The Restoration of a ‘Parts Set’ Eddystone S.940: <u>Part 1</u> - Cleanup, Mechanical /Electronic Repairs and ‘Jump Starting’ – by Gerry O’Hara, G8GUH

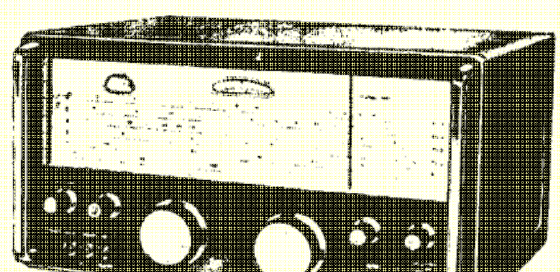
The Eddystone ‘Stop Gap’ That More Than Made The Grade

The story goes that the S.940 was conceived, designed and entered production within a few months in 1962 when the sales director of Eddystone noted that there was a gap in the market between the expensive high-end ‘professional’ sets of the time and those for the ‘civilian’ market, eg. S.840C. A mid-priced general coverage set of good quality and reasonable feature set was therefore needed. Bill Cooke was tasked with designing such a set and to use as many ‘stock parts’ as possible, targeting a street-price of around 100 pounds. And so the S.940 was born - nothing really fancy, just a solid, not-too-many frills, well-made single-conversion communications receiver for the more discerning short wave enthusiast (or the ‘well-heeled’ radio amateur as some have put it), all in the new-style case. Although not quite in the same league in terms of mechanical construction as its contemporary ‘professional’ sets, eg. 830 series and 770 series, it did its job pretty well and has proved to be a reliable and popular stalwart of the Eddystone marque. Its position in the marketplace meant that the vast majority of these receivers went into private hands – usually meaning that they were not worked as hard as those in professional use and were likely to have been looked after as a personal ‘pride and joy’ for many years following the high price paid (even if you were ‘well-heeled’) - rather than it being merely a tool in someone else’s toolkit - the ‘nobody ever washed a rental car’ syndrome.

940

The Eddystone ‘940’ is a larger and more elaborate communications receiver, with a correspondingly better performance. It has two fully tuned radio frequency stages and two intermediate frequency stages; variable selectivity with a crystal filter; built-in carrier level meter and push-pull output stage. Sensitivity is very high and outstanding results can be expected. Workmanship, construction, and finish are all to the usual high Eddystone standards. Styling is modern with two-tone grey finish.

List price **£133 0s. 0d**



Both the S.940 circuit and mechanical construction are interesting and although many features and circuit elements are derived from earlier or contemporary Eddystone models, there are one or two interesting ‘twists’ unique to the S.940. For example, the front-end has two RF stages: not the usual two pentodes, but a twin-triode (ECC189) in a cascode circuit (see sidebar on next page) followed by a pentode (6BA6). This ‘supercharged’ front-end, in theory at least, packs more sensitivity punch than the 830, which only has the cascode stage of similar design. The cascode arrangement is known for having the low noise factor of a triode combined with the RF stability and amplification factor of a pentode, along with a greater resistance to overload and cross-modulation. The S.940 also has variable selectivity (see sidebar later in this article) and a crystal filter for the highest selectivity setting (similar to the S.640 and S.730/4) – something most of the 'high-end' 830 range of receivers lack (though to be honest, doesn't really need). The S.940 also sports a product detector for SSB, a stabilized local oscillator/BFO HT line, a solid-state noise limiter and even a push-pull output stage, as per the S.770R (the 830 only has a single-ended one). All in all, not too shoddy a specification for a mid-range set!

Mechanically, the S.940 is generally typical solid Eddystone construction with only the IF cans, audio output transformer, power supply choke and the main tuning gang giving the appearance of some cost cutting when compared with its contemporary 'professional' models costing over three times more. Even so, my set is over 42 years old and these components seem to have stood the test of time – indeed my set has had enough wrist-twisting applied to the tuning control over the years to have worn-out the brass bearing fitted to the front panel, though the tuning capacitor gang seems to be ok. The all-important coil box, dial mechanism, mains transformer and most passive components are the same quality as the 'professional' sets and, although the lower-wattage resistors look to be of a marginal wattage rating, most of the bypass and coupling capacitors are the more reliable polyester or ceramic dielectric types rather than paper. One of its best features though is that, apart from a few components in the RF stages, most components are very easily accessible for servicing and repairs (see annotated layout diagrams near the end of this article) – the opposite of my S.770R's IF/AF strip...

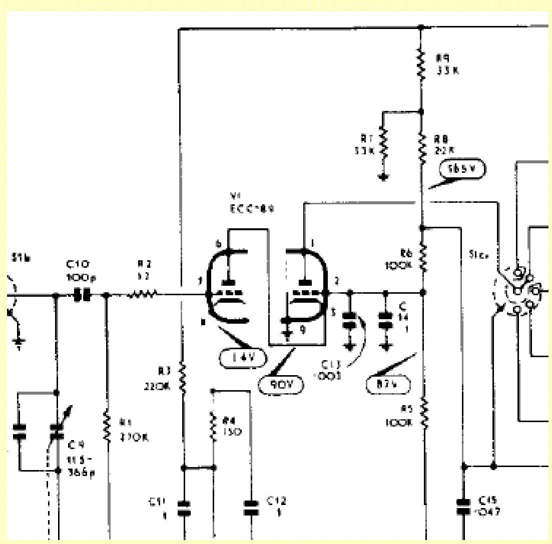
Wot, no EBay?

So, how did an S.940 wing its way into my hands? Well those that have read my S.750 restoration article may remember mention of an S.940 'parts set' that had been donated to Pat at

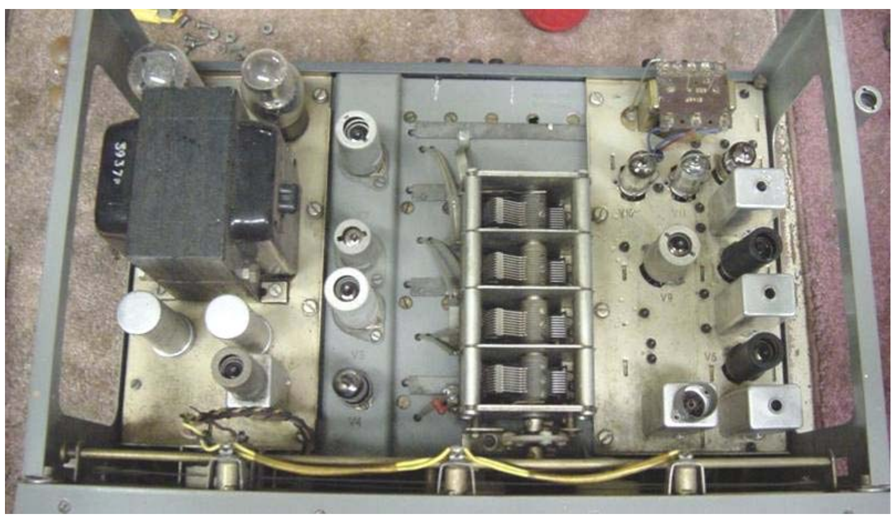
The Cascode Circuit

Developed around 1950 and used in some early TV (VHF) front-ends, this circuit comprises a grounded cathode triode stage followed by a grounded grid triode stage, effectively in series – ie, *casc*aded tri*ode*s or '*cascode*'.

Normally, direct coupling is effected between the two triode stages with the input circuit of the second stage acting as the output load for the first stage. The need for neutralisation, otherwise required for triodes in grounded cathode RF applications due to the Miller Effect, is dispensed with because the feedback voltage through the plate to grid inter-electrode capacitance of the first stage (operating at low anode volts and low gain) is too low to cause oscillation, and the second stage, connected in grounded-grid configuration, is inherently stable. The total gain of the two stages approximates to that of a pentode, but with the lower noise characteristics of a triode and with better cross-modulation characteristics. Typical valves used in this application include the ECC189/6ES8 (as in the S.940 and S.830), ECC84/6CW7 and 6BQ7.



the SPARC museum – Pat needed the mains transformer to start the restoration of his S.750 – he also kindly donated a dial bulb holder and a valve screen for my S.750 from it. On enquiring why the S.940 had become a ‘parts set’ Pat noted that many experience ‘radio fixers’ had ‘had a go’ at it but it seemed to have an ‘incurable fault’ that prevented the set from working. A couple of weeks later, I had a phone call from Pat who asked if I would be interested in adding an S.940 to my Eddystone collection? I was pleasantly taken aback, especially as Pat was donating the set to me (now ex-transformer, and he had removed the BFO unit to see if he could make it work with his S.750). You bet I would! was my reply…. I picked up the set the following weekend, complete with valves and the detached BFO – thank you Pat, very much appreciated.

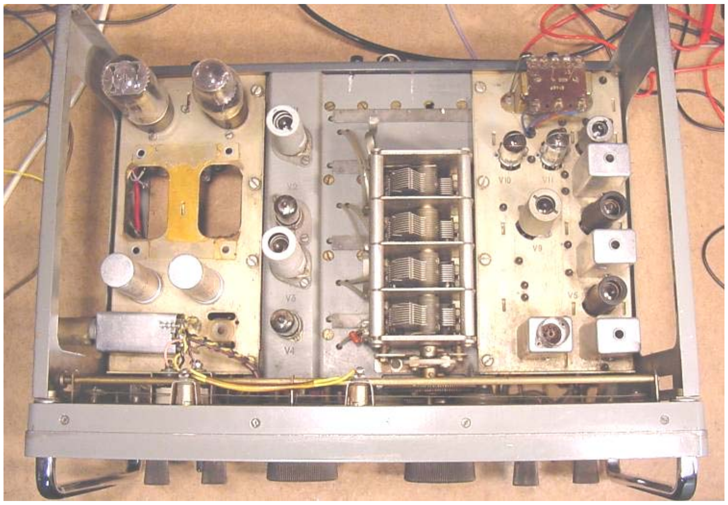


Before the mains transformer was donated to Pat’s S.750 and the BFO and dial lamp holder were removed

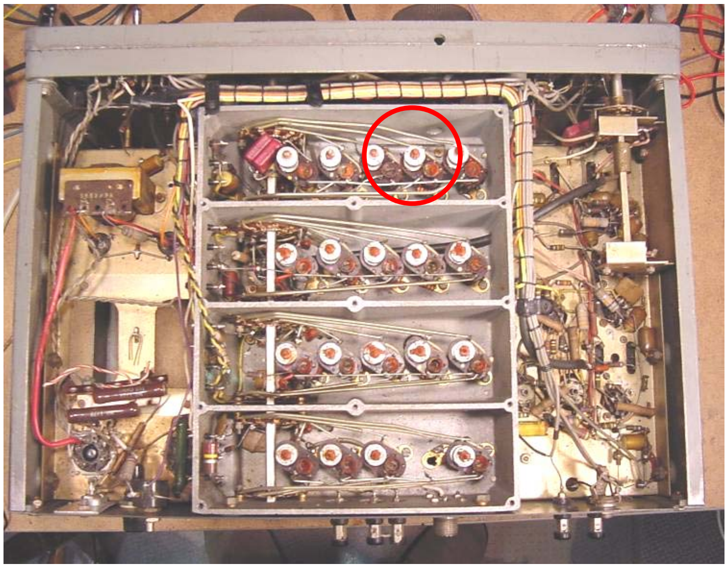
So, what could I do with an ex-parts set? – I think most folks would put it on the shelf and forget about it… especially if sets in better condition were more readily available as in the UK market, however in BC, Canada, I have to make the most of what I can get hold of. Anyway, I do get a kick out of breathing ‘life’ into needy and deserving radios, so, here is yet another restoration article, this time on the ‘parts set’ S.940.

Preliminary Inspection and Basic Preparation

Overall, the S.940 was not in too bad physical condition, apart from being an ex-‘parts set’ and therefore missing some bits (the most important being its mains transformer, the L4/C4 coil/capacitor assembly, the coil box cover and, of course, its case), as well as the BFO unit being removed, though in my posession, and the B7G-mounted crystal missing from the first IF can. There was not too much grime on the chassis and no sign of overheating in the power supply area (the transformer had been ok as it was removed by Pat for his S.750) and, amazingly no signs of the radio ever having been dropped! All the knobs were present and, apart from being dirty, the scale plate was in good shape. The finger plate was also not too bad, the main wear being underneath the Band change knob – it looked like one of the screws holding the plastic skirt of the knob in place had been loose for a long time and had gouged a channel in the fingerplate – luckily this is hidden by the knob. Physically, the main issue was that the tuning mechanism was very stiff and the circular logging scale was bent and catching badly on the front of the gearbox. This indicated that the front panel would need to be removed and dismantled (which proved to be very similar to the S.750 – see below). Beneath what grime there was, numerous paint and varnish spots were present over the chassis, indicating that the case had probably been removed for some time, and there was a number of non-standard drill holes present in the back panel.



The S.940 on arrival at the G8GUH shack – spot the differences to the photos above…



The serial number of the set, JP0608, indicated that it was built in October, 1964, according to my interpretation of the serial number information on Alan Clayton's Eddystone website (www.qsl.net/eddystone, though this site is currently down and under revision), whereas the EUG Quick Reference Guide (QRG), page 26 method does not work (the last month code is an 'L'). The 1964 date is supported by 'Oct 63' and 'Nov 63' marked on the Plessey electrolytic smoothing capacitor cans.

So, I placed the 42-year-old on my workbench, found the vacuum cleaner and paintbrush, a digital camera, made the necessary cup of tea and started…

- Removed the valves, cleaned the glass and pins and thought I might as well test them while I was at it: one bad 6BA6 in the second IF stage and there was a 5U4G fitted in place of the GZ34 (or 5Z4G) rectifier. The 5U4G tested ok, but should not be used in this application (even though it has the same pin-out) as it takes an extra amp of heater current and has a directly heated cathode – this applies the HT sooner to the rest of the receiver circuitry than for an indirectly heated rectifier such as the GZ34/5Z4G.

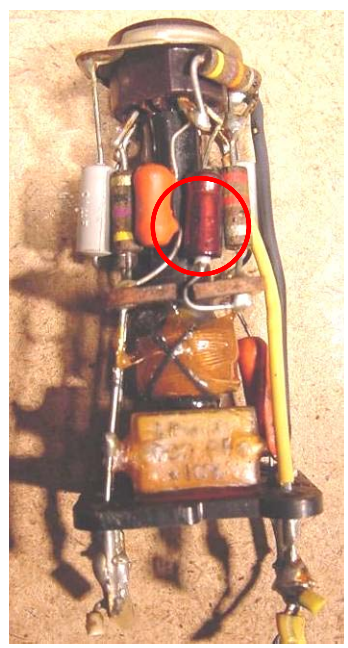
- Vacuum-cleaned the chassis, using the small paintbrush to penetrate nooks and crannies. A blast of air from my compressor cleaned out the tuning capacitor vanes. For now, I wiped the front panel with cotton wool wipes and warm soapy water and worked on the chassis with isopropyl alcohol (using Q-tips and cloths) to remove any grime. The coilbox is the usual trademark Eddystone aluminium casting and the power supply and IF/AF sub-chassis flanking the RF coilbox all cleaned up reasonably well. I plugged the non-standard drill holes with epoxy filler and painted them over. As noted above, the tuning mechanism was almost totally jammed, with the circular logging scale being so bent that it was catching on the front plate of the gearbox, meaning that the front panel would need to be removed and the mechanism serviced/repaired.

BFO unit on arrival – all present and correct but a bit detached (like me?)

- Removed the knobs: the grub screws came out easily – no corrosion on them at all – good news. I noticed that all the knobs had slight splits in the sides as on my 830: not serious enough to worry about for now at least.

