Pat Hawker's Technical Topics

PAT HAWKER, G3VA
London 37/SE22 8SS

NEAR-TO-EARTH ANTENNAS

ON A NUMBER OF OCCASIONS attention has been drawn to the value of NVIS (Near Vertical Incidence Skywave) propagation for medium-distance contacts on such bands as 3.5, 7 and 10MHz as a means of largely overcoming the problem of the skip ('dead') zone. By directing the bulk of radiation at a high vertical angle at frequencies around the critical frequency, reliable working at distances up to a few hundred miles, without a skip zone, can usually be achieved. For military applications, this requirement has encouraged the use of compact transmitting loops or very low dipoles not more than about 10ft above ground (*TT* noted many years ago the marketing by Racal of a low dipole for this application). Conventional vehicle whip antennas, on the other hand, have a pronounced null in the vertical direction.

Traditionally, amateurs plan their antennas to provide maximum low-angle radiation and so enhance long-distance working, or use vertically-polarized antennas to maximise ground-wave propagation. As William McLeod, VK3MI puts it in 'Low Radiators and High Ground Planes' (*Amateur Radio,* November 1994, pp10-14): the accepted amateur criteria for horizontal HF radiators has traditionally been 'as high as possible' not only to take advantage of ground reflection but also to clear obstructions, particularly metal conductors and sizeable buildings. Yet, on the lower HF bands, for most suburban and portable locations these conditions of height and space are virtually impossible. Furthermore, in the real world, the ground reflector is anything but perfectly conducting and should be regarded as a lossy dielectric.

VK3MI points out that for 7MHz a height of 10m is a bare quarter-wave above ground; on 3.5MHz only an eighth-wave. This raises the question whether in practice it is worth striving even for this height. What sort of performance can be expected from horizontal antennas only a metre or two above ground? VK3MI summarises the factors involved with low horizontal radiators as follows:

- For low practical heights the radiation resistance at the centre of a resonant dipole remains within the 2:1 VSWR range for the usual coaxial cable feeder so matching procedures are minimal, more so when an electrical half-wave of cable is used to transfer the centre impedance directly to the transmitter: see **Fig 1.**
- Whereas the resonant length of a dipole remote from ground is mainly determined by the length-to-diameter ratio of the conductor, when the ground becomes an increasing part of the dielectric the length is determined by the height to diameter ratio: see Tables 1 and 2. Due to the wide spread of dielectric constant no simple formula can determine this ratio.
- The losses increase as height decreases towards ground level but do not become prohibitive until very low levels are reached; for a 7MHz dipole above common clay this can be as low as $\lambda/40$ (1m). [In desert conditions, an antenna can be laid directly on the sand, or even buried a few inches below the surface and yet still radiate reasonably well - G3VA].
- The 'cone' of radiation directed vertically, then reflected back from the ionosphere, can produce non-direction communication with no 'skip distance' to some 400-500km. This is NVIS transmission and is the mode supporting most of those semi-local nets on the 3.5MHz and 7MHz bands. There is usually some fading but for SSB reception the long AGC time-constant of the receiver will alleviate this.
- Two or three hop transmission can occur where the intermediate reflection points fall at sea so some long-distance working is possible in these favoured directions without low-angle transmission lobes. Land reflection points include greater losses which soon become excessive.

VK3MI in his Amateur Radio article provides detailed test results and tabulated data, including **Tables 1** and **2**. He sums up his results as showing that: "In general, the resonant horizontal dipole is an effective radiator at very low height from ground, particularly for NVIS transmission, or where a 'concealed' antenna is required. Losses increase seriously below $\lambda/30$ and the high impedance ends of the elements should have at least this amount of separation from ground or metallic earthed objects, towers and poles - but $\lambda/30$ is only 1.5m for the 7MHz band.

"Kevlar, Black Dacron, Polypropylene Baler Twine and Nylon Rope are all suitable insulating supports with far less end effects than the single egg-shaped strain insulator wired back to a steel tower which has been commonly used. Supports of this nature have been measured with 6 to 15pF coupling to the earthed object and Table 2 can be used to estimate the end effects of this type of support.

"With the elements double-insulated inside the popular 12mm polypropylene garden irrigation piping erected at 1.5m on the post side of a suburban wooden fence a very effective concealed radiator should result. For portable use a couple of 4m bamboo poles for end supports and a saggy dipole radiator require no apology as to effectiveness for NVIS transmission but directivity, if any, depends on local obstructions and reflectors."

