Pat Hawker's Technical Topics

MORE ON THE 1:1 BALUN

THE USE AND ABUSE of balanced-to-unbalanced (balun) devices inserted between a transceiver and the antenna system, can still provoke heated debate. 'Heated' is perhaps the appropriate word since it is all too easy to use up appreciable output power from the transmitter in heating up the wires or cores of matching networks and baluns. It can be very revealing to measure power output before and after an ATU or balun especially on the lowest or highest band for which it is intended, eg 1.8 or 28MHz.

It is not surprising that many of those using dipole-type wire antennas prefer not to use either an ATU or a balun, depending on careful adjustment of the dipole element to resonance. It is, however, widely recognized that in the case of Yagi beam antennas a balun is highly desirable; there is also the question of TVI/RFI that can result from the radiation of current flowing on the outer braid of a coaxial feeder.

A long, detailed and valuable contribution to this debate has been provided by Jerry Sevick, W2FMI in 'More on the 1:1 balun' (*CQ*, April 1994, pp26-46, less some pages carrying advertisements). W2FMI reviews the various types of broadband 1:1 baluns, reviews some of the more significant balun articles that have appeared in (mainly) American journals, and also presents the results of his own experiments from which he has developed several workable designs. He covers the origins and practice of Ruthroff and Guanella ferrite toroid core baluns, the ferrite-rod balun, air-core baluns based on coaxial-line transformers, and the currently popular W2DU ferrite-bead 'choke' transformer.

In a section 'When to use a balun', he reports experiments with baluns used with a 14MHz half-wave dipole at a height of 0.17-wavelength, which gave a resonant impedance of 50**ohms**: "VSWR curves were compared under various conditions. When the coaxial cable was in the ground plane of the antenna (that is, perpendicular to the axis of the antenna), the VSWR curves were identical with or without a well-designed balun no matter where the outer braid was grounded. Only when the coaxial cable was out of the ground plane was a significant difference noted. When the cable dropped down at a 45-**degree** angle under the dipole, a large change in the VSWR took place."

From this one can deduce that with a dipole antenna, there is little or no need for a balun provided that with a horizontal element (or an inverted-vee that is balanced about its support) the coaxial feeder drops down vertically from the element. W2FMI continues:

"Feeding a Yagi beam without a well-designed 1:1 balun, however, is a different matter. Since most Yagi designs use shunt-feeding (usually hair-pin matching networks) in order to raise the input impedance close to 50Ω, the effective spacing(s) of **Fig 1** is greatly increased. Furthermore the centre of the driven element is actually grounded. Thus, connecting the outer braid (which is grounded at some point) to one of the input terminals creates a large imbalance and a real need for a balun. an interesting solution, which would eliminate the matching network is to use a step-down balun designed to match 50ohm cable directly to the lower balanced-impedance of the driven element.

"In summary . . . . it appears that 1:1 baluns are really needed for (a) Yagi beam antennas where severe pattern distortion can take place without one, and (b) dipoles and inverted Vees that have the coaxial cable feed lines out of the ground plane that bisects the antennas or that are unbalanced by their proximity to man-made or natural structures. In general, the need for a balun is not so critical with dipoles and inverted Vees (especially on 40, 80 and 160 metres) because the diameter of the coaxial cable connector at the feed point is much smaller than the wavelength." Fig 1 shows the various currents at the feed point of

USING SCRAP MOTORS, SCRAP TOASTERS

THE JUNE *TT* ITEM describing briefly how Ron Mathers, ZL2AXO had built a 230V petrol-electric generator from a salvaged lawn mower as the prime mover in conjunction with a similarly salvaged single-phase induction motor used as an induction generator attracted interest. But there were some doubts expressed by those who had not previously come across the idea that with capacitive excitation such motors can be used as generators by making use of their residue magnetism.

ZL2AXO in his article gave as reference a near 60-year old paper in an Australian professional journal: Bassett, E D and Potter F M "Capacitive excitation for induction generators", (*Trans AIEE*, May 1935, Vol 54, p540) which is unlikely to be readily available to many *TT* readers. However, Bruce Carter, GW8AAG writes:

"I was intrigued by the reference to the ZL2AXO generator and soon afterwards came across the following book in a local library: 'Electric Motors' by Jim Cox (Cox, V J), workshop practice series No 16, published by Argus Books, 1988, (reprinted 1992) 134pp, £6.95, (621.462), ISBN 0 85242 914 2. On page 47, the author provides a table of capacitance needed for 50 and 60Hz motors ranging from 0.25HP (0.18kW) to 2HP (1.5kW). Apparently, the values are better 'understated' since higher values confer no advantage. Cox's chapter on stepper motors (including disc drives) is enlightening. The chapter on identifying and using scrap motors is required reading."

To quote further from ZL2AXO's *Break-in* article: "In operation, as load is applied to the generator the terminal voltage needs to be kept constant by opening the throttle of the petrol motor. This increases the speed and results in an increase in the frequency.

The frequency is proportional to the rotor speed minus the slip speed which at full load is about 150rpm. With a load of 500W the frequency rises to 56Hz. This rise is unlikely to be a problem in normal use apart from electric clocks running fast. To assist in the setting up of the generator a frequency meter was built up using an old Jonan automobile tachometer driven by a nine volt transformer. The speed of the generator at no-load is just over 3000rpm. This needs to increase with load until at 500W output an estimated 3500rpm is reached. On the petrol motor shaft a pulley of 095mm (3.75in) diameter drives a 0.50in vee belt to a 76mm (3.50in) diameter generator pulley."

G3ERY finds that the high-impact plastics case of a discarded toaster (top) can be transformed into a housing for an antenna tuning unit, etc (bottom).