- Carefully removed all the retaining nuts from the controls using a Teflon scratch guard (see photo below) and prized the fingerplate away from the front panel casting. It was fixed at the centre using double-sided tape, the residues of which were carefully scraped away. Removed the small screws holding the BFO and crystal phasing controls in place.

- The fingerplate was generally in good condition apart from the scoring beneath the band change switch noted earlier. I decided to just touch-up the scored area for now rather than attempt a more thorough repair (the scored area is hidden by the knob anyway).

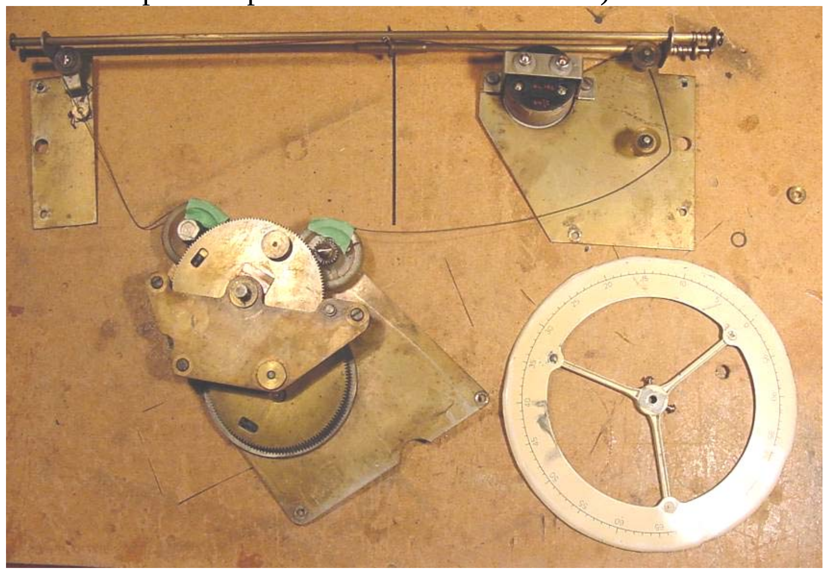


Inside the BFO unit – note C100 (10uf electrolytic) lurks in here (circled)

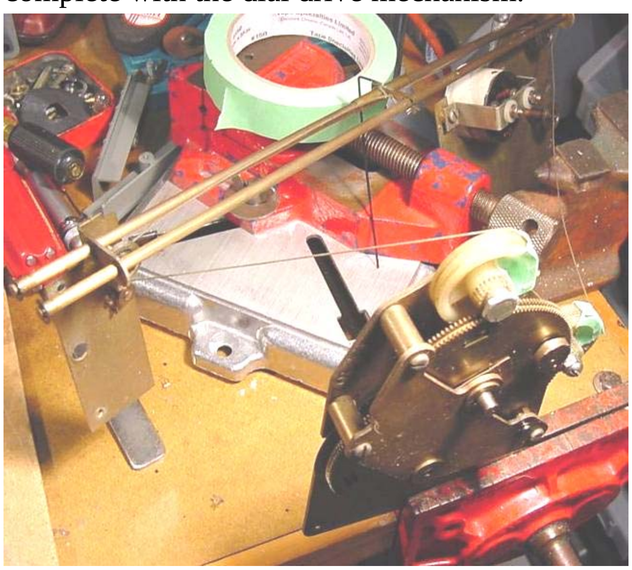
Removing and Replacing the Front Panel and Drive Mechanism

Removing the controls – note the oversized scratch guard

- Removed the dial glass by taking out the bolts holding the small cheek castings in place either side of the dial glass, along with the four screws holding the dial lamp mounting plate in place at the top of the front panel. Once these are removed, the dial glass can be lifted out easily (note: this can be done with the rest of the radio in place to clean the glass and dial plate as part of routine maintenance).



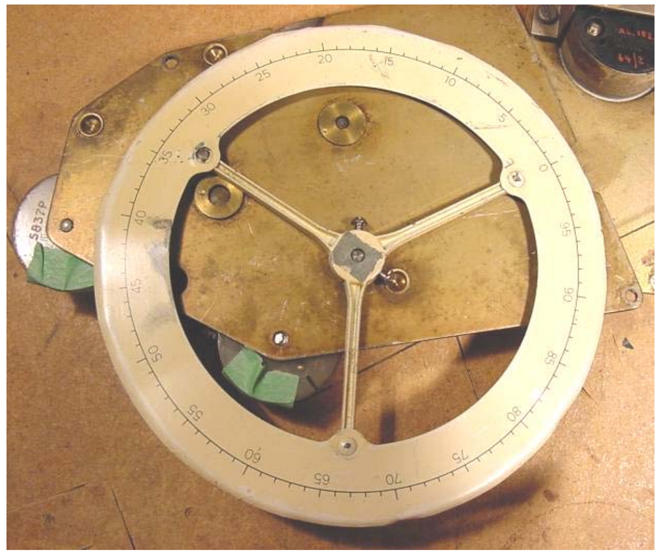
- The dial drive mechanism is remarkably similar to the S.740 that I had repaired a few weeks earlier, with the exception of the method of drive tensioning – here a spring-wire loaded jockey pulley, is located on the left plate (looking from the rear) supporting the pointer guide rods, rather than the pivoting coil-spring loaded arm on the right hand side as in the S.750.
- I took several photos of the tuning drive mechanism from all angles for reference. The drive cord looked in reasonable condition, so I decided to leave it fixed to the spool pulleys at either end and to remove the assembly intact – hoping that I would not have to re-string the dial (see EUG Newsletter #25, p17 for tips on this if you have to do it).
- Loosened the grub screws in the flexible coupler on the tuning capacitor. Removed the four outer front panel retaining bolts and spacing washers and took the chrome handles away. Removed the four inner front panel retaining bolts (these are removed from the front and are exposed once the finger plate is off). Pulled the front panel casting away, complete with the dial drive mechanism.

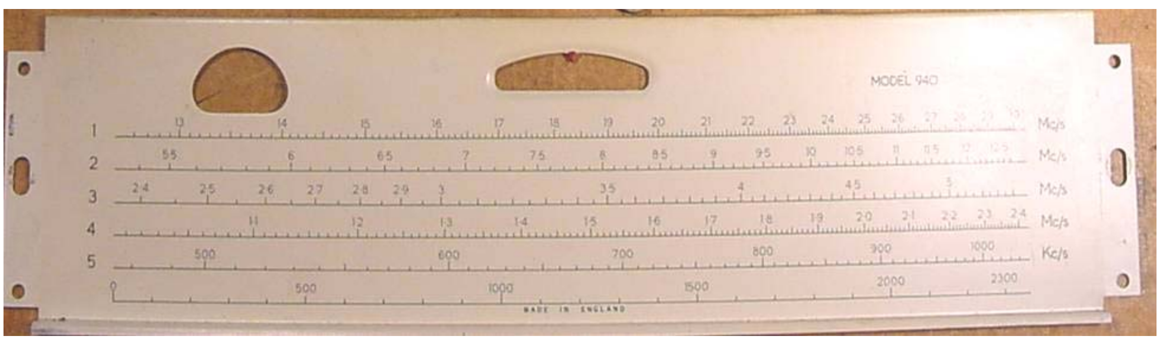


Gearbox in my bench vice for cleaning (note dial cord still attached and threaded through idler and jockey pulleys)

- I approximately centered the drive and prevented the cord from leaving its grooves on the toothed spool pulleys using two small pieces of masking tape (see photos above, left and on the next page). Careful inspection of the gearbox revealed that nothing was binding or blocking movement of the gears and that the stiffness was due to gummed-up bearings and teeth (age-solidified 3-in-One oil as per previous experience I would hazard a guess). There was little wear on the brass gears and no damage was noted on the plastic toothed spool pulleys (damage here is noted as a common problem due to rough handling and over-enthusiasm when spinning the tuning knob when suddenly the drive cord breaks and jams in the gears).

- Loosened the three screws holding the gearbox to the front panel casting, tipped it forwards and upwards slightly and the gearbox was then removed with the dial cord intact.
- Removed the two plates supporting the pointer guide bars: two screws on the left, three on the right – note that the lowest of these three has a brass spacer between it and the panel casting to give the correct clearance for the dial plate - and then pulled the tuning knob spindle out of its brass bushing.
- I removed the round logging scale (vernier) dial plate from the gearbox front spindle (photo right) and placed the gearbox into a smooth-jawed bench vice and then painstakingly cleaned each tooth on each gear and pinion using isopropyl alcohol, a darning needle and Q-tips. I used lighter fluid to remove the more stubborn 'gum' and clean out the bearings. I found that the gears were now freely-turning and I decided not to dismantle the gearbox totally, but to apply a light coating of high-quality light machine oil (not 3-in-One!) to each of the bearings and a smearing of molybdenum ('moly') grease to the parts of the brass gears that did not mesh with the plastic spool pulleys. I tried it out – much smoother now. The friction drive plate was cleaned using lighter fluid to remove any stray oil or grease, as was its mating surface on the tuning spindle.

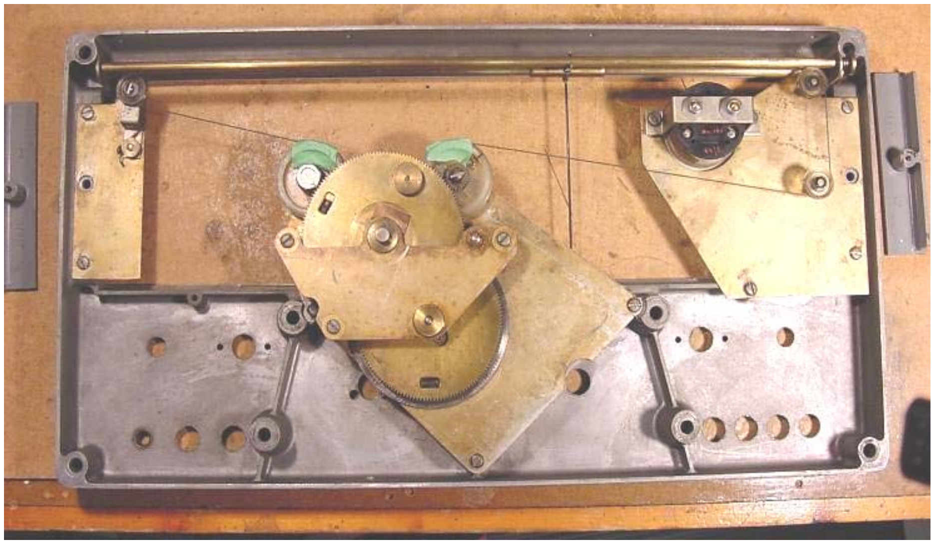




Vernier scale and main dial plate – the former looking a bit sad before cleaning…

- Cleaned the dial glass, dial plate and vernier dial using warm soapy water and cotton wool – these have very delicate markings (so be very gentle) – see photo above. The round vernier scale is constructed from a thin aluminium pressing attached to an alloy casting bushing and spokes. The metal pressing was very distorted and a considerable amount of care was exercised in trying to reproduce its original form (careful bending between fingers and checking by placing on a flat surface many times until it was deemed ok). Luckily most of the catching had been between the rear of the vernier dial and the front gearbox plate, thus preserving the vernier scale markings intact.

- Cleaned-up all the remaining drive components (idler pulleys, guide rails etc) and re-assembled the drive mechanism to the front panel casting, simply reversing the disassembly order.
- Applied a little moly grease to the guide rails.

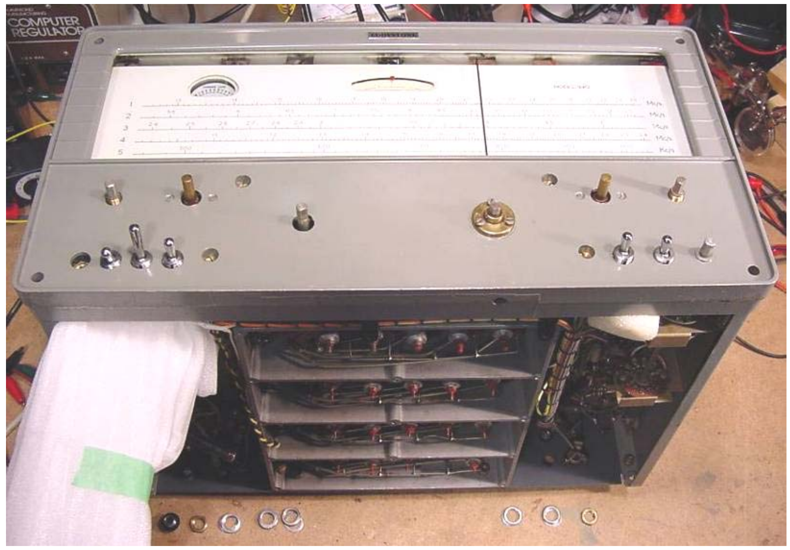


Front panel and dial drive mechanism after cleaning and re-assembly

- The tuning knob shaft was coated with moly grease prior to installation in its bushing, though I noted that the fit was a bit loose (the brass bushing was quite worn). The tuning knob was then fitted and the completed assembly tested for that sensual ‘Eddystone smoothness’ – it was there, but when spun rapidly the worn brass bushing showed itself by causing a vibration – that would need to be addressed in the future (see Postscript).
Now for the mechanical reassembly and the electronics, thinking that the latter would be a challenge with no functional power supply in the set – nothing ventured, nothing gained I suppose...

Mechanical Re-assembly

- I decided to start work on the electronics with the front panel still removed as this made access to underneath the chassis front much easier: useful if one or more of the gain controls, BFO/crystal phasing variable capacitors or panel switches needed to be replaced or serviced.
- Installed a quick-blow in-line fuse in the wiring for the HT centre tap of the mains transformer (though the transformer is still missing at this point), complete with a 200mA slow blow fuse. Also, I installed a 2A fast-blow fuse in the chassis-mounted fuseholder wired into the mains transformer primary (it had a 5A fast blow installed on arrival).
- Checked the general electrical safety of the psu unit – someone had replaced the original ‘kettle connector’ with a horrid and flimsy-looking two pin chassis-mounted plug screwed to a piece of aluminium. I decided to replace this with the Euro-connector conversion as described in my S.830/4 and S.770R articles. This done, I proceeded to check for poor connections, heat damaged wires, poor insulation etc. as well as trace the loose wires left hanging when Pat had removed the mains transformer.
- The RF and AF gain pots both looked original and tested ok after cleaning with De-oxit, and all the switches checked ok. The BFO and crystal phasing variable capacitor bushings were also cleaned with ‘De-oxit’.



- Then I re-attached the front panel to the chassis. This is easier said than done, as getting all the switches and other controls into the correct holes at the same time takes some doing! A tip to help with this (that I meant to mention in the S.750 article) is to temporarily stuff the space beneath the switches and other controls with some packing material (see photo right) – this simple expedient holds all the controls in place while you fit the retaining nuts (saves a lot of time and cursing).
- Re-attached the front panel by reversing the disassembly routine: insert the four centre bolts attaching the coilbox, insert the screws fixing the BFO/Phasing variable capacitors, then temporarily mount the finger plate using two strips of double sided sticky tape, and then insert the four bolts attaching the chrome handles (don't forget the spacing washers between the chassis side panels and the front panel).
- Re-fitted the dial glass, side cheek castings and dial lamp/scale glass retaining plate.