Apart from considerations of possible RF

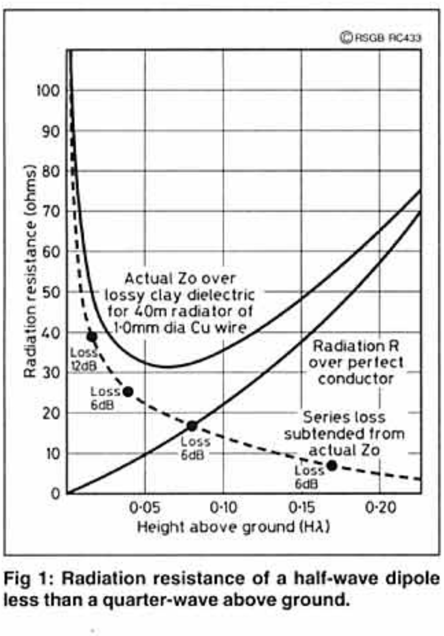

Fig 1: Radiation resistance of a half-wave dipole less than a quarter-wave above ground.

Horizontal dipole - 8m94 + 8m94 - nominal 33μH

Shape	Height (metres) End	Centre	End	Freq. kHz	Impedance Ω	'E'factor %	Measured C = pF
Level	2	2	2	7765	31.5	92.5	38
Saggy	2	1	2	7810	32	93	37
Level	1	1	1	7705	35.5	91.75	39
Droopy	0.05	1	0.05	6977	47	83	43
Level	0.05	0.05	0.05	4710	116	56	110

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Table 1: Effects of shape, close to clay ground for Dipole of 1mm dia. PVC covered wire - (hot, dry weather - green grass).

Level horizontal dipole - 8m94 + 8m94 - nominal 33μH

Height	Freq. kHz	Impedance Ω	'E'factor %	Measured C = pF	Resonant C = pF
2m0	7767	31R5	92.5	38	12.5
1m5	7745	32R	92.3	37	=
1m	7727	35R5	92	38	=
0m5	7550	45	90	40	=
0m2	7135	61	83	46	15
0m1	6400	70	76	87	=
0m05 (50mm)	4710	116	56	110	35

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Table 2: Effects of height above clay ground for Dipole of 1mm dia. PVC insulated copper wire - (hot, dry weather - green grass).

health hazards with high-power operation if the radiator is close to a living area (most current guidelines stipulate a minimum safe height of 30-35ft for high-power HF operation) there are other safety aspects that need to be considered. VK3MI writes: "Safety is an important consideration for both low radiators and for elevated ground planes. One part is physical in that any wires below 3m can be regarded as a trap for man and beast, including horses and wandering cattle. Even in daylight a thin wire can disappear against some backgrounds and at night is a very serious hazard. Therefore a protective, non-metallic guard-rail or fence is necessary, not just a coloured streamer tied in the middle of the hazard.

"Another aspect of safety is electrical as even at low power a nasty sting and RF burn can occur which, for non-technical people or for climbing children, can produce an emotional reaction far in excess of the initial injury. At medium power, around 100 watts, these effects can become severe and for higher powers the effect of corona and irradiation must also be considered. The use of unprotected low installations is not recommended for high powers and even for low power the radiator should be double insulated by enclosure in plastic pipe or conduit."

In his article, VK3MI also describes how by erecting an antenna above the double-pitched metal roof of a building about 20m long and some 6 to 8m wide, it is possible to obtain low-angle radiation: a system he dubs a 'Woolshed Reflector'. He also provides information on elevated ground-plane antennas and vehicle whip antennas.

SHARPER-RESONANCE STRIP-LINE FILTER

THE JANUARY 1994 *TT* (p40) included the experiences of P R Kemble, G3UYK in using a 144MHz strip-line filter (as originally described in *Radio Communication Handbook*) in overcoming the problem of the bursts of 153MHz data (paging) interference to 144MHz mobile reception, particularly in town centres, emphasising the relatively poor selectivity of VHF front-ends.

This item proved of interest to Uwe F W Keonneker, DL80BF of the Institute of Space Technology and Reactor Technology in Braunschweig, Germany. His problem was the reverse situation to that of G3UYK. Interference from a local 144.675MHz amateur radio digipeater to reception of BREM-SAT-signals on 137.800MHz +/- Doppler-shift. DL80BF built the strip-line filter as described in the January *TT* and found it no problem to detune the filter to 137.8MHz. Unfortunately the -3dB bandwidth proved to be 15MHz so that attenuation of the digipeater signals was insufficient. However, the insertion-loss was less than a dB despite the use of less than optimum materials for the strip lines (copper- and zinc-plated sheets of metal). This underlined that this filter-design would be beneficial for broad bandwidth and low insertion losses but unable to overcome the digipeater interference to their satellite receiver.

With the help of Ullrich Wintzer, DL7FZ, the filter was modified to give a sharper resonance though at some increase in insertion-loss. The modified filter design is shown in **Fig 2** and its characteristics shown in **Fig 3**. DL8OBF writes:

"Only two strip-lines are used with looser coupling, reducing the bandwidth but resulting in a rather higher insertion-loss of roughly 1.8dB. We have chosen galvanic coupling to the coax as this achieves better far-off rejection. For mechanical reason I used the more easily-available 'radial' capacitors with the value unchanged at 50pF. With the dimensions shown it is no problem to detune the filter to the amateur-band nor to use it for satellite reception. After cascading this filter with the pre-amplifier and a further commercially-made filter we completely eliminated the interference caused by the 144MHz digipeater.

