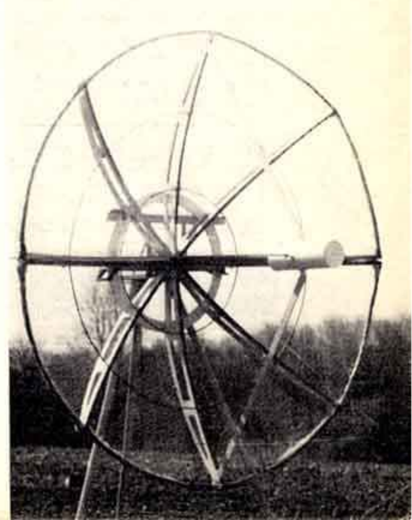
radio communication

April 1971

Journal of the Radio Society of Great Britain

DESIGNING PARABOLOIDS

page 244



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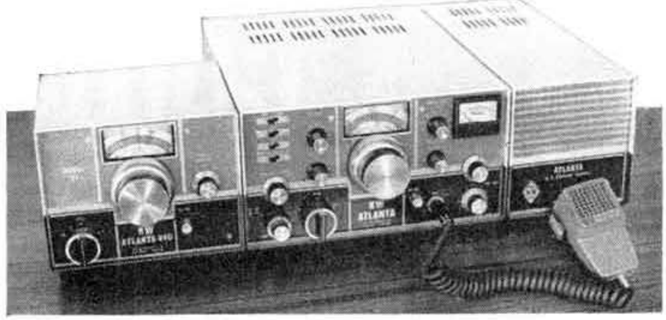

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CONTENTS

Radio Communication **(incorporating *The RSGB Bulletin*) is published by The Radio Society of Great Britain as its official journal and is posted to all members of the Society on the first Tuesday of each month**

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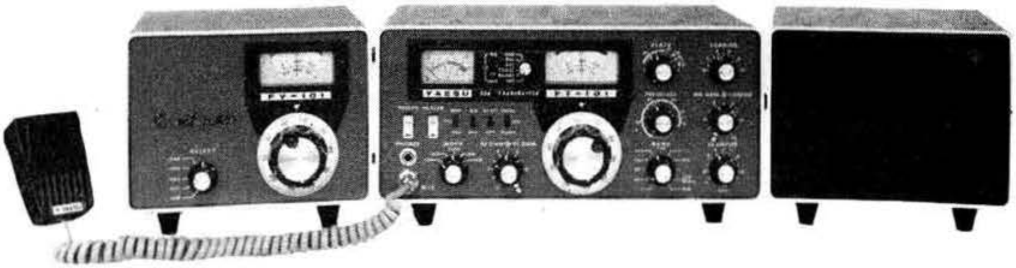

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73 de Alan and Bill

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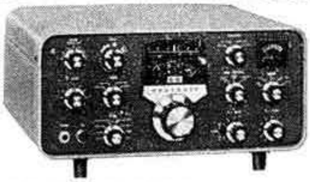

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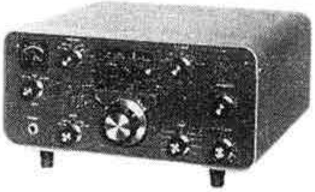

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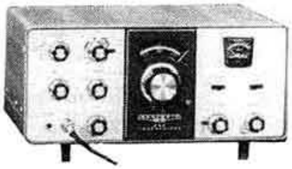

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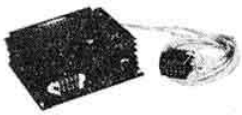

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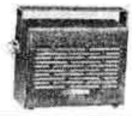

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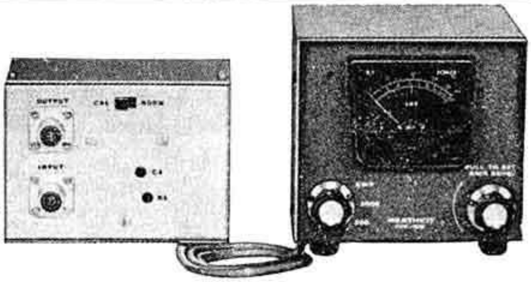