The building of a 230V AC generator from scrap is in the proud tradition of amateur radio in the days when the idea of simply buying new purpose-made equipment (even if available on a limited market) would have broken the budgets of many enthusiasts, particularly the younger generation. It bred a generation that tended always to think twice before throwing away any discarded household items that could conceivably find an amateur-radio application.

Recent notes on salvaging components from old microwave ovens (*TT*, November 1993 and February 1994) encouraged John Wood, G3EAY to look carefully at his toaster when this proved to be beyond repair. He writes: "There were no electronic components to salvage, but the high impact plastics case looked interesting. With a little modification this has been transformed into an attractive housing for an antenna tuning unit. The case was lined internally with aluminium foil, stuck on with high-impact adhesive. The illustrations show the toaster case, before and after.

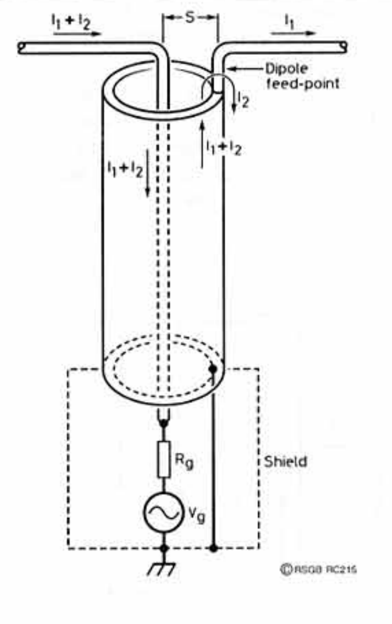
a dipole. I1 is the dipole current and I2 the unwanted inverted-L (imbalance) current on the outer surface of the braid.

W2FMI argues that "even though I consider some of the amateur articles [on 1:1 baluns] significant, their impact upon the use and understanding of these devices has not always been positive. In fact, in some cases just the opposite has been true." He points out that there are only two significant articles in the professional literature that provide the fundamental principles upon which the theory and design of this class of transformers are based, with later investigators only really extending the work of the two authors:

"The first presentation on broadband matching transformers using transmission lines was by G Guanella "Novel matching systems for high frequencies" (*Brown-Boveri Review*, Vol 31, September 1944, pp327-329). He coiled transmission lines forming a choke such that only transmission-line currents were allowed to flow no matter where a ground was connected to the load: **Fig 2(a)** . . . . The second article was by C L Ruthroff "Some broad-band transformers" (*Proc IRE*, Vol 47, August 1959, pp1337-1342). His 1:1 balun, **Fig 2(b)** used an extra winding to complete (as he said) the path for the magnetizing current with the third winding (5-6) on a separate part of the toroid forming a voltage divider with winding (3-4)." A modified form of the Ruthroff balun was introduced later by Turrin, W2IMU: **Fig 3**.

The two-conductor Guanella 1:1 balun came to be known as the basic building block for this whole class of broadband transformers. It not only presents a balanced power source to a balanced antenna system but can also prevent an imbalance current (an inverted-L antenna current) by its choking reactance when the load is unbalanced or mismatched or when the feedline is not perpendicular to the axis of the antenna.

After comparing the performance of the



Radcom Tech Topics fig 71, RC215 August 94
(50%= 1column)

Fig 1: The various currents at the feed point of a dipole element fed from an unbalanced coaxial cable feeder. I1 is the dipole current and I2 the unwanted inverted-L (imbalance) current on the outer surface of the cable braid.

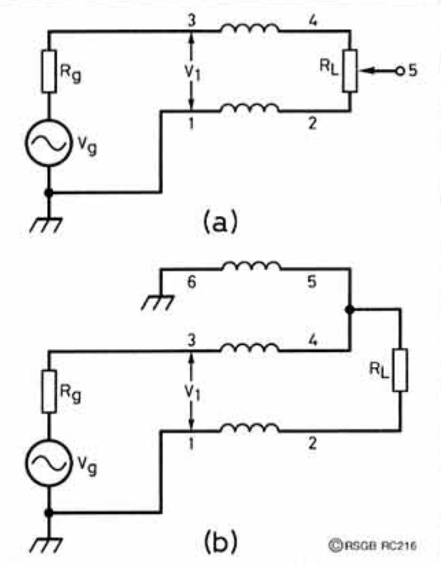


Fig 2: Two versions of the 1:1 balun as described by W2FMI. (a) The Guanella balun and basic building block; (b) the Ruthroff balun as originally drawn.

various forms of 1:1 transmission line baluns that have been described in the amateur literature, W2FMI provides details of low- and medium-power versions of his favoured bifilar toroidal (Guanella/current) 1:1 baluns. The low-power versions are capable of handling the output of most HF transceivers; the medium-power versions the full [American] amateur legal limit. **Fig 4** shows two versions of W2FMI's bifilar toroidal 1:1 baluns.

His baluns are capable of providing efficiencies of near 99% at 1.8MHz and 97% at 30MHz with type 250 ferrite material provided that the system is well matched. When a balun is exposed to a high impedance (VSWR of 2:1) voltage, the loss increases by about 40%; with a VSWR of 4:1 the loss doubles and with a VSWR of 10:1 the loss is more than three-fold.

W2FMI summarises his views on 1:1 baluns as follows: "In preparing this article I was quite surprised to see the ferrite- and powdered-iron-core 1:1 balun designs that have been available in the literature and elsewhere since 1964. They not only had poor low- and high-frequency responses, but they were also susceptible to flux in the cores at their low-frequency ends. Furthermore, since they only used single-coiled wires, they were also prone to voltage breakdown. No doubt, these designs were responsible for the poor reputation that the balun has had for many years.

