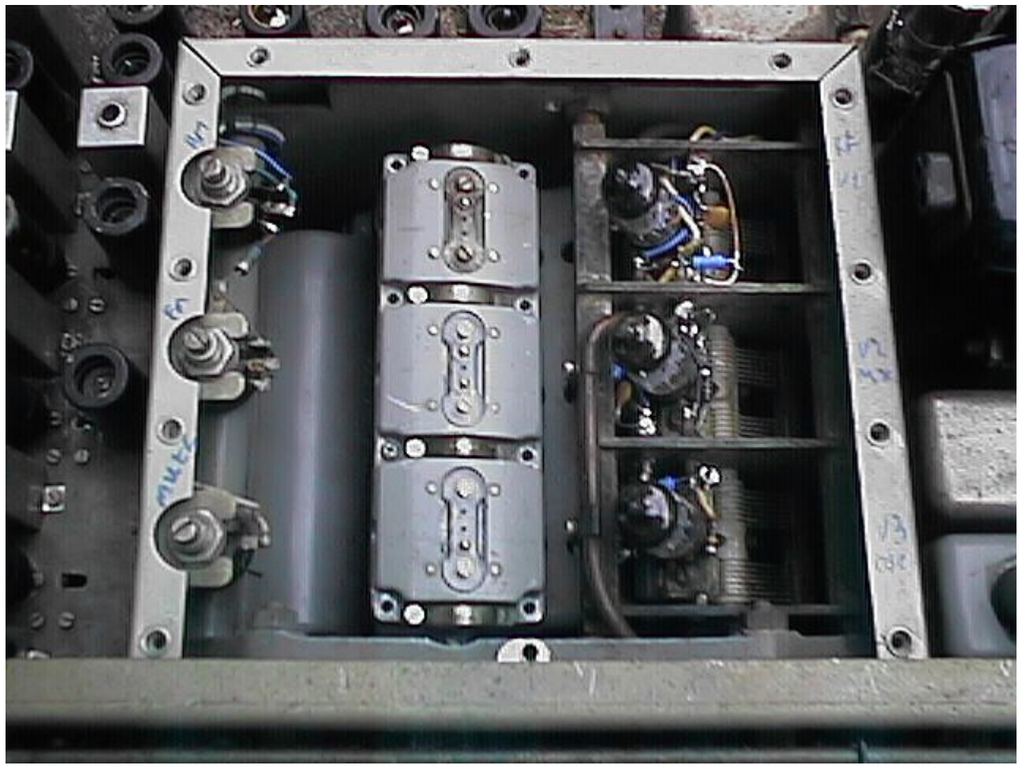
So You Think You Know How To Line Up a Superhet?

An Eddystone bedtime story.

"It works", said the guy behind the stall at the rally, it certainly looked OK. I had been interested in an Eddystone 770R ever since buying an 840C at Harpenden a few years before. The 840C had taught me just how much fun changing Hunts capacitors can be, but after some keyhole surgery and a full re-alignment it was going well. How about complementing it with its higher frequency brother (19-165MHz, AM/FM)? This idea remained unfulfilled for some time; I saw the occasional set, but always in dubious condition ("all the bits removed by the previous owner are in the bag guv!"). I like to buy things as unfiddled with as possible, the possible ravages of time (and Hunts) are as of nothing compared to some ham-fisted ‘repairer’.

This set looked reasonable and a deal was done. The set itself weighs 60lbs uses 19 valves and was introduced in approx 1952 (when mine was manufactured). Later a mark II was introduced in a more modern cabinet with the circuit substantially unchanged other than extending the AGC loop to include the RF stage. The wavechange function is performed by a very substantial turret system in which the desired coils and trimmer capacitors are rotated into contact with the tuning circuitry. This would have avoided the problems of stray capacitance/inductance in a conventional switch system working at these frequencies.



Close up of Turret tuner, note RF amplifier, mixer and oscillator valves mounted directly on tuning capacitor.