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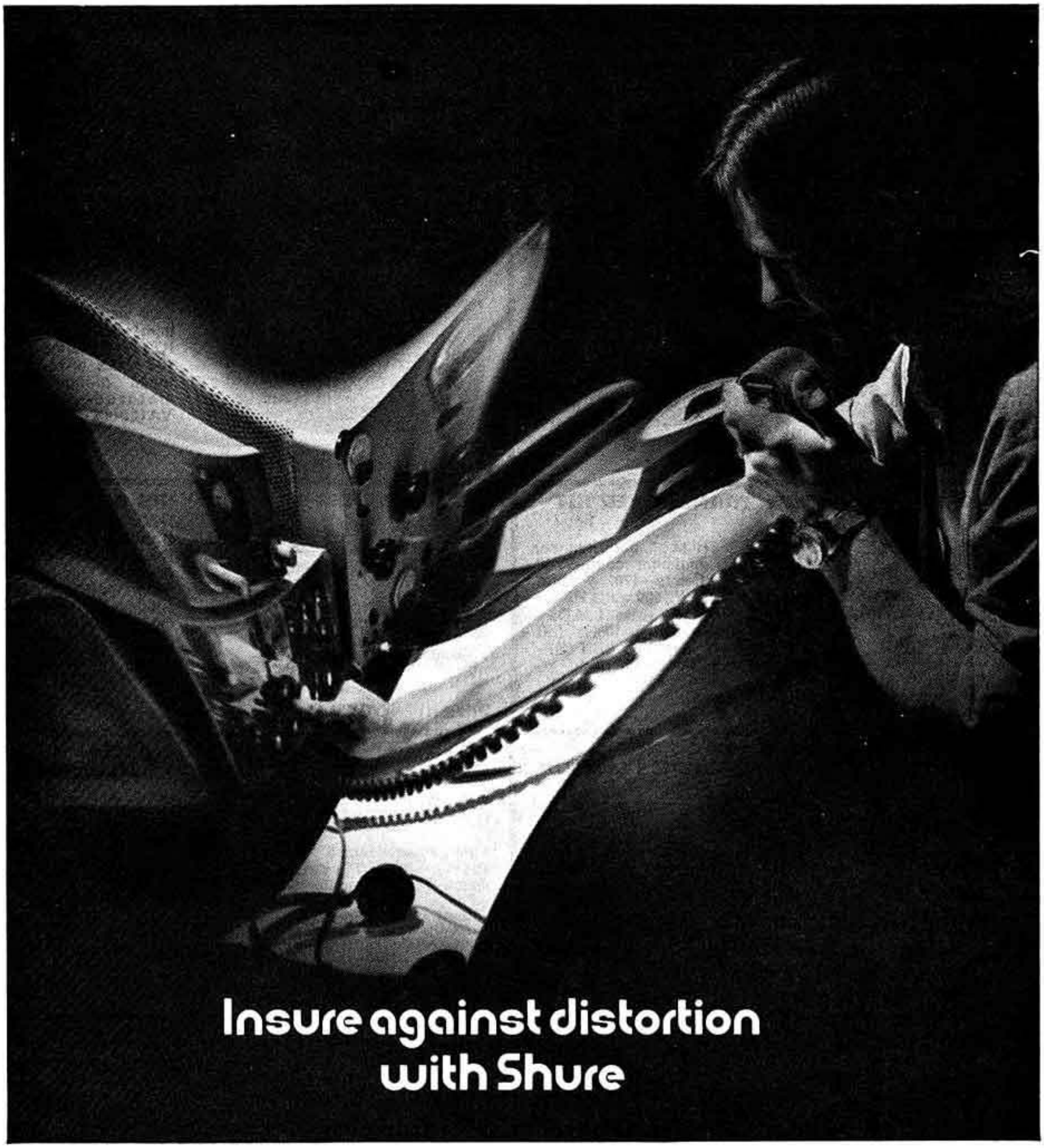
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CURRENT COMMENT

Among the happenings of the next few weeks will be decisions of considerable importance to all radio amateurs. These decisions, although unrelated, have one common factor in that they all deal with frequency allocations. Reflect for one moment; of all the various constituents of amateur radio, the maintenance (and expansion) of our bands is certainly the most vital.

* * *

On 5 June 1971 the largest and most important administrative radio conference of recent years will open at Geneva. The Space Conference itself has been preceded by preparatory meetings to establish the engineering foundations of future administrative decisions. During the past year the member societies of the International Amateur Radio Union have been seeking to obtain from their various administrations an enlightened approach to amateur space communication facilities. It is gratifying to note that almost all the countries from whom reactions have been obtained are in favour of extending the frequencies at present available for this purpose.