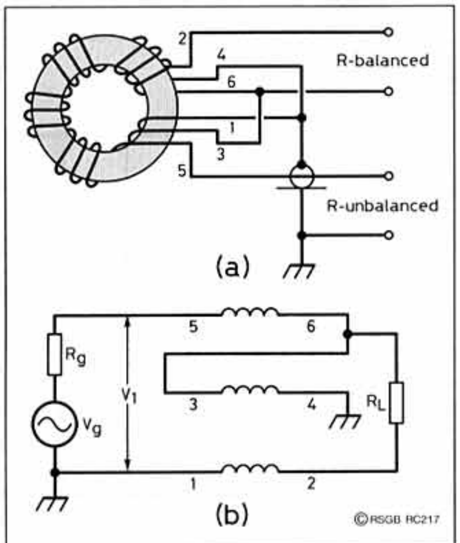


Fig 3: (a) Pictorial representation of Turrin's 1:1 balun, and (b) the schematic.

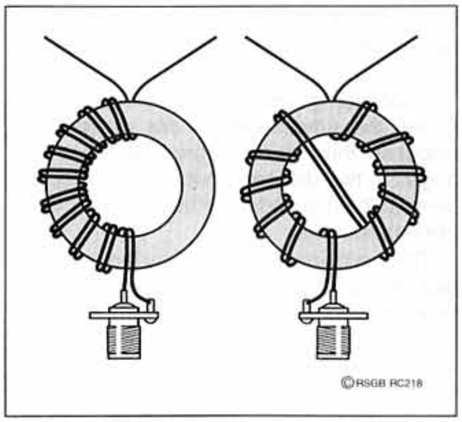


Fig 4: Illustration of two of the many versions of W2FMI's preferred bifilar toroidal (Guanella/current) 1:1 balun. The one on the right uses the cross-over technique of W1JR as used in his 1978 HF broadband balun.

"It was not until 1978, when Joe Reisert, W1JR published his article "Simple and efficient broadband balun" (Ham Radio, September 1978, pp12-15 see also ART7, p334), see **Fig 5**, using thin coaxial cable wound on the toroidal core that a balun became available with all of the attributes of a good design, namely: (a) Is efficient because it uses a low-permeability core; (b) has sufficient choking reactance to meet its low-frequency requirement; (c) is not prone to flux in the core (and hence, saturation) since it has no third winding; (d) has a 50**ohm** characteristic impedance and thus maintains a 1:1 transformation ratio with a 50ohm load; (e) has a good

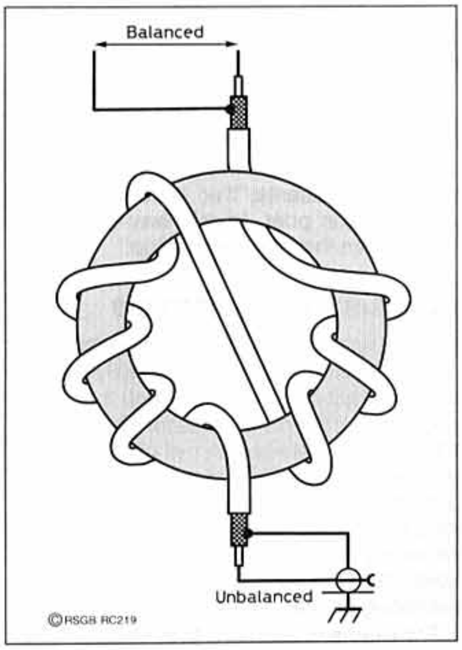


Fig 5: W1JR's 1978 broadband balun based on a thin coaxial cable winding. This used an Indiana General F368-1 Q1 core with some 12 turns (36-40-in of RG-141/U cable) and covering 3.5 to 30MHz with reduced efficiency on 1.8MHz. For use over 7-30MHz ten turns of cable should be sufficient and TC9 core might prove more suitable for lower frequencies. The basic design can be used at VHF if attention is paid to layout and lead lengths.

voltage breakdown capability (1.9kV); and (f) can handle a mismatched and/or unbalanced load.

"Succeeding investigators, however, failed to see the advantages of his design and proposed their own. Surprisingly, they belonged to two distinct groups. One favoured 'air-core' baluns and the other 'choke' (beaded-coax) baluns.

"The main argument given by the 'air-core' followers was that their balun would never experience the problems with saturation while the 'ferrite-core' balun would. The Reisert balun, however, is a current/choke type balun which could only have flux in the core by the imbalance (inverted L) current, which is much smaller than the transmission line currents. In fact, with any degree of choking reactance by the coiled transmission line, the imbalance current is essentially negligible. Therefore, saturation is not a concern with a Reisert type balun. But in all fairness, it would be pointed out that with the 4:1 current/choke and voltage baluns it is a different story. All three of these types of baluns have a 'magnetizing inductance' in their low-frequency models and hence a possibility of saturation with a poor design.

"The advocates of the 'choke' 1:1 balun claim that their beaded-coax balun can't saturate while the bifilar (current) toroidal balun can. This is entirely wrong, since they are basically the same kind of structure – neither has a third conductor which could allow a flux-causing current at the very low-frequency end. But of all the attributes listed above for the Reisert balun, the first one has the 'choke' balun at a disadvantage in the HF band. Since its transmission line is not coiled about a toroid, it does not have the multiplication factor of N-squared (due to mutual coupling) where N is the number of turns, while the toroidal balun does. Therefore, higher-permeability beads are required in order to obtain sufficient choking reactance. This results in lower efficiency."

In his final remarks, W2FMI admits to being quite sure that some readers will disagree with his views and/or think they have better designs than those of the Reisert baluns and the ones he presents: "If so, I encourage them to respond in print. In this way we will all benefit from the new information."

SOLID-STATE 'FIRSTS'?

THE NEWS ITEM in the February *RadCom* 'The Transistor Transmitter is Forty' continues to attract comment, although it must be stressed that the claim made for the February 1954 contact between Yeovil (G3CMH) and Haslemere (G3CAZ) was for the first 'skywave' contact using a transistor transmitter and not for a first contact using a solid-state device, for which there are records dating back at least 70 years, to the pre-transistor era of oscillating crystals.