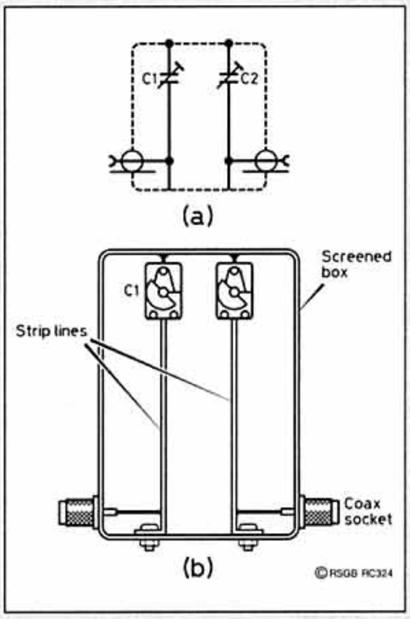

Fig 2: Modified strip-line filter with sharper resonance than the design shown in *TT* January 1994.

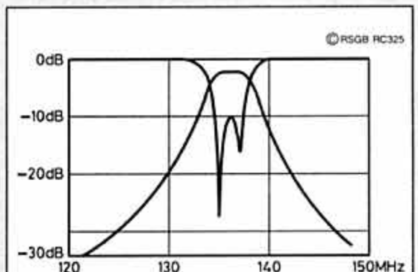

Fig 3: Return-loss and insertion-loss of the modified strip-line filter.

WHO NEEDS INTEGRATION?

TT, MAY 1991 told the 'Sad story of an electronic hobbyist' based on the account of Robert W Lucky in *IEEE Spectrum*. He explained how he had found that electronics home-construction, a hobby he had followed since youthful building of progressively more complicated radio receivers, hi-fi amplifiers, home-designed computers and writing software programs in the golden age of home-construction, had gradually been overtaken by 'keep-your-hands-off' commercial packages. He questioned whether there was any connection with the steady drop in enrolments in electronic engineering. I pointed out that amateur radio was one of the few remaining areas in which to some degree home-construction was still attractive and worthwhile - even if the golden age has lost much of its glitter.

Pierre Mosrin, F2WW draws attention to an article 'Integration: who needs it?' by an Edinburgh University lecturer, Alistair Armitage, in *Physics World* (November 1994, p80). Like Dr Lucky, his interest in electronics had been sparked off early on - in his case the result of "the long hours I spent as a youth mucking about with an electronics construction kit."

Building a succession of projects, with never enough components for more than one at a time, he found that "most of the fun came in building and debugging the circuit". Admittedly he learned "surprisingly little theory, despite the simple explanations included in the manual. Theoretical rigour (yawn) came later during my student days, and when I began teaching electronics. But I was left with an impression that tinkering with electronics was fun. This led me on to the hobby electronics magazines and the joys of our local hobby electronics store [but not apparently to Amateur Radio] . . . . Now, some 25 years later, electronics has moved on. The hobby shop has closed down due to a decline in the market. Why on earth should this be, when electronics is now seemingly all-pervasive . .

"The answer is simple: integration has killed the fun of tinkering with electronics. A glance at an RS catalogue illustrates my point. Why spend a rainy afternoon soldering transistors when you can buy a 'monolithic integrated audio amplifier' for the princely sum of 53p. turn on three pages and there is the ZN414Z receiver. this disgusting 10-transistor device provides a complete RF amplifier, detector and AGC circuit on one chip for 90p. What's even worse, the dratted thing only has three leads, labelled i/p o/p and gnd. I defy anyone to get any technical satisfaction out of building a circuit with that . . !"

But Alistair Armitage does find some positive benefits in integration: "The most important seems to be in digital circuitry and computing - an area only made accessible to the hobbyist through the advent of integration. and perhaps there will also be a renaissance in hobby electronics when we can design our own chips using home computers. Will we take our designs into the local high street silicon foundry for processing, in the way that we now get our photographs developed . . . We might then get back to the stage of mucking around with circuits, useful and useless, just for the hell of it. . . .While waiting, pass me my soldering iron - I've still a few transistors to stick into this Walkman I'm building."