The conference papers are only now beginning to arrive but some administrations have already translated support into firm conference proposals. Efforts to support the amateur case will continue until the end of the conference. The Region 1 division of the IARU will maintain at least one person at the conference and there are amateurs on several national delegations. At the invitation of the UK Ministry of Posts and Telecommunications the Society has nominated a member of Council to act as an official adviser to the UK delegation.

It will be seen that amateur radio world wide is united in approach and thought concerning conference matters. It is believed that the results will justify the effort expended.

* * *

Due to the disruption of postal services there has been little news from overseas on amateur radio matters. However, an official broadcast from the ARRL dated 25 February gave news of proposed action by the USA FCC concerning the sub-bands allocated to the various classes of USA licence holders. Broadly, the effect of the proposals is to increase the USA telephony sub-bands and to make the additional frequencies available to USA extra- and advanced-class licensees. For instance, on 14MHz the extra-class licence holder will be allocated 14,150 to 14,175kHz and the advanced-class licensee will have the use of 14,175 to 14,250kHz without interference from operators holding lower grade licences.

At a recent meeting of the Board of Directors of the ARRL it was resolved to make no approach to the FCC for the alteration of sub-bands. Among the reasons given for this decision was the effect on the facilities at present enjoyed by the members of other IARU societies. With their vast numbers and use of high power on all modes, USA operators dominate any band when propagation conditions are suitable.

One other disturbing feature is the allocation of 28,150 to 28,250kHz to novice operation. This cuts right across the IARU world beacon plan (including the operation of GB3SX) on which a considerable amount of time and money has already been spent and in connection with which a Canadian beacon station was due to commence operation later this year on 28,175kHz. Allocation to novice operation will prevent use of this part of the band for scientific purposes.

Full details of the proposals are given in *MOTA*.

At the March meeting of the Council it was decided to write to the USA FCC with comments. The IARU is in touch with all national societies to ascertain their views and to determine the necessary action.

* * *

The efforts being made by the business radio users associations to obtain allocation of part of the amateur 70cm band have been mentioned previously. These efforts are being intensified and approaches have been made by interested parties to the Ministry of Posts and Telecommunications. At the time of writing, the Ministry has made no comment other than to restate that before any alterations are considered there will be full consultation with the Society. Further comment is inopportune at this time except once again to say "use or lose".

G2BVN

QTC AMATEUR RADIO NEWS

Radio Communication circulation
The audited total average circulation of *Radio Communication* during 1970, as certified by the Audit Bureau of Circulations, was 16,954 copies per issue.

RSGB Dinner Club
Due to the delay in the posting of the journal the meeting of the Dinner Club arranged for 26 March has been postponed to Friday 23 April. Venue and booking arrangements remain unaltered, except that bookings should now be addressed to Miss Sheila Sims at RSGB HQ.

RAOTA reunion
This will be held on the evening of Friday 7 May at the Bonnington Hotel, Southampton Row, London WC1. This year there will be an informal buffet supper instead of a set meal and it is hoped that this will allow more opportunity for informal contacts between members.

Midland VHF Assembly and Dinner
This will be held at the Albright & Wilson Recreation Club, Oldbury, Nr Birmingham, on 19 June 1971.

The reception will be at 2.30pm, followed by the opening address of the chairman, Mr J. G. Barnes, G3AOS.

Four "query desks" will be manned by leading vhf men during free periods. Mr G. M. C. Stone, G3FZL, will give a lecture on "VHF in the 'seventies", at 4pm, and after afternoon tea at 5pm there will be a film show at 5.15pm. Dinner will be served at 7.30pm.

Admission will be by ticket only: Full day, tea and dinner, £2; Ladies, dinner only, £1.75; Day, including tea, 25p.

Horsham ARS
The recently formed Horsham Amateur Radio Society is the successor of the Horsham Amateur Radio Club which, formed between the wars, ceased to function during the second world war. The new society would like to hear from any ex-member of Horsham ARC and to trace the papers and records of the club.

Can you help?
Christophe Guizard, aged 15, would like to correspond on amateur radio with other boys of the same age, and would also like to spend July with an English "amateur radio" family with a son of the same age on a paying guest or exchange basis. His address is, Residence B2 Parc a Ballons, 34 Montpelier, France.