- I then fitted the replacement dial lamp holder (made originally for my S.750 to replace a bodged screw-thread one) and fitted new long-bulb #47 dial lamps –a standard in US and Canada radios – its ok to use them here as in this set the extended glass bulbs do not interfere with the drive cord.
- Next, I re-fitted each of the control retaining nuts, taking care not to gouge the fingerplate. I used a small home-made 'washer' made from Teflon baking sheet (ex-kitchen) to do this with a regular pair of pliers.
- I then cleaned the main tuning capacitor contact 'fingers' using 'De-Oxit' on the rotor contacts and re-packed the ball bearings with moly grease.
- Replaced the knobs and tightened the flexible coupling grub screws on the tuning gang shaft, having positioned the scale and the gang rotor at the same end of the travel.

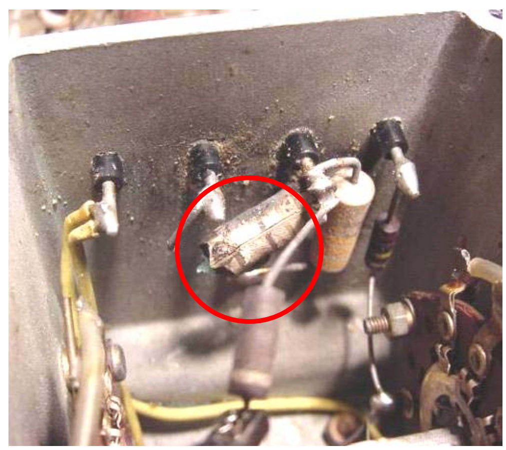
- With all valves still removed, I started to undertake some electronic checks… see pages 24 and 25 for component layout diagrams and also the circuit in the attached manual.

Electronic Testing, 'Jump-Starting' and Repairs

- First the obvious: re-fit the BFO unit. Not too difficult as Pat had left short pieces of the wires on the base pins that could be matched with some of the ones hanging in the radio.

First I removed the can from the BFO unit and did some cursory component and pin-out checks before refitting it to the chassis and re-wiring into the circuit. While I had the opportunity I checked C72 (metalised paper heater decoupler) and found it to be leaky – replaced it (blue capacitor in photo, left).

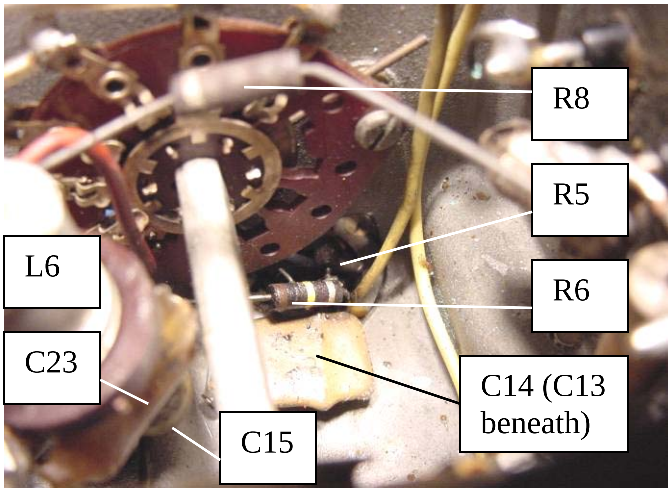
- Next up was investigation of the cause of a disintegrated resistor (R9, 3.3kohm) – see photo below – feeding HT to the cascode RF stage (V1). I suspected a component(s) further down the voltage divider chain of resistors, possibly a short circuit capacitor (C13, C14 or C15 were suspect). C15, a 400vw 0.047uf polyester, hidden twixt the end plates of L6 was found to be ok. C14 however, a 200vw 0.1uf plate ceramic, tested short-circuit (very unusual in my experience for a ceramic capacitor to do this). Some resistance measurements during dismantling confirmed that R7 was ok, but R5, R6 and R8 were out of tolerance (R5 way high at almost infinity, R6 low at 12kohm and R8 short-circuit: this could explain why C14 failed (excess voltage). Replacement of some of these components is easier said than done (though see Lighthouse issue 78, page 42 by Graham Wormald for some tips) as they are buried in the deepest recesses of the coil box, beneath the band change switch shaft and a divider cast into the box (see annotated photos below). I temporarily removed components above the valve base to clear some room, but decided to leave the band change switch shaft in place, use a pencil soldering iron and to do some pre-assembly of the new parts (apparently some of these components were pre-mounted on the valve bases and then dropped in through the top of the casting as the first step in assembly at the Bath Tub, with all the remaining components then being added around them from beneath). I used over-rated (1w) resistors for the two 100kohm units (R5 and R6) for stability and longevity. Graham suggests that R5 and R6 can be connected to the 'cold' ends of L6 (terminals nearest the valve socket), but I did it the hard way and replaced them in their original locations. I used a Mylar replacement for the shorted-out C14 and a polyester replacement for C13 (the original C13 component was low leakage but also very low capacitance).

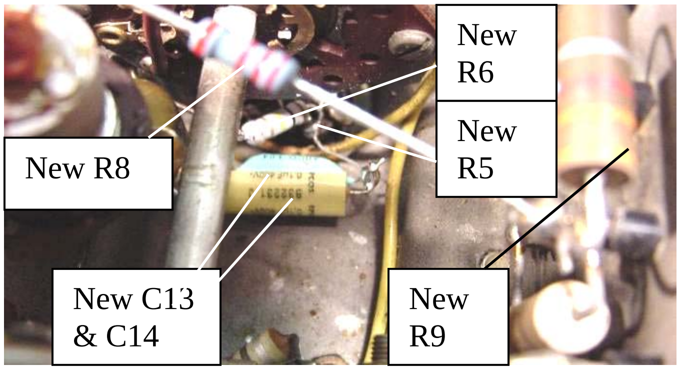


Burned-out R9 (not) feeding HT to V1

- Although the set should work ok without the phasing crystal (except on the 'crystal' selectivity position), I decided to try to locate one – although I had little success in finding the exact type (a 450kHz B7G socket, type JCF/193), I did find a 455kHz HC6U base crystal in my junk box, along with a genuine McMurdo base. I soldered two stiff wires onto the base to form an adapter and pushed it into the B7G crystal socket (pins 1, 2, 3 are connected to one side of the selectivity switch and pins 5, 6, 7 are connected to the other, pin 4 is not connected). I pushed the crystal/adapter into the B7G socket (photo right) and placed a valve screen over the top to form a look-alike replacement. Of course I needed to re-align the IF in the set to 455kHz in order to use the crystal.

- In the absence of a power transformer, I decided to undertake a few resistance/ capacitance checks of selected components reported by others or known by myself to give trouble, including the AGC line capacitor, C81, another 0.1uf plate ceramic (ok), C82 (ok), R35, R36, R37, R38 (all four replaced) and RV2 (ok) in the S-meter circuit (screen of V6), R72, R73, R74, R75 (all ok) in the power supply, R43 and R44 in the AGC diode circuit (both replaced), R57, R58, (both replaced), R62 (ok) and C103 (leaky - replaced) in the first audio/phase-splitter stages, R61, R63, R64, R65, R66 and R67 (all ok) in the push-pull output stage, and the noise limiter diode D1 (ok). C90 was also replaced (low capacitance), as were R28 and R39 in the IF amplifier stages and R5, R6, R8, R9, R14, C13 and C14 in the RF stages (the mixer and oscillator stages were ok).
- Checks on C102 and C106 ('Plessey' audio stage cathode by-pass electrolytics) indicated typical high leakage and low capacitance, so these were both replaced also.





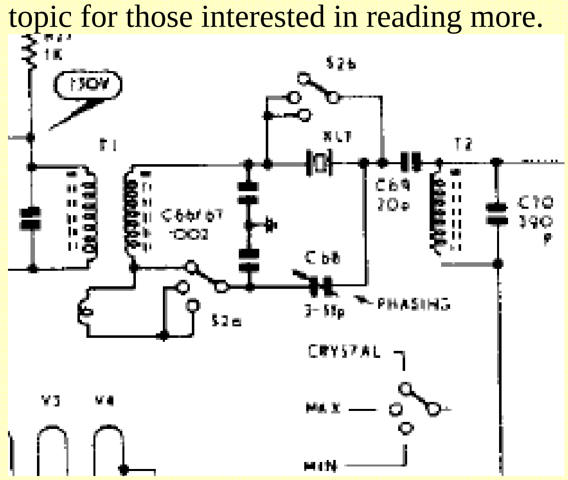
- Resistance checks on the psu filter capacitors (C108 and C109) indicated that they were leaky: these would need to be either replaced or re-formed once I was able to apply power.
- Undertook leakage checks on a few of the IF and mixer stage by-pass capacitors - all appeared ok.
- By this time I was getting more than a little frustrated at not being able to power-up the set.
- Drastic action was needed – so I decided to use another Eddystone as a temporary power supply – my S.770R was handy and has a similar power supply circuit and the same model of power transformer. I unplugged the octal plug from the rear of the S.770R

V1 valve base showing original component locations above and new components below (this disconnects all the 6.3v heater circuits except for its noise limiter valve, V10 - this being fed from a separate secondary winding, so V10 was removed). I then installed a thick ground jumper between the two receiver chassis and jumpers from the S.770R's rectifier (5Z4) cathode (HT) to the input of the HT choke in the S.940 (also disconnecting the S.770R's choke) and from the 6.3v heater transformer winding in the S.770R to the heater supply bus in the S.940. All these temporary leads were soldered in place, insulated where needed and securely held with cable ties. I installed the stabilizer valve (OD3/VR150) in the S.940 and temporarily disconnected the S-meter as it would be really imbalanced with no valve (V6) in place and could therefore possibly be damaged, plugged the S.770R into my variac and….

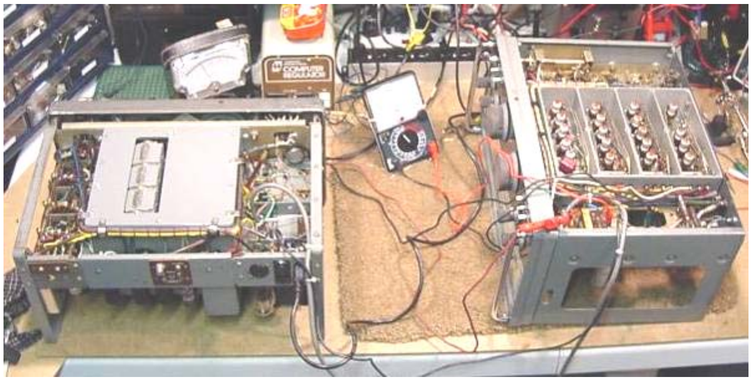
- Power at last! A bit of a lash-up I admit, but at least I could now test some of the circuits with power applied pending sourcing a suitable transformer.
- First, the HT smoothing capacitors were re-formed over a several hours by slowly increasing voltage from the variac, monitoring the HT current draw (all valves apart from the stabilizer still removed in the S.940) - increasing the voltage in stages, holding for up to an hour and also switching off/on a couple of times at each stage. As current draw fell off at each voltage increment, I increase the applied voltage by 25v, up to the full HT volts of ~250v. The OD3 lit up at just over 150v and it held steady at 149v. Leakage current at the end of re-forming was acceptably low on all the smoothing capacitors.
- Cleaned up each of the valve sockets in the set using 'De-Oxit'.
- Re-installed the remaining valves and attached a speaker and output meter.
Slowly brought the S.940 up on the variac over around 15 minutes, checking the HT

Selectivity Control and the Crystal Filter

Having an appropriate level of selectivity is, to a degree, more important than high sensitivity in a communications receiver – what is the use of a receiver picking up a signal if it cannot be separated from others nearby? The S.940 benefits from having a three-position control (S2) such that the operator can choose the selectivity needed for the particular mode of operation. On 'min', an extra degree of coupling between the primary and secondary windings of IF transformers T1 and T3 is introduced into the circuit, via 'tertiary' windings. This position is suitable for AM broadcast reception when little adjacent channel interference is present). When switched to 'max', this over-coupling is only applied to T1. This position is suitable for SSB and AM broadcast reception when adjacent channel interference is present. The S.940 is also fitted with a single crystal filter between T1 and T2. The crystal (XLT on diagram below) is shorted out so that it is inoperative in both the 'min' and 'max' sensitivity positions. In the 'crystal' position, all over-coupling is removed from the IF transformers and the crystal is allowed to resonate. This position is especially suitable for CW reception. The 'crystal phasing' control, C68, allows the adjustment of the crystal's peak/rejection notch by cancelling out (to varying degrees) the capacitance of the crystal holder. There is a 'Technical Short' on this topic for those interested in reading more.



current draw (transformer secondary fuse removed and the fuseholder bridged with a milliameter) - about 125mA at our nominal 117v AC power applied to the 110v tap on the S.770R mains transformer. At 110v set on the variac, the S.940 was still drawing 115mA (the manual does not specify a typical current draw, but 115mA to 125mA seemed on the high side, especially as the mains transformer type 3937P is only rated at 110mA HT and the 5Z4 at 125mA. I backed-off the applied AC voltage to give a current draw of 110mA (this being at about 105v AC), resulting in an HT2 voltage of only 225v.



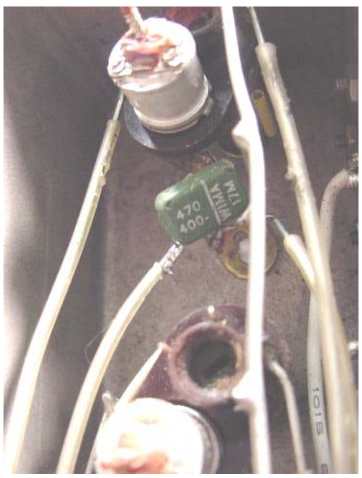
‘Jump-starting’ the S.940 with my S.770R…

- No signals could be heard, but I could hear a slight hiss/intermittent crackle and when I injected an audio signal (finger) at the AF gain pot slider this resulted in an encouragingly loud buzz from the speaker – at least the audio stages were working.
- Checked key voltages against those shown on the circuit diagram using the specified 20kohm/volt meter – most were within tolerance (allowing for the slightly low HT voltage), but some were out by a fair amount, eg. the screen voltage of V5 was reading around 125v (should be 110v). Also, the S-meter would not quite zero (odd, as all it’s associated bridge resistors had been replaced, voltages on V6 were normal and C82 checked out ok). I noted that the RF gain pot varied the cathode volts on V1 from 1.4v to 25v (seemed ok) and this also reduced the set’s current draw to 95mA at the lowest gain setting. Switching the set to ‘standby’ had a similar effect on the set’s current draw. I decided to leave things as they were for now and check to see if the set was actually functioning as a receiver…
- I tried injecting an IF signal (the standard 450kHz) into the grid of the final IF stage, yep, this was heard ok, same for the first IF and mixer stages. With the band switch still set to Range 5 (as required for the voltage checks), I set the receiver to 600kHz with the signal generator coupled loosely to the aerial connector – a signal was heard when tuning across the 600kHz marker of the signal generator (it kicked up the S-meter well past half-way). Encouraged by this, I coupled up an aerial and heard several local stations whilst tuning across Band 5. I did notice that the signals were a bit ‘thin and edgy’, perhaps indicating poor alignment of the IF stages. Band 4 was fairly ‘dead’ but with some hiss (L4/C4 missing), but there were some faint signals on Ranges 2 and 3, though Range 1 was very quiet.
- Checked the AGC voltage on a strong signal from the genny applied to the aerial input: no more than -2v of AGC control voltage could be measured on my VTVM (many sets can attain -6v to -12v on a very strong signal and even for a set with this much available gain I thought -5v would be more typical). As the S-meter, connected to the screen grid of the 2nd IF stage (V6), was showing almost end-stop, this suggested to me that something was not right in the AGC detector circuit (V7a) – I decided to check this out further once the set was at least in a modicum of proper alignment.

