Audio Note Kits

Instruction Manual

M3 Phono Board

Hard-Wiring Guide

Manual Version 1.2 - July 2007

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Section1: M3 Phono Board Build

There are two versions of the M3 Phono Board available.

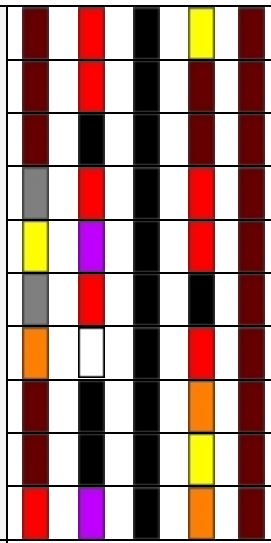
The Standard Copper Track PCB board is considered to be the simplest board to build whereas the Hard-Wired version is usually the choice of the more experienced builder.

This manual is dedicated to the Hard-Wired (trackless PCB) version.

Phono Board Parts List

The Complete Parts list for the Phono Board is shown below.

For resistor color code chart refer to the APPENDIX. You can also find an 'Interactive Resistor Color Code Calculator' on our website (available from the Links page).

Category		Quantity	Part	Designator
Capacitors (Electrolytic)		4	470uf 16v or 220uf	C3, C4, C5, C6
Capacitors (Non-polarized)		2	.33uf	C13, C14
		2	.22uf	C11, C12
		2	2.42n	C9, C10
		2	8n2 or 8200pf	C7, C8
		2	.047uf	C1 C2
Resistors		4	1M2	R25, R26, R1, R2
		2	1K2	R19, R20
		4	1K	R11, R12, R13, R14
		2	82K	R7, R9
		2	47K	R4, R6
		2	820R	R8 R10
		2	39K	R24, R23
		2	100K	R15, R16
		2	1M	R22, R21
		2	270K	R17, R18
	* Made up of 1M and 1M2 in series	2	2M2	R3, R5
Valves / Bases		3	9 pin Valve Bases	
		1	M3 Phono Board	
		3	6072	V1, V2, V3

Throughout the construction of this board, make sure that no adjacent wires touch each other. Use the black insulating sleeving provided to insulate such wires from making an unwanted (and potentially dangerous contact). Wires follow the paths to the components as indicated by the white lines on the board. Often, it will be possible to use the leg of the

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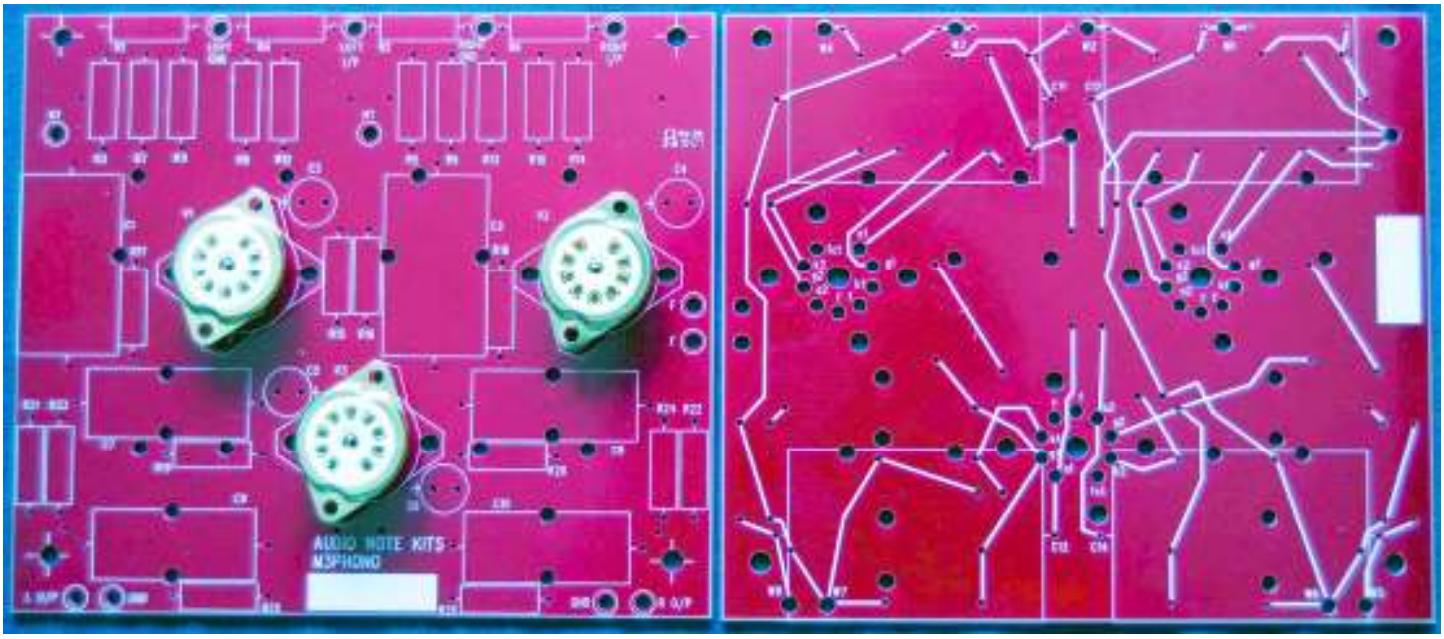
components to connect to the various points, however from time to time, the legs will be too short and will need to be extended with tinned wire.



The above picture shows the top and bottom of the M3 Phono Board. The bottom of the board shows how the leg of each component is joined to another - these are shows by the thick white lines.

Whenever making a connection you should, at the same time, trace that connection on the schematic (i.e. circuit diagram). That way you will make fewer mistakes and also learn more about the circuit.

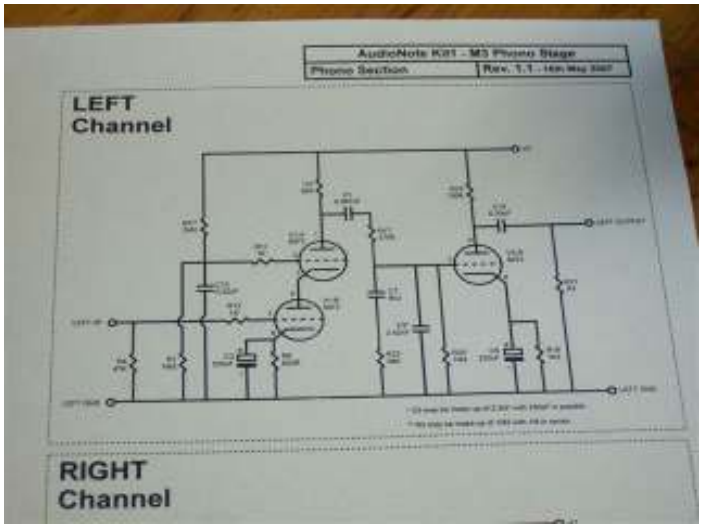
NOTE: We have included a disk in your kit that includes high-resolution pictures of most of the ones shown here in the manual so that you can zoom in on them on your computer.

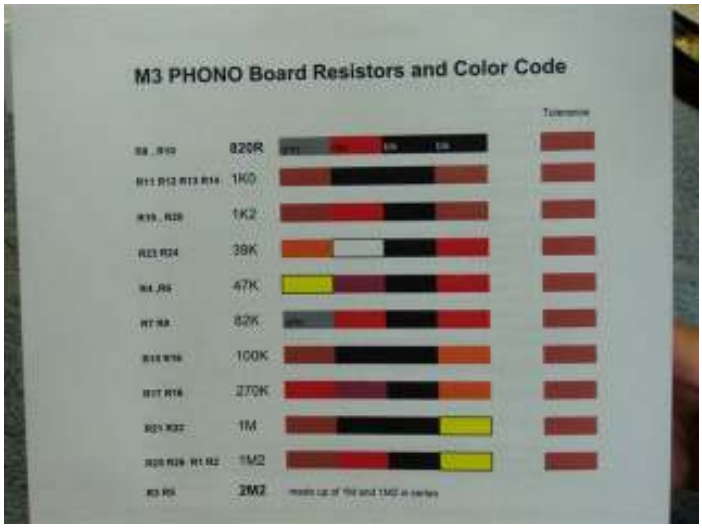
Preparation

The first step is to install the spacers onto the board as shown opposite.

Note on the underside of the board that we have white lines (stencils) that show the connections of the components.