TESTING A SCIENTIFIC CALCULATOR

A BBC TV programme recently drew attention to the errors that can arise when using certain computers; such chip errors may in some circumstances be very significant. An

WATERPROOFING DIPOLE TEES

THE PROBLEM OF providing effective waterproofing of the connection between a coaxial-cable feeder and an antenna element has been raised a number of times in *TT* and elsewhere but it seems worth emphasising that this is a perennial problem. As Dr J A Share, G3OKA puts it: "One of the curses of the British climate is the rain and the resulting tendency of rainwater finding its way into small openings and ruining any electrical contact with which it comes into contact. Over the past thirty years countless lengths of coax cable have been destroyed by rain water penetrating dipole-centre connections." [A major problem is that, particularly with air-spaced and semi-air-spaced cables, a single entry-point can ruin many metres of costly cable - G3VA].

G3OKA continues: "Some six years ago a simple waterproofing idea was noted in the *ARRL Handbook* in connection with a lightweight portable dipole design. This used a plumbers plastic Tee, three rubber bungs, DIY sealant, waterproof adhesive and some scrap fibreglass circuit board. Since adopting this practice and despite the rigours of six winters and summers, I have experienced no repetition of water penetration and the design **(Fig 4)** seems worthy of greater exploitation.

"The Plumbers Tee can be purchased from DIY stores (22mm ideal size) and suitable rubber bungs are available from stores selling home wine-making materials. A tube of black waterproof glue is recommended but clear Bostick would no doubt suffice. Superglue can be used but this makes it impossible subsequently to take the connection apart. Only a small amount of silicone sealant is required (left over from some other DIY project?). Since the full strain of the antenna is taken on the centre insulator, 3.2mm fibreglass PCB is recommended, but alternatively two pieces of standard 1.6mm board could be superglued together, but in this case it is essential to roughen the surfaces to be joined, otherwise the pieces will not adhere.

"Hold the Tee in a vice, force in the bungs and drill the holes with a hand drill, using sharp bits somewhat smaller than the required hole sizes. If done slowly and carefully the bungs will be a tight fit onto the coax/antenna-wire. Cut the centre insulator so that it is about 6mm less than the distance between the inside ends of the bungs; drill holes for the connections; and remove the unwanted copper from the centre of the insulator using a rough file or by tinning the entire area and then lifting off the copper using a sharp knife while the solder is molten.

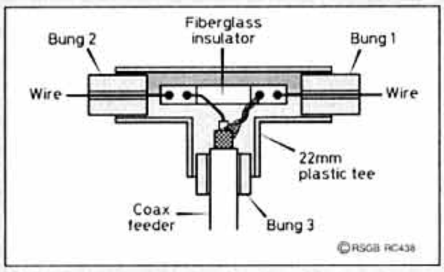

Fig 4: Detail drawing of the waterproof dipole Centre Tee.

"Fit bung (3) onto the coax and feed the coax into the tee so that it exists at one of the wire holes; feed the antenna wire through bung (1) and then through the Tee. Feed the second antenna wire through bung (2) and assemble the centre insulator. Ensure the solder joints are of high quality because it is difficult to resolder once the centre is fully assembled. It takes a little dexterity to push the insulator back into the tee, rather akin to a ship in a bottle.

"Apply Waterproof Bostick to the antenna wires close to the centre insulator and also to the inside of the Tee where bungs are going to be fitted. Slide the bungs into place and leave until the adhesive is cured. Fill the Tee-piece with the silicone sealant leaving space to fit the final bung. Curing time varies according to the sealant but at least 24 hours should be allowed. The final step is to coat the coax with more waterproof Bostick and glue the last bung into position.

"In practice, the whole assembly is light yet strong, and has withstood the wind-loading on a W3DZZ trap-dipole at 40ft in a location only a few hundred metres from the Irish Sea for the past six years without failure or water penetration.

anonymous *TT* reader has sent along a rigorous 'Engineer's test for any scientific calculator. Put calculator readout into degree mode and then press buttons as follows: 29°; sin; cos; tan; x^2; log x; 1/x; 1/x; 10^x; $\sqrt{x}$; arc tan; arc cos; and finally arc sin. The resulting readout should be approximately 29° of arc +/- 0.01.

A NEW LOOK AT THE MULTEE ANTENNA

IN CONNECTION WITH the quarter-wave folded dipole antenna, I included in the November 1944 *TT* (p62) an outline of the two-band Multee antenna originally devised by W6BCX and which has appeared for many years in editions of the *Radio Handbook*. However the dimensions given in Fig 11 were those given in *TT*, May 1965 and appear to have been taken from an article in *73* or *CQ*, although the rather different dimensions given in the text for a 1.8/3.5MHz version are as given in the *Radio Handbook*. The version reproduced in *TT* suggested open-wire line and not 300ohm ribbon with its lower velocity ratio for both the vertical and horizontal sections whereas recent editions of the *Radio Handbook* (including the 1992 edition) suggest that 300ohm open-wire TV-type line can be used. **Fig 5** shows the Handbook dimensions.

