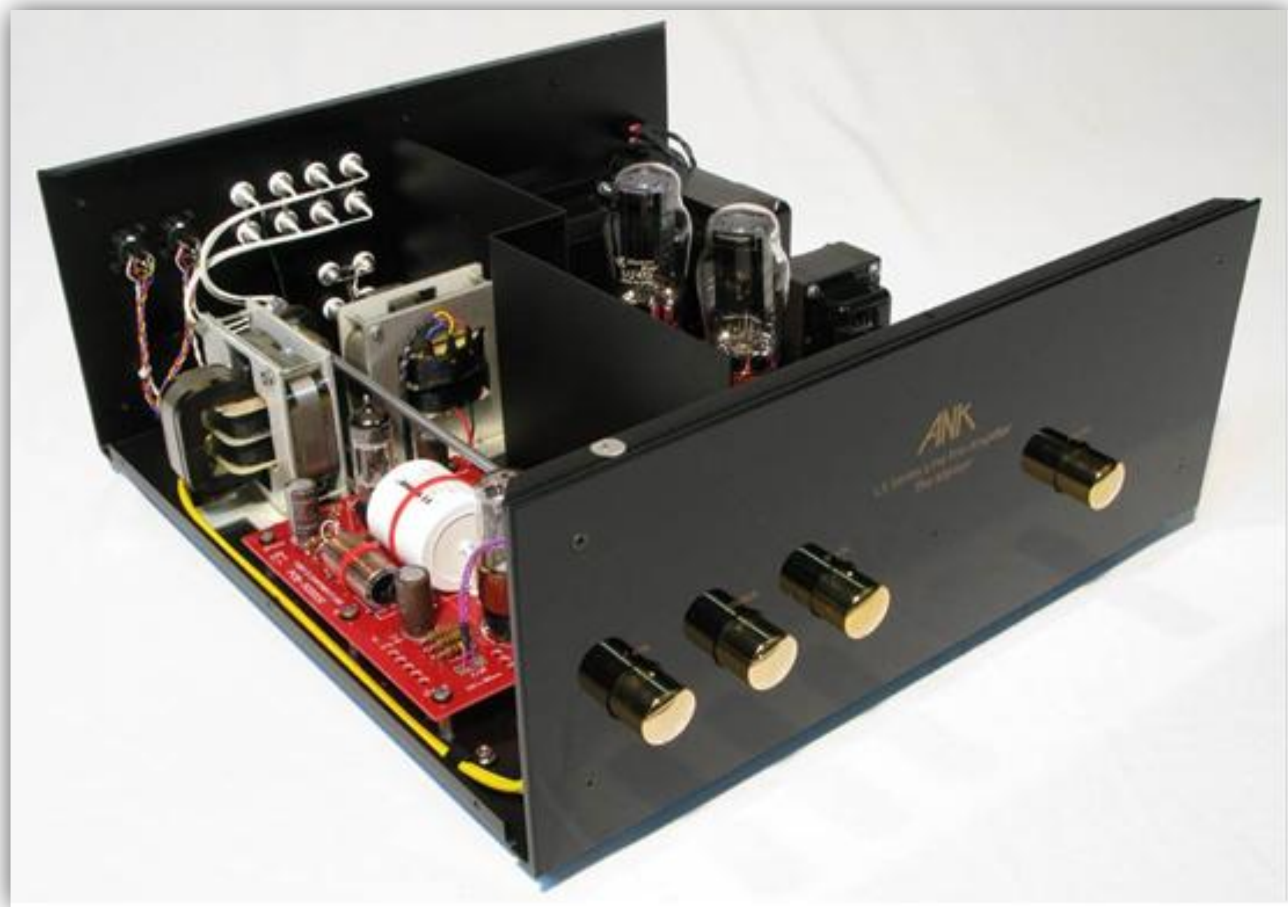
The end result…

Here's a completed kit. From the original design to the manufacturing, to the parts, to sourcing, to the kitting up, and manual development — it’s a busy process, but the end result can be magical.

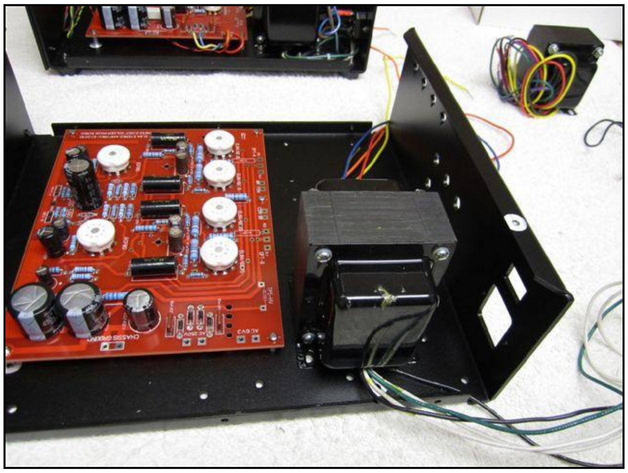


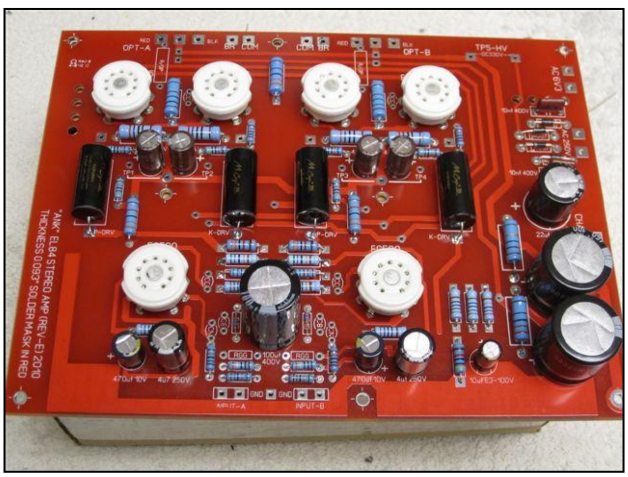
Our L5 The *Mentor* 2.0 Line Pre-amplifier C-Core (above and below)



Section 2

What's Inside an ANK Audio Kit?





The chassis and cover, along with several transformers — these could be Mains, Chokes, Output, Interstage, IV, etc.

There will be lots of hardware! We supply metric M3, M4, and M5 stainless steel hardware throughout, individually bagged for each section of the kit.

There will be resistors and capacitors, along with valve bases.

There will be chassis fittings, which include speaker posts, RCA connectors , XLR sockets.

Faceplates — both front & rear.

Tubes of course!

Wire, of course: pre-twisted, in different gauges. We use silver plated copper Teflon wire known as PTFE as hookup wire.

You will provide a soldering station and solder, a wire stripper, and a Philips screwdriver. An M4 nut driver would also be helpful for tightening nuts.

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Wow – my kit has just arrived!

There is nothing quite like the arrival of an AudioNote Kit!

This is the L6 70W Monoblock kit that has just arrived at a customer's location. It's time to start going through it and separating all the bags and parts to get ready to build the kit.

Here we have the Hardware Bag, IEC Bag, Chassis Fittings, M2 Power Supply, Line stage, and wire. These are just some of the typical bags that would be included in an ANK Audio Notes kit.

Basically, we break up each task in the kit into a separate bag with its own parts list containing all the components. We keep hardware and wire in their own separate bags for the entire kit; these in turn often have several 'sub bags'.

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2.1 Hardware, the First Bag in Any Kit

Since we are focused on the mechanical aspects of the kit, it's time for a brief lesson about the first major part that goes into the kits: Hardware. Our Mechanical expert once told me, "Hardware is Beautiful!" I wasn't sure what he meant... but now that I see the copper insert plates, black countersunk screws, stainless steel metric hardware throughout... and I can understand what he meant.

Here are some examples of M4 metric stainless steel hardware: starting from the lower left corner and going clockwise we have an M4 16mm Pan screw, 10mm screw, M4 16mm CSK(flat) screw, Fender Washer M4, 2 standoffs, and an M4 Nut; in the middle are a standard M4 washer and an M4 serrated washer.

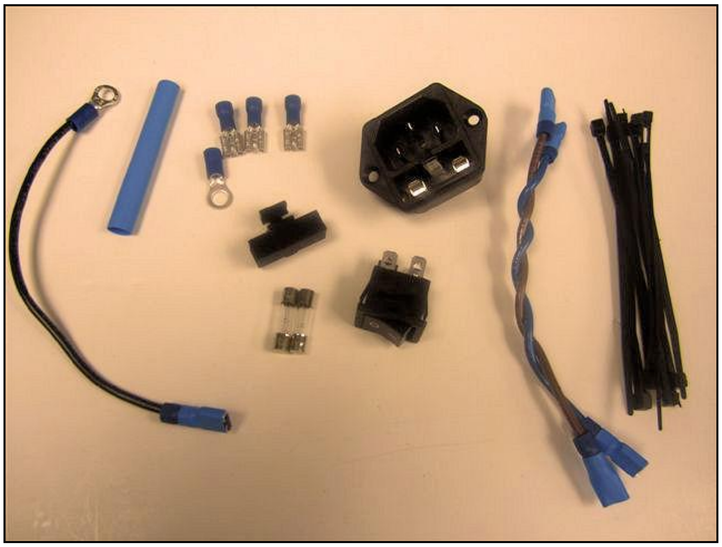
All the ANK Audio Kits use high quality stainless steel metric hardware. The Metric system uses the M designations and a typical kit will supply M3 and M4 screws (M4 being the larger). Some kits will also have M2.5 and M5 hardware, and even M6... but in general most kits use M4 screws. A typical Philips screw in the kit will be an M4 PAN Philips SS 10mm: this means it will be 10mm long, which is roughly 3/5" of an inch.

Other than screws, nuts, and washers you will also see standoffs in the kits; these are typically also M3 and M4.

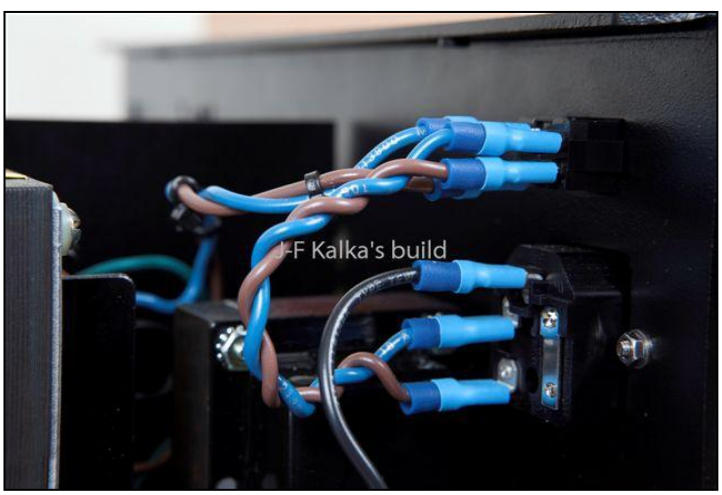
It's amazing how much hardware we go through to supply all the kits! In the early days we would buy 100 M4x10mm and 100 nuts; today we buy in 2000-5000 quantities of the best stainless steel metric hardware for the kits.

2.2 IEC, the Second Bag in Any Kit

Every ANK Audio Kit comes with what we call the IEC section. IEC (which stands for International Electrotechnical Commission) is a standard for the AC plug that is in the back of the equipment. This standardization offers the assurance that the same piece of equipment can be plugged into the AC wall source in any country in the world; all that changes is the power chord from that country’s wall socket. The IEC section is what allows the wall voltage to enter our kit and get to the Primary of the Mains transformer where we can start to supply AC voltages to the power supply.

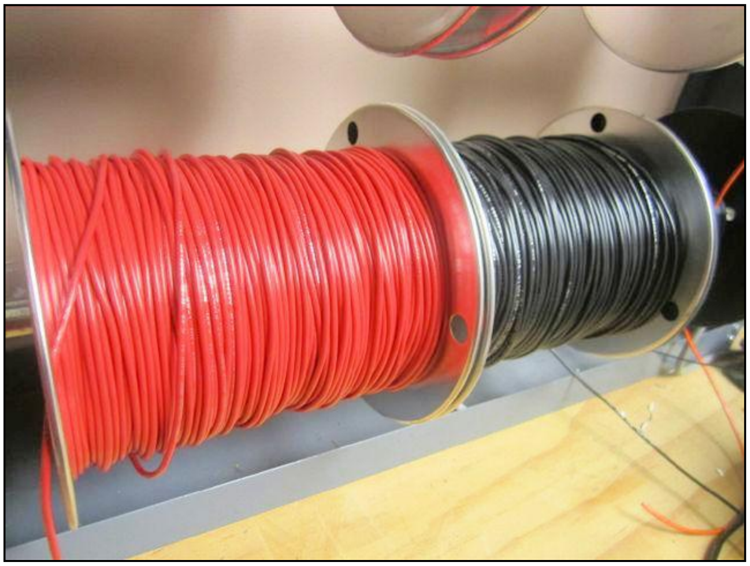


So basically this section comprises of the IEC plug, the rocker switch, fuses, the ground lug, possibly a special IEC printed circuit board (PCB), and the specially-made cables that we prepare for you so you can simply interconnect the IEC and the rocker switch. In some kits we'll have you install a crimp on the end of a transformer wire and add some heatshrink to it. We guide you through the IEC section step by step to ensure that, by following our procedure and using our premade cables, you'll have a clean and safe IEC section for your kit.



2.3 Wire

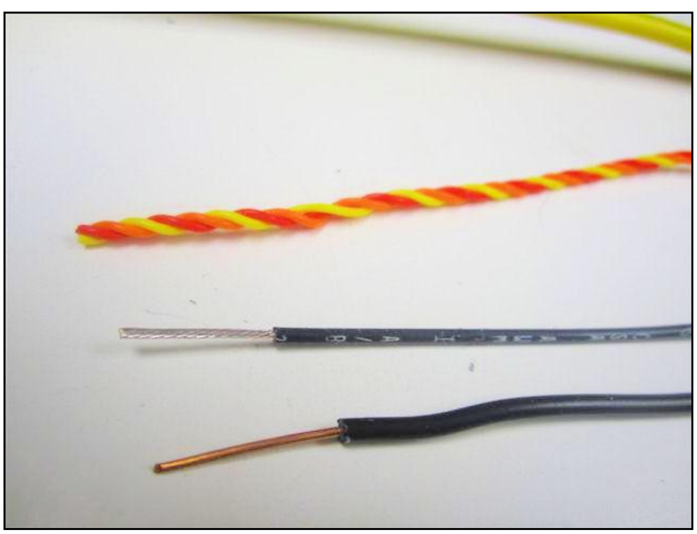
Let's talk about the wire that comes in every kit.



18 gauge (18g) stranded copper wire for Mains transformer secondary connections

ANK Audio Kits come with a number of different types of wire. We use solid core wire on the Primary of the Mains transformer to configure for the world voltage; then, on the Secondary, we typically use an 18g copper stranded wire for hookups from the Mains transformer to the power supply.

For all hookups and for the filaments and High Voltage (B+, HT) we use a silver-plated stranded Teflon (PTFE) wire.



Here you can see some solid copper wire at the bottom, along with the silver-plated stranded Teflon hookup wire we use for all HT & Ground connections. At the top is a triple twisted wire that we prepare for Right (R) Left (L), and Ground (GND) connections between PCBs in a kit.

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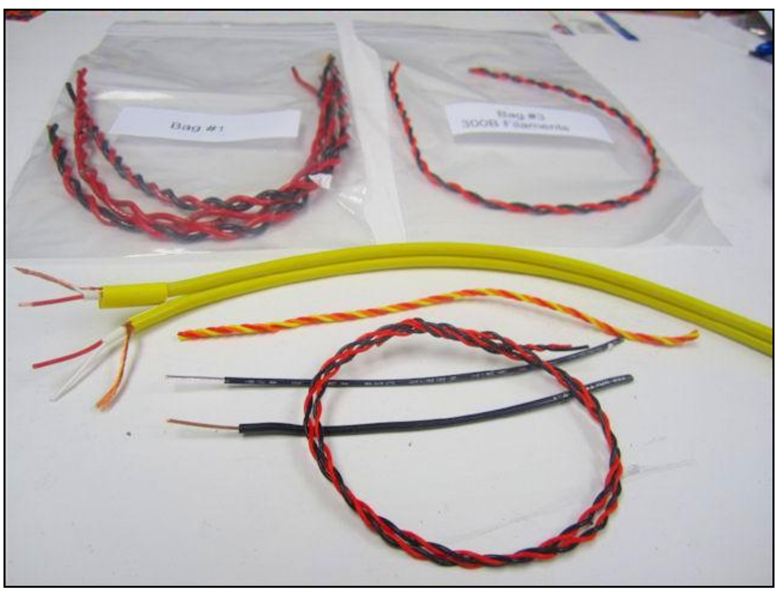
We have a separate Kit Bag called “Wire” that will be made up of several subsections of bags associated with wire from different parts of the kit.

Here is an example of a pair of Kit Bags: the bags are marked as Bag #1, Bag#2, etc. And they will sometimes have their specific designation noted, such as in Bag#3: this is for the 300B filaments in a monoblock amplifier.

A typical kit will contain about 7 kit bags. We prepare the wire by twisting it in some cases, leaving it straight, or terminating it for you.



Here you can see the shielded AN-A cable that we prepare for you in advance: this cable is typically used from an input RCA for the audio signal; it's a shielded cable, which has the ground shield wrapped around the audio signal wire, ensuring no noise pickup for any distance in the kit.

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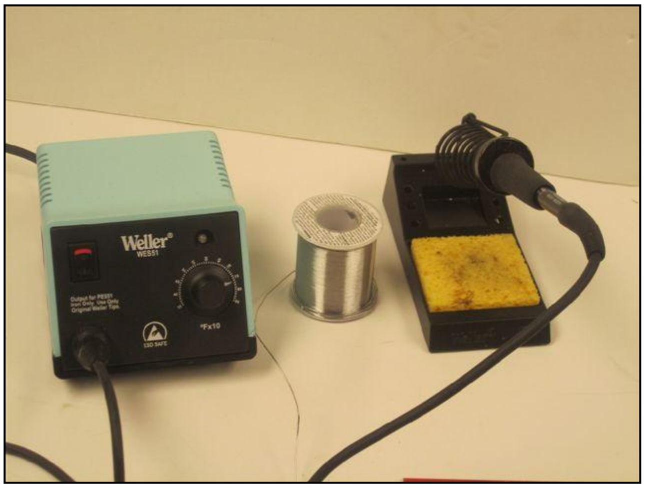
Section 3

Tools and Soldering

3.1 Tools



In addition to your solder, soldering iron. and multimeter, here are the other critical tools that you will want to build the kit.

Left: a Philips screwdriver, Center: a wire stripper, Right: a wire cutter

Usually the stripper will have a cutter on it, but the cutter allows you to get into tight places.

