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Whips, Loops & a Bit of Feedback

John Wilson compares the Wellbrook active loop antenna, costing around one hundred pounds to multi-thousand pound alternatives from Rohde & Schwarz. See which one you'd choose.

It's funny how several unconnected things come together and focus your mind on a subject you hadn't before considered.

In my case, the unconnected subjects were DefStan 59-41, BS EN 60945, the Lowe HF 350 and Wellbrook loop antennas. To explain DefStan 59-41 is an MOD EMC test standard which calls for (amongst many other things) measurement of EField radiated emissions below 30MHz, by use of an active rod antenna. BS EN 60945 is the European Harmonised test standard for marine equipment, also calling for radiated emission measurement below 30MHz but using a screened loop antenna measuring the H-field component of the emissions from equipment.

The Lowe HF-350 and Wellbrook antenna came together at the time of my review of the receiver, when I commented on the rather neat idea of Palstar in providing a switched d.c. feed to the centre of the coaxial antenna connector so that the user could feed an active antenna system. The receiver handbook mentions only the Lowe AA-150 (manufactured by RF Systems and badged for Lowe) as being a suitable antenna, but I had been evaluating the Wellbrook ALA-1530 loop at the EMC Centre with a view to using it as a low cost alternative to a Rohde & Schwarz loop antenna which I normally use. The low cost comes from the fact that the Wellbrook loop can be had for about £120 whilst the Rohde & Schwarz loop costs just over £3,500.

You can understand my interest

The ALA 1530 is made up of three parts, the one metre diameter loop with an impedance matching network and amplifier in its base, a mains power supply which delivers 12V d.c., and an intertace box which feeds the d.c. up the coaxial cable to the active bit of the antenna but prevents it from feeding back to the receiver, and also an r.f. network which allows the incoming signals from the antenna to be passed to the receiver without being shunted to ground by the low impedance of the d.c. supply. The d.c. supply can of course come from any source, such as a battery, so the ALA 1530 is equally at home when used as a portable device. If you have a receiver such as the Lowe HF-350 in which the designer has provided a 12V d.c. feed via the receiver antenna socket, then its even easier.

Couldn't Resist It

So, having the ALA 1530 available I couldn't resist trying it out on the HF-350 to see how it performed. The handbook for the receiver says that the active antenna power feed is limited by an electronic fuse, and I checked that the trip limit on the review receiver operated at 140 to 150mA, which meant that the Wellbrook would operate comfortably without tripping the supply and indeed it did operate faultlessly. I used the ALA 1530 for several days on the HF-350 and it produced terrific results; so much so that I took a closer look at the relative performance of active loops and active whips and thought that the readers of Short Wave Magazine would appreciate an article on my findings. First of all a bit of background. As short wave listeners, we are accustomed to having our receivers and antennas operating in what is known as the far field of any transmitting source. This is the region where a transmitted signal (or emission in EMC terms) is made up of an electric (or E) field, and a magnetic (or H) field which exist together to make up the electromagnetic wave.

However, in the near field which, is commonly taken to be within a distance of $\lambda/2\pi$ or roughly one sixth of a wavelength from the source, the relationship between the E-field and the H-field is difficult to determine, and the wave impedance becomes high for the E-field and low for the H-field.

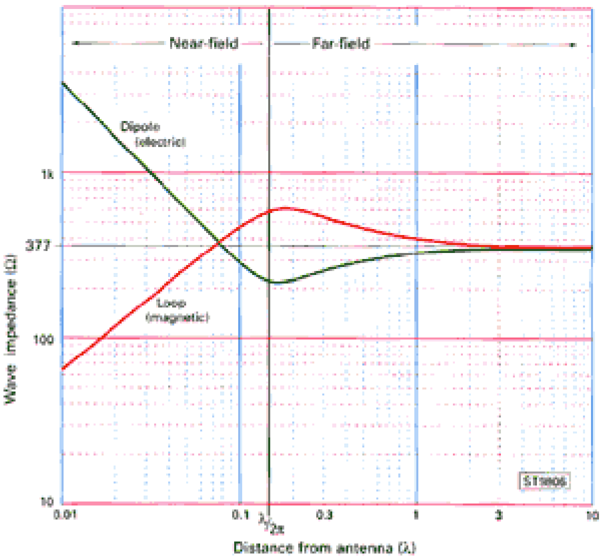

Fig.1: Wave impedence, high for E-Field and low for the H-field. The commonly accepted impedance plots for the near to far field transition.