For example, in an article in *Vintage Wireless* ('An invention that changed the world', Part 1 Vol 19 No 1) on the birth of the transistor, I noted that "although the transistor [born 1947] was clearly the first [practical] solid-state near equivalent to a triode valve, there was already a long history of crystal devices that could function, albeit unreliably, as amplifiers and oscillators . . . .

" . . . . there had been a flurry of interest in the 1920s, when peaking in 1924, articles in *Wireless World* described work by the Russian engineer O Lossev on oscillating and amplifying zincite crystal detectors . . . . Lossev had investigated many circuit possibilities for receivers and even low-power transmission: 'Using some of the circuits described, it has been possible to achieve transmission over a distance of one mile. On both sides the crystal served simultaneously as a generator and detector, so that even duplex transmission was possible.'. . ."

In 1953, the year before the Yeovil 3.5MHz skywave contact, Francis Ladd, W2IDZ made several 50MHz contacts using a point-contact transistor transmitter. He writes:

"I have some accomplishments using transistors that I would like to pass on. On March 7 and 8, 1953, I had CW contacts with W2WCM using a point contact transistor [input power 135mW]. I then modified the circuit for phone. The resulting signal was narrow-band FM. I had a phone contact with W2WCM on March 9. W2WCM then duplicated my transmitter and on March 10 we had two-way phone and CW contacts using transistor transmitters at both ends. All contacts were made in the 50MHz band and were prearranged. On March 10, I had a CW and phone contact with W2MEU which were not prearranged. I wonder if any of these contacts were records?"

W2IDZ sends along a photocopy of his log in which he recorded against the March 7, 1953 contact with W2WCM "My first QSO using a transistor transmitter . . . . I believe this is 1st 50Mc QSO using transistor." **Fig 6** shows the circuit diagram of W2IDZ's transistor transmitter as used for his first CW QSO at 1912 (local time) on March 7, 1953, as recorded in his log.

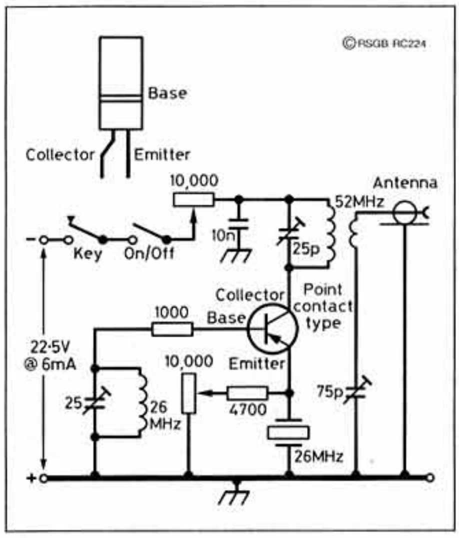


Fig 6: Circuit diagram of the CW transistor transmitter used by W2IDZ for his first 50MHz transistor contact at 1912 local time on March 7, 1953.

HOME-BREW BURGLAR ALARM

D S BROWN, G0LYX notes the increasing number of burglaries involving garden sheds, outhouses, garages etc, some of which form radio shacks with relatively costly equipment.

He provides details of a simple alarm circuit incorporates a switch-off delay circuit as now required by law.

He describes the functioning of the circuit diagram shown in **Fig 7** as follows:

(1) Mains on, press reset to activate TR1. This puts supply to on/off switch and lights the LED indicator.

2) On/off switch is placed to 'on' position. Power applied to TR2 which is in cut-off state when door/window micro- or magnetic-switch line is closed.

(3) Switch line broken. TR2 conducts activating Relay 2 which locks 'on' and simultaneously breaks circuit holding TR1 conducting. The time-constant of R1-C2 of approximately three to five minutes holds relay Rly 1 until discharged when supply to R2 is switched off (contacts 6-7 on Rly 1 also break, preventing circuit activating until reset button is pressed.

Note that the time that the alarm sounds can be varied by altering the values of R1-C2. In Fig 76 Rly 2 contacts are shown when reset button is pressed, those of Rly 2 when alarm is inactive.

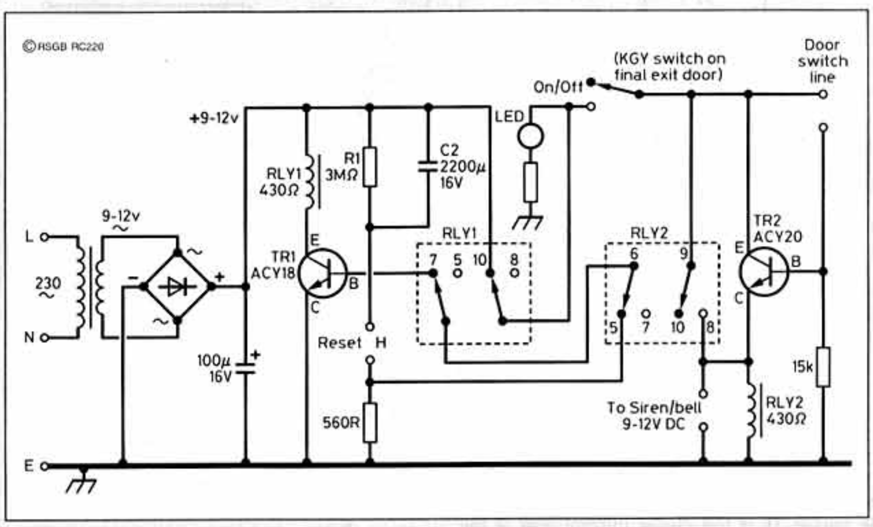


Fig 7: G0LYX's simple burglar alarm can be used to protect radio shacks, sheds, garages etc.

A CENTURY OF RADIO-TELEGRAPHY!