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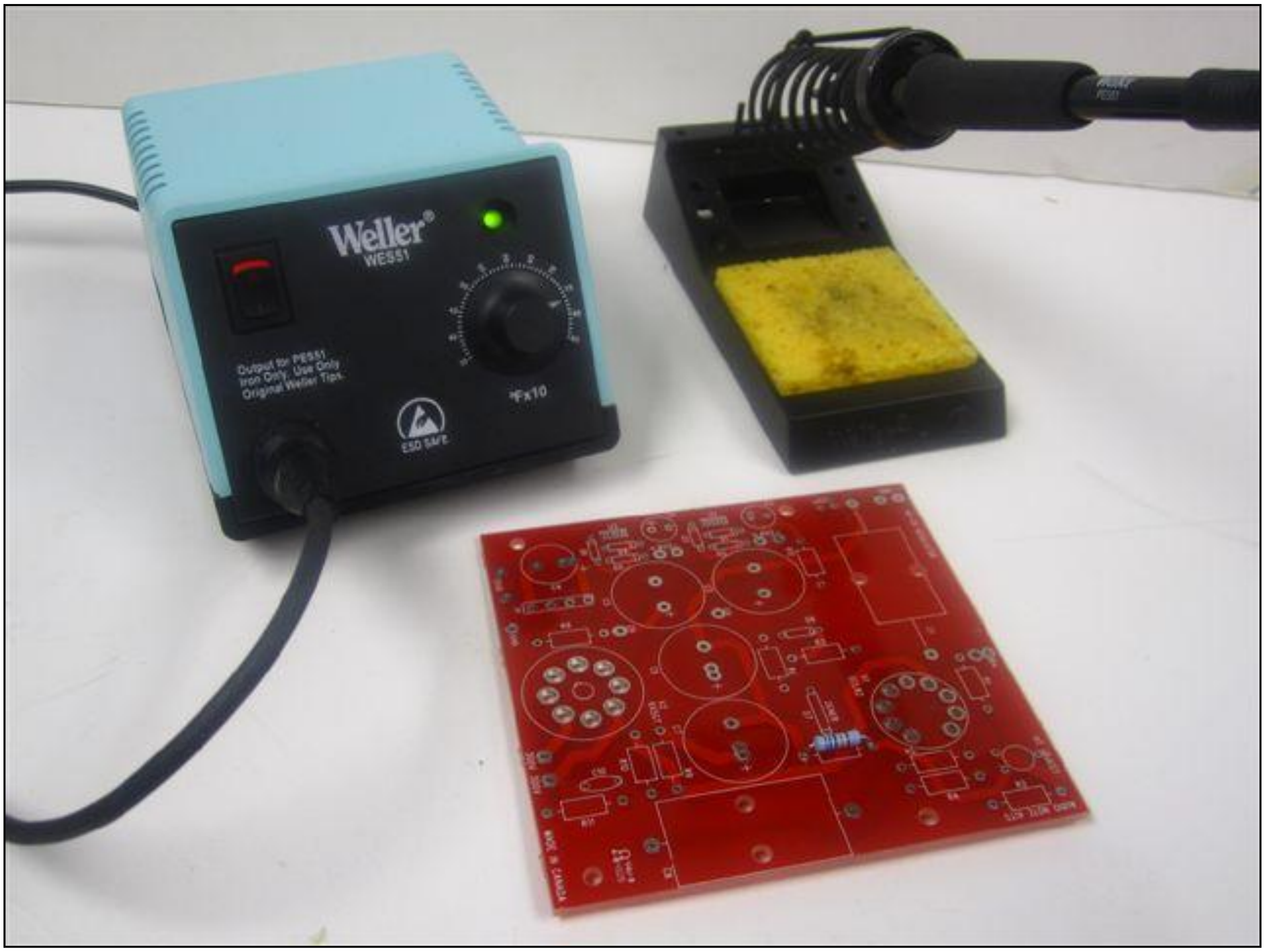
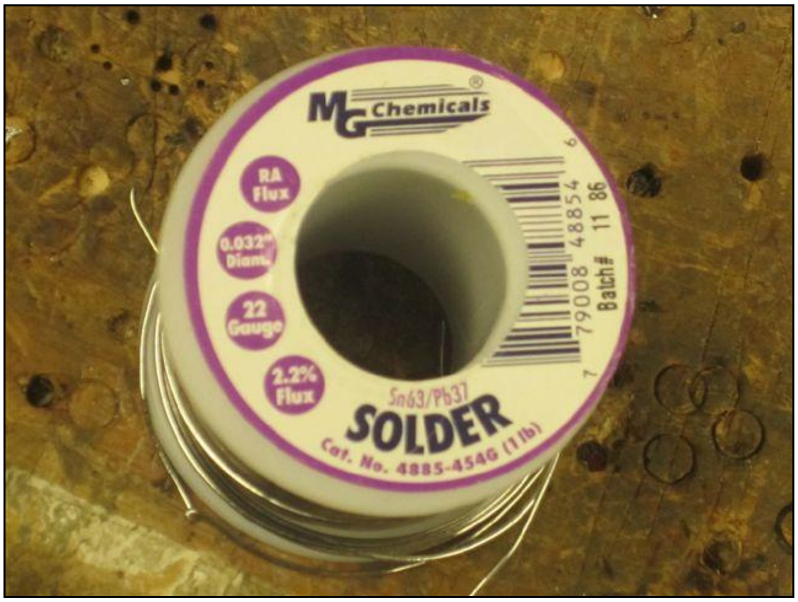
3.2 Soldering



Before starting on your first kit you will need to learn the basics of soldering: usually about 20 minutes of practice and you will be in good shape. The key to good soldering is having the right temperature and the right solder to make your connections nice and clean. The only real way to learn how to solder is to get a soldering iron and some solder and some components and practice away. If you'd like to request some practice parts with your kit we'll be happy to send them along at no charge.

Ideally, you will want to buy a solder station which contains a stand and a sponge. Check out the Weller and Hakko lines and look for either a temperature adjustable soldering station or one where the temperature is controlled by the type of tip; either one is fine. You can expect to spend anywhere between $75-200 on a unit.

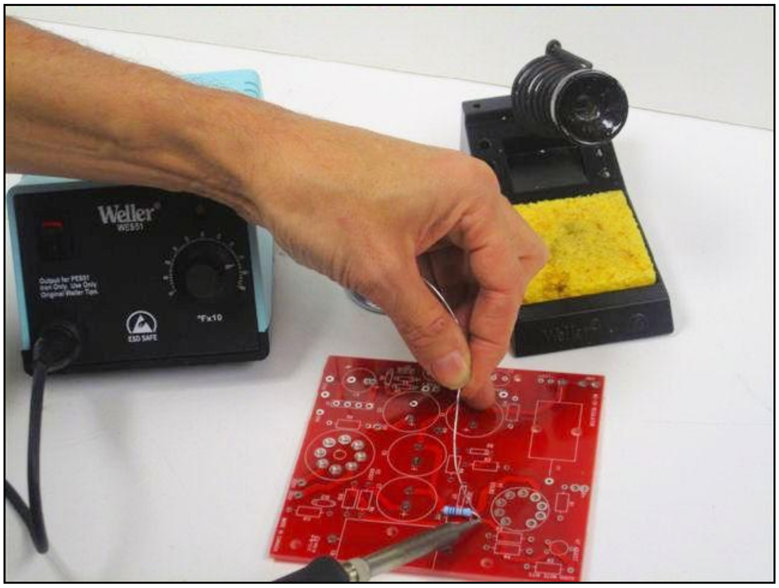
3.2.1 Types of Solder



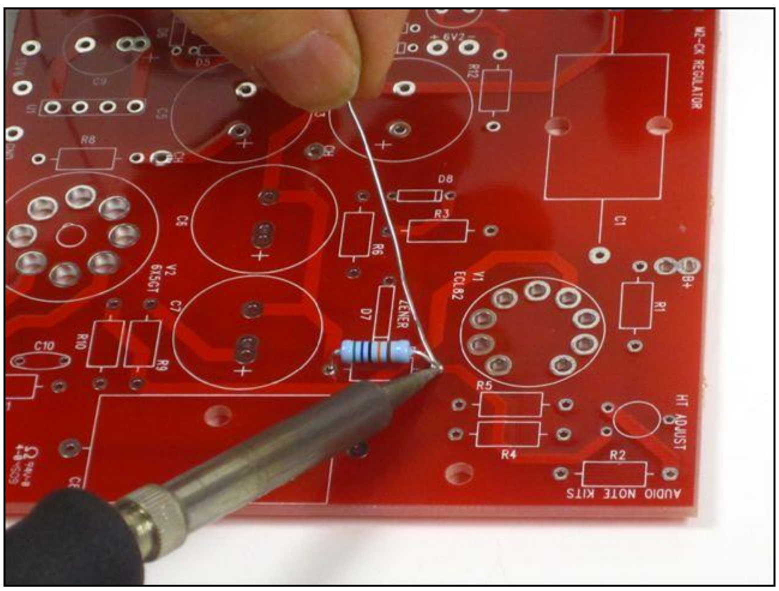
I use a 22 gauge TIN solder for my projects. This is a good solder to get started with — you may want to investigate solder containing silver for some projects; for example, WBT solder containing 4% silver:

3.2.2 Some Soldering Tips

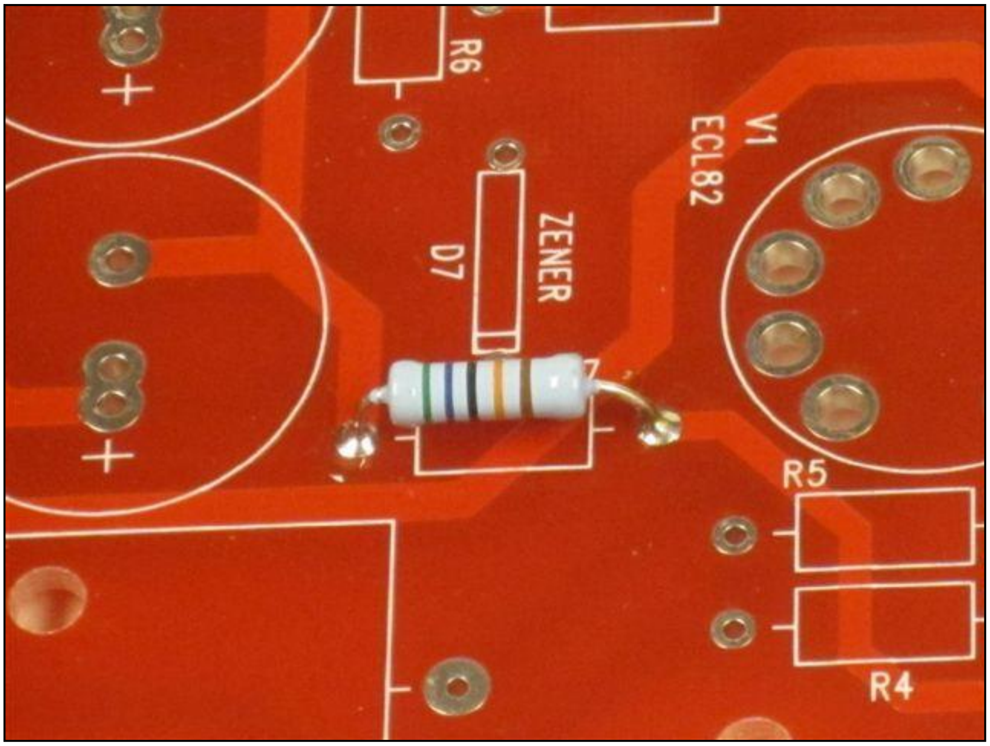
There are a few basic skills that you need for soldering and it will make your build very easy. Let's start with soldering a resistor to a PCB – one of our easiest tasks.



Here you can see where soldering iron meets solder. I usually find the hottest part of the tip is not the very end of the tip but rather the side of the tip.

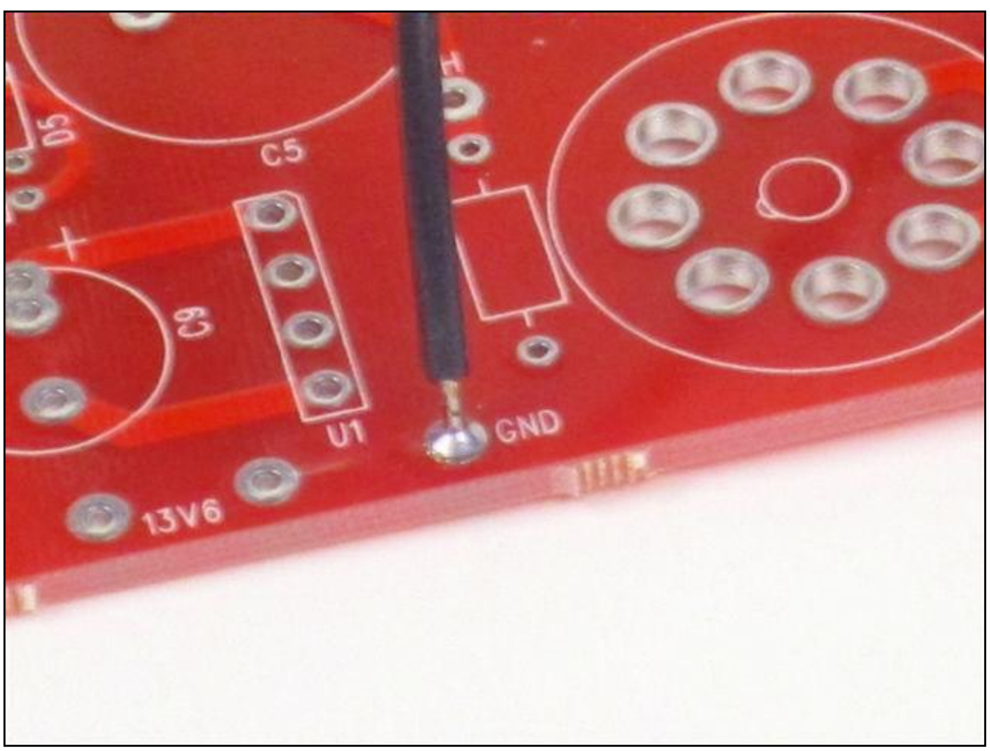


If you bring the soldering iron and the solder together on an angle as shown here you will get a nice flow, which is exactly what you're looking for.



Success!

Below is a close-up picture of a nice solder joint. You can solder on the top side of the board and the bottom if you wish. Very nice little cone like a volcano and shiny.



3.2.3 Additional Tips

Valve Bases

Use some masking tape to secure the valve base to the board prior to soldering. *The key is to make sure the valve base is level*: if your base is soldered on an angle then your tube will lean over! You'll want to solder from the underside of the board. We suggest that you use just a little solder to secure each pin to the board: perhaps just start with two pins which are opposite to each other to make sure the base stays level — then you can add more solder to the pins. In the end you can fill up the entire valve base hole.

Resistor Clearance

It's a good idea to orient your resistors so that the color codes can be read from left to right; it makes it easier to spot any issues.

It's also a good idea to not have the resistors installed right against the board, for a couple of reasons: 1) it's better for heat disposition, and 2) in some cases there are circuit traces running under the resistors and we really don't want resistors touching them. So, we use a narrow piece of cardboard cut to size as a 2–3 mm spacer: this will still let you solder while ensuring that the resistor is not pressing against the board.

Once the resistors are soldered into position clip the leads. Hold the lead that you are about to clip with one hand so that it does not go flying off and hit you in the face or eye!

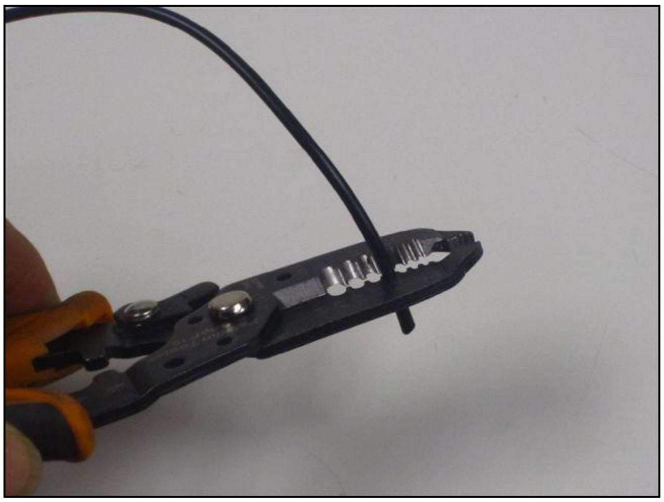
RCA Jacks

When working with the RCA jacks we use the following procedure:

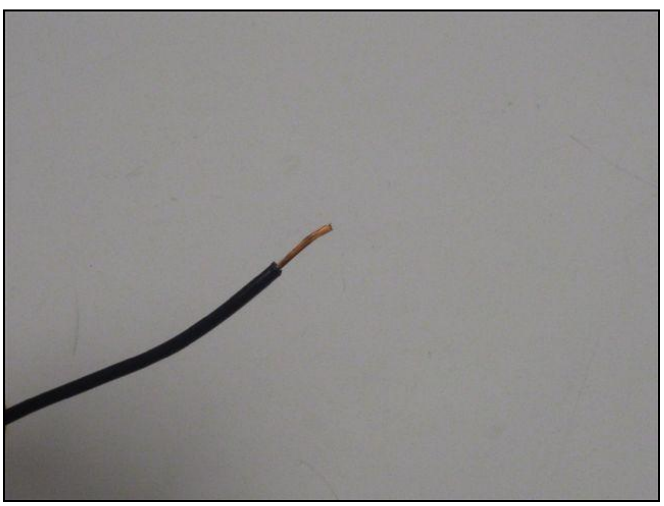
- Tin the RCA Red (signal) lead
- Tin the RCA Black (ground) lead and put a puddle of solder in the center of the RCA jack
- Heat the solder puddle and slide the Red tinned lead into the center of it
- Heat the tinned Black lead as it makes contact with the ground tab on the RCA; they will usually adhere immediately

3.2.3 Stripping

Let's strip some wire!



Wire stripper in position...



The stripped wire now showing the stranded wires.

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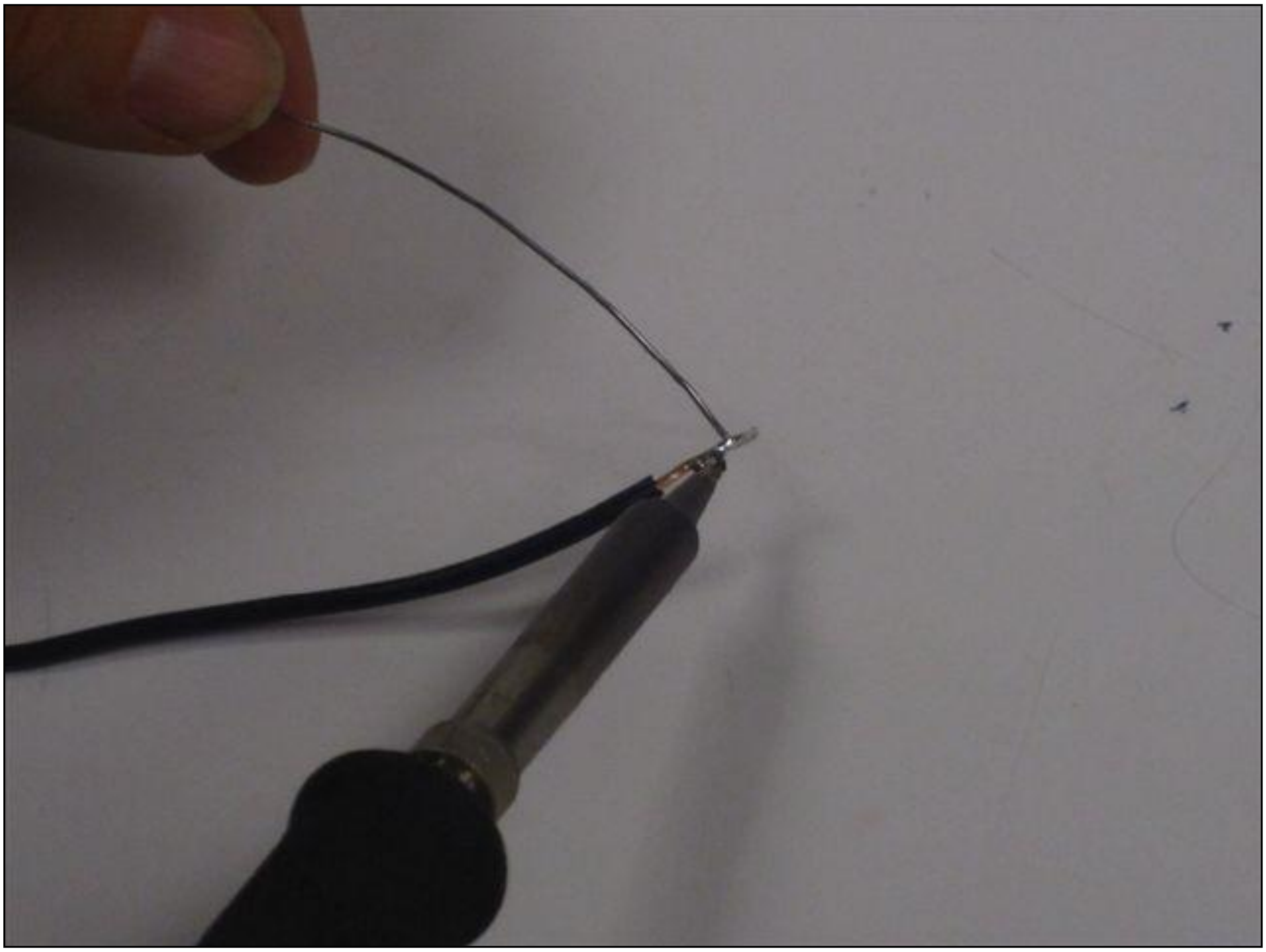
3.2.4 Tinning

Possibly the most valuable lesson you will learn in this document is the basics of tinning. Tinning is the act of applying solder to a surface — usually a wire — so that it can then adhere to another surface.



