The Bulletin

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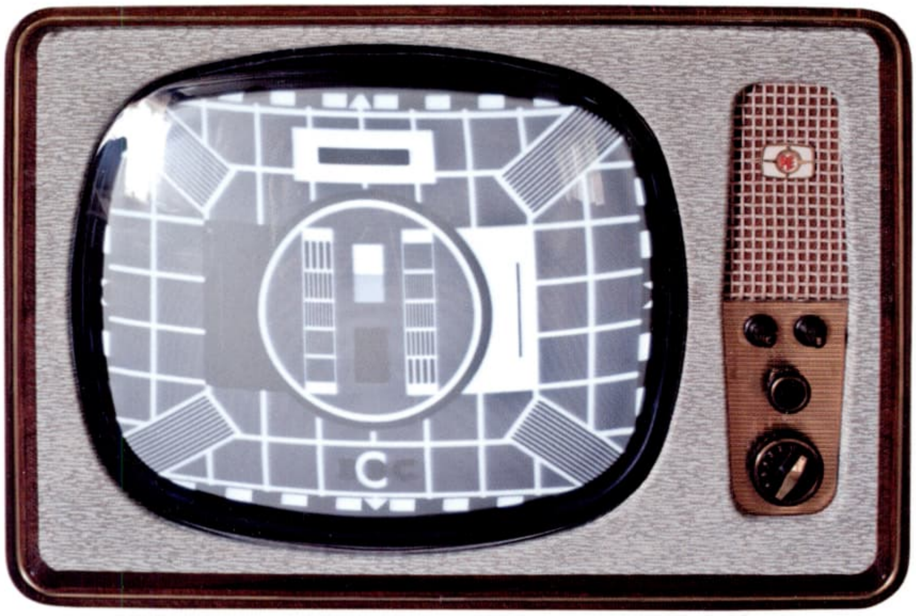

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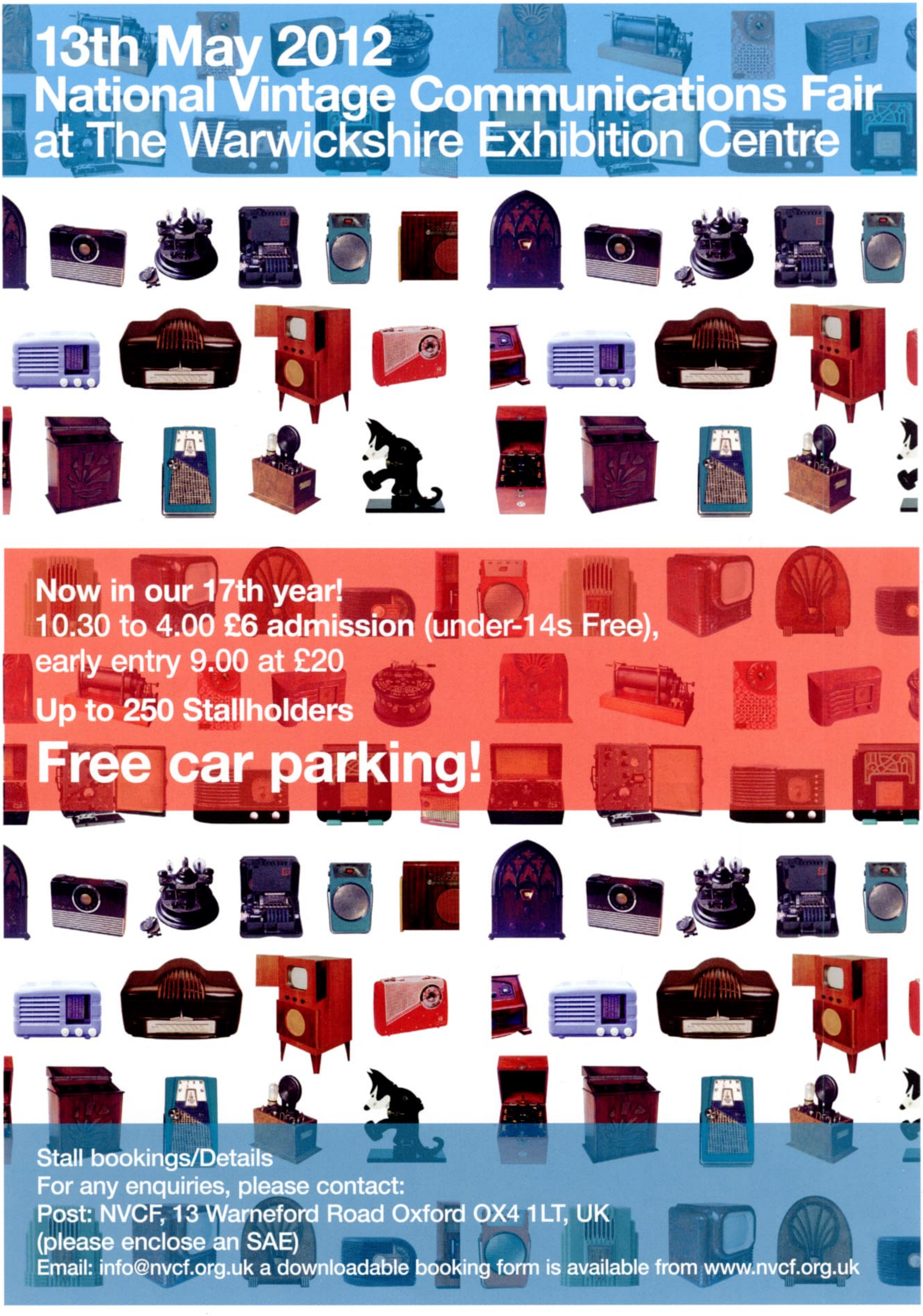
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Bulletin of the British Vintage Wireless Society
Incorporating 405 Alive
Volume 36 No.4 Winter 2011

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Separations and Printing by Hastings Print

Honorary Members:
Ralph Barrett I Dr A.R. Constable I Ian Higginbottom I Jonathan Hill I David Read I Gerald Wells

Front and rear cover: Various television sets.
Photographed by Mike Barker and Carl Glover
Graphic design by Carl Glover and Christine Bone
Edited by Carl Glover. Sub-Edited by Ian Higginbottom
Proof-reading by Mike Barker,
Ian Higginbottom and Peter Merriman

Contents

From the festive Chair

Again the dark evenings are upon us and the days seem to pass so quickly. We have been busy travelling all over the country to pick up radio collections for auction. Usually these go without a hitch, but the last one was much more eventful than usual. Having arrived and parked up we took a look around but upon starting to load the van we noticed a very flat back tyre. The next 30 minutes was taken up by fitting the spare. It was a good job we had not loaded the van with about a ton and a half of radios as the nasty Ford Transit wheel jack would never have lifted the back axle. We then proceeded to have a very long day literally digging out the stuff from room after room and workshop after workshop over several floors until at 7:30pm with a fully loaded van we set off for home just a short 110 miles away.

Here with the Bulletin is this year's DVD and also the 2012 BVWS events Calendar which was so popular last year we decided to make it a permanent feature. The format has been changed to make it more useful with bigger areas to write your own notes into. Once again the pictures are masterpieces in their own rights and would make excellent pin-up pictures when each month has passed. Extra Calendars can be purchased whilst stocks last (see below).

The DVD contains an excellent selection of period films. You will find more info on this later in the Bulletin. I would like to thank Phil Marrison and Andy Finch for much of the material featured on this year's DVD and also Terry Martini for the superb production work to make it available to us all.

It is with regret that I have recently accepted the resignation of our long standing Membership Secretary, Graham Terry. Graham has decided to up sticks and make the move to the Emerald Isle in the coming months. I am sure that you will all join me in thanking Graham for many years dedicated and sometimes fraught work in managing the BVWS membership and associated functions in such a friendly and professional manner and wish him well for the future. We are currently seeking someone to step into Grahams shoes and take on this enormously important job for the Society. However, we have decided that the book and Capacitor sales will be split off from the Membership job and will now be dealt with by myself as seen in the Bulletin adverts.

A new Committee position of "BVWS Archivist" has been created. This is to pull together all of our holdings and professionally catalogue them so that firstly we know what we have got and secondly to make the catalogue available to the members so that the material can be made use of. I am very pleased to announce that this important job has been taken up by Lorne Clark who will be well known to a good many of you already.

The BVWS website has been given a face-lift by Paul Stenning and we have many plans to make it a much more useful place for members and non-members alike. We will shortly be introducing a sales area where you will be able to order books and purchase capacitors online and make payments using PayPal directly. We will also be making a lot more of our assets available from the website as time allows. If you have any specific ideas for ways we can improve our website, then please do get in touch, although we have to be realistic on what we can do with just the few people we have.

The trial of "entry arm bands", being sold along the queue at Harpenden in September was a great success and people were in the hall in record time. This will now be in operation at all future Harpenden events. While we are talking about events, I have just returned from a very pleasant day at the BVWS Golborne Swapmeet. We packed a van with items for sale and the usual BVWS books and capacitors and even managed to squeeze in the vintage TV's for the display. The day was a great success which must be attributed to the "behind the scenes" work of the organiser, Mark Ryding and his helpers. Not forgetting all of the stall holders who turned up on a foggy Sunday morning with cars full to the brim with stock. It was certainly the best attended we have had, and we cleared almost everything that we took with us, which was just as well as the BVWS store is bursting at the doors with Auction stock and I would have had a problem getting anything back in.

It just remains for me to say, on behalf of myself and the Committee, I would like to wish everyone a very happy Christmas and the very best wishes for the New Year.

Mike...

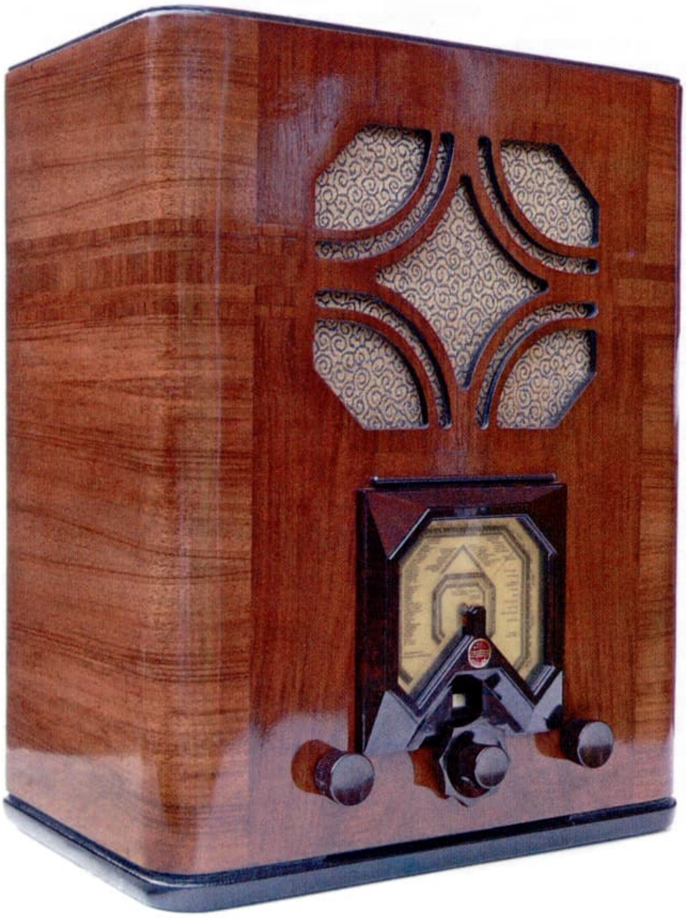
Extra BVWS 2012 calendars

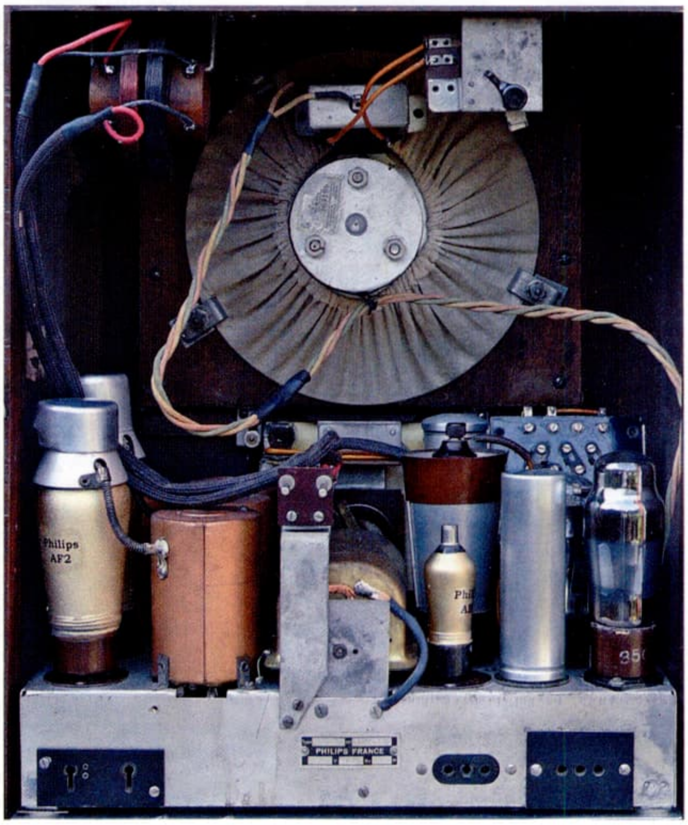
You can obtain extra BVWS 2012 Calendars directly from Mike Barker (address at top of page) by sending a cheque for £5 (inc. P&P in the UK) made out to BVWS. The money raised will be donated to the British Vintage Wireless and Television Museum.

A Philips 638A of 1934 by Gary Tempest

This is a French version of our 472A (Trader Sheet 680) but with more chic to the cabinet having nice curves rather than just a couple of straight bars across the speaker grill.

It is of course a TRF Super-Inductance model with coils wound with Litz' wire on glass formers that has the band pass filter, so there are more of those attractive topside copper cans, (see pictures taken from an excellent Internet site Ref. 1). Technically, and for facilities, it's on a par with the slightly more expensive, when new, 634A 'Ovaltiney' model but with a smaller cabinet and chassis using a reduced diameter for the coil cans. As with all of these Super-Inductance sets the chassis has solid construction and extensive screening.





I was taken with it when I first saw it: the cabinet was quite good and it had a very clean, rust free, and original looking chassis. When I removed this, and looked underneath, it had thankfully had only minimal work done. This was not recent and used French components.

It would seem that Philips often kept the sale price down by cutting a few corners with the build standard. This set does this by dispensing with tag panels and capacitors in cans, unlike the 634A that has them. All the smaller components are strung together, often with stiff bare wire in a "birds nest" fashion. Junctions are made from spirals of thin copper wire before soldering. But at least it has a chassis unlike some later Philips radios (V5 and V7) that didn't.

My aim in restoring it was not to take the easy route and just change the normal culprits by cutting out or bridging, after snipping one end. As this type of chassis is difficult, with possible damage to other components, it's easy to succumb to that. I was determined that I would remove and re-stuff and put everything back close to how it was. Of course as the set had had previous repairs it could not be exactly like it came from the factory.

Thankfully plenty of service data was available. Apart from the Trader Sheet for the 472A, that was easy to cross reference, I found the Philips data for the exact model on the same Internet site (Ref. 1). This was in Dutch but thankfully circuit diagrams and component lists are language independent.

A little about the radio (More in the Trader Sheet for the 472A)

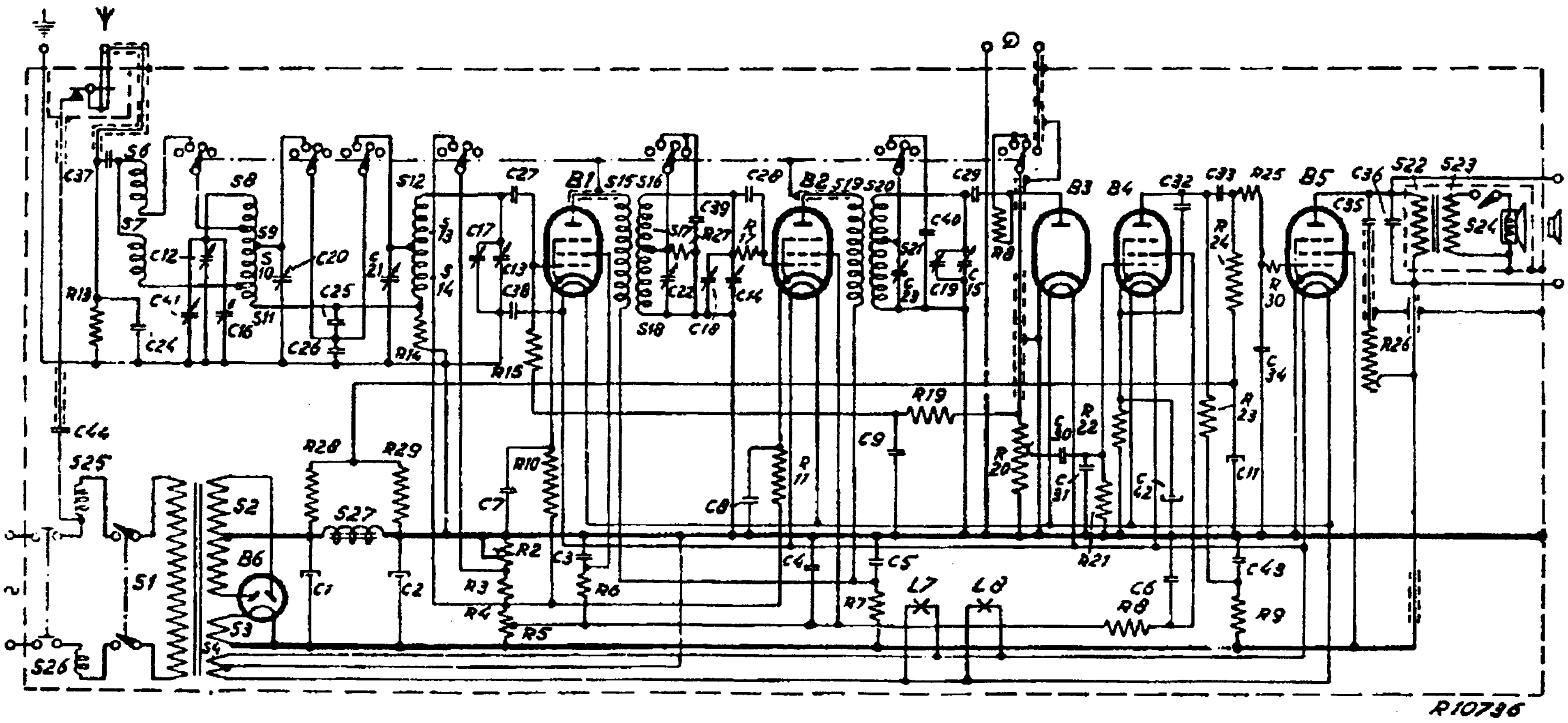
It has medium and long wave coverage with a switch position for external gramophone input. Philips was prescient and marked the switch off position with a binary zero.

The top lit dial is in two parts, having the wavelengths marked on the rear of a clear plastic sheet that is a permanent part of a mounting fixed to the chassis. A second yellowed plastic sheet, printed in a tiny font with the station names, still fluid at that time, slides in behind it through a slot in the cabinet mounted escutcheon. The idea was that your dealer would supply you with another version as the station names were updated (see picture).

When a plug for a long wire aerial is plugged in (a modern 4mm type works), it operates a switch that changes over from a capacitor from one side of the mains (not reconnected) to be used as an aerial (see picture). The aerial input feeds a bottom capacity band pass filter. Following this are two tuned RF stages with waveband switching for them and the filter.

A separate diode detector is then used with AVC derived in the normal way. This is applied to the first RF stage only. Presumably the designer did not apply AVC to the second stage because it could choke on larger signal levels if throttled back. What

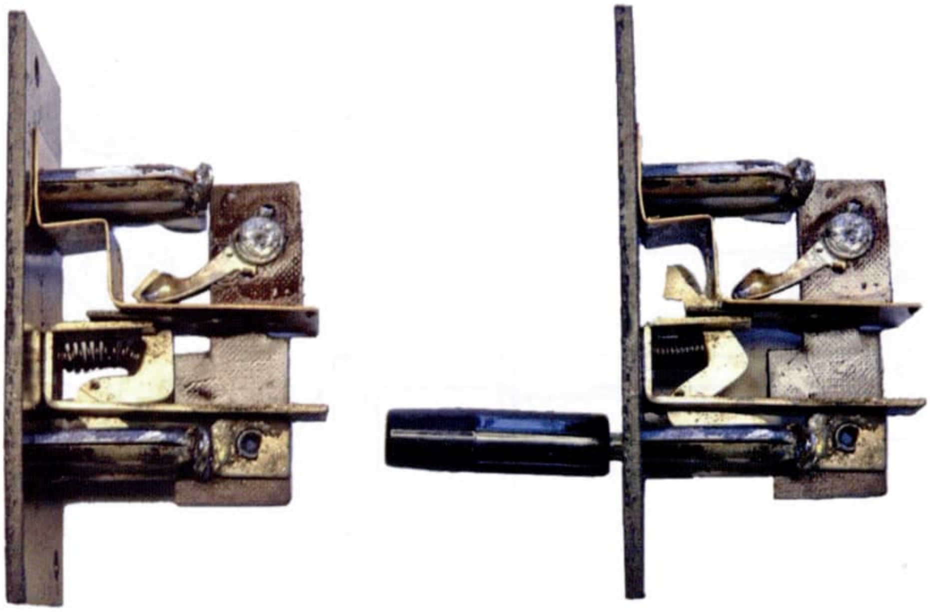
638 A



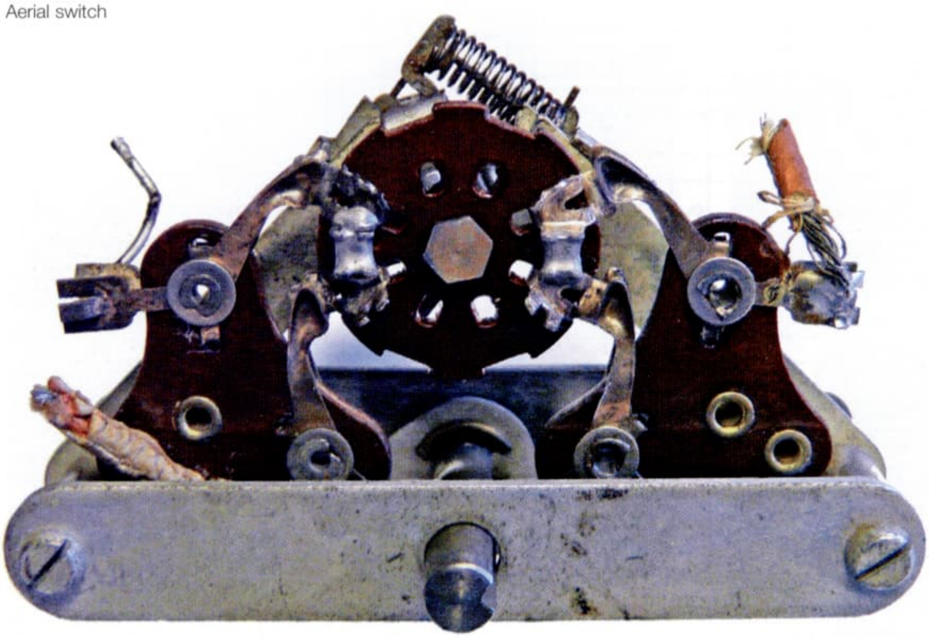
AF2, E446 AB1 E463 506

B1, B2, B4 B3 B5 B6

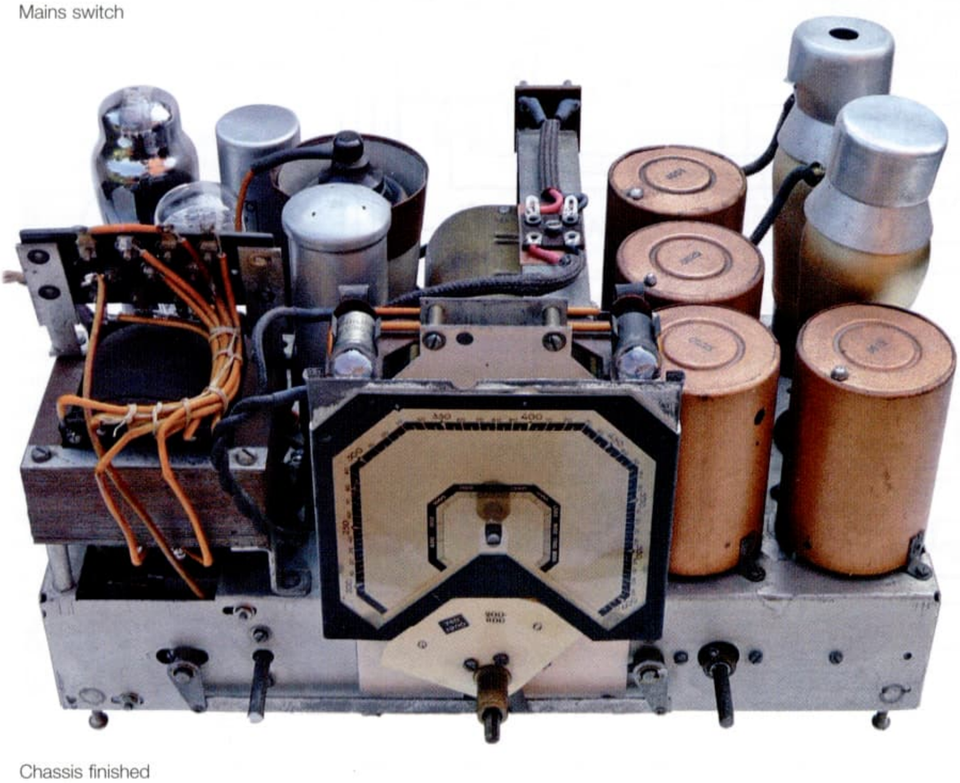
A B C D



Aerial switch



Mains switch



Chassis finished

was done though was to add a gain levelling potentiometer to the tuning gang drive. This applies more cathode bias to both RF stages, as the tuning goes from the high to the low end of the waveband, compensating for the gain increase with frequency. Philips was not the first to use this method as Grigsby-Grunow, of Chicago, employed it on the massive Majestic 90 models of around 1930. On the Philips, combined with the AVC, it is very effective and neither feature is on the four guineas cheaper Philips 834C of a year earlier. With this a second hand must always be quick with the volume control to avoid ear blast whilst tuning.

Following the detector is a slightly unusual audio pre-amp, in that the metalised valve is fitted with a cone shaped mu-metal screen (as it has no rust I'm assuming that this is what it is) for preventing magnetic hum pickup from the mains transformer. Its circuitry is conventional with good RF filtering, before the output stage. This includes a top cut tone control and sockets for using a high impedance speaker along with a rear mounted switch for optionally cutting off the internal permanent magnet type. Philips was ahead of most other makers in being able to manufacture permanent magnet speakers at this time. As the external speaker sockets are at HT potential I placed a cardboard blanking panel inside the back cover of the finished radio for someone else's safety.

The mains input is via a filter comprising a pair of air cored coils through a double pole switch, to the versatile mains transformer. This, by simply moving links, allows inputs from 100 to 250V.

A full wave rectifier along with a choke capacity filter is used for HT. The choke is in the negative of the HT supply and is used to derive bias for the output valve. Many of us must have seen examples that previous repairers didn't understand what was going on here. My Frenchman was no exception and had replaced the bias smoothing electrolytic the wrong way around (negative to earth).

Old hands please bear with me now or pass on. You will know why they made them so well but there are people who restore radios that don't. This includes a friend, who has done many but just believed it was because Philips liked making a well-engineered product. Of course we can be hopeful too that we may have newcomers to the hobby reading the Bulletin.

They made them the way they did, as that was the only way to get exceptional performance from them. No doubt they would have liked the acceptance of the Superhet to be slower, allowing manufacture without so many later refinements. Then they were only competing with other TRF radios. When many manufacturers were producing Superhets they had to add improvements like the band pass filter (two extra coils) and additions like the pot on the tuning gang that levelled the gain and so on, to be as good as a simple and cheap to make Superhet. But they couldn't sell them for much more and so they were up against a dwindling profit margin.

A reasonable band pass characteristic would be roughly rectanglular in shape of between 6 to 9kHz wide. TRF sets were trying to achieve this at every tuning position across the wavebands. For the Superhets this was not the case, as all frequencies get converted to the IF and the selectivity is mainly determined at that one frequency. In the early days there was usually a little pre-filtering by either a band pass filter or a tuned RF stage. Eventually, once they were able to make IF strips at a higher frequency, with better second image rejection, these could be dispensed with for cost reduction. The Philips Super Inductance sets have excellent coils and a design that keeps a reasonable band pass shape, across the bands, and the best for this, as is to be expected, are the radios that have the two extra coils in a band pass filter (see Wobbulator measurements later).

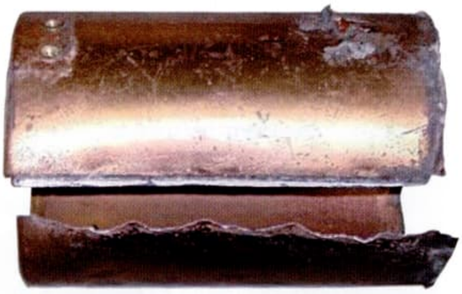
The Superhet radio chassis can have minimal expense on screening compared to a similar performance TRF one. With a TRF chassis the gain is all at one frequency and typically they tend to be unstable at the high frequency end of the MW band. This is say 1.5mHz; lower down they can be completely stable. With this 638A, for example, it will burp and burble up there, unless the screening is near perfect (more on this later). A Superhet immediately wins, as it only has a small amount of gain at the 1.5mHz before that gets converted to the lower IF. Almost all of the gain comes at this lower frequency.

In summary:
The later and more expensive Super Inductance TRF set had four coils on glass formers in big copper cans. Each section of the tuning gang needed to be screened, and a potentiometer was coupled to it to make for a reasonably constant gain across the bands. The chassis was divided into sections with switch wafers having their own compartment. There is extensive use of screened wiring.

The Superhet radio could have coils on cheap cardboard formers in small aluminium cans. Its tuning gangs could be un-screened with no coupled potentiometer as the IF strip was essentially of constant gain (but modified by AVC action of course). Compartments were dispensed with and the switch wafers used only a piece of metal between them (performance sets) or nothing at all.

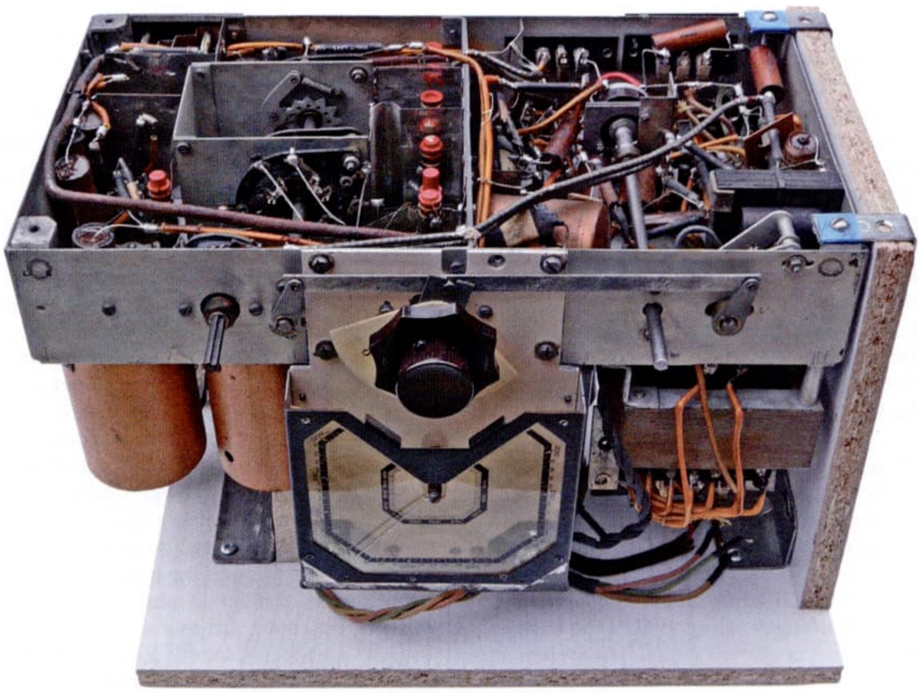
Naturally Philips covered themselves and were making a Superhet, the model 588, in 1934 whilst at the same time continuing with the Super Inductance sets. But economics spelt the end of these, wonderful as they are, and by 1936 there were no new models (Source: Ref. 2).

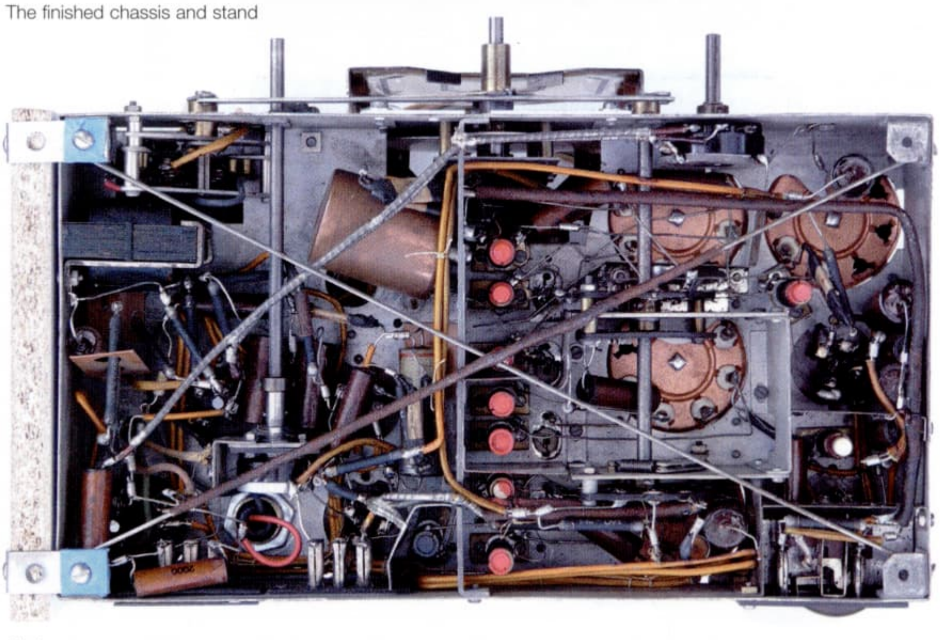
Chassis and circuit differences to the 472A
As you would expect, the valve line up is different using numbers never before seen by me. Fortunately these Philips types were in the AVO valve tester book and had for most of them Mullard direct equivalents (those used in the 472A). All the valves tested good apart from the output valve that


An opened coil can

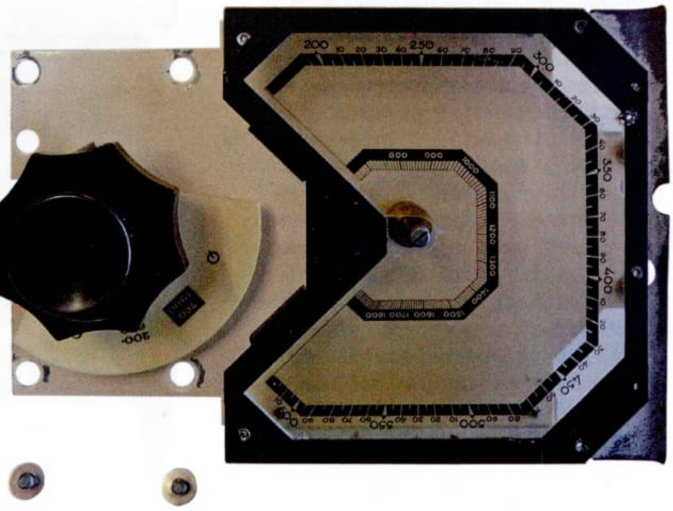

The 'works'


Europe 6 pin base


The finished chassis and stand


All done

SG20 re-metalising



The wavelength dial and fixing screws

should have been an E463. The previous repairer had fitted an AL4, which has a Ct8 side contact base, by using an adapter made from a socket and the original valve base. What he hadn't done was to change the bias from the 6V it needed, from the 22V used for the original type. The obvious replacement was a Pen4VA, as per the 472A, and I had a good one of these. It was here that I thought I was losing it, as the B7 base wouldn't fit the socket. It was similar but the spacing was definitely different even though the AVO valve data book said the E463 also had a B7 base. Thank goodness for the Internet and a search on there confirmed that the base was a Europe 6 pin, B6 but it does have one unused hole (see picture) so that at first glance and even a second look made me think that it was B7. It was fairly easy to get around as I have mastered how to change bases on valves. Off with the B7 base, on the Pen4VA, and on with the B6 base salvaged from the adapter.

I haven't confirmed every detail of the circuits between the sets; they are very close but there is an extra trimmer shown on the circuit and the layout diagram for the 638A. It is in parallel with another on the first stage of the band pass filter. Obviously not all chassis had this as mine and one pictured on the Internet didn't.

Chassis restoration

After removing the chassis and the loudspeaker from the cabinet, the first thing was to clean the chassis on top, which was only removal of dust and dirt. I took the loudspeaker bag off and it washed without shrinking in tepid water. Some rust on the speaker rim needed treating, as did the flexible cone surround, which had many radial cracks. It was reinforced by painting with thinned material glue that dries transparent.

To deal with the underside needed a stand made from scrap. What a curious thing it is under there at first sight (see picture). There are cross ties, which are bicycle spokes, going from corner to corner of the chassis. I had found before that Philips often added quick modifications to solve a problem and this must be one of them. The chassis underside is subdivided into separate areas giving excellent screening between stages. However, it would appear that not enough thought had gone into the wiring, some of it screened, that had to go between them. If it had, then the screening plates would have been notched such that the wire was below the chassis edge. As it was, running over the tops of the screens, when on a bench, and possibly even in the cabinet, it would be crushed and subject to damage. So they fitted the spokes as protective devices. They were the first things to remove for access.

Next it was essential to remove the dial, for protection, along with the distributed switch drive mechanism. The dial needed to come off anyway, as the tuning felt rough with its years of dried up lubricant. Actually, this was very easy, just four screws for the dial, a couple to loosen for the switch drive and one wire to disconnect that goes to the gain levelling potentiometer.

Slowly most of the power and audio end of the chassis was stripped out. The mains wiring to the switch had crumbling rubber insulation and the switch had no snap action. Once cleaned and lubricated it worked really well.

One of the electrolytic capacitors had been replaced previously and one was the original wet type. Even though both had threaded ends they were re-stuffed using the Hoselock connector method (Ref. 3). I'm really taken with this as it's stronger than a cut and re-joined can and there is no visible mark.

Philips wax paper capacitors are not so good that they can all be left alone. Many were down to 2M Ohm at 10V dropping rapidly as more voltage was applied. For one example it was down to 500K at 100V and falling. Some had already been snipped out and changed including the capacitor de-coupling the anode supply, to the RF valves, which in failing had taken the 1K feed resistor with it. Unfortunately, it had been done without removing the aerial switch, which gives decent access for soldering, resulting in a very dry joint. Fortunately I had some old types to replace these that looked close to Philips originals. These and some others got re-stuffed.

Removing these capacitors can be difficult and a little alarming as often they join with resistors in soldered spirals. If they had left a little wire at the end of the resistors, to clamp on a pair of forceps as a heat sink, it would have been much easier. My fear was damaging a resistor and of course I had no matching spares. The resistors are a carbon film over a ceramic body with crimped on brass end caps (was this the Philips engineers once again being years ahead of their time?) and I could imagine with too much heat and stress these coming off or worse loose to make an intermittent connection. As protection I filed two semicircles in an old pair of pliers that just gripped the end caps. Where I needed three hands then the pliers were held closed with a rubber band. Of the resistors only one was found bad, being 60% high, and I believe this was from overheating caused by a previously incorrect component replacement.

The volume control, showing signs of a previous attempt to repair it, was worn out. Fortunately I was able to adapt the existing bracket and coupling for the extension spindle to a reasonably vintage looking replacement.

Of course some of the original varnished sleeving had to be replaced as it is so brittle now that very little movement causes it to crack. Also, sometimes the only way to proceed was to cut out groups of items and then unsolder them on the bench. I bought new yellow fibreglass sleeving but it was far too bright. The solution was to paint some lengths of it with walnut varnish.

With all items back on the chassis I was almost there but first I used just a little De-Oxit on the switch wafers and 'worked' the switch. I was reluctant to buy this expensive switch cleaner as I already had two cans from other makers in the cupboard. But I'm impressed with it; it seems to work long term where others don't. It's also good, on previously cleaned valve bases, by applying a little in the sockets and working the valve up and down.

Time for Power Up

Instability

With all the previous close attention the set worked straight away with correct voltages, AVC and gain levelling across the bands. But it did have instability at the high frequency end of the MW. The metalising, to those valves that had it, looked good but I had to remake the connections to it. After cleaning, a few turns of tinned copper wire or solder braid are ways of doing it. But alas, for the two RF valves, the result simply wasn't good enough, whereas temporarily wrapping the valves in aluminium foil with a solid earth made the chassis unconditionally stable.

Valve metalising

The lowest resistance reading I got for one NOS Mullard VP4A, that I had in stores, was 6 Ohms but this was variable up to 10. This was measuring from the metalising and cathode pin to near the top of the valve. Making a reliable contact isn't easy and the best way was to use the meter probe in a pad of fine wire wool lightly rubbed on the surface.

Unfortunately the valves in the radio had readings no where as low as this. Intermittent measurements gave readings between 50 and a few hundred Ohms. One valve, a Dario, was found to be pretty much open circuit in places between two wire wool pads scrubbed on the surface a couple of inches apart. The other, a Philips, was better but still had areas in the hundreds rather than a few Ohms. To me it can only be that the metal particles held within the paint separate or fall off with time and continual heating and cooling.

The easy cure would have been to buy another NOS VP4A, the Mullard equivalent to the RF valves used, assuming I could find one. However, valves are getting scarcer and I didn't want to pension off otherwise good valves just for this. You may have read on forums that painting valves with Weld Through Primer, sold at car repair outlets, provides a conductive coating. It may conduct for an electric welder, scrubbed on the surface and at the voltages they use. However, it is no good for screening valves measuring as being non-conductive to an Avo meter, according to a friend who tried it. It does apparently make a good primer, for the cleaned glass of bare valves, for something designed for the job. This is Electrolube Nickel Screening Compound, with a resistance of less than 1 Ohm / Square, from DC to blue light, sold by the larger electronic component suppliers. It's expensive at about £20 a can but of course amortised over a few valves maybe acceptable.

I cleaned the valves, masked off and prepared a spray booth from a large cardboard box. This is essential, as is a proper respirator and goggles, as it's a dusty business. However, once sprayed and allowed to dry the results were impressive. From the metalising pin, to the top of each valve, a typical result was 1.5 Ohms with no wire wool pad needed.