Here are some tools that you will find very handy while working on the hardwired phono board – a cutter on the left, a wire stripper/cutter in the middle, and needle nose pliers on the right.





Have your schematic and Resistor Color code chart handy! These will make it easier for you to verify that you have done the correct thing as you work through the various connections.

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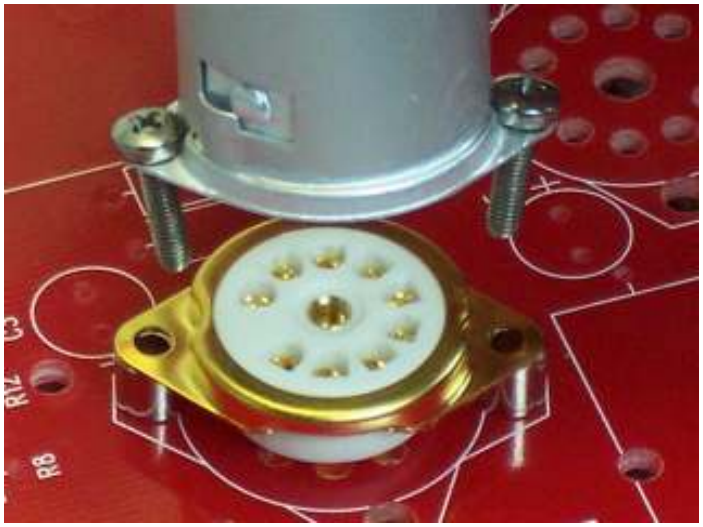
Fitting the Valve Bases

Our first installation will be the valve bases.

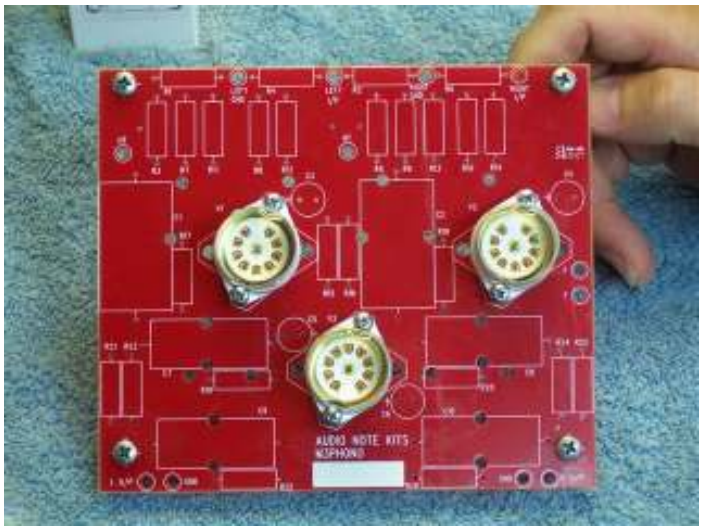


As you can see from the picture opposite the valve base is inserted in the board and the small spacers are used under the screw holes.

The Tube Shield is then used on top with the screws going through them.

Use a M3 screw from the phono hardware bag and secure with an M3 nut on the other side of the board.

Opposite, you can see the underside of the board where one of the valve bases has been fitted and secured.

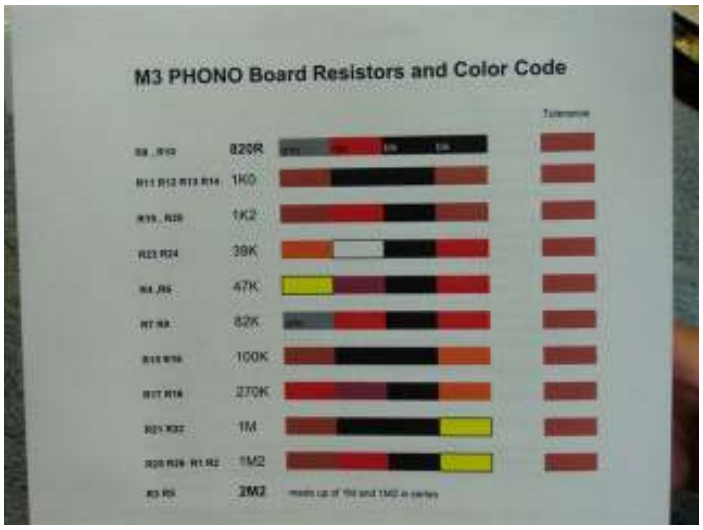


Here we have the 3 valve bases installed.

Valve base installation is now complete.

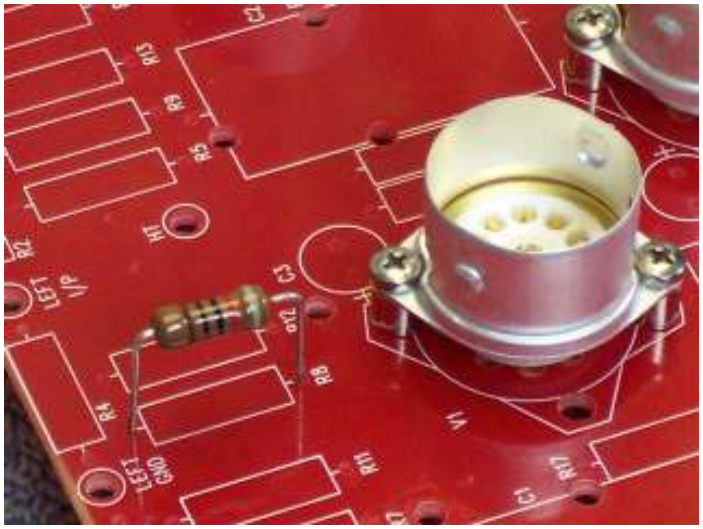
Installing the Resistors

Our next task is to install MOST of the resistors in the board. Start by referring to your schematic and your Resistor Color Code Chart. You can start at the top of the chart.



You will notice that the first resistor on the chart is the 820R resistor (R8 and R10).

Identify the two resistors that have the following color codes – GREY – Red – Black – Black followed by a thicker BROWN tolerance band.



You will need to bend the resistor leads with pliers (or neatly by hand) in order for it to be inserted correctly into the board.

So, go ahead and install the **2x 820R** resistors in positions **R8 & R10**.

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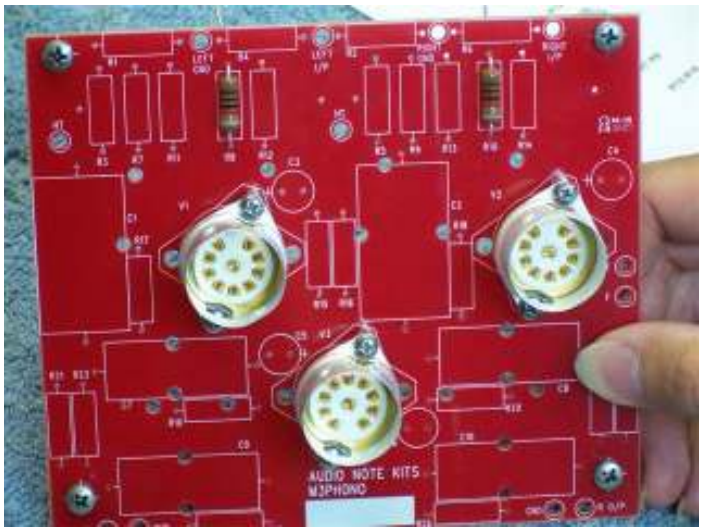
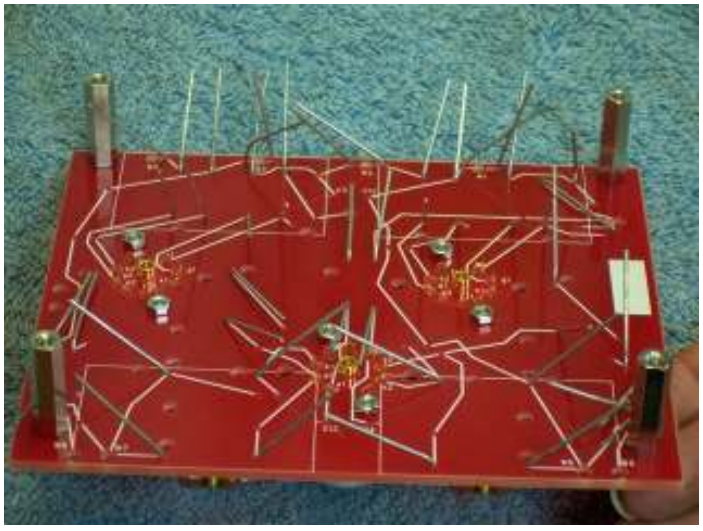
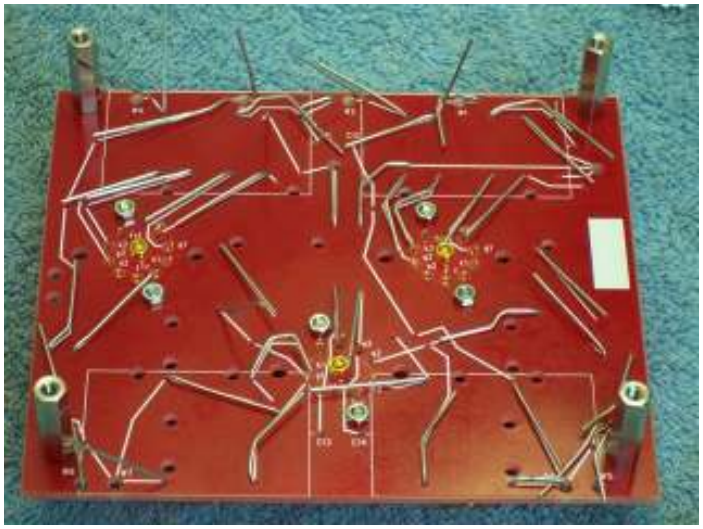