IN THE MARCH *TT* item 'The sound of spark', a brief reference was made to the fact that in August 1894, Professor Oliver Lodge of the University of Liverpool publicly demonstrated for the first time anywhere in the world that Hertzian waves could be used for telegraphic signalling in the Morse code.

A detailed appreciation of this historic event on August 14, 1894, together with an account of the many other – too often overlooked – pioneering achievements of Lodge has been described by Dr Brian Austin, G0GSF in a five-page article 'Oliver Lodge – The forgotten man of radio?' in *the Radioscientist*, Vol 5, No 1, March 1994, pp12-16: "When Lodge performed his demonstration he [like Hertz before him] made no claims for the eventual usefulness of his technique but it is the first recorded occasion on which intelligence was transmitted through space without wires. For a practical application of radio the world had to wait for the arrival in England of Marconi in 1896 . . . .

"At that demonstration in Oxford, which was at a joint meeting of physicists and physiologists on the subject of vision, Lodge transmitted Morse code letters from his induction coil and spark gap transmitter in the Clarendon Laboratory to a receiver some 60 metres away in the Oxford Museum. He described it as 'a very infantile form of radiotelegraphy', a statement reflecting his modesty but significant because it established what he had actually done when the induction coil was actuated by a Morse key operated by his assistant E E Robinson.

The receiver (**Fig 8**) consisted of a coherer, a Lodge invention, which was connected to either a Morse recorder which printed onto tape or a Kelvin marine galvanometer, the deflected light spot of which made viewing by the audience easier." By about 1897, Lodge was using his 'definitive radiator' antenna system (**Fig 9**) which as G0GSF emphasises was an early form of biconical antenna.

G0GSF shows that Oliver Lodge made many other significant contributions including an attempt in 1894 to detect radio emissions from extra-terrestrial sources, most notably the sun. The experiment failed because his coherer detector of centrimetric waves was not sufficiently sensitive but is recognized as the first attempted experiment in radio astronomy and preceded the successful experiment by Jansky some 37 years later.

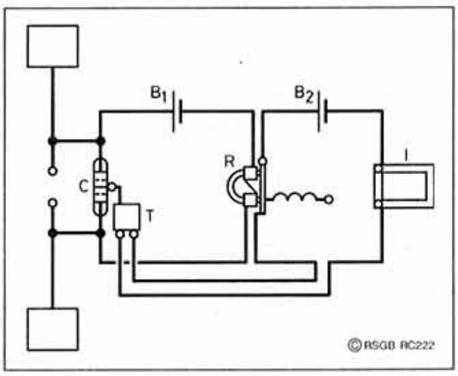


Fig 8: The receiving system used by [Sir] Oliver Lodge on August 14, 1894 at Oxford when Morse signals were received and demonstrated for the first time. B1, B2 batteries; C, coherer/T, trembler; R - relay; I inker.

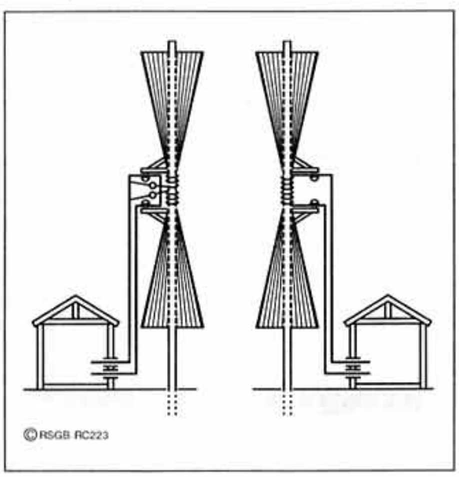


Fig 9: By about 1897, Lodge had developed transmitting and receiving antennas similar in form to the modern biconical antenna.

'KISS' VK2ABQ 14MHZ BEAM ANTENNA

VERSIONS OF THE 1973 VK2ABQ three-band two-element parasitic wire array (ART 7 etc) continue to attract interest: see for example 'Antenna Workshop' by Peter Dodd, G3LDO (*Practical Wireless*, June 1994, pp42-43) in which he traces an earlier but basically similarly shaped single-band version to W1QP/W8CPC in *QST*, October 1937. More recently, Fred Caton, VK2ABQ (formerly G3ONC) has described several even simpler and/or smaller single-band arrays, including a KISS array in *TT*, May 1992, p37. (But note that he has pointed out that the gaps between the elements given as 4-inches should have been 4-mm or about 0.25-in).

VK2ABQ has now sent along details of a simple array that does not use the 'square' folding with crossed X-type bamboo spreaders, but retains the small gaps between driven and parasitic elements. This can be erected as shown in **Fig 10** as a single-mast, inverted-vee type structure or (for a fixed array) as a conventionally suspended array using a cantenery rope in lieu of the mast.

What VK2ABQ calls the phase adjustment gaps are adjusted for equal power in the two half-wave elements, as discussed in the earlier May 1992 item. He has, however, provided details of an improved 'current sampler' giving better position stability and greater sensitivity and, in his letter, provides some further hints on construction and adjustment but I find these a little confusing, and hope that the information given above and in the May 1992 *TT* will at least prove a starting point for investigating this simple directional antenna.

VK2ABQ acknowledges that modelling of this antenna was first done on 144MHz by VK3KZ in Melbourne who built a 7MHz version which proved very effective on long-haul DX to Europe etc. VK2ABQ claims that his antenna outperforms a much larger standard 2-element Yagi array and has a forward gain of the order of 5dB and a front/back ratio of over 30dB.

I suspect that other users may find the forward power gain of such an array to be rather less impressive when compared to the theoretically possible gain for a close-spaced two-element Yagi array of 5.2dB. Nevertheless, it should provide a useful power gain and a good front-to-back ratio.