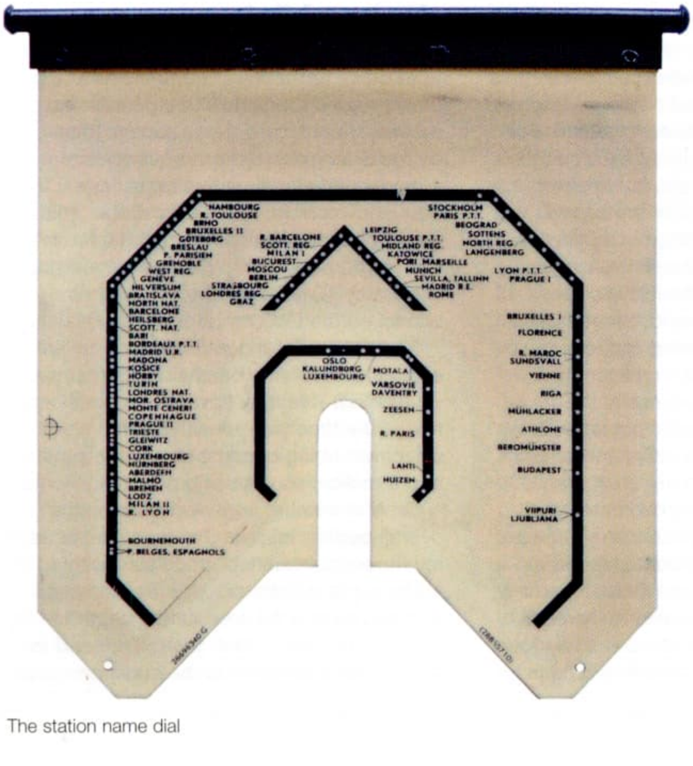
From weighing the can before and after, and knowing how much the makers said was in there, it was apparent that it would only be good for four valves of this size, or possibly five, with experience and if used more sparingly than I did.

The same friend, who had used the spray before, told me that a primer is needed if it's used on the bare glass of stripped valves: without this it falls off. Not having any Weld Through Primer I phoned Electrolube Technical Sales but didn't get a positive recommendation. They readily agreed with my suggestion that Zinser spray shellac, which seems to adhere well to everything, might work.

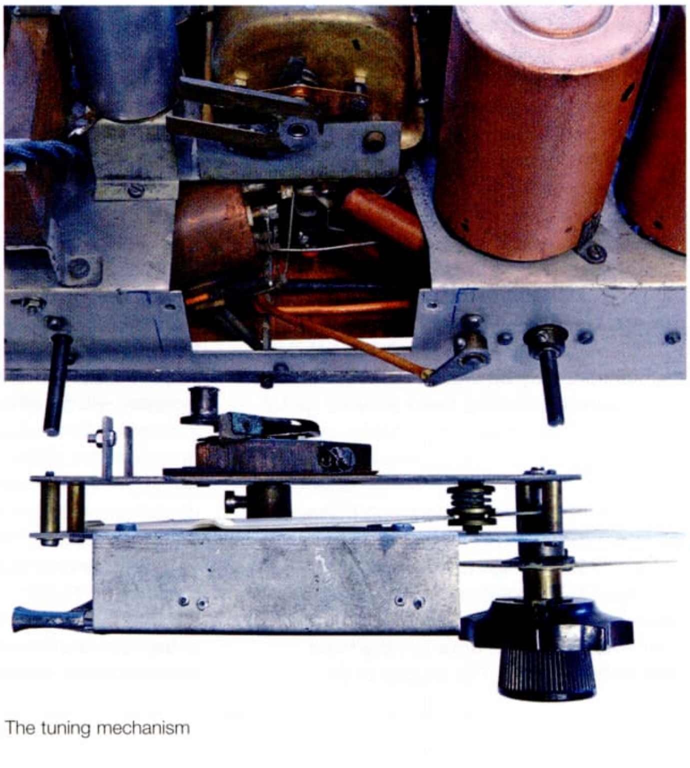
I had a good SG20 DC valve, which are very rare, that had almost zero metal coating left so it was ideal to try. After cleaning and scouring with emery cloth, I soldered a band of de-solder braid around it as a pickup to the old copper drain wire. Then, after cleaning with thinners and masking off, I tried a couple of coats of Zinser before the nickel spray the following day (after removing the masking over the pick-up band of course). Over some weeks, a few cracks appeared in the finish but it hasn't flaked off. Possibly a shrinkage problem with the primer and next time I'll try putting the valve in the valve tester for a few hours before the nickel spray. On the valves that had secure metalising, and were nickel sprayed directly, then no cracks have appeared.

Alignment

These radios are so well constructed from very stable components: tuning gang, coaxial trimmers on ceramic formers, the best coils and excellent screening that I didn't expect and indeed had been told that these chassis do not need anything to be done. It's very awkward anyway and a tool has to be made to adjust the trimmers mostly located in confined spaces (see note below). But it was worth reading how to do it on the Trader Sheet for the 472A. A lot of space is devoted to it. Basically the trimmers are adjusted for maximum, at the high frequency end, for each wave band, starting with the MW. This is with the wavelength dial mechanism centred in its adjustment range. I simply had not appreciated that the four screws that mount it have fairly large washers and the holes in the mounting plate are roughly three times that of the screw diameter. Then with the trimmers set, there follows a description of how to move the mechanism, up or

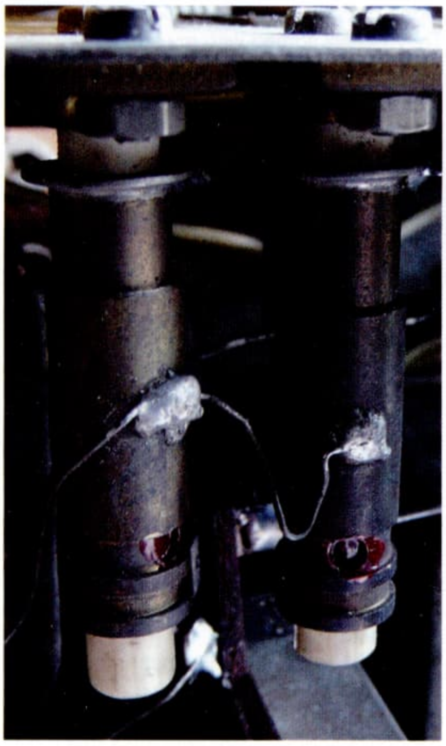


The station name dial

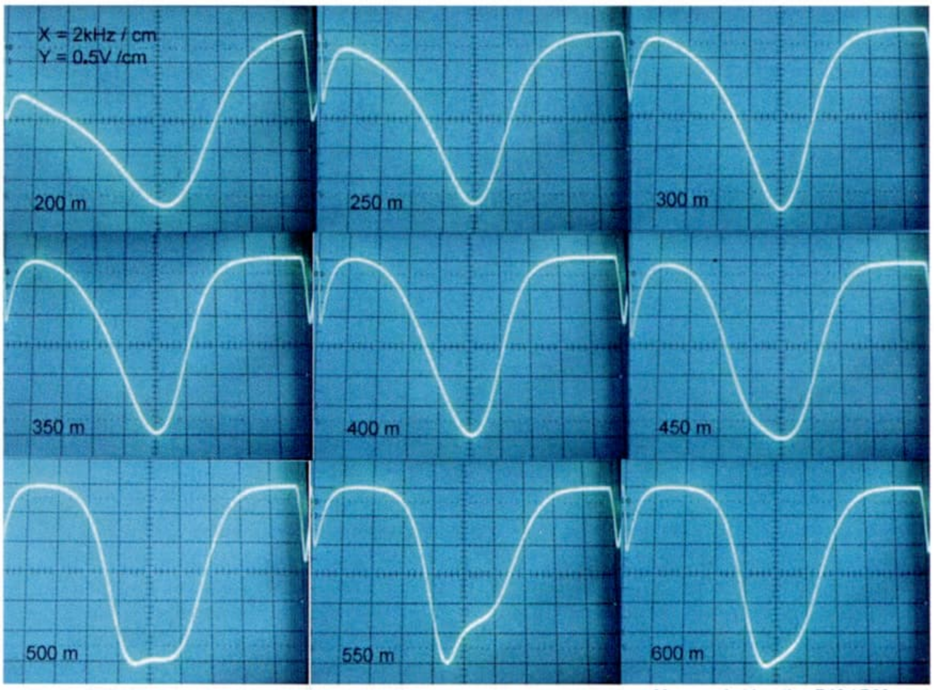


The tuning mechanism

Philips 834C trimmer capacitors



638A MW bandwidths



Philips 638A MW Bandwidths Input to skt. via dummy aerial. Measured at junction R19 / R20 820pF to ground

down and laterally, so that the tracking of the pointer is accurate to the wavelength markings. This is a really clever piece of design by the Philips engineers. By moving the dial mechanism, the roller at the rear (see picture), changes position in the forked arm of the tuning gang. As the roller can be shifted in four directions this gives a lot of possibilities. Effectively the roller can be set to move in various eccentric paths whilst the forked arm is describing a circular one. I ignored all the fine detail, given by Trader, and assumed that the trimmers were set correctly for the low wavelength end of the band and moved the dial mechanism to achieve a correct pointer setting at 550m. After a few iterations between this and 250m the pointer was amazingly accurate at almost any setting. It was almost spot on at 550m, dead on at 450m and 350m, half of a small division (about 1/16") out at 250m and one small division low at 200m. On LW I only checked for R4 and the 1500m marker, or 200kHz. This peaked at 199kHz with the signal generator and frequency counter.

There is a good tip here: when taking off the dial mechanism mark around it with a fine marker pen so that it can be put immediately back in its original position.

As the outer wavelength dial can be moved to facilitate tracking then the replaceable inner dial, with the station names that slides in behind it, through the cabinet escutcheon, may be incorrectly registered to it. However, this has been allowed for by making the escutcheon adjustable, up and down and in being able to angle slightly. For side to side correction the chassis can be moved a little on its mounting holes.

Note: I did remove a trimmer on a Philips 834C set (see picture) and they are beautifully engineered. The outer brass casing slides along the ceramic post enclosing, as it does so, the fixed tube at the bottom. The air gap is tiny.

Gain levelling

This was interesting to me to make some measurements on it. Firstly, I disabled the AVC by an earth across C9 and then used the lowest possible modulated signal to measure the audio from the output of the pre-amplifier. Then stepping across the wavebands I measured the difference with the levelling and without it by applying an earth to the R2 and R3 junction.

MW results briefly were: 550m 2dB, 450m 12dB, 350m 28dB, 250m 38dB
LW results: 1800m 3.5dB, 1600m 12dB, 1400m 20dB, 1200m 33dB, 1000m 46dB, 800m 54dB.

At first viewing this seemed very severe: time for a little thinking. The voltage developed across a single tuned circuit at resonance is proportional to its dynamic resistance. This from the old formula is R = L / Cr where r is the tuned circuit losses (this is the resistance of the coil, leakage, eddy current losses etc all lumped together). For a high R, then a large inductance would be used with a small C, to tune it. However, at the high frequency end of the band C must still be sufficiently large compared to the strays. Obviously the resistive losses should be as small as possible. As the set is tuned across the band, to the high frequency end, C (the tuning capacitor value) reduces and R will increase. The increase will be offset by a rise in the losses but this is a Super-Inductance radio, renowned for its low loss coils, and so R will still increase significantly. Now for a doubling of frequency (approximately the range measured) the capacitance will have to reduce to one quarter, because of the square root sign in the formula for resonant frequency. Thus, if there were no increase in the losses at all, R could increase by four times or 12dB. Now we have four tuned circuits so across the band the gain in this theoretical case could rise by 48dB.

From this understanding it is easy to see why the "standing bias", as it is called in the 472A Trader Sheet, is reduced on MW with switch contacts shorting out R3. On LW the coil inductance value will be larger and the losses less because of the lower frequencies. So R, and the gain of all the stages, would be greater than the MW case without this adjustment.

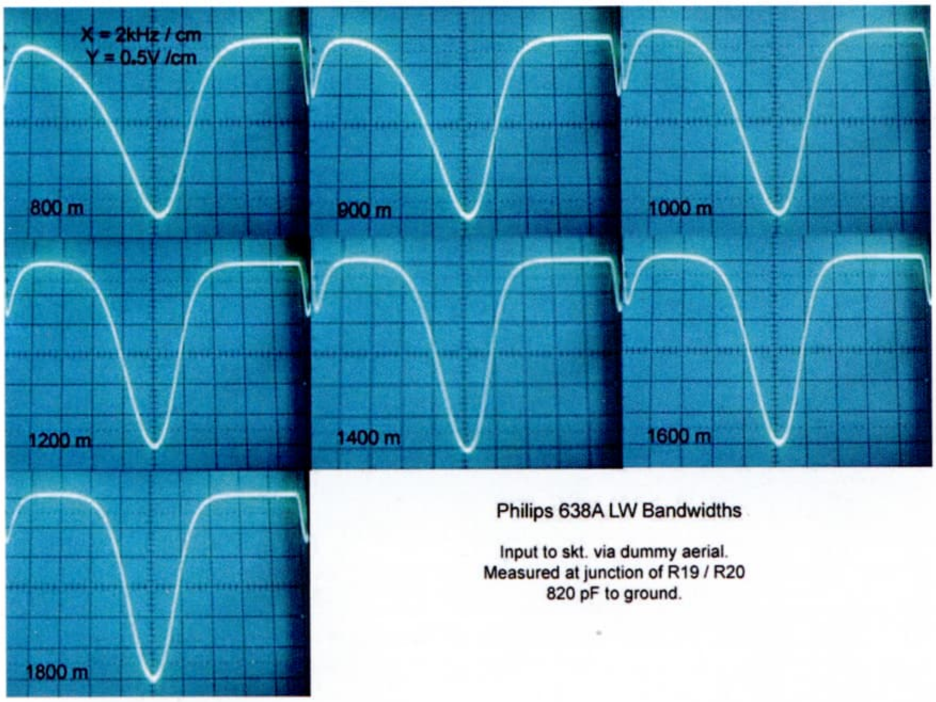
Wobbulator measurements

There is an impressive pass band characteristic right across the MW band. With my Philips 834C radio, which doesn't have it, the shape departs from 450m to 600m into two peaks, with a valley, even after optimising with the trimmers. This is of course what extra filters smooth out.

On LW there is little performance difference, between the radios, which I put down to the lower frequencies making good tuneable filtering easier to achieve. I confirmed these bandwidths by measuring the carrier frequencies of a modulated signal generator, using a frequency counter and oscilloscope. This was monitoring the detected audio for the half height point (6dB). Results were slightly lower (say 10–20%) to the bandwidths shown on the LW Wobbulator picture.

So LW has not much more than analogue telephone bandwidth (300 - 3400 Hz). This may have been fine at the time with sensitivity and selectivity being of prime importance and a mellow sound being normal.

On MW another way of measuring the overall performance of the radio was to use my 'house transmitter' modulated with an audio signal generator. This was checked first and gave a flat modulation depth to just beyond 5kHz. With the radio tuned to 400m, and measuring at the audio pre-amp



Philips 638A LW Bandwidths

Input to skt. via dummy aerial.
Measured at junction of R19 / R20
820 pF to ground.

anode, then the demodulated audio was 3dB down at 3.5kHz and 6dB down at 3.7kHz.

On MW the radio sounds much like any of the period and doesn't seem muffled, to me, on LW on the mainly speech of R4. But I do listen to mostly old radios so maybe I'm used to the smooth sound.

Cabinet

It was pleasing to see that there was no serious damage but the finish on top and part of the front had been eaten right through where someone had stuck some sort of tape over it, ironically, possibly to secure a layer of protection. Apart from that the veneer was good other than having dozens of marks that looked as if someone had tapped all over it with a steak hammer. It was the thickest lacquer I have ever come across, and seemed like about 1/16" thick and mainly had protected the veneer. It was beyond my touch up abilities and so was gently stripped using thinners. During stripping the damaged metal foil, for use as a screening plate, was scraped off the inside bottom of the cabinet. The best way to replace it was by cutting a plate from 0.5mm sheet aluminium.

Actually, before removing the old finish I squirted some woodworm holes and took Roger Grant's recommendation (article Bulletin Spring 2011) and painted the whole of the inside with "Rentokil Woodworm Treatment for Furniture" which I found in my local hardware store at £5.35 for 250mL.

It was refinished, after staining, with Mohawk cellulose lacquer. I made the colour lighter than the original thinking it had darkened with age. It was so dark that all the attractive marquetry could not be seen unless under flood lights.

The grill cloth was beautiful and I would have liked to have saved it but it had a few holes and being cream in colour the bottom was soiled black. What finally finished it was trying to remove it before a good soak of the baffle board with the worm killer. Perhaps the little varmints like to be near the vibrations as they had had a good chew on this. Fortunately I found an attractive replacement, at a reasonable price, from a new source (Ref. 4).

Conclusions

Overall this is an excellent radio that is impressive for its quality of components and attention to detail. I forgave the makers completely for stringing the components together. There are lots of clever things including being able to set the dial pointer for accuracy across the dial.

The only negative is that the cabinet is flimsy, compared to some others, being made from 1/4" plywood with insubstantial bracing. This had allowed the sides to bow in a little at the rear. However, it had been beautifully veneered with detailed marquetry.

It was a most enjoyable and interesting restoration with a satisfying outcome.

I have heard people say that these were the best TRF radios ever made and it may well be true. For sensitivity and selectivity this 638A is as good as any Superhet I have of the same era and quite a few from many years later. Of course, for sensitivity it's not as good as one having a tuned RF stage. Hum level at any volume control setting is commendably low. For interest, I temporarily removed the mu-metal screen on the AF pre-amp and 50Hz hum (volume independent) was immediately noticeable, which could have been annoying for low level listening.

It seemed to me a very well featured radio and I wondered how it compared with a couple of other radios, from the same year, at about the same price. It was easy to think of myself, with my wife, in the shop, with the radios being demonstrated by a smartly dressed salesman. So I looked up two radios shown in Reference 2: the Ferranti Arcadia (Fig. 463) and the Marconiphone 296 (Fig. 440).

The Arcadia is a 5V + R Superhet. The Marconi, fractionally cheaper, is a 4V + R Superhet. Both have a low IF and so a band pass filter is used. To aid tuning an indicator is fitted to each. The sets have a decent dial with fixed station names. Of course there are gramophone sockets but this is not switched on the Arcadia; a tag has to be removed from a panel for use. Tone controls are present on both and provision for an extension speaker but the internal cannot be switched off on the Marconi. Both have speakers with field coils. There are no mains filters, using coils, and only single pole switches are fitted. All of these radios have attractive wooden cabinets.

Back to the shop and the imagined conversation:

"That nice Mr Marconi did invent it dear, so maybe it should be that one"
"Yes! Madam but all the others are old established firms and just as good now"
"Isn't that Philips foreign?"
"Yes! Sir but they do have works here including Mullard's who make all the valves"
"But the others use a new technique called Superhet?"
"It is in its infancy Sir and will no doubt improve. The Philips is what we call a Super-Set; it's the coils you know"
"The Philips does seem to pick up more stations and sound better with no hum"
"Ah! Very observant of you Sir. It's the good design and the better permanent magnet speaker that does it"
"Alright then, we will take the Philips"
"A wise choice Sir"

Having never had a chance to try the Marconi I can't say about its performance. However, I do have a restored Arcadia, from 1933 in a different cabinet to the one shown in RR. From the Trader Sheet pictures the chassis looks almost the same with the same valve line up. There are some circuit changes but mainly around the audio stages. I can't really think that the RF performance is much improved which on my version is nowhere near as good as that of the Philips. The build quality was inferior as well.

Ref. 1: vintageradiomuseum.ontheweb.nl/
Ref. 2: Radio Radio, by Jonathan Hill.
Ref. 3: Radio Bygones No 124
Ref. 4: Bret's Old Radios, bretsoldradios@att.net

Pre war HMV Model 900 television revisited

by Ken Brooks G3XSJ

Back in 1980 I had the good fortune to find a pre war mirror lid television. Sufficient work was done to make the set work and during the early 1980's the set was used to show a small collection of early programmes recorded on Beta video tape. The gramophone attachment provided further entertainment but the radio did not work especially well and with an underlying EHT problem the set eventually became dormant. After years of stagnation I decided it was high time to revisit and recommission this magnificent instrument.

The search

As an impoverished schoolboy in the 1960's one method of feeding my well developed radio habit was through exchanging goods, or swapping. One of many swaps was a copy of Newnes Television Manual by FJ Camm printed in 1945. This was written before the reopening of the service after the war and draws heavily on pre war material. Among the many illustrations is a pictorial drawing of a mirror lid Baird receiver, and an inspirational photograph of an operating HMV Model 901 receiver. Much later I noticed this is the same photograph used for a Wireless World review published 29 January 1937.

For many years this book was my only television reference work but having joined the BVWS in 1978, and travelled to the very first Harpenden meeting in the same year (attendance: 45 persons), my enthusiasm for all things vintage wireless was limited only by space and finances. The BVWS Bulletin did not feature anything on early TV, nor was any material featured in the contemporary press, yet the thought of pre war televisions with a mirror lid continued to fascinate. I decided it might be worth attempting to find one and placed a "wanted" advertisement in the December 1979 BVWS Bulletin. Silence reigned until the following spring when I received a call from BVWS member Gerry Horrocks saying that he knew of such a television through one of his car club contacts and that it could be collected from Gerry when the seller would deliver it to his home, conveniently located half way between us.

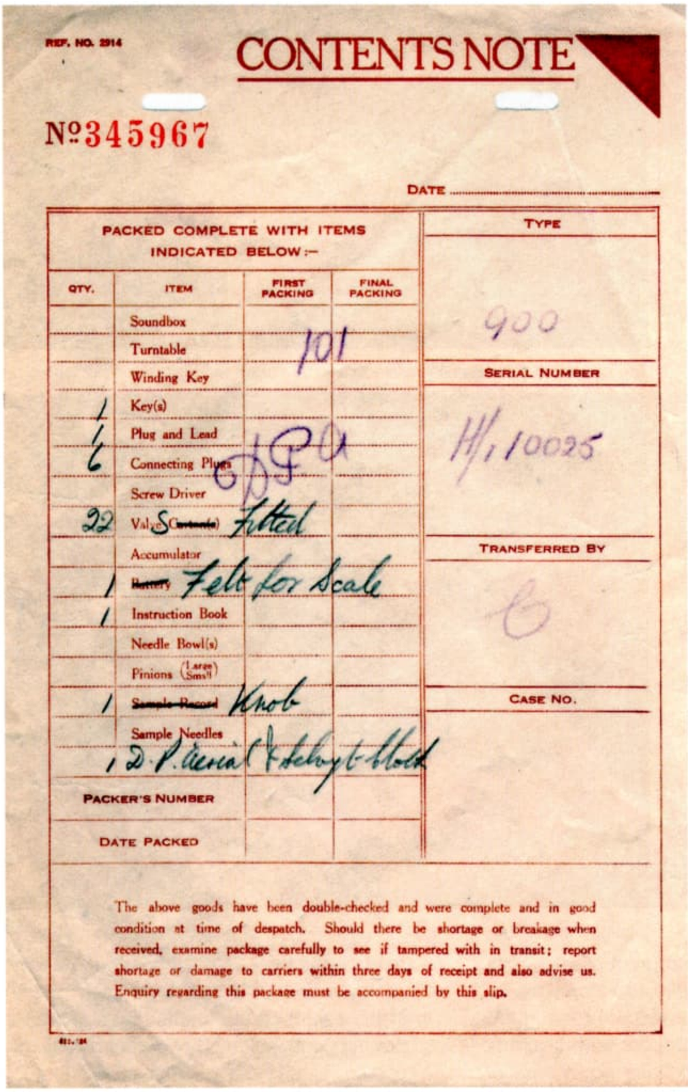
During the Easter weekend of 1980 we set off down the M4 for Berkshire with a trailer. The television I had agreed to buy on the basis of a verbal description was an HMV Model 900 mirror lid receiver. This is very heavy and bulky and is certainly not the sort of object that could be lifted into the back of a hatchback. The plan was to remove the various chassis which would fit inside the car, and transport the empty cabinet on the trailer. As a bonus, the instrument was offered complete with a separate gramophone deck and the original instruction book. Having come prepared with various tools and noted the many interconnections, the chassis and cathode ray tube assembly were extracted, the cabinet loaded on the trailer and we travelled back home along a sunny motorway wondering quite what had been bought.

Signs of life

Upon returning home all this rather strange equipment was emptied into our compact home for inspection, and it certainly did appear to be a large and daunting project. I did not know anyone with either interest or expertise in early televisions so I was completely on my own, with no supporting friends sharing my odd interest to offer encouragement. In any event I knew little about television and my sole item of test equipment was a 1000 ohms per volt multimeter. I did however write to EMI who provided part of a service manual and confirmed the date of manufacture as 1937. This was an excellent start.

The cabinet looked a rather tired and as the contents had already been removed it seemed an appropriate time to give it some attention, so partial refinishing of the lower cabinet was undertaken which immensely improved its appearance. Although the cabinet comprises a boxy, rectangular outline, much interest has been added with deco style veneer inlays in contrasting shades. Stepped feet add further interest. Unfortunately the surface silvered mirror in the lid which reflects the image was in very poor condition indeed and this was replaced.

Just after I acquired the set David Looser published an article in the magazine Television[1] describing his acquisition of a pre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CONTENTS NOTE

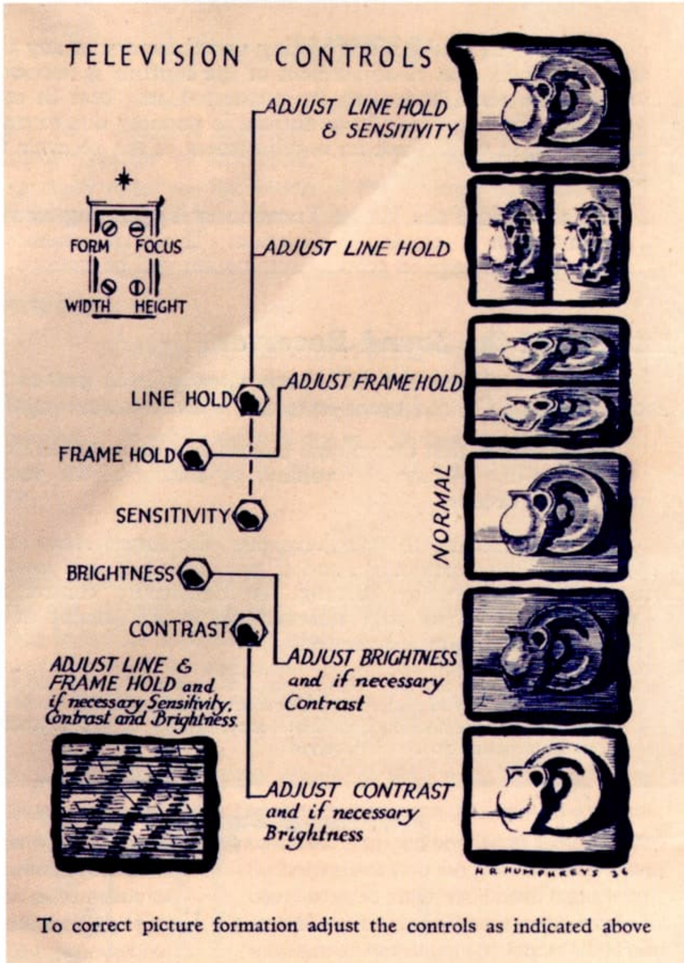
Nº345967

DATE

PACKED COMPLETE WITH ITEMS INDICATED BELOW:–				TYPE
QTY.	ITEM	FIRST PACKING	FINAL PACKING	900
	Soundbox			
	Turntable	101		
	Winding Key			SERIAL NUMBER
1	Key(s)			H/1 10025
1	Plug and Lead			
6	Connecting Plugs			
	Screw Driver			
22	ValveS ~~(Cartons)~~ Fitted			
	Accumulator			TRANSFERRED BY
1	~~Battery~~ Felt for Scale			6
1	Instruction Book			
	Needle Bowl(s)			
	Pinions (Large / Sm'll)			
1	~~Sample Record~~ Knob			CASE NO.
	Sample Needles			
1	D.P. Aerial & Selwyt Cloth			
PACKER'S NUMBER				
DATE PACKED				

The above goods have been double-checked and were complete and in good condition at time of despatch. Should there be shortage or breakage when received, examine package carefully to see if tampered with in transit; report shortage or damage to carriers within three days of receipt and also advise us. Enquiry regarding this package must be accompanied by this slip.

HMV Model 900 contents note



A page from the book of operating instructions

war HMV Model 901. I made contact with David and now had the comfort of knowing that I was not the lone eccentric battling away with old technology. After much careful reassembly the set was ready to test, and following exhaustive checks power was applied, producing a rather dim raster. With further work the signal from a newly acquired pattern generator was displayed, this being all the set could show as I was without a source of programmes. Although the set worked most of the time, I had concerns about the mains EHT transformer which had shown signs of behaving intermittently. Despite this, it was still quite exciting to have a pre war television running and I thought it worth documenting my experiences in the Bulletin. The modest little article I prepared was declined for publication in 1981 as being a bit too specialised, but a note was placed in the Bulletin saying that a copy could be obtained from the author. Membership interests did evolve quite rapidly with the formation of a Vintage Television Section within the BVWS[2] and by February 1983 the article was accepted for publication, appearing in the Bulletin[3] a few months later. It was the first BVWS article on the recommissioning of an early television.

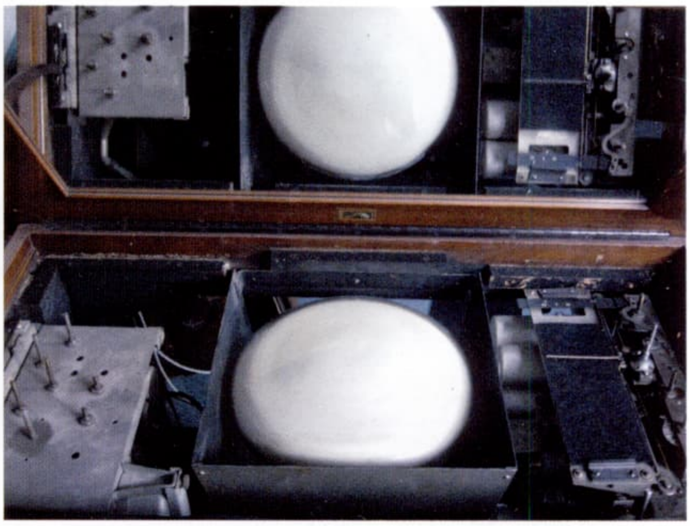
Over time a modulator was built to David Looser's design so that video tapes could be played from a domestic video machine. During this period I also got to know another enthusiast, Steven Ostler. We spent many enjoyable hours checking the RF section, testing and swapping valves so that those with the highest gain were in the early stages of the receiver to maximise the performance. All this was very satisfying, but there remained the underlying problem of an erratic mains EHT transformer. With the set more or less working, other collecting interests, and two house moves later the television receiver sat proud and uncomplaining under the ever increasing collection of oddments that came to be displayed upon the all too convenient flat cabinet top.

A start is made

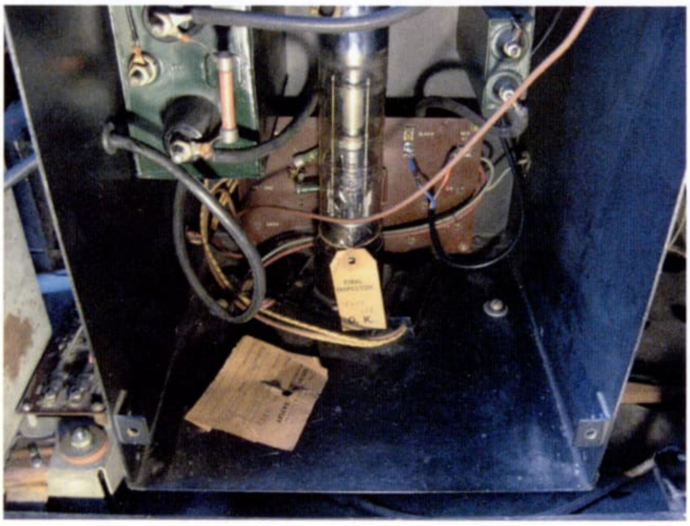
In 2005 the television power supply chassis was removed from the cabinet for Mike Barker to exercise his skills rewinding the mains EHT transformer. This had been a long term problem needing specialist attention, but when the power supply chassis was removed it was noticed that one of the three supporting pillars in the cabinet was missing. At that time I used the services of someone locally with considerable engineering expertise to make up the odd special fastener, and with his abilities in mind one of the pillars was passed to him so that an exact reproduction could be made.

The EHT transformer was repaired promptly but when I came to collect the original, and hopefully the reproduction power supply mounting pillar I was given the devastating news that "it had been mislaid". With just one pillar it was not possible to reinstall the power supply correctly, so the radio was put loosely back in place. The cabinet was reassembled and the project left on hold. Nothing was done for months when, still frustrated by the loss of my precious pattern, I contacted my supplier again to see if anything had turned up. After a couple of unsuccessful attempts to make contact by phone, and finally a personal

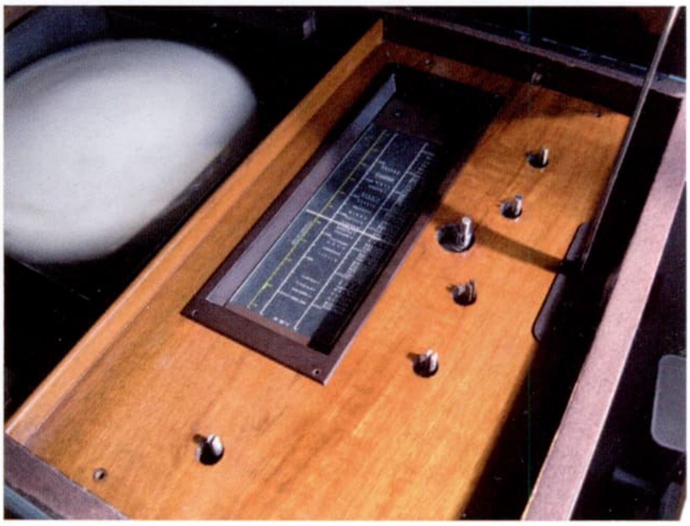
In bits



Top panels off - the beast revealed



Inside the CRT unit - Big capacitors and EHT resistor panel at rear



Getting it together

visit, a small polythene bag was triumphantly held up containing not only the original pillar but a beautifully made copy as well.

Around that time I managed to acquire an HMV Model 184 extension loudspeaker, sometimes illustrated with the Model 900 television. Information within the cabinet states that it is suited for high fidelity equipment like the HMV Model 580, 800 and 801 but does not specifically mention the Model 900 television. Its hexagonal speaker aperture does not match either the 800 or 900 models, but the styling and finish is broadly similar and they look good together.

Other projects and distractions ensured that nothing was done until much needed inspiration came attending the 2009 Bonhams sale of early televisions. After returning from that unique sale I resolved to do something constructive with the still dormant set. It appeared very straightforward, just install the power supply, connect the numerous internal cables and the set should work. Little was I to realise how my optimism was misplaced.

A tale of two chassis

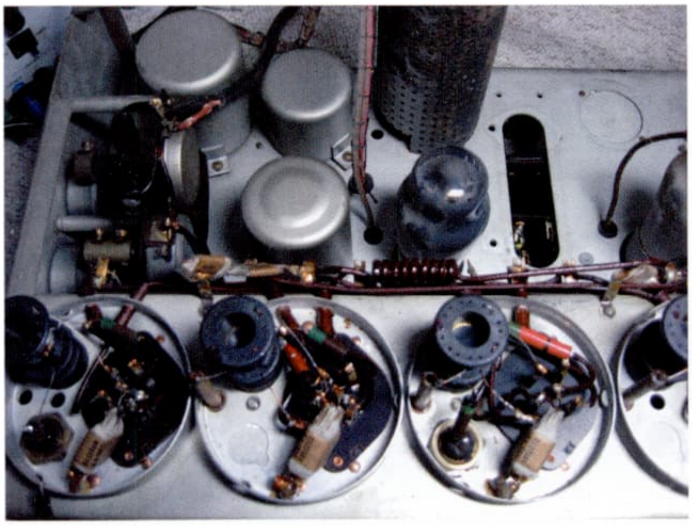
After fitting the power supply I thought it best to condition the combined TRF receiver and timebase chassis, known by HMV as the "sync and RF unit" with HT volts before applying full power. On applying volts from my capacitor reformer a serious problem was revealed. A near short circuit existed somewhere which no amount of reforming would overcome. A quick look for obvious problems was needed and HMV thoughtfully provided service hatches for both the radio and sync and RF unit chassis by means of detachable plywood panels on each side of the Model 900 cabinet. These are removed by unscrewing a couple of wood screws and lifting the panels out. When removed the undersides of each chassis and their 0 BA mounting screws are exposed.

More prominent to my now more critical eyes on the sync and RF chassis was a mass of period replacement capacitors. Some had been securely fitted with tinned copper wire but there were also badly installed replacement grey RS electrolytic capacitors, now white with creeping corrosion and dangling precariously in the time honoured manner. All in all, it was not a pretty sight. That I allowed the chassis to remain like that back in the 1980's is beyond my comprehension, yet in my innocence it was first switched on without the use of a Variac or the cautionary process of reforming capacitors without a thought of things going bang. That it actually worked without the drama of overheating or exploding capacitors I must assign to extreme good fortune.

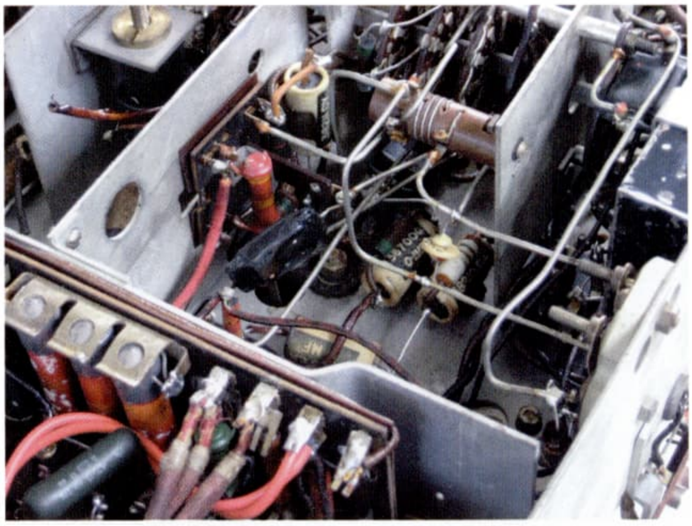
The sight of those replacement capacitors was now intolerable, and from the corrosion it was obvious that some had already failed. To replace these it would be necessary to remove the sync and RF chassis. This is no trivial task as it is mounted vertically in the cabinet and attached by numerous connections including two very heavy coaxial cables. That one cable is over two feet long, and the chassis has little space to manoeuvre it out of the cabinet makes it quite difficult.

Once out of the cabinet the chassis can be seen as a fine example of late 1930's engineering, having the RF section along one side with every valve completely enclosed in a screening can. All the valves used in this instrument are the British B series bases which would have been near the end of their design life when the Model 900 was introduced. The adjacent timebase section on the same chassis uses space generously and is easy to work on with all the minor components accessible on tag strips. Using the circuit diagram and a pictorial drawing for guidance, some eighteen capacitors were changed for modern replacements. Had the original parts been fitted they could have been refilled but without them I had to fit what are obviously modern parts. For the record, the drawings and circuit were marked up with a highlighter pen as each component was changed and a separate note made of the replacement type. I noted with satisfaction that the capacitors removed were all electrically leaky, fully justifying the exercise.

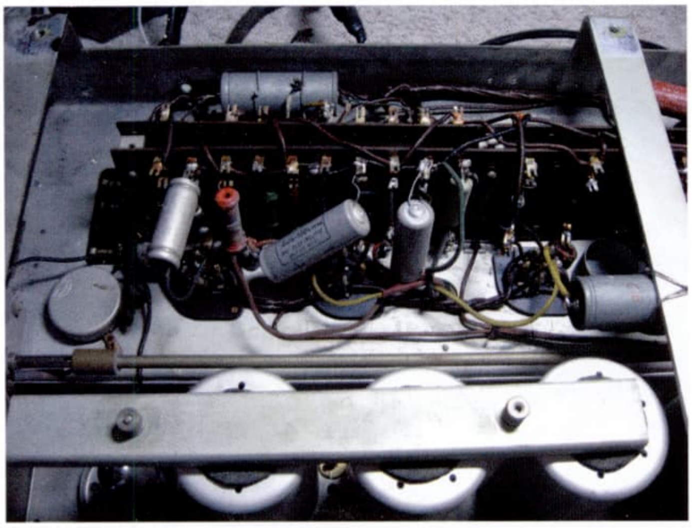
While doing this work I noted a valveholder



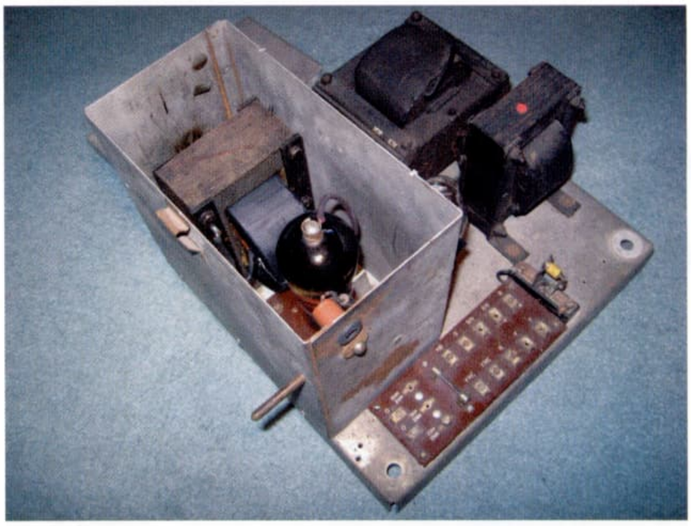
Inside the RF and sync unit - note blanked off valveholder top right



Packed components inside the HMV 900 radio chassis



RF and sync unit as found



Television power supply, EHT system in metal box

aperture in the chassis that had been blanked off in the factory. Its original purpose was almost certainly the extra valve for the 240 line Baird system, although I have not seen the original circuit to evidence my conjecture. However, the bakelite timebase control panel does have a blanking plug covering the hole where the 240 – 405 line changeover toggle switch[4] once would have been fitted, and the original engraved markings probably exist underneath what otherwise appears to be a needlessly oversize blanking plug.