Impersonation in examinations
Candidates in the Radio Amateurs' Examination and the morse test are reminded that it is a serious offence in Common Law for another person to take an examination in their place.

Radio Communications Exhibition
As reported in Society Affairs, after due consideration the Council of RSGB has decided not to participate in a Radio Communications Exhibition this year.

Realizing that the exhibitions held in the last two or three years have lost something of their former popularity, Council has decided to explore alternatives for this year.

Pirates caught
As a result of Post Office enquiries into the suspected unlicensed use of wireless telegraphy transmitting equipment, the following convictions have been obtained for using wireless transmitting apparatus without the appropriate licence, contrary to the provisions of Section 1 of the Wireless Telegraphy Act, 1949:

Mr J. N. Bailey, 5 Moorland Road, Poulton-le-Fylde, at Fleetwood Magistrates' Court on 19 November 1970. He was fined £50, plus £10 costs and forfeiture of equipment.

Mr J. R. Joseph, 119 Praed Street, London WC2, at Marylebone Magistrates' Court on 25 November 1970. He was fined £50 on each of two charges, plus £10 costs and forfeiture of equipment.

Mr R. Dixon, 102 Evans Road, London SE6, at Greenwich Magistrates' Court on 26 November 1970. He was fined £10 on each of four charges, plus £50 costs and forfeiture of equipment.

Mr B. Jenkins, 108 Shroffold Avenue, Downham, Bromley, at Greenwich Magistrates' Court on 26 November 1970. He was fined £10 on each of four charges, plus £50 costs and forfeiture of equipment.

Mr D. C. Payne, 12 Lakers Rise, Banstead, Surrey, at Epsom Magistrates' Court on 23 November 1970. He was fined £15 on the first charge, £10 on the second charge, plus £20 costs and forfeiture of equipment.

Mr P. Reed, 239 Chipstead Way, Banstead, Surrey, at Epsom Magistrates' Court on 23 November 1970. He was fined £20, plus £25 costs and forfeiture of equipment.

Mr J. W. Spendlove, 14 Sleetmore Lane, Somercotes, at Somercotes Magistrates' Court on 2 December 1970. He was fined £15 on each of three charges, plus £5 costs.

Mr K. Carter, 14 Sleetmore Lane, Somercotes, at Somercotes Magistrates' Court on 2 December 1970. He was fined £10, plus £5 costs.

Mr B. Hampsey, 31 Slack Lane, Ripley, Yorks, at Somercotes Magistrates' Court on 2 December 1970. He was fined £10, plus £5 costs.

Mr D. L. Boley, Wick Lane Cottages, Ardleigh, Essex, at Lexden & Winstree Magistrates' Court on 17 December 1970. He was fined £10 on each of three charges, plus £5 costs and forfeiture of equipment.

Mr D. M. Brown, 31 Shakespeare Road, Colchester, Essex, at Colchester Magistrates' Court on 18 December 1970. He was fined £10 on each of three charges, plus £5 costs and forfeiture of equipment.

Mr J. R. Gomer, 150 Layer Road, Colchester, Essex, at Colchester Magistrates' Court on 18 December 1970. He was fined £10 on each of three charges, plus £5 costs and forfeiture of equipment.

Mr P. E. Warner, 123 Ipswich Road, Colchester, at Colchester Magistrates' Court on 18 December 1970. He was fined £10 on each of three charges, plus £5 costs and forfeiture of equipment.

Mr J. Collins, 371 Eastern Avenue, Ilford, Essex, at Barking Magistrates' Court on 8 December 1970. He was fined £20 on each of two charges, plus forfeiture of equipment.

Mr P. Tuckwood, 28 Sherwin Street, Nottingham, at Nottingham Magistrates' Court on 4 November 1970. He was fined £25, plus £10 costs and forfeiture of equipment.

Mr C. W. Tuckwood, 14 Weatherby Close, Aspley, Nottingham, at Nottingham Magistrates' Court on 4 November 1970. He was fined £25, plus £10 costs and forfeiture of equipment.

Mr J. Grimwade, 15 Oaklands Avenue, Colchester, at Colchester Magistrates' Court on 15 January 1971. He was fined £5 on each of six charges, plus £15 costs and forfeiture of equipment.

Plagiarize and hybridize

An approach to receiver design

by PETER G. MARTIN, G3PDM/W1*

Part 2: Circuit options

Part 1 of this article outlined an approach to receiver design, and suggested techniques for achieving high performance under adverse operating conditions. The following discussion compares the circuit options available for various receiver building blocks, and gives details of design procedures.

