

Upgrading a Leak Trough-Line Mk.2

Neville Roberts

There have been many companies that have offered an upgrade service for the legendary Leak Trough-Line FM tuner in the past, but numbers are dwindling. However, quite a lot can be achieved by an amateur enthusiast without the use of specialised test equipment. Neville Roberts describes his approach to doing it yourself...

Upgrading the legendary Leak Trough-Line FM tuner was big business in the late '90s, but with rumours of the demise of FM stereo broadcasting in the UK, interest has dwindled in recent years. However, it now looks like good old FM has had a stay of execution and is set to continue for a while.

As one of the companies who used to offer a vintage restoration service puts it: "The restorations are not cheap" and with the rising cost of labour, it is becoming increasingly expensive. This got me thinking – I wondered what could be achieved by a DIYer with inadequate test equipment and limited FM tuner alignment experience?

There are, once again, some real bargains to be had on eBay and one can pick up a Trough-Line Mk.2, Mk.3 or Trough-Line Stereo for around £100 or so. Any of these are suitable candidates for upgrading.

The Mk.1 only covered the range of 88-100 MHz, and is not worth upgrading, while the later models covered the full range of 88-108 MHz. Apart from the exterior appearance, the Mk.2 and the Mk.3 are identical electrically. The later Trough-Line Stereo is very similar, but has a few minor changes to the Mk.2/3 circuit and valve line-up in order to feed the internal stereo decoder that, incidentally, used three AF126 germanium PNP transistors. Alas, this decoder falls short of the mark in terms of quality and is best replaced with a modern Phase Lock Loop (PLL) decoder, just as will be required to fit in a Mk.2 or Mk.3.

Out with the old

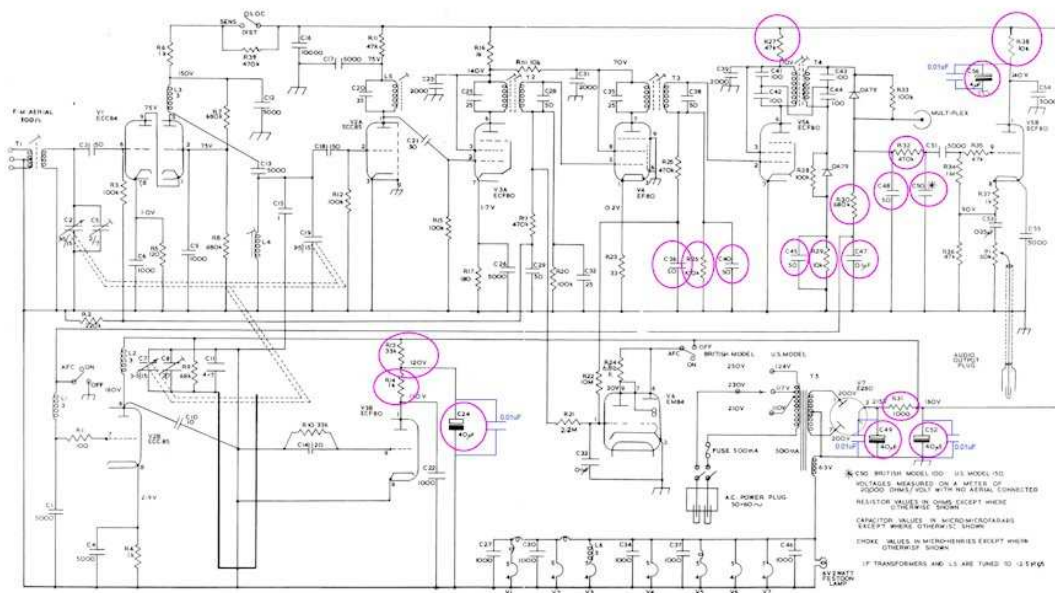
Obviously, before starting the upgrade, it is important to make sure that the vintage tuner is working as a mono tuner and, if not, carry out any necessary repair work first. From there, one can determine what needs to be done, what is desirable to do and what should be left alone!