In *TT*, October 1983, attention was drawn to the use by the IBA (now NTL) of a medium-wave vertical monopole antenna with a sloping twin-wire reflector. This approach gave a single-mast array with vertical polarization, providing roughly 3dB forward gain and an f/b ratio of from 5-15dB and better than 20dB in laboratory studies.

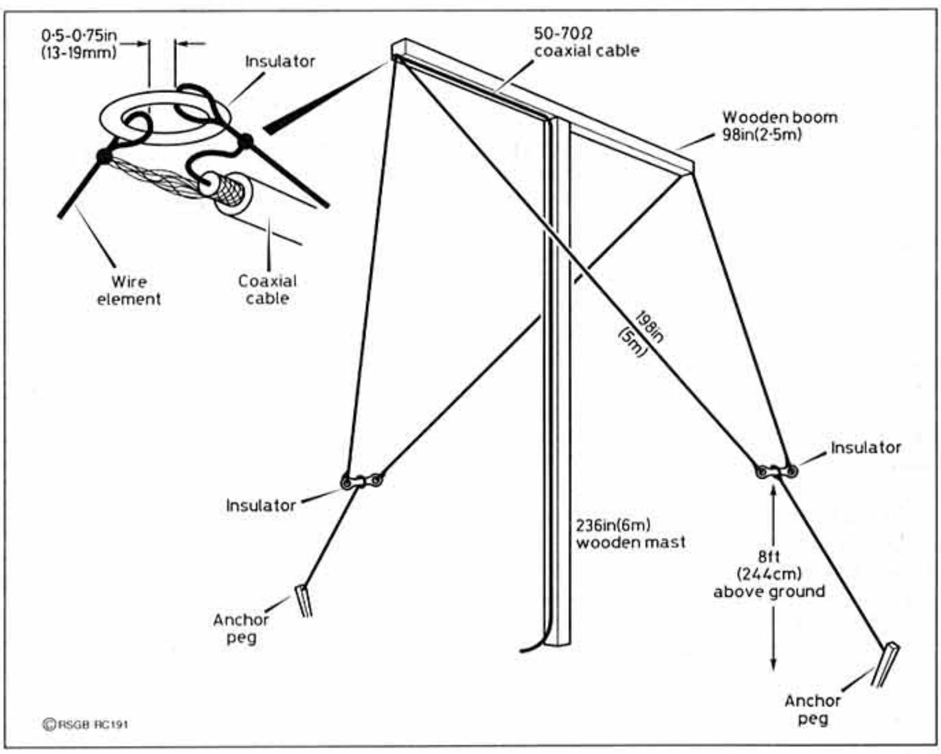


Fig 10: 2-element 14MHz 'KISS-type' beam antenna in inverted-vee form with the end 16-feet above ground level. It can be rotated at ground level by moving the ground pegs. Note that the two-dimensional representation shows the 90-deg angles as acute angles.

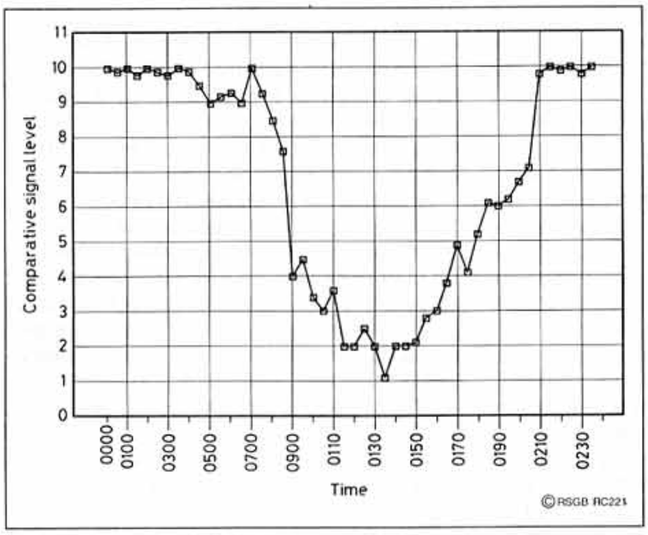


Fig 11: Plot of 1.8MHz signal levels over a 126-mile path during a September day made by G4HOJ showing that although 'daylight' existed for some 13 hours, only 4-5 hours show low levels of skywave enhancement with signals still peaking at regular intervals even through this period.

DAYLIGHT PROPAGATION ON 1.8MHZ

IN THE 1970s when I was involved with answering listeners' complaints about interference with the reception of the early Independent Local Radio medium-wave stations, it soon became obvious that the D-layer which absorbs MF sky-waves from distant high-power stations during 'daylight' does not reform immediately at dawn and (particularly in the winter months) begins to lose its absorptive characteristics some time before dusk. This has the effect that interference from distant MF broadcast stations can be quite severe during much of a 'winter day'.

From an amateur viewpoint it is worth remembering that the 1.8MHz band is an MF band and not HF (MF spectrum 300 to 3000kHz). Contrary to simplified theory, sky-wave propagation is not limited to night-time.

This point is underlined by investigations made by P Hobson, G4HOJ in the course of developing a computer program which would model and predict the performance of short loaded whip antennas. In the course of this he built about 80 different whip antennas to explore all the different parameters. His work led to really accurate computer modelling.

He writes: "Most of the text books describe 1.8MHz as having a useful working range of around 50 miles in 'daylight – when no skywave is present'. Yet I found that I could frequently work up to 150 miles to good fixed stations, and sometimes more, even at lunchtime when much of the testing was done. This encouraged me to explore the belief that sky wave propagation was often present on 1.8MHz even at noon on a summer's day.

"After a few random checks I decided that the best appliance to take the tedium out of regular and frequent checking was the computer. I wrote a short program which made the computer check the voltage on a particular port every 2 seconds, and then to record the highest level reached during successive one minute periods.... The results obtained gave no specific measurement, but rather a comparison between the signal received at a specific time of day and the best night-time signal when high levels of skywave enhancement were present. Information could be displayed on screen, or printed out.