Signal frequency circuits

Tuned circuits between the aerial and receiver mixer have two functions. They must provide high attenuation at the image frequency to minimize image interference, and must reduce the amplitude at the mixer input of interfering signals outside the i.f. passband to prevent large-signal effects.

A simple and effective approach is the use of two top-capacity coupled tuned circuits (Fig 6(a)). There is a tendency in published designs to over-couple the circuits, which results in the familiar double-humped response. The author has found it convenient to use a small trimmer to optimize the coupling on each amateur band. For critical coupling, the design equation for C_m is:

$$C_m = \frac{C}{\sqrt{Q_1.Q_2}}$$

where Q1 and Q2 are the loaded Qs of the two tuned circuits [12].

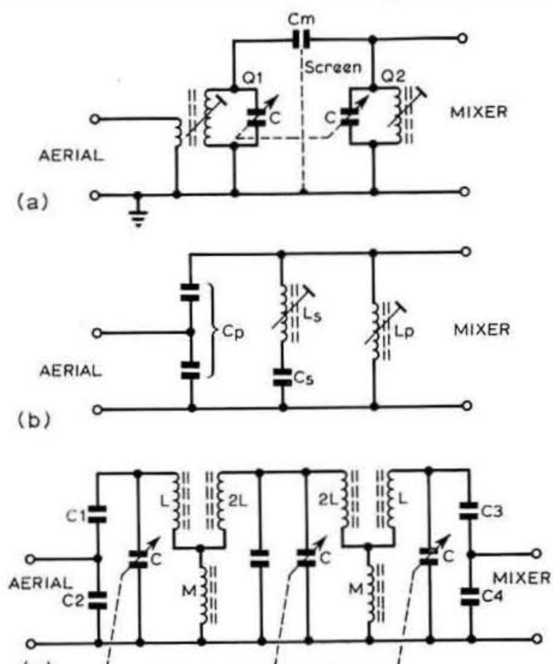

Fig 6. Preselector circuits: (a) top-capacity coupled tuned circuits; (b) Squires' circuit; (c) the Cohn filter, as described by Sabin

Squires [3] described an image-rejector circuit (Fig 6(b)) which provides 60dB of image rejection at 30MHz with a 1MHz i.f. and coil Qs of 100. This technique was used in the Squires-Saunders SS-1R receiver [13]. Although the protection offered against strong interfering signals is poor, the SS-1R receiver used a mixer capable of handling signals of over 1V. L_s and C_s are made series-resonant at the image frequency. If the local oscillator is above the signal, they look capacitive at the signal frequency and combine with C_p to resonate L_p.

More recently the Cohn filter has been described [11, 14] which provides rapid attenuation outside the passband (see Fig 6(c)). The design procedure maximizes stop-band attenuation, taking into account the insertion power loss of the filter. In design, a factor r is defined such that

$$r = \frac{A}{4{\cdot}34n}$$

where A is the desired filter insertion power loss in decibels, and n is the number of tuned circuits (with an unloaded Q of Q_u). The required coupling coefficient k, as determined by the mutual inductors M, is given by

$$k = \frac{1}{r.Q_u}$$

The first tuned circuit is loaded by the aerial, and C1 and C2 must be selected so that

$$\frac{Q_L}{Q_u} = \frac{r}{1 + r}$$

where Q_L is the loaded Q of the first resonator. C3 and C4 are selected for the required output resistance and filter voltage gain.

The three preselector circuits described are compared in Fig 7.

Wideband front-end circuits have been used in some recent receiver designs. Image interference is avoided by using a first i.f. above the highest signal frequency so that a low-pass filter meets the front-end requirements. Special

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care must be taken in mixer design, otherwise large-signal effects are rampant.

The author has experimented with varactor front-end tuning, but found that the cheaper devices were inadequately matched and generated noise under moderate bias conditions. The use of conventional variable capacitors is recommended.

An incidental point in favour of receivers without rf amplifiers is that gain is essentially constant over the entire hf spectrum. If coupled tuned circuits are used in the front-end, small variations in gain are readily trimmed out. With a suitable output indicator such receivers are useful as wide-range rf wave analyzers.