transition are shown in **Fig.1** and without pursuing this much further let's think about the near field distances for the frequencies in which we might be interested as listeners. If you are listening to Rugby on 60kHz, the near field exists up to about 800m from the source, whereas at 3MHz the near field exists up to about 17m from the source, and at 6MHz up to about 8.5m.

What has this got to do with the listening hobby?

Well, if you consider that most sources of eledrical noise such as the dreaded PC radiate their noise from the mains wiring, and that in the near field the E field dominates, it is indisputably true that an antenna which responds to the E field and which is in this cloud of radiated noise will transfer the noise to your receiver and effectively blanket any wanted signals which are arriving from the far field, in other words just those signals you want to hear and can't because of the electrical din created by your house wiring and all the devices connected to it. Haven't you ever noticed that the low frequency DXers in the USA have regular summer visits to long sandy beaches with no local inhabitants, and set up their Beverage antennas connected to receivers running from battery power? Why is that? Answers on a postcard please.

For my first tests I had at my disposal (who's a lucky chap?) a Rohde & Schwarz HFH2-Z6 active whip F field antenna and a matching HFH2-Z2 active screened H field loop antenna, together with the Wellbrook ALA 1530 active (unscreened) loop. I set each antenna in turn on a one metre tripod located just outside the EMC test centre and connected by a l0m cable to a Rohde & Schwarz ESHS-10 test receiver. I took a spectrum sweep of the frequencies from 150kHz to 30MHz and the results from the Rohde & Schwarz antennas are shown in **Fig. 2** and **Fig.3.**

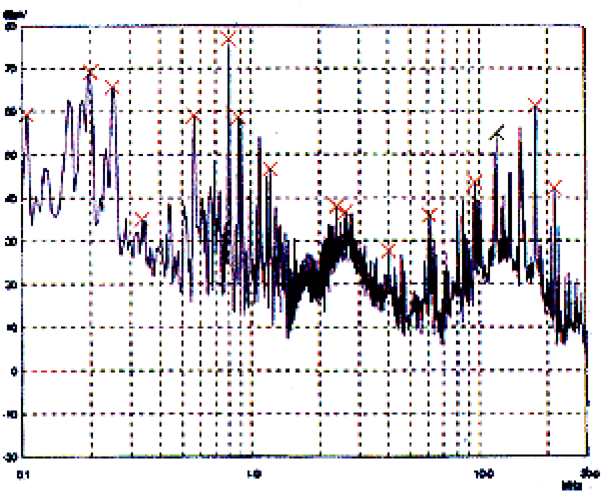

Fig. 2: The Rohde & Schwarz active whip spectrum sweep 150kHz to 30MHz.

The active whip (**Fig. 2**) shows signal levels approaching 80dB microvolts in the medium wave band, and apparent peaks of signals at around 2.5 and 15MHz. The screened loop (**Fig. 3**) has a much flatter response, with signal levels being down on the whip, which can be explained by the fact that **Fig. 2**: The Rohde & Schwarz active whip spectrum sweep 150kHz to 30MHz. the loop has an antenna factor of 20 whilst the whip's antenna factor is 8. (That's EMC talk which tells us that the whip has more built in gain than the loop.) Now for the £100 loop from Wellbrook using exactly the same set-up as for the £3500 antennas from Rohde & Schwarz.