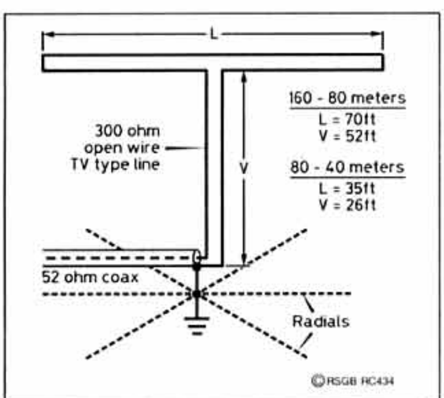

Fig 5: The Multee two-band antenna with dimensions as shown in *The Radio Handbook*.

Dr John S (Jack) Belrose, VE2CV has sent some pertinent comments on this antenna. He writes:

"I wonder whether anyone has fabricated a Multee - in my view it is certainly not a resonant antenna, but it does have interesting radiation characteristics. I can computer-model antennas, including folded antennas, provided that open wire is used.

"The purpose of my letter is to question the dimensions given in *TT*. You have suggested making the antenna out of 300W twin lead. [Actually the November *TT* referred to 300ohm *open wire* - G3VA]. This is not a good suggestion, since whatever the frequency (low-band or high-band) there is a large standing wave on the antenna. Also re-dimensioning the antenna raises the question of dimensioning the length of a radiator (which is independent of velocity factor) and dimensioning a transmission line (where the velocity factor is important).

"A folded dipole is a (sort of) complex radiator, since it carries both transmission line currents (out of phase currents) and radiating currents (the in-phase currents) on the two conductors. The velocity factors for these two modes are quite different when using 300Ω ribbon.

Let us consider a 3.75MHz half-wave folded dipole made with 300Ω twin-lead. The resonant dipole length for a half-wave radiator is about 123.2ft (37.55m), [half-wavelength times antenna factor] with an arm length 61.6ft or 18.77m. Whereas for the transmission line mode the length for a quarter wavelength is 53.86ft (16.43m quarter-wavelength times velocity factor). Therefore, for the antenna to function properly (better impedance match) you have to include shorting straps at the shorter dimension locations: see **Fig 6** for a folded dipole made from 300ohm ribbon as described in many editions of the *Radio Handbook*.

[The need for such shorting straps with folded-dipoles using 300ohm ribbon was described many years ago in *TT*, and an example appears in *ART7*, p265, derived from *The Radio Handbook* and which, incidentally, was

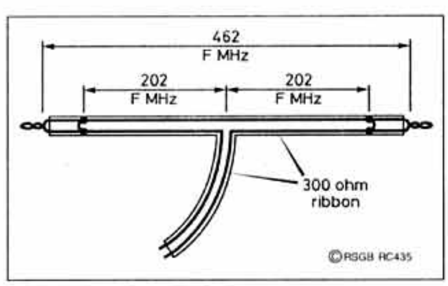

Fig 6: Single-band folded dipole formed from 300ohm ribbon feeder with shorting straps to compensate for the velocity factor of the cable as suggested for many years in *The Radio Handbook*.

used as a 14MHz antenna for many years at G3VA].

VE2CV continues: "All this raises the question: how to dimension the Multee when changing from open-wire line to 300ohm (ribbon or ladder) twin-lead? This begs the question concerning the original dimensions (dimension L2 is not a high-band half-wave times velocity factor). Furthermore, you cannot consider that the two-conductor transmission line forming he vertical element of the antenna acts like a linear (impedance) transformer, when it is fed in an unbalanced way (ie fed on one leg only).

"I have rather carefully modelled the 160/80-metre Multee, having the original dimensions for open-wire line, using a version of NEC-2. I modelled the antenna using 600ohm open-wire line (neither MININEC nor NEC can model transmission lines, particularly shorted (folded) lines, if the spacing between conductors is too small). I have assumed that the antenna is used with four insulated radials, 15.24m (50ft) long, as in the November *TT*. The height of the radials for my model is one metre, but this is not a critical dimension. I have assumed average ground characteristics (σ= 3mS/m, ε = 13).

The antenna is in the X-Z plane, the radials in the 45° planes. The input impedance, according to NEC-2 is 16 - j247Ω at 3.75MHz and 72 -j1059Ω at 1.9MHz (remember that the impedance of the open wire line for the model is 600ohm, not 300Ω). However it is clear that the antenna is not resonant in either the 1.8MHz or 3.5MHz bands.

"**Figs 7** and **8** show the computed radiation patterns. Indeed, the radiation characteristics of the antenna are as described, viz dominantly vertically polarized in the 1.8MHz band; for the 3.5MHz band the polarization is horizontal in the plane orthogonal to the horizontal element, and vertically polarized in the plane of the antenna. The asymmetry of the pattern in the plane of the antenna is interesting. The antenna's impedance will depend on the characteristic impedance of the transmission line used, the dimensions of the antenna, the length and height of the insulated radials, and to some extent on the characteristics of the ground beneath the antenna. A low-loss coaxial feeder must be used together with a good antenna system tuning unit (ASTU)."