- I tried the BFO – this appeared to work well and all of the other controls seemed to work ok except for the ‘crystal’ position on the selectivity control (not surprising as the crystal was a nominal 5kHz off the standard IF frequency and I was not certain if the crystal was still active anyway – I probably bought it off a rally stall as surplus over 30 years ago!).

So, with the sets ‘mechanicals’ working ok except for the ‘rumble’ caused by the worn driveshaft bushing (see Postscript) and its ‘electricals’ working, hopefully well enough to try a preliminary re-alignment (even if it was relying on an S.770R for its power), I reached for my red *101 Dalmatians* box of assorted ‘real’ trim tools and trusty whittled-down plastic knitting needles (can be seen at the top of photo above)…

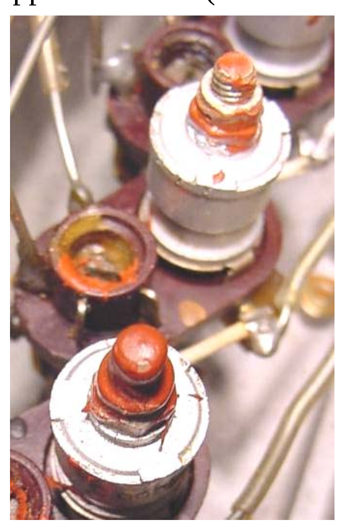
Preliminary Re-Alignment



Temporary bridging cap in Band 4 aerial circuit

- As noted, the set was a bit ‘deaf’ on all bands at this point, with only signals from known local very strong stations producing movement on the S-meter, so I decided to do a full re-alignment – this would be needed anyway due to the non-standard crystal filter frequency. Before I started, I ‘bodged’ the RF coupling to V1 on Band 4 by temporarily installing a 470pf capacitor between the wires hanging in the aerial input section of the coil box where the L4/C4 combo had been removed. Closer inspection of the IF transformer and coilpack dust cores (‘slugs’) and ‘beehive’ concentric trimmers showed signs that they had been played around with as most of the red wax seals were broken (where unbroken, the wax actually looked to have been applied professionally, though I don’t know if the Bath Tub did this – see photo below).

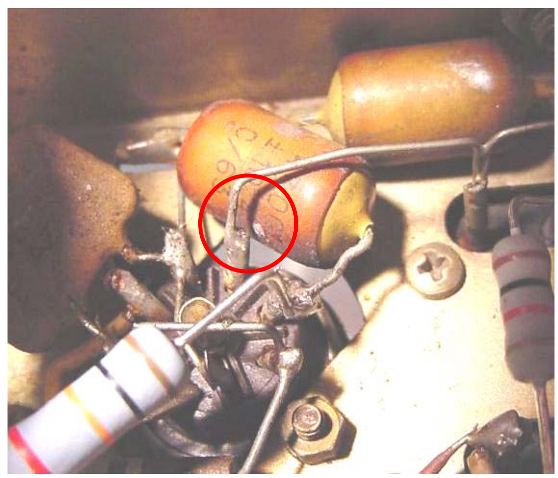
- The IF re-alignment procedure as detailed in the manual was followed to the letter, but with the signal generator set for approx 455kHz (instead of the standard 450kHz for the S.940) to allow the non-standard 455kHz crystal to be used. I first tried injecting a 450kHz signal and noted that most of the IF slugs were significantly ‘off’, especially T1, indicating these had likely been ‘twiddled’ in the past. On injecting a nominal 455kHz, the crystal was found to be working ok and the IF stages, crystal filter and BFO tuned up nicely to their new frequency - now for the RF stages.



Hardened red sealing wax on the concentric trimmers and coil slugs

- First the oscillator section (nearest the front panel). Again, I followed the instructions in the manual to the letter, using a crystal calibration marker to supplement the 1950’s valve RF genny and 1980’s digital frequency meter combination I was using. As I understand that the LO on the S.940 should always track above the signal frequency, it is useful to remember that ‘*if the oscillator frequency is higher than the received signal, the lower-frequency position on the signal* *genny dial or the higher frequency position of the receiver dial is identified as the proper signal at which to align'* (Radio and Television Receiver Troubleshooting and Repair, Ghirardi & Johnson).

- During adjustment of the iron dust cores (for low-frequency settings), I first scraped off the hardened red wax covering the ends of the cores sufficient to allow the core to be turned. Fortunately all the cores were found to be in reasonable shape despite a 'twiddler' having 'had a go' at some time(s) in the past. Adjustment of the 'beehives' (high-frequency settings) was straightforward. Only two iterations of adjustments on each range produced good scale linearity.
- The S.940 now had good sensitivity and selectivity on all bands (Band 4 with the bodged aerial circuit was not quite as good – some cross modulation and interference was noted that likely would not be there with a tuned input to V1 on this band).
- Still only around -2.5v of AGC voltage measured on the VTVM on a strong signal that hard-stopped the S-meter. I checked around V7a again: the cathode was right on the desired 45v. I changed-out the 6AL5: no difference. I disconnected C88 (a 50pf tubular ceramic) that applies IF from the anode of V6 to V7a anode – it was ok (63pf and no leakage). Re-checked R41 and R42: both ok. Staring at the component layout in disbelief, I noticed that the (bare) lead of C88 was pushed hard against the case of C82, a 0.047uf polyester bypass capacitor on the screen of V6, and the plastic film coating the capacitor sleeve had been breached at that point (light dot circled in photo right). I separated the two and the AGC voltage jumped to over -5v, indicating that although it was not forming a low-resistance short (as there was still correct voltage on the anode of V6), there had been sufficient coupling between the lead of C88 and the C82 sleeve to affect the AGC voltage – a strange fault indeed…

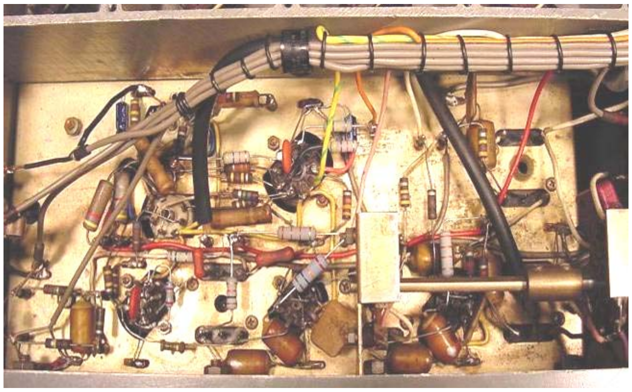


Lead from T4 secondary/C88 where it was pressed hard against the case of C82 (note small 'bare' spot' where it had been resting)

Conclusion (almost)

I left the set on 'soak' test for a few hours and tuned around the bands – pretty impressive! I re-checked all the key voltages as listed in the manual following some prolonged use of the set and they were all found to be within tolerance when the HT1 line was adjusted to the specified 240v using the variac. I noted that the set was now drawing around 95mA on standby, 105mA when a strong signal was applied and up to 115mA under no signal conditions (a little more when set to Bands 1 through 3). Also, with 120v AC applied directly to the S.770R supply, the HT1 line was at 255v and the current draw was 125mA with a strong signal applied. I figured that although the current draw still seemed high, it could conceivably be normal, especially as all the key voltages checked out ok. Once the 'real' power supply is fitted and working in the S.940 I will re-visit this issue (note: the S940 power supply has two 140ohm resistors fitted to the mains transformer HT secondary, feeding the rectifier anodes, that are not present in the S.770R supply. These should reduce the HT2 voltage by around 15v, which may help).

Having made a Perspex case for my S.750 so the innards can be seen while the set is working, I am contemplating making a similar case for the S.940 (though the innards are not quite as pretty). I could of course use the case off my S.830 for 'special occasions' (photos), though it is a difference style to that used for the S.940, the latter having only side perforations, whereas that for the S.830 has both side and top perforated sections.



The IF/AF chassis during component replacement (annotated photo at the end of the article, Page 24)

Not having a case, for now I settled for an external cosmetic job of simply cleaning all the knobs (with alcohol) and polishing them with household silicone-based polish ("Armor-All' plastic polish for car interiors can damage ABS-type plastics, which I think these knobs may be), touched up the one or two small scratches and the tiny wear patch on the finger plate using Humbrol enamel paints mixed to match – the results looks ok (the main wear/scratched area is hidden behind the Band Change switch anyway).

So, I am now the proud possessor of a piece of very functional early-1960's HF thermionic magic that was another 'dream receiver' of my youth - thanks to Pat's generosity, a little sleuthing and a few bucks worth of bits – just the transformer to sort out now: I hope the one from Pat's 'parts set' S.750 is ok or can be re-wound at a reasonable cost. If not, I will likely fit a new 'look-alike' from Hammond. **Part 2** of this article (which I think will be much shorter) will cover the rebuild of the power supply section (once I have a suitable transformer), repairs to the Band 4 aerial section, further checking and adjustments, final 'sprucing-up' and, hopefully, 'boxing-up'.

So folks, once again I am on the look out for yet another challenge…. wonder when that S.640, S.680X, S.730/4, S.888 or other magical Eddystone classic will appear wanting some TLC? I hope this article was of some interest to EUG folks and that others will be encouraged to contribute to the ever-growing EUG website in this way (remember to always keep your camera handy when fixing stuff) – the records you keep are useful for reference when wondering how something went together, but also to illustrate articles like this – a picture is definitely worth a thousand words… I would be pleased to discuss this article or any other radio-related topics with EUG folks, either by email, the EUG forum or phone (I am on 'Skype').

73's

Gerry O'Hara, G8GUH (gerryohara@telus.net), Vancouver, BC, Canada, November, 2006

EDDYSTONE

Postscript

I called Dave Simmons and he is able to supply a few still needed (Eddystone-specific) parts, including a new brass tuning shaft bearing (he had some of these machined), dial lamp holder and L4 coil (or similar). These will be fitted on arrival, as will a transformer (whether it is a re-wind or new one) and some form of case fitted (hopefully a 'real' one) – look out for Part 2...

References

EUG Newsletter/Lighthouse (from 'Super Index') ..... Issue ... Page

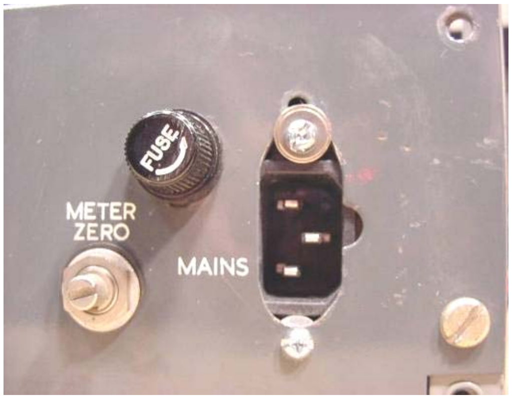
Web:

http://www.eddystoneusergroup.org.uk/ (the best – of course!)
http://bama.edebris.com/manuals/
http://www.radau5.ch (excellent source of valve info (downloadable pdf's – see the 'dir_coup' pdf file for a full technical description of cascode amplifiers)
www.qsl.net/eddystone (hopefully back on line soon)

Some Useful Books on Radio Circuitry and Repairs:

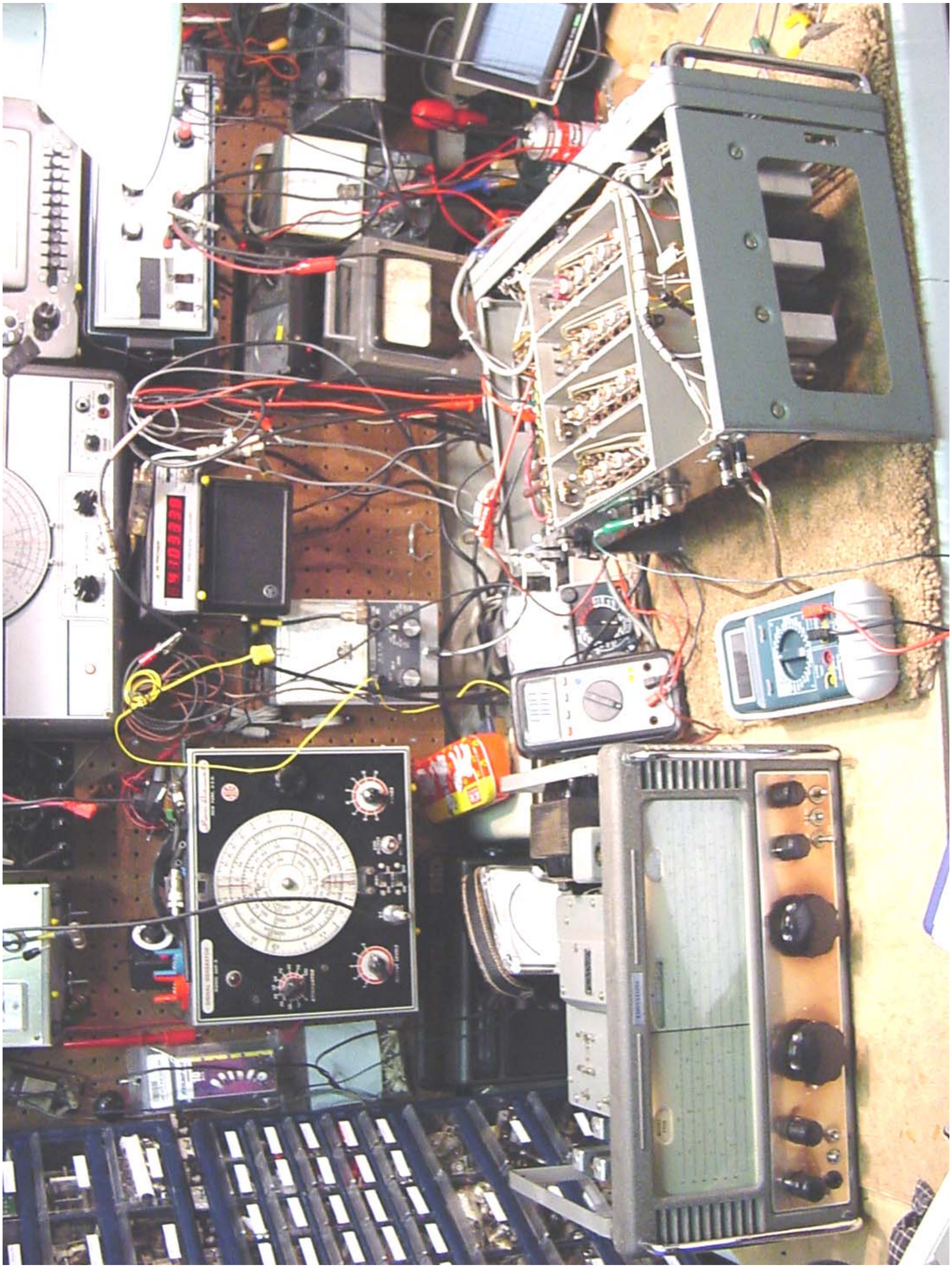
- Radio and Television Receiver Circuitry and Operation, Ghirardi and Johnson, 1951
- Radio and Television Receiver T'shooting and Repair, Ghirardi and Johnson, 1952
- Electronics One-Seven, H Mileaf, 1967
- Radio servicing: Theory and Practice, A Marcus, 1948
- Radio Receiver Servicing, JT Frye, 1955
- Elements of Radio Servicing, Marcus and Levy, 2nd Ed. 1955, (the first edition of this book can be downloaded in pdf format from http://www.archive.org/details/Elements_Of_Radio_Servicing)

Bag of duff parts removed from my S.940… any offers?



