Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

These are the beasts that won’t deliver what is expected!
But with some surgery they can be made to sound so much better!

REVISED OCTOBER 2018 – SPECIAL EDITION WITH CUSTOM PCB – PAGE 46

MS22B

MS23B

Some History

Many years ago there was a British company called World Audio Design or WAD who manufactured various amplifiers as kits for home construction. Unfortunately they ceased trading leaving a legacy of many happy customers with high performance products using the highest quality components. The pricing was very good considering how much one has to pay for similar high end equipment today, maybe they under-priced themselves but their disappearance has been sadly lamented to this day. Then came the age of relatively cheap Chinese valve amplifiers, not just offering good performance, but they looked good too. Compare the following photographs of a WAD amplifier and a Yaqin MC10L and you will see for yourself.

Because their kits were no longer available, the Author built a copy of the WAD Phono Amplifier into a small die-cast box and this performed really well. Many solid state designs were tried later, some using the latest operational amplifiers but none came anywhere near to the quality of this simple little RIAA box.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

The Author was keen to obtain and evaluate the Yaqin MS22B and one came his way as part of an amplifier deal. When he replaced his home made effort with this lovely looking piece of kit, he was very disappointed at the sound it produced. Visitors would plead with him to take it out of circuit and put his amp back into operation, was it that bad? Yes it really was!

So rather than put this amplifier away in a cupboard until its innards dried out, he decided to take a look at the circuit board with the idea of transplanting the WAD circuit into the much nicer looking enclosure. The WAD circuit uses three valves (called Tubes or Lamps in some other countries) yet the Yaqin only used two with a transistor acting as a buffer. Buffer? It is a name given to a stage that is designed to stop the effects of a following stage affecting the performance of the previous stage and also be able to drive external cables with minimum losses. A crude analogy would be using an oven glove as a buffer so you can pick up hot things without affecting your hand. Hope that is a bit clearer 😊 Anyway, Yaqin feed their RIAA circuitry from the same buffer circuit output that also feeds the signal to the output sockets. In theory therefore, different loading conditions could possibly affect the RIAA operation? Ideally the buffer should only feed signals out to the following amplifier and nowhere else and as stated, one of its properties is to be able to drive into the loads presented by the following equipment. Well the WAD circuit did not like the transistor at all, as expected the RIAA curves were all over the place so a Mosfet transistor was tried and it worked well but not as good as a third valve. So even though it means more effort in making a hole for a third valve, it is a worthwhile improvement and the only recommended way to go by the author.

Are you experienced?
You may feel that the following work is too much for you but take heart, there are others who have successfully done the conversion despite little knowledge of electronics or soldering. Soldering is a skill but it can easily be mastered by practicing on old circuit boards and there are plenty of internet sites that show how to solder, cleanliness is the key, make sure your iron tip is clean and well tinned. Avoid using lead free solder, get a small reel of 60/40 leaded flux solder and you will make good joints.

Tools
Apart from the usual screwdrivers, cutters and pliers, a Dremel with some attachments will be found most useful, the drill bit being a 0.8mm PCB drill. The author prefers to use a speed controllable hand drill for drilling the PCB holes and also for cutting the tube holder mounting hole, a stepped cone cutter makes short work of cutting this.

Some solder wick to remove unwanted solder from the circuit board is also required along with some heat shrink tubing to cover component leads and the third valve terminals. If you don’t have a heat gun then being nifty with a cigarette lighter can give good results 😊. Also some fine abrasive paper or a fibre glass pen to clean away the Green solder resist from the track ready for soldering.

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Multimeter for pre-switch-on and safety checks and above all, be prepared to take your time to produce a good job.

The task looks daunting, but not if you take your time and re-check your work as you go. The rewards are most significant!

The Author is indebted to Juha Järvelä and Mark Kerr for their contributions of other tweaks to the design and the supply of excellent photographs to complement and even better his own.

This revised edition of ‘Putting ‘LIFE’ into the Yaqin MS-22B and MS-23’ details the conversion steps that the author takes, having now converted many MS22 and MS23’s.

CHECK OUT THIS FANTASTIC VIDEO PRODUCED BY ZONE1242 ON YouTube! https://youtu.be/eSt5KbBcDEo

Electronic components you will need, you may also buy cheaper from other sources like eBay:

<table>
<thead>
<tr>
<th>Qty.</th>
<th>Ref.</th>
<th>Description</th>
<th>UK supplier (Nearest Equivalent)</th>
<th>US supplier ALLIED*</th>
<th>MOUSER (Nearest Equivalent)</th>
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<td>2</td>
<td>C2 &amp; C9</td>
<td>100nF 400V Capacitor</td>
<td>755-4472</td>
<td>70188308</td>
<td>647-QXK2GI04KT</td>
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<td>2</td>
<td>RAA &amp; RBA</td>
<td>1k 0.25W Resistor (chosen for small size)</td>
<td>135-847</td>
<td>70063029</td>
<td>279-YR1BLKCC</td>
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<td>70205469</td>
<td>71-CMF201K2000JNR6</td>
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<td>R5, R16, RAH &amp; RBH</td>
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<td>279-LR1F180K</td>
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<td>70121809</td>
<td>71-CPP12.2K2%T1</td>
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<tr>
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<td>279-H4P18KFC</td>
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<td>D1</td>
<td>1N4007 Diode (For heater voltage lift)</td>
<td>628-9546</td>
<td>70015973</td>
<td>512-1N4007</td>
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<td>2</td>
<td>C4 &amp; C12</td>
<td>3uF Poly Capacitor, audio grade, 450V</td>
<td>CRICKLEWOOD CPW3u3</td>
<td>Alternative Audyn Q4 Film Capacitor MKP 3.30 MF 400 V 5%</td>
<td></td>
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1 off – For the extra Valve V3, a B9A skirted Valve Holder with screening can e.g. CRICKLEWOOD B9AS http://www.cricklewoodelectronics.com/product.php?productid=18321&catt=23&page=1

*Name changed to Allied Electronics & Automation. https://www.alliedelec.com/

Suggestions:
The present 8200pF capacitors cannot be reused as their handling voltage is not known, but it is recommended that 1% types are used to help match channels. Needless to say, the Author has actually tried 5% Mica capacitors and the channel matching has been satisfactory, the WAD circuit has proven to be so repeatable that you can be confident in obtaining a good RIAA characteristic even without test equipment to verify. The Author uses 3u3F 450V Ansar or Audyn Q4 capacitors because they sound good and their small physical size and gauge of connecting leads are easy to work with. Expensive Russian paper in oil capacitors have been tried with no detectable improvement in sound and their size makes them rather difficult to fit so not recommended.

