

MC Valve Pre-Amplifier

This was designed as an experiment to see if valves could really perform this function as the general consensus was that they could not.

The problem of using valves is that the supplies to them must be very smooth and stable and also they are much larger than transistors and thus more prone to picking up unwanted signals like supply frequency magnetic fields.

Perhaps the biggest problem for the Author is the lack of a MC cartridge as he has used the Shure V15 Mk.3 MM cartridge for 50 years with complete satisfaction.

The power supply should not be too much of a problem and in fact the intention of this design is to utilise the high voltage supply of the Yaquin MS22 or 23, especially if it has been LesBoxed with a swap board.

The size problem was addressed by using a wire ended miniature valve, in this case the Russian 6N16 double Triode, used in the popular SRPP circuit mode.

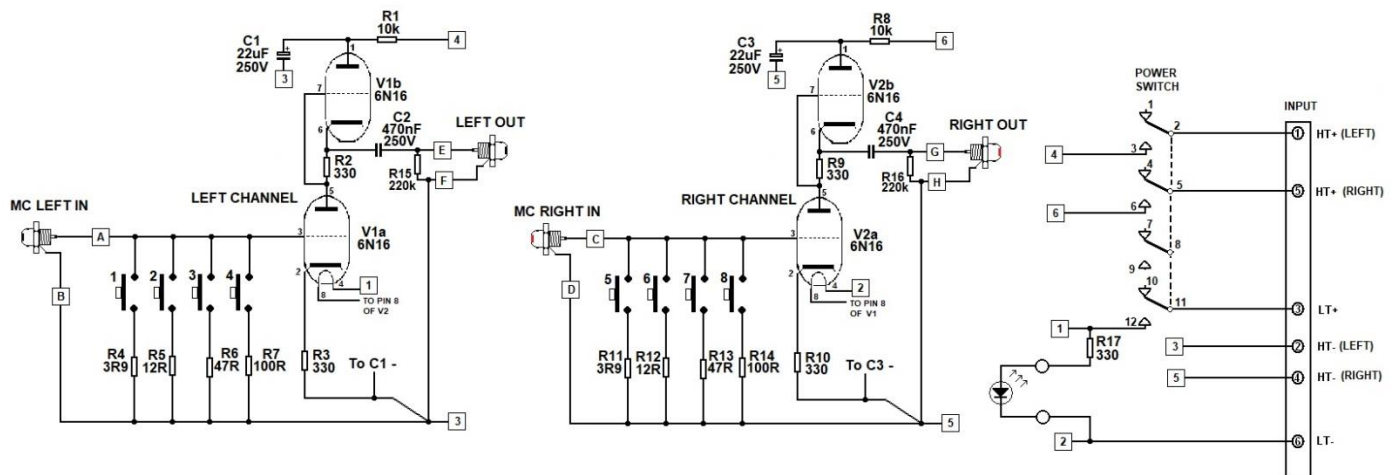
The only real problem with these valves is the high heater current which is 400mA and may tax the 12V regulator of the MS22/23. It is not so much the regulator but its small heatsink which was addressed on the swap board by adding a 6R8 resistor to take some heat away from the regulator. The extra pair of 6N16's will produce an extra volts drop of 2.5V and if this reduces the input to the regulator too much then it will drop out of regulation and create possible 100/120 Hz interference. It should be OK to reduce the 6R8 down to 3R3 if the 6R8 gives us any problems, the regulator itself is good for 1 Amp but one has to remember that the initial load current will be many times this while the valves are cold. Fortunately the series resistor will drop more voltage at this time so it will be giving the regulator a help.

The 6N16's are wired in series so they can be run from the 12V supply of the MS22/23 swap board.

The following information is for the build on 0.1" stripboard; in fact a standard Eurocard size has been used which is 38 Tracks with 61 Holes per Track. The whole circuit would probably be physically much smaller on a custom designed circuit board. The stripboard imposes its own problems, such as the need to ensure greater spacing for high voltage and trying to avoid long tracks that could pick up interference or provide unnecessary capacitive coupling.

The Circuit Board designer is relieved to some extent of this and can even place the signal tracks between Ground areas for minimum pick up of noise and even engineer-in a copper Ground plane.