Trough-Line 2 front view before upgrades



Trough-Line 2 rear view before upgrades



CIRCUIT DIAGRAM OF LEAK "TROUGH-LINE II" F.M. TUNER

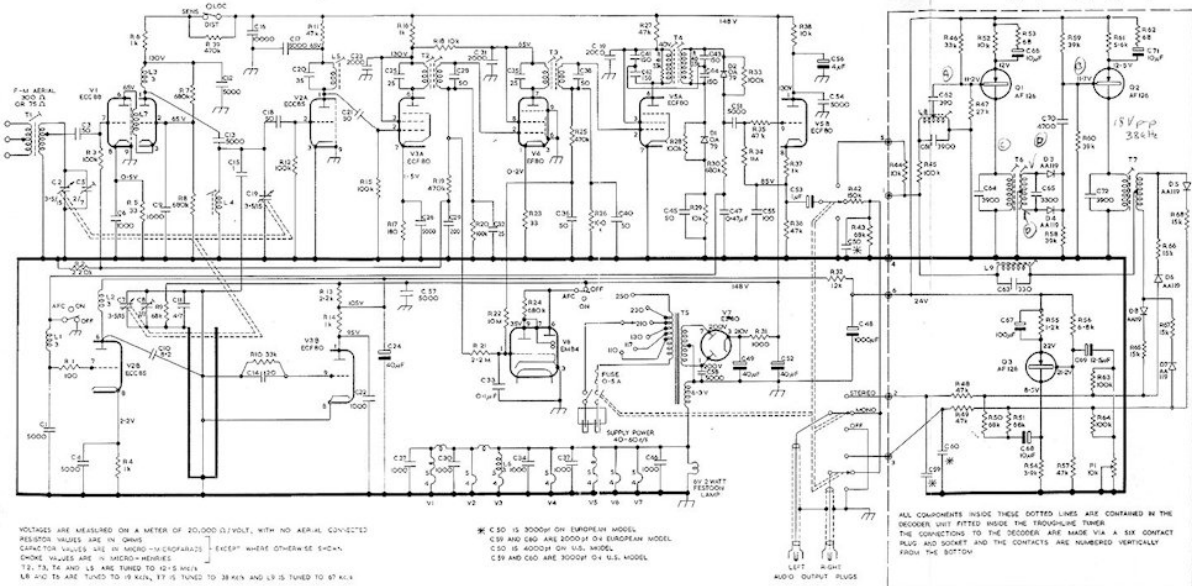
H. J. LEAK & CO., LTD.

BRUNEL ROAD • WESTWAY FACTORY ESTATE • LONDON W.3

Telephone:
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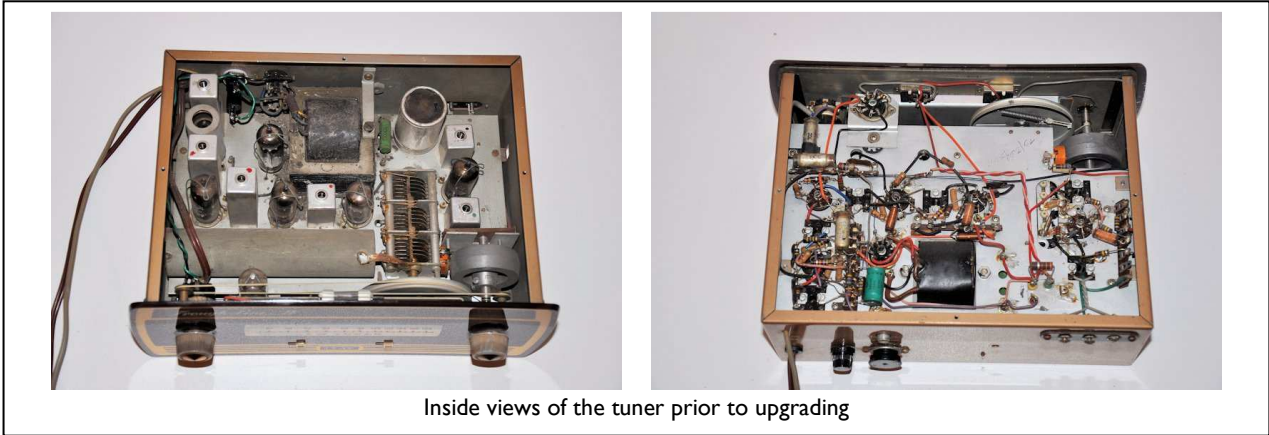
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Leak Trough line 2 circuit diagram showing changed components