For example, if I had some stranded wire and I wanted to solder it to a PCB hole, I could just stick the wire in the hole and start to apply solder, but it will take some time for the solder to adhere to the wire surface — then it needs to adhere to the hole. And to make matters worse, there could be stray strands from the wire which could cause a short with an adjacent solder tab. So to make things easier and more reliable, we will tin the wire as shown below, then insert it into the hole, and then apply a just a little solder. You will really appreciate how easily the wire will now connect to the hole.

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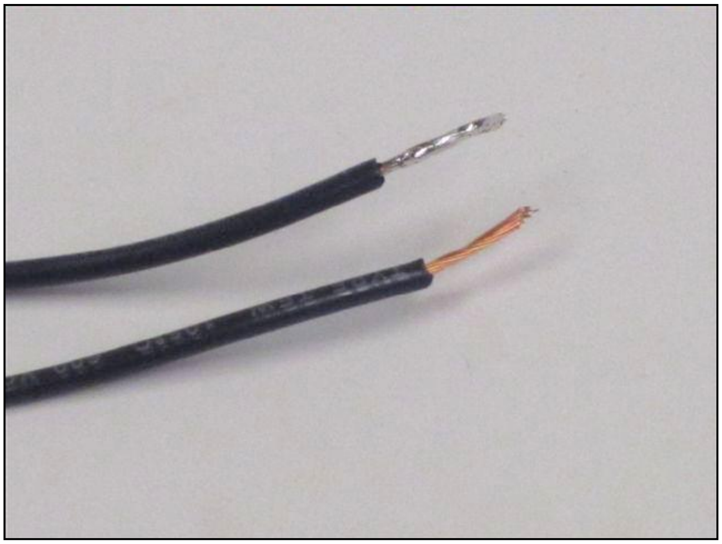
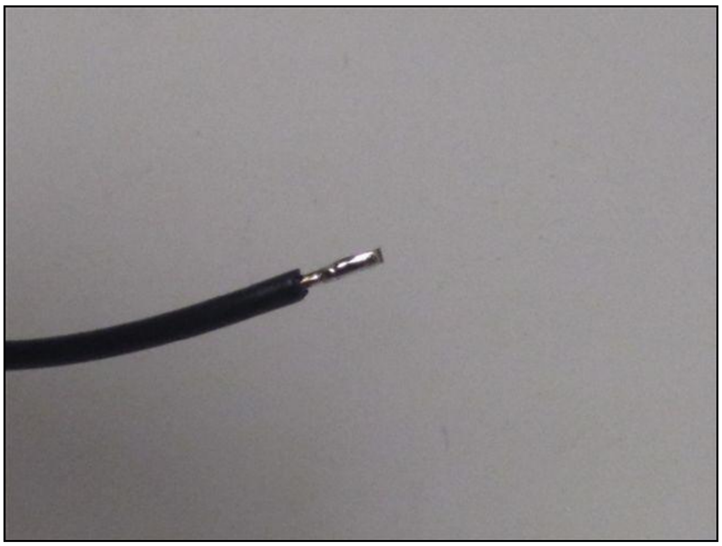
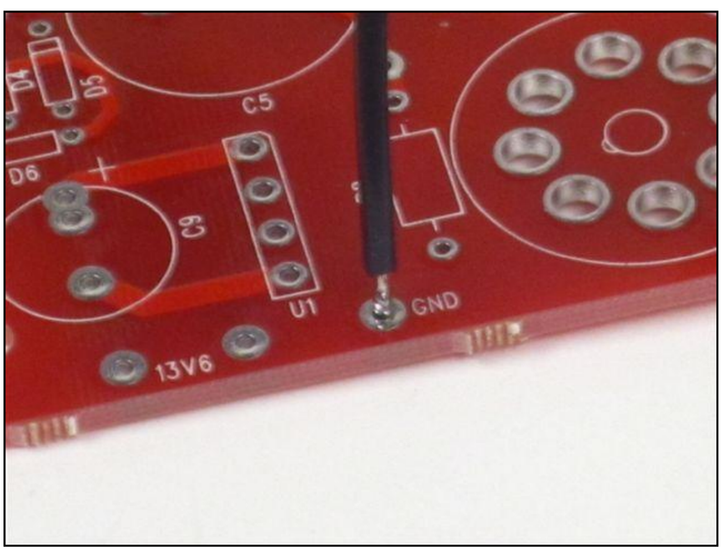


Here you can see a tinned wire and the untinned wire. Tinned wire can be much easier to work with when trying to solder it to surfaces.



Here is the tinned wire after it has been clipped.

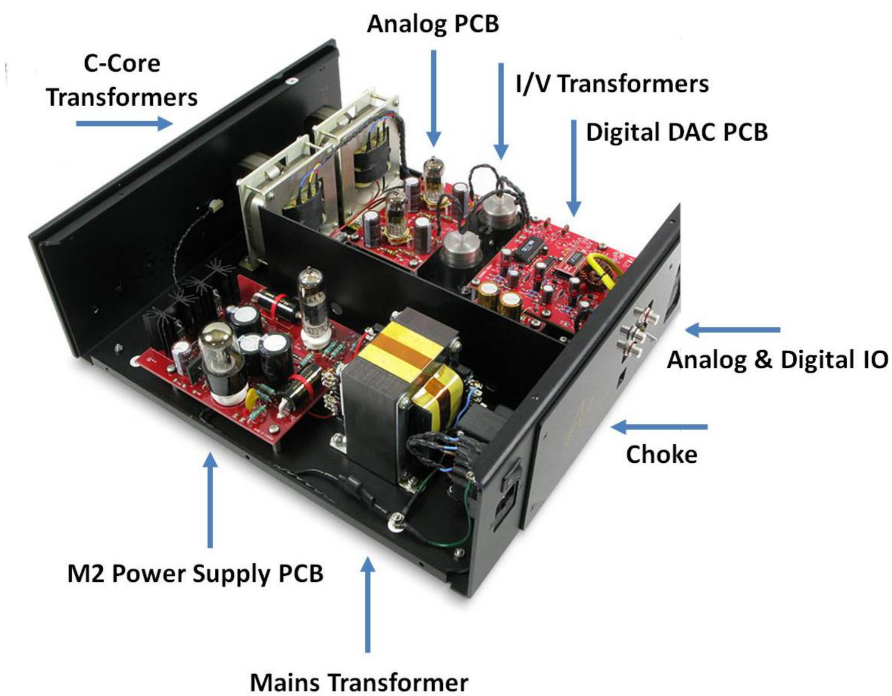


And now we'll insert the tinned wire into the hole on the PCB. Stranded wire typically has a coating on it and, when you go to solder the wire to a PCB, the coating needs to burn off. By tinning the wire you have already done this, so the tinned wire will adhere to the solder hole on the PCB much quicker.

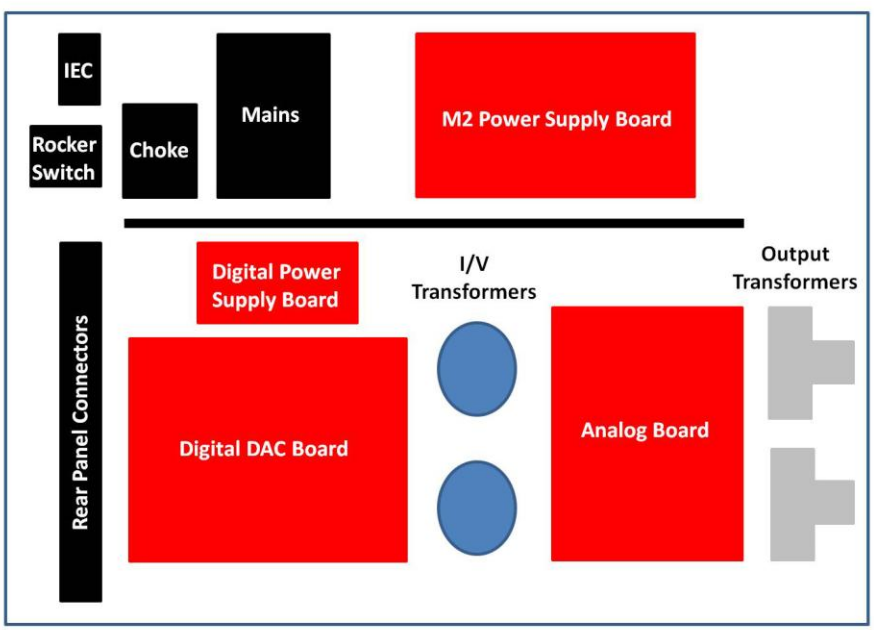
Section 4

Getting Started

Manuals are divided into sections and, to help you get your bearings, there are graphics and overviews such as:



and



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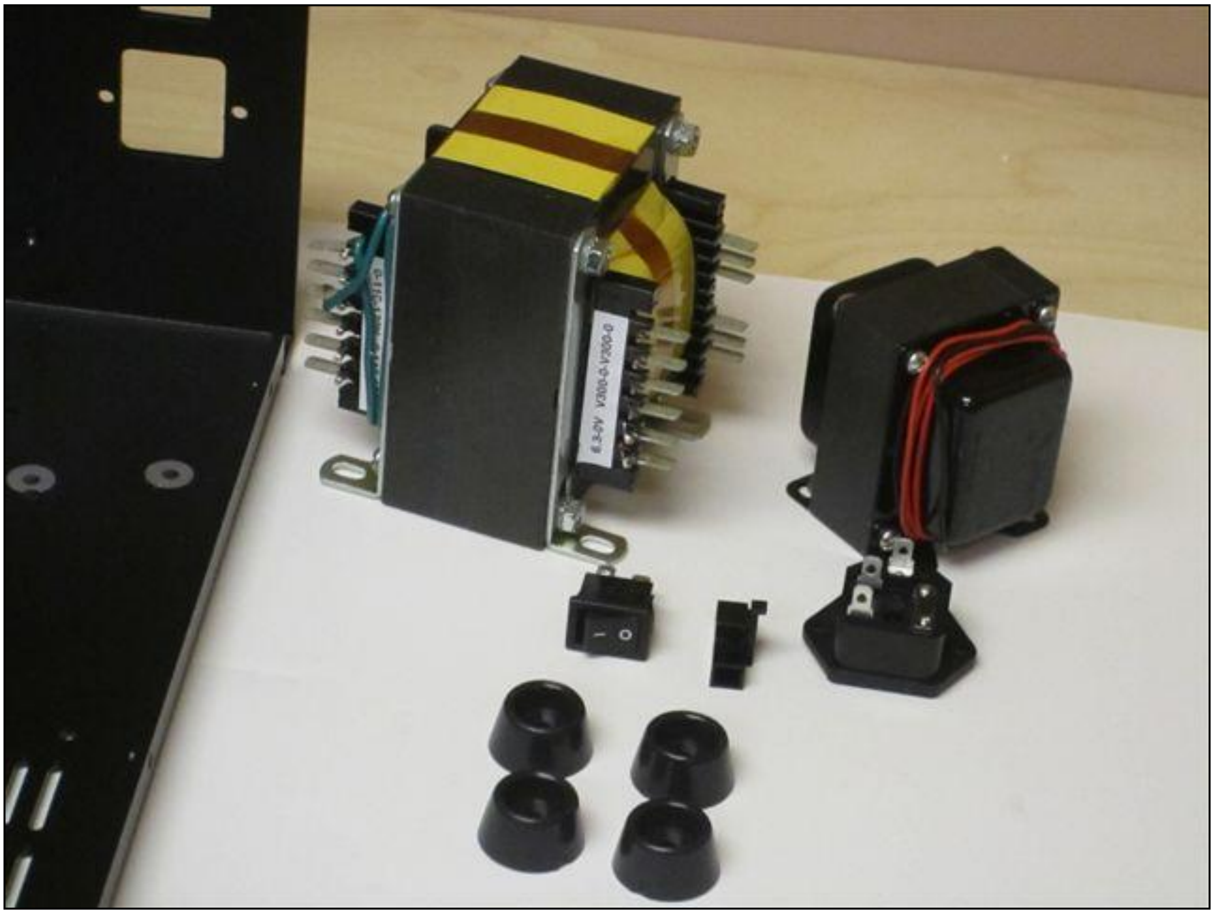
Typically, a kit build begins with working on mechanical assembly.



This involves installing the feet, the Mains transformer, IEC, fuse holder, Rocker Switch, and Choke.

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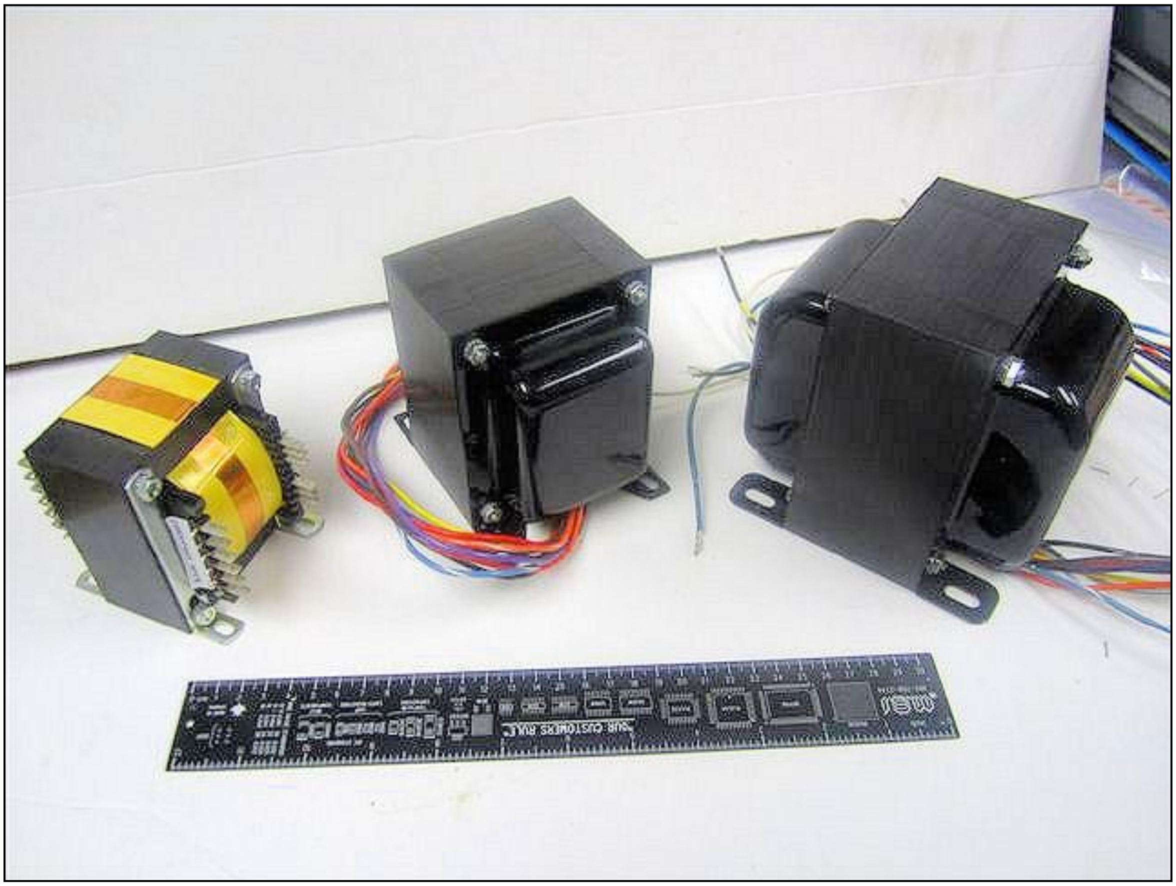
Every kit has a Mains transformer. The Mains or power transformer converts the AC voltage that comes out of the wall through the IEC plug into useful AC voltage that we can use in the amplifier, pre-amp, DAC, etc.



Shown above are three Mains transformers from the kit family: on the left is the Mains transformer used for the L2 and L4 DAC product lines. In the middle is the Mains used for the 300B amplifiers (we have two different models) and another model for the EL34 amplifiers. The Mains on the right is a large double capacity EL34 Mains used in the L4 and L6 amplifiers as an option. High quality mains transformers are expensive to make but influence the sound greatly. We have gone to great lengths to design and have manufactured very high quality Mains transformers that result in an ultra quiet operation of our products.