Above you can see the two resistors installed correctly into the board. You will also want to gently bend the leads on the underside of the board so that the resistors don't fall out as we are going to install all the rest of the resistors (except for R3 & R5). The graphic on the right you can see how the legs are bent to keep the resistor in position.

Carry on with your color code chart and install the rest of the resistors on the chart – **except for the last two – R3 & R5 - these are a special case.**



The pictures above show your Phono Board with the resistors installed.



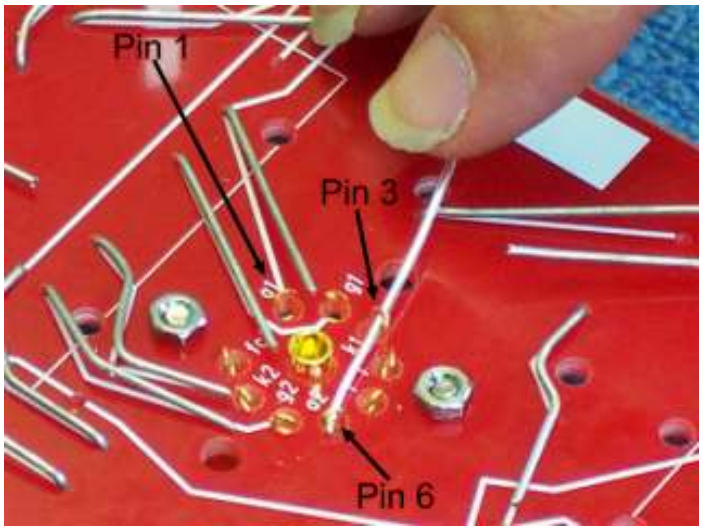
The next step is to gently bend down the resistor leads so that they are roughly following the traces.

In some cases it will be straightforward; in others you will not be sure which way to go! Do your best!

Some traces will require the needle nose pliers where you will have to bend the leads to follow the tracks!

Starting the Soldering

Once that is completed we will now perform our first soldering job! We want to connect pin 3 and pin 6 together on the V1 Valve Base.



Using the silver wire supplied with your kit you will want to slide one end of the silver wire into the valve base V1.

DO NOT CUT the silver wire yet – this is one of the tricks to using it – always have a long piece – do your soldering and then CUT when the job is completed – the wire gets very hot and difficult to handle in short pieces.

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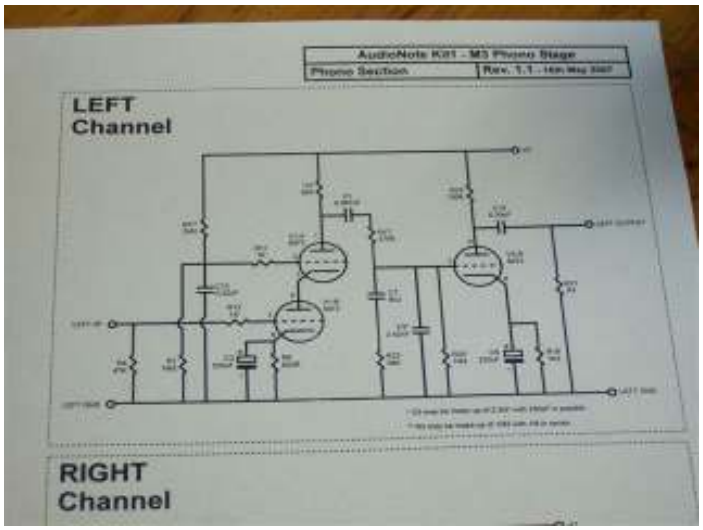
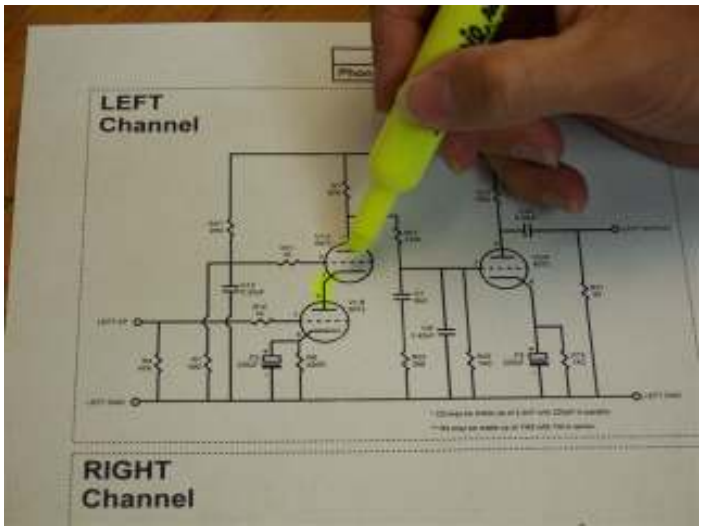
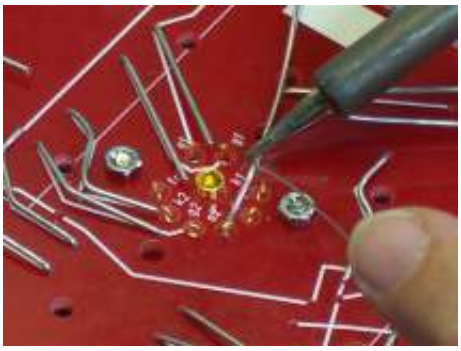




I suggest using a highlighter to keep track of your successful connections so that you know where you are up to. So in our case we have just completed the wiring of pin 3 to pin 6 of the V1 (LEFT) Valve base – so highlight the connection with a highlighter or pen. Eventually, you will be able to spot any connections that you may have missed etc.



As you can see from the above picture strip, the three steps involved here are:

- Slide the wire into position
- Perform soldering on both sides
- Cut the wire

You will be repeating this a few times!

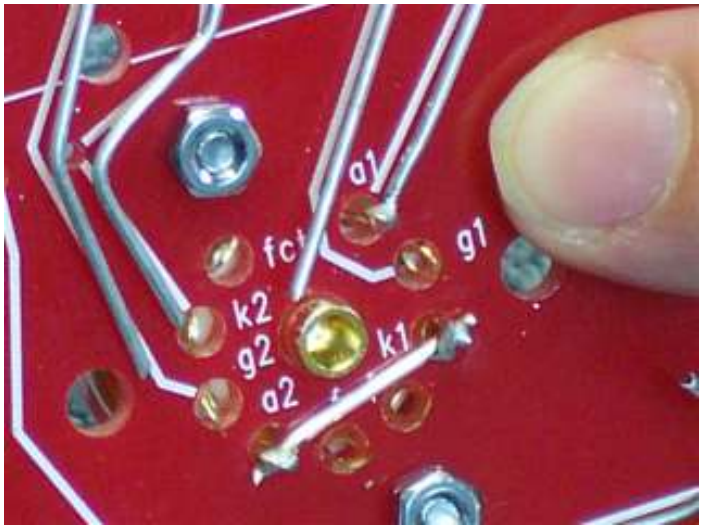
Now go a head and do the same thing for V2 and then highlight your schematic with the same connection.