"With a very stable, home-brew VXO receiver and a low active antenna, positioned to reduce response to ground-wave signals to a minimum, tests were made on a number of incoming signals, at different distances, repeated on a number of days. The equipment recorded signal level and time of day. The sampling method chosen did not record peaks and troughs since these were often so short in duration that they were missed.

"A plot made during one September day, (one of the poorest signal days) is shown in **Fig 11** with sunrise about 0525GMT, sunset about 1825GMT. Maximum temperature 22°C, minimum 10°C on a signal over a 126-mile path. Note that although 'daylight' lasted for 13 hours, only 4-5 hours show low levels of skywave enhancement. It would appear that at no time throughout the day was enhancement completely absent, although the signal levels, at their lowest, might not be usable for communication purposes at noisy locations. But from a quiet site, the enhanced signals are useful on almost every day. Occasionally, the signal levels can be high even at noon.

"Winter days seem to produce wider differences although there is more enhancement right through the day."

G4HOJ sums up his results (which have been truncated in these extracts) as "proving to my satisfaction that 1.8MHz completely out-performs the alternative bands, particularly for mobile working, when short/medium distance is the objective. Perhaps more important is the reliability of the band, both from day-to-day and difficult terrain viewpoints. While this is appreciated by those who have used 1.8MHz in the past, there are many who remain unaware of the virtues of this band."

G4HOJ's home QTH is a village several miles from Swindon where the electrical noise level is presumably reasonably low. I recall making daytime contacts of over a hundred miles on 1.8MHz in the distant days when I operated from Minehead, Somerset. A very real problem in urban and suburban locations, at least in London, is the high level of electrical noise that can swamp weak daytime signals from more than a few miles away. Even without sky-wave enhancement, reliable 1.8MHz ground-wave signals between quiet sites having good ground conductivity can comfortably exceed 50 miles and proba-

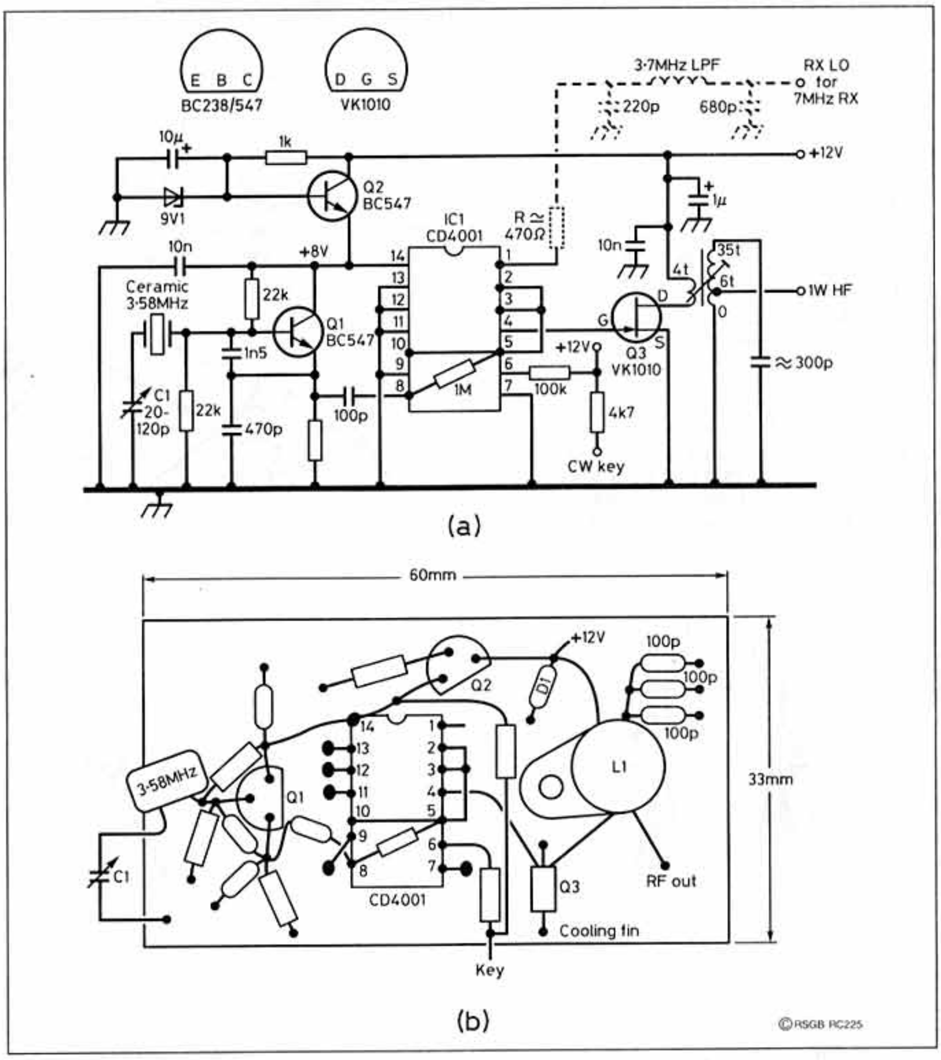


Fig 12: LA8AK's version of the QRP (1W) transmitter using a ceramic resonator in a variable frequency oscillator covering the 3.5MHz CW band.

bly well over 100 miles, particularly on over-sea paths. The main snag is the low level of day-time amateur activity. However, perhaps G4HOJ's propagation experiments will encourage more use of this interesting and valuable MF allocation.

HERE & THERE

ADDING TO THE *TT* ITEM 'Variable-frequency ceramic oscillators' (May 1994, pp54-55), Jan-Martin Noeding, LA8AK has modified the G3BBD QRP transmitter circuit, using a few transistors and a CD4001 ic instead of the CD4069: **Fig 12**. He writes: "A 100 or 120pF tuning capacitor, covers the 3.5MHz CW band and RF output is about 1-watt.