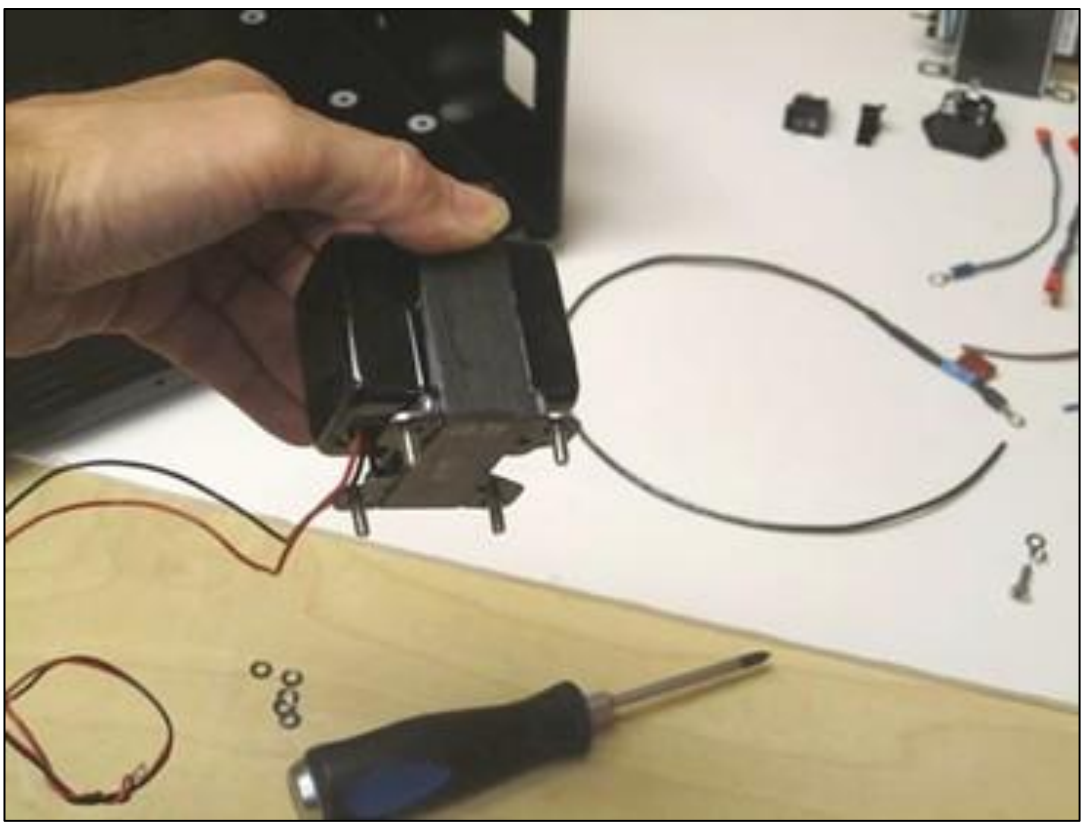
As you proceed, you'll be guided by step-by-step instructions, such as the following:

Let's begin by installing the Choke. This looks simple, but given the tight clearance between the Choke and the back of the chassis, it can be a bit frustrating. Here's a suggested way to go about it:

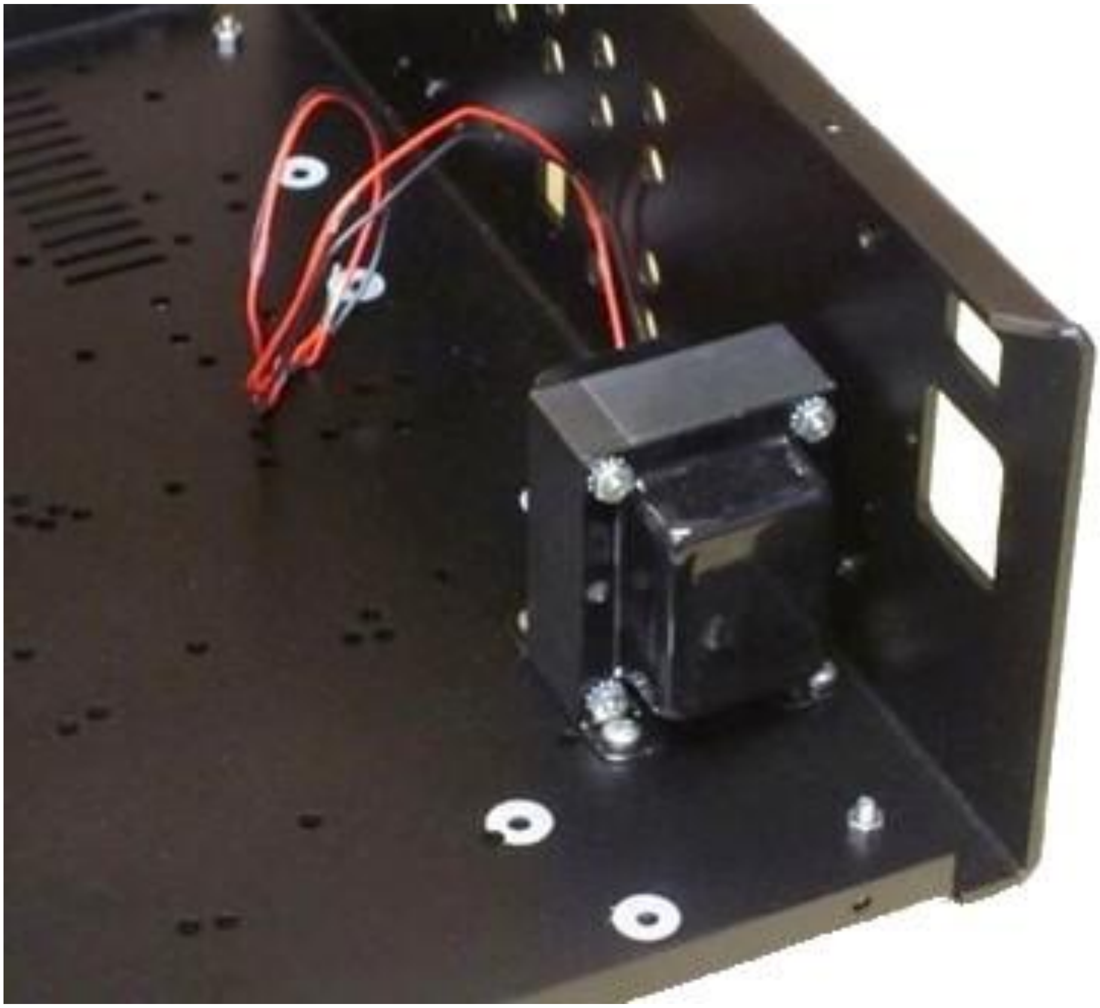
- ▢ Arrange for good lighting from above so that you can see well, especially towards the rear of the chassis.
- ▢ Neatly lay out the necessary hardware close at hand:

    - ❖ 4 M4 screws
    - ❖ 4 M4 washers
    - ❖ 4 M4 Keps K-Lock Nuts (these are M4 nuts with attached locking washers)

- ▢ Turn the chassis right side up.
- ▢ Take the Choke — which is marked CH-180 underneath — and hold it in one hand in mid air while you install the four M4 screws and washers from above into the four holes on the base of the Choke, so that you can then insert the whole unit into the chassis.



- ▢ Carefully lower the Choke, with the leads pointed toward the middle of the chassis (as shown below) and with the screws and washers in place, into the holes in the chassis. The critical need is to get the 2 crews at the rear to go through the correct holes. If the other 2 screws (the ones towards the interior of the chassis) fall out, just leave them for a moment.



- ▢ Do not turn the chassis over.
- ▢ With at least the back 2 screws now through the bottom of the chassis, successively push down on each screw from above with one hand while simultaneously securing the screw to the chassis from underneath with the lock nuts with your other hand.
- ▢ Finish up by tightening things up from below with a pair of pliers.

Section 5

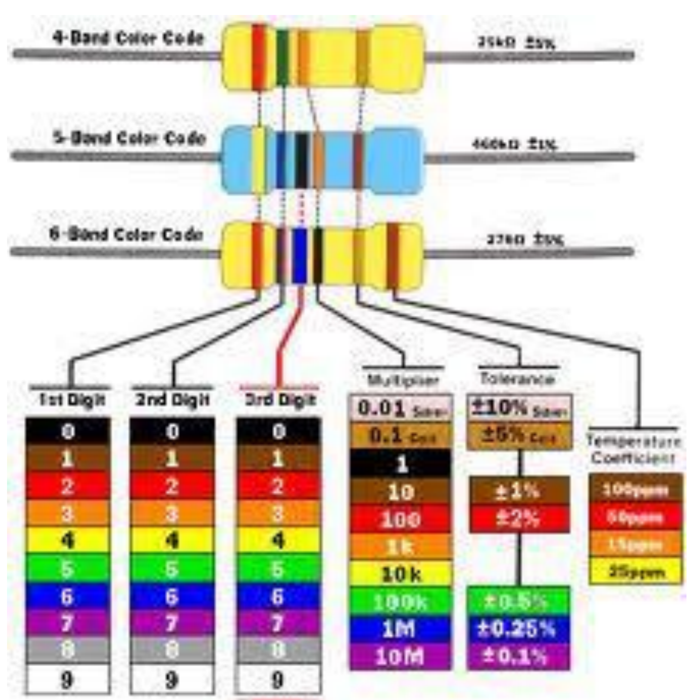
Resistors and Capacitors

Electronic audio circuits are made up mainly of resistors and capacitors and we should have a basic understanding of what these components do, what they look like, and how we'll install them in our kit.

5.1 Resistors

A resistor is a linear, passive two-terminal electrical component that implements electrical resistance as a circuit element. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. Thus, the ratio of the voltage applied across a resistor's terminals to the intensity of current through the circuit is called resistance. This ratio is represented by Ohm's law:

$$I = \frac{V}{R}$$



A resistor has a color code on it with each color representing a number between 0 and 9. So you can determine the value of a resistor by reading the colors. Another good way is to take your multimeter (on the ohms setting) and just measure the value of a resistor. Typical resistor values that you'll find in a kit are between 100R or 100 ohms and 1M or 1 megaohm. The typical nomenclature for resistor values is as follows:

1K = 1000 ohms
2K7 = 2700 ohms
100R = 100 ohms
1M2 = 1,200,000 ohms

Note how the letter is used as the decimal point!

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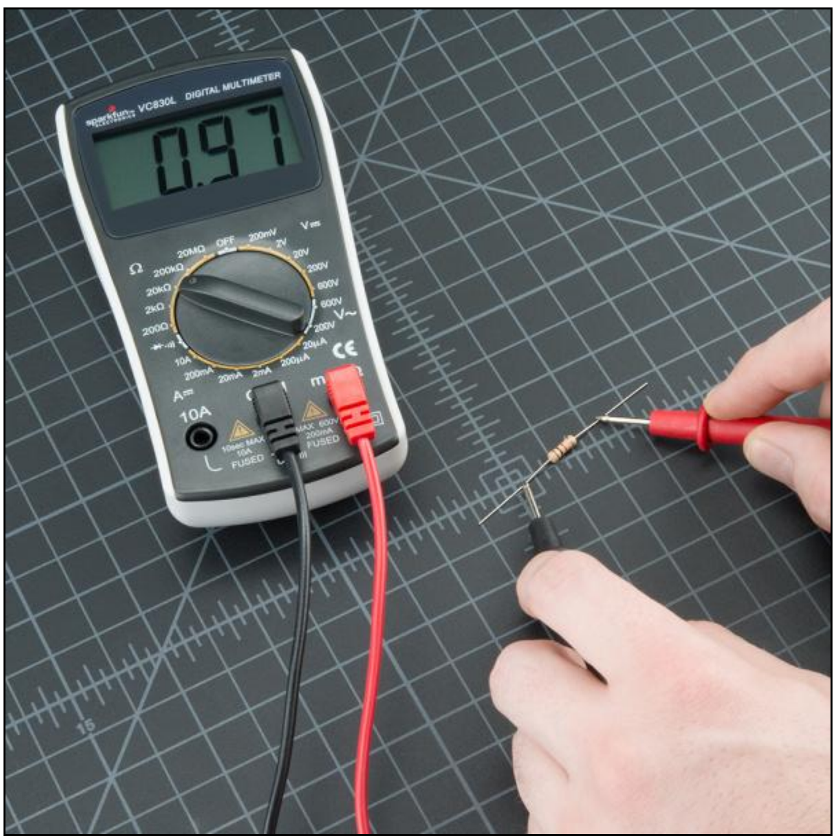
We have a nice resistor calculator on the ANK Audio Kits website (http://www.ankaudiokits.com/resistorcodes.html) and there are also plenty of good ones on the web, where you can enter the color codes and find out the resistance value, or vice versa.

Finally, we should note that resistors come in different wattages: typically we use 1/2W, 1W, and 2W resistors, though, in some applications where more power is used, we have 3W, 5W, and even 10W resistors. For example, on the 300B CATHODE we use 2 1K5 (1500 ohms) 10W resistors in parallel. When two resistors are in parallel their overall resistance will be ½ of the nominal resistance. So, for example 1K5 // 1K5 = 750 ohms. When resistors are in series they sum, so a 1K resistor in series with another 1K resistor = 2K.

5.1.1 Measuring Resistor Values

The easiest way to measure a resistor value is to use your multimeter, set it to Ohms, and make a measurement on each side of the resistor; the resistor in the picture below measures 970 ohms, which is shown as .97 on a range setting up to 20K.

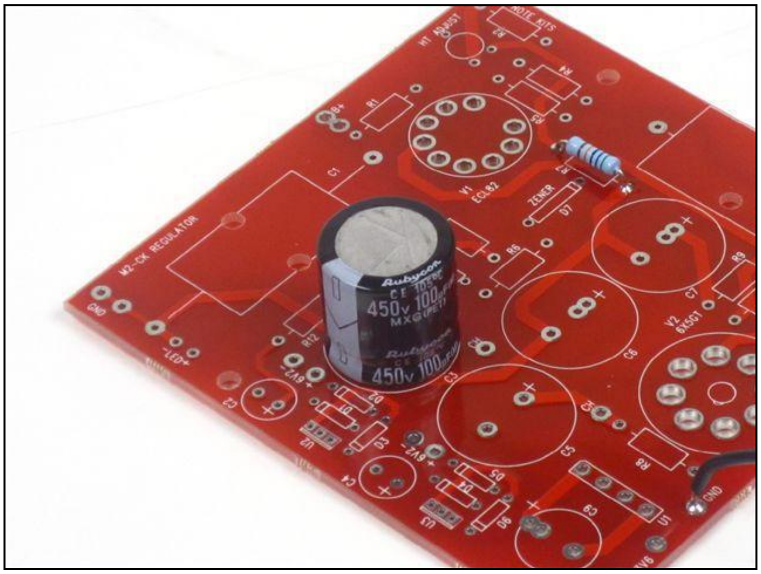


You can also use the color code chart. You may want to check out many resistor color code calculators on the internet and bookmark a favorite!

5.2 Electrolytic Capacitors

There are several types of capacitors that we use in audio circuits: electrolytic, film, silver mica are the three major types. And we use a number of high quality audiophile brands: Mundorf, Jensen, AudioNote, Black Gate, etc.

Let's look first at electrolytic capacitors, as you will be using them quite a bit .



Here you can see a 100uf 450V electrolytic capacitor installed in a PCB: 100uf is the value, which is 100 microfarads or 0.000100 of a farad!

Our kits use values such as 10uf, 22uf, 47uf, 100uf, 220uf, 330uf, 2200uf, and 4700uf — all with different voltage ratings. A very common electrolytic capacitor would be the 470uf 16V, which are used on the cathodes of many tubes!

The first thing to understand about electrolytic capacitors is that they are "polarized," which means that they have an orientation of POSITIVE and NEGATIVE, which are usually shown as PLUS and MINUS respectively. And they need to be installed in the circuit with the correct polarity or they won't work properly — even worse, they usually will explode at some point!

Mercifully, it's easy to know which way they need to be installed: an electrolytic capacitor will have a big stripe on the NEGATIVE side and we mark all our PCBs with a '+' sign to show which is the POSITIVE side.

You can see in the picture above the white stripe on the side of the capacitor; this stripe denotes the NEGATIVE.

5.3 Film Capacitors

Unlike electrolytic capacitors, film capacitors are not polarized, although some manufacturers do suggest that you orient them a certain way with respect to the direction of the audio signal; AudioNote does this also. In any case, the good news is they won't blow up or behave badly if they are put in either orientation.

The film capacitors that are used in our kits have values typically such as .1uf 600V, .22uf 600V, and .47uf 600V. These capacitors are what the actual audio signal goes through in 9 out of 10 cases, which is why they are critical for sound quality.

Generally we use Audio Note (UK), or AN, TIN film capacitors. The picture above shows the three levels of Audio Note (UK) film capacitors: on the left is the TIN capacitor, the standard level in our kits; these capacitors cost up to about $35 each. The AN copper film capacitors are twice the price and are usually ordered in a signature kit. The AN silver capacitors are very expensive, often $500 or more each.

A view of some of the different sizes of caps for the different values. Typically, the larger the values, such as .47uf or 1uf are larger than the .047 or .1 capacitors. .22 capacitors are used most often as the main signal capacitor between tube stages in pre-amplifiers and amplifiers like the L4 series and 300B.

There are many other companies in the audio industry that make film capacitors for signal path use and many DIYers will try different capacitors to get an understanding of the different sounds that different capacitors make. Mundorf, for example, makes a range of film capacitors and we use their Mundorf Supreme capacitor in a number of situations.

Section 6

Tubes

Since tubes are the heart of all ANK Audio Kits products, it seems like a good idea to take some time to understand the basics of how a tube works to amplify an audio signal. It will also help when it comes to debugging: often, to fix minor issues you don't have to know everything about audio electronics, but knowing some basics and being able to make a few simple checks can usually sort things out. A good starting point is being able to determine if it's even possible for the tube to work properly.

Basically there are two worlds of electricity, the first is AC and the second is DC. AC is an alternating current of a particular frequency: in its simplest form it's a sine wave or, in the case of an actual audio signal, it's a number of sine waves all combined together. DC, on the other hand, is simply a static voltage that you measure at a point, like a battery that is 9V or an audio power supply that supplies 260V DC.

6.1 A Key Point

You can think of AC VOLTAGE as really just DC voltage that changes value. For example, suppose you measure 260V DC at a point — and then 1 second later it reads 270V DC and then 1 second later again it reads 250V DC and then 1 second after that it reads 260V DC again — and so on. *This would be considered an AC signal*, one which seems to have a 20 volt swing and seems to take 3 seconds to repeat its cycle. This example shows a very slow (or low frequency) change in voltage, but it is still an AC signal. When we input an audio signal into our circuit (which is a set of DC voltages) we actually modulate — or <u>add</u> our AC signal onto — the DC signal. So we may have had, for example, a 260V DC level… but we added a 20V AC signal onto it, so when we went to measure our DC signal at different time points we got different values. This is a key point, because we add our AC signal to the DC and then the tube amplifies it to create a new AC signal which again is sitting on DC. Then we use a capacitor to filter out the DC component and the end result is our 20V signal oscillating around zero. Nifty!

Before we even listen to any amplifier we must first test it for "DC conditions." In other words, are all the DC voltages throughout the amplifier correct, such that the circuit can actually pass an AC signal over top of it.

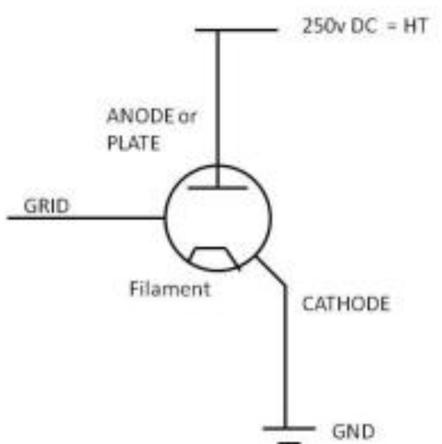
6.2 Tube Amplification

When I went to electronics college we learned all about the transistor amplifier. We had lots of formulas and most of us in the class could do all the calculations and come up with the right answers for the test!

But the basic concept of how the transistor actually amplified or even worked was missing: no one in my class could really explain it. We were taught the physics side of things — electrons being attracted from one side to another, for example, and then a lot of high level formulas where you inserted values in to calculate the various resistors and voltages to be used to achieve some sort of gain.

I thought that there had to be a simple explanation as to how it really worked, rather than discussions about electrons moving around and a lot of formulas. One day I decided to step a sine wave through the amplifying device to see if I could make some sense of it. I wanted to know: "What happened to all the voltages as my sine wave went — in slow motion — into the transistor or tube?" As a result, I came up with some simple basics that anyone can follow. Funnily enough, I've used these basic understandings to debug many circuits over the years and to explain basic operation to many kit builders. Very knowledgeable electronics people may scoff at these simple ideas, but, if you are starting from scratch — like we all were in electronics college, these simple ideas will give you a basic understanding of how an amplifier circuit works.

Have a look at this:



Above we have a generic device — which could be either a tube or a transistor: let's call it a tube and give it the proper pin names. There are basically three pins and this device would be considered a *triode*, like, for example, a 300B single-ended triode.
Let's start with the CATHODE of the tube: This is the most important point on the tube for debugging — if you have a correct voltage on this tube you can be close to guaranteed that your

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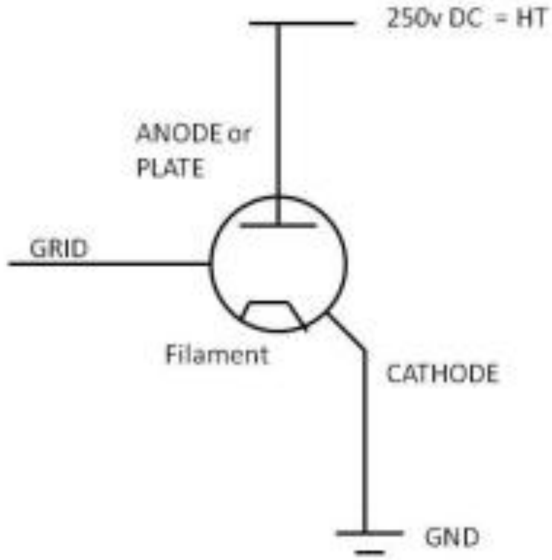
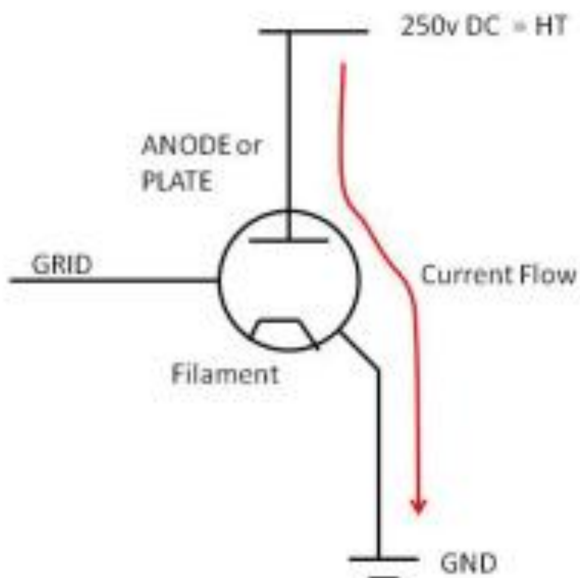
tube is ready for operation. In other words, the tube is now like a horse about to take off down the track!