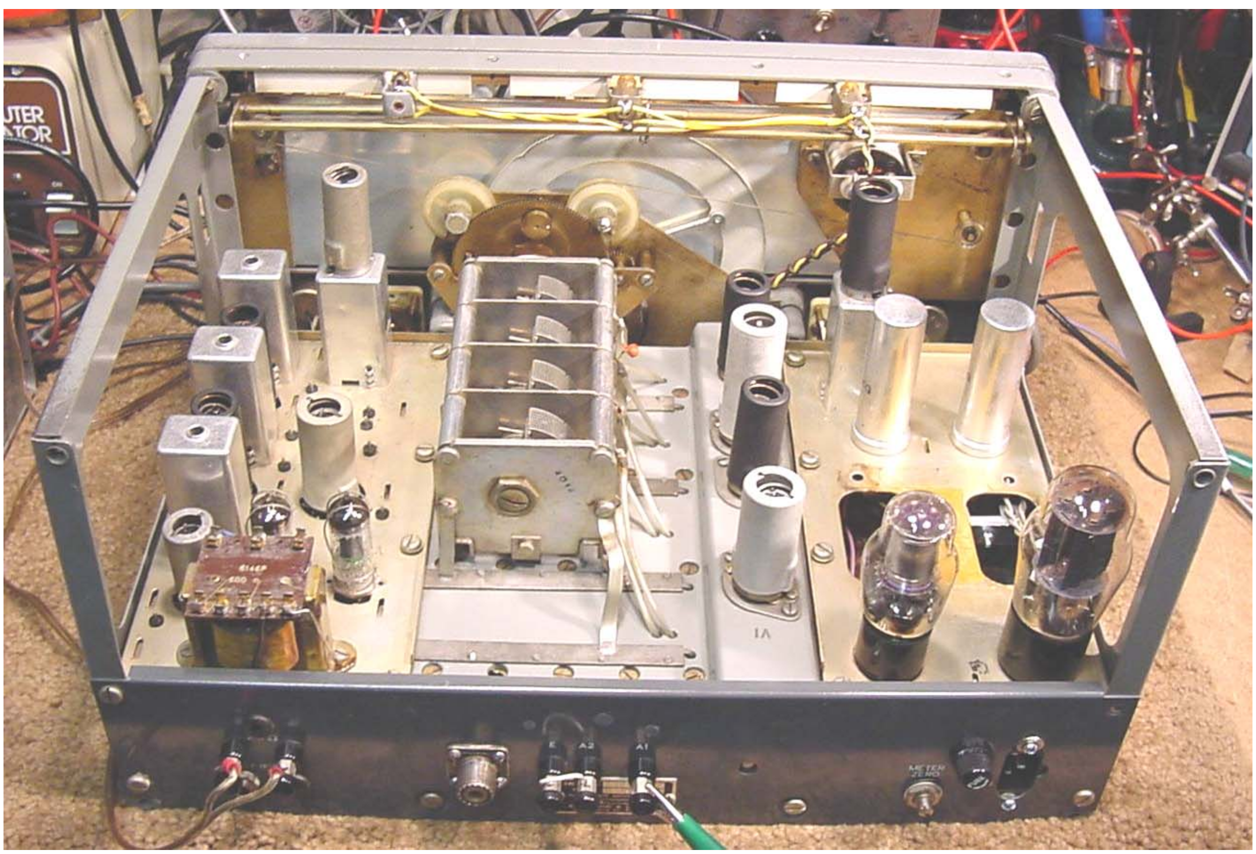
'Euro-connecter' mains connector now fitted (not much use at present!)

The S.940 looks pretty good from the front – I would say as good as my S.830/4 anyway. Here it is pulling in 'Coast to Coast AM' on 1410kHz @ 5-9+.



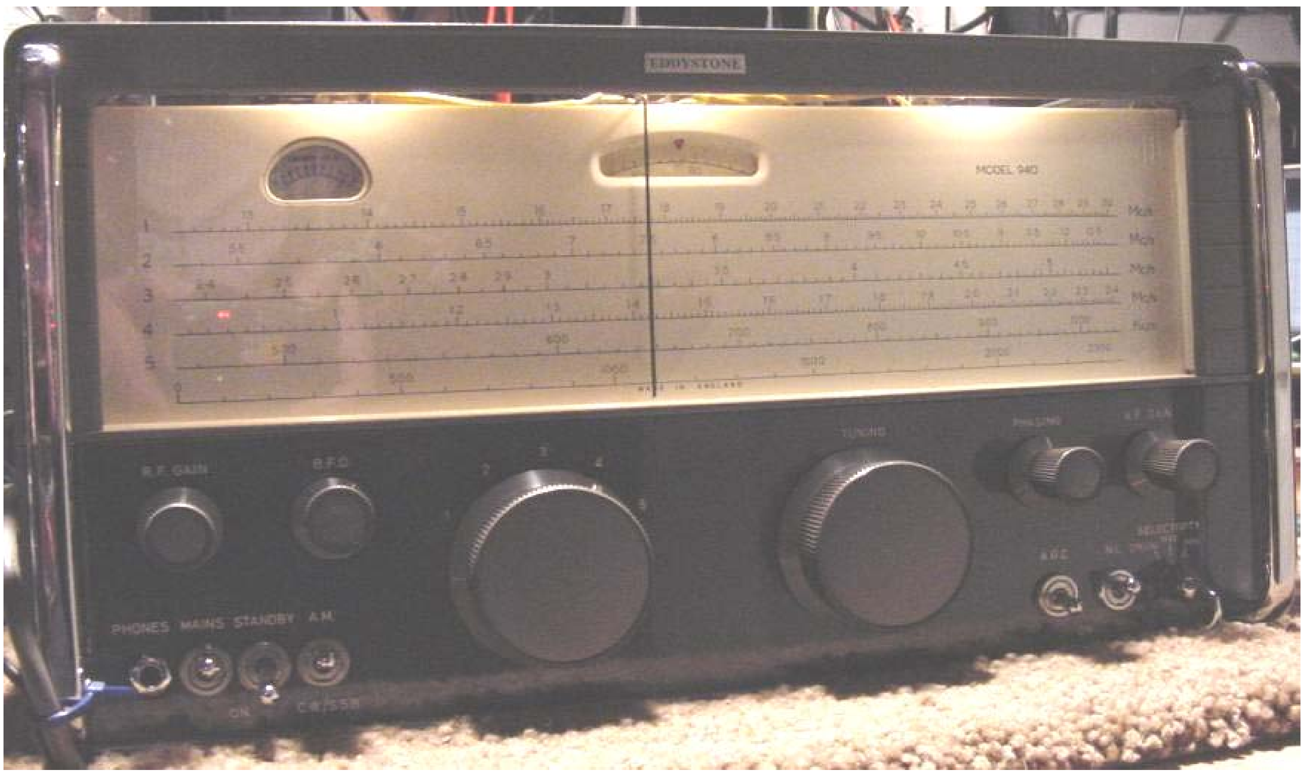
The temporary ‘jump start’ arrangement of powering the S.940 using the S.770R power supply – it feels strange switching one receiver on and the other one actually powering-up…

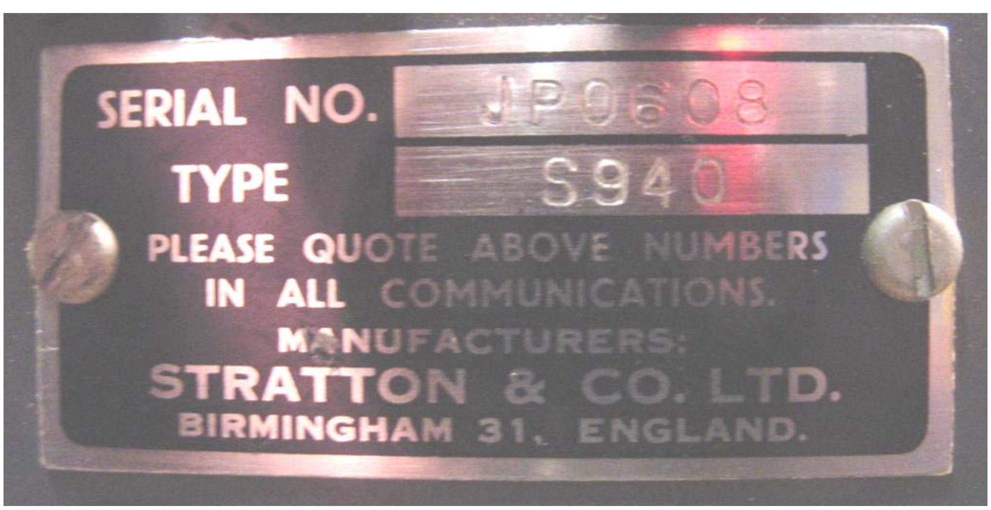
A nice shiny new 5Z4G fitted and not an electron to rectify…

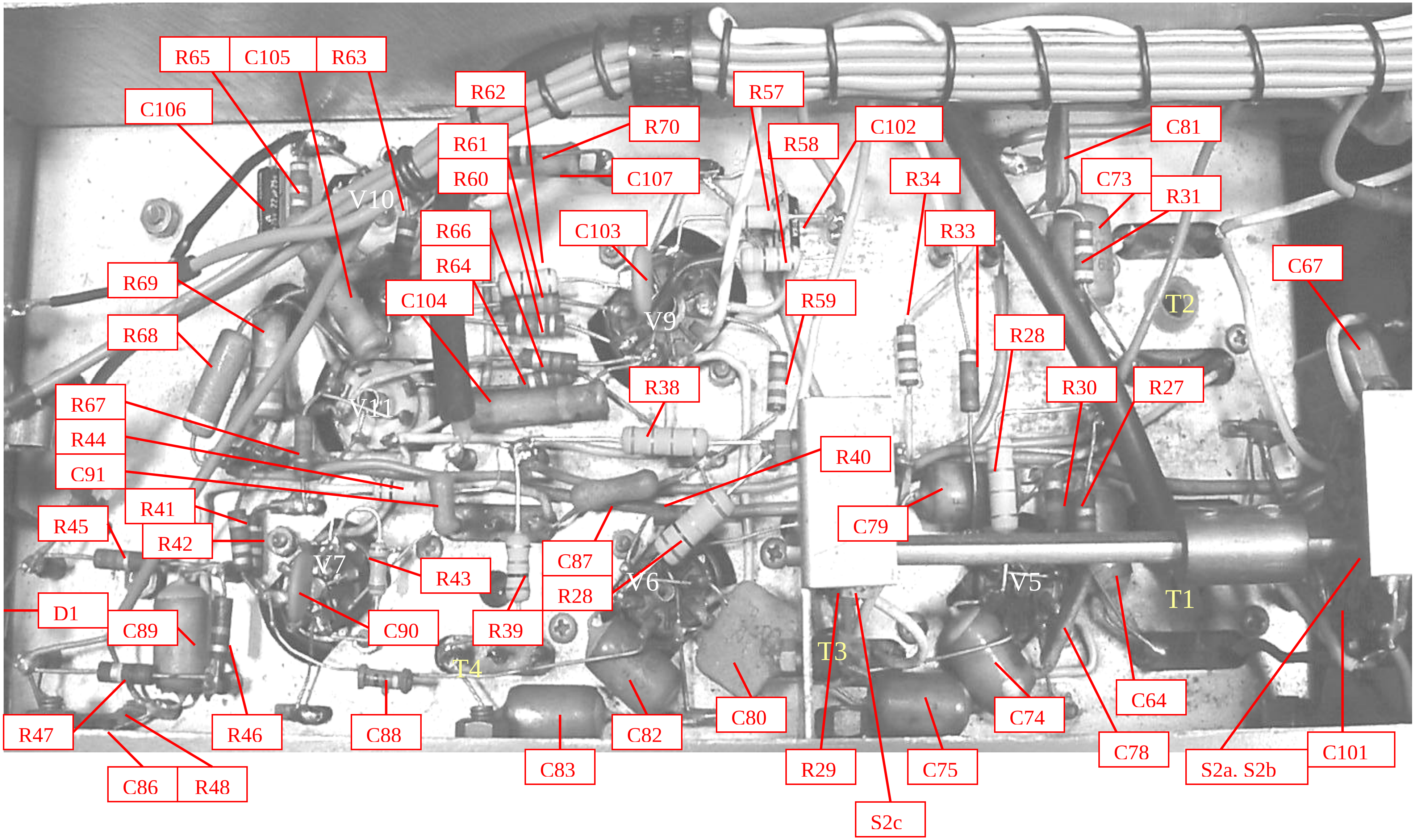


The S.940 isn’t bad inside either – “…look mum, I’m working good without a transformer…” (there surely must be less painful ways to lose a few pounds?)

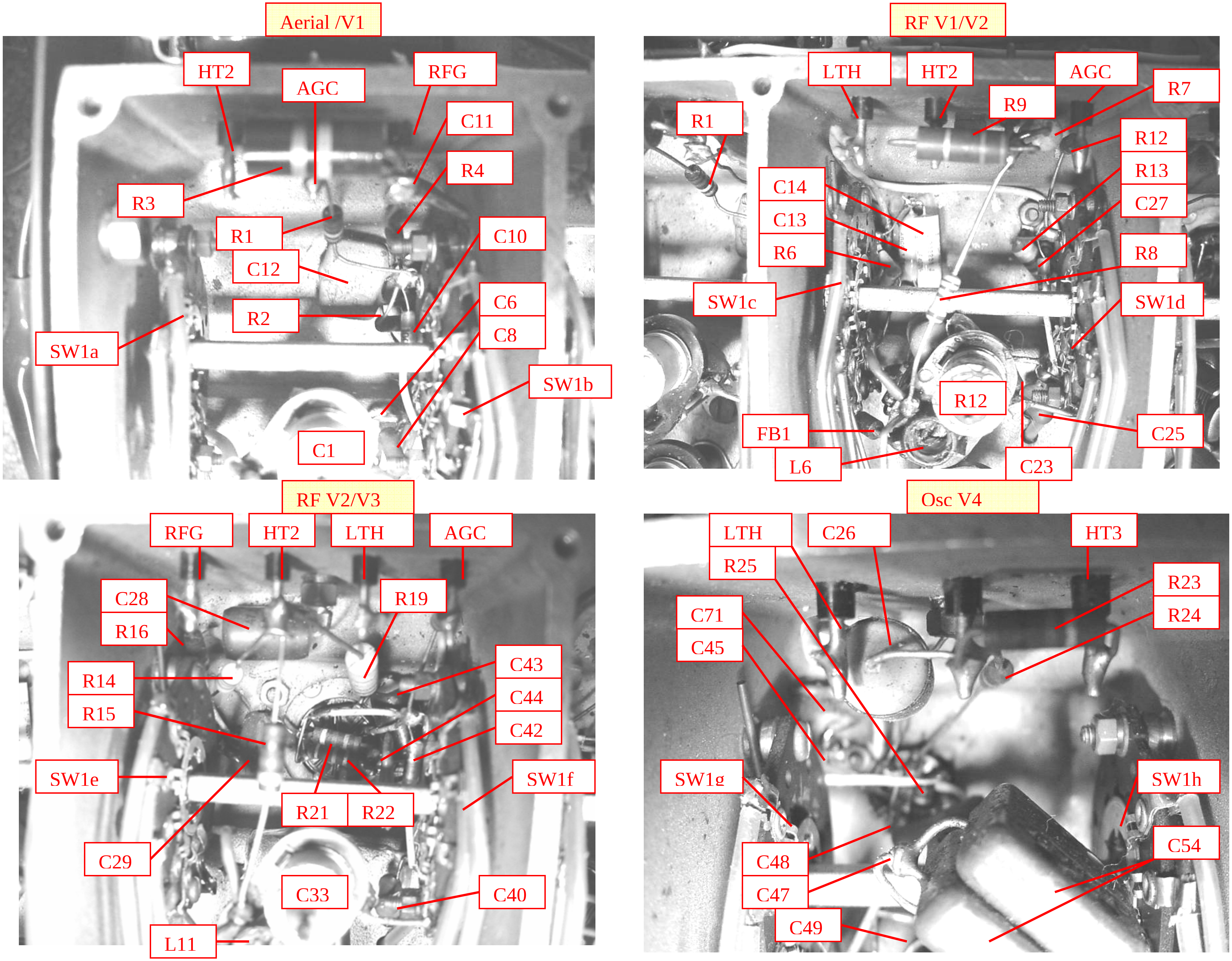
The S.940 on ‘soak test’ powered by the S.770R