"For simplicity, a parallel-tuned output circuit is used. Harmonic radiation may be reduced by using a good pi-network filter, provided that the input impedance is much higher than the load impedance. With 50Ω input/output with a single coil pi-filter, the harmonic attenuation is negligible below about 10MHz. The CMOS inverting amplifier (pins 8, 9, 10) solves the problem of the variable drive from the oscillator. If used for a receiver local oscillator, additional components may be required to establish constant RF voltage over the tuning range, in LA8AK's case for use with a 7MHz direct-conversion receiver using a RA3AAE-type harmonic mixer as mentioned in the May *TT*. **Fig 12(b)** shows how the main components for a QRP transmitter may be located using dead-bug mounting on the PCB earth side, with the IC and transistors installed upside down. L2 is 10mm diameter with iron core, dipped to 3.6MHz.

Bruce Carter, GW8AAG, provides a solution to the problem that is encountered when a coaxial cable (or other stiff conductor) has to be clipped tight to a wall, but at a corner such a method is likely to seriously damage the electrical and physical characteristics of the cable. His solution is to make use of the property of a tangent to an arc of a circle. Treat the cable run as forming a semicircle or quadrant as it approaches the corner.

The hard line of the corner is then a tangent over which the cable can 'slip' in an inch or so: see **Fig 13**. GW8AAG adds that the corner can be internal or external including two walls, a wall and floor, or a wall and a ceiling. Even a cable along one side of a sheet can be satisfactorily taken to the edge and back down the other side. Furthermore, the angle of attack to the corner does not necessarily have to be at a right angle.

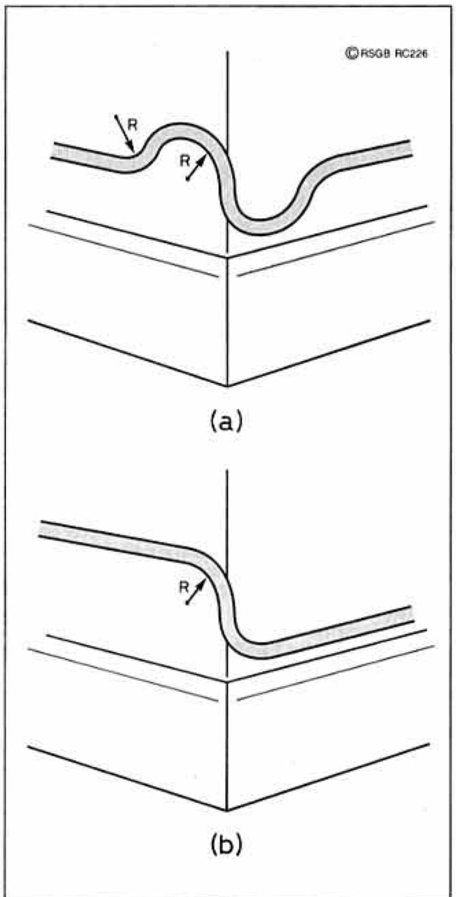


Fig 13: GW8AAG's method of overcoming the problem of taking a coaxial cable around a 90deg corner when the cable needs to be clipped tight to the walls. (a) Where it is necessary to retain the cable run at the same level; (b) where the cable run can be at different levels. R is the permitted minimum radius for the cable in use.

Two German theoreticians, L Molgedey and H G Schuster, have produced what may be a mathematical explanation, and specification of a neural network to go with it, of the so-called 'cocktail party effect' ie the problem of disentangling meaningful signals from a background of otherwise distracting noise: see an article 'Cocktail party effect made tolerable' by John Maddox (*Nature*, 16 June 1994, page 517). They go so far as to mix together two library records of crying babies and show that the separate sounds can be successfully disentangled from the mixed signal by a straightforward application of their technique. No doubt the next step will be to build the appropriate silicon chip to see whether it will function as intended." Ideal for a crowded band!

As we have noted before, the electronics industry has for many years used many chemicals and substances that are hazardous to the environment or in some cases directly to those involved in the assembly of equipments. For example, until the late 1980s, the industry used vast amounts of ozone-depleting substances including CFCs under many trade names and also 1.1.1. trichloroethane.

However the proof that man-made chemicals (particularly chlorofluorocarbons – CFCs) are seriously damaging the ozone layer, and the suggestion that they may also contribute to the global warming process have led to various international regulatory controls. As noted in an article 'The technical options for replacing CFCs for cleaning electronic assemblies' (*GEC Review*, Vol 9, No 1, 1993, pp3-20). There are now the Montreal Protocol and European Community regulatory controls. CFCs (Arklone, Freon, Frigen, Flugene, Forane, Kaltron, Fluorisol, Geneseolv, Delifrene, Isotron, Racon, Dional, Algofrene, Fronsolve, Daiflon, Flonshowa CG, Triflon, Isceon) were phased-out 85% by January 1994 and by 100% by next January. 1.1.1. trichloroethane (Genklene, Propaklone, Prelete, Sovethane, Dowclene) were cut by 50% last January and are due to be 100% phased-out by January 1996.

However, there is a range of technically-viable options. Choice for manufacturers, it is suggested, for cleaning PCBs will depend on factors other than a purely technical appraisal – cost, volume, market sector, customer requirements, health and safety, environment, etc must all be considered. GEC scientists have also been investigating 'Lead-free solders for electronic assembly' (*GEC Journal of Research*, Vol 11, No 2, 1994). The safe use and disposal of lead and lead-containing materials is an issue that is attracting considerable interest from both environmental and legislative bodies.

Correction: Although the callsign of Jorge Dorvier, EA4EO was given correctly in the text of the June *TT* item on page 53, it appeared incorrectly as EA4FO in the caption to Fig 3. ***G3VA***