The Circuit:-



The LesBoxed MS22/23 or the LesBox 5, has two separate internal HT rails for the Left and Right RIAA circuits. These are best accessed at their respective smoothing capacitors C101 and C201, using two sets of Red/Black wires. For the Left Channel, run a Red wire from C101 Positive to Pin 1 of the connector which will connect to terminal 4 on the MC board. The 0v Black wire from C101 Negative should go to Pin 2 of the connector which will connect to terminal 3 on the MC board.

Using the other set of Red/Black wires for the Right Channel, run the Red wire from C201 Positive to Pin 5 of the connector which will connect to terminal 6 on the MC board. The 0v Black wire from C201 Negative should go to Pin 4 of the connector which will connect to terminal 5 on the MC board. This has not been tried as the Author does not have a MS23 to experiment with, it may turn out better to take the HT feeds from the hot ends of the 20k resistors.

Note that the Grounds on the board Pins 3 and 5 are split into two legs on the board with one leg going to C1 and C3 Negative connections. This is to take away any capacitor ripple from the signal Grounds though this is considered not really essential as any ripple will be very small if not non-existent.

The MC Cartridge outputs are applied to board terminals A and B (Left Channel) and to C and D (Right Channel). Both channels are identical so the description of the Left Channel will suffice for the Right Channel.

The Input is wired directly from board Pin A to Pin 3 of V1 (Grid). There is a DIL switch network connected to Ground on this input, this can be switched to give a 15 cartridge loadings using a combination of R4 (3R9), R5 (12R), R6 (47R) and R7 (100R).

In the tables the figure 1 indicates a switch being placed ON.

SWITCH ORDER

| DIL SWITCH SETTINGS | | | |
|---------------------|------|------|------|
| 1234 | | 1234 | |
| 0000 | Hi-Z | 1000 | 3R9 |
| 0001 | 100R | 1001 | 3R75 |
| 0010 | 47R | 1010 | 3R6 |
| 0011 | 32R | 1011 | 3R5 |
| 0100 | 12R | 1100 | 2R94 |
| 0101 | 10R7 | 1101 | 2R86 |
| 0110 | 9.6R | 1110 | 2R77 |
| 0111 | 8R7 | 1111 | 2R70 |

RESISTANCE ORDER

| DIL SWITCH SETTINGS | | | |
|---------------------|------|------|------|
| 1234 | | 1234 | |
| 1111 | 2R70 | 0111 | 8R7 |
| 1110 | 2R77 | 0110 | 9.6R |
| 1101 | 2R86 | 0101 | 10R7 |
| 1100 | 2R94 | 0100 | 12R |
| 1011 | 3R5 | 0011 | 32R |
| 1010 | 3R6 | 0010 | 47R |
| 1001 | 3R75 | 0001 | 100R |
| 1000 | 3R9 | 0000 | Hi-Z |

On the Right Channel the load resistances will be the same but using switches 5, 6, 7 and 8.

The current flowing through V1b is set by R2 with R1 acting as Anode Load.

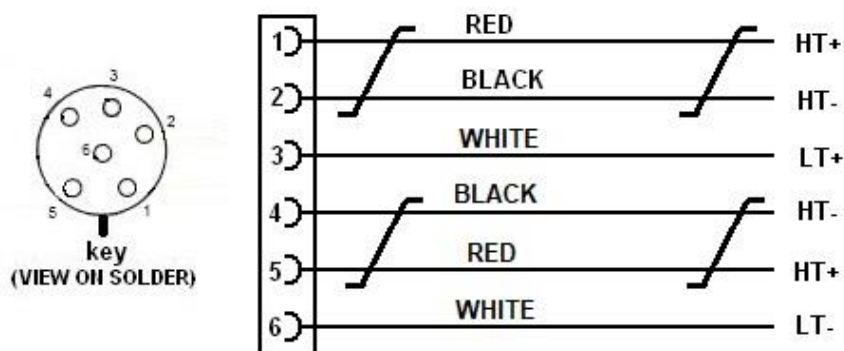
The lower half of V1a is biased in the usual way by cathode resistor R3.