The radio chassis receives attention

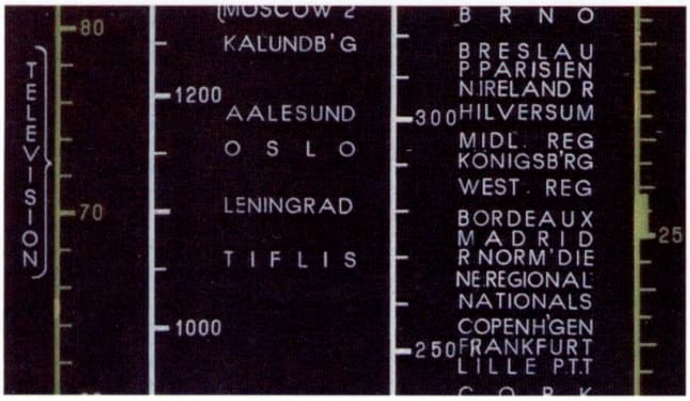
Although the radio unit had been worked upon in the past, I wanted to minimise further problems and decided to replace any other suspect or failing capacitors while the set was apart. The intuitive method of extracting the radio appears to be removal of the control panel to the right of the cathode ray tube and lifting the chassis vertically out. Even with the cabinet lid detached from its stays to give clearance, the chassis could not be removed using this method as it was too wide to clear the surrounding structure. Looking from the back of the cabinet, the only way to remove it was to ease it off its mounting blocks and move it sideways into the space occupied by the metal CRT unit. Realising the difficulty, or more likely, impossibility of replacing the CRT in the event of damage, any work in that area is undertaken with the greatest care to reduce the chance of accidents to the tube. I certainly didn't want to take out the entire CRT unit but by removing the mounting bolts it could be moved along the cabinet floor just enough to allow the radio unit to clear the cabinet. On reflection it was obvious that the CRT unit was the last item to be installed at the factory and the logical order of assembly differed substantially to my order of disassembly.

The radio is an all wave product, adapted from a standard broadcast receiver but with TV sound replacing the normal short wave position. It bears some similarities to the HMV 480 and 481 receivers of 1936 but compared with the television sync and RF unit the standard of construction is rather lower. Some components are wrapped around others instead of utilising tag strips, while other minor parts are buried making access quite difficult, all exacerbated by a high component density. Original wax capacitors were indeed leaking and were replaced by modern equivalents. At some time in the past a few Sprague capacitors had been fitted to replace factory fitted parts and although these were not obviously leaking, I replaced them anyway in an attempt to stave off problems in future. One wax capacitor, obviously a previous replacement, was made by Hunts and knowing their poor reputation I was interested to see how this example had fared over time. Sure enough, its leakage was noticeably worse than all the others I had taken out. Although I prepared a mains connection to perform a bench test of the radio, the chassis utilises an external output transformer and energised loudspeaker and setting up all those loose parts seemed a lot of work. I decided to test the set back in its cabinet, a decision I was to later regret.

Reassembly and test

Getting the radio chassis back into place was just as difficult as removing it and while trying to manoeuvre it past various internal obstacles it slipped back and landed hard, but was eventually placed in position.

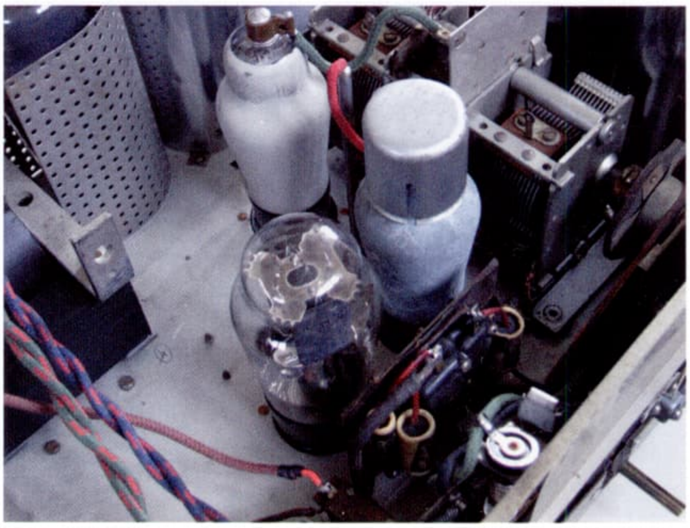
The Model 900 has a mass of internal wiring and starting with the television unit much time was spent checking and reconnecting. Fortunately, most of the interconnections are made with labelled terminals. There are also cables to be fed through numerous cabinet clips and all these were put back in their original positions. The radio unit, as noted before, is not of the same build standard as the television and connections to the loudspeaker assembly are by solder tags, inconveniently mounted upside down and requiring some patience to resolder. I got away with "just" a soldering iron burn while undertaking this work. Likewise the mains connections to the chassis are equally awkward but being tag strips,



Television section of HMV Model 900 glass scale

Pretty feet

Viewers view - control panel. Note blanking plug over redundant system switch



Inside the rebuilt radio chassis

refitting only required minor contortions.

Finally, working from above the cabinet the glass tuning scale was secured along with the three cabinet top covers and bakelite bezels, and the many control knobs were put back in their correct positions. The complete receiver was now ready for testing.

Even more problems

After a final check mains were applied via a Variac transformer and confidence was gained as the radio dial lamps increased their brilliance when the input voltage was raised to half of normal mains input. The input was increased further and something could be heard from the loudspeaker. Very careful listening around the chassis suggested it was not radio signals but something making bubbling and frying sounds ! Looking quickly inside there were yellow dancing lights inside the rectifier valve, and I rapidly switched off. Frying sounds could be heard for several seconds after switch off confirming that something had become very hot, and much more worrying was that something was obviously very wrong indeed.

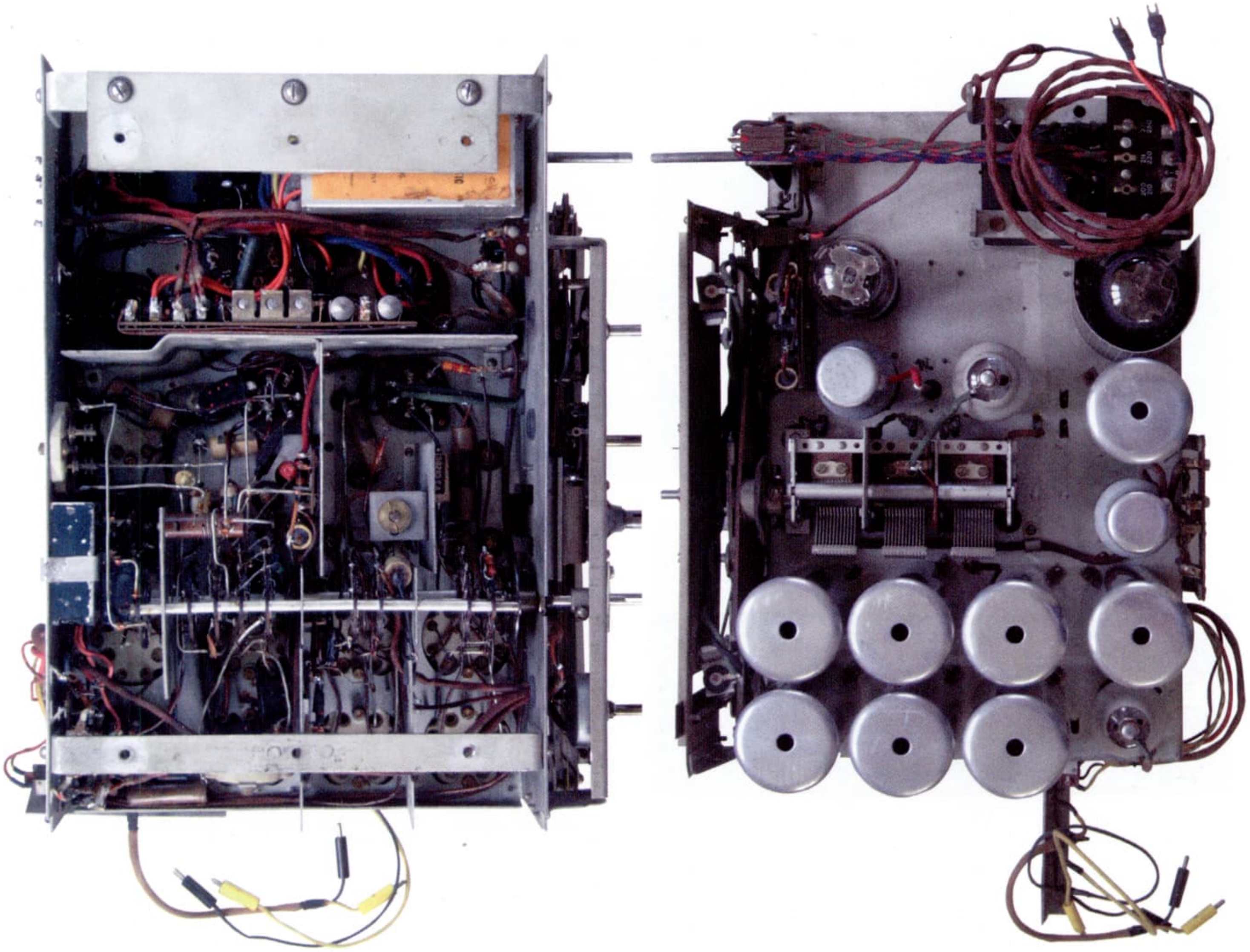
I had visions of having to take much of the set apart again to retrieve the radio chassis and I now regretted not having tested the radio unit while it was on the bench. After all the careful checking and hours of work this was a very disappointing outcome and I spent a despondent evening going over all the things that might have gone wrong and wondering if any parts had been irreparably damaged.

After returning to satisfy myself that I had not connected the mains incorrectly I re-checked all the soldered connections to the loudspeaker assembly as these carry the HT. Nothing seemed to be at fault so I removed the rectifier valve enabling the receiver to be run up slowly without the presence of HT. All seemed well but upon inspection the rectifier valve had the gettering changed from its usual silver to white, indicating a loss of vacuum. There were also tiny cracks radiating from a single point on the glass envelope and fragments of glass rattling around inside. I wondered if the valve was damaged when the chassis slipped, or if a tool had been dropped on the valve during assembly. Another explanation was some kind of gross fault in the HT circuit. Whatever the underlying cause, vacuum had been lost which caused the valve to fail catastrophically. I hoped that the mains transformer had not been too stressed.

A replacement rectifier valve was fortunately available from stock, and for the re-test, the HT was monitored as the mains voltage was raised in 20 volt steps. At 160 volts sound could be heard from somewhere. Being anxious after the last test I was now listening for sounds from the mains transformer rather than the loudspeaker. However, the sounds were from the loudspeaker and after a tweak on the tuning control signals could be heard. The mains voltage was increased very slowly, keeping the volume down so as not to mask any sounds of components failing. All seemed well and the audio side was further checked by connecting the gram input, which also worked. After such a long period of silence it was good to hear the rich plummy sounds produced by the massive wooden cabinet.

The excitement of hearing it working more than compensated for the earlier disappointment but I still had the television side to check. As the television receiver warmed up I thought I could hear the frame timebase and also the line timebase after adjusting the line hold. A raster appeared confirming that the cathode ray tube still worked but there was more testing ahead. Using an my old Cossor pattern generator as a signal source, an absence of broadcast sound was due to forgetting to switch the “gram – radio” switch on the rear panel to the correct position. After careful adjustment vertical and horizontal bars could be resolved on the CRT.

I was able to borrow a standards converter from Mike Barker and during a visit he soon had the TV controls correctly set up to display a clear but very slightly distorted Test Card C. Although broadcast sound signals could be heard on the radio unit



HMV Model 900 radio chassis

there was no TV sound coming through, perhaps because of incorrect wiring or a defective frequency changer valve.

Over the next few days while looking into this new problem, there was an unwelcome development. When connecting the record deck with its earthed signal lead, the mains plug fuse blew. On the first occasion I put this down to fatigue in the fuse but when it happened a second time I knew it was serious. Without going into detail I will just say that the radio unit mains transformer primary was leaking to earth, so it was out with the radio unit again and off to Mike Barker for a transformer rewind. Nowadays we are surrounded by quite complex but reliable electronic products that we take for granted, but at this point I noted to myself that keeping an old television going is like owning an old car. Things just keep going wrong.

Typical of these faults was one observation from an earlier test which was an inoperative focus control. This appeared to be a fault with the chain of EHT resistors and testing with the resistor panel in situ suggested an open circuit, somewhere. The resistor panel is mounted behind the neck of the tube and is not easily accessed, but by disconnecting some of the wiring it was eased out sufficiently to gain access to the the components. A 1.5 Megohm resistor had become open circuit and this was bridged by three 470 K metal film resistors.

Some time later the radio chassis was returned from Mike with its transformer rewound. Mike had used the opportunity to replace many of the modern appearance capacitors with lookalike period parts. He also rewired some of the mains circuits with new cotton covered wire, uncovered a difficult fault that I had unknowingly left during earlier work which stopped the receiver working part way down the dial, and sorted and realigned the circuits. It came back looking very smart indeed.

As noted earlier the cabinet design gives the deceptive appearance of allowing the radio to be removed and installed from above, and to dispel earlier doubts about this procedure I attempted it once again but without success. To reinstall the radio I removed the sync and RF chassis which provided maximum clearance around the CRT unit. A lengthy period of reconnecting all the internal terminals followed, routing the wires and cables to avoid any unnecessary strain and clipping them back in their original positions. The radio unit has an extension panel for the aerial and gram connections, together with a selection switch and is attached to the cabinet with two small wood screws. Their holes had become enlarged over time, preventing them from being fully tightened. To overcome this I employed a little dodge recounted by a builder. A matchstick was pushed hard into the holes and cut off flush. Thus filled, the screws once again gripped firmly and the panel was secure.

Success at last

At long last the complete instrument was finished despite many set backs. I switched on the radio receiver and it worked beautifully. To celebrate I connected up the gram and played some of my scratchy 78 rpm records. When courage had been summoned the television was switched on. I was dismayed that the television did not work initially but I need not have worried as it was just the HT rectifier with an open circuit filament. Upon replacement the television worked bringing a long sequence of work to a close.

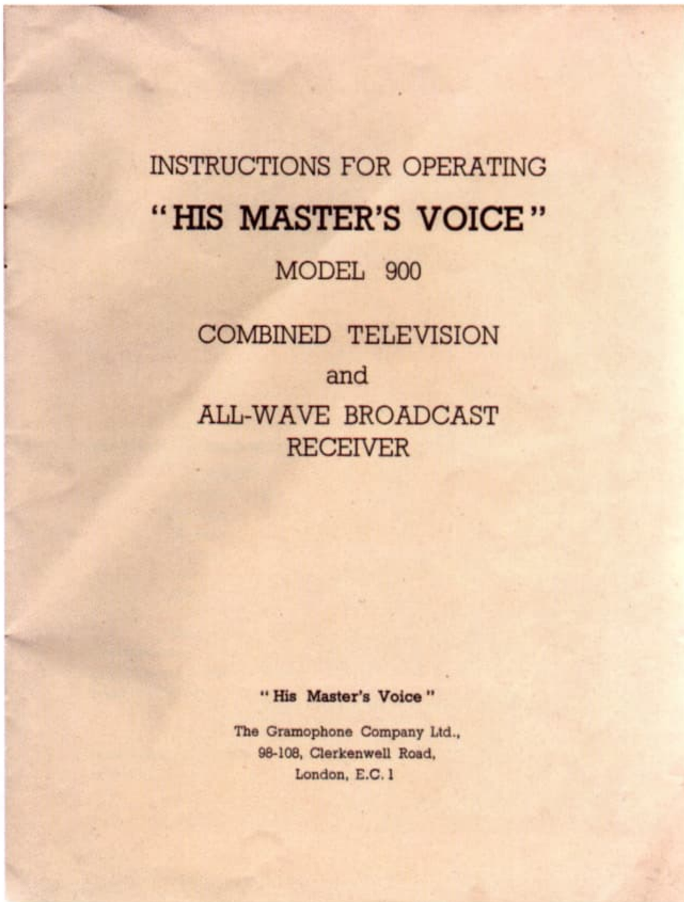
Reflections

Looking at the sync and RF unit chassis with its substantial construction and screening, one can see emergence of VHF engineering techniques that were used in the forthcoming global conflict.

Other than the technical achievement of having the complete instrument working and enjoying it in operation, it seems difficult to comprehend that I have owned this television for more years than my age at the time it was acquired. Revisiting a pile of the documents and letters from all that time ago brought back fond recollections.

Since commencing my quest in 1979 the early television scene has been

HMV Model 184 extension loudspeaker



transformed and has a very keen following indeed. Fortunately, several HMV Model 900 Televisions have survived and are in the capable hands of BVWS members. There is even an informal HMV 900 Owners Club, and one member is painstakingly reconstructing a receiver having started with little more than an empty cabinet!

This more extensive rehabilitation has certainly stretched my patience at times, and as with any piece of elderly equipment there are a few outstanding items that need attention. I acknowledge with gratitude the help and inspiration of Mike Barker without whom the project would still be on hold. This fully operative and handsome instrument is now the centrepiece of my modest collection. Moreover, as the mere custodian of this pioneering piece of technology I have the satisfaction of knowing that it is better prepared to survive the years ahead.

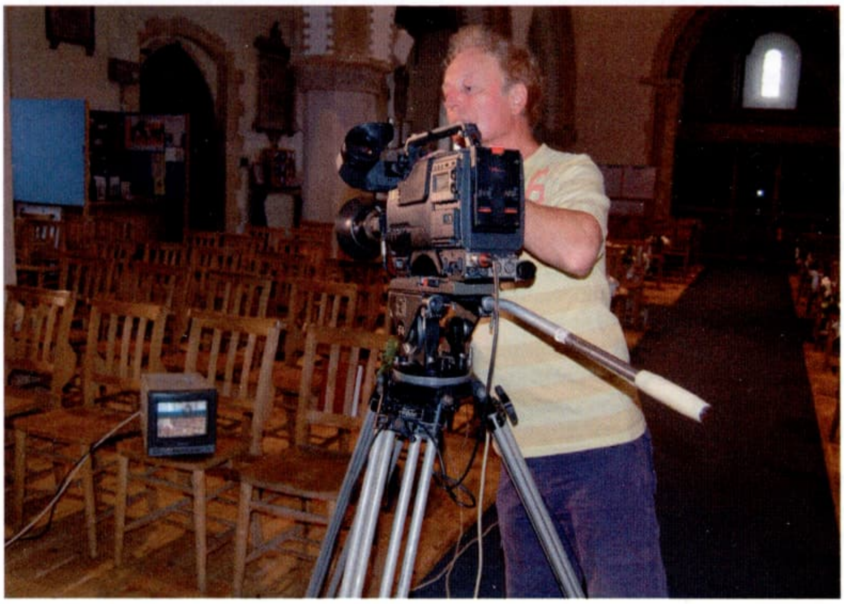
References

1 Vintage TV: The HMV Model 901. David Looser, Television, October 1980.

2 Formation of the BVWS Vintage Television Section. Page 50, The History of the British Vintage Wireless Society 1976 – 1996, Jonathan Hill, 1998.

3 The HMV 900. Ken Brooks, BVWS Bulletin, Volume 9, Number 1.

4 Television – the first fifty years. Page 16 illustrates a timebase standard changeover switch. Keith Geddes & Gordon Bussey, National Museum of Photography, Film & Television. 1986.



Holy Planking

Dicky Howett's in church again, this time to record for local posterity,the replacement of the suspended wooden floor of his local 900-year old church. It's all coming up(there are holes and large cracks in the planks and the congregation is in danger of disappearing down them). Dicky will follow the progress (holes willing) using his trusty Sony BVW 300 Betacamera. The old wooden flooring, which will be supplanted by a nice flagstone one, is about 150 years old and local historians are curious to see what may have slipped through the cracks in the intervening years. No bodies are expected but perhaps the odd gold ring or silver half crown? Dicky's initial filming (using a few strategically placed and artistically arranged red heads) covered the church interior as it exists, concentrating on the old floor areas and general holy ambience. The time scale for all this filming and restoration will be approximately 6 months, unless of course, something unexpected is unearthed...

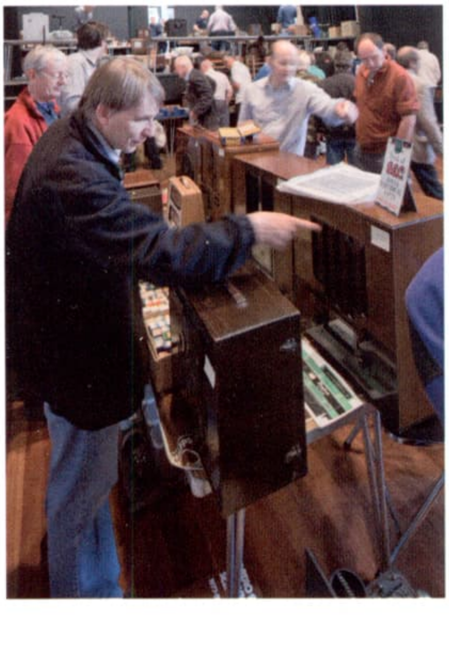
Harpenden September 25th 2011

photographed by Carl Glover





minitest



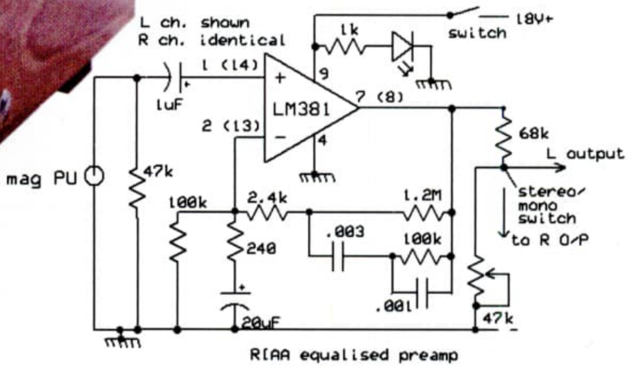
On-Live


Use a modern record deck to play your discs through a vintage radio or amplifier with this

Mini Stereo/mono preamplifier

By Tony Thompson BSc., Cert. Ed.

Radios, radiograms and many 'mid-fi' valve amplifiers of the post-war period to the late 1960s were designed to amplify the high outputs of crystal/ceramic cartridges that came as standard with most players, whether auto-change or single play. 'Modern' magnetic cartridges displaced these for true high fidelity but they cannot provide sufficient power to drive adequately most integrated vintage amplifier designs and some form of pre-amplification is essential.



RIAA equalised preamp

How unfortunate it is that long-playing records have virtually been assigned to history. Many of us have a small hoard of LPs and 45's just waiting to be given a fresh airing – yet without the equipment to do so, they languish unheard on shelf or in cupboard. Of course, a crystal or ceramic cartridge could be purchased – at a price – but it would have to be fitted to a suitable tone arm. One answer could be the purchase of an original 'vintage' record player, but few if any record players of the popular type could match the quality of reproduction available from that lovely restored vintage radio you own. A vintage radiogram can certainly provide superior reproduction, but these are bulky items at best.

If you possess a modern record deck, there is an alternative. This little battery-powered device will allow the use of a magnetic cartridge – as fitted to quality players and transcription units over the last two or three decades – to be used together with a valve stereo amplifier or one (for mono) or two (for stereo) standard valve radios. With a single radio, the left and right channels are simply combined to produce a sum of the outputs which can be fed directly into the 'gram' or 'pick-up' sockets of a vintage radio. For best results with stereo reproduction, a purpose-built stereo amplifier is unbeatable.

Description

This quality pre-amplifier is battery powered and features an LM381 dedicated stereo chip. The National Semiconductor circuitry to make an effective magnetic cartridge preamplifier including RIAA* equalisation was used as the basis for the design. Though robust, the chip should be mounted in a holder rather than soldered directly to the copper pattern, as this prevents the possibility of heat damage. The LM381 and the LM381A are electrically identical and either can be used. The 'A' suffix simply denotes a slightly superior noise characteristic.

The circuit as shown has been arbitrarily assigned to the left channel, simply to distinguish it as one of a pair! The 'right' channel is exactly the same, of course, other than the omission of the LED indicator and its 1kΩ feed resistor, two channels being required for stereophonic reproduction.

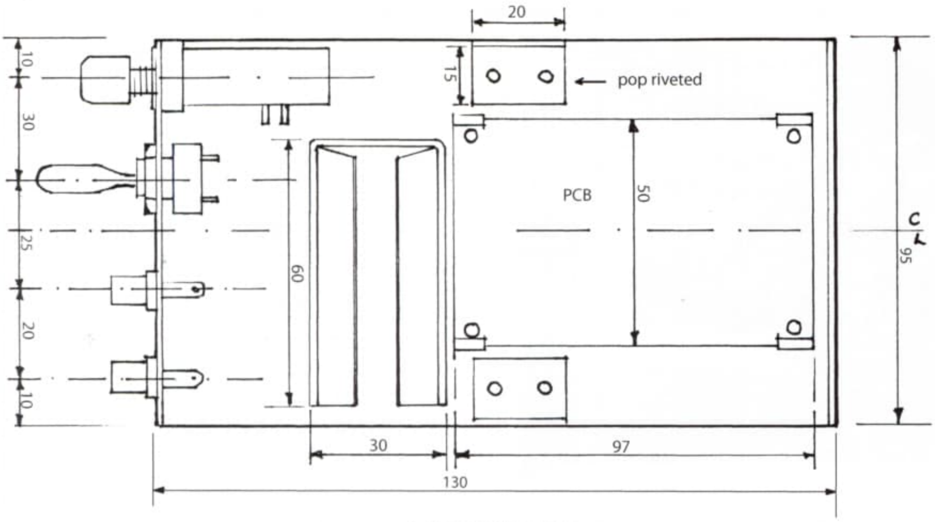
Power is provided by two PP3 9V batteries wired in series. The current requirement is a modest 20 mA or thereabouts but obviously the batteries will exhaust if the unit is left switched on and unused for long periods, so an LED indicator is included to serve as a warning that the device is switched on.

Preset output levels are used and can be set to suit the sensitivity of the main amplifier. If a radio of the 1930s TRF type is used it may be necessary to replace these with either a ganged volume control or separate controls, accessible via an external control knob. This is because the gain of a typical TRF receiver is often set by adjustment of the bias of a vari-μ RF stage with no control of the audio input level at the AF stage, the gram sockets feeding directly into the AF amplifier grid. The output presets in the prototype were 47kΩ and these worked well with my test equipment, although the value is by no means critical. Ideally, potentiometers with a logarithmic law track would be preferable in this position. If the overall output level is thought to be too low, increase the value of these, perhaps to 240kΩ as a maximum.

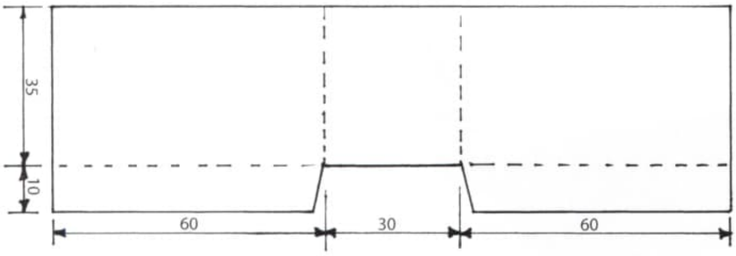
Input and output is via standard RCA phono sockets. The stereo/mono switch combines the two channel outputs into one for use with mono amplifiers and radios. When connecting a vintage radio it will be necessary to fit wander plugs in place of phono plugs.

The entire pre-amplifier is housed in a metal box which is connected via the phono connectors to the amplifier or receiver ground/chassis. In use, earthing of the amplifier/receiver and of the record deck where possible will help limit AC hum pick-up. The drawing shows the internal layout of the prototype, which would be improved by locating the battery housing close to the back wall, to allow easier wiring runs. All measurements are approximate and should be adjusted to suit available components.

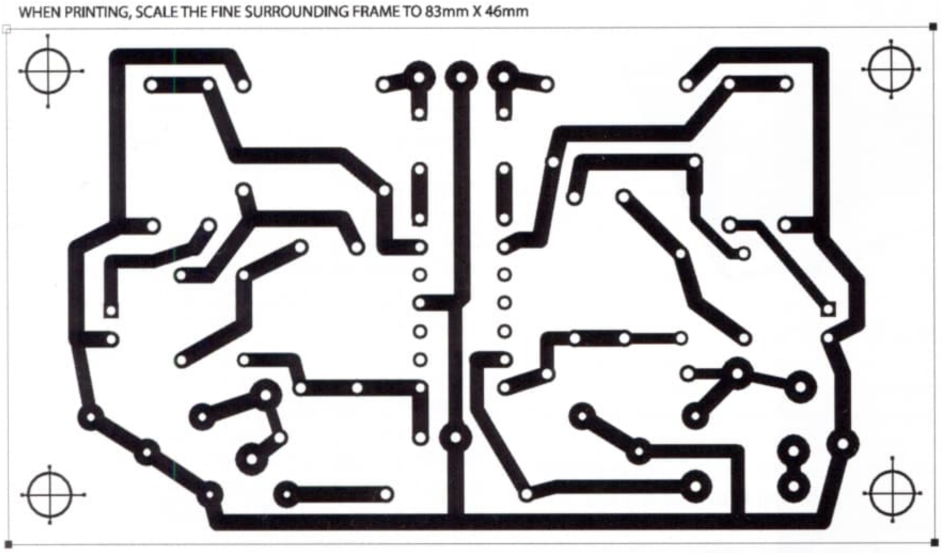
There are several ways to construct the amplifier: self-adhesive resist patterns of components and tracks can be obtained, or Vero board or plain perforated board could be used. The most efficient way is, in the author's opinion, to produce a PCB with UV sensitised copper-clad board, the use of which is discussed below.

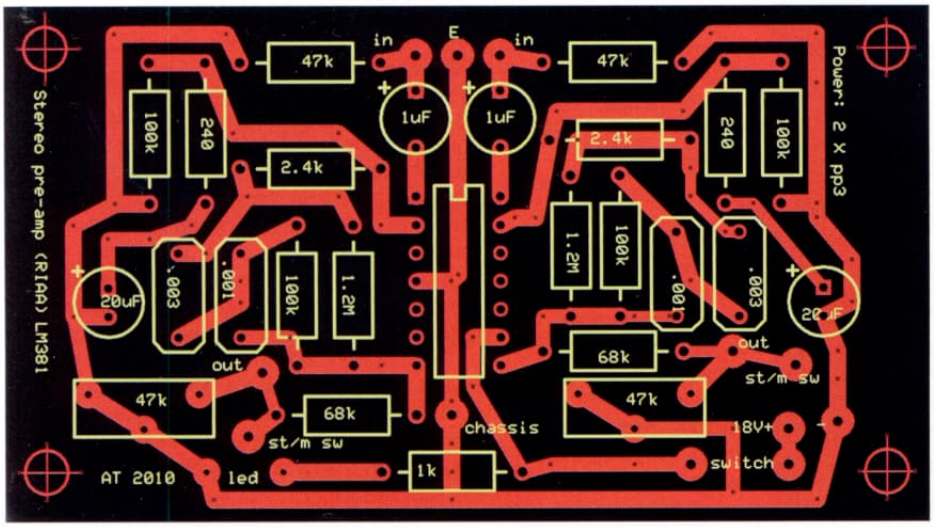


Battery container pattern



WHEN PRINTING, SCALE THE FINE SURROUNDING FRAME TO 83mm X 46mm





Making the printed circuit board

A full component layout and a matching track pattern are shown for the benefit of those readers who may wish to make their own PCB. Note the size as marked on the track pattern: 83mm X 46mm. These figures relate to the fine-lined frame surrounding the pattern. Printing to this size will guarantee a precise fit for the microchip holder. It is probably easiest to drill all holes with a 1mm drill before enlarging those for the solder pins of the pre-sets, the hole size for which should be selected with the components to hand. The holes for the PCB connection pins should also be drilled at 1mm then the pins tried for a fit. They should push in firmly from the plain back of the board with the aid of pliers. Increase the hole diameter if required and don't forget to solder the foot of the each pin to its pad.

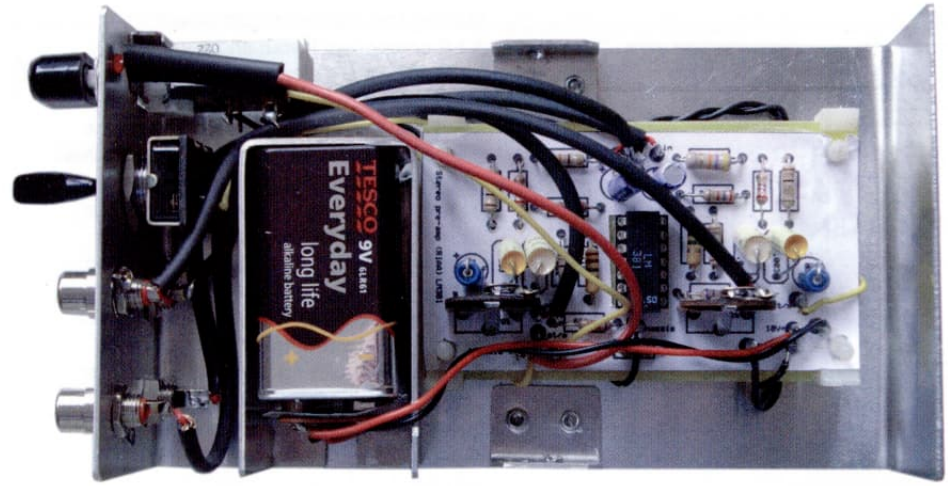
Note that the track pattern is as seen from above through a transparent board. When exposing to UV light**, prints should be placed ink-side up in contact with the UV-sensitized layer of the photoboard. It is useful to attach a print of a correctly-sized component layout to the top of the board as this helps to simplify the location of components. The four corner PCB mounting holes could be drilled in the board to position the print accurately.

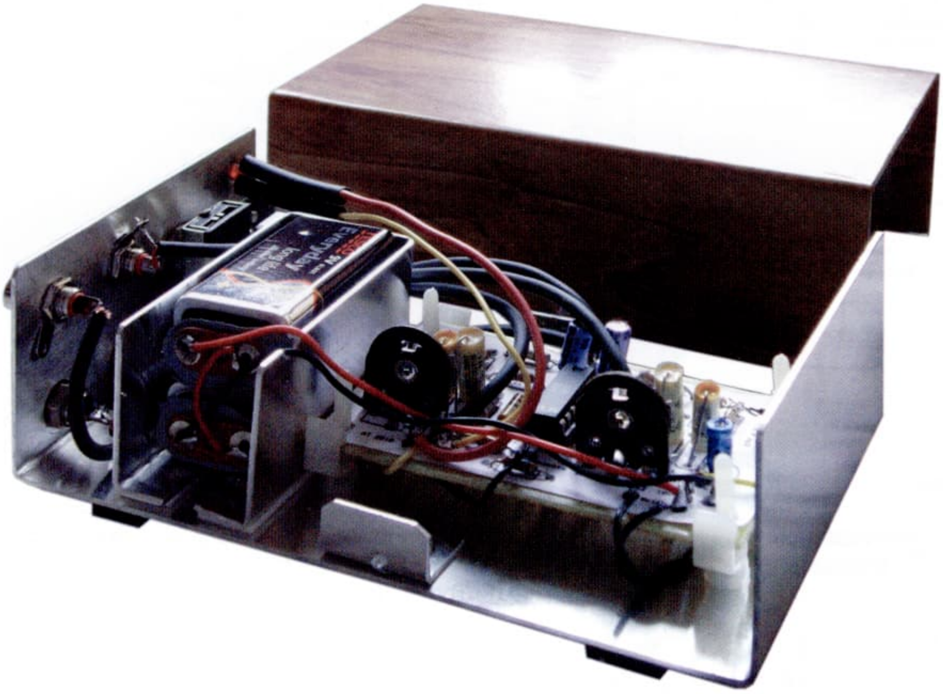
The PCB is securely mounted upon four nylon retaining pillars and connections to the board are made via single-ended PCB pins, the same type of pins that are used with veroboard construction. Double-ended pins are not needed and should not be used as there is a risk of inadvertent grounding. Screened cables link the phono sockets to the board with the screening earthed to the PCB negative line, which itself is connected to the casing metalwork. The phono sockets self-earth through the metalwork they are mounted upon. After drilling the PCB and before the fitting of components, the use of a Seno board cleaning applicator followed by a coating of Seno flux is recommended to keep the board free from oxidation and to promote sound soldered joints.

I endorse the use of a magnifier headband – it makes the assembly much easier when you can see what you are doing!

Case design and construction

The case is easily constructed from 1.2mm (approx. 18swg) aluminium alloy sheet. 90 degree folds form two U-shaped sections: one makes the base which carries the PCB and the batteries and also the front and back panels, the other a drop-over cover which is secured with countersunk self-tapping screws to two small brackets on the PCB carrying section. The use of all-metal construction creates effective screening to minimise hum pick-up from adjacent AC fields. The top panel and sides of the prototype were covered with self-adhesive woodgrain-effect plastic film. Transparent inkjet transfer paper was used for the lettering. The aluminium alloy sheet that was used is easy to fold but slightly flimsy until screwed together, although the folds stiffen the material. Thicker sheet would stiffen the structure even more but would be less easy to work and for





that reason, because of the small size of the project I would advise not to go beyond 1.5mm (approx. 16swg) maximum thickness. The two small brackets that are needed to secure the top in place were pop-riveted in position. The battery compartment is made from a strip of aluminium alloy as shown in the diagram. The chain-lines indicate folds. To avoid rivet, screw or bolt intrusion into the compartment, it can be mounted using double-sided adhesive foam pads. The two brackets to take the self-tapping screws that locate the cover need be no higher that 10mm and can be pop-riveted or bolted in place. Self-adhesive rubber pads fitted under the base help protect furniture surfaces.

All connections and controls are mounted on the front panel. These include an on-off switch, a stereo/mono switch and an LED indicator. The switch on the prototype was of the push-on, push-off variety, only used because it was to hand; any small switch should suit. The stereo-mono switch was of a toggle type in appearance but it was not a snap-over, more a sliding action – fine in this position. Again, any low-voltage switch will work, even a rotary type. Twin input and output phono sockets simplify the connection via standard leads from record deck and to amplifier.

The pre-amplifier in use

The pre-amplifier was tested on a valve stereo amplifier and, switched to mono, several valve radios. The quality of reproduction was excellent in all, with venerable long-play records sounding bright, warm and clear and able to give any CD a run for its money. Some adjustment of the output presets was needed with the valve amplifier to prevent overloading, but this was only to be expected as there is a great deal of gain from the microchip. Very slight background hum was evident but little more than 'normal' for the radios.

*I could not close this article without a brief mention of RIAA...

RIAA – what and why?

The circuit design of this pre-amplifier ensures that it conforms to the RIAA recording standard. It may be of interest to know how this came about and what its purpose is. By the 1920s, developments in vacuum tube technology had freed recording artistes from the severe constraints and limitations of the earlier entirely mechanical recording techniques, though things were not as straightforward as one may be tempted to think; electric recording techniques were, at first, producing results that were little better than the obsolescent acoustic method, but recording technology was subject to continuous development and refinement and the American Bell Telephone Company was probably foremost in the field, having used the 'Audion' (Lee DeForest's triode) to create repeaters for long distance telephone calls. In fact the company was in at the very start, having developed the improved quality microphones that set the stage for valve amplification in the recording process.

Valves and microphones notwithstanding, from the beginnings of electrical recording in the early 1920s, recording engineers and experimenters were aware of the numerous limitations and deficiencies in their equipment. The mechanical and electrical imperfections of microphones, disc recorders and associated equipment conspired to hold back the quality of recording. In particular, disc recorders of the time produced a falling characteristic as frequency rose, i.e. higher frequencies caused smaller but faster sideward (or indeed, up and down, depending upon the system in use) movement of the cutter. Lower frequencies caused a greater, slower movement. The greater bass excursions caused low frequencies to record louder than high frequencies. To help overcome this problem, Western Electric (the manufacturing arm of Bell) devised the so-called 'rubber line' disc cutter, in which the movement of a magnetic cutting head was physically damped by a so-called rubber 'resistor'. The Westrex recording system was used on the early talking movies. Notably, the team at Bell also developed the 'light valve' system of sound-on-film.

The rubber line cutter produced a more linear response but there remained a need, when cutting a master disc, for significant bass reduction – to prevent track to track breakthrough and ease the tracking of the playback stylus – and for treble boost, to reduce groove hiss when the record was played. Each record company devised their own roughly similar forms of correction. Pre-emphasis, i.e. boosting, of frequencies above about 1kHz prior to recording helped improve and level the characteristic, within the physical limits of the disc cutter, and also helped balance the uneven playback response from the heavy high-output magnetic pick-ups then in use in the domestic situation. The idea was that the tone controls of the playback amplifier (or radio) could be used to correct the rather excessive 'toppy' effect and therefore subdue some of the hiss caused by the record medium. Conversely, bass frequencies were de-emphasised to prevent groove breakthrough problems during recording, caused by the inevitably greater deviation of the cutter at lower register frequencies. Also, remembering that playback is essentially a mechanical process, reduction of bass excursions on the track of a record prevented the record player pick-up needle from mis-tracking or jumping.

The recording curves used by individual record companies were – more or less – brought into line by the early 1950s, when the Recording Industry of America created the RIAA standard. From then on, quality amplifiers were equipped with preamplifiers designed to correct the RIAA curve; but such correcting pre-amplification tended to remain in the realm of true hi-fi and middle-of-the-road items such as the average record player had no such refinements. Consequently, bass reproduction was very limited. In any case, had it been fitted, bass boost would have been wasted on the small and poorly housed loudspeaker used in most basic players. Radiograms of reasonable quality made up in part for the lack of bass by a large loudspeaker, cabinet resonance and perhaps a simple (non-RIAA) bass and treble tone control arrangement.

When the CD made its debut, the end of the road was in sight for the RIAA standard.

**Sunlight is a useful – and free – source of UV light. Print the pattern on OHP inkjet film, with the printer set to a high quality, or print on paper using a monochrome laser printer at the best quality available. The paper can be rendered more translucent to UV light by back-spraying with a fine mist of WD40. A test exposure strip should be made to avoid wastage of photoboard. For those with access to EPE magazine, see my article on home PCB making in the August 2010 issue.

Component list
1 off LM381 or LM381A twin channel microchip

Capacitors
2 off 1μF 25vw (min) electrolytic
2 off 20μF 25vw (min) electrolytic
2 off 0.003μF capacitors
2 off 0.001μF capacitors

Resistors
1 off 1kΩ resistor
2 off 240Ω resistors
2 off 2.4kΩ resistors
2 off 47kΩ resistors
2 off 68kΩ resistors
4 off 100kΩ resistors
2 off 1.2MΩ resistors
2 off 47kΩ preset resistors

Sundries
1 off 3mm LED
1 off on-off switch
1 off stereo-mono switch
1 off 14 pin DIL socket
4 off RCA phono sockets (2 red, 2 black)
Quantity of aluminium alloy sheet
4 off rubber feet, self-adhesive
2 off PP3 battery connectors
2 off PP3 batteries
4 off PCB mounting pillars
Quantity of single-sided PCB pins
6 off self-adhesive foam pads
Covering for case
4 off pop-rivets
2 off small countersunk self-tap screws
Quantity of solid-core and multi-strand core insulated connecting wire
Quantity of lightweight screened cable

Sources
Cricklewood Electronics can supply most components, chemicals and hardware for this project, including the LM381. A general search on the internet – and Ebay - for the microchip and for items such as switches, phono sockets, aluminium alloy sheet etc. can yield useful results.
Other suppliers for a range of components and hardware:
www.partridgeelectronics.co.uk
www.grandata.co.uk
www.bardwells.co.uk
www.bitsbox.co.uk
Photoboard materials also available from www.esr.co.uk

Significant addition to the BVWS Archives

Jonathan Hill has generously gifted his 'Radio!Radio' and 'The History of the British Vintage Wireless Society 1976 - 1996' archives to the BVWS. It was clear that the BVWS needed someone to look after such archival material and I was asked if I would be prepared to take on the role of BVWS Archivist. I feel passionately that institutions such as the BVWS should preserve their collective and accumulated history and so I was happy to be co-opted onto the committee as Archivist.