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Basically, you will be converting the circuitry from the feedback arrangement used by Yaquin (called a Yin Yang circuit) to the straight filter technique as shown in block form below.

Whilst you are doing these changes, you will also add a diode to the heater regulator to give the heater voltage a lift of approximately 0.7V and take it from 11.8V to the more ideal 12.6V.

You will also be doing some changes at the RCA jacks that will remove the hum loop that has given owners such a headache; of course you may have already done this.

It is the Author’s opinion that any small residual hum that still remains is either due to the magnetic fields from the mains transformer acting upon the metal parts of the input triodes of each channel. Also power line frequency vibrations from the transformer cannot be ruled out. Real high end RIAA amplifiers use a remote power supply to get over such problems, however the level is so small after converting the MS22/23 that it cannot be heard at normal listening levels on the main amplifier.

IMPORTANT SAFETY NOTE!
PLEASE CHECK THAT THE POWER INPUT IS REMOVED BEFORE STARTING!

AS YOU PROCEED THERE ARE DIFFERENCES BETWEEN THE 22B AND THE 23B WHICH HAVE TO BE OBSERVED.

Nothing too severe, the circuit is the same; just the mechanics have altered slightly. MS23B changes will be highlighted in Blue as you go through the conversion.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Taking apart.

You have to completely remove the circuit board to get totally free access to the components that require deletion and/or changing but first you need to get into the Beast using a cross head screwdriver and a small size 10 torx driver.

It is strongly advised to apply some wide sticky tape or kitchen towel across the top and sides of the transformer cover to prevent any scratches that may be accidentally picked up during the conversion work.

Best to pull out the two valves now and store in a safe place.

The Yellow indicated screws are 6mm machine thread screws.
The Light Blue are 8mm self tap and the Purple are 10mm self tap screws.

On current MS23’s all screws are 6mm machine thread screws.

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The cover should now slide slightly towards the front to disengage the rear lip after which the cover can be lifted away. The Author found this slightly difficult due to a foot screw fouling on the internal screening frame. In this respect it will be found helpful to also remove the top right hand foot as shown in the above picture. **This is not a problem on MS23’s that use a different type of foot.**

Now before commencing on the board, make sure the internal capacitors are fully discharged! These can be discharged by holding a suitable low value resistor (one of your new 1k2 1W should do) across + and – of C17 for 20 seconds. Check with your Multimeter switched to DC Volts that the capacitors are all but discharged.

The front panel is detached by removing two size 10 Torx screws on the amplifier top side. As you withdraw the front panel you will see a connector providing supply to the front panel LED assembly, disconnect this connector to allow the front panel to be totally removed.

Now detach the four white plugs from the circuit board connectors, don’t worry, they are easy to identify when it comes to re-assembly.

Just to ease your mind for when it comes to re-assembly, the Author has made a note for you!

Left Channel INPUT (White inner) to XS1
Right Channel INPUT (Red inner) to XS2
Left Channel OUTPUT (White inner) from XS3
Right Channel OUTPUT (Red inner) from XS4.
With reference to the photo below, now unsolder the two White wires (on later MS23B models this may be a 2 pin plug with Blue wires), the two Yellow wires and the Earth wire going to the circuit board at the position marked G2. On the MS23 there are two black wires on G2 and not a Yellow/Green wire as shown. In fact there have been a number of production variations so make a note of where the Ground wires have been attached. Some will go to G2, some to the STAR Point, some use a connection to the left of the STAR (hidden by the Yellow twisted wires) and some units even have a connection on the ground track that connects to the lower electrolytic capacitors C15 and C16. It seems Yaqin have tried many ways to reduce hum in these units whereas a mu-metal shield around the power transformer could have also been tried.

The author now likes to do all of the mechanical work on the chassis first, that is the fitting of the pre-wired holder for V3 and changes to the RCA jack phono sockets. The board can be put aside for rework later. **Prewire the valve holder** with 250mm long wires, the Author uses colour codes for easy identification.

Red for Anodes (Plates) at Pins 1 and Pin 6, Green for control Grids at Pins 2 and 7, Black for Cathodes at Pins 3 and 8 and a twisted pair of any colour for the heaters at Pins 4 and 5.

The solder tags run from Pin 1 to Pin 9 clockwise from the keyway gap, looking at the tag side of course.

The connections (including the unused pin 9) should be covered with suitable heat shrink tubing as shown. **Do not bend the tags at this time as it makes mounting the holder difficult.** When the holder has been mounted to the top side of the chassis, then the tags should be carefully bent to the horizontal to allow replacement of the board with no danger of short circuiting to the board components.
We can now turn our attention to the chassis modifications, first look at the following photo.

Remove the two 6mm long size 10 Torx headed screws and the central cross head screw (marked with asterisks), the latter secures an internal screening frame and may be either threaded or of the self-tapping variety.
First step:

Check that the Ground lugs of the RCA sockets are not soldered together, this applies to both the INPUT and OUTPUT socket pairs.

As shown in the photo, if you find the two Ground tags soldered together then separate the tags and Black wires. The newer units appear to have some kind of thread locking varnish applied which makes it difficult to loosen the fixing nut. The author removes both Black wires and excess solder, then reheat the connection whilst turning one of the RCA jacks with a 15mm socket or combination wrench. With luck the two tags will separate and you should continue turning until the tags are well spaced apart. Finally reconnect the respective Black wires to their own independent tags.

On both of the OUTPUT RCA jacks we will be fitting R10/RAH to the LEFT OUTPUT and R21/RBH to the RIGHT OUTPUT.
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First prepare R10/RAH and R21/RBH as shown, the larger resistor (chosen for illustration) is R10 or R21 (1k) and should be twisted with RAH or RBH (1 Meg) as applicable, tinned and cut to 5mm, the other end of the 1k (R10 or R21) is also cut to 5mm.

Taking the LEFT OUTPUT RCA first, the White wire from the centre connection is removed and soldered to the 5mm free tail of the 1k Ohm resistor R10. Note position of RAH

Don’t get these two resistors mixed up or you will have very low output!

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Now slide a short length of suitably sized heat shrink tubing over RAH and R10 to the joint just made with the White wire. Afterwards flip back the 1 Meg resistor RAH and form as shown.

Solder the twisted section to the RCA jack centre pin.
Trim as required the remaining wire of the 1 Meg resistor RLH and solder to the Ground lug of the RCA socket together with the Black wire already there.