The turret incorporates six ranges, the upper two of which (75MHz-114MHz & 105-168MHZ) do not have any adjustable cores in their inductors. Adjustment is made on the low point of these ranges by squeezing and stretching the coils (more on this later). Demodulation options are CW, AM, narrow FM and wide FM. Adjustable muting, noise limiter, IF gain control, S meter and standby switch are also featured. A previous owner of my set had also fitted a front panel switch to bypass the AGC, why I don’t know, possibly for CW use when the BFO is on. Judging from the wire used it was done a long time ago.

I connected the set to my roof mounted FM aerial and switched on.....it worked, just. Classic FM was rather hissy and distorted. A visual inspection of the chassis revealed no Hunts capacitors, just a lot of a waxy looking type which could easily be mistaken for resistors due to their colour banding. I tested all the valves in my AVO VCM which revealed some to be past their best. Replacements were obtained and fitted, performance was slightly improved, but still pretty awful. Further investigation revealed a very sick cathode resistor bypass capacitor on the RF stage. Things improved a bit, perhaps all that was needed now was re-alignment? Here we hit a snag, most RF generators in common circulation don't go much above 30MHz - no use on a set that starts at 19MHz. A friend came to the rescue with the long-term loan of a Taylor AM/FM generator (thanks Terry!). This goes up to 120MHz and incorporates a crystal reference, OK so it's still not fast enough but using harmonics one can get there. This is the minimum standard of equipment sensibly required to work on a set of this kind. I also acquired a Heathkit which goes up to 100MHz on fundamentals.

So now the alignment could begin; here I noticed a problem fairly quickly, the peak alignment varied depending on which oscillator was in use. Observing the output from the oscillators on a 'scope I noticed that the waveform from the Taylor was much more like the classic AM envelope, the Heathkit produced a much more lopsided envelope, it's interesting to speculate what this means in sideband terms, since the detector is a simple diode this may not matter much, but something was causing differences.

Anyway using the Taylor things were improving, but still sensitivity seemed low, in particular the normal FM broadcasts were still not strong enough to produce any AGC voltage. Then one day the breakthrough: going up and down the IF strip I realised that one of the 4 stages was hardly contributing anything. The HT supply is fed to each IF stage via a resistor and decoupling capacitor. I had suspected this stages' capacitor before and had checked it by temporarily bypassing it with a new one, this was a mistake. The old cap (one of the resistor lookalikes) had sunk in value from 10nF to 1pF, but as I had aligned it in this state the tuning of this stage was far off where it should have been, hence bypassing alone was not enough to show the problem. Replacing the cap and re-aligning the whole strip yet again bought a 10 fold improvement. Hooray; now I was home and dry..or was I? If one cap was playing up what were the others like? Much earlier I had tested one or two caps using a digital capacitance meter, it had indicated about 11 or 12n for the 10n types; this seemed reasonable. Further investigation using the 15V driven ohms range on my analogue meter showed the problem: the cap meter was reading high because of leakage. Testing more of the resistor lookalikes showed them all to be either leaky as hell or 1pF: they were all going to have to come out. This meant changing approx 35 capacitors in all - not a small job on such a tightly packed set. Eventually it was done after locating suitable replacements for all the values required - itself not so easy these days.

The big improvement was in the muting circuit, which now functioned with a snap on/off action much like a modern hi-fi tuner - impressive. In fact when I first acquired the set the muting had not worked at all, it only began to respond, albeit slowly, when I changed the valve socket used by the noise amplifier. This was curious since the original was a McMurdo which I normally consider to be good quality. So far I have had to change two sockets which just seem to have lost their contact springiness.

Things had improved, but there was still no sign of AGC (except when applying very large test signals). The service manual I have for the set is actually for the Navy version, but there is little difference from the 'civilian' version. The IF alignment procedure given was to connect the generator to the last stage first then work backwards towards the mixer attenuating as necessary. By this time I had done this many times and could probably have done it blindfolded; then it occurred to me - as the generator is connected it will have an effect on the stray capacitance present in the circuit. Therefore when the generator is removed and moved to the next stage the alignment will be fractionally out. This time once I reached the mixer I peaked up all the previous cores; this made a big difference. Finally I had some AGC on Radio 4!