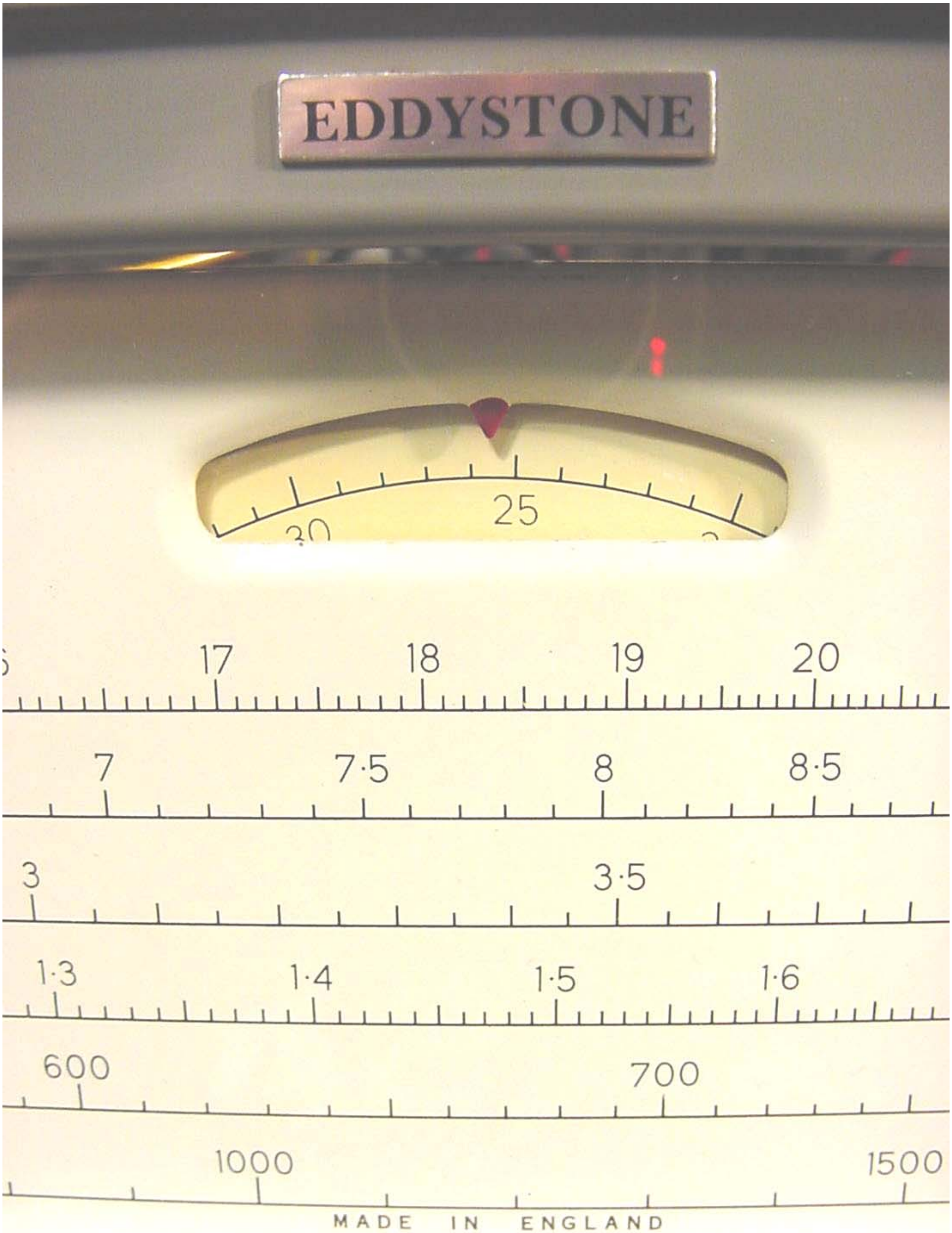




S.940 IF/AF sub-chassis with components identified



S.940 RF sub-chassis with components identified


EDDYSTONE
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1500
MADE IN ENGLAND

Eddystone

COMMUNICATIONS RECEIVER MODEL 940

INSTRUCTION MANUAL

The EDDYSTONE Model 940 is a general purpose communications receiver covering the frequency band 480 kc/s to 30 Mc/s in five switched ranges. A single conversion circuit is employed and the receiver is suitable for AM, CW and SSB reception. A built-in mains pack provides for direct operation from all standard AC supplies.

Audio outputs are available for connection to an external loudspeaker, telephones and remote lines. The output stage employs a push-pull circuit and is capable of excellent quality. Circuit arrangements are such that the speaker output is automatically interrupted when telephones are in use but the line output is maintained under all conditions of operation. Audio input terminals are fitted at the rear so that the audio section of the receiver may be used alone.

Three positions of IF selectivity are provided one of which involves the use of a single crystal filter having a phasing adjustment which takes the form of a panel control.

Other features of the Model 940 include a built-in meter for measurement of relative carrier level or for use as a tuning indicator, a noise limiter for AM reception and an extremely efficient AGC system. The Local and Beat Oscillators are operated from a stabilised supply. Two RF Amplifiers are used, the first stage being a double-triode cascode arrangement. Provision is made for control of an external relay which may operate an associated transmitter from the Standby switch on the front panel.

Rugged construction and high quality components are employed throughout, the receiver is of a most convenient size, can be adapted for rack-mounting and is attractively finished with modern styling. The strong steel cabinet and chromium plated panel handles give adequate protection against rough usage. Continuous operation is possible in all areas under extreme climatic conditions.

TECHNICAL DATA

Frequency Coverage

480 kc/s to 30 Mc/s in five ranges as follows :—

Range 1	..	12·7 — 30·0 Mc/s
Range 2	..	5·4 — 12·7 Mc/s
Range 3	..	2·4 — 5·4 Mc/s
Range 4	..	1·03 — 2·4 Mc/s
Range 5	..	480 — 1030 kc/s

Intermediate Frequency

450 kc/s with crystal filter and variable selectivity.

Valve Complement

V1	ECC189	(CV5331)	1st RF Amplifier (cascode).
V2	6BA6	(CV454)	2nd RF Amplifier.
V3	6AJ8	(CV2128)	Mixer Stage.
V4	6C4	(CV133)	Local Oscillator.
V5	6BA6	(CV454)	1st IF Amplifier.
V6	6BA6	(CV454)	2nd IF Amplifier.
V7	6AL5	(CV140)	AM Detector/AGC Rectifier.
V8	6BE6	(CV453)	CW/SSB Detector.
V9	12AU7	(CV491)	Audio Amplifier/Phase Splitter.
V10	6AM5	(CV136)	Push-pull Audio Output.
V11	6AM5	(CV136)	Push-pull Audio Output.
V12	GZ34*	(CV1377)	HT Rectifier.
V13	VR150/30	(CV216)	HT Stabiliser.
D1	2E1†	—	Noise Limiter (silicon diode).

*5Z4G (CV1863) may be fitted in this position.

† DD006 may be used as an equivalent.

Power Supply

110V or 200/240V AC (40–60 c/s).

Consumption

Approximately 80 volt-amperes.

Fusing

Live input : 1 Amp.

Input and Output Impedances

Aerial input	..	75Ω (nominal) balanced or unbalanced.
Audio input	..	0·1 MΩ (approx).
Audio outputs	..	Loudspeaker : 2·5/3Ω.
		Lines : 600Ω balanced or unbalanced.
		Telephones : Nominally 2000Ω but suitable for a wide range of impedances.

TYPICAL PERFORMANCE FIGURES

Sensitivity

3uV for a 15dB signal-to-noise ratio. (50mW output and 30% mod.).

Selectivity

The following figures are indicative of the overall bandwidths obtained in the broad ('MIN'), narrow ('MAX') and 'CRYSTAL' positions.

Position	–6dB	–20dB	–40dB
'MIN'	10 kc/s	15 kc/s	22 kc/s
'MAX'	4 kc/s	8 kc/s	12 kc/s
* 'CRYSTAL'	400 c/s	2 kc/s	3·5 kc/s

* Phased for symmetrical response.

Image Rejection

1 Mc/s	..	90dB.
8 Mc/s	..	75dB.
20 Mc/s	..	40dB.

Calibration Accuracy

0·5% on all ranges.

AGC Characteristic

The audio output level will not change by more than 9dB when the carrier level is increased by 100dB above 5uV.

Audio Output and Response

Maximum output at the 2·5 or 600Ω terminals (when used independently) is of the order 3·5 watts.

The audio response is level within 3dB over the range 100 c/s to 8 kc/s.

Distortion

Not greater than 5% at 1 watt in 2·5Ω (1000 c/s).

Hum Level

46dB below 1 watt.

CIRCUIT DESCRIPTION

The RF Section

This portion of the receiver comprises two RF Amplifiers V1 and V2, a heptode Mixer Stage V3 and a separate Local Oscillator V4.

The 1st RF Stage employs an ECC189 vari-mu double-triode in a series cascode circuit. The input is fully tuned on all ranges and provision is made for connection of balanced or unbalanced feeders of 75Ω impedance. The cascode amplifier maintains excellent signal-to-noise characteristics throughout the entire tuning range and is superior to the more conventional pentode amplifier usually found in this position.

Careful layout of the components associated with the cascode stage, inclusion of the grid stopper R2 and efficient grounding to signal frequencies of the second triode grid (pin 2 : C13 and C14) ensure stable operation at all frequencies. The HT supply is derived from the voltage divider R7/R9 while the correct bias for the second triode is obtained across R5.

A high gain vari-mu RF pentode (6BA6) is used in the second stage of RF amplification. Like the first stage, this amplifier is also fully tuned and provides added protection against image signals and spurious responses.

Initial operating bias for V1 and V2 is developed across R4 and R16. These resistors are not directly earthed but are returned to chassis via R32 and the 10,000Ω variable resistor RV1. (R32 is normally shorted by S3b). RV1 functions as a combined RF/IF Gain control, its control range being increased by a small bleed current which is derived from the HT1 rail via R3.

A separate Local Oscillator is employed in the frequency conversion stage and as a result only the heptode portion of the 6AJ8 (V3) is used. The control grids of V1, V2 and V3 are each returned to the AGC line via R1, R12 and R20 respectively.

A tuned-anode circuit is used in the Local Oscillator Stage (V4) which employs a 6C4 triode and operates above the signal frequency on all ranges. HT is obtained from the stabilised 150V supply (HT3) and oscillator injection is taken from the control grid (pin 6) via the coupling capacitor C45 to g_1 of the heptode Mixer. A measure of temperature compensation is obtained on all ranges from the small ceramic capacitor C62 which is located on the main tuning gang.

All the tuned circuits associated with the RF Section are housed in a partitioned diecast chassis which is extremely robust and ensures a high degree of mechanical stability. All inductors except those actually in use are short circuited by the Wavechange switch to prevent absorption effects.

The IF Section

Output from the Mixer valve (V3) is taken to a two-stage IF amplifier tuned to 450 kc/s. 6BA6 vari-mu RF pentodes are used in both stages (V5 and V6), the first of which is controlled by the combined RF/IF Gain control RV1. AGC is applied to both stages via R31 and R34.

A total of seven tuned circuits are used and the amplifier features variable selectivity which is achieved by switched tertiary windings on two of the transformers (T1 and T3). In addition, a selective crystal filter can be brought into operation when the Selectivity switch is moved to the third position. The phasing capacitor (C68) associated with this filter is brought out as a panel control so that maximum benefit can be derived from the filters' variable rejection notch.

The cathode of the 1st IF Amplifier (V5), like the cathodes of the two RF Stages, is returned to chassis via R32. As mentioned previously, this resistor is normally shorted by the Standby switch (S3b). With the switch in the ' standby ' position R32 is brought into circuit and the voltage developed across it due to the cathode currents of V1, V2 and V5 (plus the bleed current through R3), is sufficient to effectively mute the receiver. A double-pole double-throw switch is used for S3 and the unused section (S3a) can be wired to operate an external relay should this facility be required. (See Installation).

Variation of the screen current of V6 due to AGC action is utilised to operate the built-in Carrier Level Meter (M1). This is wired between a tap on the screen feed (R37/R38) to V6 and the slider of a potentiometer (RV2) which forms part of a potential divider across the main HT supply. RV2 allows the voltage across the meter to be set to zero so that the meter needle can be set to the ' O ' mark on the meter scale under ' no-signal ' conditions. On receipt of a signal, AGC bias causes the screen current of V6 to fall so reducing the voltage across R37 and, by unbalancing the bridge network, causes the meter to read.

Detectors and AGC

Two separate detectors are used, a normal series diode circuit for AM and a product detector for CW and SSB.

The AM Detector employs one diode of a 6AL5 (V7B). Audio developed across the load resistor R48 is fed to the Mode switch (S6b) via the series type Noise Limiter D1. This is a small silicon diode and can be taken out of circuit by closing S5.

A mixing type detector (V8 : 6BE6) is used for CW and SSB reception and this is housed in a small screening can which is located on the power unit chassis. Like the 1st Oscillator, this stage is run from the stabilised HT supply which is applied to V8 by S6a when this is placed at CW/SSB. Signal input for the CW/SSB Detector is obtained from the secondary of T4 and is coupled in via C91.

Variation of ' pitch ' on CW signals and correct adjustment of the carrier insertion frequency on SSB signals is by C98 which provides a swing of at least 3 kc/s either side of the IF. Output is taken across the anode load R54 via the filter R56/C95/C96 and the coupling capacitor C97 to the Mode switch S6b.

The remaining half of V7 (½ 6AL5) is used as the AGC Rectifier and is fed direct from the anode of the last IF Stage via C88. The AGC is delayed by biasing the cathode of V7A from the divider R43/R44. AGC is fed to the two RF Stages V1 and V2, the Mixer V3 and both 450 kc/s IF Stages V5 and V6. AGC can be taken out of operation by S4 which earths the AGC line.

The Audio Stages

AF output from the appropriate detector is selected by S6b and routed to the AF Gain control RV3. Terminals at the rear of the set allow external audio signals to be introduced at this point. The slider of RV3 feeds the grid of V9A (½ 12AU7) which is the 1st Audio Amplifier and is resistance-capacity coupled to the Phase Splitter V9B.

Two 6AM5 pentodes are used in the Audio Output Stage. One of these (V11) is driven from the anode of V9B, the other (V10) from the cathode. Negative feedback is introduced by R63 and R66 and also by the unbypassed cathode resistor of V9B.

The output transformer has two secondary windings, one of 2·5Ω for connection to an external loudspeaker and the other of 600Ω for use when the receiver output must be transmitted over remote lines to some distant listening point. This winding is electrostatically screened from the primary and the other secondary.

Telephones are tapped into a resistive divider (R70/R71) which is fed from the anode of V10 via the blocking capacitor C107. An auxiliary contact on the jack socket breaks the loudspeaker earth return to interrupt the speaker output when telephones are in use.

The Power Supply

This portion of the receiver is of conventional design and employs an indirectly heated full wave rectifier (GZ34 or 5Z4G) for HT. In addition to the main HT supply (HT1), two other supplies are provided as follows :—

HT2 : HT supply for V9.