Repeat procedure to the Red wire on the RIGHT OUTPUT socket with R21/RBH.

Refit rear panel into the chassis and secure with the two torx head screws on the top surface and two cross head screws on the bottom edge at the chassis corners.

Refit the fixing screw that holds the internal screen to the rear panel.

Below is a simple template (shaded in Grey) for you to make from thin card or stout paper, using this template you can position the mounting hole correctly for the extra valve V3. The template card comes into its own where a large number of chassis need to be drilled. This is how the author fits the extra holder on the MS23 due to his limited metal working facilities, but take a look at Page 37 where John (celebabe on the diyAudio Forum) shows how he did it whilst retaining the original tube shield.

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After making to the sketch, place the template onto the underside of the chassis using the present large holes as a guide to placement. Simply centre mark or punch the required position for the pilot hole and then cut the panel for the valve holder. Despite not looking as good, the Author thoroughly recommends only topside mounting of the new holder, which at least on the MS23, can be concealed with a modified cover.

**There is caution here!**
If you make this hole too large it will reduce the metal available for the actual fixing screws which is why topside mounting is so recommended!

Some valve holders, particularly the skirted type, require a larger hole than depicted e.g. 22mm. The safe solution here is to carefully cut the hole until the new valve holder fits comfortably into it. Be careful of machining operation swarf when cutting the large hole for the extra valve. It helps to keep the amplifier body tilted forward slightly during these operations to prevent metal particles finding their way into the power transformer cover.

The holder should be retained with suitable screws, shake proof washers and nuts, but clear away the Black anodising at the underside fixing points so that the shield will be properly grounded.

The author recommends that the keyway gap faces the power transformer but this may not be possible with some valve holders as there appears to be no design standard for pin orientation.

Alternative mounting sketch:

![Diagram showing alternative mounting sketch](image)

The next things to make are the EQ’s which will be fitted to the board later when the wires from V3 have been attached. They are the last components to be fitted before the board plugs from the rear panel RCA Jacks are re-attached.

Once these have been made the work on the printed circuit board can commence.
Cut legs of the 8200pF capacitors (C5/C13) to approximately 10mm. Bend down the right hand leg of one and the left hand leg of the other as shown. The author likes to apply a small 5mm length of 1.2mm heat shrink tubing to the leg that is bent down as, when it is installed, it gives some protection to the wire from a nearby fixing nut. Later, the bent leg on the Left capacitor will connect to pin 2 of V2 whilst the Right capacitor bent leg will connect to pin 7 of V1. Add the 39k2 resistors (RAC/RBC) and add some 1.2mm heat shrink tubing to the uncut end of these resistors.
Finally apply some 3.2mm heat shrink tubing to cover the resistors and their connection with the capacitors.

Put these aside for fitting when the board is refitted.

**The 200pF EQ's**

Place resistors RAF (75k) and RAG (18k) in parallel, i.e. together side by side and trim as required. Then apply some solder to the joints.

Repeat procedure with RBF (75k) and RBG (18k).

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Add these resistor networks in series with the 200pF capacitors C3 and C10. One leg of these capacitors is kept straight and cut to 10mm length. The other leg is also cut to 10mm but bent down at 90 degrees. This end is soldered to the resistor network and then covered, along with the resistors, with 3.2mm heat shrink tubing.

![Resistor Network](image)

Now also put these aside for fitting later when the board is refitted.

We now commence work on the printed circuit board which starts with removing all of the components that are no longer required.

**The Circuit board conversion.**

On the Left Hand channel, remove components C2 (10nF), R11 (560 Ohms), C3a and C3b (100pF each), R2 (2k), R3 (100k), R8 (680k), C5 (8n2), R9 (30k), C6 (2n2), R10 (1k), R5 (2M), R7 (82k), R6 (100k), C4 (1uF), C7 (1uF) and Transistor V3.

On the Right Hand channel, remove components C9 (10nF), R14 (560 Ohms), C10a and C10b (100pF each), R13 (2k), R15 (100k), R19 (680k), C13 (8n2), R20 (30k), C14 (2n2), R21 (1k), R16 (2M), R18 (82k), R17 (100k), C11 (1uF), C12 (1uF) and Transistor V4.

**Remove the Yellow link wire that skirts around V2 (already done in the photo).**

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Now remove the short wire link marked as 5MM which is presently connected to pin 1 of V2.
You DO NOT want this! On the MS23 this is shown as a 6MM link!

Use some solder wick to clear all solder pads for re-use followed by a wash and scrub with Isopropyl Alcohol (IPA) and a small stubby brush.
All the Yellow starred components are no longer needed.

If you are fed up with being blinded by the Blue LED’s, applicable mainly to the MS23, then also remove R25 (820 Ohms). This is shown to the left of the heat sink and can be replaced with a 120k 1W later. The board should look like this:-
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References will still point to the original Yaqin component numbers but where new parts are added, a letter system is used to avoid any confusion. Component references like RAA, RAB, RAC etc. refer to the Left Channel whereas their counterparts on the Right channel will be called RBA, RBB, RBC etc.

One thing to remember! When you are working on the printed circuit side of the board, the Left channel is on the Right Hand side as you look at it! The Author has been caught out a few times by this 😊

Views of the actual circuit boards may differ due to production changes, particularly the change in Valve Holders and the addition of slots between valve pins on later models. Some of the photos were taken at advanced stages to what is being described so ignore other components that are not applicable to the work in hand.

The procedure for track cutting, drilling and component placement has been changed from previous issues, all the cutting, drilling and component placement is all done in 3 set stages, i.e. all cleaning, cutting then drilling. This is how the author now does the board rework as he found it better to complete each stage whilst tooling was to hand.

**Preparation before Track Cutting and Drilling** -
- a) De-solder pin 2 and pin 6 of V1.
- b) De-solder pin 1 and pin 2 of V2
- c) Remove all 3mm nuts and fibre washers from the valve holders.

1. **CLEANING AWAY GREEN SOLDER RESIST.**

**ADDITIONAL HEATER DIODE D1**

Centre trace from 7812 to Capacitor.

**RAA**

Note that fixing nut and insulating washer have been removed for better access. A large area as this will be dissected later.
**Putting ‘LIFE’ into the Yaqin MS-22B and MS-23**

<table>
<thead>
<tr>
<th><strong>RAB</strong></th>
<th><strong>RAD</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Located on bend to the right of fixing nut and also at far end of the pad that takes the 2M resistor and Capacitor.</td>
<td>To the right of pin 8 and to the left of the 10mm ground link.</td>
</tr>
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</table>

**RAE**

There is only one area requiring preparation (for RAE) and this is at V1 Pin 6. The other end of RAE will make use of the old transistor V3 Base pad.