I have now started the process of collating, cataloguing and indexing material, starting with Jonathan's 'Radio!Radio!' archive. This is a comprehensive and fascinating collection of material accumulated during the evolution and production of Jonathan's seminal work. Of particular significance are the numerous original 35mm B&W negatives of images from the book. It is now over 25 years since those images were taken and they will, I am sure, prove of great value to future collectors and researchers.
Other archive material that will be catalogued includes Jonathan Hill's 'The History of the British Vintage Wireless Society 1976 - 1996' archive, the Pat Leggatt archive and part of Gordon Bussey's 'The Setmakers' archive, the latter having been generously gifted to the BVWS by John Chapman.
The ultimate aim is to have all archive material under one roof and searchable via an online catalogue. We also plan to digitise as much of the material as possible, although this is going to be a considerable task.

For enquiries regarding the BVWS archives, please email me in the first instance at archivist@bvws.org.uk .

Lorne Clark

Jonathan Hill (left) presenting part of his 'Radio!Radio!' archive to Mike Barker, May 2011

The Wonder of Woonsocket

Dicky Howett visits The Museum of Broadcast Technology

So where the heck is Woonsocket? Well, it's in the US of A somehere near Providence and Rhode Island. Woonsocket is a smallish town, not unlike Billericay in Essex, but with a 'Bailey And Loan' building, purchased and gifted to the Museum to house an ever expanding collection of ex-broadcast technology. I travelled down from Boston (holiday time a year or two ago) and my genial hosts for the day were Paul Beck and Jay Ballard of ABC TV (NY)

While the actual Museum facilities are not yet open to the public, construction plans are proceeding apace, and an array of technology exhibits are being planned and developed for display on two floors. (15,000sq ft). The Museum's first floor will be dedicated primarily to videotape systems. It also will feature an early television control area and audio/radio control area.

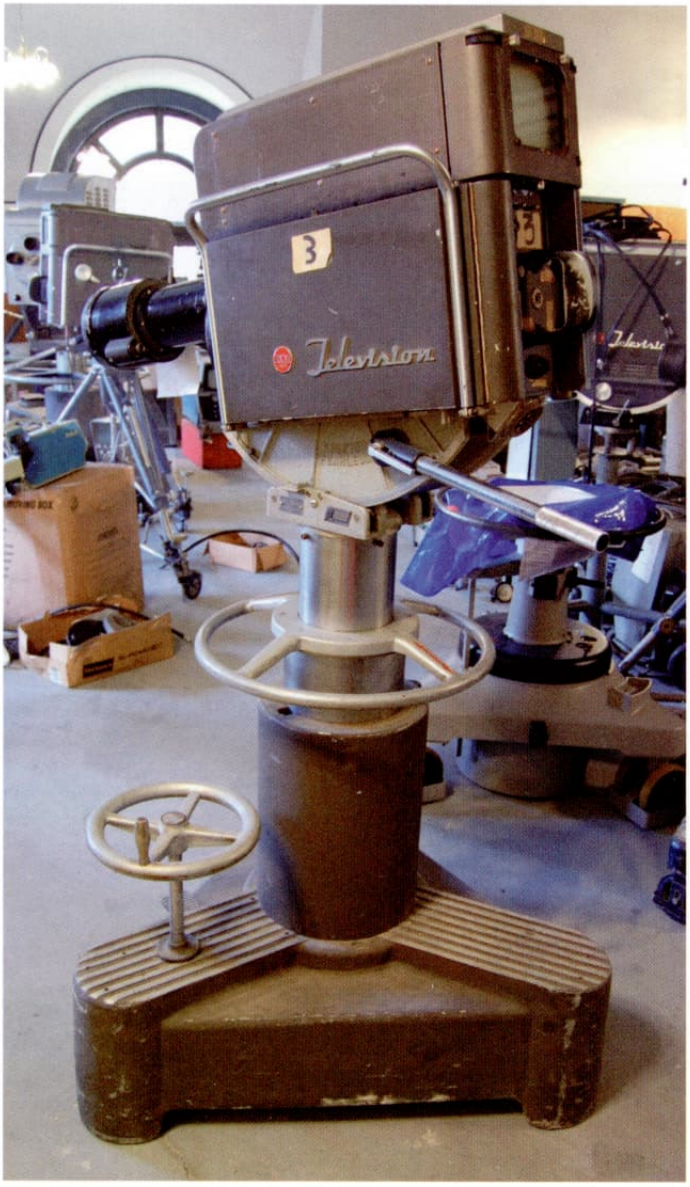
The second floor will feature a wide variety of vintage television cameras and related production equipment displayed in an operational studio setting with sets, live production elements and techniques typical of the early TV era.

As the Museum's curator and archivist Paul Beck is a driving force for the MBT as well as a dedicated and well-informed technology collector of many years. Paul worked 10 years in broadcast television, 8 years in corporate television, and another 25 years in the higher education communication & broadcast community. Paul brings a broad and detailed perspective of technology history to the museum and its work that stems from his many years as an accomplished technologist in the industry.

Paul has also pioneered several novel methods and techniques for the handling, recovery and re-mastering of old small-format videotapes and for transferring early video programs to modern digital formats. He has also developed an optical wet-gate transfer process for 8mm, Super 8mm and 16mm films. Beck also serves as Film & Video Archivist for the New Haven Railroad Historical and Technical Association, producing many new DVD's that feature the images and history of a bygone era.

The Museum's Advisors are:
Jay Ballard
Henry Berman
Bobby Ellerbee
Pete Fasciano, (Webmaster)
Herb Ohlandt
Chuck Pharis

Contact information:
Museum of Broadcast Technology
144 Main Street
Woonsocket, RI 02895
maindesk@wmbt.org

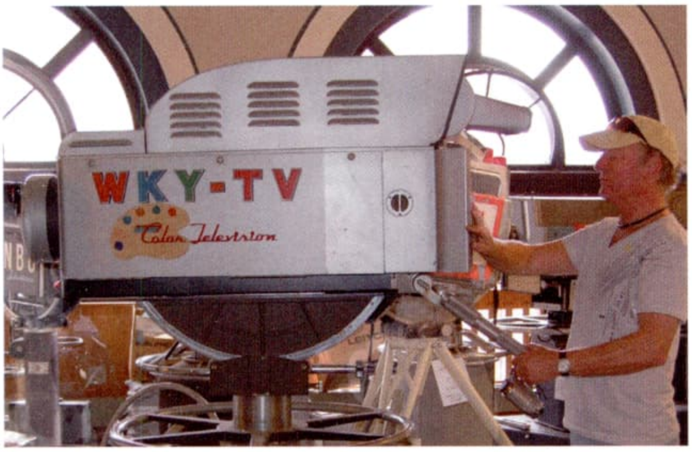


An RCA TK11A sitting on a PD1 pedestal. Very mechanical and very heavy.

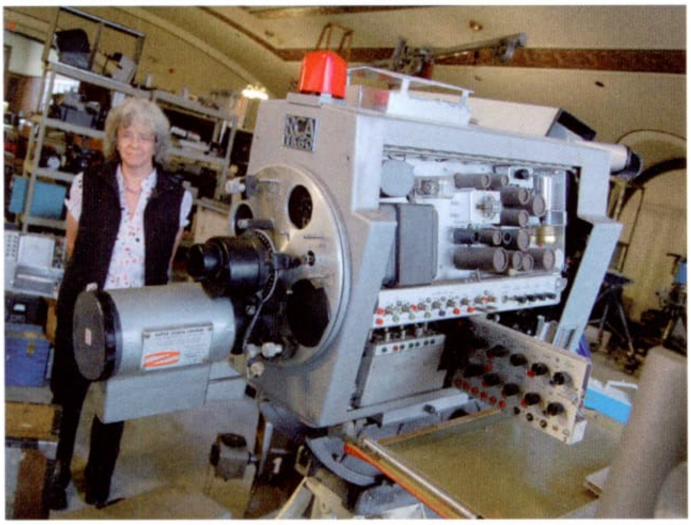
Dicky is presented with a needed Houston Fearless pan bar from Woonsocket. 3,500 miles to collect it.

A Little Shaver. So called Norelco 'portable' from the 1970s. Not so light tho'....

TK 42 colour camera. 3 Vidicon and 1 Image Orthicon tube combined. Not a happy mix.



Dicky manhandles a TK41C. This camera type was capable of producing under the right conditions, very pleasant colour pictures.



A TK 60 with its sides exposed and a Zoomar.

Norelcos and Ikegamis. The museum seems rather short on Pye Marconi and EMI cameras. (ie: to date, none at **all**)

A TK41C missing a few 'eyes'

VT machines down below. (video grab)

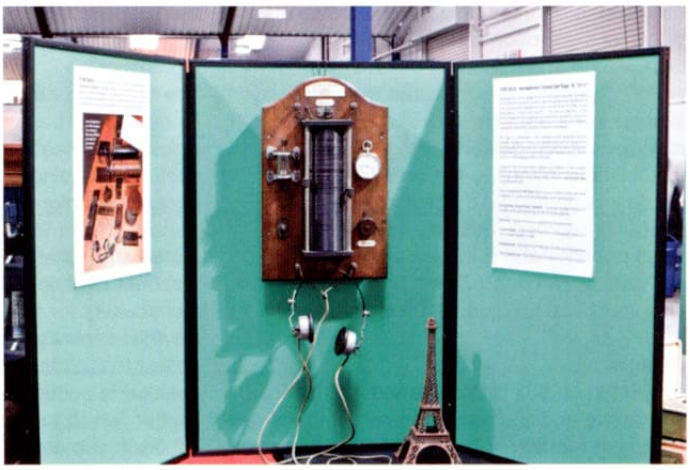
Bundles of Kliegl Scoop lights and the odd Mole

A PC 60 ex-CBS News. Note the camera's grab handle is tubular. Later models had one piece body panel oblongs. The things you learn.....

NVCF!

photographed by Lorne Clarke


On The Air
The Vintage Technology Centre



The Emerson 868 'Miracle Wand' 4 Transistor Receiver by Henry Irwin

The Emerson Radio and Phonograph Corporation of Jersey City, New York produced some of the most representative examples of that exuberant style so characteristic of the late 1940's and early 1950's period in American design. In common with some other American manufacturers, they initially embraced the new transistor technology by releasing a tube/transistor hybrid in 1955 before introducing their first all transistor pocket radio, the 849, in 1956. Then, early in 1957, the Emerson 868 was released.

Emerson with its Miracle Wand antenna on top.

With no pretensions towards pocketability this was a large portable radio by American standards, measuring 10-1/4 ins wide by 9-7/8 ins tall. It was a 4 transistor design intended to make the new transistor technology more affordable to the mass market and sold initially for just over forty dollars. The extra space allowed Emerson to address some of the criticisms of earlier sets, poor battery life, thin tinny sound and mediocre sensitivity.

My example was purchased through Ebay several years ago. Housed in a two tone maroon and tan plastic cabinet it sported the "Miracle Wand", a ferrite antenna inside a large handle that rotates through about 90 degrees. This was used in the sales publicity and Emerson announced it as "unique" although Zenith and Motorola also introduced radios with this feature.

Design

The Emerson 868 is unashamedly of its era. This is not purist abstract modernism but the brash modern of the 50's automobile. It aims to grab attention and does so by making a feature of the oversize centrally located tuning dial and emphasising the ribbed handle cum antenna. The "V" or "Jet wing" motif, symbolic of the dynamism of the new jet age, is also incorporated in the design, framing the central dial between checkered panels and contriving to make the symmetrical layout more dynamic.

Construction

The case is constructed in two sections, hinged at the base, with the contrasting plastic front heat welded to the main section. Hingeing the back down reveals chassis techniques that represent the transition from valves to solid state. A plated steel chassis which looks as if it should contain a set of valves in fact has sockets for three iridescent blue Raytheon transistors and a further one bolted to the chassis. The four inch speaker is bolted to a U shaped steel section which carries all the main parts either on sub assemblies or tag strips.

There is a lot of space beneath the chassis. An examination of the large central piece of card with its connectors reveals why; this radio was designed to take two huge 9 volt batteries, one either side of the speaker, in parallel!

Some American collectors have suggested this radio was originally designed for tubes and changed at the last moment. I may be wrong but I am not so sure. Looking at the space between the present chassis and the back of the case there isn't enough room for B7G valves to sit horizontally.

Circuit

With only four transistors this budget design uses Raytheon 2N271 PNP transistors in both the mixer and the single IF amplifier stage and a 2N138 and a CK751 in the audio driver and output. The 2N271 has a performance roughly comparable to a Mullard OC44 and to make the most of the single IF stage it is interesting that a similar device is used in the IF amplifier presumably to utilize its high gain and high cut off frequency. In designs with two IF stages it was more common to use lower spec. devices such as OC45 or its equivalents.

The single IF stage has to work hard so the first IF transformer is double tuned to retain reasonable selectivity. There is a single 4.4 pf neutralizing capacitor between collector load and base while the second transformer is single tuned and feeds the 1N60 detector diode.

Audio is coupled from the volume control to a conventional audio driver and then via a transformer to the single Class A output stage. It is here that a very early form of Raytheon Power transistor is used, the CK751. Essentially an audio transistor with a tab welded to its case that allowed it to be bolted to the chassis. There is no negative feedback around the output and the standing current drain is about 20ma.

It should be noted that the chassis earth is held at negative potential as in a valve circuit but this means that with PNP transistors, which would normally have a positive earth, the collectors have to be fed from the negative supply so all bypass capacitors are returned to the negative rail. (Fig. 1)

In some respects this circuit is close to the standard valve superhet with its single IF stage and single ended output, albeit implemented with triodes!

Repair and restoration

When I unpacked my 868 after its journey from the USA the first thing I did after an initial check and dusting off was to apply some power. Although designed to draw its current from two large obsolete Eveready 276 cells in parallel a single PP9 or equivalent in HP7 cells can be connected. Surprisingly it worked after a fashion.

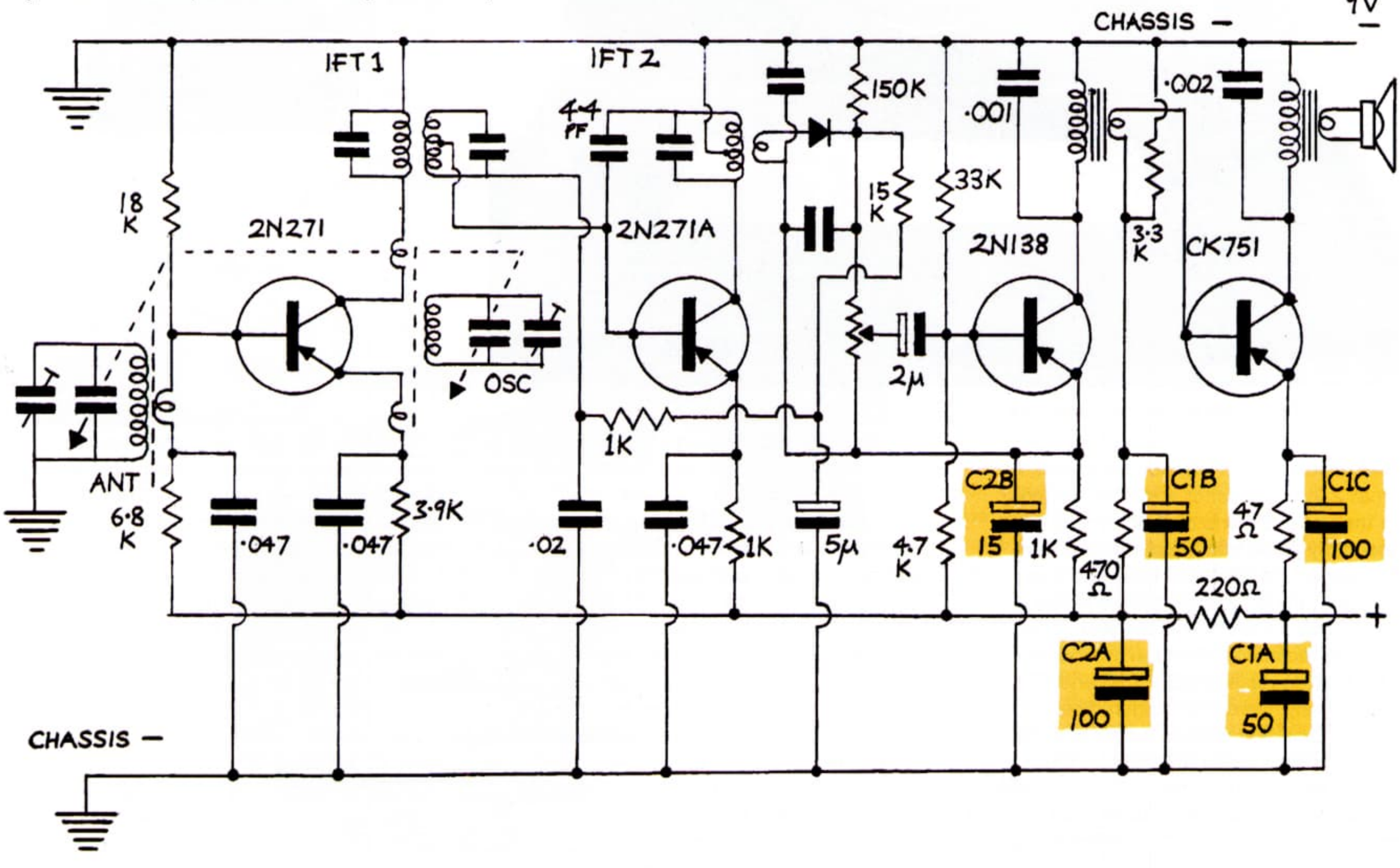
Sensitivity, as might be expected, was not great and on the audio side the sound was thin and lacking in bass. There was also a hint of increased distortion if the radio was left on for more than a few minutes. The components most likely implicated in this would be coupling and bypass capacitors associated with the audio stages or AGC, either through reduction of capacity or leakage upsetting the biasing of the transistors. In my experience leakage or shorts in low voltage electrolytic capacitors are uncommon but it can happen. The most obvious candidates were the two large wax and cardboard multiple capacitors which between them contain five individual units between 15 and 100 mf and which dominate the outside of the chassis. I had never seen anything like these in a transistor radio before and although they looked as if they had been designed for valve circuits examination of the cases showed voltage ratings of 10 volts.

I suspected that the integrity of the electrolyte in these was not good after all these years. My initial intention was to retain the case and re fill them if necessary as they were such an integral part of the chassis. The alternative was to retain the cases but snip the wiring and insert modern capacitors on the underside.

Obviously the next thing to do was to remove the chassis and examine the rear. The main chassis and speaker loosen easily enough from the case after removing four star head and two hex head screws but to extract it requires unsoldering four wires that come from Emerson's "miracle" antenna in the handle. This of course means that you cannot complete RF alignment with the chassis removed "sans" antenna. After this I had to bridge two tags on a strip to restore DC conditions to the mixer transistor base. Looking at the rear side revealed point to point wiring reminiscent of a valve chassis but without the valve holders. It also revealed just how little space there was for inserting new capacitors. This revelation confirmed me in my intention to try and refill the big multiple capacitors but with some trepidation as I wasn't quite sure how without destroying the whole cardboard assembly. I decided to post enquiries on a few American restoration forums but without success. Then I came across a site by chance that described refilling valve type electrolytics of card and wax construction and which required an oven at very high temperature and messing about with hot wax! That and the possibility that I would end up destroying the original cases was sufficient to disabuse me of that idea.

Back to plan B! A search through my supply of modern electrolytics and a careful examination of the wiring showed that I might just be able to fit in three replacements underneath the 2mf coupling capacitor to the base of the driver transistor provided that it was removed temporarily. It was an aluminium tubular but inside a cardboard tube and tests indicated low capacitance so it would have to be replaced as well. I decided I wanted to retain the cardboard cover since it was authentic and would also partly disguise the new components underneath. The cover was slit for about 5mm with a sharp blade and slid off while the end with the

Fig.1: 868 circuit. Multiple cardboard electrolytics shown in yellow.



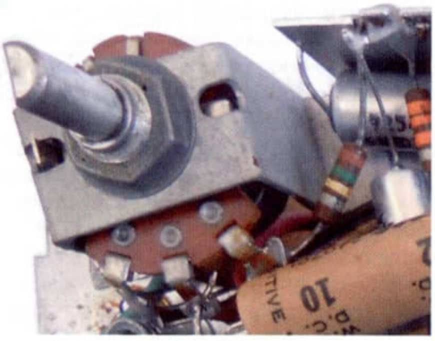


Fig.2: Replacement components beneath refilled coupling capacitor.

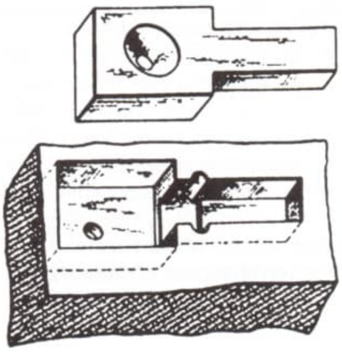


Fig.3: Raytheon's double well graphite jigs allowed better control over the alloying process.

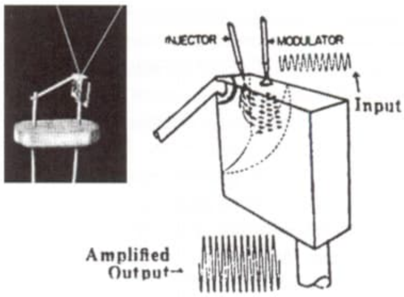
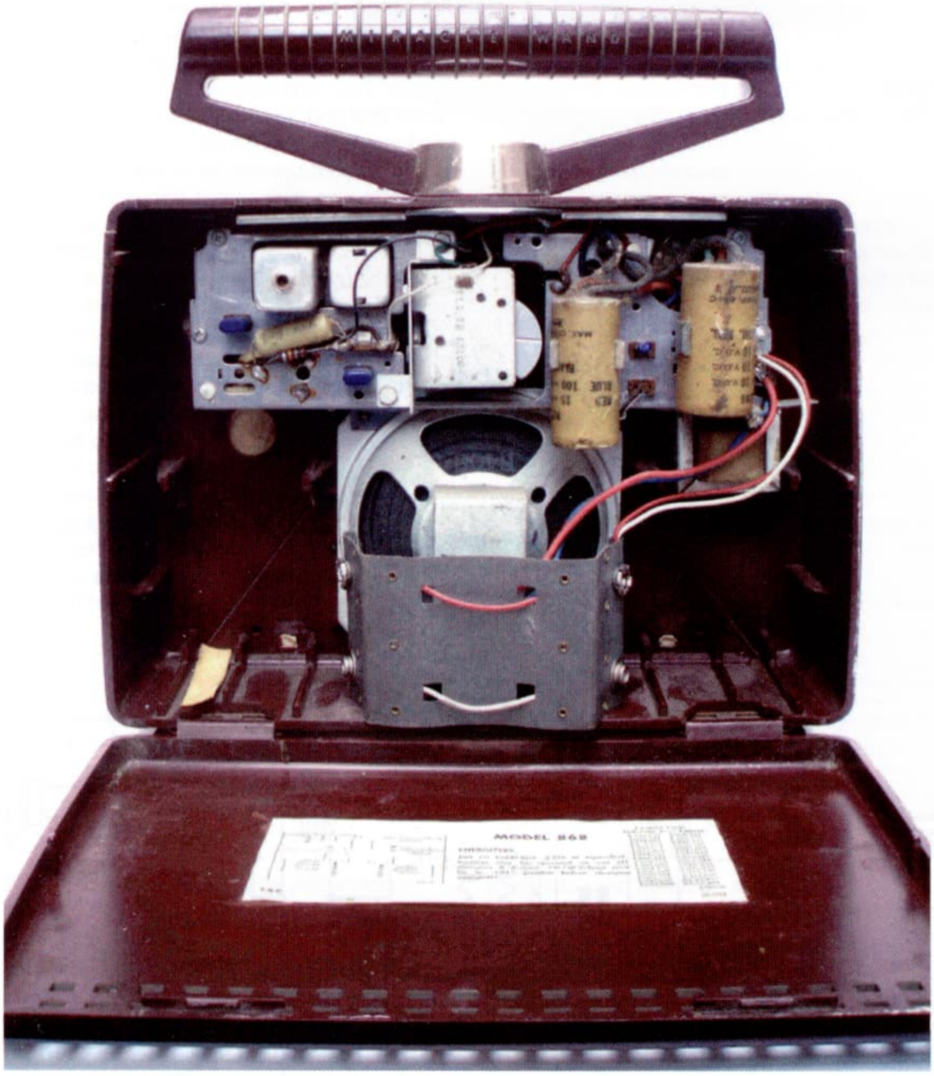
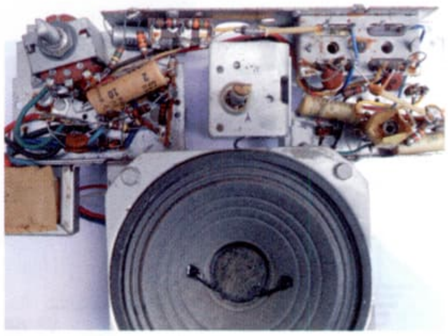


Fig.4 ; Raytheons Spacistor using a space charge avalanche effect.



Rear of the 868 opened with its huge battery capacity.

Emerson 869, the Bling version with gold front and silvered side panels.



Reverse side of chassis, audio section at left side, RF at right.

rubber grommet and + connecting wire was removed from the aluminium can. A small 2.2 mf capacitor was then soldered to the re used + end connector and the assembly glued into the cardboard tube. The projecting wire from the - end was brought through a small plastic spacer which was painted silver and also glued.

Small radials of 22 and 47mf and an axial of 100mf, to replace C2B. C1B and C1C respectively, were then soldered between various tags and chassis points after their plastic covers were removed to expose the aluminium cans. The capacitors these replace were originally contained within the multiple units C1 and C2. Finally I rewired C4, the refilled cardboard sheathed coupling capacitor, from VR1 wiper to its original tag above the replacement units (fig. 2).

This more or less completed the electrical restoration apart from checking voltages and peaking up the IF at 455khz which awkwardly has to be done with the chassis out of the case. Also awkward was the fact that alignment of the antenna and oscillator trimmers would have to wait until the "Miracle Wand" was reconnected and the chassis back in its case. I also unplugged the transistors from their sockets a few times to ensure that the contacts would be wiped of any corrosion and removed a little bit of rust from the chassis edge.

Before extracting the innards the two front knobs had to be removed. This was aided by squirting a little WD40 down around the shaft collars and after an hour they came off easily with a cord puller. The brass inserts were showing signs of corrosion so they were removed by drilling in from the back shaft with a small model drill on low revs and carefully pushed out. After removing the old lacquer with steel wool the corrosion was polished off with Brasso wadding and rubber gloves. Rather than use a spray I used a small touch up bottle of car lacquer, dropping a blob in the centre of the insert and coaxing it out to the edge with the supplied brush.

This remains liquid longer than spray but is only suitable for small areas.

Cleaning the case is complicated by the fact that numbers , lettering and logos are in shallow surface indentations filled with gold paint. This notoriously can go a dirty grey green colour or worse, get rubbed off completely. After dusting everything with a blower brush I washed the case and knobs in washing up liquid which is relatively benign towards the printing and lettering. To do this properly the handle assembly should be removed however since its pivot is attached to a base plate which is bolted and glued to the case, I cheated and masked the pivot with bluetak.

Unfortunately scuffs and scratches on polystyrene over a long period retain dirt very tenaciously and on some areas of the tan front section I had to revert to Cif household cleaner. This had to be applied sparingly with a finger to avoid it removing the remaining lettering, left for about 30 seconds and the scuffed areas rubbed with a finger nail. The residue was rinsed off with a moist tissue. The remaining maroon sections of the case, cleaned but dulled by the washing up liquid, were polished to restore some shine with Brasso and a soft cloth.

Raytheon transistors?

The Raytheon transistors used in the 868 will not be familiar to many in this country. In fact Raytheon is a name we associate more with the defence industry but in America in the early 1950's they became a major quantity producer of transistors.

When William Shockley took out his patent for a junction (as distinct from a point contact) transistor in 1948 the first devices were manufactured by the "grown" junction process. This involved pulling a rod of germanium from a molten N type melt, doping the melt to P type and double doping back again to N type. By this means a single crystal was formed with alternate N,P and N regions. This process posed some manufacturing problems not least of which was how to locate and attach wires to the thin P type base region and initial yields of viable devices were low.

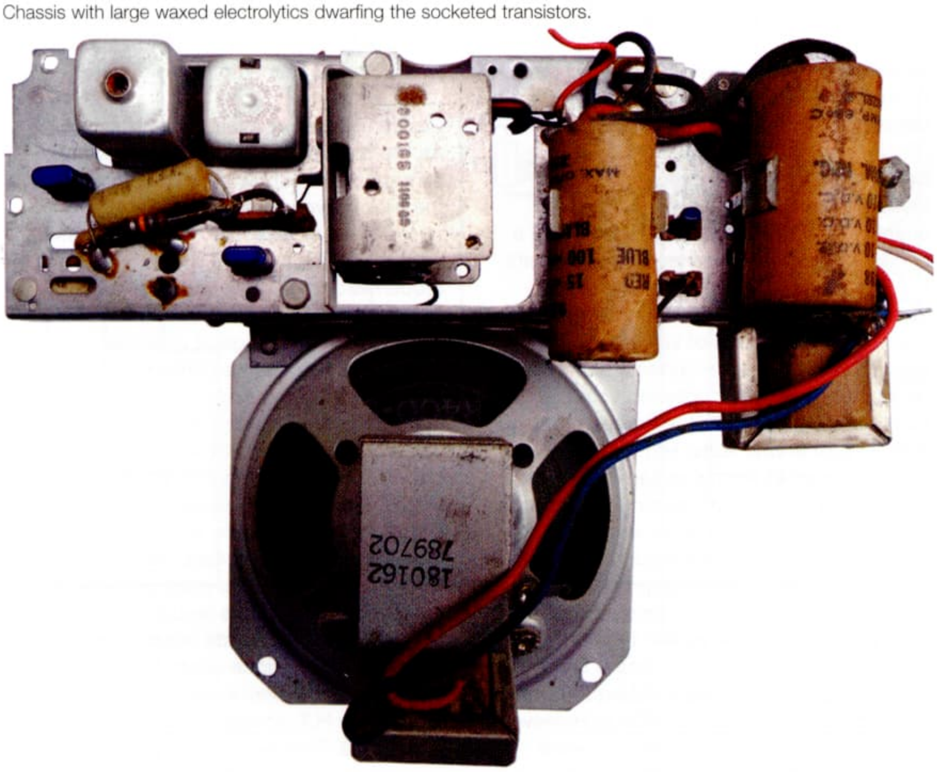
In 1952 General Electric devised a process whereby small pellets of indium were placed on opposite sides of single crystal wafers of N type germanium. These were then heated in a furnace causing the indium to melt and dissolve into the germanium surface. When cooled the re crystallized area comprised an alloy of indium and germanium which was P type, the indium pellets becoming the emitter and collector connections. By this means the PNP "alloy" transistor was born.

Then there was the model 869 which had an identical case but with a sprayed gold front, silvered checkered panels and a reflective Emerson logo roundel. Probably considered slightly vulgar at the time it is now of course highly collectable.

Raytheon were one of the first companies to begin manufacture of the new "alloy" or "fused" junction transistors on a large scale. Having bought licences from Bell and General Electric they quickly invested in production facilities, devising methods to enable more reliable production. One of these was a double well graphite jig (fig. 3) which allowed the indium pellets to be accurately located on the germanium wafer during the alloy process. By 1954 they were producing large quantities of transistors for hearing aids. Their early transistors were encapsulated in plastic cases and soon they began to get feedback of changes in characteristics and device failure which was attributed to moisture molecules migrating through the plastic and contaminating the junctions. These claims of poor reliability stung the company and subsequent Raytheon devices had double protection with junctions encapsulated in polythene and hermetically sealed in metal cases.

Having marketed a successful range of AF and RF alloy junction transistors the company then embarked on the development program of an exotic device termed the Spacistor (fig. 4) which promised very high frequency characteristics. This development proved very protracted and ultimately unsuccessful. Raytheon had backed the wrong commercial horse while other companies had developed diffused junction and planar technology and they subsequently withdrew from the consumer device market.

Chassis with large waxed electrolytics dwarfing the socketed transistors.



Final Thoughts

When the chassis was reinserted in the case and the miracle wand antenna connections re soldered I was gratified to note that the audio was stronger, clearer and free of residual distortion. There was now some additional lower midrange body to the sound but disappointingly still no real bass. Perhaps this was about the best that could be expected given the original capacitor values and coupling transformer types in the class A output. Also apparent was a higher than expected level of hiss from the audio driver transistor.

Surprisingly the selectivity and sensitivity were moderately good considering the single IF stage and the limited amplification available, about on a par with many average UK six transistor designs. This demonstrates what can be done with "hot" transistors in a basically no frills circuit. Generally the RF side performed better than expected but the audio, although relatively loud and clear, let the side down.

The Miracle Wand antenna as expected gave some problems with hand capacity detuning when the handle was picked up. This was only noticeable on weaker stations and at the high frequency end of the band. Other manufacturers who adopted this had the same problem and the idea was soon abandoned.

Emerson can claim to have fulfilled its aim of good battery life and sensitivity on a budget transistor model but not necessarily a richer sound given the case size. None the less an interesting and "fun" early transistor design.

There were several colour variants of this radio, the reverse of my model with tan sides and a maroon front and also a green and yellow version. Then there was the model 869 which had an identical case but with a sprayed gold front, silvered checkered panels and a reflective Emerson logo roundel. Probably considered slightly vulgar at the time it is now of course highly collectable.

The Retro Single by Peter Lankshear

An announcement by the New Zealand Vintage Radio Society of a one valve receiver competition aroused my interest, the more so when I saw that there were some rather unusual rules.

The maximum size was 6 inches by 6 inches by 12 inches. A maximum of three controls was allowed. A single semiconductor diode in addition to the valve was permitted. One cunning rule of the contest limited the supply voltages to only 30 + 3 volts, restricting the ability of most valves to perform properly. Current would be no problem as each supply was to be rated at 2.0 amperes.

In the heyday of home receiver construction, designs for one valve receivers appeared literally in their hundreds. At that time, as distance reception (DX) was of prime interest, sensitivity was important, and consequently grid leak detectors, invariably with regeneration, were practically universal. Obviously it was an advantage to use a twin valve to obtain extra amplification and, a one valve detector and audio stage receiver could be capable of serious work. I recall in the 1940's receiving in New Zealand, American West Coast M.W. stations on a set using a single type 19 double triode valve.

Several configurations for a set using a single twin valve are possible.

1. A regenerative triode detector and single audio stage

2. A pentode half as an R.F. stage, plus a triode detector, thereby increasing selectivity and the threshold for receiving weak signals, but at the expense of audio power.

3. Another is to have an R.F. stage, a semiconductor diode detector, and an audio amplifier. This would have superior audio quality, but restricted sensitivity.

4. Reflexing was popular in very early designs whereby the amplifier stage is used twice, first as an R.F. amplifier and then after detection as an audio amplifier.

5. A superhet is possible with a double pentode with one half as a self oscillating mixer, the other half as an audio output stage and using a semiconductor diode detector. With these possibilities and the number of twin valves still available today, the combinations could be extensive.

Selecting a Suitable Valve.

My target was to find a valve with useful quantity of anode current combined with a decent mutual conductance at only 30volts H.T. My AVO MK IV Valve Characteristics test instrument gave some surprising results. A quite wide selection of valves tested showed that the anode currents and mutual conductances at the published voltages had little relationship to the figures obtained with only 30 anode volts. High mutual conductances at normal voltages do not always translate to high readings at 30 volts.

The obvious starting point would be battery powered valves although the range of double types available is limited. Of the directly heated types, the classic class B double triodes such as the 19 and 1J6 showed up reasonably well, and it is not surprising that these featured frequently in the home brew sets of the 1930's. However, their performances at 30 volts H.T. were restricted. The relatively little known double triode 3A5 (DCC90) proved the best. This valve was primarily intended for low voltage transmitters in weather balloons. With the exception of the 1D8GT there are no triode pentodes in the directly heated range, and its triode's almost zero performance with a 30 volt supply made it a non starter.

Plenty of Current Available

As the competition power supply would be capable of supplying plenty of current, the next move was to explore the possibilities of indirectly heated valves. With triode/ high gain R.F. pentodes, triode/hexode oscillator/ mixers and the triode/audio power pentodes, in large variety, the range of possible candidates broadened considerably.

The only available triode/ R.F. pentode in the octal range was the 6F7, but its triode performance at 30 volts was minimal so my attention turned to the Noval range. Those tested were the 6U8, ECF80 and ECF86. Unfortunately, like many others with high mutual conductance characteristics, at 30 volts they proved to be poor performers.

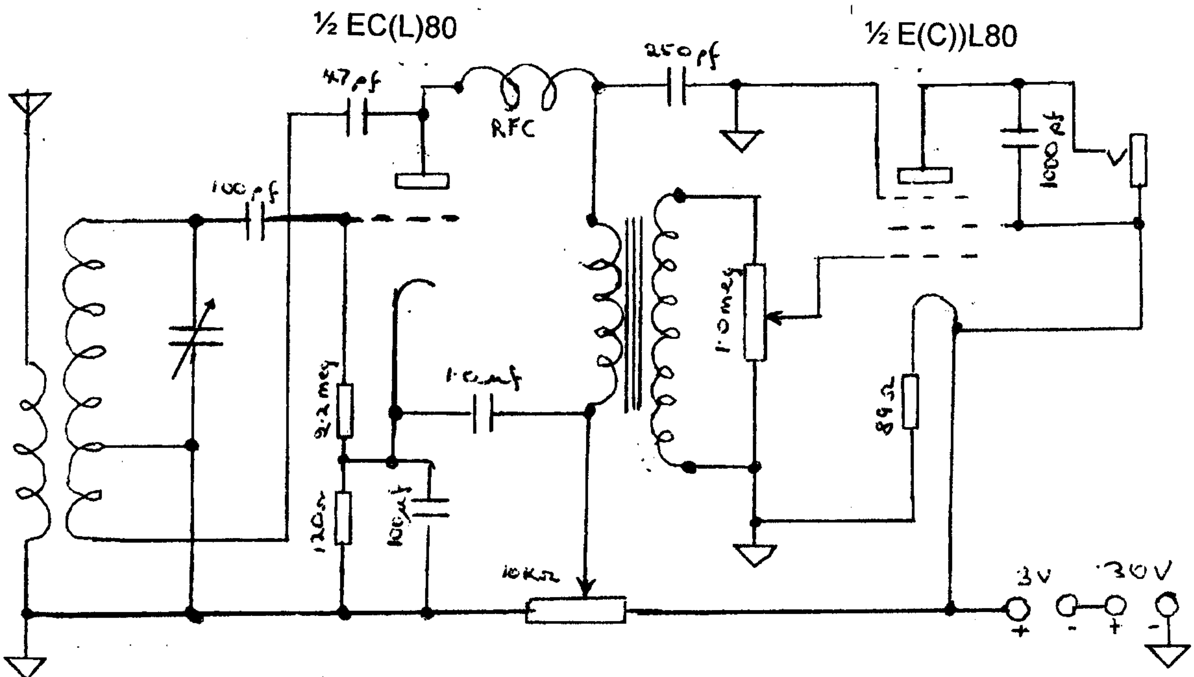
Most triode hexodes would be unsuitable as they have the hexode injection grid tied internally to the triode control grid. One exception is the well known ECH81/6AJ8 and its low H.T. voltage equivalent the ECH83. This was a possibility.

A surprising discovery was that the ECH81 and ECH83 valves I had were in fact identical and all tests, visual as well as electrical, confirmed this. This valve was a possible candidate for options 2 and 3.

It is not possible to make a nine pin based double pentode with separate cathodes, but towards the end of the valve era a few were released with 10 pin bases. By using one half of one of these as a self oscillating (autodyne) mixer feeding a diode and the other half as an audio amplifier it is possible to create a one valve superhet. This could be a very effective receiver so I tested one of these valves, an EFL200. Operating at normal voltages this valve has exceptional performance, but again, at 30 volts H.T. the performance is abysmal. Had it been better, I would have pursued the matter further.

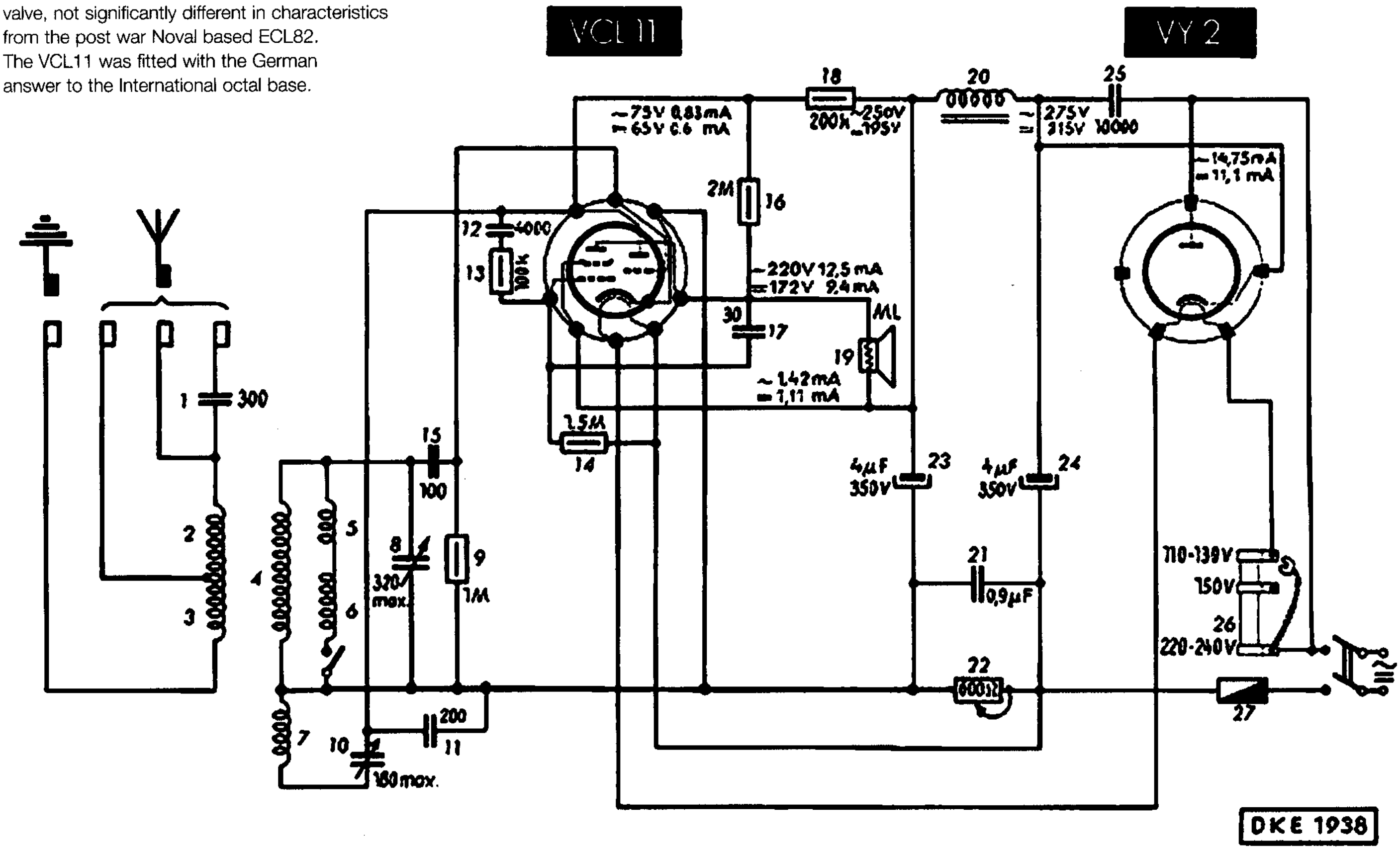
The low mu type double triodes were possibilities, but better still were some audio triode/pentodes in the ECL series. Of these the ECL80 showed the most useful 30 volt performance characteristics. The triode section Gm measured 1.00ma/V at 2.0ma anode current, suitable for a grid leak detector, and its pentode section passed 5.00ma with a Gm of 2.00ma/V – the best of any valve tested. In fact this anode input of 150 milliwatts would be capable of driving an efficient loudspeaker.