The output is fed to the output RCA Jack from Pin 6 via the capacitor C2 to board Pin E and Ground provided by Pin F.

It is possible that board Pin E could attain a voltage if this is left unterminated, that is if the amplifier is not connected to the host RIAA when the amplifier is powered up.

A 220k resistor (R15 and R16) is placed across the output pins to help bleed away any voltage should this happen.

Power Connector



Parts Guide

Hardware except for the circuit board which is listed separately.

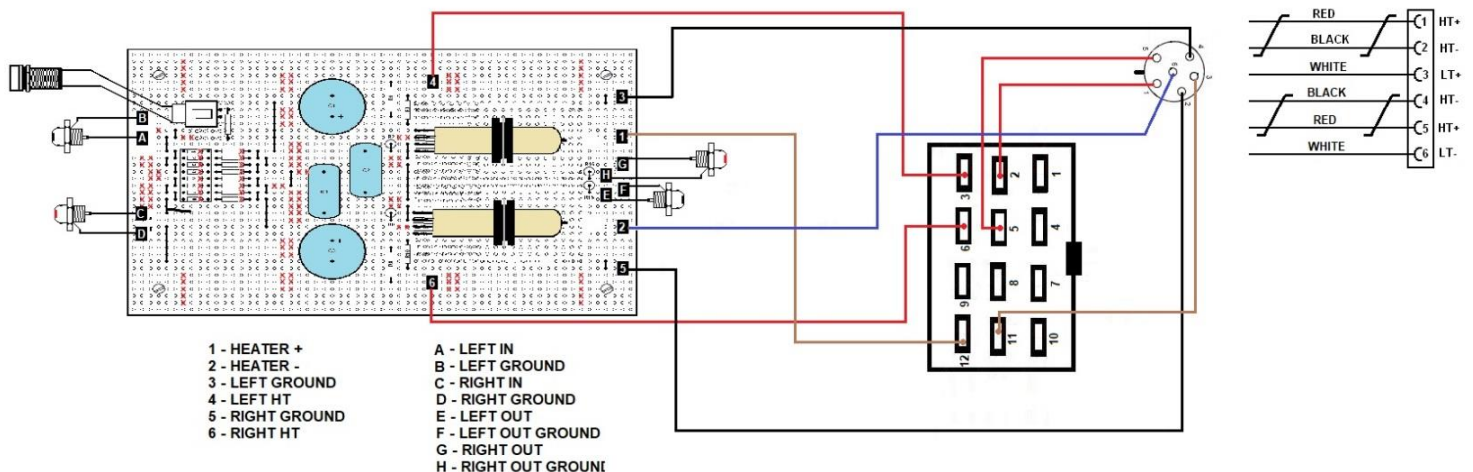
| Ref | Description | Supplier | Part |
|-----|---|---------------|----------|
| 1 | Diecast Box, Hammond 1590, 187.5 x 119.5 x 52 | RS Components | 528-7268 |
| 2 | RCA Jack, Red (2 off) | Cricklewood | PCAR |
| 3 | RCA Jack, Black (2 off) | Cricklewood | PCAB |
| 4 | Rubber Foot (1 Pack of 4 off) | Cricklewood | FTR194 |
| 5 | Power Input connector, 6 way | Cricklewood | YC600 |
| 6 | Power on/off switch, 4-pole change-over, toggle. | Cricklewood | TM42N |
| 7 | M3 countersunk Head Screw x 12mm (4 off for board fixing) | | |
| 8 | M3 Pan Head Screw x 8mm (4 off for Feet) | | |
| 9 | M3 Clench Nut (8 off, 4 acting as spacers) * | | |
| 10 | M3 Nut (4 off) | | |
| 11 | M3 Penny Washer, 10mm, (4 off) | | |
| 12 | Mating Plug for Item 5 | Cricklewood | YL600 |
| 13 | Single screened and plain wire as required | | |

* If you do not have a clench nut kit then fit suitable screws and where necessary 5mm Board Spacers.