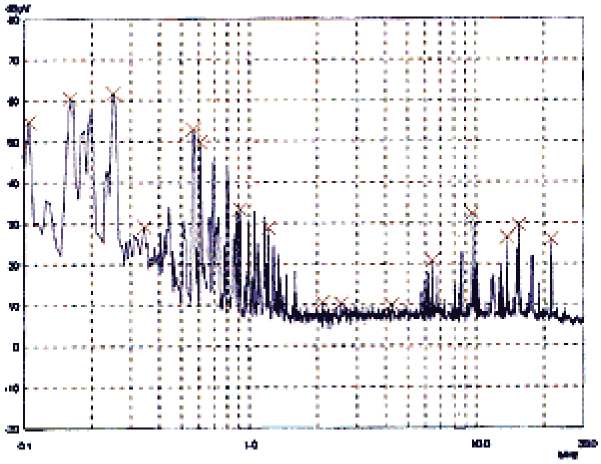

Fig.3: The Rohde & Schwarz screened loop 150kHz to 30MHz

The results are shown in **Fig. 4** and it doesn't take sharp eyesight to see that not only are low frequency signals well up to those shown by the active whip, but the noise peak at 2.5MHz from the whip is no longer present and real signals can be seen, and the signal levels between 5 and 22MHz are as high as those using the whip but there is no background noise peak at 15MHz, simply more real signals appearing out of the noise floor and then disappearing again in between each peak.

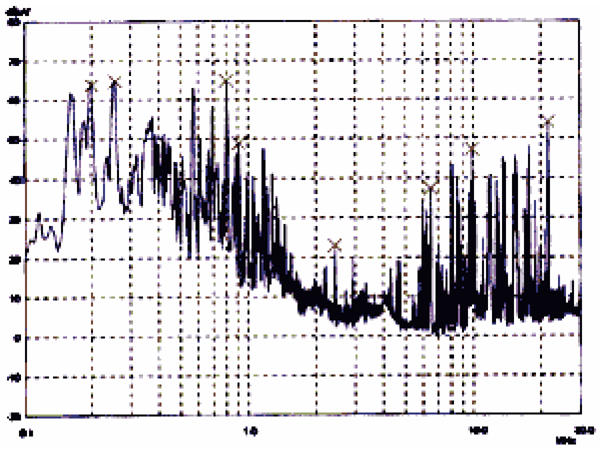

Fig.4: Wellbrook's £100 loop using exactly the same set up as for the £3,500 Rohde & Schwarz

What does this all mean?

I took another sweep over the range 1 to 5MHz using the Rohde & Schwarz active whip and repeated the same sweep using the Wellbrook loop.

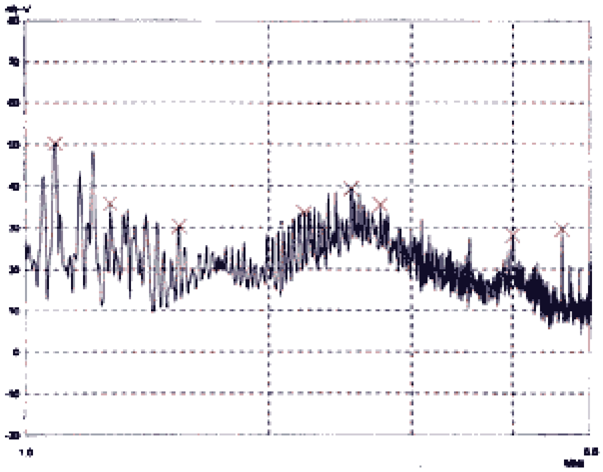

Fig.5: The off air signals from the Rohde & Schwarz active whip

Compare **Fig. 5** which shows the signals from the active whip, against **Fig. 6** which shows the signals from the Wellbrook loop taken three minutes after the whip measurement. The massive peak of noise around 2.5MHz from the whip can be seen to consist of a comb of discrete signals, but the loop antenna shows no sign on these at all, and indeed real signals can be seen in the very region blanketed by the noise produced by the whip.