CIRCUIT DIAGRAM

Leak Trough Stereo circuit diagram



Inside views of the tuner prior to upgrading

Before starting to replace aging components, it is most important to decide first what not to touch. I had already learnt through bitter experience many years ago how to convert a working FM tuner into spare parts for the junk box by tweaking coils without the necessary test equipment or expertise! Apart from a multimeter and digital capacitance/inductance meter, I didn't have any RF equipment available, so I decided early on not to touch the RF/IF stages at all. The coils, etc, would have been carefully setup during manufacture. Furthermore, there are a number of components that are not easily replaceable, such as those contained within the IF cans and others, such as feed-through capacitors.

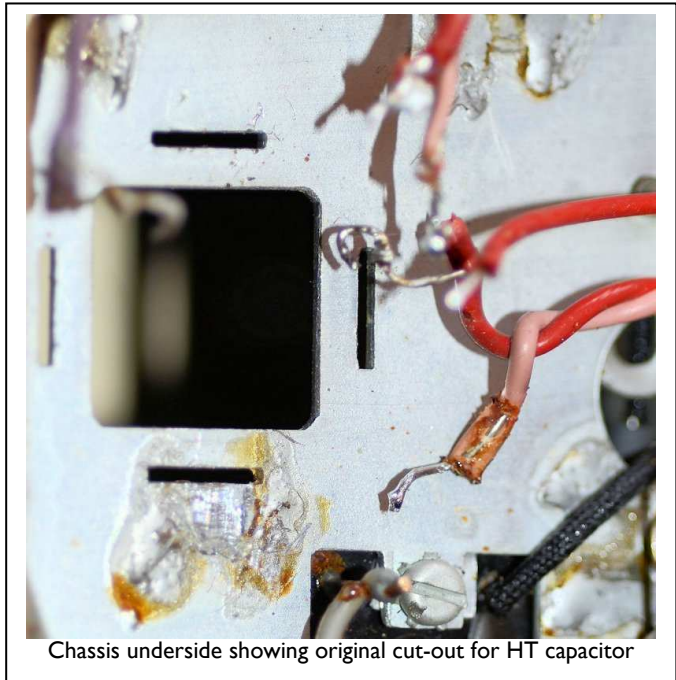
It is well worth testing the valves if one has access to a valve tester. The original ones are 'old shield' Mullard types. They do tend to last well, but if you do have a dud, you should be able to replace them with NOS valves for a few pounds each.

Another thing worth checking that is likely to be an issue with any unit of this age, was the little rubber feet may have perished. New self-adhesive feet are readily available for a couple of pounds and the ones I used were black polyurethane 20.5mm square x 13.2mm high.

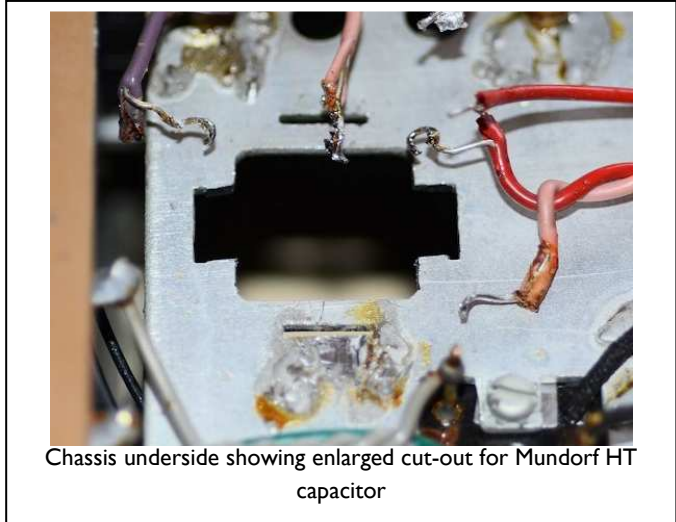
In the 'must replace' category are the 50 year-old electrolytic capacitors and that means re-building the HT power supply. That's not as difficult as you might think as there are only 4 components and one of those is the rectifier valve! Also a must is fitting a quality stereo decoder, but more about that later.