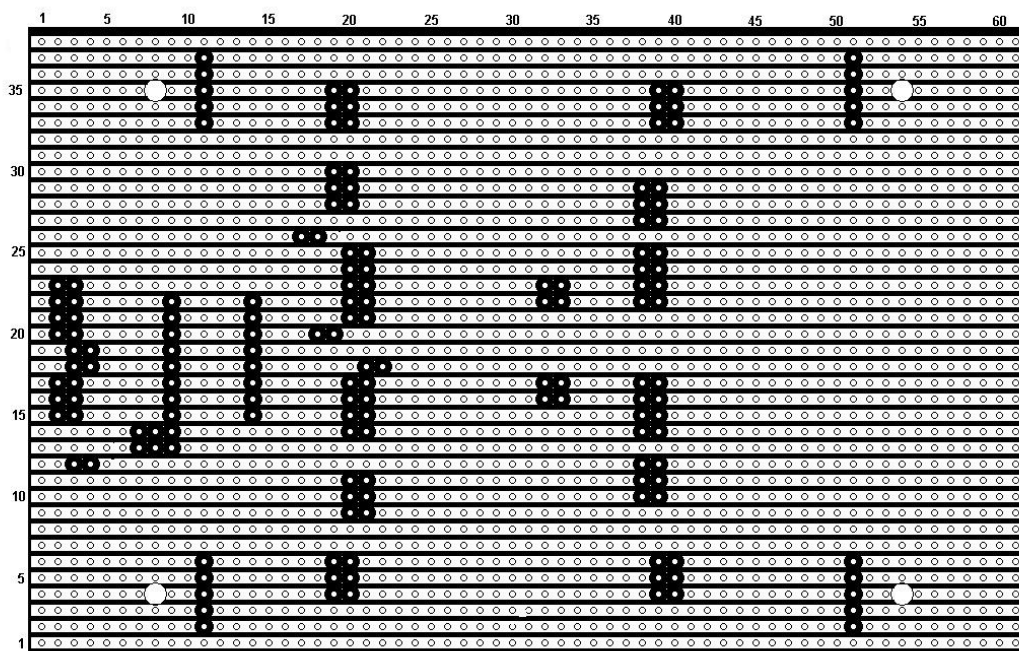
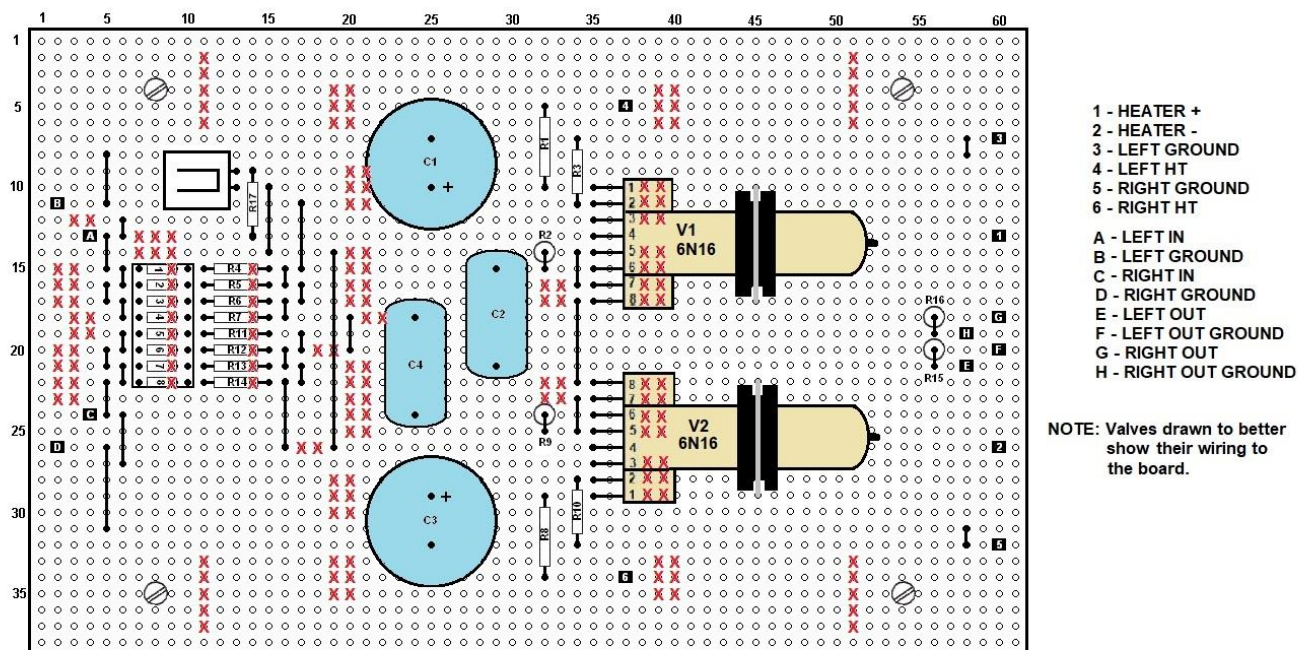
Circuit Board