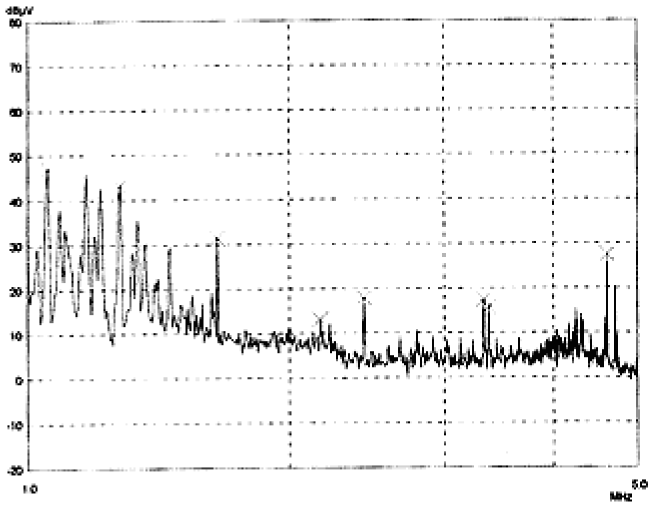

Fig. 6: The off air signals from the Wellbrook loop taken three minutes after the whip, Fig. 5 measurement

Where did this noise come from?

Quite simply from the PC which was running the receiver control software, but this was located within a screened control room some 10m away from the antennas and hence within the near field. Surprising Results I have to admit that I was very surprised by the results and reverted to manual control of the test receiver in order to tune around as a short wave listener. Sure enough, between 1.5 and 5MHz there was an unholy din from the Rohde & Schwarz whip, and a quiet background from the Welibrook loop. Switching off the control computer killed the received noise from the whip, but there was still a higher background present, presumably coming from the general noise on the mains wiring of the building. Its really rewarding when theory and practice coincide, and this was just such an occasion.

However, to prove the point I took the Wellbrook loop home again and simply plonked it on to my work bench where I do all my receiver measurements. I set my own spectrum analyser (Rohde & Schwa rz) to sweep between 2 and 5MHz and connected my usual 10m balun fed wire to the input. The results are shown in **Fig 7**, and you can see evidence of a familiar comb of signals extending right across the frequency range. These were traced to my own computer (at which I am now sitting) in the next room about 8m from the spectrum analyser, although the l0m wire runs directly away from the PC .

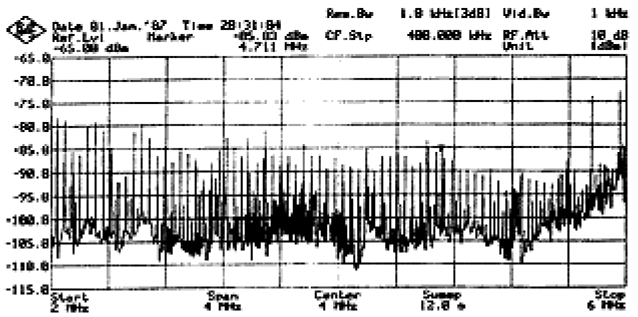

Fig. 7: Spectrum sweep of John's usual 10m balun-fed wire, note the comb of computer generated noise extending right across the frequency range

I then connected the Wellbrook loop to the spectrum analyser and the results can be seen in **Fig. 8**. Where is the comb? Not there, and doing the same comparison with the HF-350 connected to the wire and then the loop confirmed that you could hear real signals using the loop but nothing but PC generated hash when using the 10m wire.

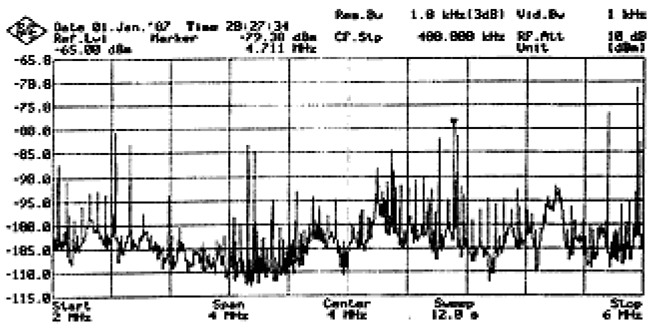

Fig. 8: The Wellbrook loop connected to the spectrum analyser. Where is the comb?

Take a look at the marker on the spectrum analyser display which is set to a signal at 4.711 MHz, and compare the recorded levels between the 10m wire and the Wellbrook loop. The loop actually gives a 6dB increase in the received signal and without any background noise. These measurements incidentally were taken less than four minutes apart, so they do constitute a real signal difference. I should also mention that the PC in question is only a month old and carries the proper CE labelling, so it fairly represents any recent computer set-up and is not some old clunker of a system from the Dark Ages.