So, first up was to source a replacement for the now unobtainable triple can electrolytic capacitor which would doubtless have gone leaky by now. It is essentially three 40uF 300V capacitors in one can. What does fit the bill perfectly is a 50uF + 50uF 500V in one can – a Mundorf M-Lytic High Voltage dual power electrolytic capacitor to replace both C47 and C52 in the accompanying circuit diagram, plus a separate axial-lead Suntan 47uF 450V which replaced the third capacitor C24 nicely.

To replace the triple can, first unsolder the connections to the three solder tags. Then untwist three of the four retaining tags on the can. The fourth one is soldered to the chassis and I found the easiest way to remove it was to tap a thin screwdriver



Chassis underside showing original cut-out for HT capacitor



Chassis underside showing enlarged cut-out for Mundorf HT capacitor

HT power supply. That's not as difficult as you might think as

underneath it and prise it away - the capacitor then comes away easily. Using a junior hacksaw blade, I enlarged the hole by cutting away the bit of metal on the top and bottom slots. The Mundorf then fitted nicely in the space and the earth tag was soldered onto the chassis in the same place as the old can with my iron turned up to maximum heat! I also fitted a capacitor clip on the capacitor and secured it with a single nut and bolt through a hole drilled in the chassis – see photos.

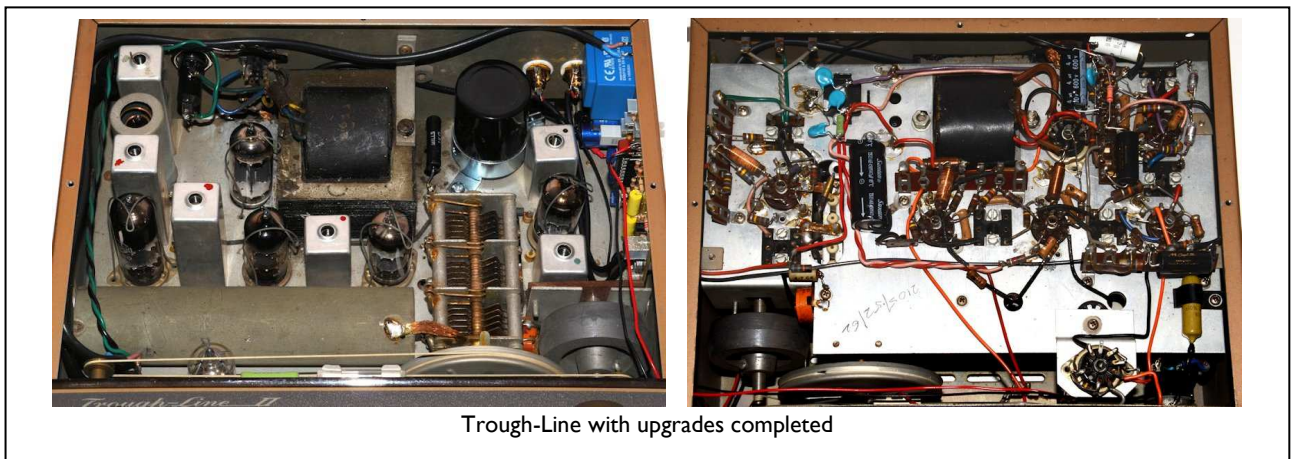
The next task was to replace the other electrolytic capacitor C56 (4uF 250V) with a new 4uF 600V counterpart. I also fitted all these with a bypass 0.01uF 1KV ceramic disc capacitor (the bright blue ones in the photographs) as electrolytics are not good at high frequencies.

The other power supply component requiring replacement was the 1K ohm 15W resistor next to the Mundorf can and that was replaced with a modern Mills wire-wound type.

With reference to the circuit diagram, it can be seen that most of the components around V5B will never be used as that part of the circuit is for the mono output. Remove the mono output flying lead as this will not be required after fitting the stereo decoder. Change the components circled on the diagram with new carbon resistors and polystyrene film for the low value capacitors. As for the 0.1uF and 0.25uF capacitors, replaced these with 0.1uF and 0.22uF 630V Mundorf ZN capacitors respectively.

Allow yourself plenty of time to do these component changes and ensure you have a good temperature-controlled soldering iron available, or a fixed one of around 40W to do the job. Some of the tag strips require a lot of heat to melt the solder – especially those connected to the chassis earth.