Let's look at some other things in this picture. We have something called HT or High Tension — this is basically the highest level DC voltage that we are going to use to run our tube — it's what the power supply will supply to the tube. It sits at this voltage all the time — it does not change.

At the bottom of the tube you can see GND — this is ground potential or zero volts.

The current flows from HT to GND, as you can see in the following:

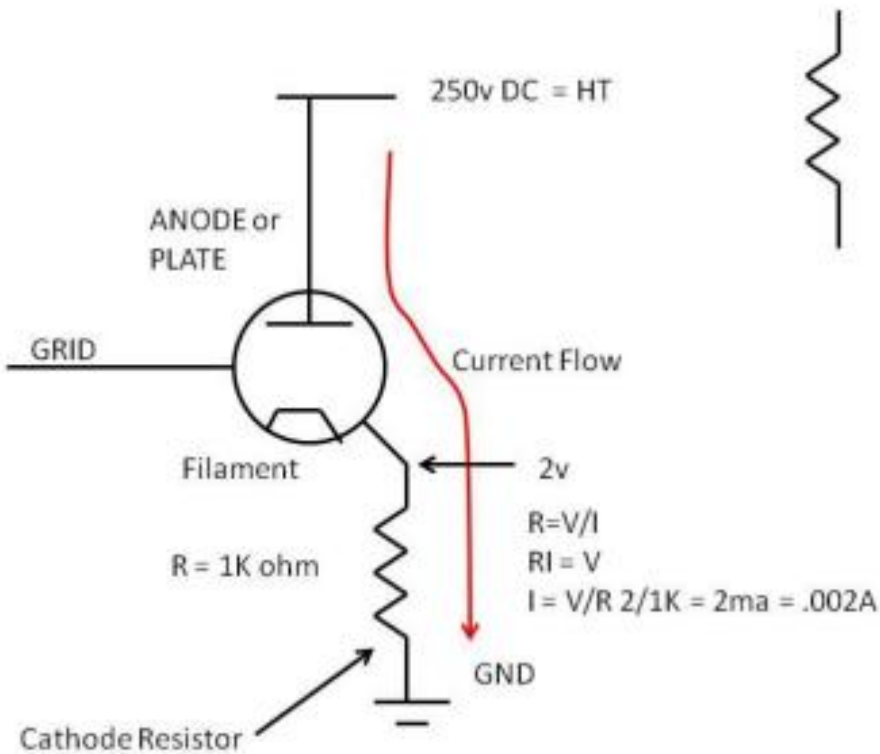


One of the most important facts about this current flow is that actually the current does not change "much" — it's called a constant current source. If we fix the resistance and HT is constant, then we've set up a tube for a constant current — for example, 2 ma — to flow through it, since I = V/R.

Definition

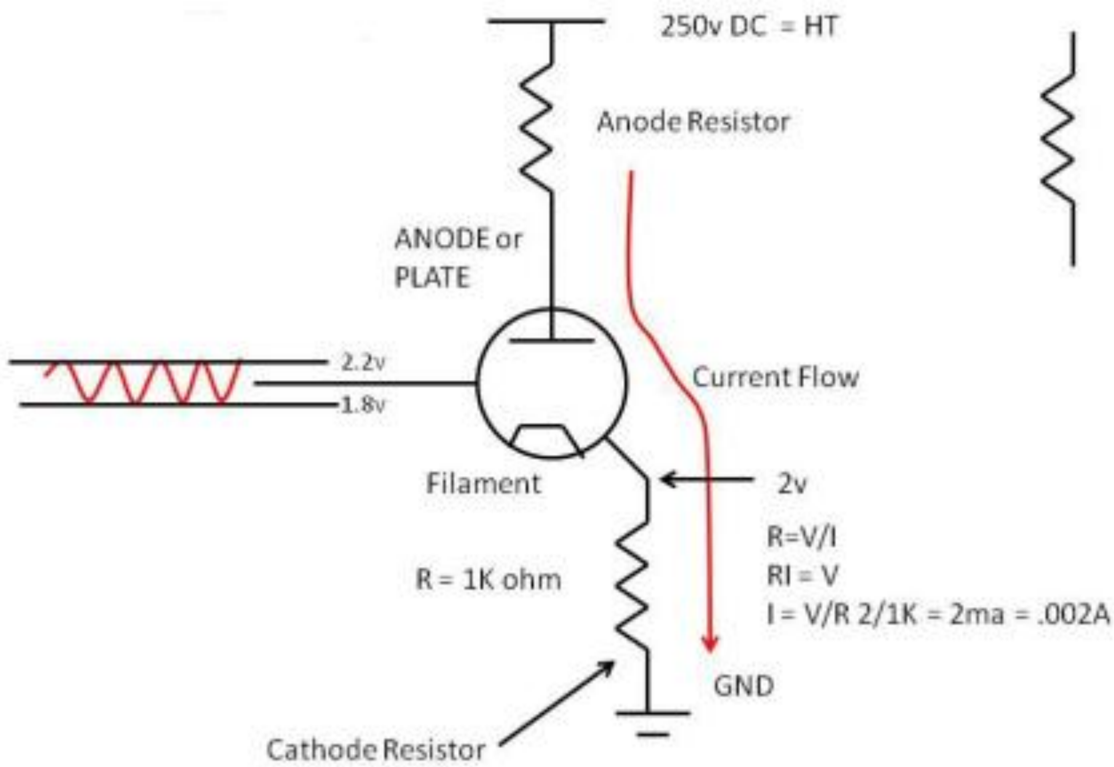
When we say we are going to "bias" a tube that means that we are going to set up certain voltages and resistors in order that the tube can actually operate: if you like, it's like getting an aquarium ready — making certain that its size and water temperature are such that a fish of a specific size and environmental needs can comfortably thrive in the aquarium.

When a tube has been properly biased and is working correctly a large current flow will occur from HT to GND; think of it as a river flowing in one direction. So, how do we prepare a tube so that it can operate correctly and amplify our signal?



Let's start by adding a resistor in the current flow path; this resistor is called the "cathode resistor" because it sits between the CATHODE of the tube and GND. In our example, when we measure the CATHODE voltage we get 2V — so, using Ohm's Law, we can calculate how it'll all work: by using a 1000 (1K) ohm resistor the current will be .002A or 2 ma (I = V/R). And, we can verify by checking the tube data sheet that the current (2 ma) and voltage (2V) are values that are within the specifications of our tube.

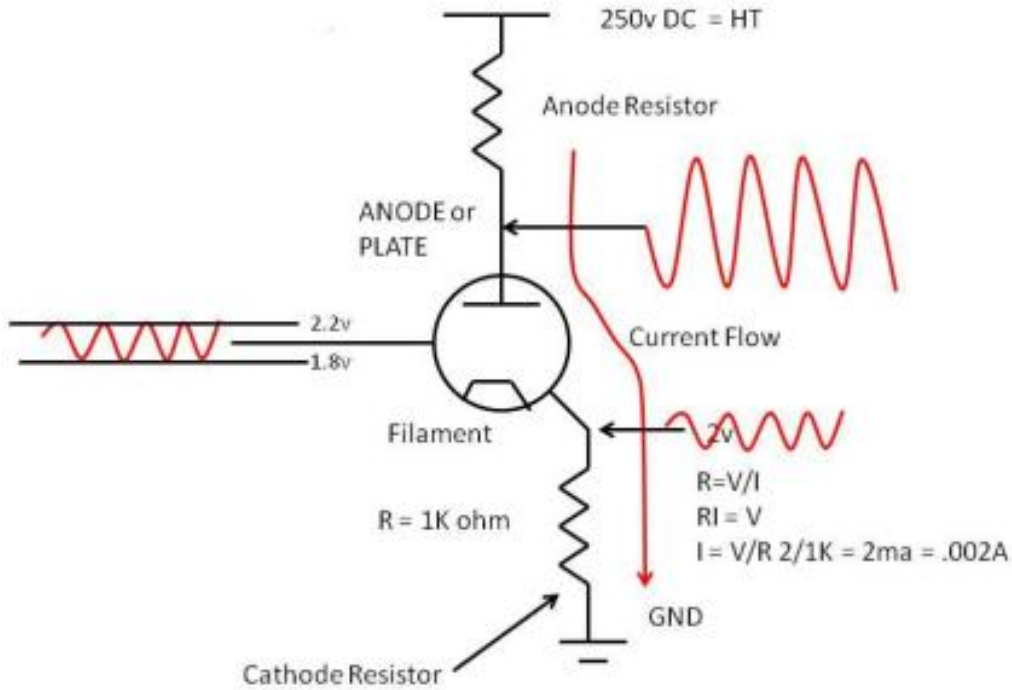
Whether it's a 300B with a cathode voltage of 70V DC or a 6SH7 with a cathode voltage of 1.5V every tube has a cathode voltage and an associated current flow. And by using your multimeter you can measure the cathode voltage of any tube — and, heaven forbid!, if you measure a cathode voltage of 0V you know for a fact that this tube is not conducting any current and is not operating.



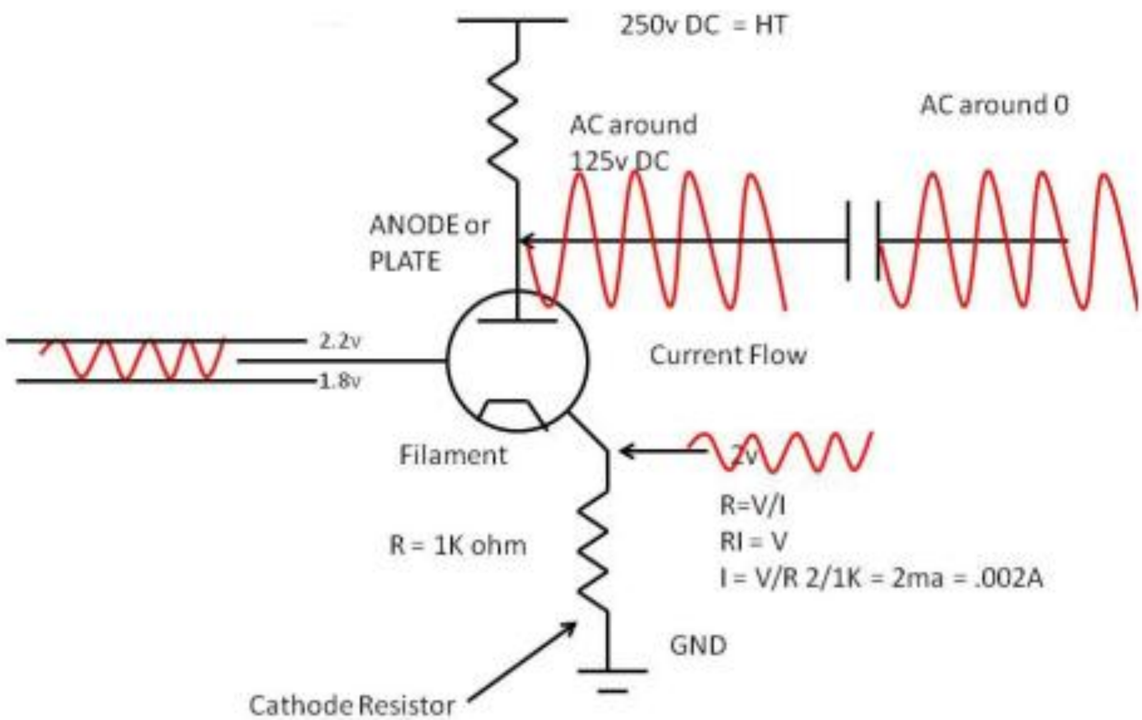
Now by installing an "anode resistor" we can control the voltage drop from HT to the ANODE of the tube. For example, our tube specification manual says that this tube likes to see no more than 150V at the ANODE; therefore we would come up with a resistor that would drop 100V (from 250V to 150V), given the amount of current flowing through the tube which, in our case is 2 ma, so R = V/I or 100/.002 (2 ma), which is 50000 or 50K.

So now we have our two resistors selected, along with our HT voltage and operating current. We're all set and our tube is operating.

I like to use the analogy of a swimming pool with enough water in it — let's say 6 feet deep, such that a swimmer can now comfortably swim across the pool. The specifications for a 5'10" person to swim in this pool is that we need a minimum of 6' of water and, say, no more that 8' of water (The overflow level of the pool).



Now let's look at what happens when we input an AC or audio signal of a frequency in the audio spectrum (for example, 0.4V AC at 1 KHz) into the tube. Given that the DC voltage at the GRID with no audio signal is usually fixed (at 2V DC in this example), the AC voltage will swing or "wiggle" the GRID voltage (peak to peak) from +2.2V to +1.8V, back and forth; this now becomes the GRID voltage.



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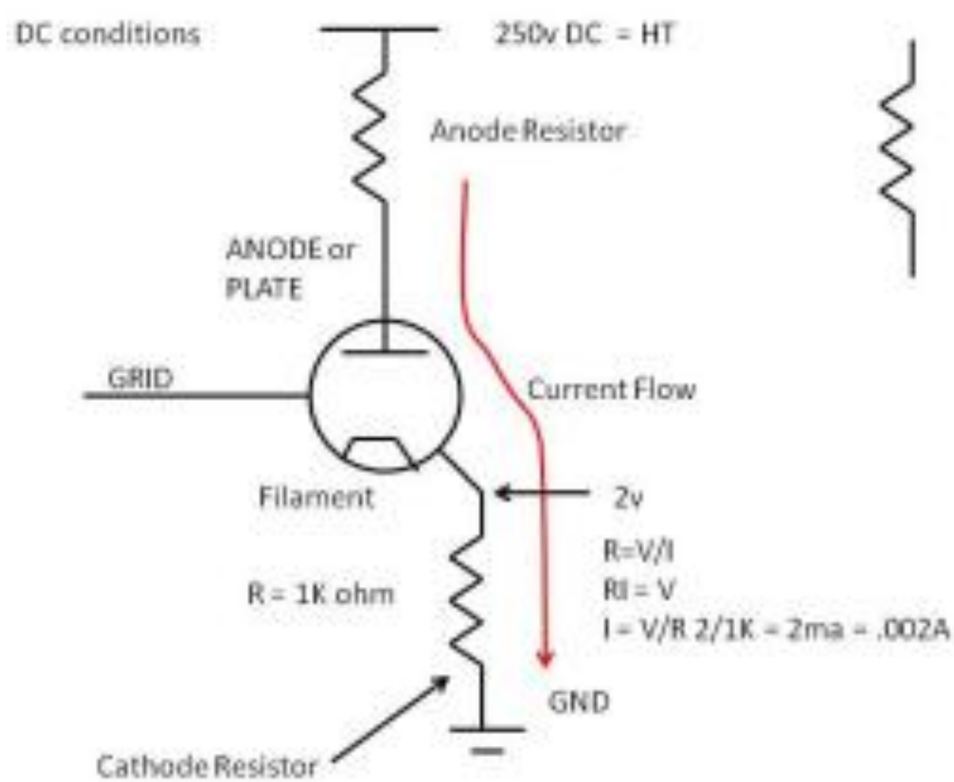
Now here's how the magic works: a tube or a transistor is constructed such that the voltage at the GRID is directly linked to the voltage at the CATHODE, so by "wiggling" the DC voltage at the GRID we are also "wiggling" DC voltage by the same amount at the CATHODE. In this example, then we'll see a 0.4V DC voltage swing at the CATHODE, mirroring the GRID... but — and it's a BIG BUT — we are feeding a larger constant current flow through the tube path, as shown below.



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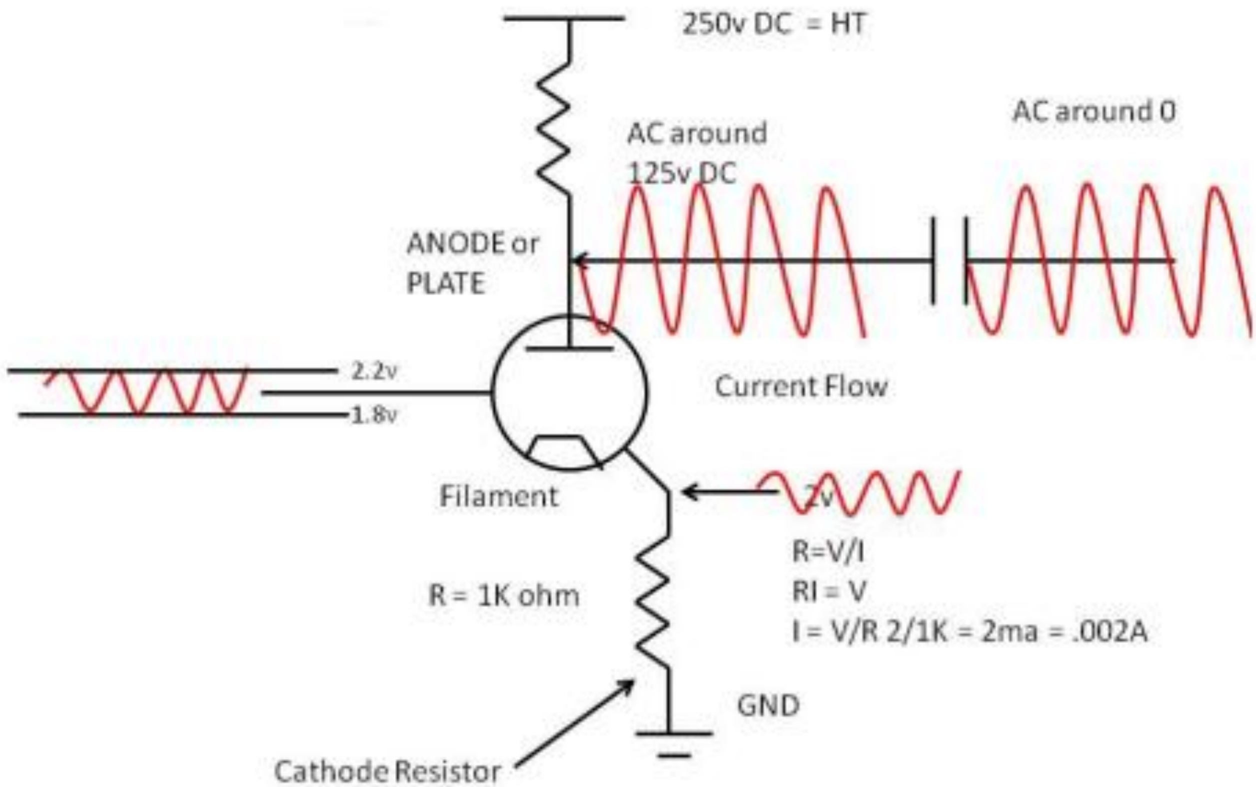
So, as the CATHODE voltage varies, now by adding 0.2V to it, we increase the current flow slightly. This **same current** flow is now going across the anode resistor… but the large resistor at the ANODE causes a larger voltage drop than the 0.2V. The drop across the anode resistor now could be 2V, which is a 10 times increase! This would be considered a 10 times "gain." To summarize this magic, what we have is a mirror action where whatever "wiggle" occurs at the GRID gets mirrored to the CATHODE and then amplified by the larger voltage drop across the anode resistor. This is how a sine wave, or audio signal (which is made up of many sine waves of different amplitudes and frequencies, making the music we listen to) is amplified.