Now we will start to make some other soldering connections to the valve bases. We are not going to show you every detail of the phono board build but rather show you the techniques involved and the correct order that you should do things and then leave it up to you make your own decisions on connections etc…

Lets start by looking for some easy connections of the resistors to the valve bases.

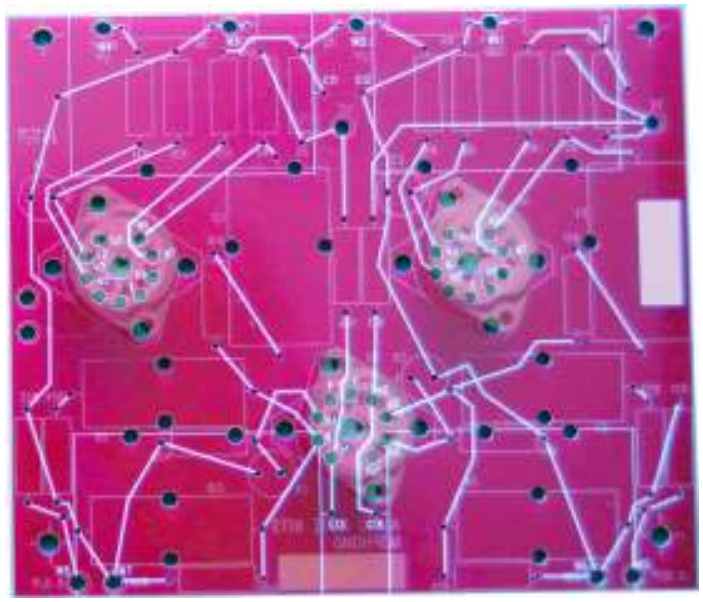
For example, looking at the base on the upper right in the picture opposite, let's pick some easy connections that we can make – the connection to PIN 1 looks very easy – Bend the lead enough with the pliers to fit it into the valve base pin 1.

This is the leg of R7 that is connecting to the valve base.



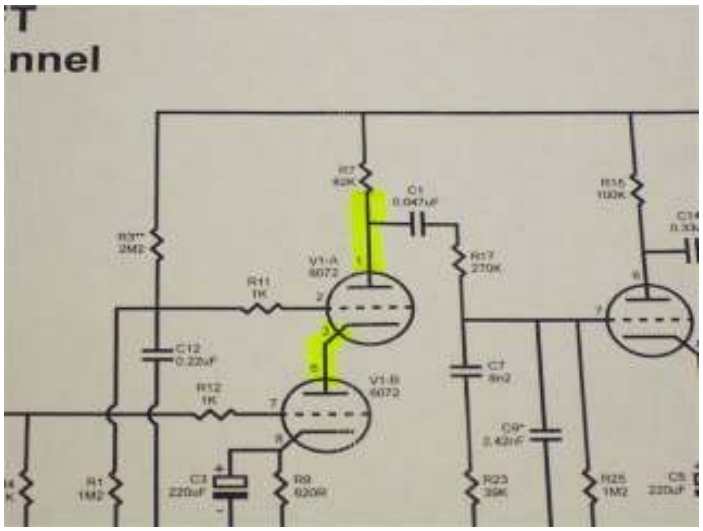
Here you can see that the leg of R7 has been connected to PIN 1 of the valve base V1.

Once it has been soldered you may or may not want to clip the end – Be careful of your eyes when cutting little pieces as they can flick off – use your hand to cover them or try to hold on to the piece that will come off with pliers.



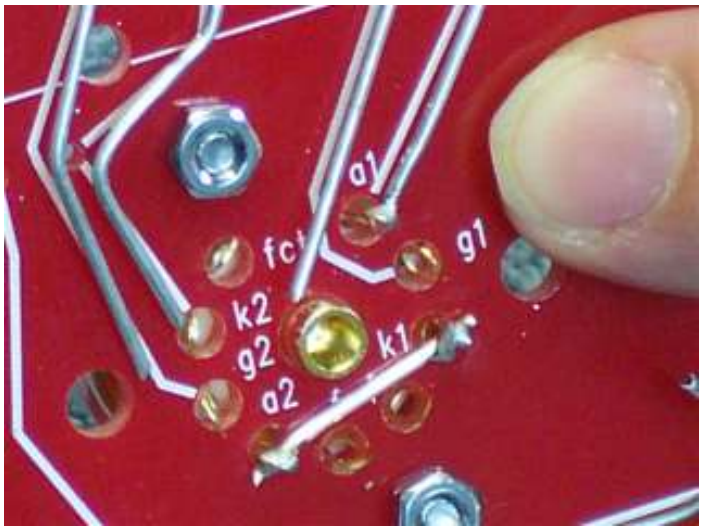
The graphic on the left is a view of the underside of wiring side of the board with the top side inverted and overlaid transparently.

This can sometimes be helpful - saving you continually turning over the board.



Once that wiring has been completed of R7 you will want to update your schematic as shown opposite.

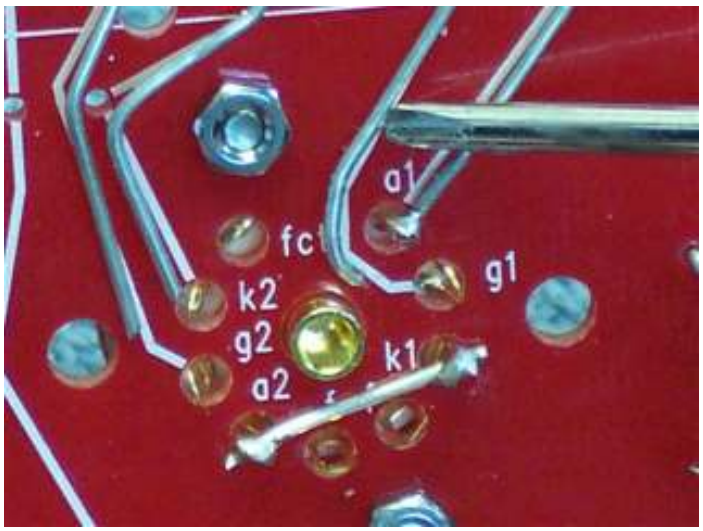
We just need to show you a few more techniques and then you will be well on your way to completing the resistor connections. How about a break and congratulations so far!



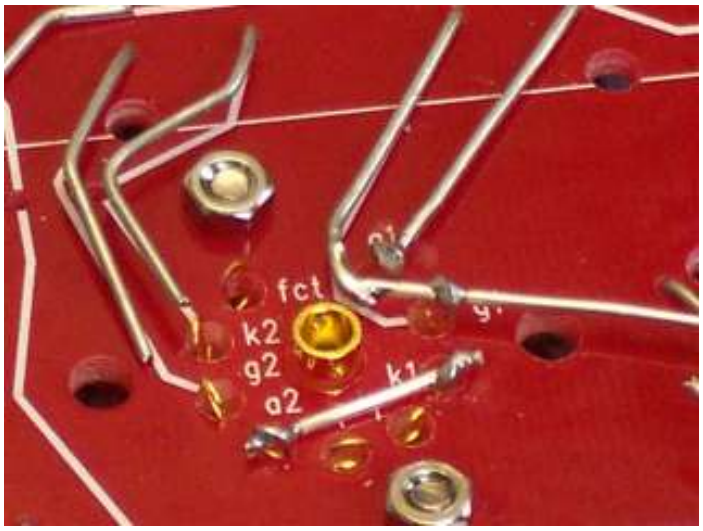
Let's make a connection now to pin 2.

As you can see from the trace on the board the wire must curl around and connect to pin 2.

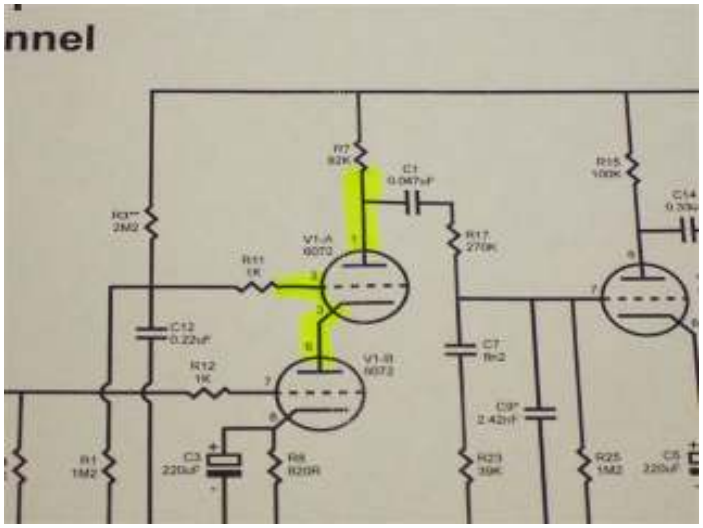
Often it will not stretch all the way there so we use the silver wire to complete the connection (see next two picture for completion).