HT3 : Stabilised HT supply for V4 and V8.

A double pole switch is used for mains supply switching and the live line is fused at 1 Amp by the standard type cartridge fuse FS1.

INSTALLATION

Unless otherwise specified, the Model 940 is supplied complete with all valves in a form suitable only for surface-mounting. A rack mounting version (940/RM) is available to special order but standard Models can be modified for rack-mounting (19″ rack width) by fitting rack-mounting brackets and a special cabinet. The latter has cut-outs along the two vertical leading edges to give clearance for the mounting brackets which are attached to the rear of the panel. The ¼″ BSF spacing washers located between the panel and side-plates are removed when the brackets are fitted. Cabinets and mounting brackets can be supplied to order; quote D3377/2 for the cabinet and 5912P for the mounting brackets of which two are required.

All external connections with the exception of the telephone output are located at the rear of the cabinet and this point should be borne in mind when selecting the most suitable position for mounting the receiver.

Mains Input Connections and Voltage Adjustment

The AC mains supply is connected to the polarised socket at the rear using the mains connector provided with the receiver. The lead is left free at one end so that the user can fit a plug of a type suitable for connection to the local mains supply. The individual wires are colour-coded as follows :—

RED : live line. BLACK : neutral line. GREEN : earth.

It is important to check that the mains transformer is adjusted to suit the local mains voltage before making connection to the supply. A small three-way two-pin voltage selector plug is provided for this purpose on the side of the mains transformer. When the receiver leaves the factory the selector is set in the 230V position which is suitable for AC mains voltages in the range 220–240V. For operation from other supplies the selector should be set as follows :—

110V : 110V position.

200/220V : 200V position.

Aerial Input

Two aerial terminals labelled 'A1' and 'A2' are provided in the centre aperture at the rear of the cabinet. When the aerial feeder to be connected is coaxial (unbalanced) the 'A2' terminal should be linked to the earth terminal 'E' which is adjacent to it. The inner conductor of the cable is connected to the 'A1' terminal and the outer to 'A2.' Random single wire aerials should also be connected to 'A1' with the link in position as described above.

When using balanced feeders remove the link between 'A2' and 'E' and attach the feeder to 'A1' and 'A2.'

Earthing

Although the receiver is earthed by virtue of the supply earth it may be desirable to attach a more direct earth especially if a high level of local noise is experienced on the lower frequencies.

The earth lead should be of heavy gauge, as short as conveniently possible and should be soldered to the earthing point to ensure a good connection. A specially designed earthing clip may be used if this is more convenient but under no circumstances should reliance be placed on a twisted connection. The earth lead should be connected to terminal 'E' adjacent to the two aerial connections.

Loudspeaker

Two spring-loaded quick-release terminals labelled 2·5Ω and located in the left-hand aperture at the rear allow connection of an external loudspeaker. Any good 2·5/3Ω unit can be used. Suitable speaker units in the EDDYSTONE range are the Cat. Nos. 906 and 935, full details of which are available on request.

Line Output (600Ω)

Connection to this output is made directly at the output transformer to three solder tags which are clearly marked 600Ω. The middle terminal is labelled 'CT' (centre-tap) and must be connected to the receiver chassis when a balanced output is required ; otherwise make no connection to this terminal.

The output is taken from the two outer terminals. To make connection, remove the cabinet (four screws at rear), pass lead through left-hand aperture and through hole above the 2·5Ω terminals. Either tie a knot in the cable or fit a suitable cable clamp six inches from the end of the cable to prevent damage should the cable be pulled accidentally.

Now pass the lead through the hole in the chassis at the rear of the transformer and make soldered connections to the tags provided.

Telephones

This output is suitable for use with telephones of almost any impedance. Connection is made with a standard jack plug at the socket on the left-hand side of the panel. Insertion of the plug immediately interrupts the loudspeaker output but not the line output.

External Relay

If the receiver is used in conjunction with an associated transmitter it may be desirable to control the latter from the Standby switch on the receiver. One section of this switch is available for this purpose and leads can be connected to the appropriate tags (the two furthest from the lower edge of the panel on the unwired side of the switch). These tags are shorted when the switch is at 'standby.'

The lead can be passed through the hole used for the 600Ω output above and for neatness can be laced to the existing cable form.

OPERATION

When the receiver has been installed in accordance with the instructions given above, it can be brought into operation by moving the Mains switch to the 'ON' position. An indication that the mains supply is completed to the receiver is given by illumination of the tuning scales. The receiver will become operative after the normal valve warming-up period provided the Standby switch is at 'ON.' This control is arranged to mute the receiver by desensitising three of the amplifying stages. It will be found most useful when the receiver is used in conjunction with an associated transmitter since the transmitter can be controlled by the same switch if so desired. When the switch is set to 'STANDBY' all HT supplies are retained so that drift during standby periods is kept within the smallest possible limits. The receiver functions normally immediately the switch is moved to the down position.

While the receiver is warming-up, select the appropriate range and tune approximately to the required frequency. The range numbering around the Wavechange control is repeated at the left-hand end of the tuning scales and all calibration is in megacycles except on the lowest frequency range (Range 5) where frequencies are indicated directly in kilocycles.

The settings of the two gain controls will be determined by the following factors : (1) type of signal, (2) strength of signal, (3) whether or not AGC is in use. Generally speaking, AGC will be of most value when receiving AM (telephony) signals. With AGC in use, the RF Gain should be fully advanced to secure maximum AGC action and under these conditions the desired output level is obtained by adjustment of the AF Gain. For reception of CW (telegraphy) with AGC 'OFF,' the AF Gain should be well advanced and the RF Gain reduced to prevent overloading of the pre-detector stages. SSB (telephony) signals are received best with much the same combination of gain adjustments as used for CW reception.

Selection of the appropriate detector for the desired type of reception is by means of the Mode switch which has two positions labelled respectively 'AM' and 'CW/SSB.' Except in the case of preliminary tuning of SSB signals the Mode switch should always be moved to the appropriate position before attempting to tune the desired signal. On SSB it usually proves easier to tune the signal in the 'AM' position before proceeding to resolve it completely.

CW Reception

When tuning CW signals the Selectivity switch should be set to 'MAX.' The BFO (Pitch) control (to the right of the RF Gain) provides a total swing of some six kilocycles so that adequate variation of the beat note is available. The oscillator can be set either above or below the signal and a check should always be carried out to determine which setting gives the least adjacent channel interference. When this form of interference is particularly severe, advantage can also be taken of the built-in crystal filter which is brought into operation by moving the Selectivity switch to the 'CRYSTAL' position. By careful adjustment of the Tuning, Crystal Phasing and BFO Pitch controls a great reduction in the interference level will be obtained together with a consequent increase in the readability of the wanted signal.

AM Reception

Preliminary tuning of AM signals can be carried out with the Selectivity switch in either the 'MIN' or 'MAX' positions. The strength of signal, conditions prevailing and the interference present will be deciding factors in the choice of selectivity position. The crystal filter can be introduced if interference is particularly severe but since the filter is designed primarily for selective CW reception, the quality of the received signal is bound to suffer due to attenuation of the higher audio frequencies. Impulse noise can be reduced when the Noise Limiter (NL) switch is put in the 'ON' position. The Noise Limiter is only operative on AM since adequate noise suppression obtains on CW and SSB by virtue of the detection system which is employed.

SSB Reception

Tuning SSB signals calls for more precise adjustment of the controls than either of the foregoing modes. The Selectivity switch should be set to the ' MAX ' position for SSB reception.

Initial tuning is carried out with the Mode switch at ' AM,' AGC ' ON ' and with the RF Gain well advanced. With the controls set in this way, tune for maximum deflection on the built-in carrier level meter. It should be noted that the meter reading will be subject to large variations due to the speech on the signal and some practice is necessary to judge accurately when the signal lies correctly in the IF passband.

Now place the Mode switch in the ' SSB ' position, switch off the AGC and reduce the RF Gain setting. Without touching the tuning, swing the BFO Pitch control **very slowly** to either side of the centre setting. In one direction the signal will tend towards greater intelligibility and the BFO should be set at the point which provides the most natural sounding speech. Slight alternate adjustment of the Tuning and Pitch controls will now render the signal fully readable with reasonable quality.

If the transmitting station changes sideband or the receiver is now tuned to a station using the opposite sideband, the Pitch control must be adjusted to a similar setting on the opposite side of the centre frequency.

Carrier Level Meter

This is operative only when the AGC is ' ON.' It can be used either as an aid to accurate tuning or for comparison of carrier levels. Always set the tuning so that the meter needle is at its peak.

A pre-set control (Meter Zero) is available at the rear of the set to allow the meter needle to be adjusted to the ' O ' mark under no-signal conditions.

MAINTENANCE

Reliability in operation is a most desirable asset, a maxim which has been applied during development of the Model 940 receiver. As a result, only the most modern top grade components having adequate ratings have been employed. The valves have been chosen from a range of current types well known for their performance in receivers of this kind and the mechanical layout and construction are such that there is little possibility of damage due to rough handling.

If the receiver fails in operation, switch off immediately to avoid the possibility of damaging some expensive component. It may be that the fault is a relatively simple one and the following notes are given for guidance of an inexperienced user in checking for what to an experienced service engineer would be an obvious fault.

First and foremost ascertain that all external connections are made correctly. The loudspeaker lead may have broken or become disconnected at the receiver terminals or at the speaker unit itself. Likewise, the aerial feeder may have broken adrift causing all but the strongest signals to be lost.

When the receiver has had a chance to cool down (say five minutes), momentarily close the Mains switch and observe whether the dial lights come on or not. If the lights remain ' out ' and the mains lead to the set has been checked and found fully serviceable, the most likely cause is a burned out fuse at the mains input. This may be due to a receiver fault or may only be the breakdown of a normally fatigued fuse.

Whichever is the case, fit a replacement fuse (standard 1¼" cartridge type rated at 1 Amp) and switch on again. Allow the usual warming-up time and ascertain whether the receiver becomes operative in the normal manner. If this is the case then the trouble was most likely due to the fuse itself or possibly a violent surge in the mains supply voltage.

However, if the fuse burns out more or less immediately (i.e. lights come on for a short period and then go out), or the receiver runs for an hour or so and then fails again, the fault is a more serious one and the receiver should be taken to the nearest EDDYSTONE Agent who will rectify the trouble at a reasonable charge.

If it is necessary to take the receiver to an engineer who is not familiar with EDDYSTONE equipment, take these instructions with the set. They contain information which may enable the engineer to clear the fault more rapidly than would otherwise be the case.

Pointer Drive Cord Replacement

In the unlikely event of the drive cord either breaking or slipping out of the pulley grooves, replacement will be much simplified (even when the original cord is undamaged) if a new length is obtained. This can be made longer than the length actually required (approximately 4') and will therefore be easier to handle. Replacement will present no problems if the instructions given below are followed carefully.

NOTE : In these instructions, left and right are as viewed from the rear of the receiver.

1. Remove the cabinet after taking out the four retaining screws at the rear.
2. Take off the old drive cord by slackening the 6BA screws let into the drive pulleys.
3. Set the tuning control so that the tuning gang is fully meshed.
4. Secure one free end of the replacement cord to the 6BA screw in the left-hand drive pulley.
5. Feed the cord through the pulley slot and into the groove nearest the panel (cord leaving pulley from right to left).
6. Pass cord around jockey pulley (under then over) and across the dial between the pointer guide rods. Sufficient tension should be applied to cause the jockey pulley to take up a position one quarter of an inch from the guide rod support bracket.
7. Move the pointer to the right-hand end of the guide rods (past tuning meter) and then slide the cord up and over the retaining spring. The spring may be depressed slightly to simplify this operation.
8. Pass cord over top right-hand guide pulley, under bottom right-hand guide pulley, under meter and across towards the right-hand drive pulley.
9. Lay the cord in the groove nearest to the panel and wind three complete turns in an anti-clockwise direction. Ensure that the cord lies snugly in the pulley grooves and that the tension is maintained at the jockey pulley.
10. Press cord into pulley slot and secure to 6BA screw. (If screw is not immediately accessible, rotate tuning control to unmesh gang so that the screw comes into a more convenient position. The cord should be held firmly in line with the pulley groove whilst doing this).
11. Check that the jockey pulley is correctly tensioned and then cut off the surplus cord at the right-hand drive pulley.
12. Move gang to fully meshed position and set pointer to ' O ' on logging scale. Check drive for free and normal operation and correct vernier tracking.
13. Check the dial calibration against a suitable frequency standard.
14. Replace cabinet and fit retaining screws.

Cleaning Scale and Scale Window

1. Locate the three screws disposed vertically at each end of the rear of the scale plate. Take out the centre screw at each end and remove the small side castings at the extremities of the glass window.
2. Remove the three dial lamp holders from the rear of the scale support. These are clipped into position and are easily disengaged from the fixing slots by squeezing together the two sides of the holder.
3. Remove the four countersunk screws along the top edge of the panel and take out the long scale support.
4. The glass is now free and can be removed by lifting up and tilting back slightly.

Valve and Dial Lamp Replacement

The valves used in the Model 940 are standard types and no difficulty should be experienced in obtaining replacements. Any recognised equivalent is suitable if the type specified is not available, e.g. ECH81 can be used in lieu of 6AJ8, EB91 for 6AL5, etc.

All valves are easy of access and can be changed without difficulty. Screens or retaining clips must be replaced after fitting a new valve.

Dial lamps are rated at 6·5V @ 0·3A and are standard miniature bayonet types.

Re-alignment — General

In the unlikely event of a complete re-alignment being necessary, the following instructions should be followed in full. In the more usual case of partial alignment required to compensate for ageing components, etc. the relevant instructions can be extracted as required.

It must be stressed that alignment adjustments should not be tampered with unless there is a clear indication that alignment is in fact required. Alignment should only be carried out by fully skilled technicians equipped with suitable test instruments.

Re-alignment of the IF Transformers and BFO

Test Equipment Required.

Signal Generator covering the intermediate frequency of 450 kc/s with modulation at 400 c/s.

Output Meter matched to 2·5/3Ω.

Trimming tool (screwdriver type).

First disable the Local Oscillator by shorting out the section of the tuning gang nearest to the front panel. Set the Wave-change switch to '5,' Tuning to 700 kc/s and the RF and AF Gains at maximum. Switch off the Noise Limiter and AGC and put the Mode switch in the 'AM' position. Alignment must be carried out with the crystal filter in circuit so the Selectivity switch should be at 'CRYSTAL.' Adjust the Phasing control so that the capacitor is at its 'half-capacity' setting and check that this occurs when the index mark on the control knob is at 12 o'clock.

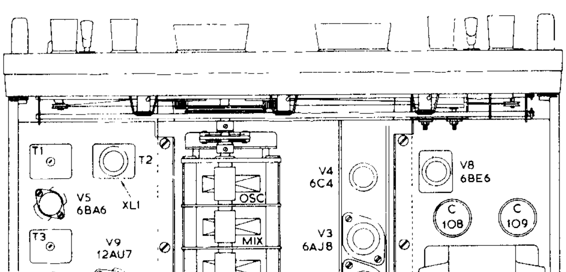
Connect the Signal Generator output lead to the stator of the Mixer section of the tuning gang (adjacent to Oscillator section) and the Output Meter and Loudspeaker to the 2·5Ω terminals at the rear. Allow 10—15 minutes for the equipment to reach operating temperature and then tune the Signal Generator to approximately 450 kc/s with modulation at a depth of 30% (400 c/s).