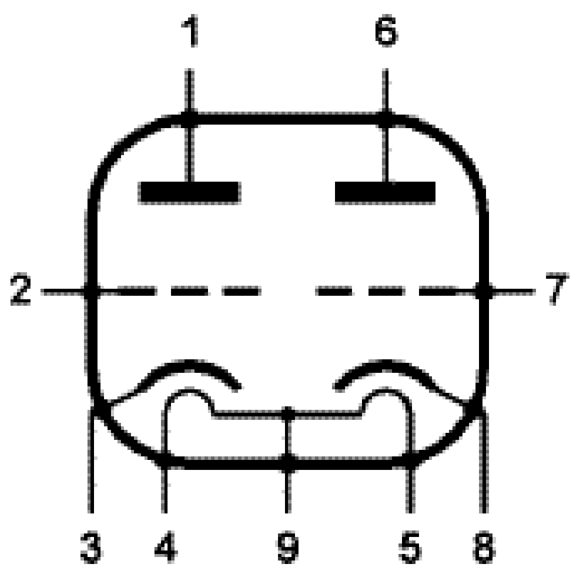
It's important to note that, in an amplifier output stage, we actually don't have an anode resistor, but rather the Primary or input of a transformer which would have a resistance of, say, 1K5. This looks like a resistor to the tube. The transformer then "transforms" this amplified "wiggle" to the Secondary; it's pure genius! And this is only the very beginning…

6.3 What is the Filament?

The filament is an important concept when dealing with tube audio gear.

When you see a tube glowing in the dark, what gives it that glow? It's the filament voltage that is applied to the tube. On a typical tube like, for example, a 12AU7, there are two pins (out of the 9) that are reserved for the filament voltage. By providing 12.3V DC to pins 4 and 5 of this tube we are satisfying the filament voltage requirement: a tube will not work without a filament voltage applied to it. Some tubes — like the 6922 tube used in the DAC 2.1 — only accept a 6.3V filament voltage, which can be AC or DC. We chose to make it DC so that there is less of a chance for hum to occur.

Some tubes — like the 12AU7, 12AX7, 5687, and many others — accept either 6.3V or 12.3V. For example, if you are wiring things up for 12V on a 5687 you will use pins 4 and 5; if you are wiring things up for 6.3V on a 5687 you will connect pins 4 and 5 together and connect your 6.3V to 4–5 and pin 9. The 5U4G rectifier tube used in the Kit 1 and the Legend and interstage Monoblocks uses 5V AC for the filament; the 300B uses 5V DC or AC — again we use DC; the 6SH7 in the Monoblocks uses 6.3V AC. So, as you can see, there are all sorts of combinations for getting filament voltages to a tube.



Here we see a 12AU7 which has two amplification sections in it; it's called a "dual triode." You can see that pin 1 is the ANODE of the first device, pin 2 is the GRID where the audio signal enters, and pin 3 is the CATHODE.

Then you'll see pins 4, 9, and 5 — these are the filament pins; this tube can be configured for either a 12V or a 6V filament. Incidentally, the filament is shared by both halves of the tube!

For 12V operation we'd connect to pins 4 and 5; For 6.3V operation pins 4 and 5 are connected together and the filament voltage is applied to pins 4–5 and 9.

Usually filament currents are small: for example, on the 12AU7 you are dealing with 300ma. On an EL34 in CLASS AB mode (the mode we run the L4 EL34 amplifier in) we are using 6A AC filaments! — that's a lot of current flowing out of the wall! And thus the great sound.

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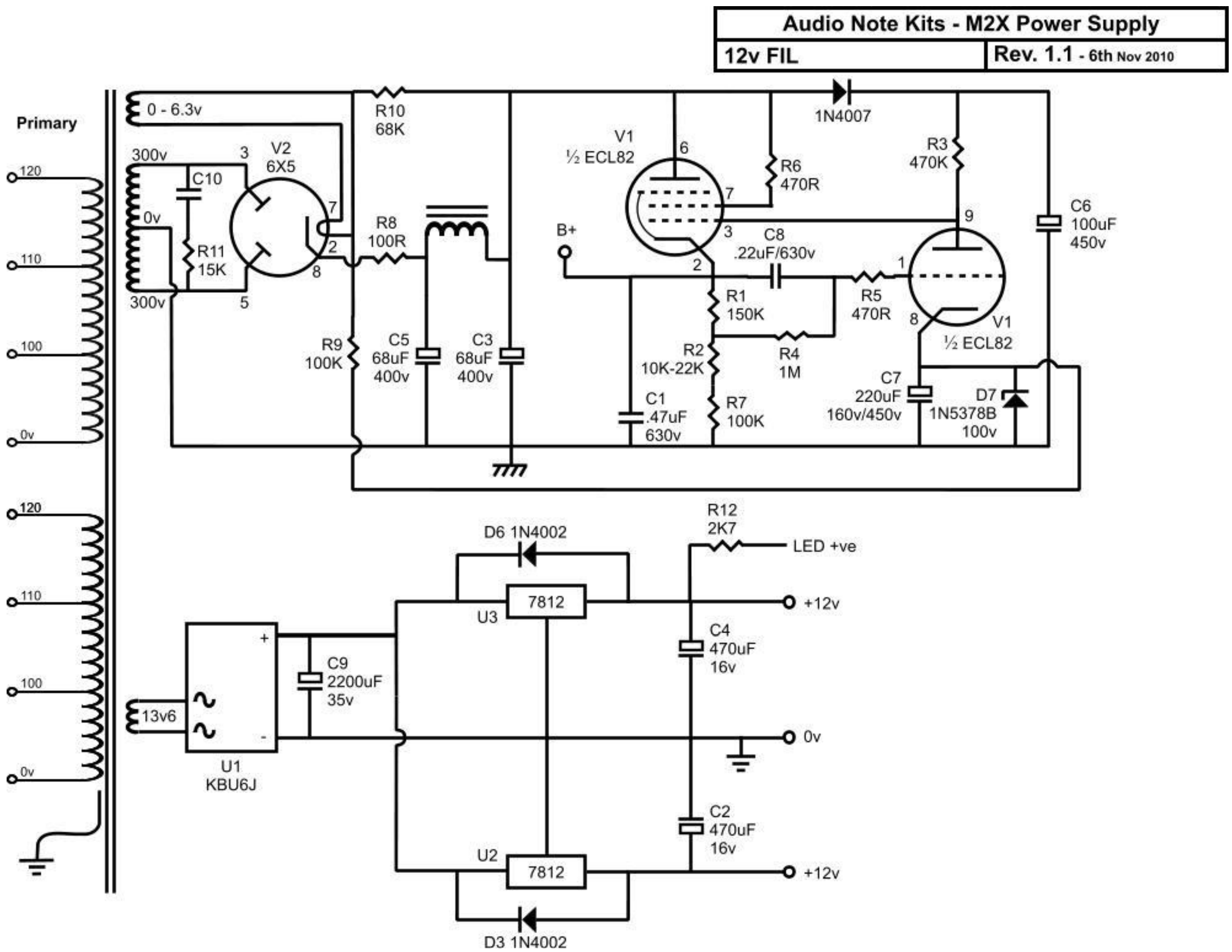
Section 7

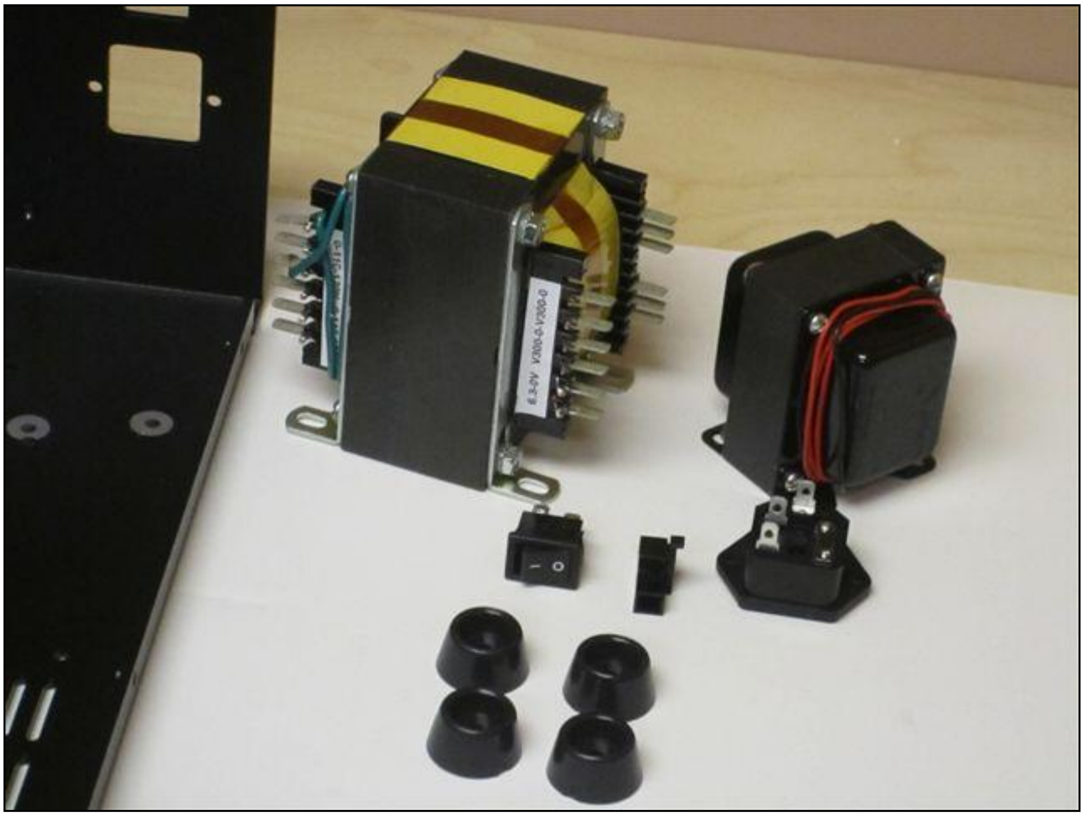
Schematics



Let's take a look at a schematic and see if we can understand the various components.

Above is the power supply schematic for the L2, L3, DAC 2.1 3.1, and 4.1 series of products. We won't analyze the whole schematic but we'll goes as far as V1, the ECL80 regulator. On the left side we see the Primary of the Mains transformer; this is connected to the wall voltage (120V AC in North America). On the right side of the double line representing the Mains transformer we have the transformer Secondary, at the top of which we can see 0–6.3V. This is a 6.3V AC tap which we will use to supply the filament voltage to the 6X5 rectifier tube. The rectifier converts the AC voltage into a full wave rectified signal, which is almost like DC and which we can smooth out and use for the HT voltage in our power supply.

To the right of the Secondary taps we can see V2, which represents the 6X5 tube. Pins 2 and 7 are the filament pins, and pin 8 is the output of the rectifier which connects to a 100R (100 ohm) resistor which in turn connects to a CHOKE. The CHOKE is the smaller component to the right of the Mains transformer in the picture below.



A CHOKE is basically a single wire going in, wrapping around a core, and then going out; it does not allow voltages to change quickly… so it acts to smooth out the DC voltage that came out of the rectifier. C5 and C3 are electrolytic capacitors, which we have discussed: you can see the POSITIVE side (white box) and the NEGATIVE side, going to Ground (the Ground symbol is at the bottom of C3.

The V1 tube is an ECL82, and each circle in the schematic represents half of the ECL82; this tube has two separate functioning parts in it. Finally, the bottom half of the schematic shows the circuit for the DC filament voltage that gets generated.

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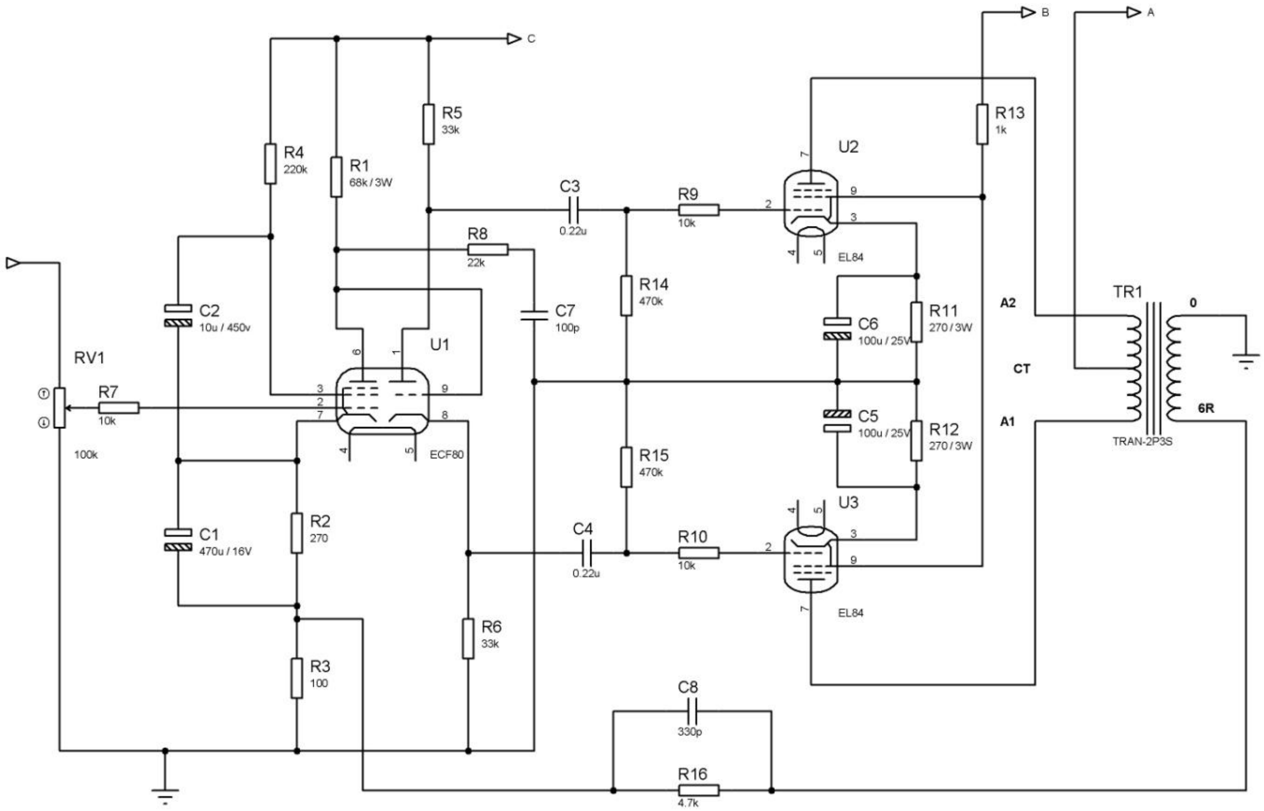
The following schematic is for the L1 EL84 integrated amplifier. It shows just one channel of this stereo amplifier: see if you can follow this schematic through from the left side, recognizing resistors, capacitors, and tubes — and maybe an output transformer.



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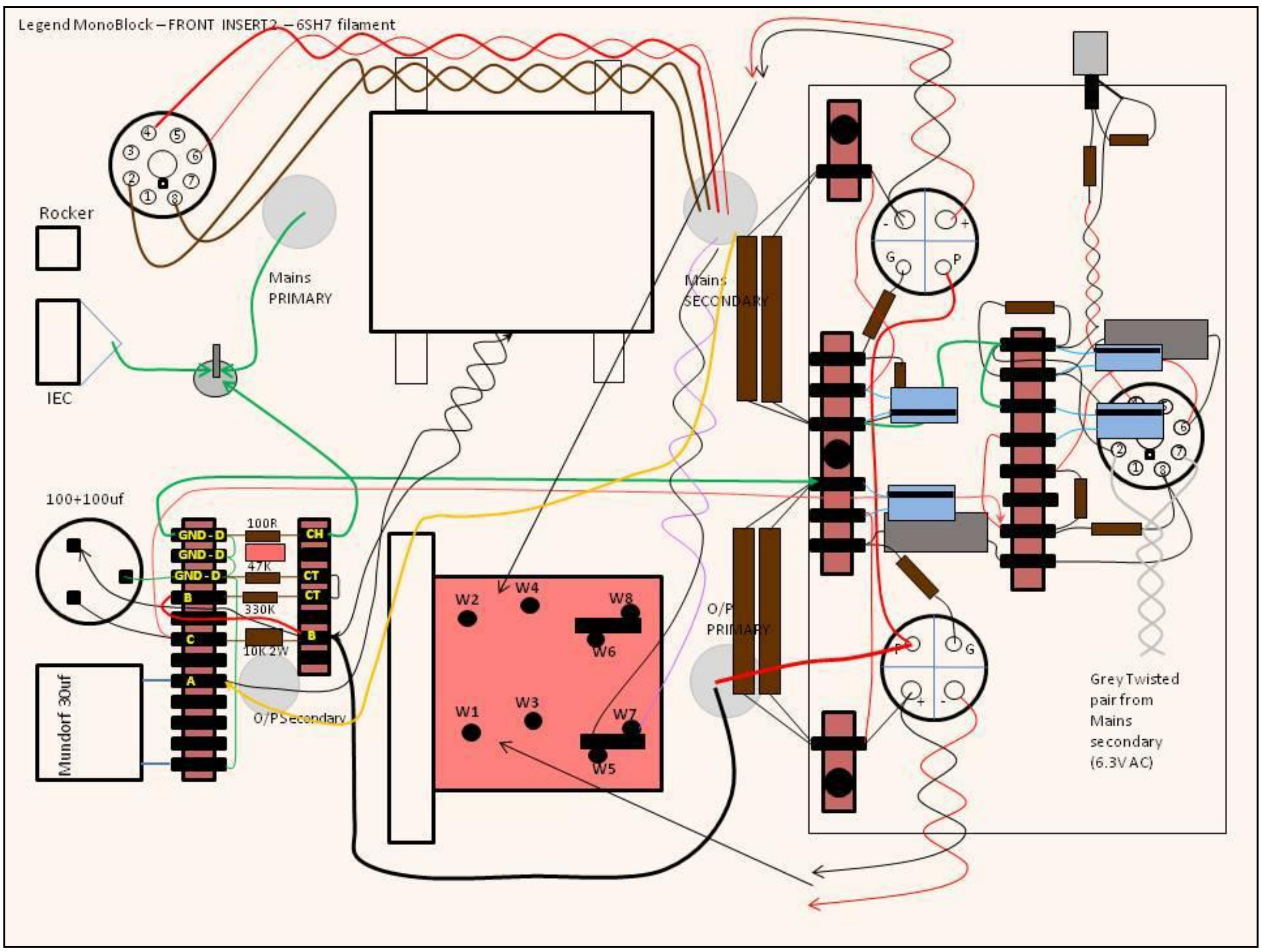
Section 8

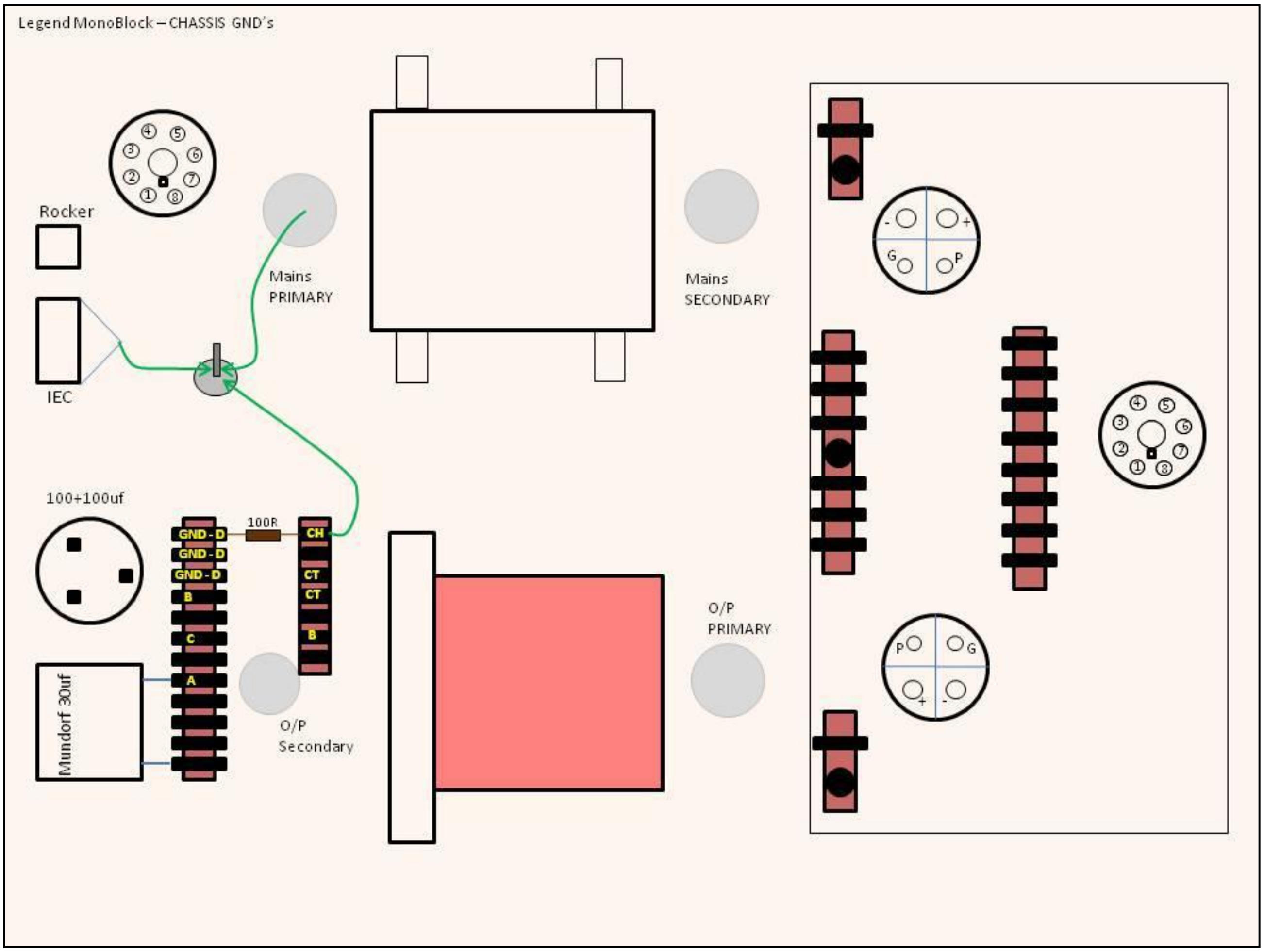
Interwiring

When it comes to tube audio we use both hardwiring (point to point wiring) and printed circuit boards (PCBs) for different applications. In some cases a PCB makes the most sense, in others hardwiring makes more sense.