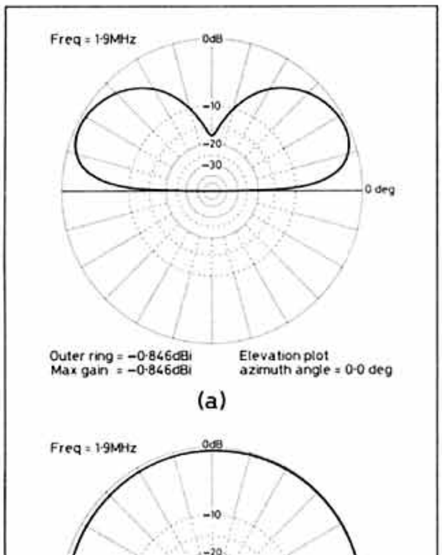

Fig 7: VE2CV's computed radiation patterns for the Multee antenna at 1.9MHz.

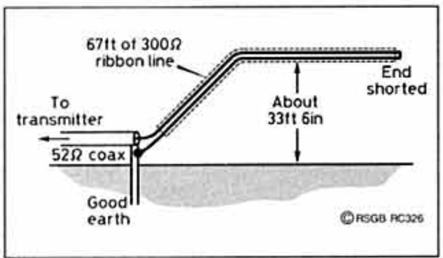

Fig 9: λ/4 ground Marconi antenna for 3.5MHz using 57ft of 300- or 450-ohm ribbon line. A good earth system (preferably including radials or elevated counterpoise) is needed for good performance.

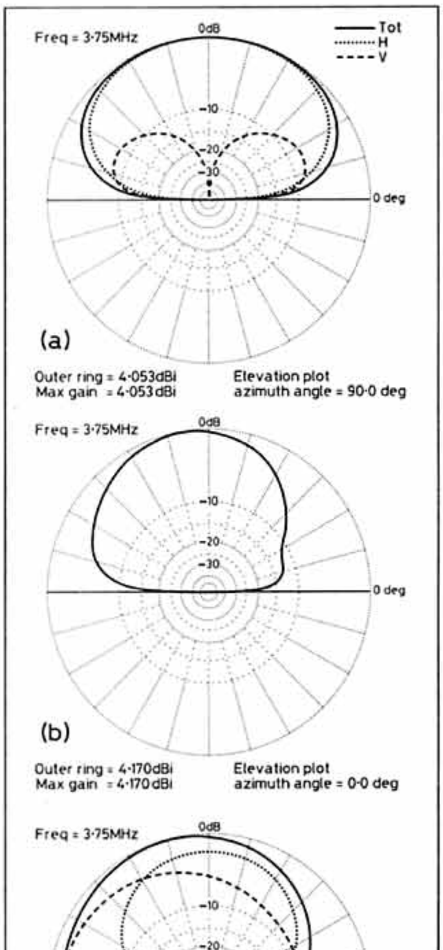

Fig 8: VE2CV's computed radiation patterns for the Multee antenna at 3.75MHz.

QUARTER WAVE MARCONI ANTENNA

AN OLD BUT STILL useful compact antenna idea for the lower-frequency bands is revived in *CQ*, June 1994. This is the λ/4 grounded Marconi antenna fed from coaxial cable using 300Ω or 450Ω ribbon feeder (or open line): **Fig 9**. For 3.5MHz some 67ft of cable is used and the length can be halved for 7MHz or doubled for 1.8MHz (preferable at double the height of the horizontal span). A good earth or radials system is essential. At low power, it is believed that a length of coaxial cable could be used short-circuited at the far end.

'CORROSION' BETWEEN DISSIMILAR PLASTICS

BILL COOPER, G4CIA, RAISES the question of whether 'corrosion' can occur between dissimilar plastics. This followed the discovery that after keeping a short power lead coiled up and held by a strong elastic band to the clear plastic cover of his computer chess set for a period of several months the power lead had etched several concentric grooves into the cover, deep enough not to be removable by polishing. He points out that this could have significant implications since it is not unusual for dissimilar plastics to be in close contact in expensive electronic equipment.

Since my knowledge of plastics technology is virtually non-existent, it seemed worth seeking expert opinion from Dr Dick Biddulph, G8DPS who writes: "The report from G4CIA of 'corrosion' between flexible PVC cable and a 'hard plastic clear cover' (probably polystyrene) is almost certainly migration of the plasticiser from the PVC which then attacks the polystyrene. Flexible PVC contains about 50% of one of several types of plasticiser some of which migrate faster than others. This can be felt with some cables as they become sticky with age.

"This is only likely to occur when flexible PVC is one component and the other is a simple thermoplastic such as polystyrene or acrylic plastic such as Perspex. It is very unlikely to affect thermosetting plastics such as phenolics (Bakelite), epoxys (Araldite) or polyurethanes (solder through wire insulation)."