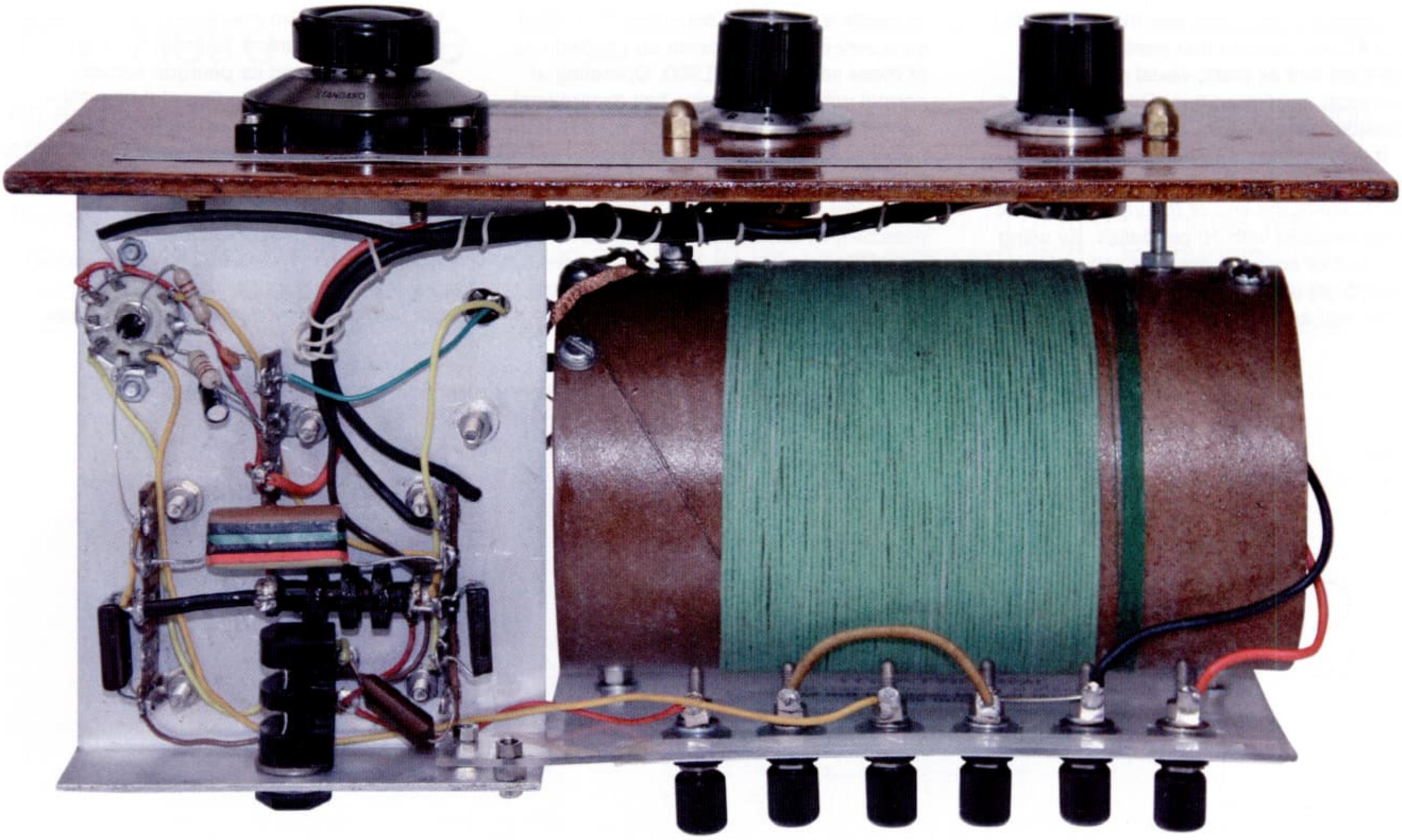
Where did this research lead?
Configuration (1) was well tried and proven. 2 and 3 were possible using a ECH81, but would not develop much audio power.

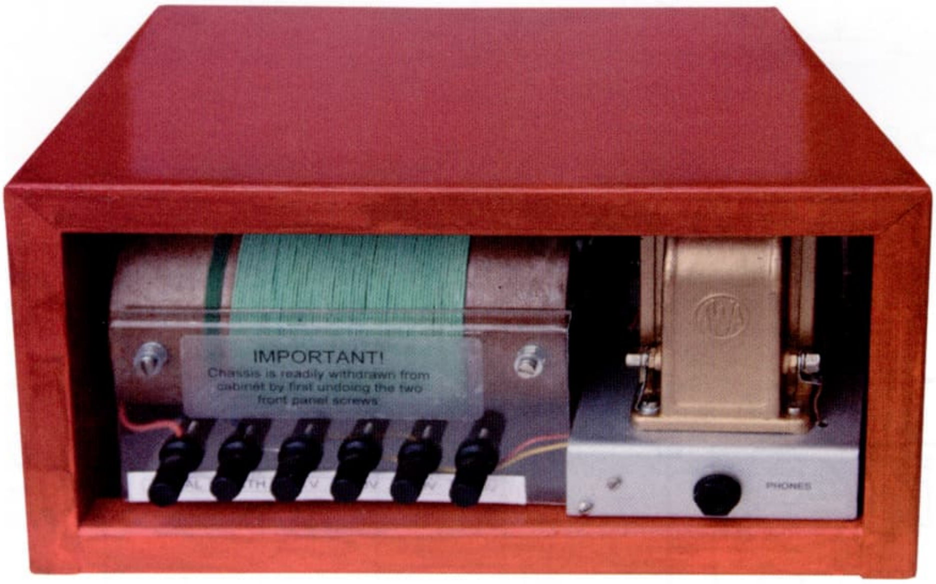


RETRO SINGLE

Below: The DKE38 used a Telefunken VCL11 valve, not significantly different in characteristics from the post war Noval based ECL82. The VCL11 was fitted with the German answer to the International octal base.







Reflexing (4) would have provided an interesting project but they can be complex and tricky to control, And as we have seen, (5), the one valve superhet was not a starter.

Triode Detector plus Pentode Output.
I decided to use an ECL80 valve with the triode as a regenerative grid leak detector and the pentode as an audio amplifier. The grid detector was first used by de Forest in his pioneering vacuum tube a century ago. (He didn't really know how his detector worked!). The great break through came with the addition of positive feedback, or regeneration, an arrangement generally, but not universally, credited to Edwin Armstrong who first announced it around 1915. The regenerative grid leak detector has never been equalled for gain or versatility. It is basically a diode directly coupled to a triode automatically biased by the signal. (The triode's grid doubles as the diode which demodulates the signal and generates the bias). It does have limitations, but they are far outweighed in this case by its performance. The grid leak detector loads the tuned circuit to the detriment of selectivity, but this is largely countered by the use of regeneration. Another problem, shared by some other detectors is that it is square law, a mathematical way of saying that its sensitivity in not linear. Halving of the signal strength results in the audio output being reduced to one quarter. However, by the use of regeneration and high efficiency tuned circuits these problems are minimised. (All this is a simplification of what is a quite complex device. A full analysis occupying several pages is given in depth in textbooks such as Sturley or Terman).

Another advantage of the classic triode grid leak detector is that it works well with a relatively low voltage on the anode and the 30 volts allowed by the competition is fine. This has one proviso. The voltage is that appearing at the anode which means that very little can be lost in the load. If say a typical load resistor of 100 KOhms was to be used, and assuming 1.0ma anode current, the H.T. supply would have to be 130 volts. Obviously resistance coupling was not possible for the competition. The answer is of course, an audio transformer or headphone load with a resistance of 1000 ohms or so. (One reason no doubt why the judges specified 1000 ohm headphones as the test load).

Transformer coupling has the advantage of providing free amplification of 3 or 4 times. I decided to use an AWA audio transformer with a ratio of 3 ½ to 1. which reflects about 100KOhms from the 1.0 meg volume control.

Efficient Tuning Coil

The tuning coil is really the heart of this type of receiver and much depends on its efficiency. An example of a high performance receiver using large coils is the marine SE1420/IP501 described in the Autumn 2010 Bulletin. With its large diameter coils wound with heavy wire its performance has been reported as outstanding.

This would be a good start but first I had to find a suitable coil former. The maximum the cabinet size would permit was a former about 6 inches long and 3 ½ inches in diameter. I was pondering on this when I visited my photo processing store. There on the counter and for the asking was the sturdy Bakelised core from a roll of printer paper that looked ideal. The next, step was to test it for low losses. Twenty seconds in the kitchen microwave oven created very little heat – at broadcast frequencies it would be quite satisfactory. (Some cardboard tubing can catch on fire after a minute or so in a microwave oven, indicating a poor power factor which would affect coil efficiency.) For the main winding, I had some heavy cotton covered multi insulated strand litzendraht wire. The finished winding was moisture proofed with polystyrene varnish, a very low loss cement made by dissolving foam plastic packaging in lacquer thinners.

Many years ago I purchased a calibrated Japanese planetary tuning dial which now I hoped would match up with a small American made tuning capacitor. Accurate dial tracking requires correctly shaped capacitor plates. I was lucky. With a bit of coil pruning and a small trimming capacitor, perfect tracking was achieved.

Coupling to the aerial of a regenerative receiver is quite important. As in many design factors a compromise is necessary as you can't have it both ways. Close coupling of the aerial winding gives greatest gain but at the expense of selectivity. As receiver gain was a judging factor I gave signal transfer priority. Ideally the aerial winding would have switchable taps but this would have meant a fourth control that was not permitted in the rules.

Hartley Oscillator

There are many methods of obtaining regeneration, but all depend on feeding a small amount of the correctly phased signal from the detector's anode back to its grid. I chose a Hartley configuration, one of the earliest oscillators with a feedback winding an extension of the main tuned circuit. One of its virtues is that as the feedback winding is part of the main tuned winding, very little coupling is needed. In my case, with the high efficiency coil, only four turns were required. This contributes to smooth regeneration with little interaction with the tuning. Four turns is only 6% of the total. Smaller coil diameters can require as much as 30%.

Regeneration needs to be controlled and there are again several ways of doing this. An early method was to vary the coupling to the tuning coil with a physically adjustable feedback coil. Another popular way is to couple the feedback winding to the anode via a variable capacitor, but in my case, as available space was restricted, I decided to use a potentiometer control of the detector anode voltage to provide a smooth and effective control
The detected signal is connected to an audio transformer that provides a useful gain of more than three times (about 10db). This in turn is connected to a 1.0meg volume control, not necessary in early receivers, but today essential in preventing overload of the audio stage when receiving modern high powered transmissions. Another function of the control is to provide a resistive load to the transformer. When connected to an inductive load such as an audio transformer, regenerative detectors often develop an annoying continuous squawk at the point of maximum sensitivity. A high value resistor connected across the transformer effectively cures this problem.

Conventional Audio Stage

The output stage design was simply settled. There seemed to be no reason why a standard pentode configuration and values would not scale down for 30 volts H.T. This proved to be the case and connected to an efficient speaker it provides a comfortable listening level from local transmissions.

Power supplies of 30v and 3.0v were provided by the judges. To get as much H.T. as possible, an obvious move was to series connect them to total 33 volts. To light the valve, a dropping resistor of 89 ohms was used to provide the correct current through the heater.
The rules regarding overall size presented a small challenge. For maximum coil efficiency the coil needed to be kept as much as possible apart from any metalwork. This entailed mounting the coil at one end of the cabinet and mounting the other components compactly at the other end. An unexpected bonus is that it is large enough to act as a loop aerial.

How well does the receiver perform? It is sufficiently sensitive and selective to receive without an aerial, and separate without interference, six local stations at speaker volume and the onset of regeneration is so smooth as to be almost imperceptible. It may seem unusual for a one valve receiver to have a volume as well as a regeneration control but it is essential when the Retro Single is connected to a "long wire" external aerial. Without the control, the sensitivity is sufficient for local stations to easily overload the output stage.

A lot of work and detail can go into creating even a simple receiver. Imagine then the time taken in creating a large communications receiver. Little wonder they could cost a lot of money.

Footnote: Whilst I was draughting the circuit of the Retro One, I had a déjà vu moment. I realised that given resistance coupling I had produced a very similar receiver to the last version of the German 1938 Deutscher Kleinempfanger DKE38, (Peoples' Radio). It has been said that there is nothing new...

Murphy day at Mill Green Museum, September 18

Setting up

Poor linearity was cured by putting them on their side!


A58V, 1938

A56V, 1938

V136C

V683XDS V410 V114 V84 V114C

A42V Mirror lid TV 'Murphy's first', 1937

The Murphy 'Astra'

Reproduction Ekco Dials by Robert Darwent

Several Ekco models, most notably the A22 model, use large circular or semi-circular backlit dials. The original dials were screen printed on to celluloid or alternatively what appears to be Perspex and because of their size and shape are difficult to reproduce. Undaunted, I decided to try and make my own reproduction versions. This is an account of my attempts to date.

I mentioned previously in my 'A22 Rebuild'[1] article in The Autumn Bulletin that I was fortunate enough to acquire a mint A22 bakelite case and that I had undertaken serious work on a reproduction chassis for it before later managing to obtain a complete but damaged set. Part of that work was to first make some sort of replacement dial. The dial used on the A22 is such a major part of the overall design, appearance and appeal of the set that without being able to produce a satisfactory replacement there was little point in considering making a reproduction chassis at all.

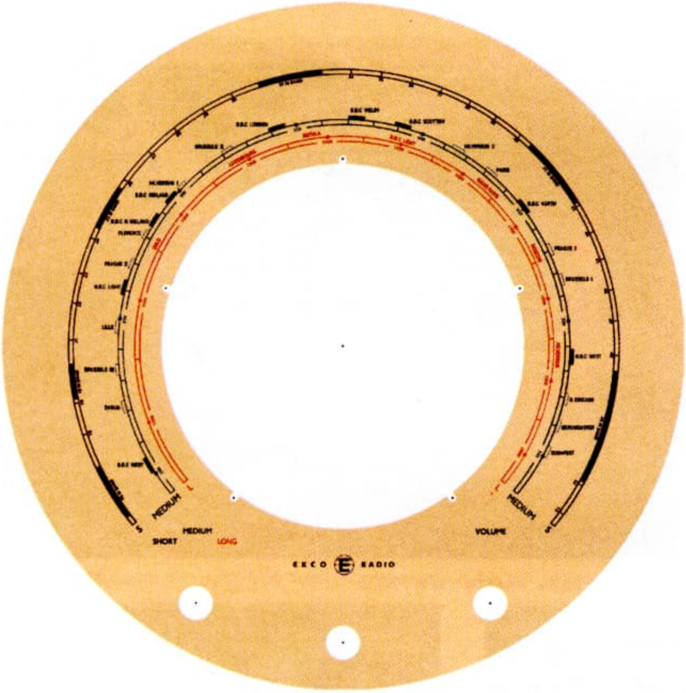
I began by obtaining as many images of the A22 dial from the internet, books and magazines that I could. From my research in this area I quickly realised there were two distinct dials used on the A22;

Type 1

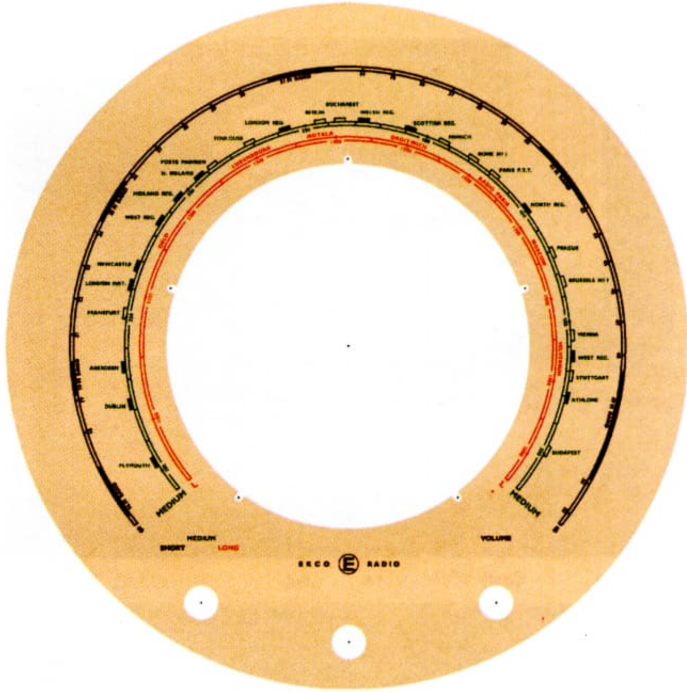
From the station names on the dial, the earlier of the two dials has 'Bucharest' at the twelve o'clock position on the green medium wave legend and 'Droitwich' at the one o'clock position on the red long wave legend.

Type 2

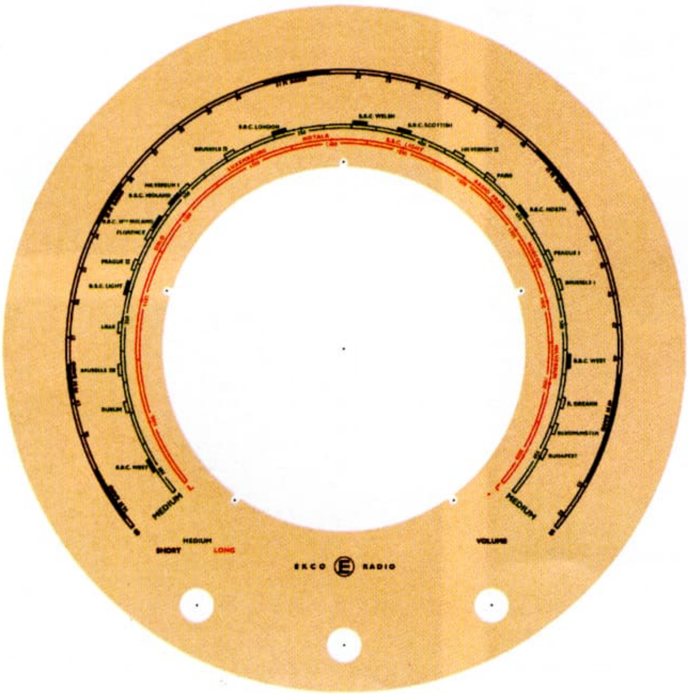
This dial has a reworked green medium wave legend showing the then new BBC



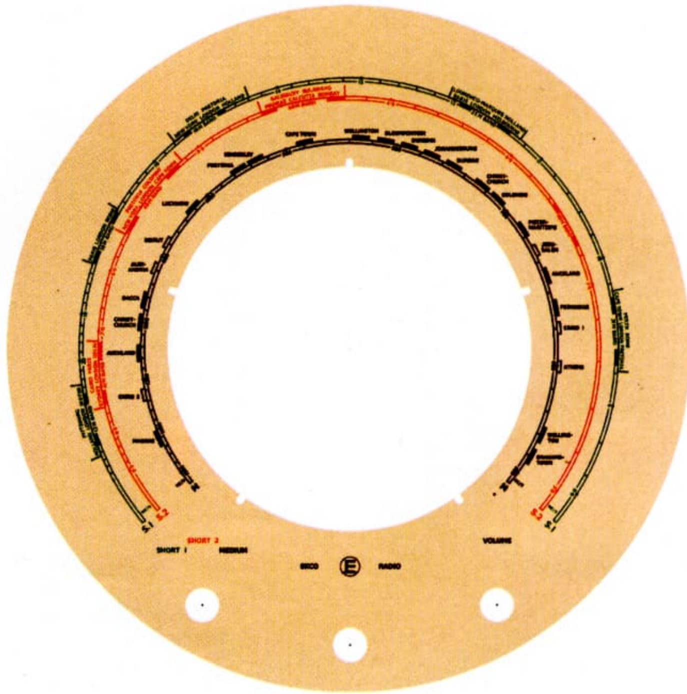
A22 artwork first attempt



A22 Type 1 artwork



A22 Type 2 artwork



A22T export artwork

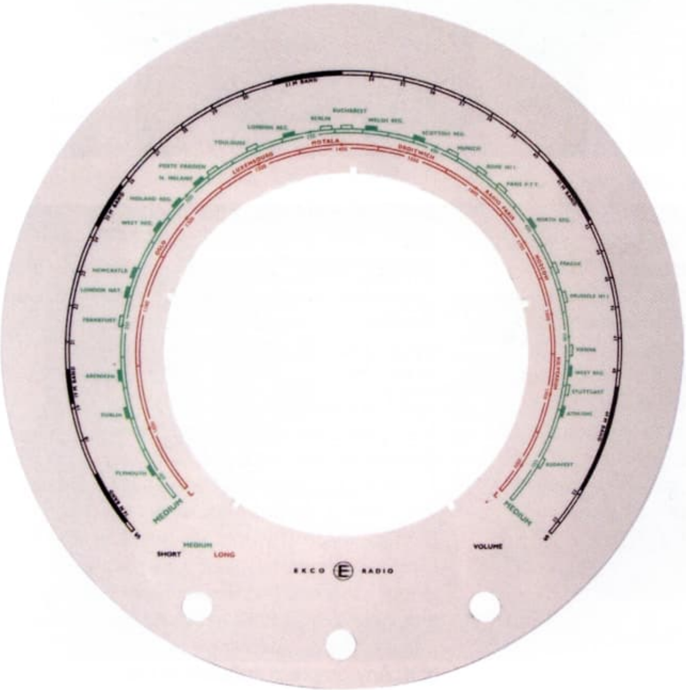
regional services, with 'BBC Light' at the one o'clock position on the red long wave legend instead of 'Droitwich'.

It appears that the colour of the short wave legend on both types of dial can be either black or blue, with the black legend more commonly seen. There are also, apparently original, dials in circulation which use much thinner legends and font. So far I have only seen images of this kind of dial, but my initial efforts were in fact based on images of this type as they were the best I had to work with at the time. A further variation can be seen between the dials used in the black/chrome and brown/bronze versions of the A22. The background of the dial in the black/chrome set is much 'whiter' than the corresponding dial used in the brown/bronze model.

I also came across tantalising references to a third type of A22 dial used on the rare export version of the set, the A22T. This model has two short wave ranges and medium wave instead of short, medium and long used on the domestic sets. More on this particular dial later.

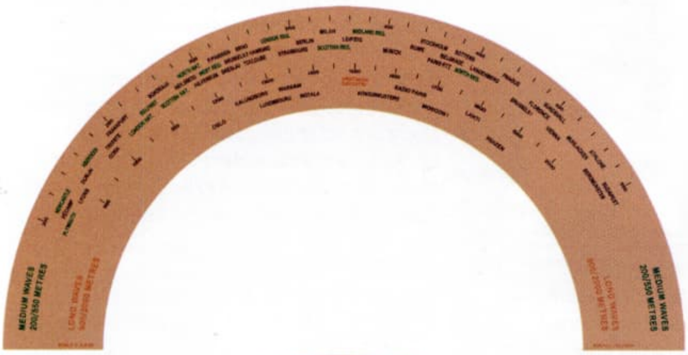
I now had all I needed to make a start at my computer using suitable graphics software. Despite not having an original dial to work with I could still take accurate measurements from the bakelite case of the diameter of the visible area of the dial and by taking further measurements from appropriate dial images I could place the dial legends and details fairly accurately. I achieved this by noting the X,Y co-ordinates using my graphics software of all the major detail, such as frequency markers, station name positions, and so on. From this co-ordinate information and knowing the co-ordinates of the exact centre of the dial I could calculate using trigonometry the angular position of all the dial details to transfer to my reproduction. After several evenings' work I had completed my first attempt. Considering it was achieved only by using visual estimates taken from images I was more than happy with how it turned out.

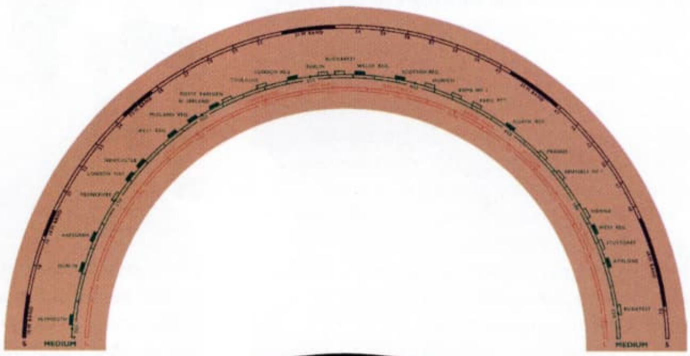
A few months later I obtained the complete A22 which was the subject of my earlier article which gave me an original (Type-2) dial to work with. Several months later again I managed to acquire a second complete A22 set which had the alternate 'Bucharest' (Type-1) dial fitted as well. These original dials enabled me to return to my artwork again in order to produce versions that followed the originals more faithfully and with greater accuracy. I initially scanned the two dials and turned the resulting images into master references. This ensured that all the dial detail was very accurately located in the reproduction version.

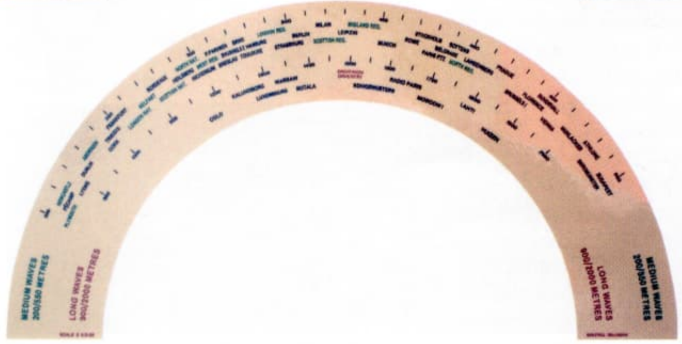


A22 Type 1 reproduction dial. Below: AD65 artwork

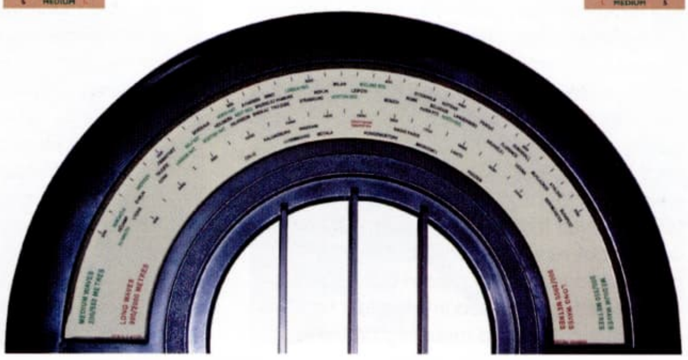
A22 Type 1 reproduction fitted. Below: Hybrid artwork



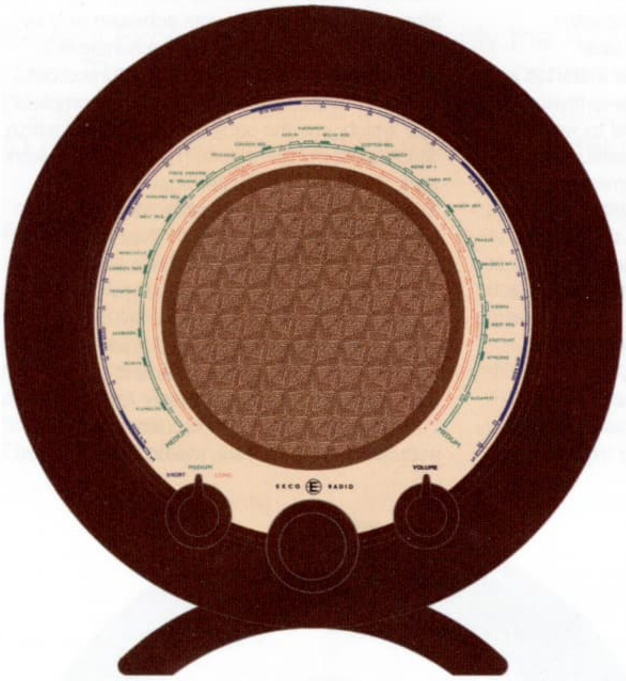




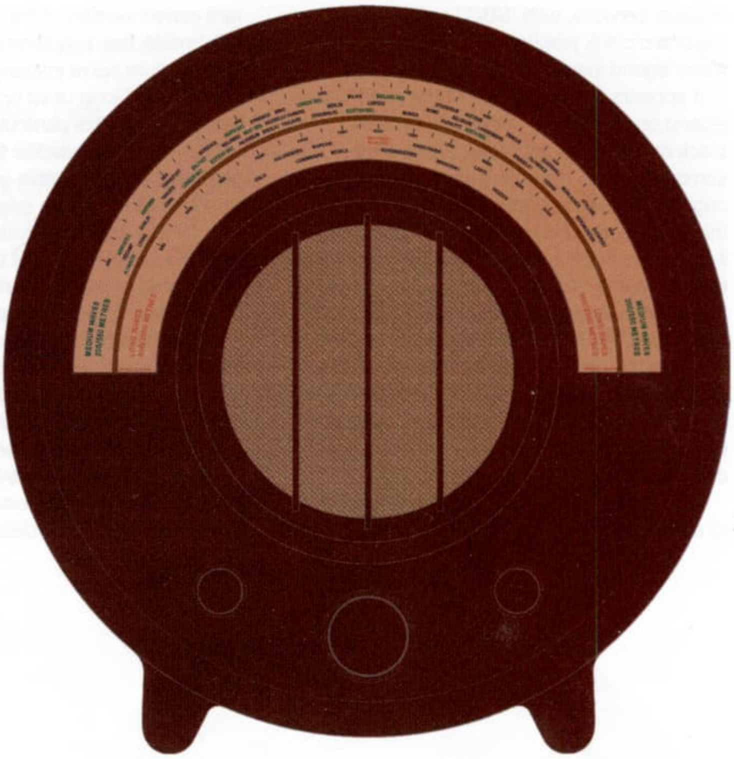
AD65 reproduction dial



AD65 reproduction fitted



Virtual A22



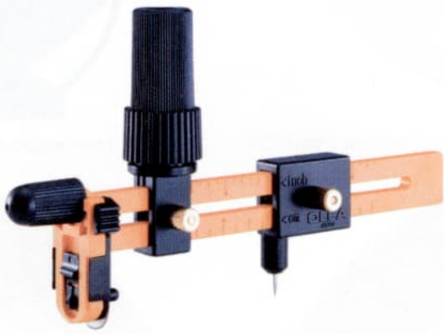
Virtual AD65

The graphics software I use is quite antiquated compared to modern programs and lacks the useful 'layers' function. However by assigning a single colour of the palette to each legend, obviously red to long wave, green to medium wave and so on, I was able to simulate this missing function. In fact this was how the original dials were screen printed, using just three or four legend colours and the background colour.

At this point the particular colour shades used was not important. When the artwork was complete the legend colours and background could be varied independently of each other to achieve the correct colour match to those used in an original dial. Towards this end I created virtual graphic images of the A22 and AD65 sets into which I could test fit the artworks. Why bother you may ask? Well, due to the way the eye perceives colour, the background colour in particular of a dial artwork can look too dark until it is viewed against the bakelite of the case into which it is to be fitted when surprisingly it often then looks too light! So having virtual bakelite cases to assist in this way greatly sped up the colour matching process.

Having accurate artworks is one thing, how to produce actual physical dials from them is another. As mentioned previously the original dials were screen printed on to Perspex or similar. Getting a professional company to do this for me using my artworks was an option but probably expensive. Instead, and since I own an A3 sized photo quality inkjet printer which is large enough to print out an A22 dial, I decided to experiment. Printing out at 600dpi resolution on to good quality silk finish photo inkjet paper produced very encouraging results. Backlighting the photo paper with a torch showed that a similar result to a backlit original dial was achievable, but how to protect and mount the printed dial so that it could be fitted and used in an actual set?

I initially considered mounting between two thin sheets of clear Perspex, which would probably have worked, but first I tried laminating the photo paper several times in an A3 hot pouch laminator. I found five or six pouches produced a thickness and rigidity comparable to an original dial, with the surface of the dial having a very similar finish to that of polished Perspex as per the original. All that remained was to carefully cut out the dial. Initial attempts were cut by hand with craft knives, etc which gave acceptable results, but I later obtained a large enough circle cutter which gave a much cleaner cut in a fraction of the time.



Circle cutter

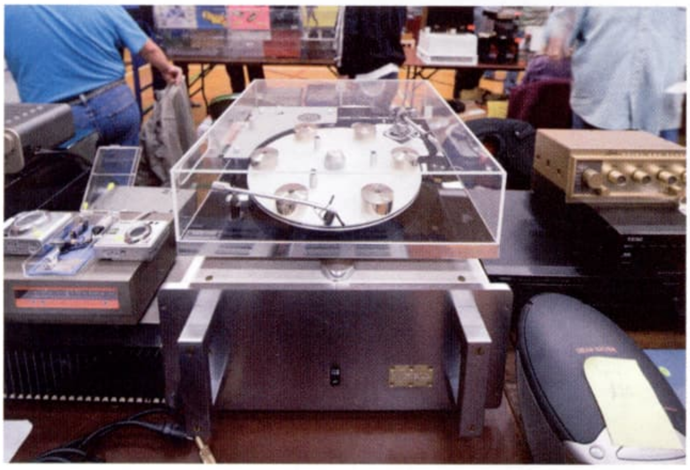
Returning to the export A22 mentioned earlier. After much trawling of the internet I eventually came across websites in Brazil[2] and in Iran that had images of this elusive set, unfortunately too small in size and resolution to be really useful. Later I was fortunate to come across a completed on-line auction listing of another example of this export set showing several close-up images of the dial. None of the individual images showed a complete dial face, but a collage of all the images gave me the detail and information needed to attempt the reproduction artwork. Employing the same techniques outlined earlier I took co-ordinates and produced angular information of all the detail enabling me to create the accurate export dial artwork shown here.

I have since, using exactly the same techniques, successfully produced a reproduction AD65 dial and for use in a spare AD65 case I have, a custom dial which is a sort of a hybrid of all the detail of a Type 1 A22 dial compressed into the half-circle sized dial of the AD65.

I have purposely not been specific about the graphics software package I used to produce these artworks. As mentioned, it is rather antiquated and consequently no longer available. I continue to use it simply because I am experienced with its operation and it is still capable of producing what I ask of it. Any graphics software is only a very useful tool and the exact software employed is not that important as being experienced and familiar with its operation. To that end I recommend anyone interested to begin learning with a currently available package and to persevere with your chosen software. There are no short-cuts here I'm afraid, proficiency is only gained with time, effort and a lot of trial and error. But I hope you will agree that the results can be well worth it.

References
(1) BVWS Bulletin - Vol.36 No.3 Autumn 2011
(2) http://www.radioantigo.com.br/ekco.html

Audiojumble October 9 2011 photographed by Carl Glover




REVOX








The EF91 – *not* the Valve that Won the War

by Stef Niewiadomski

That honour of course probably goes to the EF50 (and its various service codes) for its role in allied radio and radar equipment during World War II. The EF91 was an unromantic 'workhorse' valve made by the million and designed into umpteen TVs, radios, transmitters, pieces of industrial equipment and test gear. Like the EF50, it has a story worth telling.

Figure 1: An 'identity parade' line up of EF91s and several of its aliases, including the CV138 and CV4014 service equivalents.

Figure 2: The 'classic' pose of the Mullard EF91, showing the bluish colour band around the anode structure of the valve.

Just after the war there was a need for a compact, high frequency pentode for use in the RF and IF stages of the new TVs being designed to benefit from the resumption of public TV broadcasting in June 1946. For lower production costs and compactness the all-glass B7G 'miniature' envelope (17mm in diameter and 46mm tall, excluding the pins), released in the US in 1941 and first used in the 9001/2/3 series of valves designed for use at UHF, was the natural choice. The resulting valve, which we commonly refer to now as the 'EF91' (see later for a discussion of whether this was the first incarnation) was produced and consumed in vast numbers, helping to satisfy the demand for TVs in the late 1940s and early 1950s. In correspondence with Philip Taylor, he believes valves using the B7G envelope were probably first manufactured in the UK by Mazda in about 1943, presumably using machinery shipped over from the US.

The Humble EF91 and its Aliases

So far I have referred to the valve as the 'EF91', which is certainly the generic name by which the valve and its many equivalents are known today in the UK. In the US the valve is commonly known as the '6AM6'. From this distance in time it's not clear whether it was the EF91 itself or one of the valves that we regard as being its 'clones' which appeared first: it may well be that the 8D3, the 6F12, or even the Z77 or 6AM6, was the first 'EF91' to reach production.

It's tricky to pin down the exact date of introduction for the EF91 and its equivalents, but judging from the first production dates there were several TVs using the 6F12 and Z77, it must have been sometime prior to 1946 that the valve first appeared in prototype volumes and was being tested in newly-designed equipment. It was probably the Murphy V114 TV that has the honour of being the first commercial set that used Mazda 6F12s (as RF amplifier, sound and vision IF amplifiers, and video amplifier, see: www.murphy-radio.co.uk/murphybilia/cats/V114_2.jpg) September 1946. The V114 is often considered to be the first new TV designed in the UK after the war. By 1950 the EF91 was well established, and there were many of them in the Bush TV22 and TV24 sets.

The EF91 was designed as a high gain, high impedance, screened pentode, and became the universal valve of the late 1940s and the 1950s, as can be seen by the large number of manufacturers who made direct equivalents. Mullard described the EF91 as a 'Miniature RF pentode primarily intended for use as RF and IF amplifiers, or mixer valves in television receivers'. In fact it could be used from AF to VHF up to about 200 MHz, and because of its versatility and low cost, quickly found itself designed in large numbers into most types of electronic equipment, especially into TV sets of course, its original intended application.

In TRF and superhet radios it was used for RF and IF amplification, for oscillators, frequency changers and multipliers, detectors and audio amplifiers. The famous Racal RA-17 receiver, numerous pieces of professional test gear, some Eddystone receivers, and of course many TV sets designed from about 1947 onwards used the valve. The Swiss Radiomuseum at: www.radiomuseum.org/, run by Ernst Erb (HB9RXQ, EA8BGN), is a useful way of searching for the use of a particular valve (or transistor) in radios or TVs.

The Many Equivalents

In Europe you are likely to find EF91s (and equivalents) manufactured by GEC, Osram, Mullard, Marconi, Cossor, Brimar, Mazda, STC, Chelmer, to name just a few. Consequently the EF91 has many aliases, including the Z77 (Marconi); 6AM6 (Brimar and many US manufacturers); 6F12 (Mazda); 8D3 (Brimar, until they recoded the valve as a 6AM6); 6064 (Brimar special quality version of the EF91); M8083 (Mullard special quality version of the EF91); and 5A/189K (STC). If that's not enough for you there are also the 5A/160K, 6024, HP6 and V888 which are also candidates for EF91 equivalents, but about which no firm information has been tracked down so far.

There are several 'service' versions of the EF91, including the CV138, the rather strange CV2001 (see more about this valve later), CV2195, CV4014, CV5377, CV10327 and maybe a few other CV numbers.

Identity Parade Line up

Figure 1 shows an 'identity parade' line up of EF91s and several of its aliases, including some service equivalents. When you're looking for an EF91 for a project, any of these valves should do the job, and often valves are marked with more than one number: for example I've seen Mullard valves marked EF91 and 6AM6. I particularly like the bluish colour of the glass around the anodes in the Mullard valve – see Figure 2 for the 'classic' pose of the Mullard EF91. The reason for this bluish colour is interesting and was discussed recently on the UK Vintage Radio Repair and Restoration forum.

Inside the EF91 (and many similar valves) the anode runs round only part of the cathode/grid structure, and so a significant number of electrons pass through the grids and the gaps in the anode, and into the glass envelope. It was found that this gradually caused gas to be released from the glass, and over the extended lifetime of high reliability valves required by, for example the GPO, it was sufficient to impair the efficiency of the valve and to shorten its life. Therefore, the centre part of the glass envelope was coated (by vacuum deposition) with a chemical. This kept the electrons from the glass and thus reduced the gas released, and thus lengthened the working life. The actual colour of the coating varied with the temperature of the firing, and has no significance.

Some manufacturers of 'EF91s' use a different technique to protect the glass from these stray electrons. For example, I've seen some M-OV CV138s with what appears to be a metallised internal coating.