Our kits have some nice graphics for hardwiring and interwiring the various components. Here's the final slide in the Legend Monoblocks for wiring all the components together:

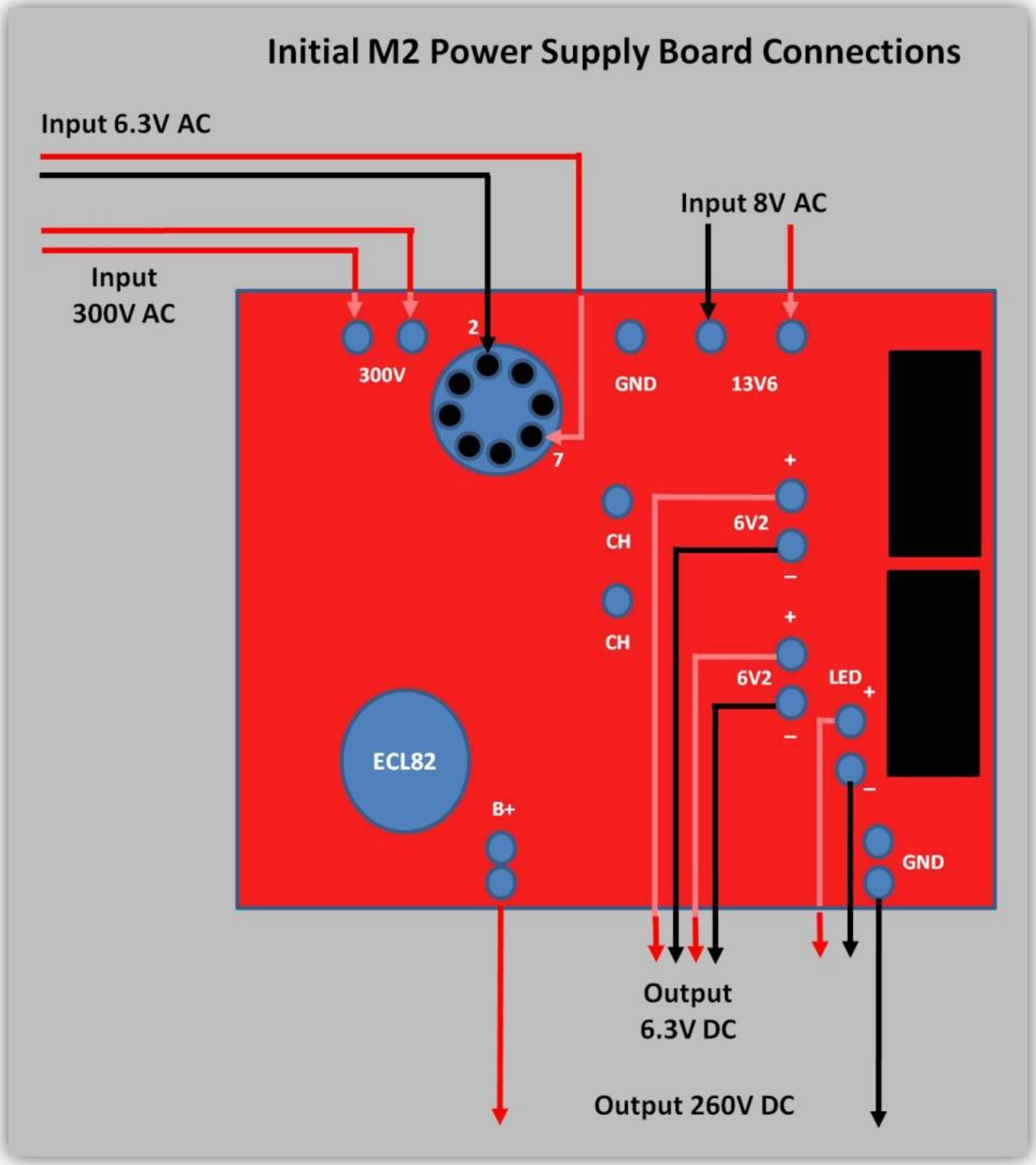


That looks very complicated! But we don't start there: interwiring is a gradual process, starting with wiring the basics and slowly adding on. Here an early slide, connecting 3 wires to the chassis Ground:



The succession of slides will step you through the interwiring phase a few wires at a time. We've found that the best way to guide you through building the kit is with graphics and photographs: we typically supply high resolution pictures on disk of most of the pictures in the manual, so if you really need to zoom in on a section to see what is going on you can do so.

Interwiring graphics come in several formats. Here's are a couple of different ones:



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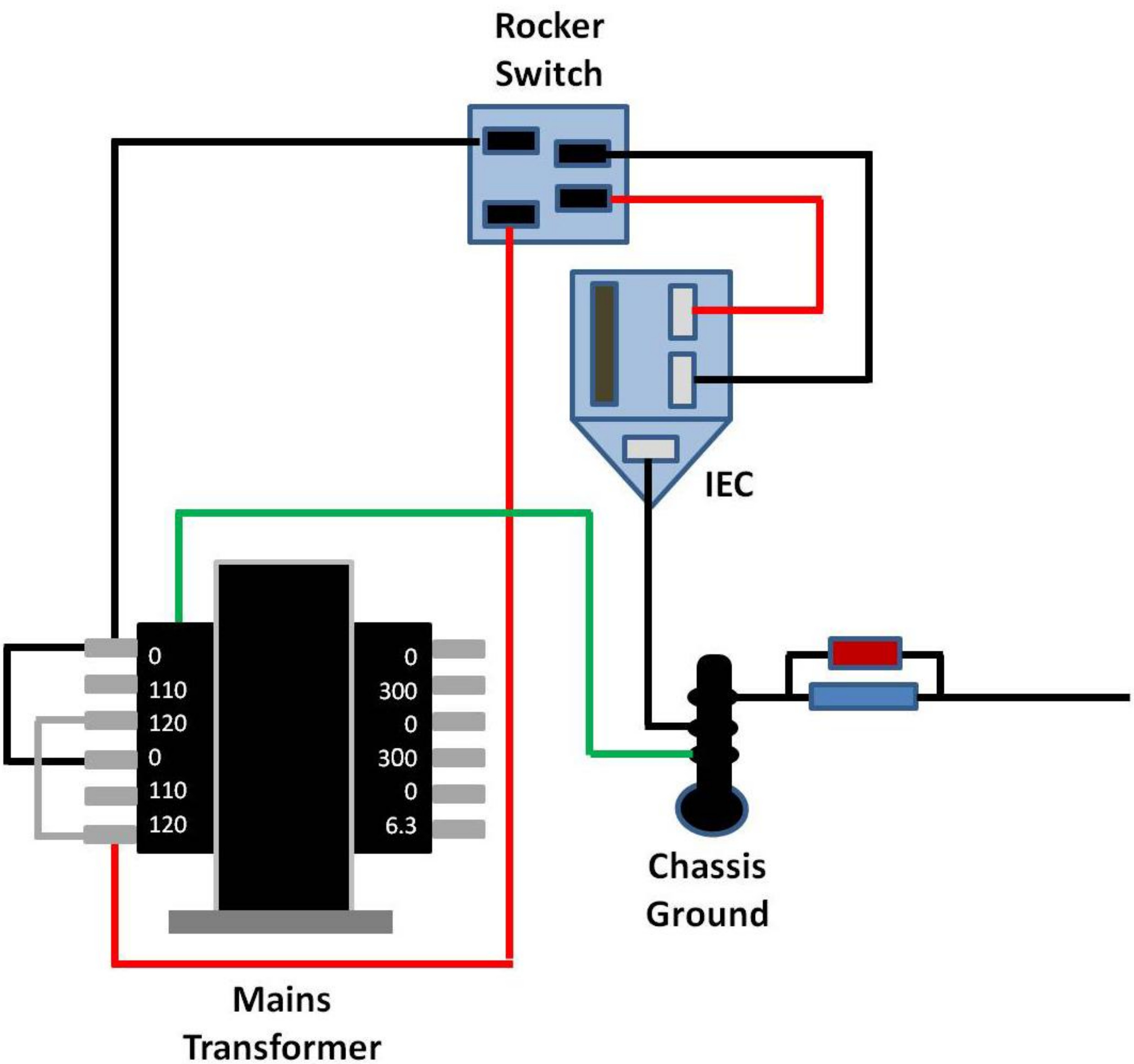
AC Power On/Off (120V)



If you check out the ANK Audio Kits website (www.audionotekits.com) you will see the interwiring charts for the Legend and the Interstage Monoblocks.

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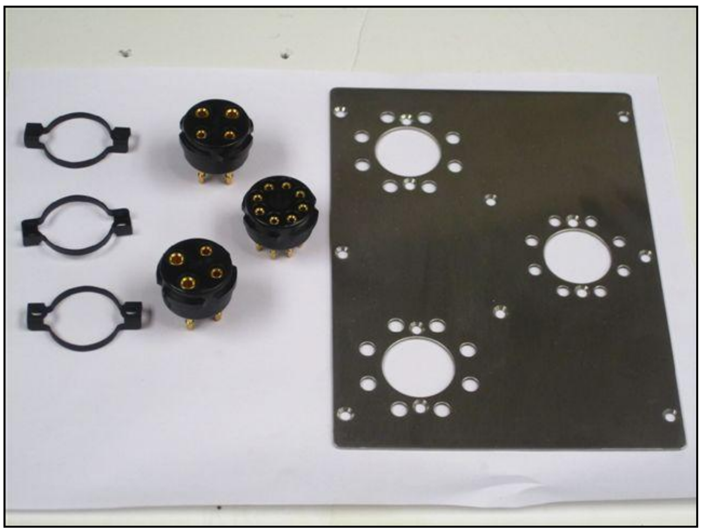
Section 9

Guided Tour

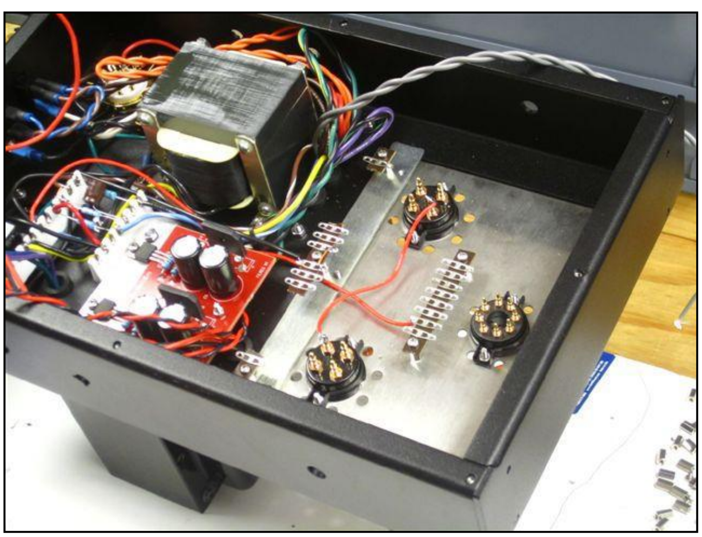
ANK Audio Kits is very proud of our products. They represent our commitment to offering you the highest possible audiophile quality at very affordable prices. So we thought you might like a brief guided tour through some of the products and features of our products.

Here's a look at some of the types of valve bases we use in many of the kits. These may be 4-pin, 8-pin, 9-pin, and even a 7-pin for a new L1 series tube power supply.

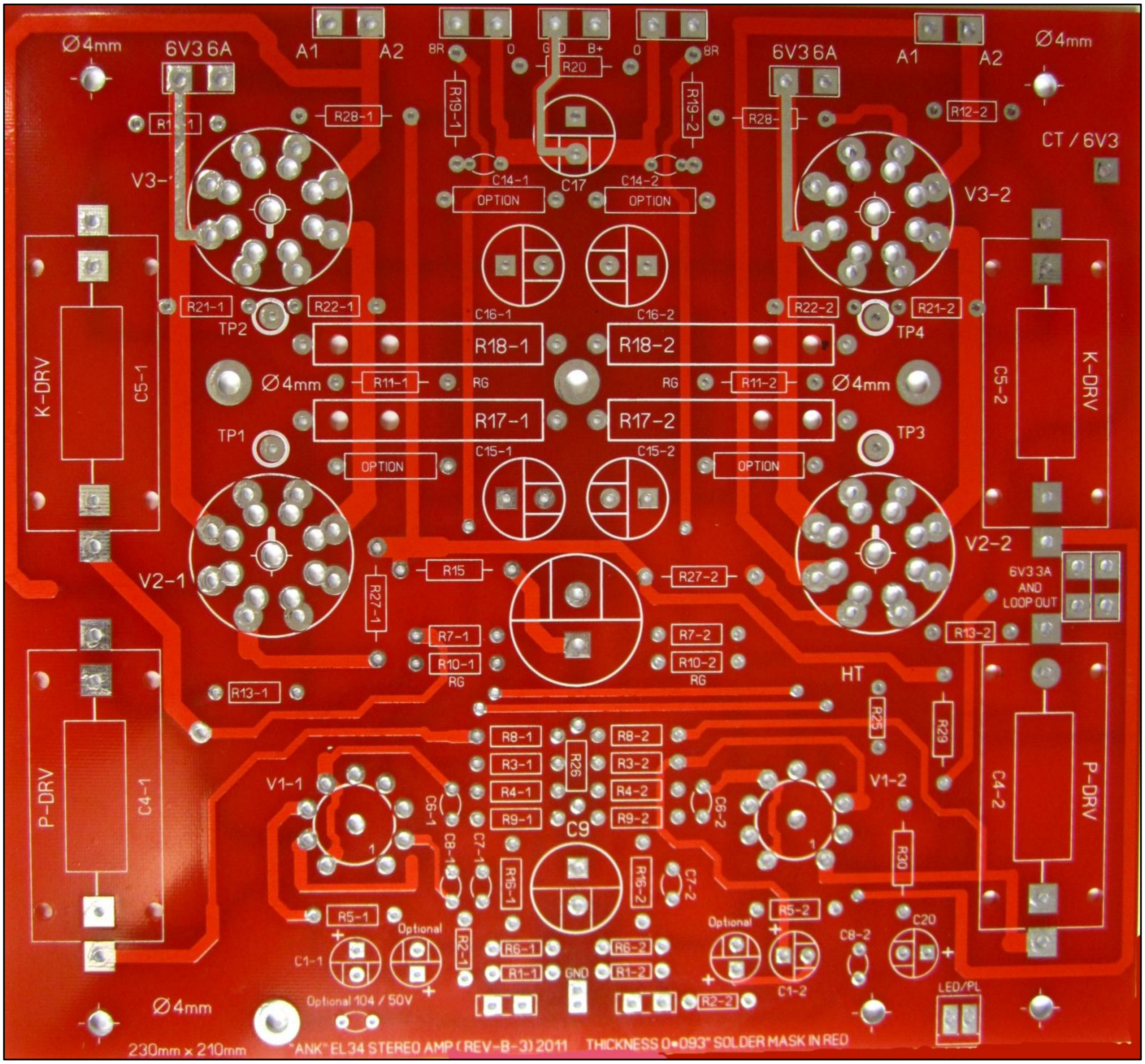


Valve Bases and Configurable Insert Plates.

Here's a picture (from the underside) after the front insert plate has been installed.