THE 'OS-CON' ELECTROLYTIC CAPACITOR

EUGENE TRUNDLE in *Television* (December 1994, pp98-99) draws attention to a new form of electrolytic capacitor to add to the present ranges using aluminium and tantalum as the positive electrode in foil or solid form. This is the Os-CoN (Organic Semiconductor) capacitor, introduced by Sanyo, which has an electrolyte in solid form rather than the gel or solution of semiconducting manganese dioxide used in conventional types (**Fig 10**).

The electrolyte is based on the organic semiconductor TCNQ, a complex salt in a fine-powdered black crystalline form termed N-n-butyl isoquinolinium which in production is melted, inserted, immersed and cooled in carefully-controlled conditions. This new type of electrolytic capacitor would seem to be of particular interest for amateur radio equipment and switched-mode PSUs since its main feature is its good high-frequency characteristic, approaching that of a film capacitor and much better than that of a conventional electrolytic. Eugene Trundle states that "at frequencies above 100kHz a 47uF os-con capacitor is superior to a special low-impedance 1000uF aluminium capacitor whose physical size is twenty times greater." The temperature and frequency characteristics of an os-con are claimed to be such that it can replace three components in a noise/ripple filtering circuit: **Fig 11.**

Thus it would appear that the os-con eliminates the need to parallel a ceramic capacitor across an electrolytic in HF circuitry - a practice which, as shown in *TT* (May 1993, p58), may prove self-defeating. With the os-con, apparently, the increase in impedance above 1MHz, as shown in **Fig 12 and 13**, is caused by the inductance of the lead-out wires, which at HF should be kept as short as possible.

Fig 19, from the *Television* article, shows the construction of an os-con capacitor. There is an aluminium case with aluminium oxide as dielectric. But instead of a porous or vented seal the os-con has an impervious resin seal, since there is no electrolyte evaporation when in solid form. Sanyo are marketing the capacitors in tubular and surface-mounting forms. For a given type (capacitance value and working voltage) they are roughly equivalent in size and price to solid tantalum electrolytic capacitors, that is slightly bigger and rather more expensive than aluminium types; they are currently available with capacitance values from 0.1µF to 220µF and voltage ratings from 6.3V to 25V. The temperature coefficient of the os-con is superior to that of aluminium

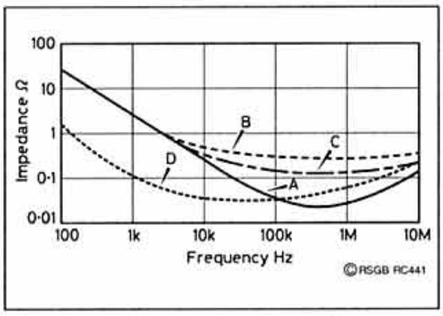

Fig 12: Frequency characteristics of different types of electrolytic capacitors at 25°C. A os-con (47µF, 16V); B low-impedance aluminium electrolytic (47µF, 16V); C tantalum electrolytic (47µF, 16V); D low-impedance aluminium electrolytic (1000µF, 16V). (Source *Television*).

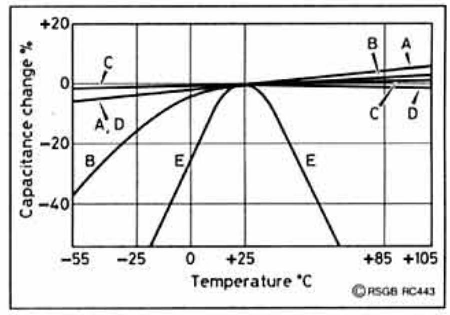

Fig 14: Temperature/capacitance characteristics of different types of capacitor. A os-con; B aluminium electrolytic; C tantalum electrolytic; D Mylar film capacitor; E ceramic capacitor. (Source *Television*).

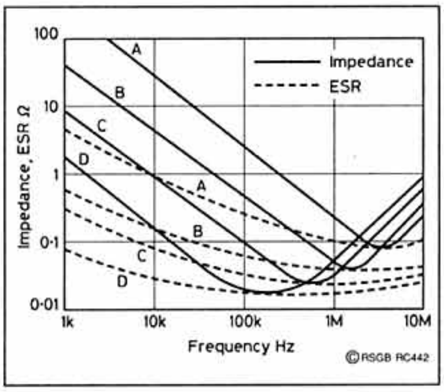

Fig 13: Os-con impedance and ESR ratings over the range 1kHz to 10MHz (at 25°C). A 0.47µF, 25V; B 4.7µF, 25V; C22µF, 6.3V; D 150µF, 16V. (Source *Television*).