| Ref | Description | Supplier | Part |
|-----|--|----------------------------|----------|
| 1 | Eurocard size strip-board, 38 tracks, 61 Holes per Track | RS Components | 518-5932 |
| 2 | 8 way DIL switch | Cricklewood | DLS80 |
| 3 | Wire ended double Triode Valve, 6N16 (2 off) | Internet Supplier (Russia) | 6N16 |
| 4 | Suitable rubber grommet for securing valves, 10mm i.d. (2 off) | Internet? | |
| C1 | 22uF, 250V | RS Components | 365-4672 |
| C2 | 470nF, 400V | RS Components | 191-2875 |
| C3 | 22uF, 250V | RS Components | 365-4672 |
| C4 | 470nF, 400V | RS Components | 191-2875 |
| R1 | 10k 0.25W | Cricklewood | M10k |
| R2 | 330R 0.6W | RS Components | 683-3540 |
| R3 | 330R 0.6W | RS Components | 683-3540 |
| R4 | 3R9 0.25W | Cricklewood | Q3R9 |
| R5 | 12R 0.25W | Cricklewood | M12R |
| R6 | 47R 0.25W | Cricklewood | M47R |
| R7 | 100R 0.25W | Cricklewood | M100R |
| R8 | 10k 0.25W | Cricklewood | M10k |
| R9 | 330R 0.6W | RS Components | 683-3540 |
| R10 | 330R 0.6W | RS Components | 683-3540 |
| R11 | 3R9 0.25W | Cricklewood | Q3R9 |
| R12 | 12R 0.25W | Cricklewood | M12R |
| R13 | 47R 0.25W | Cricklewood | M47R |
| R14 | 100R 0.25W | Cricklewood | M100R |
| R15 | 220k 0.25W | Cricklewood | M220k |
| R16 | 220k 0.25W | Cricklewood | M220k |
| R17 | 330R 0.6W | RS Components | 683-3540 |

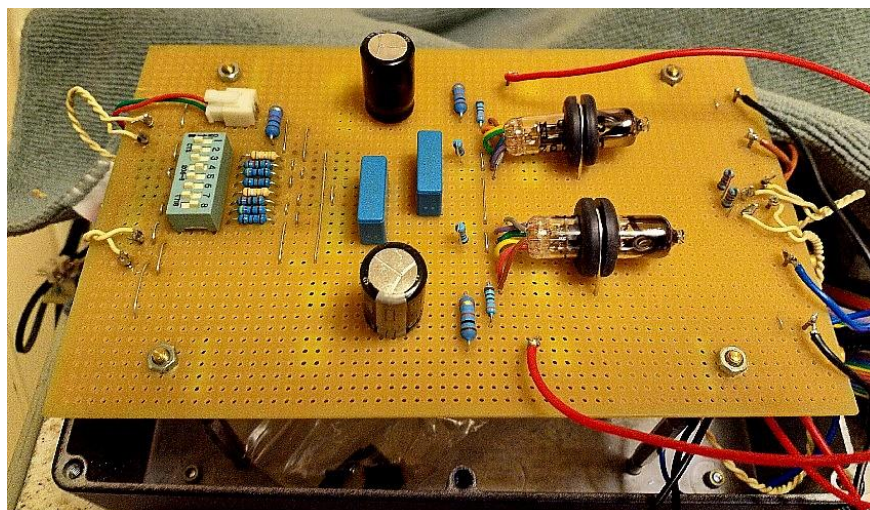
Physical Wiring



Prototype Board Layout.