Our printed circuit boards (PCBs) are ultra thick and sturdy, with all the best grounding strategies in place so that even first-time kit builders can install the components, run the tests, and have a perfectly working amplifier. Here's an L4 EL34p Power Amplifier PCB:



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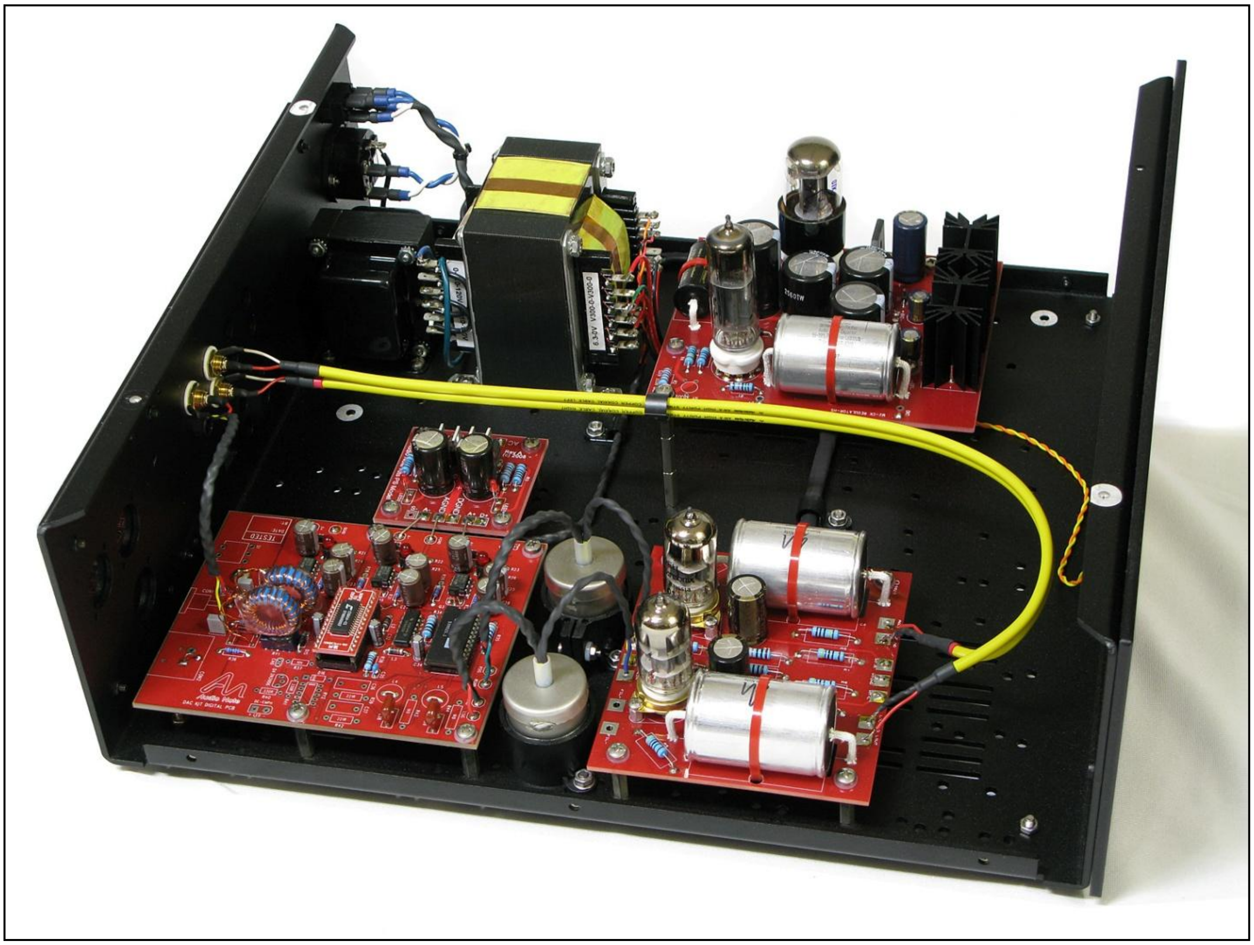
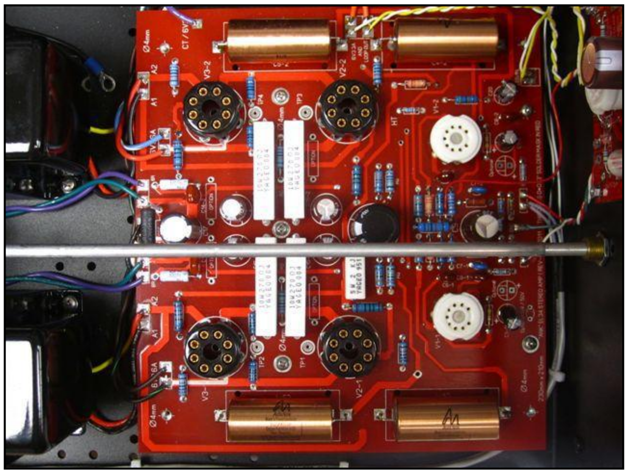
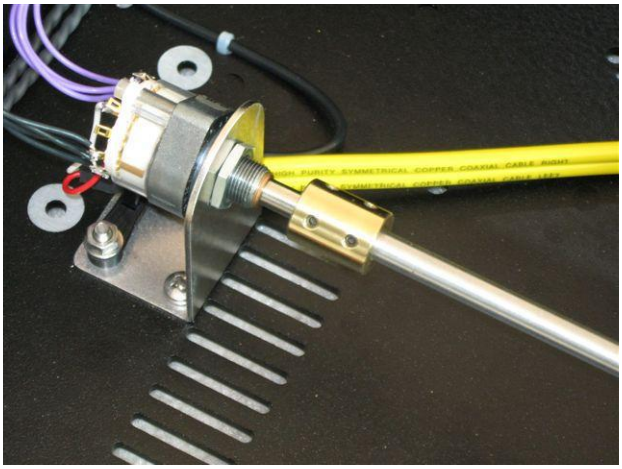
We have many excellent professional build pictures of our kits on our website kits so that you can try to build your kit the way a professional builder would go about it, as best you can. Here's an example:

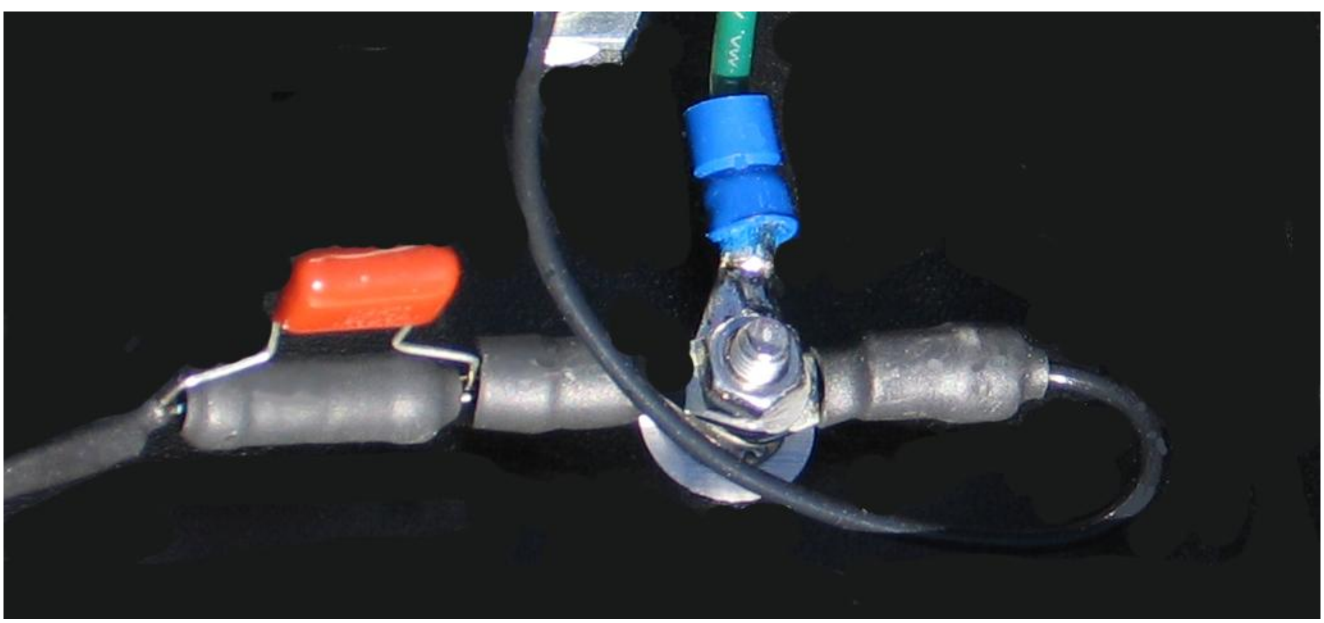


We've added extension kits to the pre-amplifier and integrated amplifier line such that you would have very short wire lengths in the kit thus reducing any chance of hum or noise pickup.





And, for any jobs that we think you might have trouble with, we prepare for you in advance: for example, IEC cabling, shielded cable terminations, twisting of wires, etc. Here are a couple of examples:



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ANK Audio Kits is particularly well known for its Single-ended product line. Here's a picture of the Legend Monoblock, which is a single or parallel 300B or 2A3 amplifier. We use copper insert plates to configure for a single or parallel operation, and a stunning look and sound.

Below is the Kit 1 Amplifier. All ANK Audio Kits have a finished product presentation – no one will ever know you built a kit!

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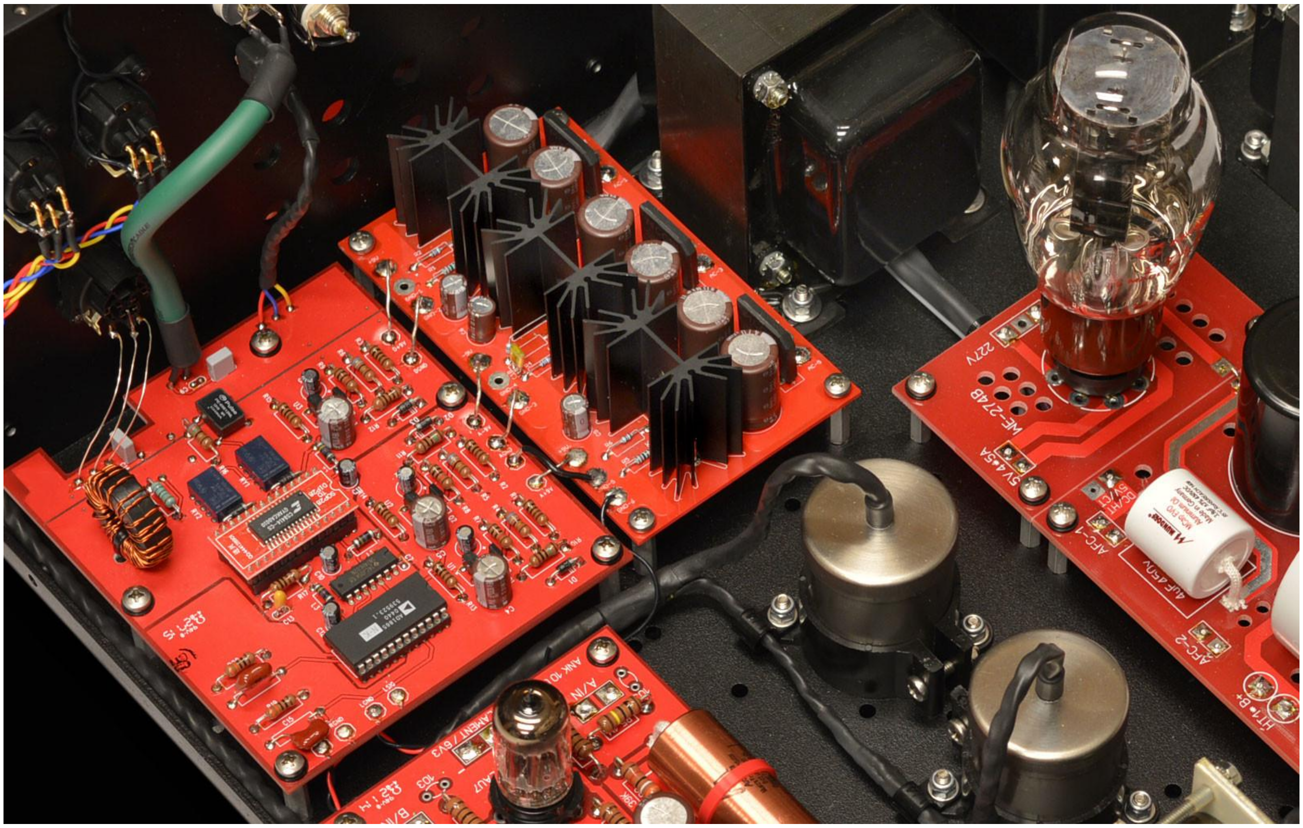
We're also well known for of Digital to Analogue converters (DACs). These DACs all follow the Audio Note (UK) tradition of Non Oversampling Resistor Ladder Architecture (R-2R) pure digital to analog conversion method which hardwires digital information directly to output voltage.

Here's a picture of our beautiful DAC 5.1 Signature:



which features such advanced technology as:

- Digital Board (SHUNT)
- Super Regulation Board
- Large Can I/V Transformers
- 12AU7 and ECC99 Line Stage
- Triple C-Core O/P Transformers
- SHUNT Power Supply 5U4GB/WE274B
- Dual Mains Transformers
- Mentor Filament Board
- WBT Silver 75 ohm SPDIF input.
- AES/XLR input
- Silver Input Cable

Like several other of our products, the DAC 5.1 Signature is also available as a finished product, professionally factory assembled, for customers in the United States only.

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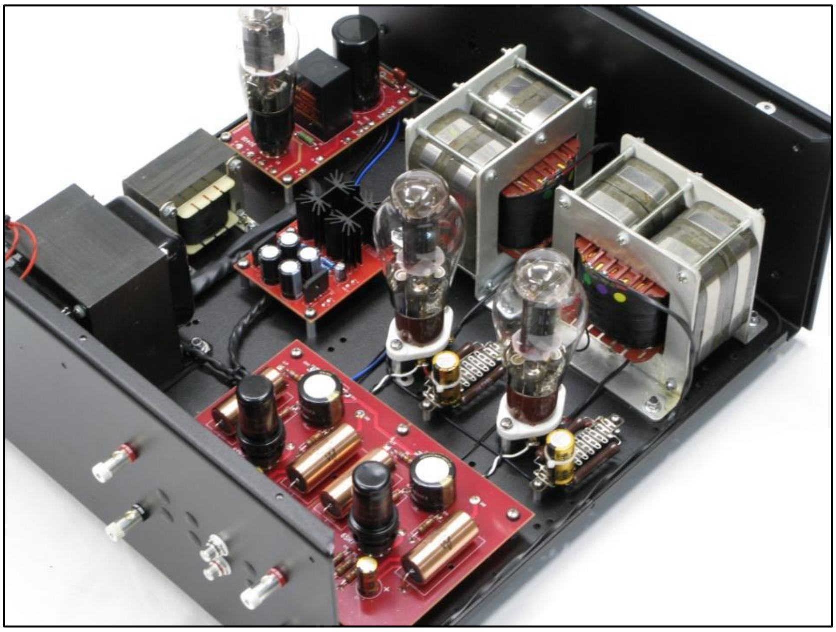
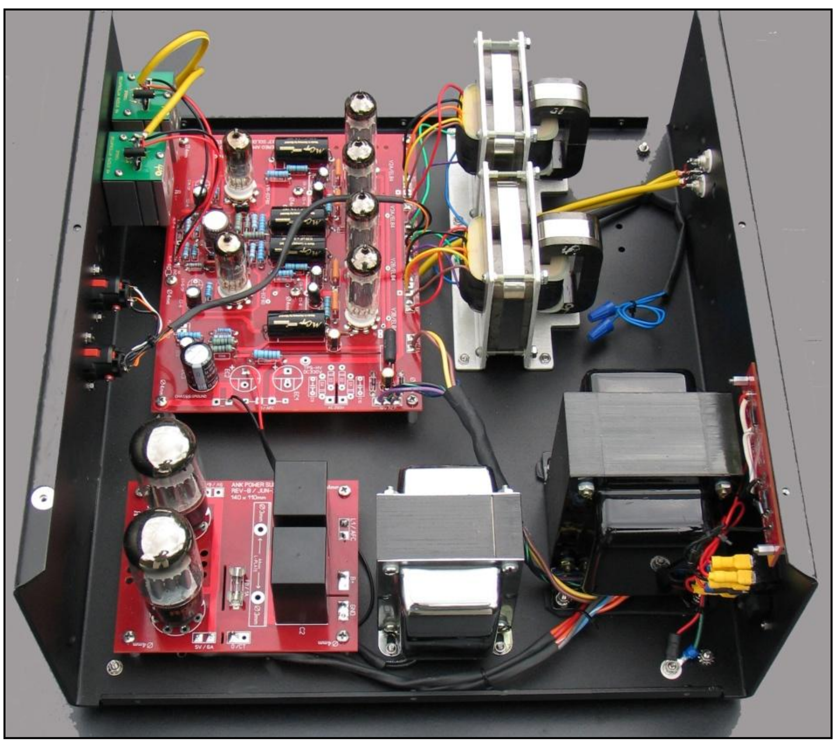
And we're always developing new products, in many instances involving upgrades and new configurations based on current products.

Here are a few of our recent offerings:

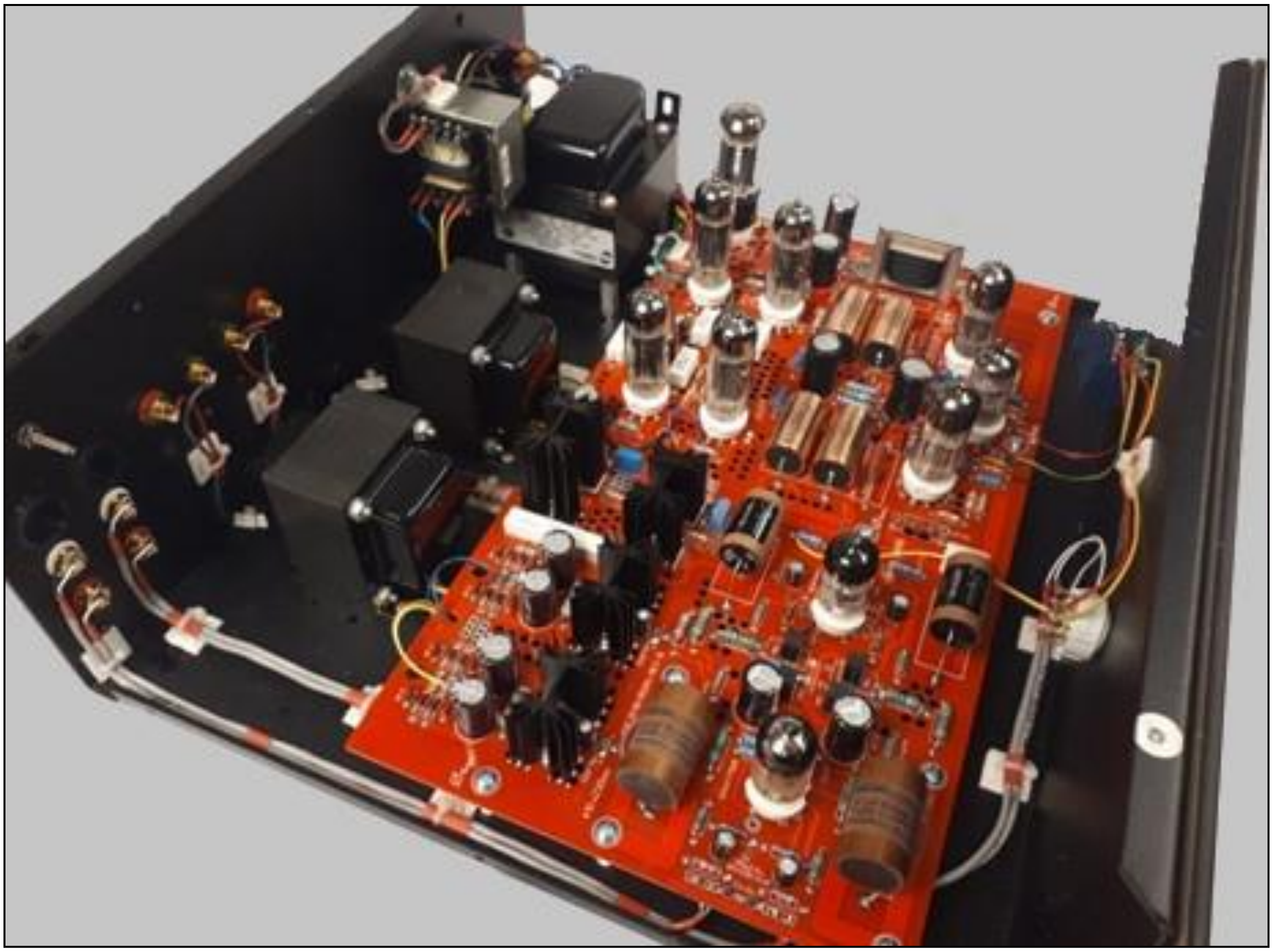


Mentor SET 300B Amplifier



L4 Headphone Amplifier C-Core

www.AudioNoteKits.com
audionotekits@rogers.com



EL84 Integrated Phono Amplifier

I hope that you've enjoyed this brief guided tour of ANK Audio Kits. I hope also that this guide has provided you with tips on building a kit and some insight into what is involved in tube electronics.

Please stay tuned to our website (http://www.ankaudiokits.com/ANK-Audio-Kits-Home-Page.html) for new products and other useful information.

Regards,

Brian Smith — Director ANK Audio Kits

ANK Audio Kits

www.AudioNoteKits.com
audionotekits@rogers.com