**RBA**

Just one long area, between input connector and Pin 7 of V2. NOTE: Nut and Washer removed to assist in the work.
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**RBB**
At pin 2 of V2 and left hand side of the track
Connecting to the 2M resistor and capacitor.
NOTE: Nut and Washer removed to assist in the work.

**RBD**
Pin 3 of V2 and bottom end of 12.5mm link
(Highlighted by *)

**RBE**
Pad of Pin 1 of V2 (Highlighted by *)
2. **TRACK CUTTING ASSOCIATED WITH THE PREVIOUS AREAS.**

**HEATER DIODE D1.**

Cut track with Dremel or a craft knife

**RAA**

Important: Leave track connected to the 47k Resistor. Only isolate the valve pin.

**RAB**

**RAD**

**RAE**

Track cut shown by Yellow arrow

**RBA**

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RBB
Track cuts shown by Yellow arrow

RBD

LAST TRACK CUTS
RBE
Two cuts here, top one is a safety isolator.

3. TRACK DRILLING
HEATER DIODE D1

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**RAE**

Only one area requiring drilling and this is at V1 Pin 6.

**RAD**

**RBA**

**RBB**

**RBD**

PIN 3 of V2 and bottom end of 12.5mm link

**RBE**

PIN 1 of V2
4. **NOW WE ADD COMPONENTS ASSOCIATED WITH THE DRILLED LOCATIONS.**

Mount Diode D1, it is polarised and must be wired the correct way round. The right hand photo shows how the diodes cathode, indicated by a silver band, is mounted uppermost.

At V2 Pin 1 pad, add the insulated link wire to connect to V2 Pin 1 (where the 6mm link was removed) and the other end to C10A (end not connected to C10B). Just use a solder tack at Pin 1 to hold wire as another component (RBE) is destined to be located here later in the hole you drilled for it.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

MOUNTING OF RAA 1k 0.125W

MOUNTING OF RAB 316k 1%

MOUNTING OF RAD 2k2 1W (Red/Red/Red)

RBB? NOT YET!
This resistor will be piggy backed over RBE as we shall see later!

Note how RBD 2k2 is mounted, the long bare lead may be covered with thin sleeving if desired.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

RAE

Note how RAE 180k is mounted, the long bare lead (at high voltage) should be covered with thin sleeving.

**IMPORTANT** Fit a reversed board pin at the capacitor hole 101/50V that is linked to the RAE connection at the old transistor V3 Base pad. This will provide a connection to pin 2 of the extra buffer valve and the RAF/RAG/C3 EQ network later. Also fit a reversed board pin at transistor V4 Base pad. This is the pad closest to the valve fixing nut. This will provide a connection to pin 7 of the extra buffer valve and the RBF/RBG/C10 EQ network later.

MOUNTING OF RBE 180k

NOW PIGGY BACK RBB 316k

KEEP A TINY AIR GAP BETWEEN THE TWO RESISTORS RBE AND RBB.

The task gets easier now with the fitting of components in the holes vacated when the old components were removed.

Insert a 100nF capacitor at C2 and C9 positions.
Insert a 1M Resistor at R5 and R16 positions.

Insert a 330k Ohm 1W resistor at R6 and R17 positions.

Insert a 120k Ohm 1W resistor at R3 and R15 positions.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Insert a 150k Ohm 1W resistor at R7 and R18 positions. Note that if you mount R7 on the print side of the board it gives more room on the component side for the new output capacitor C4 when it is fitted later.

Insert 1k2 1W resistor at R2 and R13 positions.

Fit new output capacitors at C4 and C12 positions.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

The replacement HT (B+) capacitors C15 and C16 can now be fitted. Make sure you have the correct 25mm maximum height capacitor types and that these are mounted the right way round with their negative tags towards the front edge of the board. Note: Due to supply problems, the 100uF capacitors have now been replaced with 68uF 350V types.

As a safety precaution, add RAJ and RBJ across the pins of each capacitor. These 330k resistors will ensure that any residual charge on the capacitors is drained after a few minutes yet there value will not add any appreciable loading to the HT (B+) line.

Now for those wishing to reduce the almost eye damaging glow of the front panel Blue LED’s, here is the answer. Replace R25 with a 120k 1W resistor, the author has a surplus of 100k 1W resistors which he uses for this task.

That’s it! Make sure that you have replaced the 3mm nuts and washers removed earlier. You can now drill the board with 3mm holes to take the wires for the extra valve, use a 4mm for its heater wires.

The photographs on the next page shows the locations. Carefully feed the wires through these holes from the component side and if you colour coded the wires then this should be easy to do. Once the board is in position and the wires pulled through then they can be terminated as required. Remember to push back the tags of the third valve V3, this will allow the board to be slid back into place. It is OK to flex the board slightly to get the large capacitors on the front of the board to pass by the valve. Slowly take up the slack in the wires from V3 as the board goes in, the most frequent obstruction is the heat sink so check that the wires are not snagged on it.

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Below is an early photograph; the Red Anode wires should now be fed through holes further up the board to connect with the 10mm link solder pads feeding R22 and R23 (see above and next page).
Here is a view of a wired board.

With the board now fixed in place and V3 wires connected, reconnect the Yellow supply wires to the board edge connectors and connect the grounding wires as required.

Reconnect the White heater wires or with later units, replace the two pin connector that provides the supply.

Now for the last part – fitting the EQ’s
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Fitting the EQ’s  (See also lower picture “Positions of EQ connections favoured by the Author”).

Right hand channel (V2) showing the 8200pF EQ connected to pin 2 of V2. The other end is connected to 0V Ground, there are a number of suitable places for this.

The 200pF EQ is shown connected to the Ground rail that runs across virtually the whole width of the board, easily located here as the wide track going underneath the heat sink outline painted on the board.

The other end is connected to what was the Base pin of the old Transistor V4, just to the left of the top fixing nut. A solder pin inserted here helps to carry both the EQ connection and the Grid wire to new valve V3.

This is the Left Channel (V1) where the 8200pF is connected to pin 7 of V1. The other end is connected to a convenient 0V ground, like the other channel, there are a few locations for this.

Also to be seen is the 200pF EQ connected to the Ground Rail running across almost the whole width of the board, though this is partially hidden by the 8200pF capacitor. This is also connected to what was the Base pin of the old Transistor V3. The author now uses the vacant capacitor pad that is linked to the V3 pad.