As you can see we have curled the lead with the pliers and now we must extend with silver wire to pin 2 of the valve base…

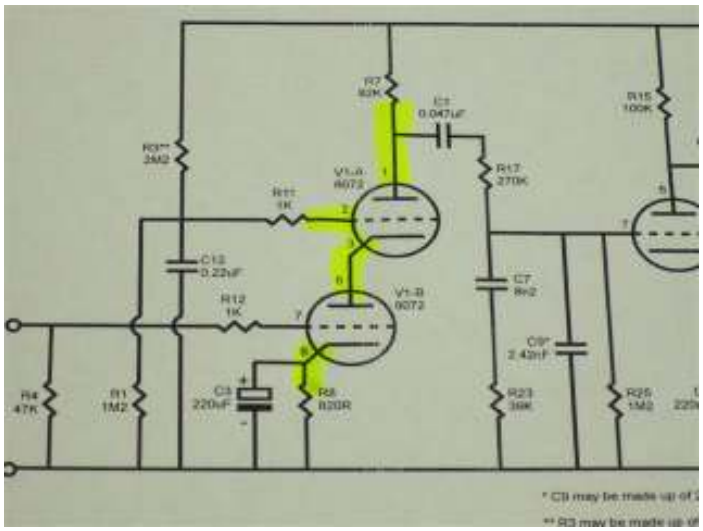


In this picture we have fed the silver wire through the valve base pin 2 and then applied some solder to the valve base pin. Then we have soldered to the resistor lead to complete the connection.



Let's update our schematic with the new connection we have just made – pin 2 of V1 valve base connecting to R11.

This picture shows that we have completed the connection of pin 8 and are in the process of using silver wire to complete the connection of pin 7 – again using a long piece we will solder and then cut.

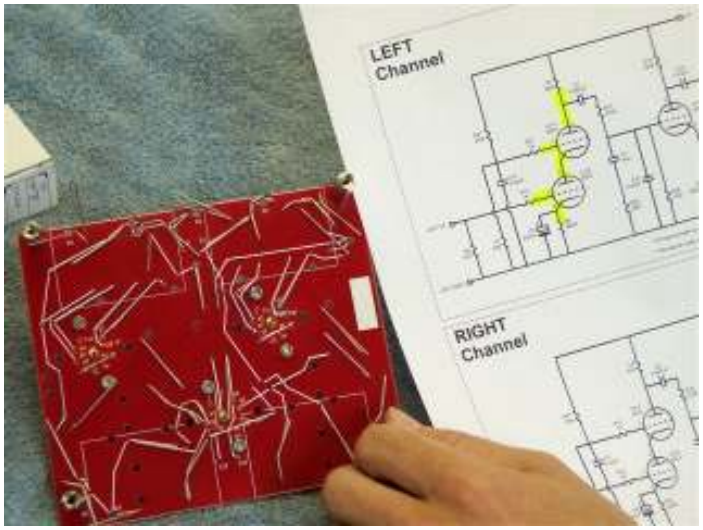


We have completed all the connections to the valve base V1 – *Note that I have not highlighted pin 7 yet but I should do that now!*

The only pins not connected now are pins 4 & 5 - these will be used for our filament wiring - in other words we will be using some wiring from the power supply board to connect to these pins to provide the filament current (this subject is dealt with later in the guide).

The other pin not connected is pin 9, which is not used.

Congratulations as we have just completed all the connections to V1.

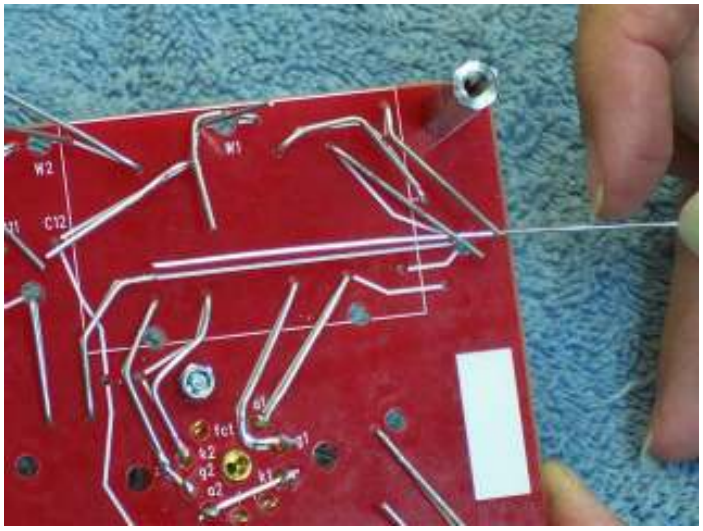


It is always good to double-check your connections after completing them, making sure that the stencils on the back and the schematic and your connections all correspond!

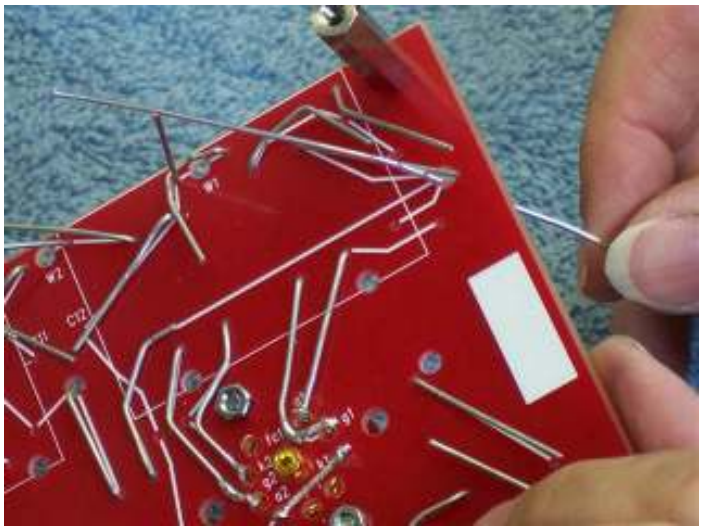
I would suggest that you go over and do the same to V2 now using the same techniques and updating your schematic highlights!

Another technique that you will use quite a bit of is longer extensions of silver wire – You will need to do this when you connect to the HT – The HT (or High Tension) is the point on the circuit where the DC voltage from the power supply will come in and provide the overall electrical DC for the phono circuit…

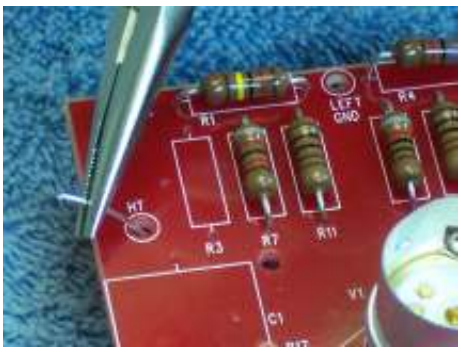
If you look on the component side of the board you will see two circles with HT marked on them. Let's wire up the HT terminal for V1 – do this by using the silver wire to extend.



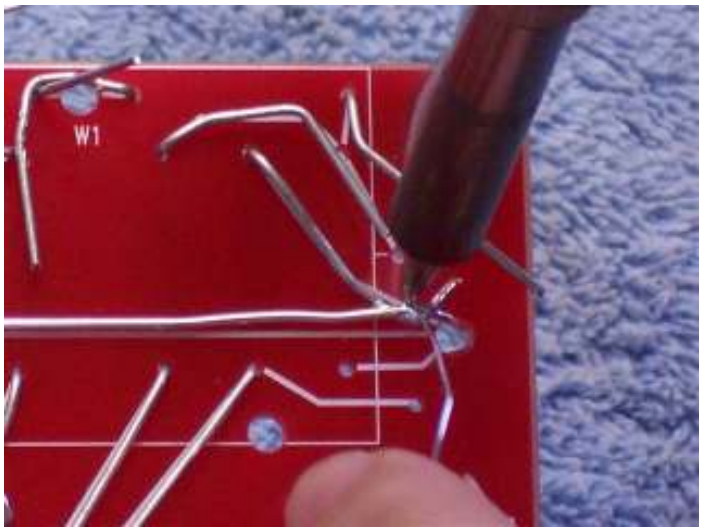
You can see here that I am laying down a length of silver wire that I will be soldering to for the HT connection.