I went on to take a look at another incidental advantage of the using a loop antenna in sorting out signals, particularly at low to medium frequencies. As anyone who has rotated a portable radio will know, the loop (or ferrite rod, which is just another loop) shows a broad peak and very narrow nulls in signal strength the classic figure of eight pattern.

The Wellbrook loop exhibits these sharp signal nulls when the plane of the loop is at 90" to the direction of the incoming signal, and this can be used to notch out, or at least reduce the level of an unwanted signal. I used my 900/909/918kHz set-up and watched the amplitude of the 909kHz Radio 5 signal as I rotated the loop - (just held in my hand). I was able to see a 20dB reduction in the 909kHz signal, and when I did the same thing on a receiver it was dramatic to hear the 918kHz signal become so much clearer when the 909kHz was nulled out. I am told that you can null out Atlantic 252 and hear signals behind it

Amazing!

As another practical observation, the Rohde & Schwarz handbook for their active whip lays great stress on the susceptibility of the whip amplifier to inadvertent damage from electrostatic discharge. Being such a high impedance device, (several MOhm), a single touch from a charged finger will destroy the input amplifier. If you use an active whip and place it outside on a pole, there is a serious danger that a nearby (and I mean within several kilometres) electrical storm or even a rainstorm will generate a high enough voltage on the whip to cause damage.

When I was an active radio amateur using a G5RV antenna with open wire feeders into a parallel tuned antenna coupler, I could always tell when a thunderstorm was around because I could hear the spark discharges between the plates of the antenna tuning capacitors in the tuner and they were proper wide spaced variables. By total contrast the loop is a very low impedance device and highly unlikely to have any such problems, making it a much safer bet for the hobby listener.

Conclusions?

I am going to buy and keep the Wellbrook ALA 1530 active loop since it is clearly a much better listening antenna than my 10m balun fed wire. Everything I have read in the Wellbrook literature is absolutely borne out in practice, and I have to say that you would be well advised to get copies of this literature because it expands on what I have said here and is very informative about antennas in general and loops (of course) in particular. Given the choice between an active whip and an active loop, I would take the loop every time. It is infinitely better than the whip in terms of Efield noise rejection, performs every bit as well if not better than the classic end fed wire, has very useful nulls for rejecting unwanted signals (although you need to rotate it), and is much less likely to suffer damage from electrostatic charges when used as the listener is likely to use it. It's a magic device and works particularly well with the HF-350.

I also intend to send a slightly modified Wellbrook loop off for formal calibration at the National Physical Laboratory, because I can see it as a very useful backup for the Rohde & Schwarz HFH2-Z2 at the EMC Centre. If you want to do the same, be prepared for a calibration bill from NPL for something like £500.

And So To Other Things

The AR88 review certainly stirred up some activity. I have been truly astonished at the number of readers who own an AR88, and this may explain why so few are available on the market. Regular users obviously feel like I did about the sheer pleasure of having one quietly simmering in the corner and taking a surreptitious twiddle at the tuning dial when the latest solid state device irritates ones ears. Typical comments came from Mike Penn who said, "Closing my eyes I could almost smell that unmistakeable odour that came with operating that beautiful radio", and Ted Walker who wrote "I have two SP- 600 Hammarlund receivers, an HRO-60, an NRD-525 and AR7030. For audio quality of h.f. and m.w. broadcast band stations, however I favour the AR88D with its superb tuning and practical control layout". Ted also says that his AR88D which he lifted out of its original box, was complete with all documentation and spare parts such as filter choke assemblies, output transformer and an 'S'-meter which was a SmA movement zeroed to the right and labelled dB above lpV reading from 6 to 100dB. However the meter is marked with the familiar MOD arrow which may suggest non RCA origin, although the spares box is labelled with Canadian Westinghouse markings. Does anyone else have more information? The final remark from Ted is Black boxes may come and go but an AR88 and the like, it seems, go on forever.