IMPORTANT! Despite being covered in heat shrinkable sleeving, leave a tiny gap between the resistors RAF/RAG and RBF/RBG as the tracks that lie beneath them carry full HT (B+) voltage.

Positions of EQ connections favoured by the Author.

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Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

You can now connect the four plugs to the board and temporarily replace the bottom cover with just two holding screws. If you have a digital Multimeter to hand, then it is a good idea to do some ‘cold’ checks on the circuitry before powering up. Temporarily fitting the bottom cover will save you undoing all of those screws should you find anything wrong?

Just a reminder - valve pins are numbered 1 to 9 clockwise looking from UNDERNEATH. If you are looking INTO the socket where the valve actually goes, then you have to count the pins in an anti-clockwise direction, pin 1 in this case being the first pin after the gap.

It helps to do the measurements if you make up some special leads for locating into the small holes of the valve sockets.

If the unit has been powered up at all then verify that the HT rail is fully discharged before carrying out the following tests. This can be verified using pin 1 and/or pin 6 of the new valve V3 and the GROUND Terminal.

If RAJ and RBJ have been fitted then the HT (B+) will be discharged to a safe level after 5 minutes. If these resistors have not been fitted then refer to the safety instruction at the top of page 6 where a 1k2 1W resistor can be used to discharge the smoothing circuit.

Check with your Multimeter switched to DC Volts that the capacitors are all but discharged.

The following tests are also condensed as a quick check list in a following table form, resistance tests are to +/-5% tolerance.

HT Checks:
a) Connect the Multimeter between Pin 1 of V3 and Pin 1 of V1. The resistance measured should be around 140k Ohms. (Checks R22 and R3)
b) Transfer the probe on V1 Pin 1 to Pin 6 of V1, to be 350k Ohms. (Checks R22 and R6)
c) Connect the Multimeter to the other Anode (Pin 6) of V3 and measure to Pin 6 of V2 to be 140k Ohms. (Checks R23 and R15)
d) Transfer the probe on V2 Pin 6 to Pin 1 of V2, to be 350k Ohms. (Checks R23 and R17)

Signal input checks:
e) Connect the Multimeter between the L/H Phono Input and V1 Pin 2, to be 1k Ohms. (Checks RAA)
f) Connect the Multimeter between the R/H Phono Input and V2 Pin 7, to be 1k Ohms.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Ground Checks:
Connect the Multimeter between the rear panel GROUND terminal and the following points.
g) L/H Phono Input to be 47k Ohms. (Checks R1)
h) R/H Phono Input to be 47k Ohms. (Checks R12)
i) V1 pin 3 to be approximately 1k2 Ohms. (Checks R2)
j) V1 pin 7 to be approximately 1316k Ohms. (Checks R5 and RAB)
k) V1 pin 8 to be approximately 2k2 Ohms. (Checks RAD)
l) V3 Pin 3 to be approximately 150k Ohms. (Checks R7)
m) V3 Pin 8 to be approximately 150k Ohms. (Checks R18)
n) V2 pin 8 to be approximately 1k2 Ohms. (Checks R13)
o) V2 pin 2 to be approximately 1316k Ohms. (Checks R16 and RBB)
p) V2 pin 3 to be approximately 2k2 Ohms. (Checks RBD)

Signal output checks:
q) L/H Phono Output to be approximately 1M Ohms. Checks RA
r) R/H Phono Output to be approximately 1M Ohms. Checks RB

Valve interconnects:
s) V1 pin 6 to V3 Pin 2 to be approximately 180k Ohms. If you measure something much higher
don’t panic, you are on the wrong Grid of V3 so move the Multimeter probe from Pin 2 to Pin 7.
(Checks RAE)
t) Connect the Multimeter to the other Grid of V3 (i.e. if you were on Pin 7 go to Pin 2 or visa versa)
and measure to V2 Pin 1 to be approximately 180k Ohms. (Checks RBE)
u) A resistance test between V3 Pins 1 and 6 should show a virtual short circuit and proves that both
halves of the valve are connected to the B+ (HT) line. It might be prudent at this point to do a quick
check between these two valve pins and Ground to check that no short circuit exists.

<table>
<thead>
<tr>
<th>CHECK LIST IN TABLE FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test point</td>
</tr>
<tr>
<td>a) V3 Pin 1 to V1 Pin 1</td>
</tr>
<tr>
<td>b) V3 Pin 1 to V1 Pin 6</td>
</tr>
<tr>
<td>c) V3 Pin 6 to V2 Pin 6</td>
</tr>
<tr>
<td>d) V3 Pin 6 to V2 Pin 1</td>
</tr>
<tr>
<td>e) LEFT Phono Input to V1 Pin 2</td>
</tr>
<tr>
<td>f) RIGHT Phono Input to V2 Pin 7</td>
</tr>
<tr>
<td>g) LEFT Phono Input to Ground</td>
</tr>
<tr>
<td>h) RIGHT Phono Input to Ground</td>
</tr>
<tr>
<td>i) V1 Pin 3 to Ground</td>
</tr>
<tr>
<td>j) V1 Pin 7 to Ground</td>
</tr>
<tr>
<td>k) V1 Pin 8 to Ground</td>
</tr>
<tr>
<td>l) V3 Pin 3 to Ground</td>
</tr>
<tr>
<td>m) V3 Pin 8 to Ground</td>
</tr>
<tr>
<td>n) V2 Pin 8 to Ground</td>
</tr>
<tr>
<td>o) V2 Pin 2 to Ground</td>
</tr>
<tr>
<td>p) V2 Pin 3 to Ground</td>
</tr>
</tbody>
</table>
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

<table>
<thead>
<tr>
<th>q) LEFT Phono Output to Ground</th>
<th>950k</th>
<th>1050k</th>
</tr>
</thead>
<tbody>
<tr>
<td>r) RIGHT Phono Output to Ground</td>
<td>950k</td>
<td>1050k</td>
</tr>
<tr>
<td>s) V1 Pin 6 to V3 Pin 2</td>
<td>171k</td>
<td>189k</td>
</tr>
<tr>
<td>t) V2 Pin 1 to V3 Pin 7</td>
<td>171k</td>
<td>189k</td>
</tr>
<tr>
<td>u) V3 Pin 1 and V3 Pin 6</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

AS WITH ALL WORK CARRIED OUT ON CLASS 1 EQUIPMENT, DO AN INSTRUMENT PAT TEST OR EQUIVALENT ON THE POWER CONNECTOR, CHECKING FOR A GOOD ALL ROUND EARTH BOND NOT GREATER THAN 100 milli-Ohms AND AN INSULATION NOT LESS THAN 100Meg Ohms AT 500V.