Here I am inserting the silver wire through the HT hole so that it will follow the trace and connect to the resistor lead.



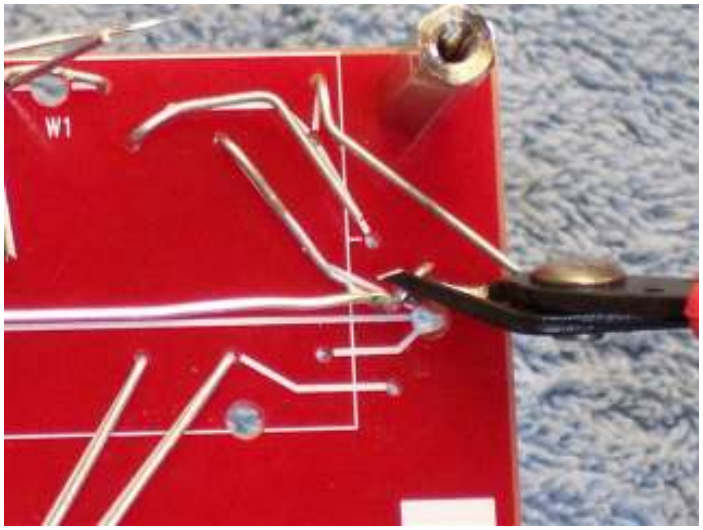
On the component side of the board you will want to bring the silver wire through, curl it, and clip it so that you have a nice hook in order to connect to later!



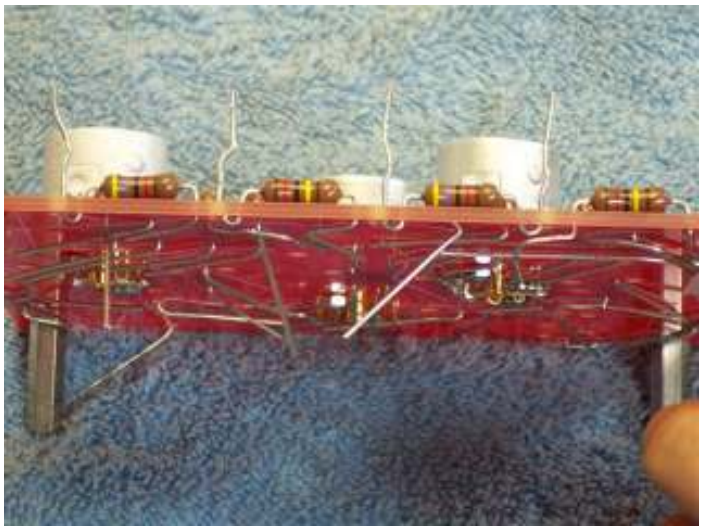
Here I am soldering another lead to the silver wire that is the HT.

At this point you should have enough skills to start working your way through the soldering process. Before proceeding, however, please read the following additional techniques.

Additional Techniques and Tips

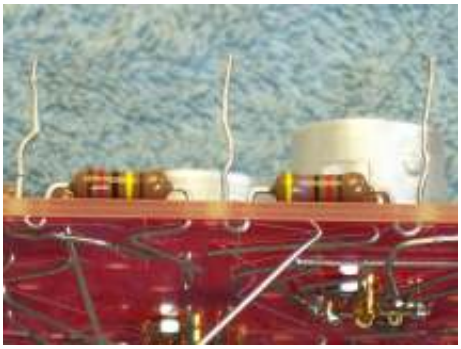


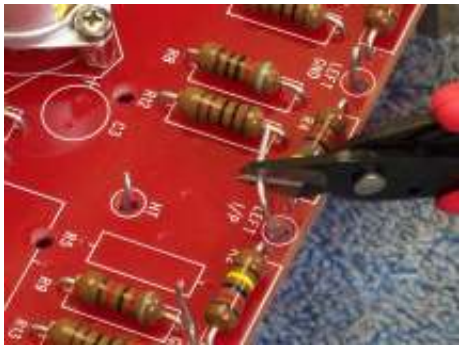
Use your cutters to cut off excess wire after you have made a solder connection.



This picture shows the next tricky part of the board - all the input resistors.

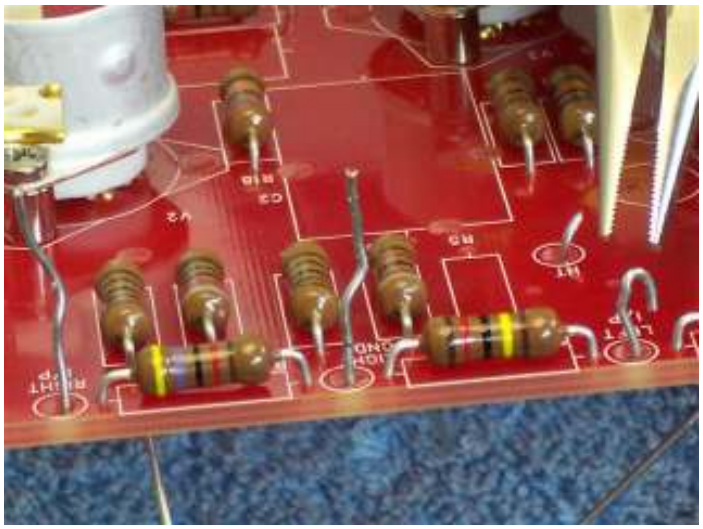
These resistor legs need to be bent and pulled through the holes in the board Right I/P. RIGHT GND etc…



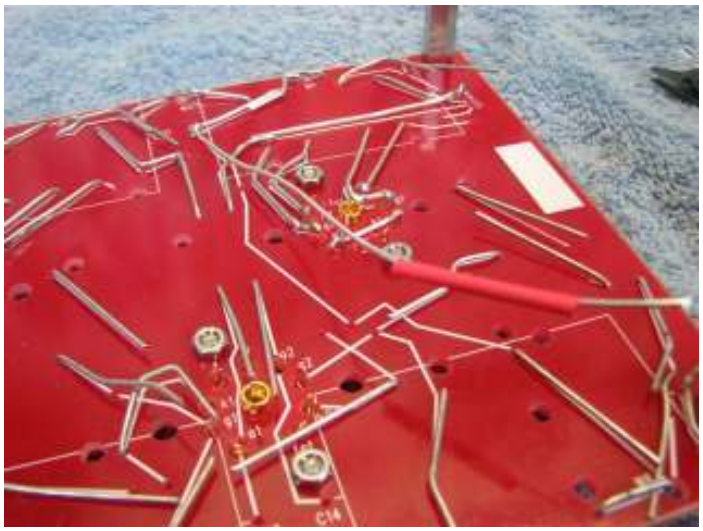


Use your needle nose pliers to perform this task.

The legs are fairly flexible and can be bent around a bit.



On the top side of the board you will want to snip a little length and then curl the lead so that it created a little hook like we did with the HT.



USING INSULATION

You will notice that in your kit you will have some thin heatshrink. You will use this in situations where the wires are coming close in contact with each other. When this is going to happen you need to cut some heatshrink to ensure that the wires will not short with one another!

You will need to use a hair dryer, or heatshrink gun, to heat up the heatshrink so that it wraps – even with heat shrink it is a good idea not to have two wires touching.

There are times where wires need to cross each other or need to go between valve bases – its ok to have the wires go above the board somewhat so that they do not touch other wires.

Continuing Construction

Now that you have familiarized yourself with the various techniques required, you can continue with construction.

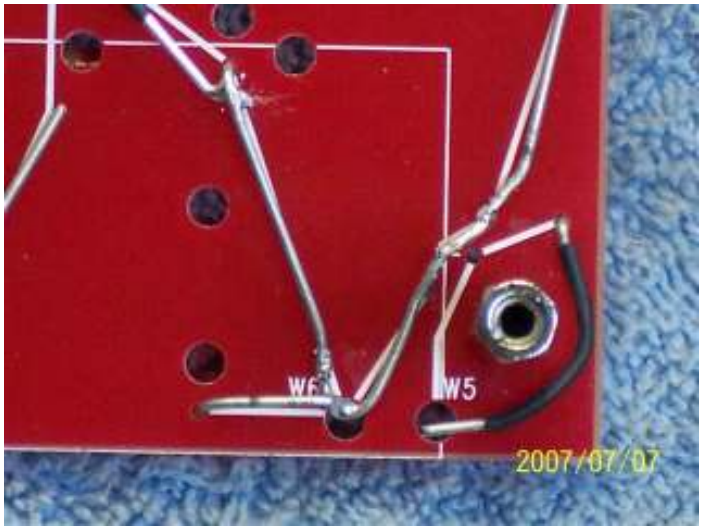
Continue completing soldering connections for all the resistors **except for R3 & R5**.