On Test



The Author did some quick tests before powering the board up, checking that the input termination resistors worked OK and left it set at 100 Ohms.

LEFT Channel tests: 1 = 4.3 Ohms, 2 = 12.4 Ohms, 3 = 47.5 Ohms and 4 = 100.2 Ohms.

RIGHT Channel tests: 5 = 4.3 Ohms, 6 = 12.4 Ohms, 7 = 47.5 Ohms and 8 = 100.3 Ohms.

He then did a check for adjacent strip shorts, always useful to do especially on the valve connections and High Voltage strips. Most important to check the High Voltage lines go nowhere except to where they should go.

There was a problem with the Right channel as it was not giving any decent output. The Left Channel without the MC Amp requires 4.5mV (-47dB) for 0dB at 1kHz. With the MC Amp connected it only required 0.5mV input (-66dB) for the same 0dB output thus giving an additional gain increase of just under 20dB.

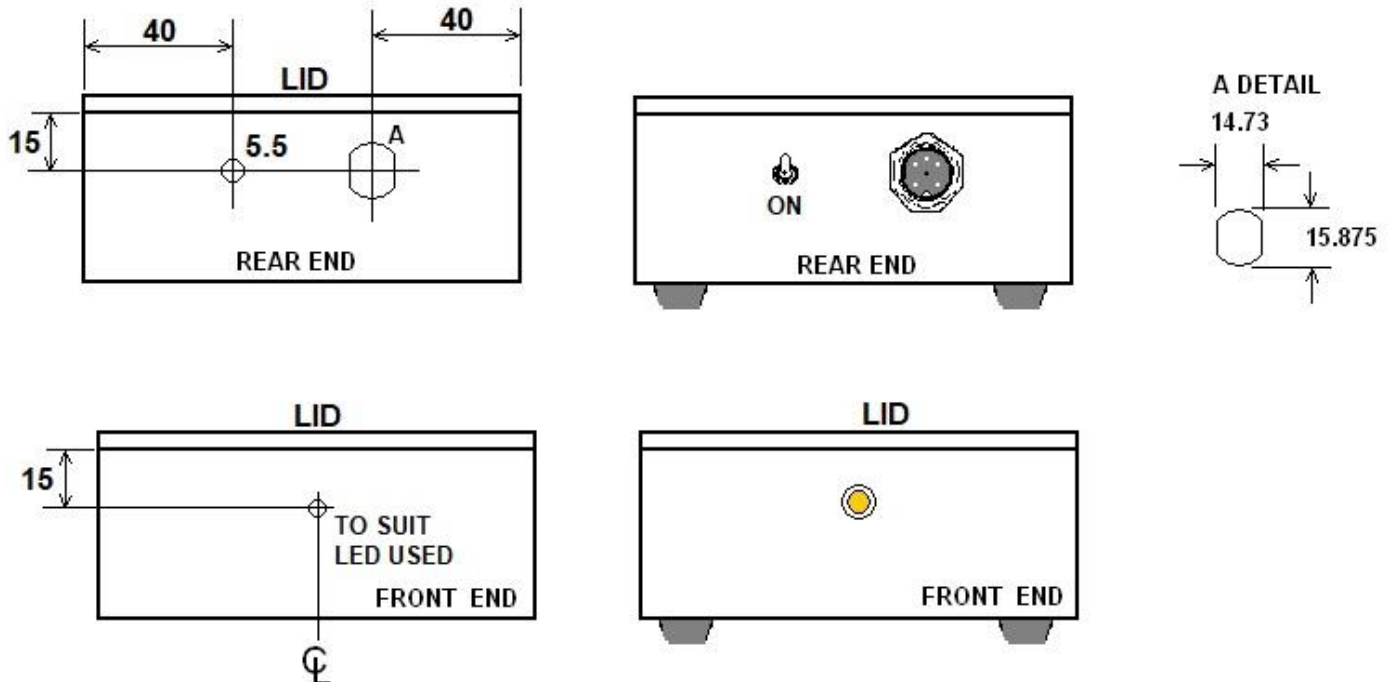
The Right channel was not working because the HT feed was incorrect and once reconnected it gave the same results as the Left Channel. The response on both channels was essentially flat from 10Hz to over 60kHz. The Author found the RIAA curves degraded particularly at 10kHz and above but this was found to be due to the companion LesBox 4 being used for tests was picking up too much 50 Hz from its power supply, well it was sat on it! 😊

When the three items were separated then the RMS voltmeter gave expected RIAA readings, just shows how sensitive the Authors test gear is and how important to keep power transformers away from the sensitive RIAA circuits.