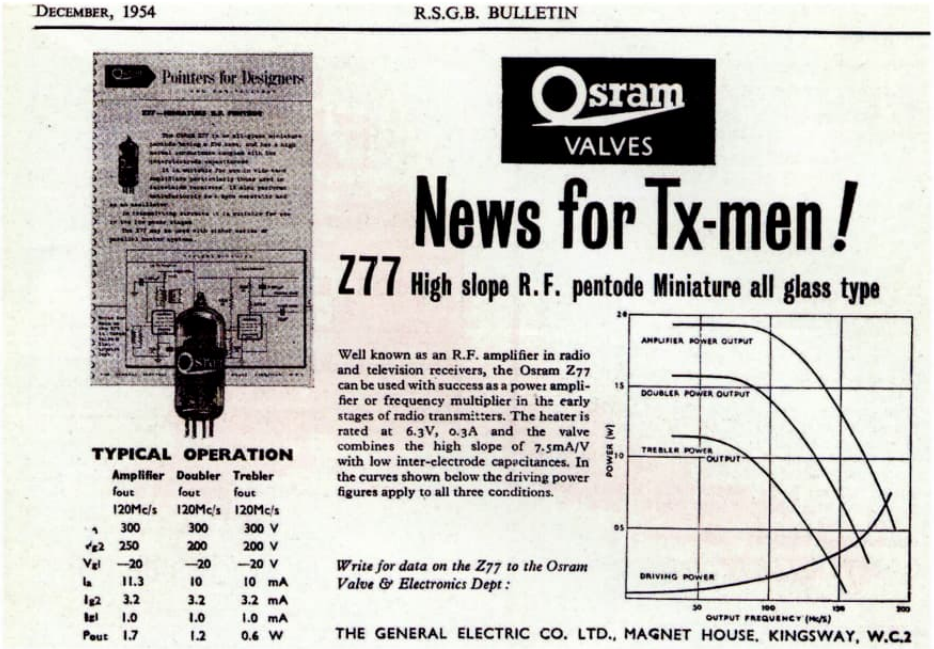


Figure 3

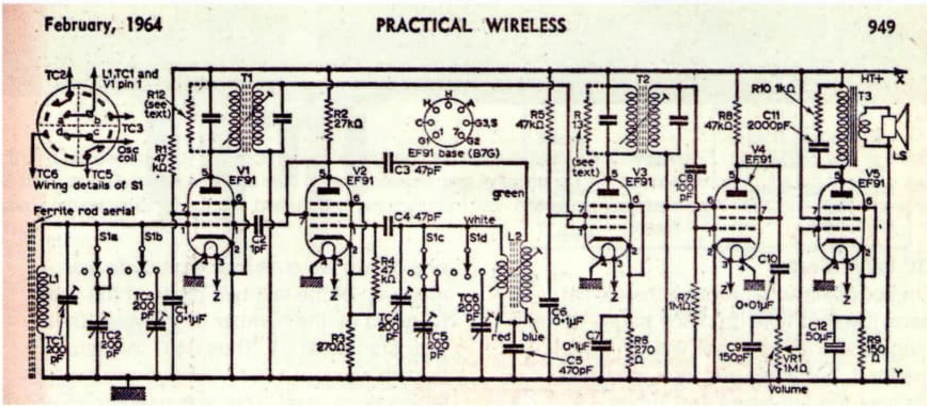
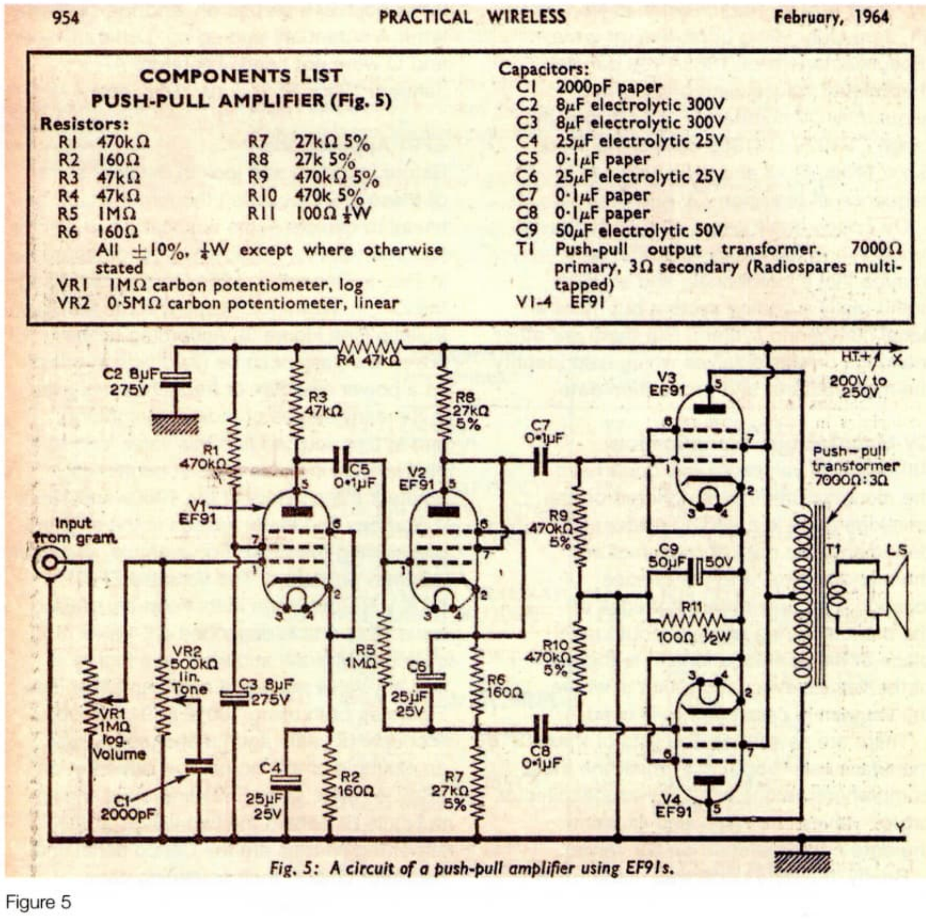


Figure 4: Schematic of the EF91 radio in PW February 1964.


954 PRACTICAL WIRELESS February, 1964

COMPONENTS LIST
PUSH-PULL AMPLIFIER (Fig. 5)

Resistors:
R1 470kΩ
R2 160Ω
R3 47kΩ
R4 47kΩ
R5 1MΩ
R6 160Ω
R7 27kΩ 5%
R8 27k 5%
R9 470kΩ 5%
R10 470k 5%
R11 100Ω ½W
All ±10%, ¼W except where otherwise stated
VR1 1MΩ carbon potentiometer, log
VR2 0·5MΩ carbon potentiometer, linear

Capacitors:
C1 2000pF paper
C2 8μF electrolytic 300V
C3 8μF electrolytic 300V
C4 25μF electrolytic 25V
C5 0·1μF paper
C6 25μF electrolytic 25V
C7 0·1μF paper
C8 0·1μF paper
C9 50μF electrolytic 50V
T1 Push-pull output transformer. 7000Ω primary, 3Ω secondary (Radiospares multi-tapped)
V1-4 EF91

Fig. 5: A circuit of a push-pull amplifier using EF91s.

Figure 5

Figure 3: The December 1954 RSGB Bulletin advert for the Osram Z77. As you can see Osram was the valve-making division of GEC.

Figure 4: The 5-valve switched station MW/LW superhet from the February 1964 issue of Practical Wireless in K V R Bowerman's 'The Versatile EF91' article. As shown the circuit only covers the medium wave: modifications were shown of how to obtain long wave coverage.

Figure 5: The 4-valve push-pull audio amplifier, using all EF91s of course, also published in the February 1964 issue of Practical Wireless. This looks like a very useful bench amplifier to have around today.

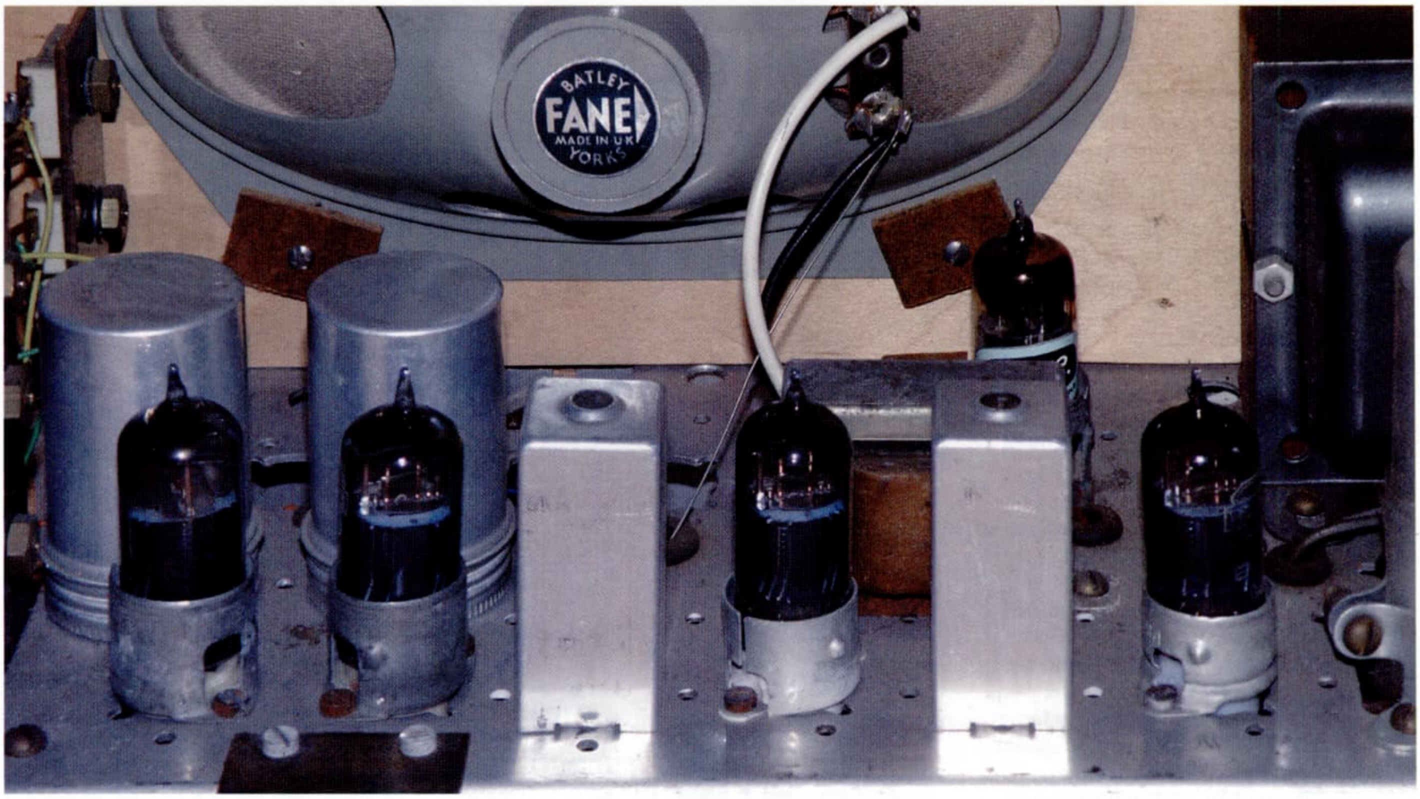


Figure 6: The EF91-based 5-valve switched MW/LW superhet I bought on eBay. Hopefully you can see the blue tint of the Mullard EF91s used. Behind the two valves at the left of the chassis are the Denco aerial and oscillator coils in their screening cans. See also the Fane elliptical loudspeaker: after disappearing between 1989 and 2007 Fane was resurrected and now manufactures in Wakefield, not too far away from the original location in Batley, Yorks.

CV Valve Codes
I'm not going to reproduce the CV list here, it would take up many pages of the magazine and the editor wouldn't thank me for it, but when you look at such a list (see 'Radio Valves and Tubes – 3 Military 'Common Valve' (CV) Equivalents' by Geoff Arnold. Radio Bygones No 11, June/July 1991, or on-line at: www.tubecollector.org/cv/1963/) you can see that related valves were often given sequential CV numbers. For example, the range CV1929-CV1958 covers the 6Hxx, 6Jxx, 6Kxx, 6Lxx and 6Nxx variants in sequence of their non-CV numbers.

CV codes don't give a clue as to the function and 'civvy' identity of a valve (maybe that's intentional), and as such aren't really a coding system but more a serial numbering system. But there are other markings on these valves which help identify the manufacturer and production date.

CV Manufacturer Identification
Although CV valves usually don't have the manufacturer's name printed on the envelope there is a coding system that documents the date of manufacture, the manufacturer, and the precise location. Because different stages of the manufacturing process could take place at different locations, it is the site of the valve's evacuation, that is where the vacuum is created, that is used.

There are several on-line lists of these manufacturers' code, but I think the most comprehensive one is at: www.tubecollector.org/cv-valves.htm. This also explains the date coding system on CV valves.

Briefly, the date code was made up in one of two ways. A four digit code was made up of the last two digits of the year followed by the number of the week in the year starting at 01. Thus 6407 indicated the 7th week of 1964. Alternatively two letters were used. This was used up to January 1st 1965. In this scheme the first letter A = 1945 and so on, and the second letter A = January and so on. Letters I and O were not used. Therefore AA = January 1945, NF = June 1957, etc.

EF91 Applications
Before I plod on and look in detail at some of these EF91 variants I thought it would be useful to explore some applications the valve has been put to, outside its intended career in TVs. In December 1954 Osram advertised the Z77 in 'News for Tx-men' in the RSGB Bulletin (see Figure 3). According to the advert the valve 'can be used with success as a power amplifier or frequency multiplier in the early stages of radio transmitters', and in fact you can find this valve (and its equivalents) in these roles in numerous amateur transmitters of the 1950s and 1960s.

You can find many articles in the amateur press using the EF91. For example, Practical Wireless published 'The Versatile EF91' by K V R Bowerman in its February 1964 issue. This article described a 5-valve switched MW/LW superhet (see Figure 4) and a 4-valve push-pull audio amplifier (see Figure 5), both using 100% EF91 line-ups. A couple of years ago I managed to buy an example of this home-built superhet on eBay. A photo of its EF91 line-up is shown in Figure 6. Behind the two valves at the left of the chassis are the Denco aerial and oscillator coils in their screening cans.

The cheapest I could see the EF91 being sold for in this 1964 issue of Practical Wireless was 2/9d: the cover price of the magazine that month was 2/-, so hopefully you can get a feel for how expensive or cheap the valve really was. Interestingly the cheapest valve in this issue was the EF50, at 1/6d, so if you could stand to use 'old technology' the EF50 was definitely a bargain!

Another all-EF91 project was 'A TRF Communications Receiver' by R H Wright in the September/October 1959 issue of Practical Wireless, as was 'A Simple 3-Valver' by T M Bush in the December 1962 issue. In Practical Wireless for July 1961 'An Amateur Communications Receiver' by P Hayes was published, which used EF91s for the RF amplifier, mixer and oscillator stages, and the three IF amplifiers.

The British Valve Association
The number of identical valves to the EF91 (and many other valves of course) is partly because of the existence of the British Valve Association (BVA), established in 1926 and which continued into the 1950s. This was (http://en.wikipedia.org/wiki/Vacuum_tube) valve manufacturers in the UK that was (supposedly) chartered to protect the interests of the UK valve industry from foreign competition. This organisation dictated (amongst other things), the price of valves; how and where they were to be sold and what discounts could be applied; and of course how they were numbered, though as we know many manufacturers used their own historical numbering systems. US types, such as the 6AM6, manufactured in the UK by companies

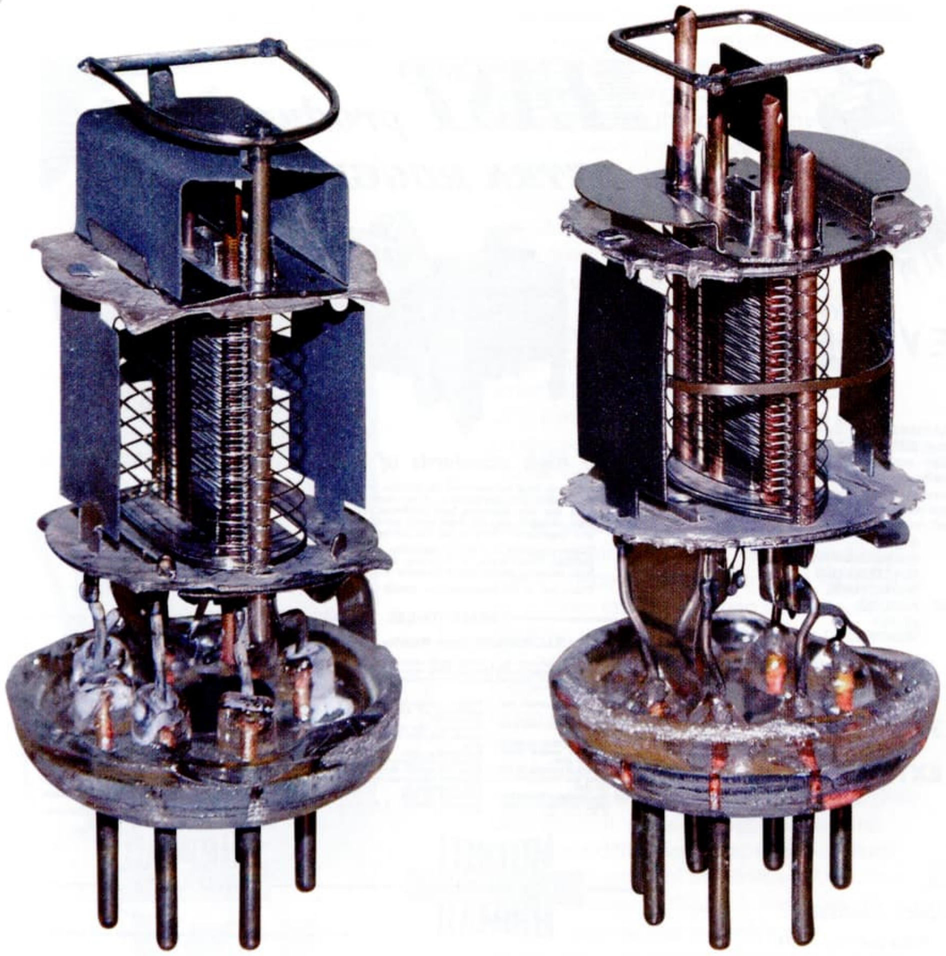
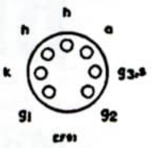


Figure 7

Mullard

			EF91
Vh	6·3	V	High slope r.f. pentode.
Ih	300	mA	
Va	250	V	
Vg2	250	V	
Vg3	0	V	
Rk	160	Ω	
Ia	10	mA	
Ig2	2·6	mA	
gm	7·6	mA/V	
μg1–g2	70		



B7G

Ediswan

EF91

R.F. Pentode - 6·3V, 0·3A Heater

Typical Operating Conditions

$V_{a(b)}$	250V
V_{g2}	250V
V_{g1}	−2V
I_a	10mA
I_{g2}	2·5mA

Characteristics

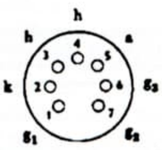
g_m	7·5mA/V
r_a	1050kΩ

Rating

$V_{a(max)}$	250V
$P_{a(max)}$	2·5W
$V_{g2(max)}$	250V
$P_{g2(max)}$	800mW

Base

B7G



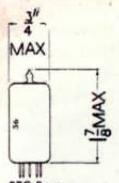
Viewed from free end of pins

Price & Purchase Tax

List Price 15/-
Purchase Tax . . . 4/11
Total 19/11

Figure 8

6AM6



Current Equipment Type

TYPE **6AM6**
(Previously Coded 8D3)
MINIATURE
HIGH SLOPE
R.F. PENTODE

The BRIMAR type 6AM6 is an indirectly heated high slope pentode of the "all glass" construction, fitted with a miniature type base. It is particularly suitable for use in wide band amplifiers and television receivers, where it may be employed in the R.F., I.F. or V.F. stages. In conjunction with a suitable oscillator the 6AM6 will function satisfactorily as a frequency changer at frequencies up to 100 Mc/s.

RATINGS

Heater Voltage ...	6.3 volts
Heater Current ...	0.3 amp.
Anode Voltage ...	300 volts max.
Anode Dissipation ...	2.5 watts max.
Screen (g_2) Voltage ...	300 volts max.
Screen Dissipation ...	0.8 watts max.
Heater to Cathode potential ...	150 volts max.

OPERATING CHARACTERISTICS
[Suppressor Grid (g_3) connected to Cathode]

Anode Voltage ...	200	250	volts
Anode Current ...	9.0	10.0	mA
Screen Voltage ...	200	250	volts
Screen Current ...	2.25	2.6	mA
Control Grid (g_1) Voltage ...	−1.5	−2.0	volts
Cathode Bias Resistor ...	135	160	ohms
Anode Impedance (Approx.) ...	0.8	1.0	meg.
Mutual Conductance ...	7.5	7.5	mA/V
Input Resistance at 45 Mc/s. ...	7,000	8,200	ohms
Control Grid Voltage ... (For Cathode Current cut-off)	−4.5	−5.5	volts
Working Input Capacity ...	10.4	10.1	pF
Change in Input Capacity ... (g_1 biased to cut-off)	2.3	2.0	pF
Inner Amplification Factor ($\mu_{g1 \cdot g2}$) ...	70	70	

INTER-ELECTRODE CAPACITANCES *

Input ...	7.5 pF
Output ...	3.2 pF
Control Grid to Anode ...	0.01 pF

** With close fitting shield connected to Cathode.*
Type 6AM6 is a commercial equivalent of the CV138

VALVES PAGE 49

Figure 9

Figure 7: An MWT Z77 and a Mullard EF91 side by side, with their glass envelopes removed. You can see that they are not mechanically identical, but were electrically close enough to be called equivalents. The anode consists of the two vertical plates which are strapped together 'round the back'.

Figure 8: The brief specs of Ediswan and Mullard EF91s, showing that the transconductance (gm) parameter is slightly different, but close enough to make no significant difference in most applications.

Figure 9: Specification of the Brimar 6AM6, from the 1952 Brimar valve manual. Note that the sheet indicates that the valve was 'previously coded 8D3', so it looks like the re-branding away from the 8D3 code was complete by this date.

Figure 10: A section of the 1947 RSGB Service Valve Equivalents booklet, priced at 9d at the time. As you can see the CV138 was stated to be equivalent to the STC 8D3 and the Mazda V888 (which actually appeared as the 6F12), but there is no mention of the EF91 at this date.

CV Desig-nation	Commercial Descriptions	CV Desig-nation	Commercial Descriptions
5	GU21 (MOV)	87	KRN2 (EMI)
6	DET20 (MOV)	88	S28A, 3A/148J (STC)
9	AL60 (Mul.)	118	SP61 (Maz.)
16	S25A, 3A/145J (STC)	124	807 (USA), 5B/250A (STC)
18	DET19 (MOV), 4074A (STC), RK34 (USA)	127	S30A, 3B/401J (STC)
20	V1906 (Maz.)	131	9D6 (STC)
24	HL41 (MOV)	133	6C4 (USA)
25	4242A (STC), 242 (USA)	136	7D9 (STC)
26	813 (USA), 5C/100A (STC)	138	8D3 (STC), V888 (Maz.)
31	U20 (MOV), FW4–500 (Mul.)	140	6AL5 (USA)
32	866A (USA), 2V/400A (STC)	152	GU21 (MOV), 4049C (STC), RG3–1250 (Mul.)
49	HK54 (USA), 3B/501A (STC)	171	210VPT (Cos.), VS2, W21 (MOV)
53	S26A, 3A/146J (STC)	176	XP1·5 (HIVAC)
65	Pen25 (Maz.)	181	ECC32 (Mul.)
66	RL37 (Mul.)	185	PM202 (Mul.)
82	S27A, 3A/147J (STC)	187	U19 (MOV)
84	4033A, 3B/102B (STC)	190	DLS10 (Edi.)
		200	MZ2–200 (Maz.)

Figure 10

Figure 12

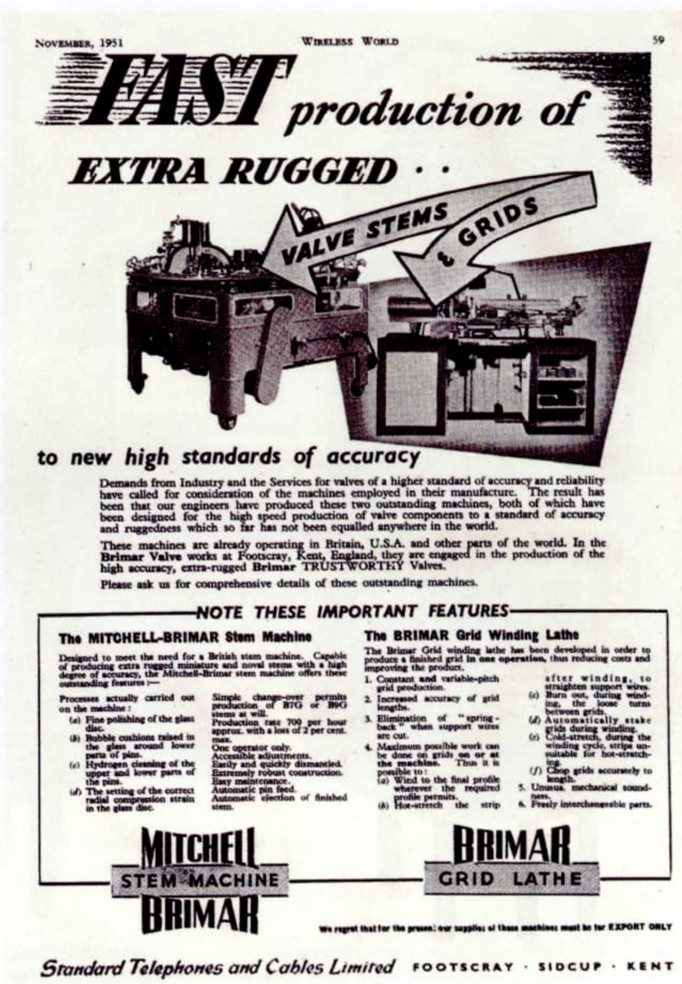


Figure 13

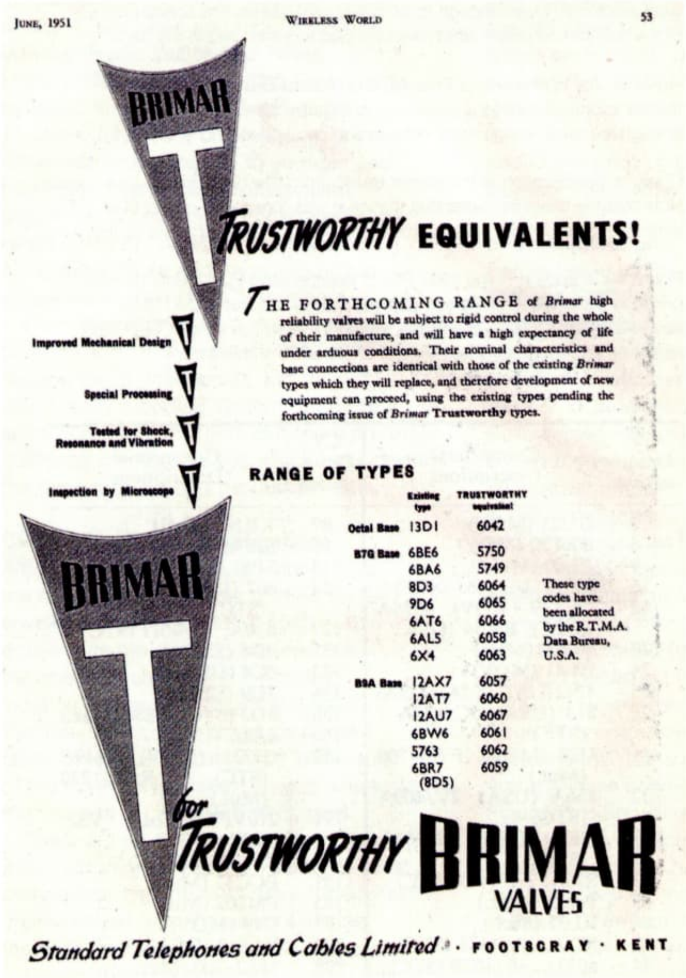


Figure 14

Figure 12: Brimar's advert from Wireless World in August 1953, emphasising the improved quality you got with a Brimar 6AM6/8D3, rather than an EF91, etc, and encouraging readers to 'Brimarize'. Remember that Wireless World was aimed at radio professionals and so the intention was to get radio set designers, or those who specified the components in the sets, to call for Brimar valves. Note the impressive list of set manufacturers claimed to be already using the Brimar 6AM6/8D3.

Figure 13: A Brimar advert from Wireless World in November 1951 featuring stem making and grid winding machines.

Figure 14: Brimar describe the 6064 as a 'Trustworthy' version of the 8D3. Described as 'the forthcoming range of Brimar high reliability valves' it looks like the range of valves hadn't quite hit the streets yet.

Figure 15: The 6064 was definitely a re-design of the 8D3 and Brimar explained the design of the 'Trustworthy' range in Wireless World for March 1952. Here's a diagram from the article showing some of the ways the structure of a valve could be modified to make the valve more reliable. All these modifications weren't necessarily applied to the 6064.

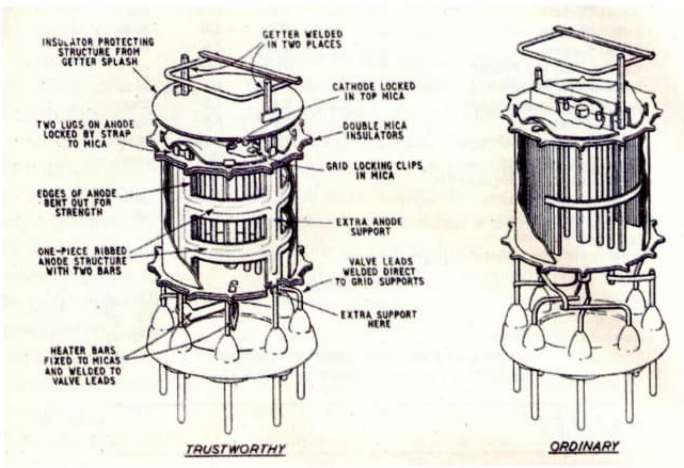


Figure 15

Figure 11: Photo of the CV2001 valve, or more accurately this seems to be the code for the valve-plus-socket assembly.

such as Brimar, sold in the UK at the same price as their UK counterparts because of the BVA's rules, whereas in the US they sold for something like half this price. Of course although this protects the valve manufacturers' profits it can also have a negative effect on equipment manufacturers, but remember that in many cases the valve manufacturers and the radio manufacturers were divisions of the same company. This type of price fixing is generally frowned upon and is unlawful today.

The BVA encouraged the exchange of patents and specification information amongst its members so that second (and third, and fourth, etc) sources were produced for many popular valves. This gave radio manufacturers the confidence that a particular valve wouldn't suddenly disappear, say for example because of a fire at a particular factory. The valves so produced weren't necessarily mechanically identical to each other (as can be seen from Figure 7, showing the internal construction of an MWT Z77 and a Mullard EF91) but were electrically close enough to be called equivalents. How close is 'close enough' is a good question. Figure 8 shows the brief specs of Ediswan and Mullard EF91s, and shows that the transconductance (gm) parameter is slightly different, but 'close enough' to make no significant difference in most applications. The specification of the Brimar 6AM6 (from 1952) is shown in Figure 9: note that the sheet indicates that the valve was 'previously coded 8D3', so it looks like the re-branding away from the 8D3 was complete by this date. It may be that 8D3 was regarded as being an 'old-fashioned' code whereas 6AM6 projected a more modern image.

There is clearly a 'story to be told' about the BVA, beyond the scope of this article. 'The Setmakers' by Keith Geddes and Gordon Bussey, published by BREMA in 1991 contains much useful information about the organisation and how it operated.

All manufactures published their own lists of 'equivalents' between their own valves and those of other manufacturers, including American types, so cross-referencing was relatively easy. Amateur organisations, such as the RSGB, also produced booklets showing the commercial equivalents of CV valves, especially just after the war when surplus CV valves were being released into the amateur market in vast numbers, and were easier to lay your hands on than commercial valves. Figure 10 shows a small section of the 1947 RSGB booklet (see: http://frank.pocnet.net/other/docs/ServiceValveEqu_RSGB_1947.pdf. This document comes up for sale on eBay quite often). As you can see at the time the CV138 was stated to be equivalent to the STC 8D3 and the Mazda V888 (which was probably a development code for the valve that actually appeared as the 6F12), but no mention of the EF91 at this date. It's interesting that the CV138 was available so early in the life of its commercial equivalents: maybe the valve was used in service equipment before its use in commercial radios and TVs?

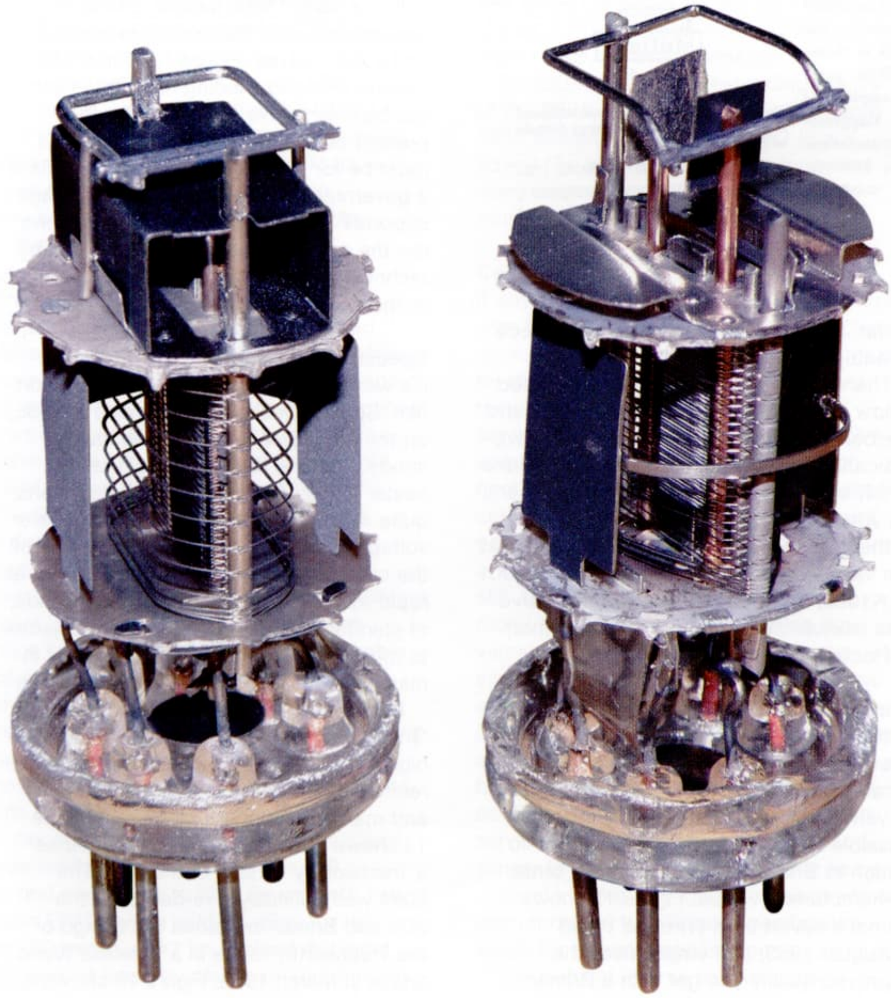


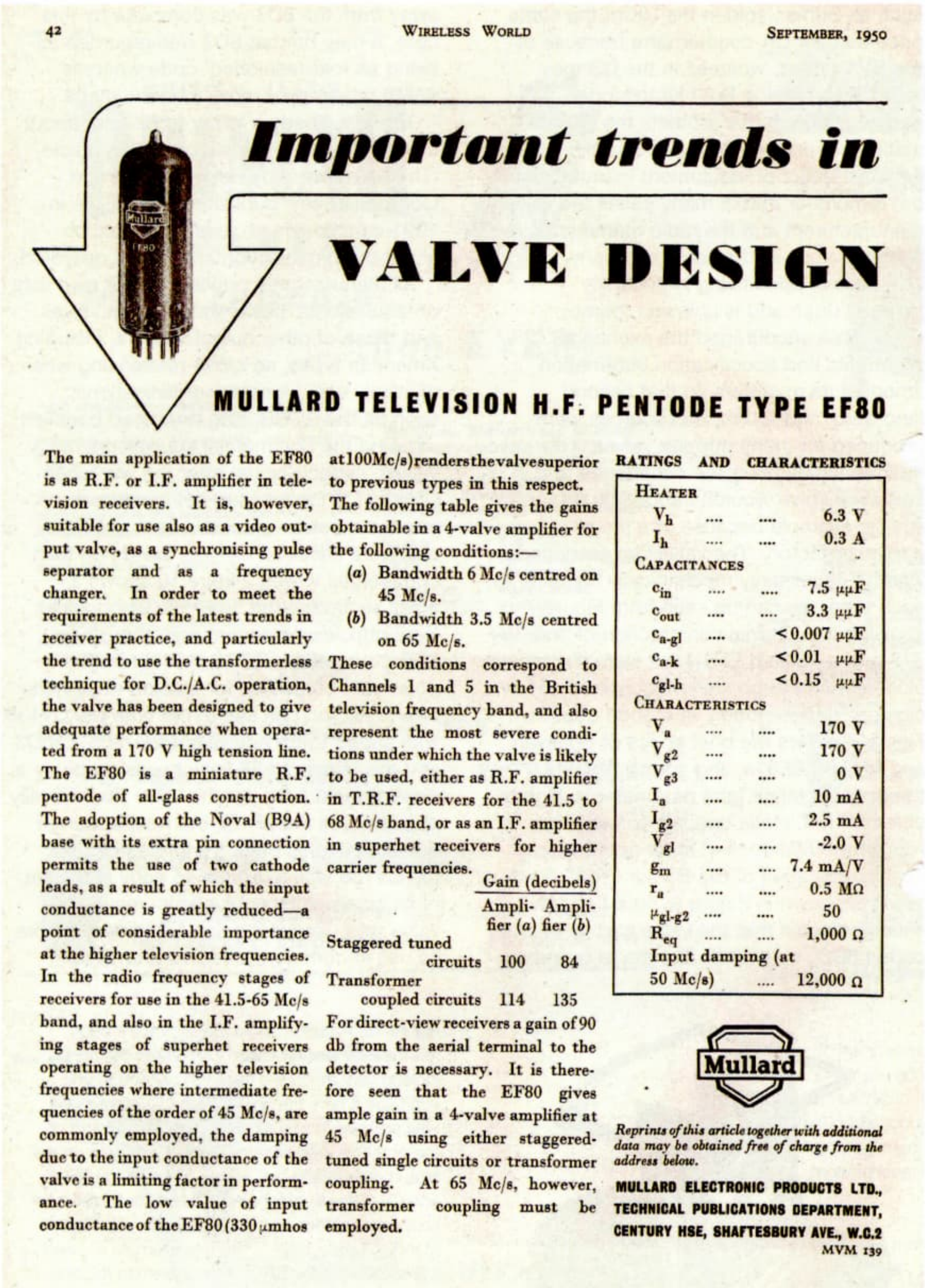
Figure 16

Figure 16: A dual-marked GEC CV4014/6064 (on the left), and a Mullard CV138 (on the right) looking very much like the EF91. Although you can't see it here the anode of the CV4014/6064 was pressed from a single piece of metal and so the potential weakness of the welded joints on the strap between the two anode plates in the EF91 and CV138 was eliminated. The getter is also now supported at four points, rather than two. The manufacturer's code 'Z' for this example showed it was made in the M-OV Hammersmith factory.

Figure 17: A few lines from a page of Mullard's Comprehensive Valve Price List with Mullard Equivalents, Third Edition, issued in November 1952. The list shows the Mullard EF91 being a direct equivalent to the Brimar 6AM6.

6AL5	9/–	EB91
6AM5	13/–	EL91
6AM6	17/6	EF91
6AQ5	13/–	Brimar
6AT6	12/–	Brimar‡

Figure 17


42 Wireless World September, 1950

Important trends in VALVE DESIGN

MULLARD TELEVISION H.F. PENTODE TYPE EF80

The main application of the EF80 is as R.F. or I.F. amplifier in television receivers. It is, however, suitable for use also as a video output valve, as a synchronising pulse separator and as a frequency changer. In order to meet the requirements of the latest trends in receiver practice, and particularly the trend to use the transformerless technique for D.C./A.C. operation, the valve has been designed to give adequate performance when operated from a 170 V high tension line. The EF80 is a miniature R.F. pentode of all-glass construction. The adoption of the Noval (B9A) base with its extra pin connection permits the use of two cathode leads, as a result of which the input conductance is greatly reduced—a point of considerable importance at the higher television frequencies. In the radio frequency stages of receivers for use in the 41.5-65 Mc/s band, and also in the I.F. amplifying stages of superhet receivers operating on the higher television frequencies where intermediate frequencies of the order of 45 Mc/s, are commonly employed, the damping due to the input conductance of the valve is a limiting factor in performance. The low value of input conductance of the EF80 (330 μmhos at 100 Mc/s) renders the valve superior to previous types in this respect. The following table gives the gains obtainable in a 4-valve amplifier for the following conditions:—

(*a*) Bandwidth 6 Mc/s centred on 45 Mc/s.
(*b*) Bandwidth 3.5 Mc/s centred on 65 Mc/s.

These conditions correspond to Channels 1 and 5 in the British television frequency band, and also represent the most severe conditions under which the valve is likely to be used, either as R.F. amplifier in T.R.F. receivers for the 41.5 to 68 Mc/s band, or as an I.F. amplifier in superhet receivers for higher carrier frequencies.

	Gain (decibels) Amplifier (*a*)	Amplifier (*b*)
Staggered tuned circuits	100	84
Transformer coupled circuits	114	135

For direct-view receivers a gain of 90 db from the aerial terminal to the detector is necessary. It is therefore seen that the EF80 gives ample gain in a 4-valve amplifier at 45 Mc/s using either staggered-tuned single circuits or transformer coupling. At 65 Mc/s, however, transformer coupling must be employed.

RATINGS AND CHARACTERISTICS

Heater	
V_h	6.3 V
I_h	0.3 A
Capacitances	
c_{in}	7.5 μμF
c_{out}	3.3 μμF
c_{a-g1}	<0.007 μμF
c_{a-k}	<0.01 μμF
c_{g1-h}	<0.15 μμF
Characteristics	
V_a	170 V
V_{g2}	170 V
V_{g3}	0 V
I_a	10 mA
I_{g2}	2.5 mA
V_{g1}	-2.0 V
g_m	7.4 mA/V
r_a	0.5 MΩ
μ_{g1-g2}	50
R_{eq}	1,000 Ω
Input damping (at 50 Mc/s)	12,000 Ω

Mullard

Reprints of this article together with additional data may be obtained free of charge from the address below.

MULLARD ELECTRONIC PRODUCTS LTD., TECHNICAL PUBLICATIONS DEPARTMENT, CENTURY HSE, SHAFTESBURY AVE., W.C.2
MVM 139

Figure 18

Left: Figure 18: It's only September 1950 and Mullard already regards the EF80 as the valve to design into new TV sets.

Beware of using too much of the information in the booklet: there are several inaccuracies on just this first page. To be fair on the compilers it must have been difficult to obtain relevant and accurate information so soon after the war.

The CV2001

An interesting variant on the EF91 was the CV2001, which has flying leads apparently for soldering directly into equipment. See Figure 11 for a photo of this valve, which I was very lucky to come across at the BVWS meeting in Wootton Bassett about a year ago. If you look closely at the arrangement the valve looks like a 'normal' EF91 (presumably it's actually a CV138 or similar service-spec valve, or even a CV4014), plugged into a socket which has flying leads attached for soldering into equipment. The valve is labelled CV2001, which presumably is the designation of the combination of valve plus socket. It's still a mystery exactly what this valve was used for and I have no 'definite sightings' so far. If you've seen one used in a piece of equipment please let me know.

The valve in the photo has 'VF' printed below the ↑ (up arrow) symbol (just 'round the corner' of the photo and out of view), indicating the date of manufacture of June 1964, so this is well into the transistor era. As you can see, below the CV2001 code is the marking 'KB/AD': 'KB' indicates that the valve was made to specification K1001 or K1006; and 'AD' shows that this valve was manufactured at Thorn-AEI (Brimar) in Rochester.

Brimar and Brimarizing

In the early 1950s Brimar (the valve manufacturing division of STC) launched a campaign to 'Brimarize' the consumers of valves, that is to get as many as possible to design in Brimar valves, or to switch to Brimar if they were using other manufacturers' valves. Figure 12 shows Brimar's advert from Wireless World in August 1953, and emphasises the improved quality you got with a Brimar 6AM6/8D3, rather than with an EF91, etc.