When you are done, your board should look something like the picture opposite.

Refer to your Hi-Res disk – pictures 100_8374, 8375, 8376, 8377, and 8378 for close up pictures of the board at this point.

If you look at the bottom left corner of the wiring side of the board you will see the spacer that is very close to the trace going to W8.

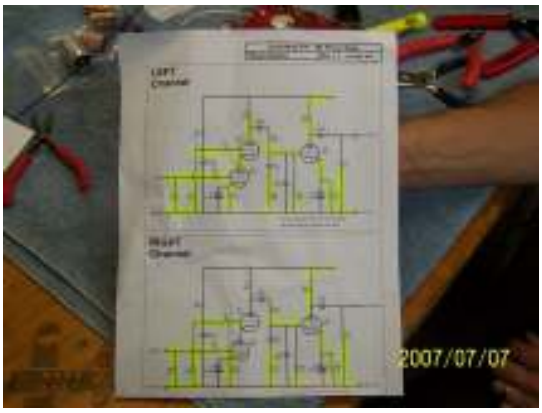
You have two options – to use some heatshrink tubing and follow the trace **or** route the trace around the outside of the spacer as shown in this picture.



The same for the lower right side and W5 - you can route the wire along the trace shown on the board **or** go around the spacer to give you a little more space.

You can see in both cases that even though I have routed around the spacer, I have used shrink tubing to make sure that there is no potential short.

The picture opposite shows how the top side of the board should look like at this point. Your schematic should also be well marked by now.



Installing R3 and R5

R3 (left channel) and R5 (right channel) are a special case as each of them is actually made up of two resistors. The value of these resistors is 2M2 (or 2.2Meg ohms). Since this resistor value is not available in Tantalum, we are going to put a 1.2M (1M2 1W) resistor in series with a 1Meg 1/2W resistor.

Twist the resistor and solder.

After soldering the resistors together, clip the extra wire.

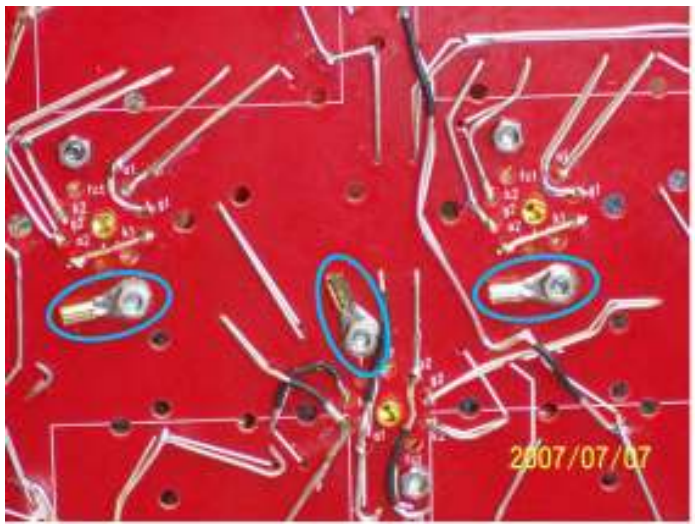
You should now have a nice “U” formation.

Install the resistor into the R3 position as shown and then solder under the board into correct position (refer to your schematic).

Then do the same for the R5 position

Once these resistors are in position you have completed all the resistors.

Adding the Tube Shield Grounds



You will want to remove the three GND Lugs from your Hardware Phono Bag and then install them in the positions shown in the picture opposite.

You will need to take the M3 nut off each screw and install the GND lug underneath the nut against the board – then secure with the nut.

Use some of your silver wire to connect the GND lugs to the GND planes and solder.

Be careful with this particular connection as is comes very close to a wire - you must make sure that there is some clearance.

Graphic showing the GND lugs that are connected to the valve base and soldered with SILVER wire to the GND Planes.

IMPORTANT NOTE
When working with silver wire always work with a long piece – solder in position THEN cut off – never work with a small correctly fitting piece of silver as it will be very difficult to manage

RULE: LONG wire in position -> Solder both ends -> Cut.

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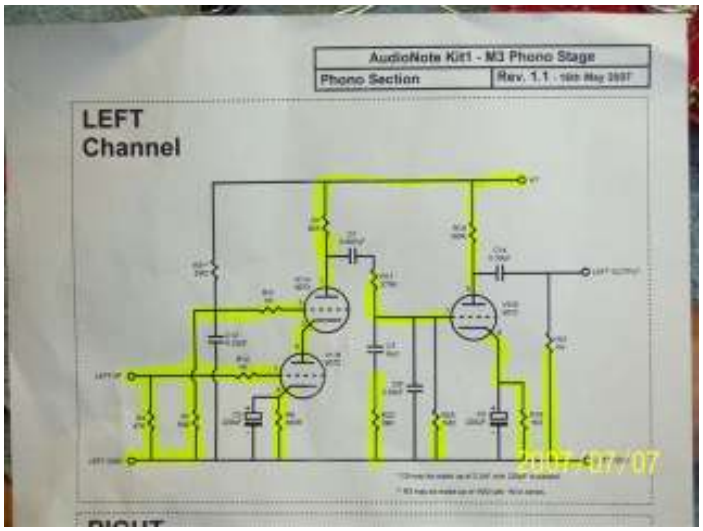


At this stage all our resistors are installed and I have highlighted my schematic - see opposite.

Installing the Capacitors

First, we will install the 4 Electrolytic capacitors – these are all 470uf 16V and are used on the cathode of the tubes. These capacitors are polarized meaning that there is a + and a – (Negative) and its **very important** that they are put into position correctly – you will see the + marking on the board. On the capacitor you will see a side with a long stripe on it – this is the Negative side.

The top level view of the board with the capacitors installed.

The underside of the board shows the 4 capacitors installed into position and soldered.

In some cases you will use the leg of the capacitor to extend along a trace.

Install C1, C2, C7, and C8.

The picture opposite shows TIN capacitors installed in the C1 & C2 positions and copper caps installed in the C7 & C8 positions.

Note that normally you will be using either all tin or all copper depending on what level Phono Kit you have ordered.

These FILM caps are not polarized such that they can go in either way without any problems – however there is a recommended method to have the side of the cap with the Line on it on the side where the audio signal is entering. As you can see from the picture, the line on these caps is towards the top of the board for the .047uf position.

The .0082 caps are positioned with the LINES towards the center of the board.

This is the underside of the board with the four film capacitors installed.

The next step is to install the 2.42n Farad capacitor that we have made for you into positions C9 & C10.

This capacitor is made up of a 2,200pf and 220pf in parallel which makes a 2,420pf (or 2.42nf) capacitor.

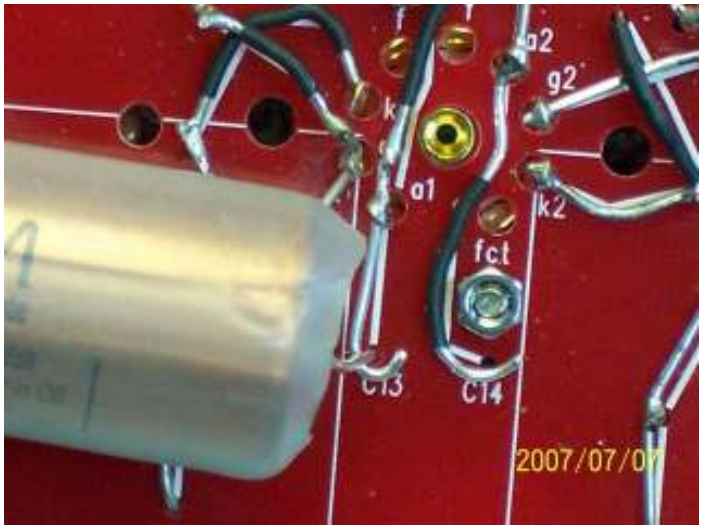
You can see how we bend the resistor to fit into position

Now we come to the home stretch – We need to install the 4 Film capacitors that will be installed on the **underside** of the board.