Now set the attenuator to a suitable level and tune the Generator for a peak reading on the Output Meter. It should be remembered that the receiver IF is in its most selective position and the tuning adjustment must be made very carefully to ensure that the output frequency is set accurately to the crystal peak. The attenuator should be adjusted to give a convenient reading on the Output Meter.

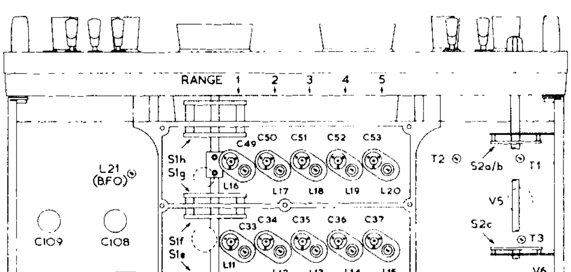
Peak the ferrite cores in T1—T4 (see Plan view for location) to obtain maximum reading on the Output Meter. It should be noted that the cores will tune in two positions : i.e. to an 'inner' and an 'outer' peak. All cores except the bottom (primary) core of T1 are set to the 'outer' peak : i.e. the one which occurs when the core is furthest from the opposite coil. The bottom core of T1 is set to the 'inner' peak while the core in the crystal filter output coil (T2) can be set to either peak.

Increase the attenuation as alignment proceeds and ensure that on completion a sensitivity of the order 7uV is obtained for an output of 50mW (IF selectivity at 'MAX). If this figure is not achieved, stage by stage checks should be carried out with the Generator applied directly to pin 1 (grid) of V5 and V6. Typical sensitivities to be expected are (1) at grid of V5 : 220uV for 50mW output, and (2) at grid of V6 : 14mV for 50mW output. A low sensitivity in either position will most likely be due to a faulty valve (6BA6) or low gain in the audio stages. AF sensitivity is of the order 120mV for 50mW output (1,000 c/s) with the signal applied at the AF Input terminals. (All sensitivities quoted with loudspeaker disconnected).

After the amplifier has been aligned in the 'CRYSTAL' position, a check should be made on the symmetry of the response in the 'MAX' and 'MIN' positions. If the response is asymmetrical in the 'MIN' position, slight re-adjustment of the bottom (primary) core of T1 will allow correction without affecting the response in the other positions of the switch.



Plan view of Receiver



Underside view of Receiver

Once the alignment of the IF Transformers has been completed, check that the Generator is tuned to the crystal frequency and then cut the modulation. Set the receiver Mode switch to the 'CW/SSB' position and adjust the BFO Pitch control so that the capacitor is at 'half-capacity.' Check that, at this setting, the control knob index lies at 12 o'clock.

Now adjust the BFO core (L21) for zero beat and then check that the swing of the control covers at least 3 kc/s above and below the centre frequency.

This completes alignment of the receiver IF Section: the Generator and the shorting link on the forward section of the tuning gang can now be removed.

RF Alignment

Test Equipment Required.

Crystal Calibrator giving markers at 1 Mc/s and 100 kc/s intervals over the range 480 kc/s — 30 Mc/s.

Standard Signal Generator covering the range 480 kc/s — 30 Mc/s with an output impedance of 75Ω and modulation at 400 c/s.

Output Meter matched to 2·5/3Ω.

Trimming tools (screwdriver and concentric trimmer types).

The first step in re-alignment of the RF Section is a check on the accuracy of the dial calibration to ascertain whether adjustments are required in the Local Oscillator Stage. Set up the receiver for CW reception with the BFO in the centre of the IF passband. Connect the Crystal Calibrator to the aerial input terminals and check the scale accuracy at 100 kc/s intervals throughout each of the five ranges. Calibration accuracy should be within 0·5% (i.e. within 25 kc/s at 5 Mc/s, 75 kc/s at 15 Mc/s etc.). If the indications are that the calibration accuracy is outside the limits quoted, re-alignment should be carried out using normal tracking procedure. Adjustments should be made at the spot frequencies listed in the Table below. When the Signal Generator is used as the signal source for oscillator alignment it must be standardised against the Crystal Calibrator.

Range	Trimming Frequency	Trimmer	Padding Frequency	Core
1	27·0 Mc/s	C49	13·5 Mc/s	L16
2	11·5 Mc/s	C50	5·8 Mc/s	L17
3	4·8 Mc/s	C51	2·5 Mc/s	L18
4	2·2 Mc/s	C52	1·1 Mc/s	L19
5	950 kc/s	C53	500 kc/s	L20

The oscillator tracks 'high' on all ranges. On Ranges 1 and 2 there is a possibility of setting the oscillator on the low side of the signal and a check should be made to ensure that the response with minimum capacity or minimum inductance is selected. Care should be taken to balance any interaction between the trimming and padding adjustments which should be repeated at least twice to achieve the desired accuracy.

Once the scale calibration has been checked and corrected if necessary, alignment of the RF and Mixer circuits can be commenced. The Output Meter should be connected to provide a clearer indication of maximum output than is possible with the speaker alone. The receiver input impedance is 75Ω and the Signal Generator should be arranged to match this impedance when connected to the 'A1' and 'E' terminals at the rear. Modulation should be 30% at 400 c/s. Alignment adjustments are made at the following frequencies, tuning for maximum output with the appropriate trimmer or core. As with oscillator alignment each adjustment should be repeated at least twice to reduce errors due to interaction.

Range	Trimming Adjustments			
	Frequency	1st RF	2nd RF	Mixer
1	27·0 Mc/s	C1	C18	C33
2	11·5 Mc/s	C2	C19	C34
3	4·8 Mc/s	C3	C20	C35
4	2·2 Mc/s	C4	C21	C36
5	950 kc/s	C5	C22	C37

Range	Padding Adjustments (Core)			
	Frequency	1st RF	2nd RF	Mixer
1	13·5 Mc/s	L1	L6	L11
2	5·8 Mc/s	L2	L7	L12
3	2·5 Mc/s	L3	L8	L13
4	1·1 Mc/s	L4	L9	L14
5	500 kc/s	L5	L10	L15

SPARES

Spare parts should be ordered by quoting the circuit reference (where applicable) and the part number given in the list below.

Coils

L1 : D2677/1	L11 : D2677/2
L2 : D2680	L12 : D2681/1
L3 : D2683	L13 : D2684/1
L4 : D2686/1	L14 : D2687
L5 : D2689/1	L15 : D2690/1
L6 : D2678/1	L16 : D3281
L7 : D2680/1	L17 : D3282
L8 : D2684	L18 : D3283
L9 : D2687	L19 : D3284
L10 : D2690/1	L20 : D3285

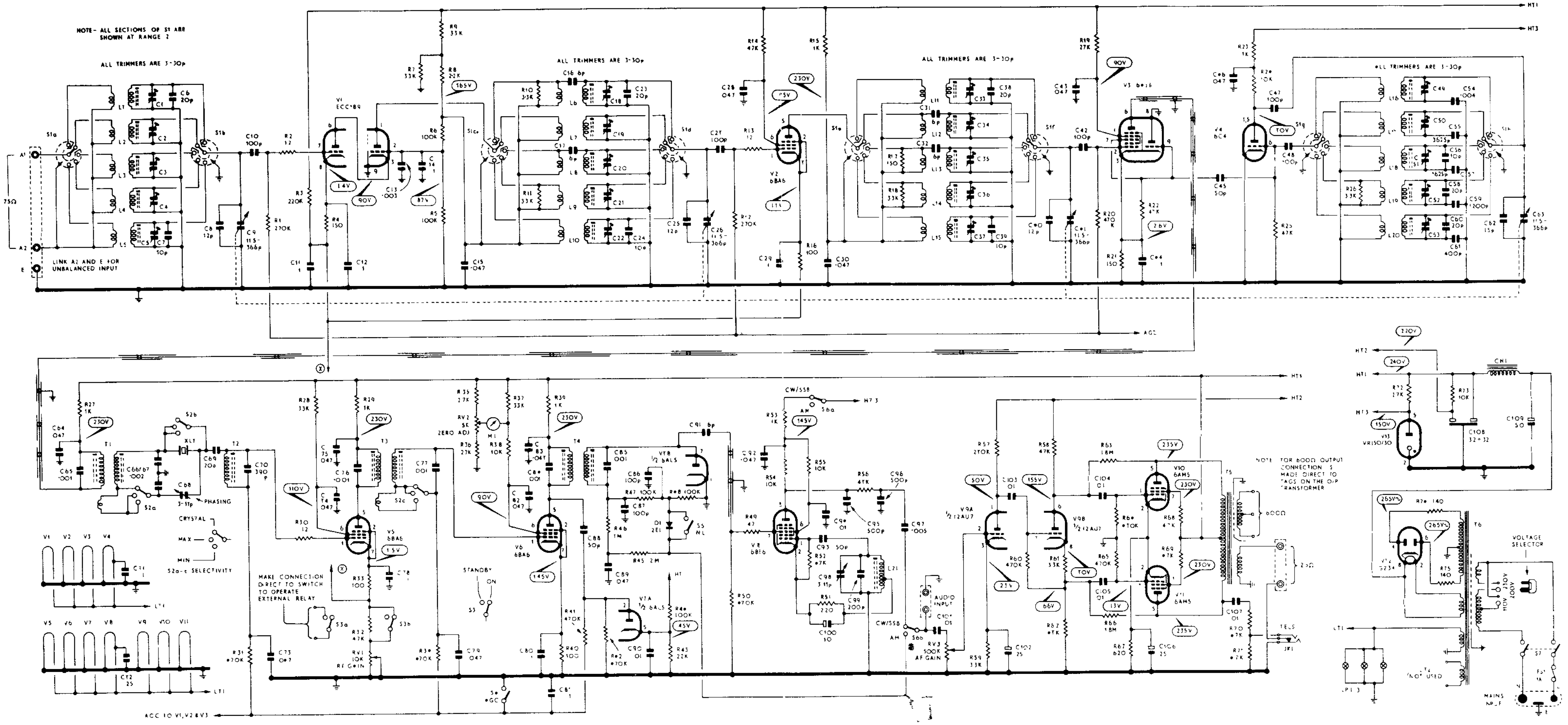
Transformers and Choke

T1 : D2901	T5 : 6146P
T2 : D2892*	T6 : 3937P
T3 : D2924	CH1 : 5863/1P
T4 : D2902	

* Excludes crystal.

Miscellaneous

Crystal XL1 — Style E 450 kc/s ±·05%. : 6240P.
Glass window : 5847P.
Control knobs — small : 5816P.
Control knobs — large : 5817P.
Control knobs — chrome : 5780P.
Dial lamps : 3131P.
BFO Unit : D2891.



CAPACITORS

C1–5, 18–22, 33–37, 49–53 : 3–30 pf Air Trimmer. (C49–53 may be 4–29 pf).
C6, 23, 38, 60, 69 : 20 pf Silvered Mica ± 10% 350V DC.
C7, 24, 39, 58 : 10 pf Silvered Mica ± 10% 350V DC.
C8, 25, 40 : 12 pf Tubular Ceramic±10% 350V DC.
C9, 26, 41, 63 : 4-gang Air Spaced Variable.
C10, 27, 42 : 100 pf Polystyrene±5% 125V DC.
C11, 12, 14, 29, 44, 71, 78, 80, 81 : 0·1 uF Plate Ceramic+80—20% 200V DC.
C13 : 0·003 uF Metallised Paper±20% 350V DC.
C15, 28, 30, 43, 46, 64, 73–75, 79, 82, 83, 89, 92 : 0·047 uF* Polyester±10% 400V DC.
C16, 17, 31, 32, 91 : 6 pf Tubular Ceramic±10% 350V DC.
C45, 88, 93 : 50 pf Tubular Ceramic±10% 350V DC.
C47, 48, 86, 87 : 100 pf Tubular Ceramic±10% 350V DC.
C54 : 0·007 uF Polystyrene±1% 125V DC.
C55 : 3625 pf Silvered Mica±1% 350V DC.
C56 : Reference not allocated.
C57 : 1625 pf Silvered Mica±1% 350V DC.
C59 : 1200 pf Silvered Mica±1% 350V DC.
C61 : 400 pf Silvered Mica±1% 350V DC.
C62 : 15 pf Tubular Ceramic±10% 350V DC.
C65, 76, 77, 84, 85 : 0·001 uF Polystyrene±5% 125V DC.
C66, 67 : 0·002 uF Polystyrene±5% 125V DC.
C68, 98 : 3–11 pf Air Spaced Variable.
C70 : 390 pf Polystyrene±5% 125V DC.
C72 : 0·25 uF Metallised Paper±20% 150V DC.
C90, 101, 103–105, 107 : 0·01 uF Tubular Ceramic±20% 350V DC.
C94 : 0·01 uF Metallised Paper±20% 150V DC.
C95, 96 : 500 pf Metallised Paper±20% 350V DC.
C97 : 0·005 uF Tubular Ceramic±20% 350V DC.
C99 : 200 pf Silvered Mica±5% 350V DC.
C100 : 10 uF Tubular Electrolytic 16V DC.
C102, 106 : 25 uF Tubular Electrolytic 25V DC.
C108 : 32+32 uF Tubular Electrolytic 350V DC.
C109 : 50 uF Tubular Electrolytic 450V DC.

*0·05 uF may be fitted as alternative.

RESISTORS

R1, 12, 57 : 0·27 MΩ±10% ½ watt.
R2, 13, 30 : 12Ω±10% ½ watt.
R3 : 0·22MΩ±10% ½ watt.
R4, 17, 21 : 150Ω±10% ½ watt.
R5, 6, 44, 47, 48 : 0·1MΩ±10% ½ watt.
R7, 28, 37 : 33,000Ω±10% 1 watt.
R8 : 2,200Ω±10% ½ watt.
R9 : 3,300Ω±10% 1 watt.
R10, 11, 18, 26, 59, 61 : 3,300Ω±10% ½ watt.
R14 : 47,000Ω±10% 1 watt.
R15, 23, 27, 29, 39, 53 : 1,000Ω±10% ½ watt.
R16, 33, 40 : 100Ω±10% ½ watt.
R19, 35, 36 : 27,000Ω±10% 1 watt.
R20, 31, 34, 41, 42, 50, 60, 64, 65 : 0·47MΩ±10% ½ watt.
R22, 25, 32, 52, 56, 58, 62, 70 : 47,000Ω±10% ½ watt.
R24, 54, 55 : 10,000Ω±10% ½ watt.
R38, 73 : 10,000Ω±10% 1 watt.
R43 : 22,000Ω±10% ½ watt.
R45 : 2MΩ±10% ½ watt.
R46 : 1MΩ±10% ½ watt.
R49 : 47Ω±10% ½ watt.
R51 : 220Ω±10% ½ watt.
R63, 66 : 1·8MΩ±10% ½ watt.
R67 : 620Ω±10% ½ watt.
R68, 69 : 4,700Ω±10% 1 watt.
R71 : 4,700Ω±10% ½ watt.
R72 : 2,700Ω±5% 6 watt wire-wound.
R74, 75 : 140Ω±5% 6 watt wire-wound.

VOLTAGES

All voltages indicated on the circuit above were taken using a meter of 20,000Ω/V sensitivity and an applied mains voltage of 240V. A variation of −5% should be allowed and readings should be taken between the point indicated and chassis. Range switch should be at '5,' Gain controls at maximum. Mode switch to CW/SSB, Standby switch to ON and AGC OFF.

ERRATA

The following corrections apply to the circuit above:
C54 should read: ·007
C56 is not fitted and should be deleted.
C58 should read: 10p.
The note above L16 should be amended to read:
ALL TRIMMERS ARE 3–30p OR 4–29p.
Transpose references V10 and V11.
Note that the following capacitors are directly earthed and not via C54, C55 etc. as shown: C49, 50, 51, 52, 58, 53 and 60.

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