In the 1953 Brimar Radio Valve and Teletube Manual there was a 'Brimarize' section 'written especially for the Service Engineer, to help him to select a satisfactory replacement valve for one that is obsolete or unobtainable'. There is also a section on 'Valve Ratings' with particularly useful recommendations on the voltage that should be applied to filaments (on directly heated valves) and heaters (on indirectly heated valves). It advised that nominally 1.4V filaments could be operated in the range 1.25V-1.4V, and heaters (presumably of nominally 4V, 5V, 6.3V and 12.6V) could be operated at ±7% of the nominal value. This is really useful information, which I've searched for, but have never been able to find, on valve data sheets.

Valve Making

The National Valve Museum at http://r-type.org/static/advert.htm links to a DVD including much valve data, and also films of valve making in Osram in 1930 (complete with a rather French-sounding accordion sound track), and EF80 manufacturing at Mullard's famous Blackburn works. It's also worth searching on YouTube for valve films. It's fascinating how many sub-factories were involved in the process to produce all the bits and pieces, and subassemblies before the valve was assembled and evacuated.

In the early 1950s several Brimar adverts featured some of the machines used to make their valves. Figure 13 shows stem making and grid winding machines. Note the comment: 'We regret that for the present our supplies of these machines must be for export only'. I wonder if this is a government-imposed rule to encourage exports? You would think that in the long run the spread of advanced valve-making technology to the rest of the world would be to the detriment of the UK-based industry.

Special Quality Valves

It's worth looking at Mullard's rather short film 'Special Quality Valves' made in 1956, on the 2010 BVWS DVD, if you have it handy. We tend to think today that the heater is the weak point of any valve, and quite rightly we are careful with the heater voltage we apply. The film shows some of the other breakdown mechanisms, such as rapid mica wear and the fracture of welds, of standard valves when they are subjected to mechanical vibration found typically in many industrial and military environments.

Brimar adopted the rather vague term 'Trustworthy Valves' when referring to their high reliability or ruggedised (as we would refer to them today) versions of the EF91, and many other valves of course. Figure 14 shows how the 6064 is described as a Trustworthy version of the 8D3. The 6064 was definitely a re-design of the 8D3 and Brimar explained the design of the Trustworthy range in a Wireless World article in March 1952. Figure 15 shows a diagram from the article showing the way the structure of a valve could be modified to make the valve more reliable. The article makes it clear that this does not represent any particular valve type but is a general illustration of the technique.

As far as I can tell the CV138 was not the service equivalent of a ruggedised valve, and so I though it worthwhile to open one up and take a look at the structure inside. Since I had a GEC CV4014 I also opened this up and as you can see from Figure 16 this has a modified structure and so I presume it is based on the 6064, rather than the EF91. The Mullard CV138 looks very much like the EF91. This makes me wonder how reliable the CV138 was: can anyone out there comment on whether the CV138 was reliable under military conditions?

Service Valve Reliability

In Wireless World for March 1951 the question 'How Reliable is a Radio Valve?' was posed. The answer was a qualified 'not very', as concluded at a recent IEE meeting. One speaker reported that 'the valve was quite reliable enough for present day entertainment purposes, hardly adequate for serious industrial use, and quite inadequate for aircraft equipment'. C S Cockerell (was this the self-same inventor of the Hovercraft?) had tested a large number of valves, including the CV138, and had found that out of 18,700 samples, 697 had either developed faults during a 50-hour test on stationary racks or had found to be faulty when drawn from stores.

This leads to me to the conclusion that the CV138 was simply the EF91 (or its aliases) procured under a common code, and not tested or selected for robustness. I presume since the CV4014 was the service version of the ruggedised 6064 or the M8083, then it should have been considerably more reliable in service duty. It was used for example in the Murphy B40 naval receiver.

Prices Then and Now

As discussed earlier the BVA regulated valve prices for a long period, and certainly during the 'design in' life of the EF91 and its equivalents. Figure 17 shows a few lines from a page of Mullard's Comprehensive Valve Price List with Mullard Equivalents, Third Edition, issued in November 1952. The list shows the Mullard EF91 being a direct equivalent to the Brimar 6AM6, and the Mullard price is 17/6d, which presumably was also the price of the Brimar valve, in the UK at least. Earlier in the price list a table on purchase tax 'payable on valves and television picture tubes on and after 11th April 1951' was shown. In addition to the 17/6d list price for the valve, purchase tax of 7/7d was payable to the government. According to my calculation this represents a tax rate of 43%!

Because the valve is so ubiquitous and was made in vast numbers it is still easy to find and cheap to buy. Be warned: I've seen EF91s being sold on eBay for up to £20 each - don't be mislead (for most projects at least) by claims of high quality specimens, matched pairs, 'rare' versions with special markings, and so on. This valve is not in the same class as those used in 'classic' Hi-Fi and guitar amplifiers. You'll find it at radio rallies, vintage radio meetings, and on the www, and you should be paying about £1-£2 per tested, boxed valve. You'll always find a few EF91s sloshing around at the bottom of a box of old valves: try these if you wish, but don't pay much more than 50p each for them. I'm sure the TV restorers amongst you will have bucket loads of EF91s.

The EF50 and EF80

Although in theory the EF50's useful design in life probably ended at the end of the war, as late as September 1965 Practical Wireless published 'The Versatile EF50' by J B Wilmot. This article is a very useful reference for valve users, showing the pentode used in various detector configurations (with and without reaction); RF and IF amplifiers; audio pre-amplifier and output stages; and as a phase inverter.

The early 1950s was a time of rapid development in valves even though the basic technology was by now many decades old. The EF91 was probably the valve of choice in TVs for only 3 years or so before Mullard started to 'push' its replacement, the EF80. See Figure 18 for Mullard's September 1950 view on why the EF80 was now the valve to design into new TV sets, thereby implying that the EF91 was obsolete in that application. A set of component parts and sub-assemblies for the EF80 are shown in 'The Making of the EF80' at: www.r-type.org/static/ef80.htm.

Perhaps as a way of extending the life of the EF91, in Wireless World for March 1950 Mullard featured the EF91 in an advert 'An electronic timer for long time delays using the EF91' - rather remote from its original intended application.

Conclusions

If any valve can claim to be 'the valve that won the peace' then I think the EF91, and its many equivalents and derivatives, must be close to the top of the list. Its sheer number of commercial, industrial and service aliases is evidence that the valve was extremely useful, at first as a high frequency amplifier in post-war TV sets and then more generally where a robust general purpose pentode was needed.

Because EF91s and equivalents are still easy and cheap to get hold of I didn't feel too guilty about 'letting the vacuum out' of a few examples in the interests of science to reveal the internal structures. This made it easy to see the differences between various manufacturers' commercial, ruggedised / industrial (or by the rather vague term 'Trustworthy' - as Brimar insisted on calling them), and service versions of what we today tend simply to call the EF91. I think this helps us understand the way in which valves were manufactured to different specification levels for different applications.

The subject led me to briefly cover some aspects of valve manufacturing and reliability. The internet has given us access to films of valve manufacturing and a search on YouTube is always worthwhile. The influence on valve sourcing and pricing of the BVA was briefly covered, and I'm sure there's much more to be investigated into how and why this organisation operated in post-war Britain.

This article was originally published in Radio Bygones Magazine and is reproduced by kind permission of the editor.

Useful References

'Radio Valves and Tubes – 1 Numbering Systems' by Geoff Arnold. Radio Bygones No 9, February / March 1991.

'Radio Valves and Tubes – 2 UK & US Military Equivalents, pre-1944' by Geoff Arnold. Radio Bygones No 10, April / May 1991.

'Radio Valves and Tubes – 4 Further Data' by Geoff Arnold. Radio Bygones No 14, Christmas 1991.

'Valve Coding Systems' by J Alexander. Practical Wireless February 1960.

'Valve Codes ... What do they Mean?' by Alan Guy. Radio Constructor July 1964.

A searchable index of comprehensive valve data can be found at: http://tdsl.duncanamps.com/tubesearch.php

More information on the British Valve Association can be found at: http://en.wikipedia.org/wiki/British_Valve_Association

The National Valve Museum at http://www.r-type.org/static/museum.htm is a valuable source of valve history and data, including many high quality photos of the valves featured.

A searchable list of CV valve codes and a full list of CV valve manufacturers' codes can be found at the Virtual Valve Museum at: www.tubecollector.org/cv-valves.htm

Details of the Brimar factory codes can be found at: http://myweb.tiscali.co.uk/g8hqp/audio/brimarcodes.html#DPK

Mullard/Philips valves carry a code showing type; manufacturer or country of origin; year, month and week of manufacture; and change symbol. A comprehensive explanation of these codes can be found at: http://frank.pocnet.net/other/Philips/PhilipsCodeListAB.pdf

A fascinating history of valves can be found in 70 Years of Radio Tubes and Valves by John W Stokes. Published by The Vestal Press Ltd, New York in 1982.

Radio Valve and Transistor Data by A M Ball is a useful short-form of valve data. Various editions, published by Iliffe.

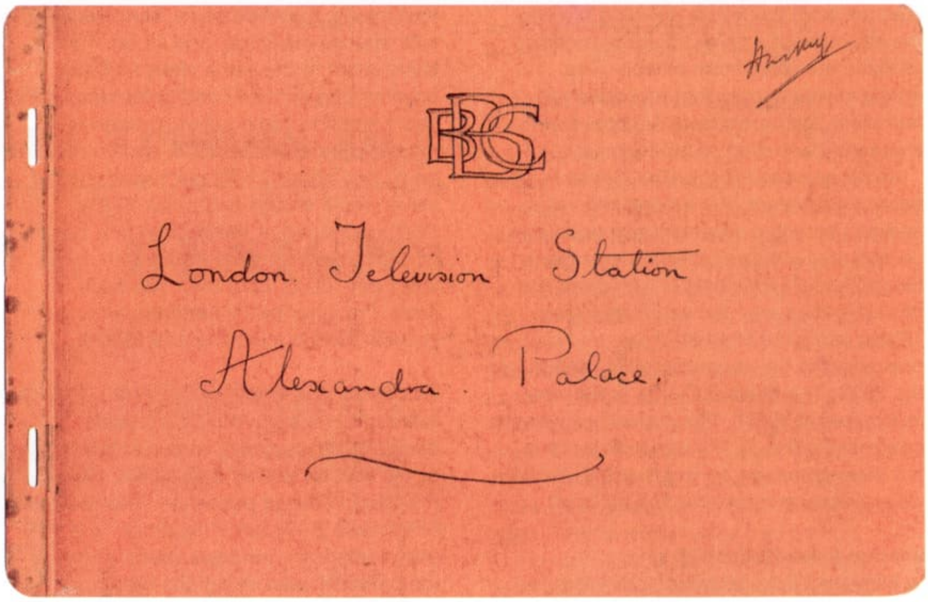
All valve period ARRL Handbooks had a useful valve reference data section at the back.

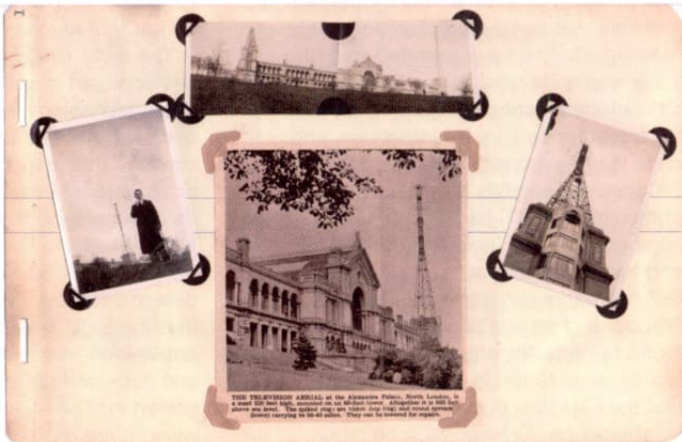
There are many editions of the Mullard Technical Handbook around which contain useful valve data.

Photographic memories of Alexandra Palace

A selection of pictures taken in the earliest years of Television from Alexandra Palace. Photographer not yet identified.

The BVWS wishes to thank the owner for the kind loan of the album so that we could reproduce the images for everyone to enjoy.





DESERTED AT LUNCH-TIME, the studio can now be seen with its remarkable collection of apparatus. The powerful array of lamps consumes up to 60 kilowatts when strong lighting is wanted. Note the snake-like coils of armoured cable conveying the light impulses to the control room. There are two studios at the Alexandra Palace.

1938

Producer's glass-partitioned control room above the studio. The vision-sound notice on the wall lights up when the studio is "alive."

10

Variety show in Studio B
acrobats in action.
1937

Crooner Les Allen
with accompanist
1937.

A Play in Studio A
showing Camera positions
1937

Miss Elizabeth Cowell.
with Geraldo & his Orchestra. May 15th 1936

The Box of tricks.

14

Radio — lympia 1938

J. Judd. G. Pain. E. Langley. Sutton. P. Campbell. Macnamara. C. Wilkins. H. Rigg. H. Sampson

C. Maddon. Elizabeth Cowell. D.H. Munro. M. Allen. H. Pringle

16

Radiolympia 1938

"Cabaret Cruise."

Watch me Baker at Rain.

17

Radio lympia 1938

The "Laifouns" Chinese jugglers

18

the man at the wheel

Radiolympia 1938

Full Cast.


Pat
Kilpatrick
&
Alex Moore
"Dancing Lessons"
to announcers
Leslie Mitchel
&
Elizabeth
Cowell.
1939.


1938.


The North London traders
Exhibition

Carolyn Marsh
in television party
25/12/36

A. Croxton Smith
from the Craft
Dog show
shows one of
the prize
winners

1937

The singing
box of tricks

1937

Queenie
Leonard
singing in
Queue for
Song

1938


Grid Leak at the Show
DAILY SKETCH
RADIO AT A GLANCE
RADIOLYMPIA, FRIDAY, SEPTEMBER 3, 1937
RADIOLYMPIA FEATURED IN PICTURES
Burndepts provide the foreign newspapers.
View of Main Hall at Radiolympia.
The Radio Queen examines the R.G.D. King of Radio.
The Wireless Set of 1912.
Two well-known beauties examining the 120-guinea H.M.V. television set.
The Radio Queen, from painting by Pisani, presented to R.M.A. by Daily Sketch.
PISANI
G.E.C. television Set at £35 to attach to the ordinary radio.
A Novel Feature
Burndept stand is an "All-world" centre; news comes through on teleprinters and all the leading newspapers of the world are on hand.


Next Move in Television and Radio?
Grid Leak Tells You in the Daily Sketch
DAILY SKETCH
Get the Sense of Things by reading Candidus
IN THE THEATRE.—A brilliant stage setting.
The famous E.M.I. Emitron Camera used for Television.
The valve sensation —Hivac-Harries all-stage valve.
The Radio Queen tries out the high spot of Radiolympia. This is the set which uses only one type of valve.— Gambrell, Ltd.
A new Power L.S. which can be heard distinctly five miles away, made by Tannoy, Ltd.
The Celestion super loudspeaker as used for extension to other rooms.
Printed by John Waddington Ltd., 108, Albion Road, N.16, and published by the Daily Sketch and Sunday Graphic, Ltd., 200, Gray's Inn Road, London, W.C.1.


THE "DAILY SKETCH" FREE INSURANCE SCHEME COVERS THE WHOLE FAMILY
RADIOLYMPIA
August 25 - September 4
Organised by the Radio Manufacturers' Association
GRID LEAK AS YOUR ALL-ROUND GUIDE
FOR sixteen years Wireless Exhibitions of a national character have been held in unbroken sequence in the Metropolis of the Empire.
PISANI'S Radio Caricatures
EVER READY RADIO, LTD.
PHILIPS RADIO, LTD.
VARLEY, LTD.
PILOT RADIO, LTD.
COSSOR, LTD.
DECCA GRAMOPHONE CO., LTD.
BUILDER OF BELMONT
YOUR ORDERS
ORDERS
DYMATRON A CLASSIC MASTERPIECE
ALBA SEEING YOU


WIRELESS PROGRAMMES APPEAR IN THIS FORM EVERY DAY IN TH E "DAILY SKETCH"
DANCE BANDS
American and British: Al Roth, Al Collins
NAT., 7.30; REGS., 8.0
Wireless To-day
AT HOME AND ABROAD
'PROM.'
Heddle Nash (tenor), Ida Haendel (violin)
NATIONAL, 8.0
200 Kc. NATIONAL 1,500 M.
877 Kc. LONDON 342 M.
668 Kc. NORTHERN 449 M.
1,013 Kc. MIDLAND 296 M.
767 Kc. SCOTTISH 391 M.
PICK OF THE CONTINENTAL PROGRAMMES
OPERA:
RECITALS:
CHORAL:
MILITARY BAND:
LIGHT MUSIC:
ORCHESTRAL CONCERTS:
VARIETY:
SYMPHONY CONCERT:
BOURNEMOUTH and PLYMOUTH (203 M.)
NEWCASTLE (267 M.)
WESTERN (285 M.)
WELSH (373 M.)
ABERDEEN (267 M.)
BELFAST (307 M.)
DUBLIN (531 M.)
TOO GOOD A TURN TO BE 'BURIED'
It Takes Us Out of Ourselves
Good morning, everybody!
This is GRID LEAK calling.
TELEVISION
Mullard
IN THE RADIOLYMPIA THEATRE: 3.0, 6.0 and 8.0 p.m.
Paula Green; Rupert Hazell and Elsie Day; Mamie Souter; Three Heroes; Forsythe, Seamon and Farrell; Royal Master Singers; Dagenham Girl Pipers; Payne and Hilliard; Navarre; Leonard Henry; Louis Levy and Orchestra; Sutherland Felce; Donald Thorne and Harry Farmer; Bobby Howell and Orchestra.
LONGER TELEVISION PROGRAMME
In order not to disappoint the enormous crowds which will visit Radiolympia to-morrow, the B.B.C. has decided to extend the transmissions on that day.
Before this week these four people had never heard radio before; they were presented with sets. Three of them were paying their first visit to London.
Cossor 45-guinea television table set.

Attaché Radios by Mark Johnson Book reviewed by Carl Glover

One of the 'hardy perennials' of the car boot sale, the attaché portable is the type of set which is often overlooked due to its ubiquity. Luckily for us, Mark Johnson took notice and went beyond the call of duty by putting together a book which lists almost every attaché radio manufactured in the UK.

The book fills eighty action packed pages with professionally photographed portable sets, plus contemporary advertising, Mark Johnson displays the unique looks of the attaché portable presented in a graphic style sympathetic with the subject .

Because it is the type of radio which doesn't reveal its personality until the lid is lifted is probably one of the reasons why this type of set is not as popular as its mains powered peers. Consequently Mark shows the sets with the lid raised, revealing a staggering variety of colours, finishes, dial, knob and speaker configurations which one only becomes aware of when confronted by a book such as this.

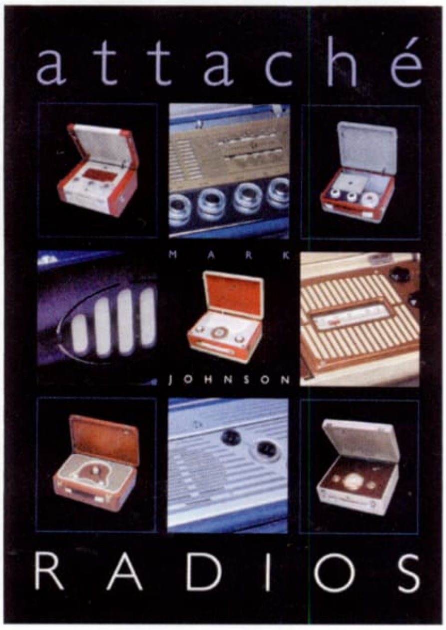
Most of the sets featured have an almost unexplainable 'Britishness' too them, like you would expect in something such as a Car manufactured by Bristol, or post-war furnishings and fabrics. American-derived styling seems curiously absent, maybe because the attaché portable was almost exclusive to these shores, where for twelve years it experienced healthy sales until the transistor set changed the world forever.

The beginning of the book gives a brief history of the attaché phenomenon before launching into the individual sets themselves, which are listed by manufacturer, ranging from Alba all the way to Vidor. Batteries, power supplies and promotional material relevant to the sets and manufacturers are also covered.

A nice touch are references to appropriate service sheets for those who want to repair sets of their own. The last page of the book lists equivalent valve and battery types which would be of use to restorers who need replacement parts.

As we move further away from the post–war years, attaché sets become more unique, rather like how early transistor radios have become in the last decade. *Attaché Radios* is a very useful guide for the collector who wishes to add something a little bit different to their collection, for those who don't collect, this book does a worthy job of showing us the colourful relics of post–war Britain.

Mark Johnson has done a commendable job with *Attaché Radios* and is to be commended. I heartily recommend this book!

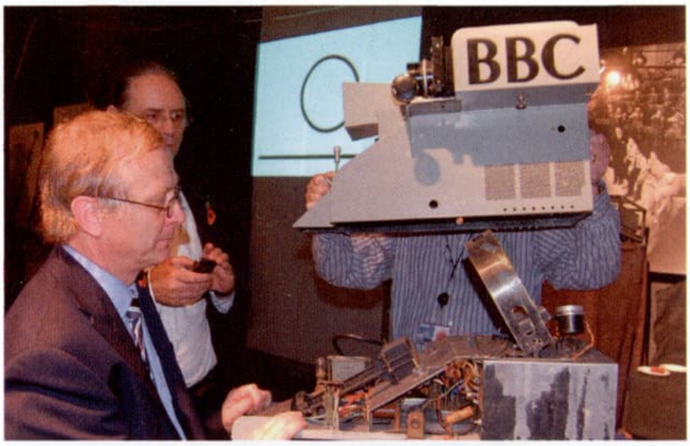


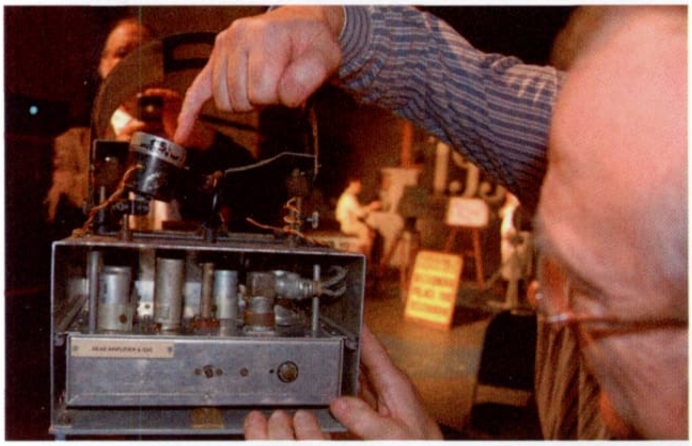
BVWS Books, ISBN 0-9547043-2-0
£12.00 (+ £2.50 p&p UK) £3.50
EEC (rest of world £5.50)
(see advertisement on page 72 for details)

Lifting the lid off television

Dicky Howett reports:

On Wedneday 2nd. November 2011, BBC Television celebrated 75 years of 'High Definition' broadcasts with a modest gathering at Alexandra Palace. Cake and wine were on offer as well as an opportunity to meet various 'AP' tv personalities (amongst whom Zena Skinner and Michael Aspel) and also to prise the top off an original Emitron camera. Attendee Paul Marshall (exhibiting his functioning Image Iconoscope camera) discovered that although the EMI's Ike-type picture tube was missing, all the (surprisingly small amount) of head electronics were intact.

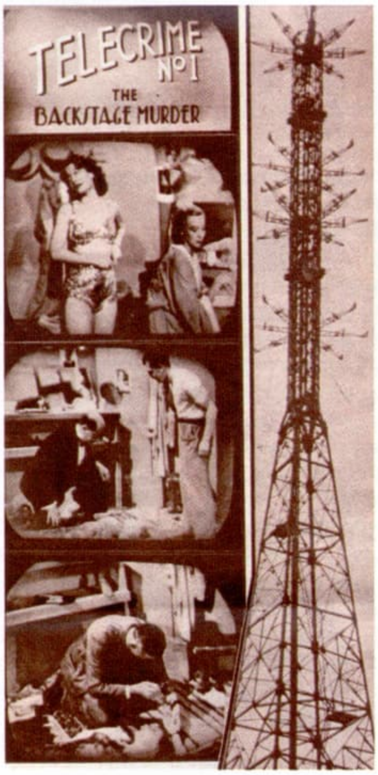


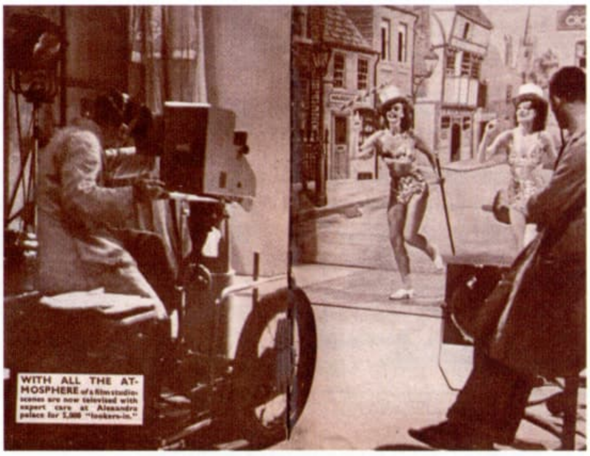


All Seeing Eye

Dicky Howett scans a pre-war magazine.

Billed as a 'Radio and Television number' the August 27th 1938 edition of 'Weekly Illustrated' featured glimpses of pre-war BBC television, now 75 years of age. So what did those '5 thousand lookers-in' get to see? Well, a back stage murder for starters, screened live from the studios at Alexandra Palace and plenty of scantily-clad young ladies for seconds. Billed as a 'Telecrime' devised by Eric Crozier of Weekly Illustrated, the drama involved the viewers by dishing clues as the show proceeded. The viewers then had to guess 'who dun it'. Of the quality of the drama, one has to wonder, but the photos taken from the screen (and re-printed in a magazine) show a remarkable pictorial quality. On a good day these 405 line monochrome images, shot with Emitron cameras with reverse angle and upside down viewfinders, must have been truly remarkable.

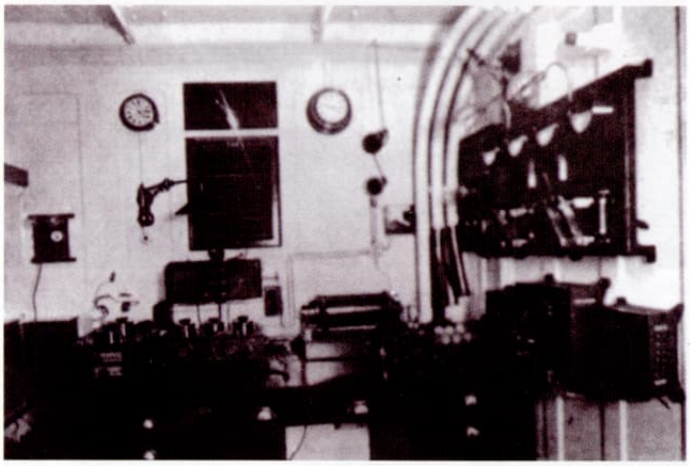




Wireless aboard *Titanic* by Ralph Barrett

The radio of *Titanic* was the most powerful state–of–the–art equipment of any vessel at sea, only equalled by that of *Olympic*.

A 1 1/2kw transmitter was the Marconi standard on ships of that period. For *Titanic* and *Olympic* the transmitter was made more powerful by installing a larger motor–alternator, viz.5kw. It should be remembered that amplification at the receiver was not possible. Additionally the fixed spark gap of the transmitter was replaced by a rotary device. There is no evidence that the emergency transmitter was used during the disaster, since the motor alternator would turn all the time Titanic's lights were on.



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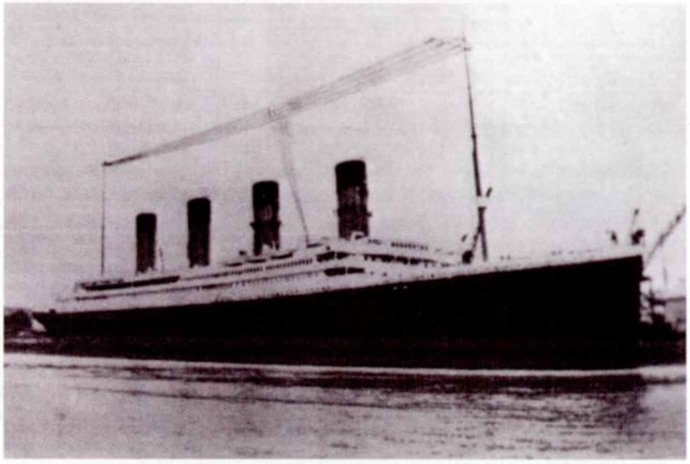

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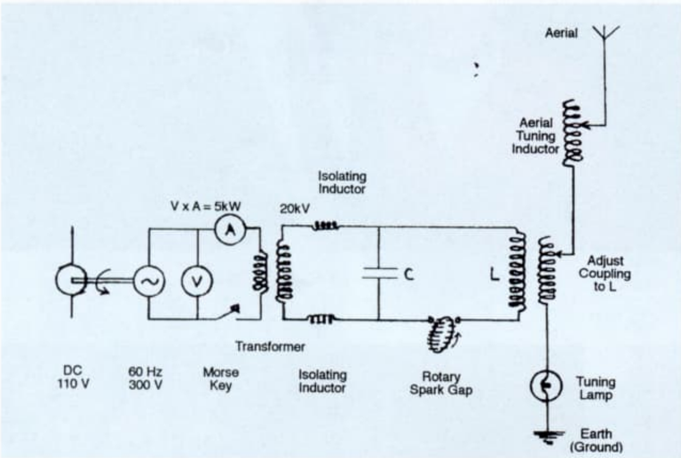

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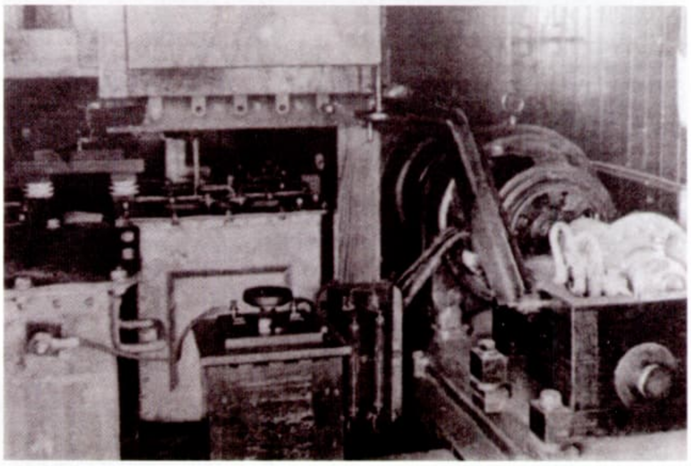

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The motor–alternator, with output of 300 volts at 60Hz, was driven from the ship's lighting supply, 110 volts direct current, which had a steam generator and an oil engine as reserve,with a battery of accumulators as a standby.

The picture of *Olympic*'s radio room shows the placement of apparatus, similar to the *Titanic*. The pneumatic tubes would convey 'Marconigrams' (radiotelegrams) from the radio or purser's office, upon the payment of a fee.

The guaranteed working range of the equipment was 250 miles under any atmospheric conditions. Actually communication could be kept up to 400 miles, while at night the range was often increased to about 2000 miles.

The aerial was supported by two masts 200 feet high, 600 feet apart, and had a mean height of 170 feet. It was used for the double purpose of transmitting and receiving on 600 meters and 300 meters. An earth connection was made to the hull of the ship.

A 100 watt reserve transmitter in the form of an induction coil can be seen on the right of the operating desk. The power supply was eight 2 volt accumulators, which would work until the 16 volts is reduced to 8 volts.

The induction coil would be connected directly to the aerial and would transmit on the frequency characteristic of the aerial, ie inherent C and L.

In the picture, fixed to the facing partition is the Marconi standard magnetic travelling band detector, with its clockwork winding handle. It was used in conjunction with the multiple tuner, below, on the desk.

The *Titanic* first sent CQD (phonetically 'seek you,' a call to all stations, and D for 'distress') then later SOS, which had been agreed at an international conference of 1908. SOS has no intrinsic meaning, but was adopted as being the easiest to send and the easiest to decipher. The idea came from 'SOE' in use by German ships, modified because the single dot of 'E' could be missed. *Titanic*'s call–sign was MGY; 'M' stood for Marconi, and is in use today for Great Britain, as well as the more usual 'G' prefix.

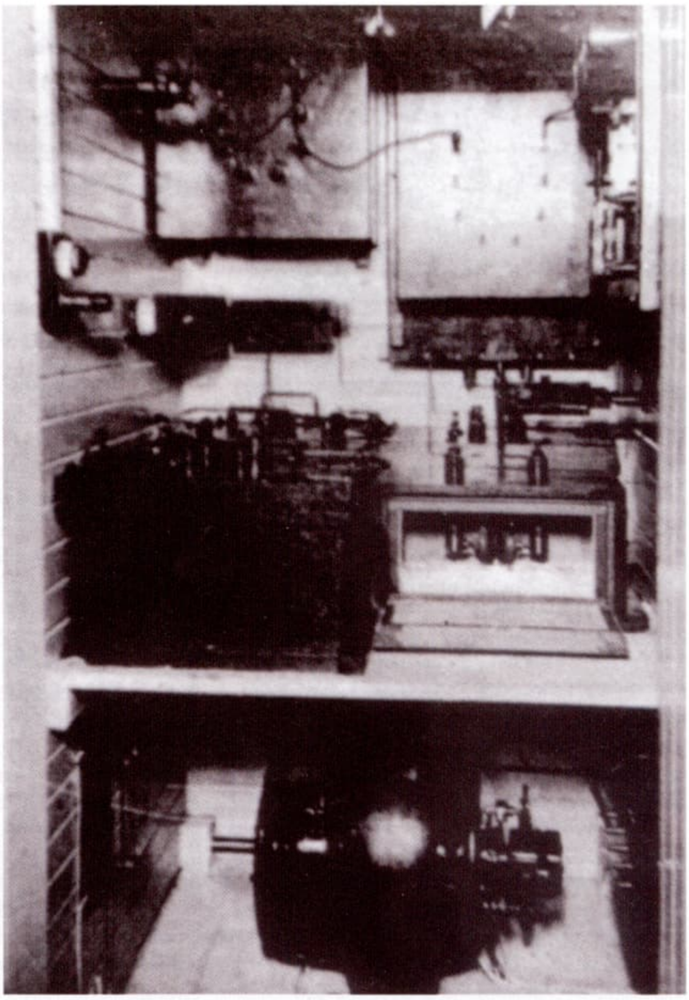
Retuning the aerial would be desirable if the aerial height is altered; with the aerial's approach to the water during the sinking, a series of V's was sent during this process, among the final signals heard from Titanic.

Tuning and resonance is a fundamental of all radio: Resonance is between energy of the electric field and energy of the magnetic field – stored in C and L respectively.

To describe the transmitter schematic the 300 volt output from the motor–alternator can be interrupted for signalling by a Morse key.

The primary of a transformer takes the

5



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1: Olympic's radio room, circa 1911. Three pneumatic tubes are to the right. Next, on the desk, the induction coil. The magnetic traveling band detector is central, facing the viewer. Under it is the multiple tuner, with three adjustment knobs. Under the hanging earphones is the valve receiver. To the right on the wall is a switchborad, and below is the motor-alternator stater control.

2: Titanic's wireless aerial is clearly visible in this photograph taken at Southampton.

3: Schematic of Olympic/Titanic wireless apparatus.

4: Transmitter of yacht Mahroussa. At extreme right is the studded disc, aerial tuning inductor at top, with sockets for adjustment. Underneath is the 300v to 20kV transformer; to the left is the aerial coupling unit; the knob in the foreground is the tuning lamp bypass and brightness control, to set the adjacent lamp's glow level.

5: Operating room of a 1¹/₂kw transmitter, similar to that aboard the cable ship.

5: A 1¹/₂kw transmitter's silent compartment, side open and the spark gap cover removed to show the dome-shaped electrodes.

300 volts which is stepped up to 20,000 volts, then via isolating inductors is fed to the frequency determining oscillatory circuit of C and L. A spark gap is between C and L consisiting of metal studs on a rotating disc.

The 20,000 volts is applied to C (energy of the electric field), the high voltage breaks down the air with a spark across the gap, and a surge of current is made through L (energy of the magnetic field).

The current through L induces current into a nearby coupled inductor of the aerial circuit, and so oscillations become evident in the aerial inherent capacity and the aerial tuning inductor.

At the exchange of energy between C and L of the aerial circuit, energy is lost, ie radiated away (due to Maxwell 1864). The coupling together of the stable frequency generating circuit (due to Hertz 1888) was the subject of the famous 1900 patent No. 7777 of Marconi.

A tuning lamp is provided in the earth circuit. Also note transmission on 300 meters is affected by the addition of another capacitor in the aerial circuit (a second harmonic).

One spark only is needed to put the C and L resonant circuit into oscillation. With a fixed gap, the reaction from C and L could produce another spark, an arc, by feedback, and therefore waste energy.

A rotary spark gap was invented by Marconi. A rotating steel disc having studs on it revolves between electrodes, so making a self-quenching spark gap. Additionally the number of studs will create a musical note, at the receiver, of 400Hz. Differing notes could distinguish transmitters at the receiver.

The 1913 picture from the SY Mahroussa shows the studded disc, on the shaft of the motor-alternator, in a similar manner of the Titanic.

The rotary spark gap increases the efficiency of the transmitter by about 50% over the fixed gap type.

A fixed gap, with cover removed, can be seen in the silence compartment, side open, of the pictured 1¹/₂kw transmitter.

Reception utilized the Marconi magnetic travelling band detector, colloquially known as the 'Maggie', which was connected to the aerial via the multiple tuner. The latter contained three resonant circuits; the three knobs could adjust to the incoming circuit and reject an interfering signal.

The 'Maggie' was a Marconi patent from an idea by Rutherford. A moving iron wire belt is magnetized to near-saturation by a permanent magnet, and so is non-linear to a current of the radio wave in the primary coil; then detection by rectification is had of the modulating spark of a transmission, and is heard in the telephone. A second permanent magnet erases, and so prepares the belt again. It is a recording method.

A diode valve was used in a reserve receiver, but beacause of poor vacuum in the valve, was not so sensitive as the 'Maggie'. A coherer receiver made a further reserve, and could operate paper tape inker.

About the new BVWS DVD

I am very pleased once again to have been able to produce the members' DVD and would like to tell you a little bit more about the content that has been included on this year's disc.

Our first film is very much on a wireless communication theme, entitled "Ship to Shore"; the film produced by the Post Office, is a snapshot of the then coastal wireless service operations. The story is a typical "a day in the life of", and centres on a couple of dramas at sea to highlight the importance of the service and its contribution to the fishing community. Shot in colour, there are various communications receivers to be seen in operation, the footage is believed to date from the late 1960s.

The theme of our second film EMISPHERES looks at the many different manufacturing aspects of EMI. Dating from the 1970s, the film gives an insight into the colossal size of the organisation at a time when the company was still manufacturing around the globe. The film is primarily a publicity vehicle, designed to promote and inform the viewer of its various activities, most notably in the fields of recording, television and CT scanners.

Television is in our thoughts this year as we celebrate the 75th Anniversary of the birth of High Definition Television. In response to a number of requests from members over the years, we had hoped to be able to bring you a classic BBC film, "Television Comes to London". Both myself and your chairman, Mike Barker had made exhaustive enquiries with the BBC with a view to securing clearance to be able to include this film and possibly one or two others. After a number of fruitless phone calls and emails, earlier this year I was finally pointed in the direction of BBC Media who quoted a rate of £250 per minute of footage. Naturally just the one film would have cost the society several thousand pounds in clearance fees which we simply could not afford. BBC Media also stated that this was at reduced rate due the fact that we were charitable society. Naturally we are all very disappointed with the outcome. However we are delighted to be able to include a vintage television related film, entitled "Television Tomorrow". This short film looks at the post war television industry in the US and the prospects that await ex-serviceman in the emerging medium.

Mullard and Philips are no strangers when it comes to films of a technical nature. Both firms had a large educational output during 1950s and 1960s which covered many aspects of electronics. This was conveyed through pamphlets, film strips, slides and 16mm film.

I am therefore delighted that we have been able to include the latest find produced by these superb libraries. This particular film entitled "The Secret Writing of the Electrons", is produced for Philips under its series of "Magical Electrons" titles. The film explores the electron in every day applications and the uses that the oscilloscope has. The footage probably dates from the early 1950s. The film features plenty of period kit including Philips produced oscilloscopes and includes an artistically displayed range of Cathode Ray Tubes. There is a very small fault with the original optical sound part way into the film with the narration disappearing for a few seconds. I do hope this will not spoil your enjoyment of this rare film.

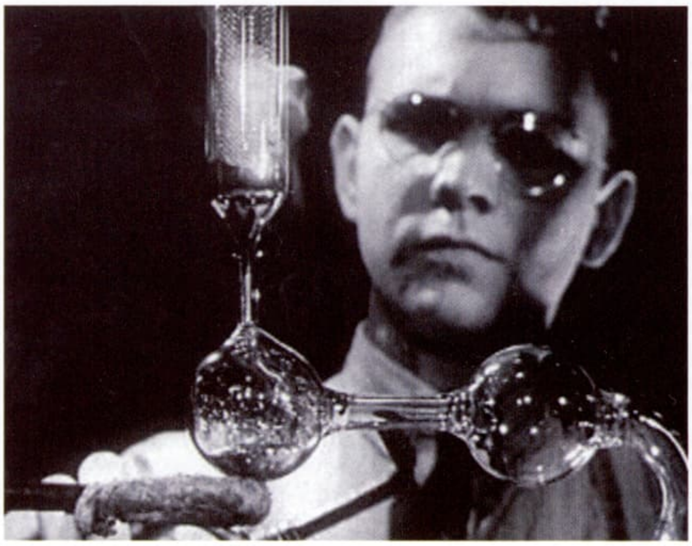
Finally, we have included some additional material in the form of an historic audio transcription. The recording is of Lord Reith, first Director General of the BBC. Reith recorded a very short message for replay at a staff reunion held on 1st Oct 1970. The recording was made in Edinburgh just prior to this function on 21st September 1970.

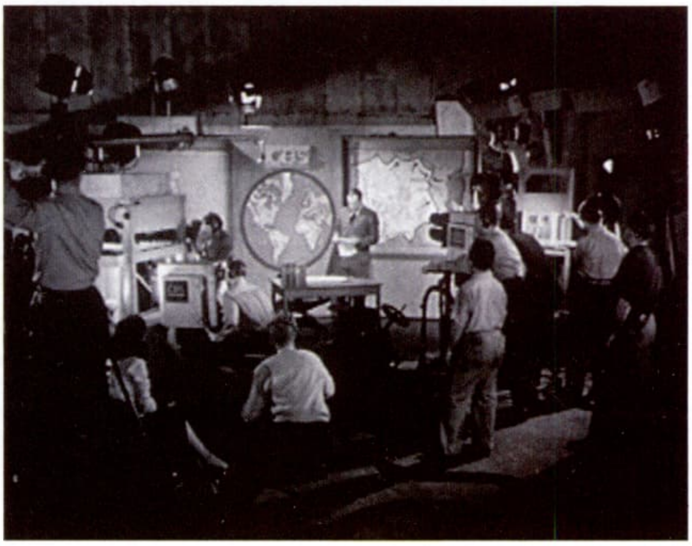
Although Reith has often been described as the architect of the BBCs early success, it was his autocratic approach that became the stuff of BBC legend. The term Reithian has entered the dictionary to denote a style of management, particularly with relation to broadcasting.