Now we come to the home stretch – We need to install the 4 Film capacitors that will be installed on the underside of the board – In the picture opposite you can see the .22uf capacitor being inserted into the holes on the board in the C12 position. The line on the capacitor is closest to the spacer or the side of the board.

You will notice that these capacitors have a clear heatshrink insulation on them – DO NOT REMOVE THIS – the reason for the heatshrink is because the copper (or tin) outer shell of the capacitor is conductive and needs to be insulated so as not to cause any shorts on any wires that it touches.

Install the other .22uf capacitor beside it in the position C11 position with the line closest to the spacer in the corner or the left edge of the board.



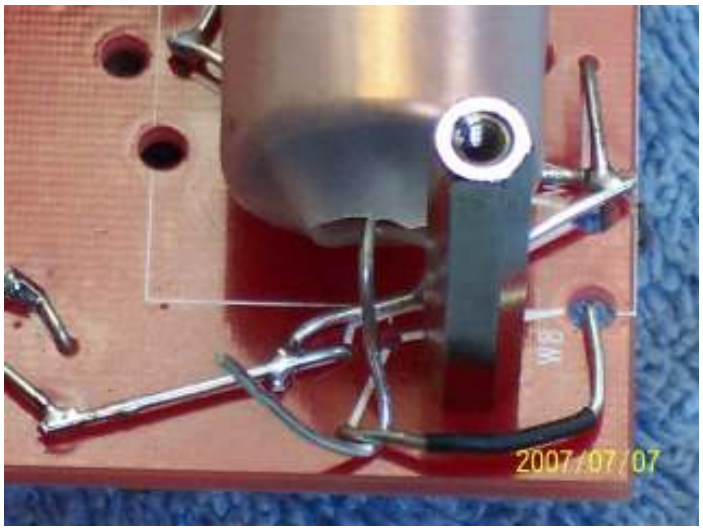
You will notice in this picture that the hook I created earlier can easily be soldered to the capacitor that we install on the underside of the board.

We now have the 2 .22uf capacitors into position

We will now install the 2x .33uf capacitors into C13 & C14.

When installing these capacitors, the lines will be positioned closest to the center of the board.

These capacitors will take a little more care – Solder the pin closest to the center of the board FIRST.



This picture is showing the other side of the capacitor. This is the tricky part that goes around the spacer.

Since I am a little crowded I am going to solder the wire directly to the wire as shown opposite rather than inserting in the hole for the capacitor.

To complete the connection here for W8 you will want to use some silver wire to connect to the lead.

On the top side of the board you will have some extra capacitor lead from the caps we installed on the underside of the board – Clip these about 5 mm from the top of the board and curl down.

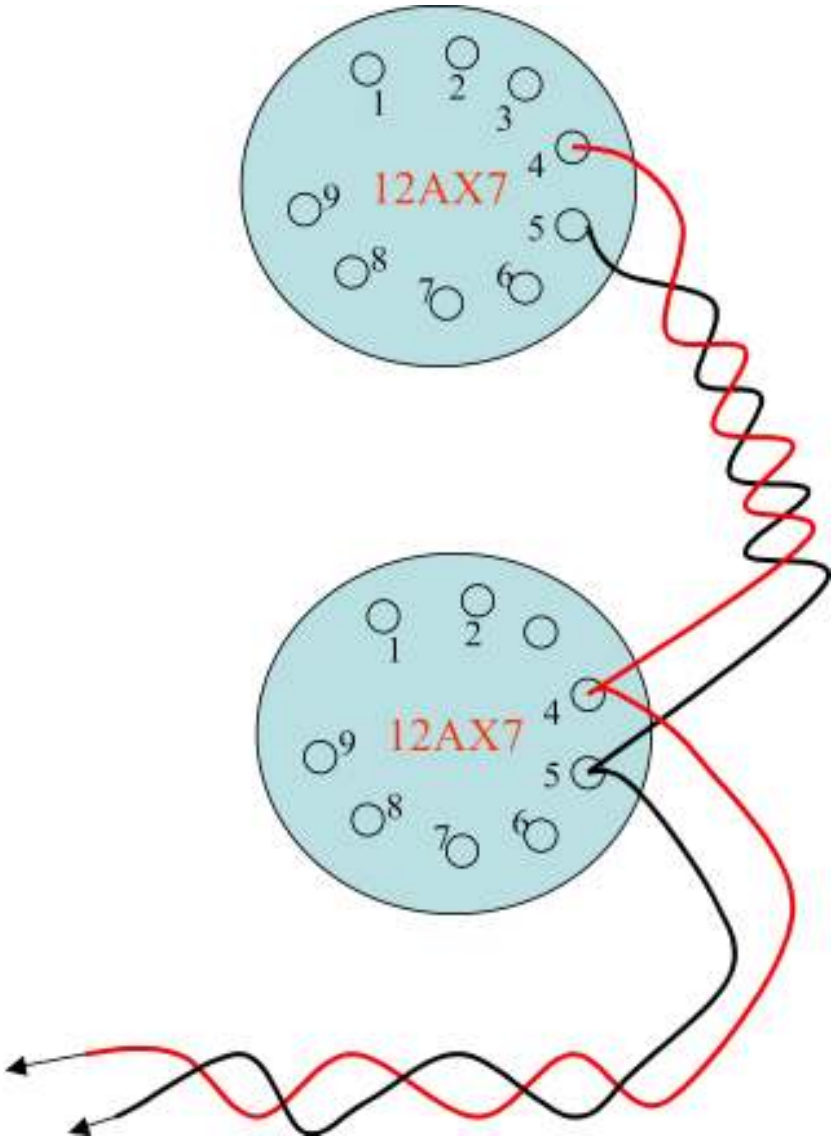
You will now have to do a similar operation on the other .33uf capacitor installed into C14.

Congratulations – You have completed the M3 Phono Board.

Section 2: Final Wiring

Using some red black twisted filament wire you will need to “Parallel the filaments on the V1 and V2 tubes – the reason for this is that we have 2 filament supplies coming from the power supply – we will use the filament supply to power the V1 and V2 tubes and then use the second filament supply for V3 – the output tube.

In order to parallel the filament refer to the graphic below:



Next you will want to connect the twisted wires from the M2 power supply 6V2 filaments to pins 4 & 5 of V1 OR V2.

Then connect the other filament wiring from the power supply to V3.

Connect the HT from the power supply (B+) to the HT on the M3 Phono Board.

Connect the GND from the power supply GND (near the LED) to one of the input GND’s on the M3 phono board.

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Section 3: Testing the M3 Phono Board

If you have an OHM-meter you can use it at this stage to do some preliminary checks. From the top side of the board we are going to measure some resistances from the Tube sockets.

Check for the following resistances:

V1 pin 8 to GND	820 ohms
V1 pin 7 to GND	48K
V1 pin 2 to GND	1M2 ohms
V1 pin 1 to HT	82K
V1 Pin 3 to pin 6	zero ohms

V2 pin 8 to GND	820 ohms
V2 pin 7 to GND	48K
V2 pin 2 to GND	1M2 ohms
V2 pin 1 to HT	82K
V2 Pin 3 to pin 6	zero ohms

V3 pin 8 to GND	1K2
V3 pin 7 to GND	1M2
V3 pin 3 to GND	1K2
V3 pin 2 to GND	1M2
V3 pin 6 to HT	100K
V3 pin 1 to HT	100K

Left output to GND	1M
Right Output to GND	1M

Check the resistance across C11 and then check C12 – should be over 1M.

If all these check out then you should be very close.

Next step is to double Check that the 4 capacitors 470uf 16V are installed properly with the + - in the correct orientation.

Hook-Up and Voltage Checks

The next stage is to install the Phono Board into the chassis and

1. Connect the filament supply from the M2 power supply board to the Phono Board
2. Connect the HT
3. Connect the GND

Without installing any tubes – turn on the amp and check for HT voltage of 260V on the phono board.

Check between pins 4 & 5 on each valve base and check for 6.3V DC.

If all is well then power down and install the tubes.

Power back on and check for the following voltages across the resistors:

LEFT Channel	
R7	100v
R15	130v
R19	1.6v
R8	1v

RIGHT Channel	
R9	100v
R16	130v
R20	1.6v
R10	1v

If all the voltages check out then we can hook up the RCA's and the AN-A or AN-V cable.

Start by tinning the input and output wires on the M3 phono board – This is done by adding some solder to the hooked wires that are coming out the board at the Right I/P and Left I/P and R GND and L-GND.

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