If all tests are OK then you can fully fit the bottom cover into place.

**VERY IMPORTANT!**

If the supplied Yaqin power cable has a plug with a sleeved Earth Pin, or a fuse that is not clearly seen, it is unsafe and illegal, cut it up and dispose of it. This really is a fire starter when plugged into the standard UK 30 Amp ring main system, as it contains no fuse at all; the wire colours do not comply with UK legislation and worse still, the Live and Neutral connections have been found reversed inside the Plug!

If the supplied Yaqin power cable has a plug with a sleeved Earth Pin, or a fuse that is not clearly seen, it is unsafe and illegal, cut it up and dispose of it. This really is a fire starter when plugged into the standard UK 30 Amp ring main system, as it contains no fuse at all; the wire colours do not comply with UK legislation and worse still, the Live and Neutral connections have been found reversed inside the Plug!

Fit a new IEC cable and Plug, fused at 3 Amps though 5 will be acceptable.

**DO NOT USE!**

Cut out a copy of above label and stick to bottom cover using double sided tape.

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Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

So is there anything we can do with the original MSS23B valve cover that is now ready for the scrap bin? Yes there is! Read on.

Fellow Yaqin enthusiast Mark Kerr had his MS23B converted but decided to modify the original tube cover for further use. Here is his write up on the work he did, thanks for sharing Mark.

With the rear of the shield facing towards you using a pencil and a steel ruler mark two lines 7mm in from the edge of the upright section so they are parallel to the outside edge and extend from the fold to the curve to the top surface. Extend the lines from the curved edge so they meet the outer edges of the oblong cut-out in the centre. Hopefully the image should explain the outline required.

This mod is to allow the shield to be replaced after carrying out the 'Les Box' mod on the Yaqin MS-23B.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Using a junior hacksaw with a sharp blade, cut down this line from the centre cut-out to the crease being careful to not go over the outer edge of the line nor past the crease at the base (yes my example in the next photo shows what happens if you do, thankfully as it faces the rear it is slightly forgiving).

Cover the flat portion at the rear with the two screw holes in tape and secure in a vice or similar

Gently flex/wiggle the cut portion to and fro above the crease and it should break off with metal fatigue.

Dress the edges with a file and sandpaper (fine grit), then clean and remove all particles before re attaching.

John (celebabe on the diyAudio Forum) shows how he mounted V3 whilst retaining the original tube shield. There are no measurements available but hopefully the pictures tell enough of the story.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Looks stock

But it's not
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Used 12mm nylon standoffs
Notice in the above picture John has raised the tubes using saver sockets so as to show off the tubes. Without screening cans being fitted however, it may allow RF fields to inject noise into the amplifier. Here are two photos of the saver socket version.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

The final result. I did need to widen the holes in the shield in order to raise the tubes, but I think this looks great!

Thanks John for sharing your idea.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Here is a fully converted MS23B photo from Juha Järvelä

And that’s it apart from a good session with your favourite vinyl to discover the magic that is now there!

Happy Listening…. Lez at ntlworld dot com
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

The circuit after conversion.

---

**EXTRA 6dB GAIN CAN BE ACHIEVED BY APPLYING LINKS AT C1 AND C8 POSITIONS BY LINKING ACROSS THE VACANT PADS OF THE UNUSED 560 OHM RESISTORS R11 AND R14. THIS IS NOT RECOMMENDED FOR NORMAL USE AS IT INCREASES THE CHANCE OF DISTORTION BY NEGATING THE LOCAL FEEDBACK.**

**VOLTAGES TAKEN WITH A SUPPLY INPUT OF 244V 50Hz.**
The power supply.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

A strange problem discloses itself.
As of the cover date, the author has converted many MS23’s but recently had a problem with two newly manufactured units. One decided to cut out after 20 mins, the other after 2 hours, indicated by the front panel LED being dimmed or extinguished. The 12V regulator was over heating and going into thermal shut down, the filament winding of the power transformer after rectification was giving 18 Volts instead of the usually expected 16V. The regulator is thus now dropping just under 6V and dissipating around 3 Watts. The heat sink should be adequate but bear in mind that there is limited air flow for it to do its job properly. The answer to the problem, should you experience the same, is to fit a 7W 6.8 Ohm resistor inserted between the reservoir capacitor C20 and the input of the regulator. You have to make a track cut, as shown in the photographs, but at least the regulator input will now be more correctly connected directly onto C20, via the new resistor. The resistor takes 3V away from the regulator which now only has to dissipate 1.35 Watts, allowing the heatsink to ensure the regulator does not reach its internal thermal limit. The circuit operation has been checked, using a Variac, to ensure that the regulator still does its job with low supply voltages. The best place to sit the resistor is in the gap between the board and the outer case, lengthening the wires as required, covered in small bore heat shrink sleeving. Thankfully, this change can be done without having to remove the board and only required on units that exhibit the ‘shutdown’ problem.
MAKING A LESBOX 4 MS23 PCB FOR BOARD SWAP.

We start by fitting all components required on what will be the bottom side of the new PCB.

Apart from the resistors all highlighted by the silk screen, we will also fit the 2-pin connectors, 3-way terminal blocks, D1, D2, and the two small trimmer capacitors CT101 and CT201.

You may ask “Why the bottom side first?” This is to give easier access to the solder pads which would otherwise be obscured by the larger components on the board top side.

D1 & D2 – 1N4007 (Observe small oblong on right hand side of board silk screen is the Grey band end)
R1 – 100k 1W
R2 – 6R8 5W wire wound. After mounting, short it out with a wire link.
(The resistor may only be required where the transformer gives an excessive heater voltage. This will manifest itself by the Blue LED dimming or in some cases, extinguishing after a period of time.)
R3, R4, R109 & R209 – 330k 1W
R5, R113 & R213 – 150k 1W
R6 – 22k 1W
R101 & R201 – 47k
R102, R202, R114 & R214 – 1k

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Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

R103, R203, R115 & R215 – 1M
R104 & R204 – 316k
R105 & R205 – 39k2
R106 & R206 – 120k 1W
R107 & R207 – 2k2
R108 & R208 – 1k2
R110 & R210 – 180k
R111 & R211 – 75k
R112 & R212 – 18k
R116 & R216 – 20k 0.6W
CT101 & CT201 – 50pF Trimmers

Now fit the three miniature terminal blocks, the author likes to fit a Black terminal block for the Ground wires. Make sure they are mounted the right way around with the holes for the wires located around the board edge.