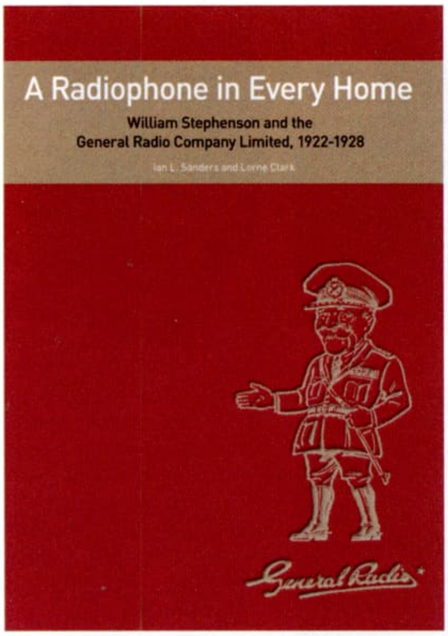
Reith died aged 81 on the 16 June 1971 a few months after this message was made. I have set this short historic recording to a specially produced slide show.

I am indebted to BVWS members Phil Marrison and Andrew Finch who have very kindly provided us with all the material included on this year's DVD.

Finally, I would also like to take this opportunity in asking that if you have any material that you think would be of interest, to get in touch with us via the BVWS committee. Contact details are located in the front pages of The Bulletin. The society can arrange for your film or video footage to be transferred should it prove to be of interest.







Exciting New Book

A Radiophone in Every Home - William Stephenson and the General Radio Company Limited, 1922-1928 by Ian L. Sanders and Lorne Clark with foreword by Jonathan Hill.

During the life of the British Broadcasting Company, 1922-1927, literally hundreds of wireless manufacturing firms sprung up to take advantage of the new craze for 'listening-in'. In the fiercely competitive market of those pioneering days, many of these businesses were to survive just a few years at most. While much has been written on the history of the larger companies that survived during this period of attrition – names such as Marconi, Burndept and General Electric – very little has been published about the smaller enterprises.

In their fascinating new book, Ian Sanders and Lorne Clark open a window on the history of the General Radio Company Ltd. which, although one of the smaller companies, had huge ambition, drive and creativity imparted largely by its enigmatic founder William Samuel Stephenson, later Sir William Stephenson.

Stephenson, a Canadian by birth and a WWI air-ace, returned to the UK after the Great War and rapidly made a considerable fortune with his 'pictures-by-wireless' system which was adopted by most of the world's major newspapers. In 1922 Stephenson took over the General Radio Company. and from the very start showed himself to be a skilled and canny innovator with a flair for innovative marketing. The company manufactured radios, amplifiers, headphones, and loudspeakers together with a wide range of wireless accessories. For a while they even worked on the development of a system of mechanical television and held a key patent concerning transmitter-receiver synchronisation.

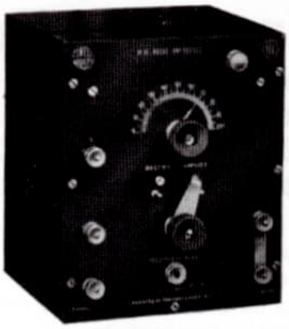
William Stephenson went on to achieve notoriety as Churchill's Second World War intelligence chief, Intrepid and has often been referred to as the model for Ian Fleming's fictional super-spy, James Bond. Numerous books have been published about Stephenson's life but, until now, little has been written about his involvement with wireless, at the dawn of British broadcasting. A Radiophone in Every Home is the chronicle of a company that, although long gone, still has an intriguing story to tell. With its some 140 pages and 200 illustrations, this full-colour hardback volume is at once a compelling and rewarding read and a solid reference work. Included are a number of useful appendices and a comprehensive index. Scheduled for publication – December 2011.

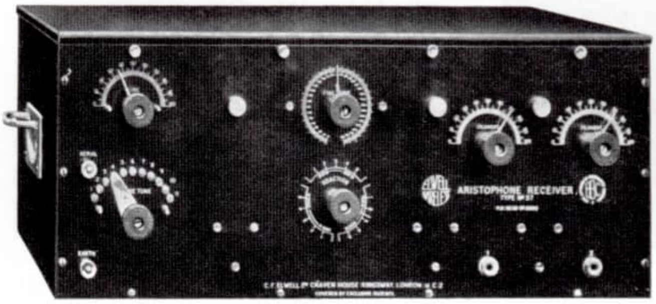
Published in the UK by Loddon Valley Press, price: £19.95 + P&P. To pre-order your copy please contact Loddon Valley Press on 0118 9345606 or visit: www.earlywireless.com/loddonvalleypress.htm.

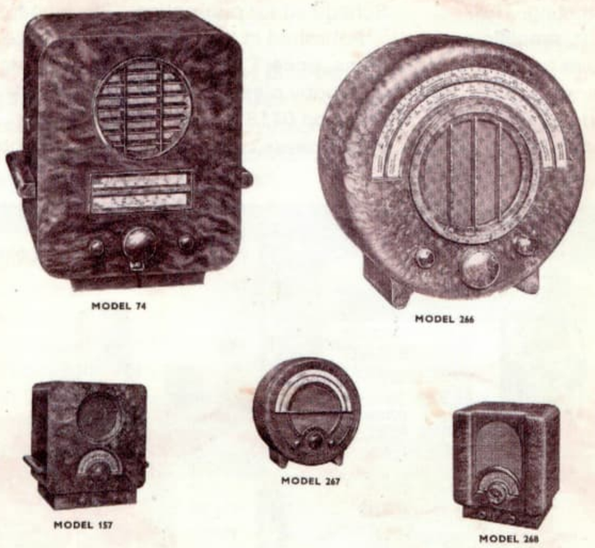
Letters

Dear Editor
C.F. Elwell Limited -
Request for Information

The firm of C.F. Elwell Limited produced receivers and components for a few years from about 1922 to 1925. The company's crystal set – the Panel No.11 – is the most commonly found surviving example of the company's products. However, Elwell produced a full line of valve sets under the Aristophone trade-name and other receivers using the Radiocraft and Statophone marques. Any information – catalogues, advertising material or best of all the location of receivers – is sought for a research project. Any leads would be most welcome. Please contact Ian Sanders at: author@crystal-sets.com.







SHEET No. 1

MODEL 74

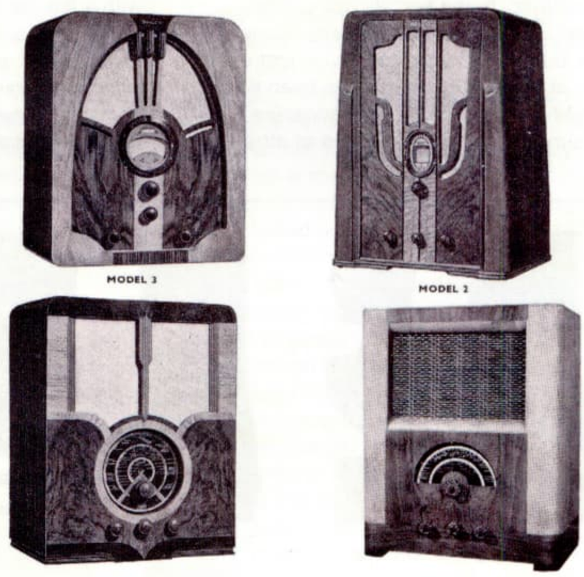
MODEL 266

MODEL 157

MODEL 267

MODEL 268

MODEL	TYPE	MAINS	VALVES 1	2	3	4	5	6	7
74	Superhet 2 W/B	A/C D/C	SP4(5) DS/PEN	VP4(5) DVS/PEN	TDD4 DDT16	AC/PEN DP/PEN	R2 —	— —	— —
157	Superhet 2 W/B	A/C D/C	SP4(7) SP20	VP4(7) VP20	TDD4 TDD25	AC/PEN PEN/20	IW2 —	— —	— —
266	Superhet Reflex 2 W/B	Universal	FC13	VP1321	PEN/DD/4020	UR1	—	—	—
267	Superhet Reflex 2 W/B	A/C Universal	FC4 FC13C	AC/VP1 VP13C	2D4A DD620	AC2/PEN PEN36C	IW3 1D5	— —	— —
268	Superhet Reflex 2 W/B	A/C	FC4	AC/VP1	2D4A	354V	AC/PEN	IW3	—



SHEET No. 4

MODEL 3

MODEL 2

MODEL 4

MODEL 1 and 7

MODEL	TYPE	MAINS	VALVES 1	2	3	4	5	6	7
1	Superhet 2 W/B	A/C Universal	6A7 6A7	78 78	75 75	42 18	80 1D6	— —	— —
2	Superhet 2 W/B	A/C Universal	6A7 6A7	78 78	75 75	42 18	80 1D6	— 301	— —
3	Superhet 2 W/B	A/C Universal	6A7 6A7	78 78	75 75	42 18	80 1D6	— 301	— —
4	Superhet 3 W/B	A/C Universal	6A7 6A7	78 78	75 75	42 18	80 1D6	— 301	— —
7	Superhet 3 W/B	A/C Universal	6A7 6A7	78 78	75 75	42 18	80 1D6	— —	— —

Dear Editor,
The attached pages from a Radio Rentals booklet may be of interest to other members, as it gives model numbers of sets in their range of radios, many of them Ekco lookalikes. It was recently donated to the Amberley Museum Radio Collection, by the daughter of the late manager of the Radio Rentals shop, that used to be in Montague Street, Worthing.

Yours sincerely,

David Rudram

Dear Editor,
My interest in radio and TV began when I was at secondary school. Part way through the Summer term of 1970, a new pupil started, his name was Richard Shortland and as the term progressed we became good freinds. Richard lived with his grandparents in Heanor, Derbyshire, which was a short bus ride from my house. Richard had the use of the attic room, which contained many chassis of old radios and TVs. I was quite fascinated by it all, even though I did not know one component from another, never mind what role it played in the particular circuit. Most of this junk came from Richard's uncle who worked for Telefusion, a TV rental and sales company, who had a shop on the corner of Ray Street in Heanor. Gradually more junk came along, even some from the local tip! I vividly remember seeing small screen 405–line TVs scattered around in the rubbish. Looking back I should have saved them from some of the local lads, who used to remove the valves and use them as targets for airgun practice.

By now, Richard asked me if I wanted to

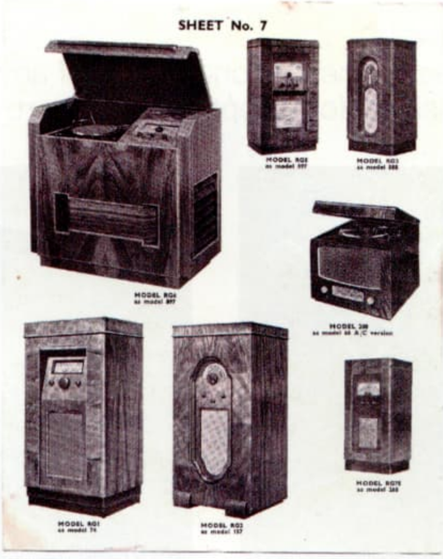
go to a radio rally at the weekend with his uncle. The venue was the lower Ryknield School in Derby, the car park was practically full, which must have reflected the popularity at the time. Walking into the school building I encountered my first sight of ham, military, and commercial radio equipment plus more junk – I was in heaven! I almost bought a 19 set because it looked so good. This visit prompted me to visit the local bungalow which happened to have an impressive mast in the garden. It belonged to a fellow named Fred Allsop, G3IFA. He took me to my first meeting at the Derby and District Amateur Radio Society which happened to have a 'Junk Sale' on at the time. I have been a member ever since.

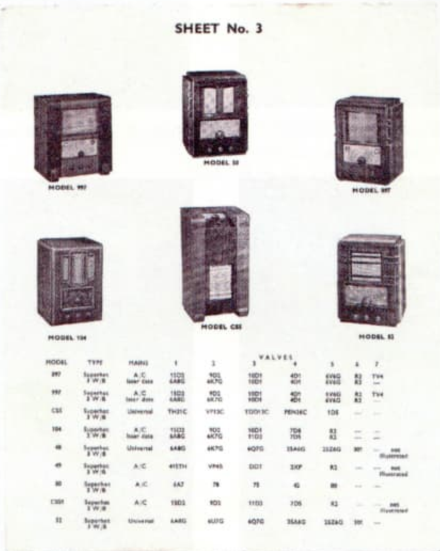
After leaving school, Richard and I lost touch, it would be good to see him again. Fred G3IFA, who was an inspiration to me, sadly passed away some years ago.

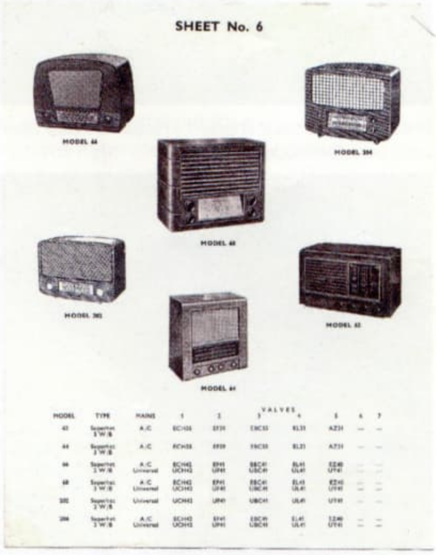
I did not know it at the time but I had just become a member of the oldest radio club in the world - the Derby Wireless Club, which was formed in 1911. In the preceding years several model engineering enthusiasts had been experimenting with the new science of wireless, and in the Spring of 1911, Professor GP Bailey gave a lecture at Derby Guildhall entitled: 'Scientific Progress in our Time', in which he demonstrated the ringing of bells and the lighting of lamps by means of wireless waves. This prompted the local experimenters to form a group, and under the guidance of S. Grimwood-Taylor and A. Trevelyan-Lee a local wireless club was formed. A room in the old bank chambers, Iron-Gate, Derby was used as an experimental station with the call sign QIX. In 1912 the club moved to new premises on Full Street, Derby, and in February 1913 an exhibition was held. This was featured in both the Daily Sketch and The Daily News and Leader newspapers. The club flourished even during The Great War and in 1932 celebrated its 21st birthday. At the beginning of WWII all transmitting activity ceased when equipment was confiscated by the authorities. In 1947 *The Derby and District Amateur Radio* Society was formed, both clubs merged in 1954, it was agreed that they should incorporate Derby Wireless Club in its title. This year celebrates the club's 100th birthday, we have been given a special call-sign GB100D. The club's archives contain many photographs from the last 100 years and some are of the club room on Full Street in 1912/13.

Visitors to the club are always welcome on every Tuesday, it would be nice to see some new faces, you may even decide to become a member. The club now meets at the Carlton Road United Reform Church, Carlton Road (Ring Road End) Derby DE23 6HE. For more information click onto our websites: www.d.a.d.a.r.s.org.uk or www.derbywirelessclub.org.uk

Yours sincerely
John Gregory G8IHA



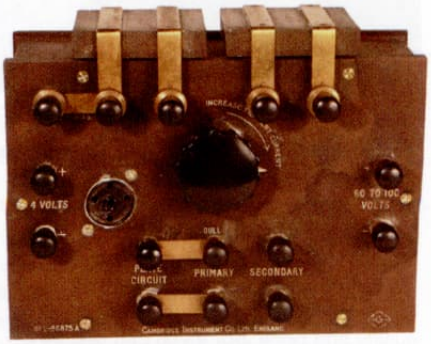


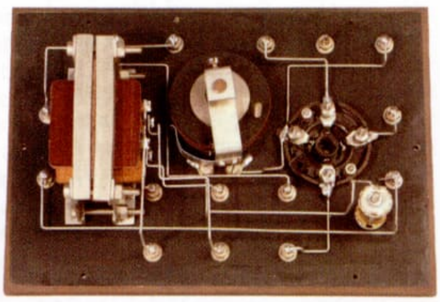


Mystery item made by Cambridge Instruments Co Ltd England No L-86875A

I bought this nice looking item a few weeks ago at our swapmeet in Antwerp (Belgium) from a collector who had to clean up his house because he was moving to another bigger house. He could not remember *where it came from. Fortunately the* condition is excellent, I had to buy it. I wonder what it is and what it's used for, can anybody help?

Rudi Sillen





The MiniMod by Ian Liston-Smith

The battery-operated MiniMod uses the headphone output of any portable audio player to generate an amplitude-modulated signal for reception on a nearby medium-wave radio.

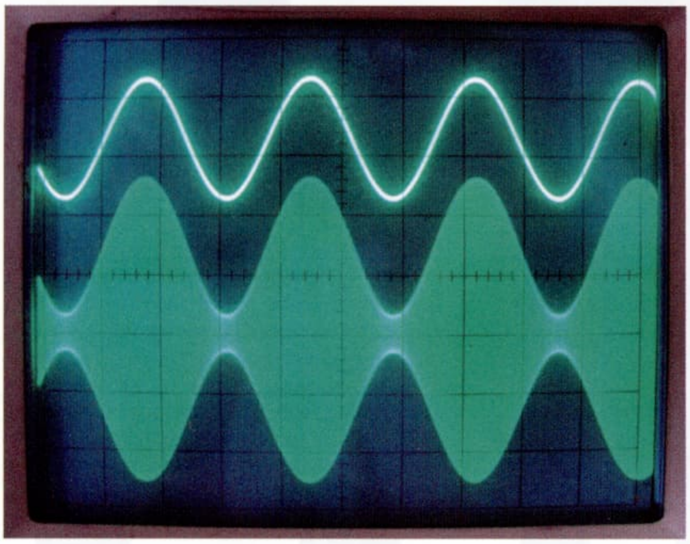


Photo 1: Upper trace shows 1 kHz audio input. Lower trace shows undistorted modulation envelope

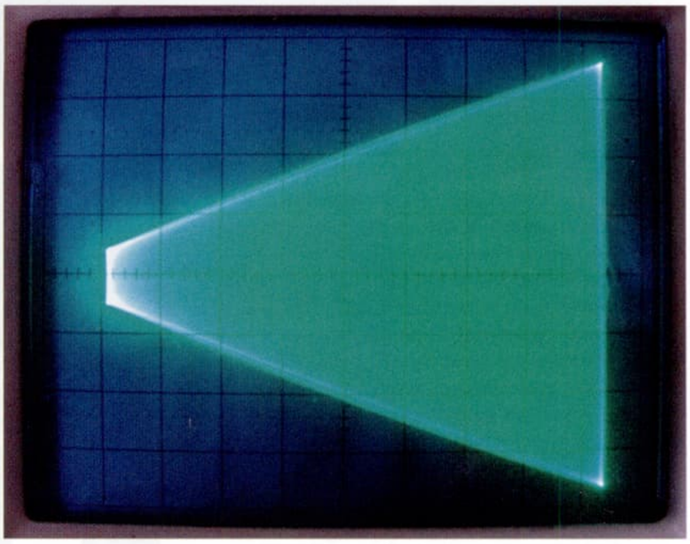


Photo 2: Trapezoidal trace shows straight edges and no distortion

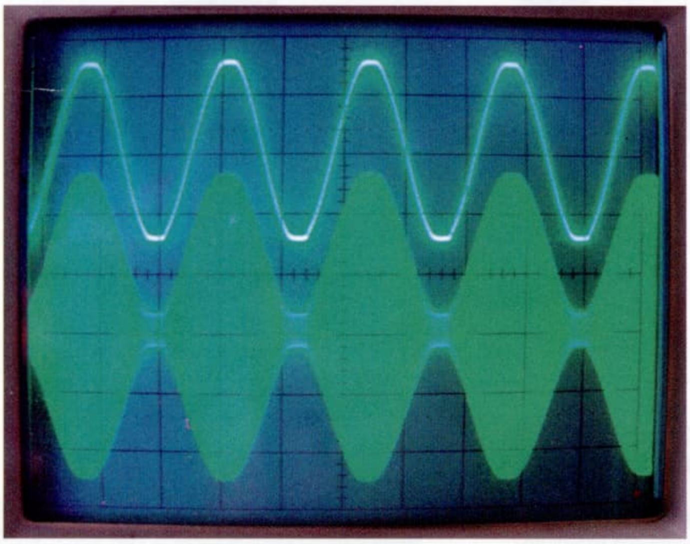


Photo 3: Symmetrical clipping starting beyond about 80% modulation depth

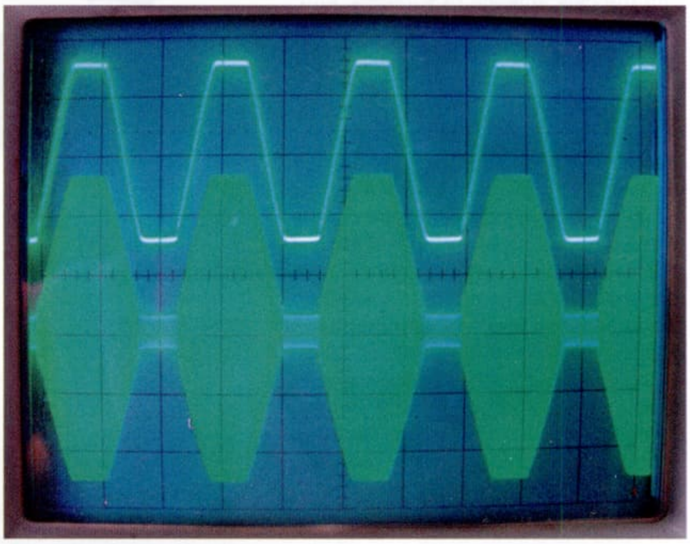


Photo 4: Severe over modulation!

With the declining number of medium-wave stations on an increasingly noisy band, it is getting harder to enjoy our vintage sets. For these reasons, various mini medium-wave transmitters have become available so we can tune into our own "stations". These devices vary in complexity, sound quality and price, but if you can restore a vintage radio then you can build the circuit described here. Small modulators need not be complicated to work really well.

I have designed AM transmitters for Ofcom-licensed medium-wave stations so it was a challenge to see what I could do with a few components to produce a nicely modulated signal from a simple solid-state device with a range of only a few feet.

The huge variety of free internet podcasts on any subject under the sun, together with plays, audio books and of course music, makes such a gadget very useful when it is inconvenient to listen via the computer or to wear headphones, whether listening on a vintage radio or not.

If you are not squeamish about covering your home and garden with a stronger signal, then see the simple three-transistor, crystal-controlled design "Generating an alternative MW programme source" in BVWS Bulletin volume 25 number 3 - Autumn 2000. If you prefer something with a limited rage, then this no-frills design is for you...

Design requirements

High quality sound: There is no point restoring a radio to work as it did when it left the factory if it ends up faithfully reproducing a poorly modulated signal. As can be seen from photos 1 and 2 there is no significant distortion on the modulated carrier when properly adjusted.

Simplicity: I have seen some designs using dozens of components to include audio processing, frequency synthesis and modulation depth indicators - all essential features for a "real" transmitter. And to do these things well, complexity is inevitable. However, for a simple device radiating little more than the local oscillator of the radio receiving it, I don't think they're necessary.

Headphone audio feed: MP3 players are widely available and cheap – less than £10 in some cases. If you own a CD- or Walkman-type player, the headphone output from these is equally suitable.

Battery operation: The total current consumption of this device is only about 8 mA so will run for many hours from a 9-volt PP3-type battery. Battery operation also reduces the risk of modulation hum in mains-powered radios when the signal source is very close. The MiniMod will continue to work well until the battery falls to about 5 volts.

Reproducibility: In order to appeal to home constructors, a design must not contain obscure junk-box parts. All the components used here are freely available. Inductors L1 and L2 are available from one main UK

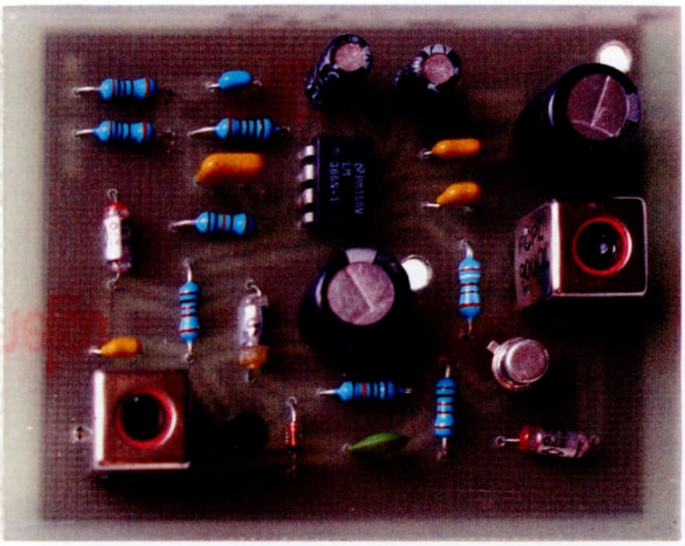
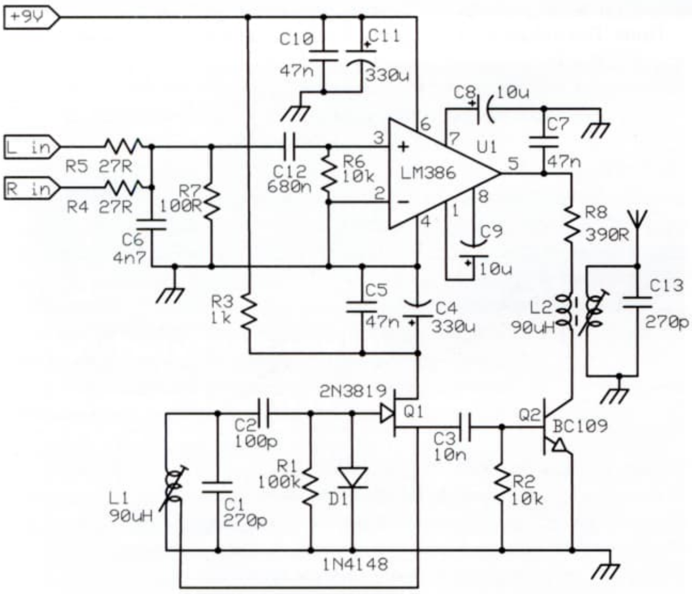


Photo 5: The circuit board



Components list

C1	270pF	R1	100k
C2	100pF	R2	10k
C3	10nF	R3	1k
C4	330µF	R4	27R
C5	47nF	R5	27R
C6	4.7nF	R6	10k
C7	47nF	R7	100R
C8	10µF	R8	390R
C9	10µF		
C10	47nF	D1	1N4148
C11	330µF	U1	LM386
C12	680nF	Q1	2N3819
C13	270pF	Q2	BC109
L1	90µH - see text		
L2	90µH - see text		

source, but are only 75p each (plus nominal postage charge) and while writing this in early July 2011, I confirmed that there are a couple of hundred in stock (but you could wind your own - see later).

Generating the carrier

At the heart of any transmitter is the circuit (or circuits) which generate the carrier frequency. For stability reasons, most transmitters mix oscillators running at different frequencies to get the final carrier frequency. (OK, there are loads of exceptions to this, particularly in older or simple amateur radio equipment...) But in a very low power circuit we can get away with just amplifying the oscillator running at the carrier frequency. So what are our options?

Quartz crystals: If the frequency is not going to be changed, a crystal oscillator is by far the easiest to design. It is fairly immune to frequency drift and pulling by varying loads, and at room temperature a crystal oscillator running below about 5 MHz can be tweaked to within 10 Hz of the specified frequency - and usually much closer - thus virtually eliminating a heterodyne from a co-channel station if used on medium-wave.

Unfortunately, if you want a quartz crystal cut for a medium-wave channel, they have to be made to order costing £20 to £30. You can pick up cheap crystals that will oscillate somewhere on medium wave, but they are unlikely to be on channel. It's possible to get much cheaper crystals operating at higher frequencies and divide or mix them to operate on medium wave, but that significantly complicates the circuit.

Synthesizer: This is too complex for something as simple as this project, and adds significantly to battery-current drain.

VFO: A free-running L-C variable frequency oscillator is not ideal as temperature-related drift and FM-ing can degrade performance. But with careful design these shortcomings can be made negligible at frequencies below about 10 MHz – as demonstrated by the free-running L-C local oscillator in most domestic superhets.

Ideally the VFO should operate exactly on a channel so that the almost inevitable co-channel station at night does not cause a heterodyne. Unfortunately with a simple LC oscillator this isn't easy to maintain (hence the use of a crystal oscillator in the design mentioned above) and the MiniMod is likely to drift by just a few tens of Hertz for the first minute or so of use. Drift only becomes noticeable on an AM radio when it approaches hundreds of hertz.

In practice, once set up, the MiniMod signal should swamp all but the strongest co-channel stations, which you would avoid anyway.

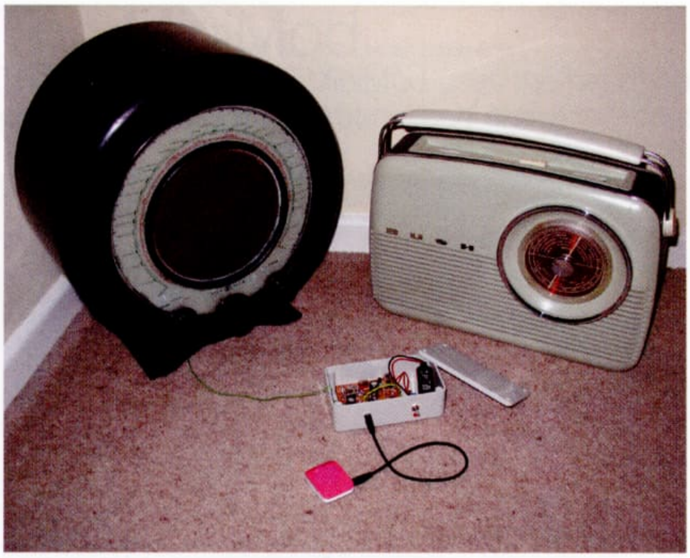
The circuit

The construction method is not critical; Veroboard or other matrix boards will do. None of the component values are critical either, and plus or minus 20% will be near enough. However, C1, C2 and C13 should be close to the quoted values and be mica or polystyrene types to maintain temperature-related frequency stability. (The translucent polystyrene types often have one end slightly coloured. This indicates the outer foil connection and should be connected to the "most grounded" side of the circuit as it provides some self screening.)

Inductors L1 and L2 are both 90 µH variable inductors, supplied by Spectrum Communications (phone/fax: 01305 262250). These inductors are tapped at 25% from one end and have a low impedance secondary winding. The secondary is not used in L1 and the tapping is not used in L2. (One end of L1's unused secondary winding should be earthed to aid frequency stability.)

These inductors are compact and screened, but there is no reason why a keen constructor couldn't wind their own on a large ferrite bead, bit of ferrite rod or a toroid, although frequency stability is likely to be worse than the specified coils. (Full technical details of these coils available at www.spectrumcomms.co.uk/Spectrum%20Coils.htm)

The 2N3819 FET is widely available as is the BC109, although most general-purpose NPN silicon transistors will be suitable.



All set up to tune into something different...

The oscillator: This is a standard FET Hartley configuration and L1 sets the oscillator frequency.

Any oscillator should have a stabilised voltage supply to help maintain frequency stability. However, I found that the frequency shifted by only about 200 Hz between a supply of 4.5 and 12 volts. This is a much greater voltage range than will be encountered from a PP3 battery so voltage-related frequency drift renders a regulator unnecessary.

A voltage regulator may help smooth out any audio frequency ripple that could reach the drain of Q1 and cause unwanted frequency modulation. However, I found that a 330µF electrolytic capacitor, C4, with a 1k ohm drain resistor R3 did the same thing - another reason why a voltage regulator wouldn't present any advantages.

Theoretically, to fully isolate the oscillator, it should be followed by a buffer stage. This prevents modulation-induced impedance variations of Q2 from affecting Q1 and causing slight frequency modulation. In practice I found the amount of FMing to be barely detectable when listening on an SSB receiver and completely unnoticeable in normal AM.

Modulator: Although the modulated signal is mono, most sources will be stereo so a simple method of combining the left and right channels is required. (The proper way these days is to use op-amps, but that's not necessary here – I'm trying to keep this simple.)

Resistors R4 and R5 couple the left and right channels without directly shorting them together and R7 acts as the load replacing the low-impedance headphones the audio player is expecting to see. Capacitor C6 prevents any RF getting into the player. With such low power RF, decoupling here is hardly necessary, just good practice.

The signal from the player's headphone output is amplified by U1. The LM386 amplifier is designed for low-current battery use and will work down to a supply of about 4.5 volts. The output at pin 5 always sits at half the supply voltage, ensuring a symmetrical audio waveform. RF is prevented from getting back to the audio stages by C7.

RF output: The modulated DC output from U1 supplies the RF amp Q2 via current limiting resistor R8 through the low-impedance winding of L2. This simple arrangement only provides about 80% modulation (see photos), but as most simple envelope detectors start to distort at modulation depths much higher than this, it's not a noticeable disadvantage. Many broadcasters don't usually exceed 85 to 90% modulation either.

Transistor Q2 operates in class C and the modulated signal appears across the tuned circuit of L2 and C13. The antenna can be any thin insulated wire 50 cm to 2 m long. Any longer and it will affect the tuning range of L2, which is adjusted for maximum RF output.

I experimented with a number of ways of radiating the signal, including tuned loops of various sizes, but decided the L2/C13 arrangement was the most convenient.

The eagle-eyed will notice that there is no low-pass filter on the RF output. A single tuned circuit with reasonable Q such as this reduces harmonics significantly and since Q2 only dissipates about 20mW and the tiny antenna is much, much less than 1% efficient, I don't think we need to worry about the harmonics...

The circuit does not include any audio compression or audio-frequency tailoring. Compression makes the station sound "louder" and overcomes noise, particularly at the edge of a broadcaster's service area but requires complex circuitry to do well.

Frequency tailoring by medium-wave broadcasters restricts the higher modulating frequencies to prevent the station spreading to adjacent channels, usually boosting audio frequencies at about 2.5 to 3.5 kHz before cutting hard above about 4.5 kHz.

The signal from the MiniMod will be strong when placed close to the radio and the frequency response will be determined by the receiver's IF bandwidth. If your audio source has tone controls, you can use these, although increasing the audio player's output at frequencies beyond the receiver's IF pass band will not increase the treble content as heard on the radio. (The circuit's 6 db audio bandwidth approximately 20 Hz to 15 kHz)

Setting up

I would strongly advise that initial set up is done during daylight. The large number of stations which fade in after dark can make finding the signal a bit tricky, especially if L2 has not yet been peaked when the radiated signal may be quite weak.

With a non-metallic trimming tool (a match or cocktail stick cut to a fine wedge will do) screw the cores of L1 and L2 flush with the top of the formers.

Lay the antenna close to the radio; 50 cm of wire should be enough to start with. Initially set the volume from the audio player to about half way and connect its headphone output to the MiniMod.

Find the signal on the radio; this should be very roughly around the middle of medium-wave. If this is a clear spot on the dial, just peak L2 for strongest signal. If not, then find a clear spot on the dial and adjust L1 until you can hear the MiniMod. Peak L2 for the strongest signal; the peak for L2 is quite broad.

Note: The inductance range of L1 and L2 give a frequency range of about 900 kHz (cores flush with top of the formers) to 1600 kHz (cores screwed all the way down). This corresponds to about 330 to 187 metres. I'd recommend staying near the middle of this range if possible as although the two tuned circuits have very similar ranges, it is not exact. You may find that one end of the range of L1 might be just beyond the range of L2 so you won't be able to peak it. (If you want to shift the frequency range, increase or decrease the values of C1 and C13 by up to 50pF each.)

Lengthening the wire antenna up to about two metres will increase the range of the signal, as will connecting an earth (from a radiator pipe for example) to the negative battery connection. You will need to experiment a little with the proximity of antenna to the radio for the best results. Don't forget to give L2 a final tweak for maximum signal.

Things to look out for

After dusk, you may notice interference from stations that were inaudible during the day. If this happens, retune the MiniMod to a clear spot, move its antenna closer to the radio and/or adjust your player's headphone output level

Avoid the second harmonic of the receiver's intermediate frequency (e.g. 2 x 465 = 930 kHz) as you'll probably experience a nasty heterodyne.

If you have severe interference from the mains or nearby electronic devices, place the MiniMod's antenna as close to the antenna circuits of the radio as possible. In extreme cases, if the radio has an antenna socket, a direct connection via an isolating capacitor (say 0.01 µf) can be tried, but this may overload the receiver. Alternatively you could try pushing the insulated antenna wire into the antenna socket without making a direct connection.

Most miniature FM radios use the headphone lead as the receive antenna. If you connect one of these radios to the MiniMod to relay an FM station, it may not work.

Keep your audio player away from the radio as these devices can radiate interference from their electronic circuits through their unscreened plastic cases.

Do not set the headphone volume from your player too high as this will over-modulate the MiniMod and distort the signal. It should be just high enough to give a clear sound.

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Mike Barker, Pound Cottage, Coate, Devizes, Wiltshire, SN10 3LG
chairman@bvws.org.uk

News and Meetings

GPO registration Numbers

Martyn Bennett is the custodian of the BVWS GPO Registration Numbers list. As many members know, the project of assembling this list was started in the early days of the BVWS and was carried on by the late Pat Leggatt. Members are strongly urged to help build the list, whenever they get the opportunity, particularly as it is something that will help with the identification of vintage wireless in years to come. The list is by no means complete and the GPO no longer have a record of the numbers granted to wireless manufacturers. The BVWS Handbook contains the current listings - one in numerical order and one ordered by name. Please let Martyn have any additions, or suggestions for corrections, by mail or over the phone.

Martyn Bennett, 58 Church Road, Fleet, Hampshire GU13 8LB telephone: 01252-613660 e-mail: martyb@globalnet.co.uk

November 25th Festive Music Night at The British Vintage Wireless and Television Museum
December 4th Wootton Bassett

2012 Meetings
12th February Audiojumble
4th March Harpenden
25th March Golborne
May 13th NVCF at Warwickshire Exhibition Centre
9th June BVWS Garden Party
10th June Harpenden
July 1st Wootton Bassett
23rd September Harpenden
7th October Audiojumble
18th November Golborne
2nd December Wootton Bassett

The British Vintage Wireless and Television Museum: For location and phone see advert in Bulletin.
Harpenden: Harpenden Public Halls, Southdown Rd. Harpenden. Doors open at 10:00, tickets for sale from 09:30, Auction at 13:30. Contact Vic Williamson, 01582 593102
Audiojumble: The Angel Leisure Centre, Tonbridge, Kent. Enquiries, 01892 540022
NVCF: National Vintage Communications Fair See advert in Bulletin. www.nvcf.co.uk
Wootton Bassett: The Memorial Hall, Station Rd. Wootton Bassett. Nr. Swindon (J16/M4). Doors open 10:00. Contact Mike Barker, 01380 860787
Golborne: Golborne: Golborne Parkside Sports & Community Club. Rivington Avenue, Golborne, Warrington. WA3 3HG contact Mark Ryding 01942-727428
Mill Green Museum: Bush Hall Lane, Mill Green, Hatfield, AL95PD
For more details with maps to locations see the BVWS Website: www.bvws.org.uk/events/locations.htm

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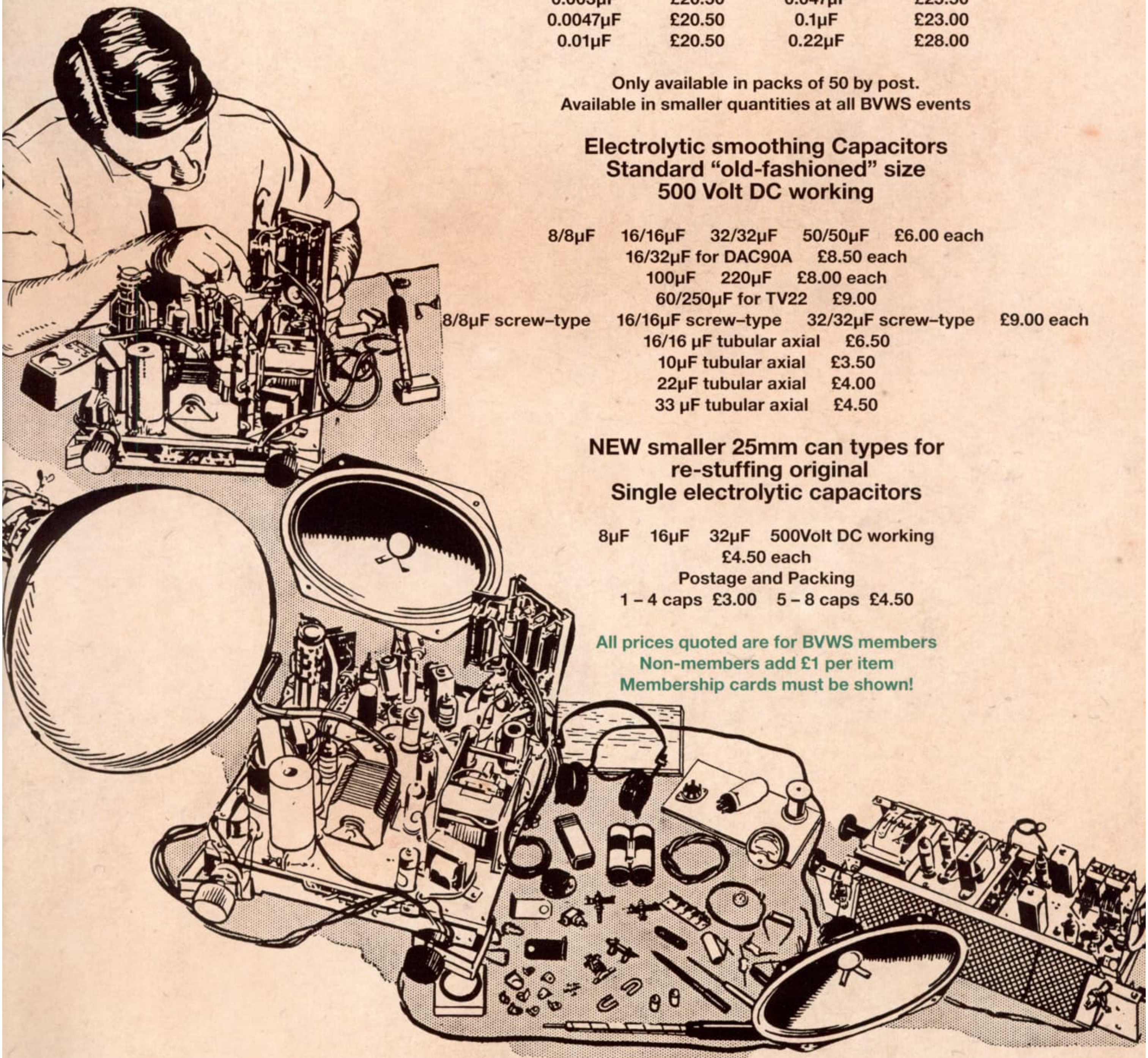

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