So all done then? - Er no. Now another problem which had been apparent for a while became even more obvious: The 770R has a front panel Aerial trimmer which tunes the input stage of the RF amp. As this was rotated at some points on range 2 the RF amp was obviously bursting into oscillation. Now Eddystone presumably suffered from this a bit themselves since a 12 ohm grid stopper is included in the RF stage. Increasing the value of this resistor improved matters, but take it too far and RF gain is compromised since a lowpass filter is being formed by this resistor and Cin of the first Valve. Much experimentation eventually led to the discovery that the effect was markedly reduced by adding extra heater decoupling (there are already feedthrough capacitors, which I would have thought would be enough at the frequencies giving trouble ~100MHz).

So with the IF sorted time for a realign of OSC/RF stages on each range, here another problem became obvious: with the high levels of IF gain now available and the frequencies in use, any movement in the proximity of the turret caused a large effect in output level. The only way I found around this was to reduce the IF gain control, increase the input and hope that this would have a negligible effect on the alignment - this seems to be true.

So now on to ranges 1 & 2, now here the inductors are adjusted by squeeze'n'stretch. The accuracy that can be achieved in this way is obviously less than for an adjustable core. This is acknowledged by Eddystone who give tuning accuracy on ranges 1&2 as 1% but 0.5% on the others. Squeezing a coil reduces the inductance and so raises resonant frequency for a given C.

Alignment on range 2 was pretty close already, but it was on range 1 that the problems really began. The image rejection gets poorer as the frequency increases; this means that if the stage is slightly misaligned it can get very difficult to tell whether you are adjusting to the main or the image response. The only way I found around this was to continuously check that the image was always above. In common with most superhets the local oscillator runs faster than the tuned frequency. The 770R IF frequency is 5.2MHz therefore if a signal is tuned at 150MHz there will be an image response at 160.4MHz.

I had great difficulty aligning range 1 at the low end, the adjustment afforded by squeeze'n'stretch was not sufficient. Here I encountered something unexpected: the range 1 coils are a single turn only, formulas given in reference books normally refer to multiturn types. With a multiturn coil increasing the diameter increases the inductance. On the 770R I found the opposite to be true for the oscillator coil - whether this means that, in fact, stray capacitance is dominating I don't know.

By now the rather early plastic that the coils are mounted on had began to crack up under the strain. I phoned Centre electronics who had no range 1 packs left (surprise, surprise) but they did have range 2 which would give me some new parts; this I duly ordered. The chap there also said that these sets can be spoiled on range 1 by people trying to tweak them up for 2m band use. Also the turret can apparently suffer from leakage due to insulation breakdown.

I have now rebuilt the range 1 coil pack and aligned it, this has been made easier by my acquisition of a Marconi TF913 FM receiver tester, this unit covers the full frequency range on fundamentals and has a very accurate dial. (Does anyone have the circuit diagram?)

Meanwhile I have put a wideband discone type aerial in the loft and this has given me better reception of aircraft etc.

So I now have two outstanding problems:

1) the instability in the RF amp.
2) even with many hours spent optimising alignment range 1 is still approx. 15dB less sensitive than range 2.

With a standard MW/LW job it's relatively easy to judge performance subjectively (does a good spin of the dial reveal plenty of stations etc.). On a more specialist set it gets very difficult to know when the end has been reached, how good was it when it left the factory?

This an unusual renovation report in that
A) I haven't finished the job yet!
B) I haven't mentioned the cosmetics.

In fact I haven't done much cosmetically other than clean the glass. I don't normally bother much with cosmetics until I know that the unit is working well enough to justify it. I will need to retouch the crackle paint at some time. I have also re-greased and adjusted the turret gearbox mechanism since any slop here also causes tuning drift.There are plenty of other things that have needed attention which I have not bothered to document in this report, and I must have now spent literally hundreds of hours working on this set - and it's still not over!.

In closing I would be very interested to hear from anyone else who has rebuilt one of these receivers to hear of their experiences. I would also like to thank Terry Martini, Peter Baxter and others who have provided help and sympathy in appropriate measures.

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