Fit the miniature 2-Pin plugs; these can be reclaimed from the old board. Take careful note of their orientations. They all mount with pins uppermost except the lower left LED plug which points downwards. Note how plug XS4 and XS3 are temporarily prised up, this will allow access to the solder pads for C203 and C9. Once these components are fitted later, the two plugs can be carefully placed back against the board.

**Due to V3 socket, it is important that you now fit the central 13mm stand-off pillar.**

You can also fit the four 10mm stand-off pillars to the four board edge mounting locations. These stand-off pillars can be obtained from the old board along with their securing screws.

The board should look like this. NOTE: The heater wiring will be added later so as not to obscure solder pads of components to be mounted on the upper side.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Before building the top side of the board, some components require work of a mechanical kind. The Regulator has to be mounted to the heat sink and will require a 6mm long M3 screw, shake proof washer and nut. It is also required to be treated with a thin film of heat sink thermal compound so that its metal tab makes a good thermal bond with the heat sink. There may be enough by re-using the old regulator and salvaging what’s left remaining on the old heat sink. The new heatsink has a better performance than the original one.

The skirted valve holders are special and have integral grounding pillar, you need to add a 7mm spacer and two 4mm screws.

For V3, one of the old MS23 PCB valve holders can be used, remove from old board and carefully remove the skirt flange. The photo below shows one being used.

Construction of the top side of the board should start with;

D3 & D4 – Bridge rectifiers. There are two sets of pads to accommodate the most popular lead configuration. Polarity is important!

7812 Regulator – Fit complete with its heatsink.

Valve holders – For mounting the valve holders, first clean or pre-tin the legs then fit to board, securing with the 7mm spacer and two 4mm screws. Make square to the board, holding the assembly if required, while soldering the Grounding stand-off lug. With its position now securely held you can solder all nine pins of the holder.

The side of the board you have been working on should look like this:
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Now we add the remaining components, there are a number of electrolytic capacitors which MUST be placed onto the board the correct way round.

The White segments in their respective circles are where the Negative (-) wire has to go and the larger electrolytic capacitors have their Positive (+) wires indicated by a square solder pad rather than a round one.

C1 – 1000uF 25V Body Height 21mm Width 12.8mm
C2 – 100uF 25V Body Height 11.5mm Width 5.3mm
C3 – 47uF 350V Body Height 21mm Width 16.3mm
C4 – 47uF 350V Body as for C3
C5 – 47uF 350V Body as for C3
C6 – 47uF 350V Body as for C3
C7 – 47uF 350V Body as for C3
C8 – 47uF 350V Body as for C3
C9 – 47uF 100V Body Height 13mm Width 11mm
C101 & C201 – 68uF 350V Body Height 26mm Width 16.2mm
C102 & C202 – 100nF 400V
C103 & C203 – 8200pF Silver Mica
C104 & C204 – 160pF Silver Mica
C105 & C205 – 3.3uF 400V
R9 – 10k 5W radial wire wound resistor.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Make up the twisted wiring harness as below. Solder the free end of the 110mm to the HTR OUT pads (located between terminal blocks) and solder the first 70mm daisy chain link to V1 pins 4 & 5. As with all of the heater pins, there are additional solder pads for you to use. The second daisy chain link, connecting both 70mm pieces, should be soldered to V3 pins 4 & 5 and finally, the free end of this last 70mm daisy chain should be soldered to V2 pins 4 & 5. The wiring should be held in place by one or two small zip ties.

There are three sets of pads at the HTR OUT pads should you prefer to use three separate cable runs which along with better wire may make for a neater appearance. The author just grabbed a roll of power earthing cable for this prototype.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

The following is for those who want to test their boards in isolation, but for those confident to do the tests in the MS22/23 mainframe then jump to the SIGNAL TESTING section.

**For testing in isolation**, a power transformer giving 230V AC and 15V AC is required. A cheap alternative and safer, is to use two standard back to back power transformers. These MUST be placed in a well-insulated enclosure of course. First one is 20VA 15V and the second is 12VA 15V. If you use types with twin secondary’s like below, then make sure the windings are paralleled correctly, 0 to 0 and 15V to 15V.

![Power Transformer Diagram]

NOTE: The centre screw of the 230V and 15V AC terminals is not used; it merely acts as a safety gap between the supply wires to reduce the chance of a short circuit due to a stray conductor wire.

**SIGNAL TESTING**

Before powering up you will of course need to plug in 12AX7 valves to each of the three sockets. If you have a Variac or lamp limiter, it may be a good idea to initially use this so that the chance of a fault will be spotted before a lot of damage is done. If you otherwise feel confident, then apply the AC power supplies and check for HT (B+) between the Black Ground terminal block and either pin 1 or pin 6 of V3.

Check across the + and – pads of the HTR OUT for approximately 12.6V. Check between the Black Ground terminal block and the pads of the HTR OUT for heater lift. Depending on the pad being measured you should get approximately 29V or 42V.

For signal testing you will need a low distortion sine wave generator with a levelled output and spanning 20 Hz to 20 kHz. The author uses a HP 209A with an in-line 30dB attenuator.

Measurements should be taken using a wide frequency range RMS voltmeter. The author uses a HP400EL with enlarged decibel scale.

Additional tests can be made using an oscilloscope. The author currently uses a HP 54600B.

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Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

Unless you are testing in the MS22/23 chassis, you will need to interface the board under test with your test equipment. The authors' test equipment has BNC connectors so four interface cables were made by cutting two 2 metre BNC-BNC cables in half. Each cable was then fitted with mating pre-wired two pin sockets, bought from eBay.

If you have an oscilloscope then a quick check would be to inject 1kHz into the MS23 and set oscilloscope for a display of say four vertical divisions.

Then set signal generator to 20Hz and not that the oscilloscope display has increased such as to be off the screen.

Set the signal generator to 20kHz and not that the oscilloscope display has decreased to a very small deflection.

Having proved this occurs on both Left and Right channels, you can now set the trimmers if required.

Inject a 1kHz sine wave to J1 and monitor output on J3, set constant output sine wave generator to give 0dB output on the RMS Voltmeter.

Switch sine wave generator to 20kHz and adjust CT2 to give -19.6dB on the output.

Repeat for J2 and J4, adjusting CT1 for -19.6dB on the output.