With the component upgrades complete, it was time to consider a stereo decoder.



Two channels are better than one

Following some research, I found one company, One Thing Audio, who can supply a top quality stereo decoder board, complete with its own mains power supply on board, suitable for installing in a Trough-Line for £120.

The decoder is based around the LM4500AN Hi-Fi FM demodulator. It has a quoted very low distortion figure of 0.1% and features a blend circuit which optimizes the signal-to-noise ratio under weak signal conditions by gradually combining left and right channel information.

There are three potentiometers on the decoder board – VR1 adjusts the input gain, VR2 is the oscillator lock and VR3 is the stereo separation control. VR2 and 3 are 'factory set' and should not require adjustment, but VR1 will probably need rotating clockwise to reduce the level as the output from a Trough-Line tuner is quite high.



The bulk of the work to fit the decoder is drilling the case to accommodate the two RCA phono sockets on the rear panel and the three mounting holes for the printed circuit board (for which One Thing provide a drilling template). Also included with the board is a little red LED as the stereo beacon, which I wanted to mount in the front dial backplate next to the EM84 tuning indicator.

When drilling (and filing) the metalwork, be sure to use plenty of masking tape (especially on the front dial) to minimise the risk of scratching the paintwork should the drill slip! It is really worth the effort of doing this carefully as the final result can look very professional, which is very rewarding.

To connect the decoder, first wire up the stereo output sockets and then connect the decoder input to the multiplex output socket (I connected this at the tag strip end, rather than the phono socket) via a supplied 1uF 160V coupling capacitor. Next, hook up the stereo LED beacon (observe the correct polarity of the LED) and finally the mains input to the connections on the Trough-Line on/off switch.

Time to switch on and listen!

Premier performance

With the AFC switched off and the Trough-Line tuned in to Radio 3 at 90.7MHz, the tuning indicator again showed a good, strong signal and the stereo beacon lit up, showing that all was well.

There was no audible hiss (or hum for that matter) and the Trough-Line was so quiet that I wondered if I had connected everything up correctly. As it turned out, it happened to coincide with a pause between movements of a broadcast concert and when the orchestra started playing, I quickly realised that all my efforts had been richly rewarded!

The sound was absolutely superb – full and rich as you might expect from a valve tuner and excellent image placement. But what was really incredible was the sense of presence and the feeling that you were sitting there in the studio with all the performers. It is difficult to put into words the sense of immediacy and realism I felt. I worked briefly for the BBC as a student in the 70's, during which time I had the opportunity to work in a studio and it was like having that experience all over again with the atmosphere of a live performance all around you.

Incidentally, I have never experienced any drifting with the Trough-Line, so I tend to leave the AFC switched off – partly because it is unnecessary, but mainly because I like to see the lovely green glow of the 'magic eye' next to the red of the stereo LED!

As I have mentioned previously, do not attempt to adjust the IF cans without the necessary test equipment or expertise. If you do feel some re-alignment is required, send it off to a professional company, like One Thing Audio, who can do this for you. However, there is one exception – the Foster-Seeley discriminator coil (T4 on the circuit and the one located next to the fuse at the rear). This is the one can you can tune by ear.

To carry out this adjustment, make sure that the station is optimally tuned once the tuner has had at least 10 minutes to warm up. Leave the AFC switch in the 'off' position. Then, with the appropriate trimming tool, gently turn the bottom slug in both directions about half a turn until you locate the optimum setting for minimum distortion. Then go to the top slug and do the same until you achieve maximum audio output.

However – a word of warning. The slugs might be seized up, in which case, do not attempt to force them as they can easily disintegrate and you can even damage the plastic core. In that case, leave well alone, or send it away for professional care if absolutely necessary.



Conclusions

Although the modifications I have described here are for a Trough-Line Mk.2, they equally apply to the Mk.3 as the circuit is virtually identical. A similar set of upgrades can be performed on the Trough-Line Stereo by noting the different numbering of the components on the newer model and by replacing the old stereo decoder. The Trough-Line Mk.1 is not worth upgrading for use as a Hi-Fi component because of its limited frequency range.

You will find that upgrading a Trough-Line is a highly rewarding experience and you will end up with a tuner that will not be out of place in the best audio systems.

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