Tony Lawes also remembers having an AR88D to which he fitted what may have been a correct 'S'- meter which had a scale in the same amber colour as the main dial and mounting arrangements which allowed the meter glass to fit almost flush with the receiver front panel. He recalls spending some time in Gibraltar with the RAF, where the club station (remember ZB2A?) used an AR88LF which had the same meter albeit with a cracked front glass. Jacques D'Avignon recalls that the ARS8D used at the Montreal h.f. station for the North Atlantic h.f. circuits in the mid-SOs had an 'S'-meter fitted in place of the RCA logo panel and goes on to tell that these were the days when BOAC were flying Stratocruisers and making transit stops in Gander Newfoundland, and when all h.f. traffic was in a.m., not s.s.b.

A detailed letter from Paul Essery GW3KFE who compares the AR88 performance to that of a recent h.f. transceiver comments, "Perhaps the greatest thing it (the AR88) had was an absence it was designed to be a communications receiver not an ornamental addition to an advert! It lacked hundreds of buttons, the hundreds of memories and the bells and whistles but a stranger could walk up to it and drive it immediately. It would receive c.w., s.s.b., a.m., even f.m. quite happily, one could switch off the a.g.c., and above all it demonstrated the truth of the adage there's nowt that a single valve can do that can't be done nearly as well by a score of i.c.s plus a couple of hundred discrete transistors". Strong words from a man who can truly be said to know what he is talking about.

Finally

a note on an unusual variety of AR88 came from Mr. M. Dixon who has a sample with a blue/grey front panel, a main tuning dial without the bands designated alternately dark and light, and the tone control replaced by one labelled 'Diversity IF gain'. Well there's one clue for a start, because its fairly clear that this particular AR88 was used as part of a dual or triple diversity receiver set-up. The only information I have on this topic is the RCA handbook for something known as the DR-89 which is a receiving system made up from three AR88s mounted in a rack with a unit called a Tone Keyer and another called a Monitor Unit.

The handbook contains a wonderful dissertation on the principles and practice of diversity systems which is almost worth reprinting as a separate article, because it is a useful commentary on the clever engineering that existed in the 1940s and how those engineering skills were used to ensure continuity of h.f. service under difficult ionospheric conditions. If you have a DR-89 and want to use it, RCA recommend that your antennas are erected as an equilateral triangle with a minimum of 1000 feet along each side. Not quite the thing for the suburban garden. However back to the blue/grey AR88; the receivers shown in the DR-89 handbook have the normal black crackle finish and the tone control in place at the top left hand corner. There is however a small control knob labelled 'Diversity IF gain' fitted between and below the selectivity and noise limiter switches, the position matching that of the phones jack on the left hand side of the lower panel.

Having thus failed to identify Mr. Dixon's receiver I turned to the bible covering this subject, otherwise known as Raymond Moores Communications Receivers The Vacuum Tube Era: 1932-1981 and located on page 102 the very receiver listed as the CR-88A dating from the 1940s, having a smooth grey pane and forming part of the DR-89A triple diversity receiver unit. So presumably that is the end of the story, except for the fact that the CR-88A should have a crystal phasing control under the main tuning knob, so I am writing to Mr, Dixon to find out more about his particular receiver. The bible also mentions a rather tasty sounding CR-88B manufactured from 1951 which had push-pull 6K6s in the audio and a single band in use tuning dial. Has anyone actually got one of these? Incidentally, Raymond Moore's book has just come out in its 4th Edition and is available from the SWM Book Store. Since mine is only the 3rd edition I had better get my skates on before they sell out.

Finally, finally

I am looking for a BC-348 or BC-312 receiver for my own pleasure and would be willing to pay a fair price or better still swap one of my own receivers for it. How about my Trio R-820 as a straight swap? You'll never get a better deal than that (but it has to be an unmodified, complete and immaculate BC-348). Happy listening, and my thanks to all those who have written in appreciation of my efforts to show just how good the classics can be. At my age (62) there is a tendency to believe that older is better!

SWM

The ALA-1530 active loop antenna can be obtained from **Wellbrook Communications,**
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Beulah,
Llanwrtyd Well,
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Phone 01591 620316

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