Note: If trimmer range is insufficient it may be necessary to alter the value of C9 and C10 as required but there are additional pads on the board for adding, for example, a 10pF Mica capacitor.

Some typical voltage measurements. HT at the 20k resistors = 198V and 201V
AC input on Heaters Terminal Block = 17.3V
AC input on 200V Terminal Block = 216V
Heater supply from regulator = 12.45V
Heater lift = 29V/42V

If you don’t have a suitable RMS meter then you can use an oscilloscope and a 1kHz square wave, adjusting the trimmers for best square wave on the oscilloscope. However you will need to construct a reverse RIAA network to fit between the 1kHz signal generator and the phono amp input.
SWAPPING THE LESBOX 4 PCB FOR THE MS23 PCB.

Taking apart.

It is strongly advised to apply some wide sticky tape or kitchen towel across the top and sides of the transformer cover to prevent any scratches that may be accidentally picked up during the conversion work.

Best to pull out the two valves now and store in a safe place.

Remove the Yellow and Light Blue indicated screws.

The cover should now slide slightly towards the front to disengage the rear lip after which the cover can be lifted away. The Author found this slightly difficult on the early MS22’s due to a foot screw fouling on the internal screening frame. In this respect it will be found helpful to also remove the top right hand foot as shown in the above picture.

You also need a Torx size 10 screw driver to remove the screws on the chassis top securing the rear and front panels. As you remove the front panel, disconnect the 2 pin connector mounted on the rear.

Now before commencing on the board, make sure the internal capacitors are fully discharged!
With your Multimeter switched to DC Volts check across + and – of C17 to ensure the capacitors are all but discharged.
Putting ‘LIFE’ into the Yaqin MS-22B and MS-23

These can be discharged if necessary by holding a suitable low value resistor (a 1k2 1W should do) across + and – of C17 for 20 seconds (see next photo).

Now detach the four white plugs from the circuit board connectors, don’t worry, they are easy to identify when it comes to re-assembly.

With reference to the following photo, now cut the two White wires (on later MS23B models this may be a 2 pin plug with Blue wires), BUT ensure the cut is as close to the solder point as possible as spare wiring is at a premium. With respect to the 2 pin plug with Blue wires, then likewise cut off the plug but as close to the connector as you can. These wires carry AC voltages so it does not matter which way round they go when you terminate them later into their designated screw terminals.

Now cut off the two Yellow wires as close to the solder point as possible. These wires also carry AC voltages so it does not matter which way round they go when you terminate them later.

Now cut off the Ground wires, there may be as many as three, sometimes they are coloured Yellow/Green else simply Black but once again, save as much wire length as you can while doing this. There is normally an Earth wire going to the circuit board at the position marked G2. On the MS23 there may be two black wires on G2 and not a Yellow/Green wire as shown. In fact there have been a number of production variations, some will go to G2, some to the STAR Point, some use a connection to the left of the STAR (hidden by the Yellow twisted wires) and some units even have a connection on the ground track that connects to the lower electrolytic capacitors C15 and C16.
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The circuit board should now be removed; this is held in by four countersunk head 3mm screws. Put these safely away with the other screws you removed as they will be needed for the new fit.

Next you have to cut the chassis for the extra valve V3.

Below is a simple template (shaded in Grey) for you to make from thin card or stout paper, using this template you can position the mounting hole correctly for the extra valve V3. The template card IS NOT TO SCALE so don’t cut it out thinking it will be correct, you have to measure this up as shown onto suitable paper/card and cut it out. The dark grey areas are the holes already present and show how the template is positioned around them.

Simply lay card on the underside of chassis as shown and drill/mark the centre spot for the new valve holder.

Alternative mounting sketch:

Simply centre mark or punch the required position for the pilot hole and then cut the panel for the valve position. After a small pilot drill, the author runs through a 6mm drill then applies a cone cutter. These are cheaply available on the internet and allows easy cutting of the 6mm hole to 28mm. Drill from the inside to outside to prevent marking the panel top.
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Be careful of machining operation swarf when cutting the large hole for the extra valve. It helps to keep the amplifier body tilted forward slightly during these operations to prevent metal particles finding their way into the power transformer cover. The author runs a wide tip Black Sharpie around the inside of the new hole to make it look like the other two.

Fit the four 10mm threaded pillars and countersunk screws from the old board and offer up the new board to the chassis. Don’t actually secure the board yet as you may appreciate a bit of room to get the wires into the terminal blocks.

Wiring up

Strip off a small amount of insulation from the two Yellow Wires and insert into the miniature terminal block as shown. Note that the centre position is not used to deliberately act as safety spacing against stray wires causing a short circuit on the transformer.

Likewise strip off a small amount of insulation from the three Ground wires and insert into the miniature terminal block as shown.

Likewise strip off a small amount of insulation from the two Blue (or White) wires and insert into the Heater miniature terminal block as shown. Note that the centre position is also not used to deliberately act as safety spacing against stray wires causing a short circuit on the transformer.

NOTE: The photo is of an earlier board but the wire connections are the same.
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The board can now be secured with the four countersunk screws you put by earlier.

It is now necessary to connect up the audio channels and the LED cable.

It was not possible to obtain matching 2 pin connectors for the ones fitted inside the MS22/23 but if you have alternative ones, these will be found to be OK. They will just about provide enough pin grip to the mating half. Fit the connectors so that their side with a small ramp goes under the shortened plastic extension, give a nice push and they should mate nicely.

Transfer the LED cable from the old board to the new, connect the free end to the front panel and offer this up to the main chassis. It may be necessary to move the 160pF capacitors slightly to one side to prevent contact with the front panel LED circuit board as the panel is re-fitted.
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Do not adjust the trimmer capacitors, these have been set for you and if disturbed, will require special test equipment to reset for optimum RIAA characteristics.

**Common connection break (only if you have had hum problems)**

Check that the Ground lugs of the RCA sockets are not soldered together, this applies to both the INPUT and OUTPUT socket pairs.

As shown in the following photo, if you find the two Ground tags soldered together then separate the tags and Black wires. The newer units appear to have some kind of thread locking varnish applied which makes it difficult to loosen the fixing nut. The author removes both Black wires and excess solder, then reheats the connection whilst turning one of the RCA jacks with a 15mm socket or combination wrench. With luck the two tags will separate and you should continue turning until the tags are well spaced apart. Finally reconnect the respective Black wires to their own independent tags.

FINALLY - Replace bottom cover and power-up, checking that the Blue LED on the front panel is lit.

**ENJOY!**
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