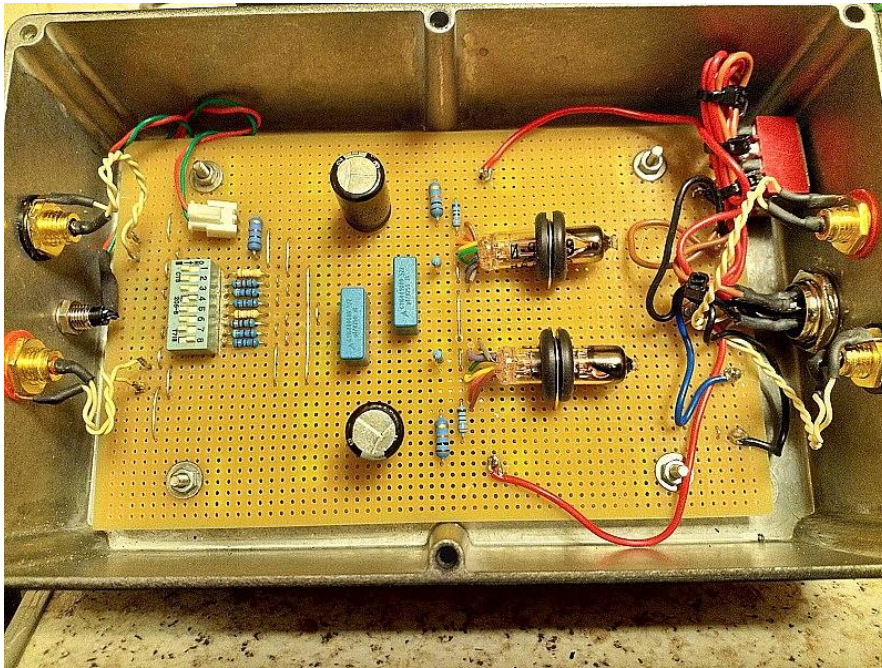
Now to send the unit to someone with a MS23 or LesBox who also has a MC cartridge, so that a real dynamic test can be done?

A strange thing for the Author to build considering that he has no MC cartridge to test it with. 😊

Example Box layout



Board in its box



Both channels are essentially flat from 10Hz to over 60kHz.

The power switch was a pain and not recommended if you want an easy life wiring up. Mounting a little higher together with the input socket would not be a bad idea!

The 6H16B double triode is designed for amplification of low-frequency voltage and generation of high-frequency currents.

The 6H16B double triodes are superminiature devices enclosed in glass bulb and provided with eight flexible leads and an indirectly heated oxide-coated cathode.

The 6H16B double triodes are resistant to ambient temperature from -70 to $+100^{\circ}\text{C}$ and relative humidity of 95 to 98% at $+50^{\circ}\text{C}$, as well as to mechanical loads: linear loads up to 100 g, vibration loads up to 10 g, multiple impact loads up to 10 g and single impact loads up to 500 g.

Maximum weight: 4 gr.

Service life guarantee: 750 hr.

ELECTRICAL CHARACTERISTICS

| | | | |
|----------|--------------------------|--------------------------|-----------------------------|
| U_h | 6,3 V | $S^2)$ | $5,0 \pm 1,25 \text{ mA/V}$ |
| I_h | $400 \pm 40 \text{ mA}$ | $\mu^2)$ | 25 ± 5 |
| U_a | 100 V | $R_{g1k}^3)$ | 32 k Ω |
| $R_k^1)$ | 325 Ω | $U_{\sim \text{eff}}^4)$ | $\leq 15 \text{ mV}$ |
| $I_a^2)$ | $6,3 \pm 1,9 \text{ mA}$ | | |