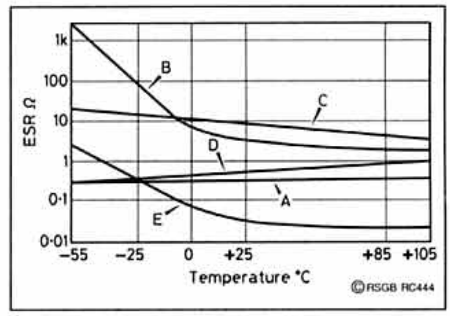

Fig 15: ESR/temperature characteristics of different types of capacitors. A os-con; B aluminium electrolytic; C tantalum electrolytic; D Mylar film capacitor; E ceramic capacitor. (Source *Television*)

and tantalum capacitors particularly at low temperatures (below 0°C): **Figs 14** and **15.** The ageing characteristics are also very different. With no electrolyte solution to dry out, there is a very gradual and relatively small capacitance loss over a very long time, with a life-span expected to extend to centuries at normal working temperatures. It is also claimed that, for example in switch-mode power supplies, the permissible ripple current with an os-con is about four times that of an aluminium electrolytic and about ten times that of a solid tantalum type. It would clearly be inadvisable to attempt to replace a faulty os-con capacitor with a conventional electrolytic.

Apparently the basic crystal formulation was first synthesised by DuPont and studied for capacitor use by Sprague over 30 years ago but production only became possible with Sanyo's development of a melting immersion method.

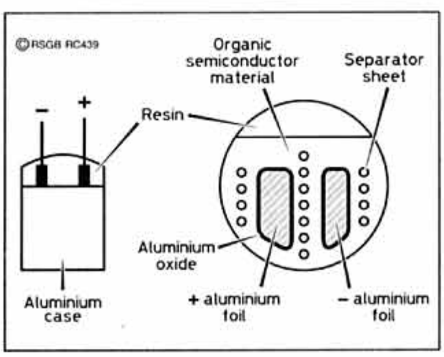

Fig 10: Construction of the OS-CON electrolytic capacitor introduced by Sanyo. (Source *Television*, December 1994).

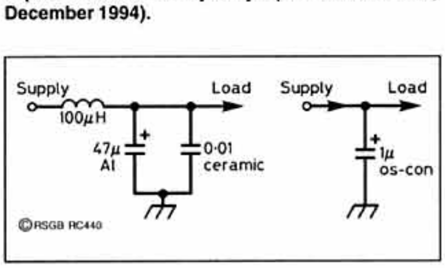

Fig 11: The temperature and frequency characteristics of an os-con capacitor enable it to replace three components in a typical noise/ripple filtering circuit. It is claimed that these two configurations both provide similar filtering over a wide temperature and frequency range. (Source *Television*).

HERE AND THERE

IVAN JAMES, G5IJ hopes that in the flurry of radio pioneering centennials, we do not forget the work of Admiral Sir Henry Jackson, president of the Society in 1922, the year in which the decision was made to change the name from the Wireless Society of London to the RSGB. In December 1895, the then Captain Jackson read a paper in the *Proceedings of the Royal Society* describing experiments by Jagadis Bose at Calcutta University who used equipment based on that shown by Sir Oliver Lodge in 1894 (see *TT* August 1994).

Jackson soon began to experiment with wireless telegraphy on the deck of HMS Defiance, then used as the Torpedo School in the harbour at Devonport. This was in early 1896, some months before the arrival in the UK of Marconi in March 1896, by which time Jackson had succeeded in sending and receiving messages over a distance of nearly one-and-a-half miles. The full story is told in *The Origins of Maritime Radio.* by R F Pocock and G R M Garratt (G5CS) from which both Jackson and Marconi (with whom he was soon in contact) emerge with great credit. As G5IJ puts it: "Let us hope that 1996 does not pass without some appreciation (by RSGB, RNARS or local societies) of the pioneering work of Admiral Jackson (1855-1929)".

Gordon Mather, G3GKA notes that the 'cohering' of lightly packed copper filings in a glass tube caused by 'oscillatory' current was the subject of a British Patent (No 156 of 1866) under the names of C and S S Varley as a means of providing lightning protection for telegraph stations, thus preceding the coherers of Oriesti (1884), Branley (1890) and Lodge (1894), although not for 'wireless' communications. (Source '*Science for the Citizen*' by Lancelot Hogben, p742). The use of a coherer for radio was indisputably a Lodge contributiion.

A practical application of 'high-temperature' (liquid nitrogen cooled) superconductors is being tested in the USA by the mobile cellular radio company Ameritech based on work by Illinois Superconductor. The idea is to use superconducting materials to form bandpass VHF/UHF bandpass filters at mobile base stations. Very much higher-Q is claimed than with more conventional techniques, making possible 'brick-wall' filters at UHF. See report 'Superconductors move into mobiles' by Charles Arthur in *New Scientist*, 24 September 1994, p17. ♦