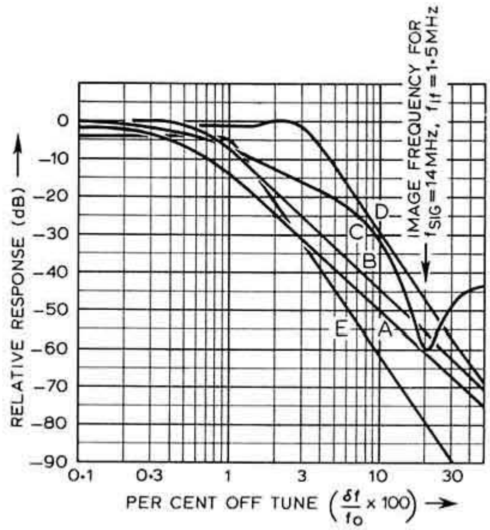

Fig 7. Preselector response curves: (A) coupled tuned circuits with coefficient of coupling (k) equal to half of critical value (k_c); (B) coupled tuned circuits with $k = k_c$; (C) Squires' image rejector circuit (estimated response); (D) Cohn filter with 1dB insertion power loss; (E) 4dB Cohn filter

The mixer

It has already been shown that the receiver mixer must be capable of handling large signals without introducing distortion, and that it must have a sufficiently low noise figure (4dB to 8dB) to resolve the weakest amateur signals without the assistance of an rf amplifier. Three different types of active device will meet these requirements: field-effect transistors, hot-carrier diodes and some types of beam deflection valve.

The best field-effect transistors suffer from cross-modulation effects at signal levels above 200mV in conventional circuits, although Sabin [11] claims a figure of 800mV for the 2N4416 in a balanced configuration (Fig 8(a)). They make excellent mixers because of their almost ideal square-law transfer characteristics, and their high input impedance aids circuit design. Kwok [15] has shown how to design mixers for optimum noise figure, conversion gain and cross-modulation performance. He concludes that for large signal-handling capability, devices should be selected with a high V_p (pinch-off voltage) or high I_{DSS} (zero-bias drain current), and operated with a bias voltage (V_{gs}) equal to $0{\cdot}8V_p$ and a local oscillator injection level of ($V_{gs} + 0{\cdot}6$)V peak.

Hot-carrier (Schottky barrier) diodes are commonly used in double-balanced mixer circuits (Fig 8(b)), and have been used in direct-conversion receivers [16]. High local oscillator drive power is needed to achieve a dynamic range comparable to fet circuits, and theoretical conversion loss is 3·9dB. The high drive power requirements of these mixers can be reduced by applying dc bias to the diodes. Cowley and Lepoff [17] have shown that this can also reduce intermodulation distortion. The noise figure of a double-balanced hot-carrier diode mixer is typically 8dB.

The advantages of an ideal double-balanced mixer of any type are:

(a) infinite isolation between the signal and oscillator terminals (ports), and hence low oscillator radiation;
(b) infinite isolation between the signal and i.f. ports, and hence high i.f. rejection; and
(c) reduced intermodulation distortion.

A useful review of diode mixers and their performance has been published by Mouw and Fukuchi [18].

Beam deflection valves are familiar in ssb transmitter balanced modulator and mixer circuits [19, 20, 21], but Squires [3] has shown that the RCA-7360 is capable of exceptional performance as a receiver mixer. Jeffers [22] developed these ideas further and found that signal levels of no less than 2·5V were needed to cause 3 per cent cross-modulation. As the 7360 has balanced deflection electrodes and anodes, it has many of the advantages of the diode ring mixer. Furthermore it has a conversion gain of up to 20dB, a typical 5dB noise figure and high input impedance (Fig 8(c)).

The 7360 is a valve, not a semiconductor. However, the mixer stage of a receiver has the most stringent signal-handling specification to meet, as has the power amplifier in a transmitter, and the use of valves for either function is still justifiable.

The author has experimented with a semiconductor mixer analogous to the 7360 circuit (see Fig 8(d)), but a large-signal assessment has not yet been made. TR1 (2N3823) is a signal frequency current source whose output is switched between TR2A and TR2B by a square-wave local oscillator. I.f. output is taken from the TR2 collectors. TR3 (2N3704) forms a dc current source which defines the quiescent drain current in TR1. This can be varied from 0·5 to 5·0mA by RV1. RV2 sets the conversion gain of the mixer, so that a compromise can be reached between noise figure, signal-handling capabilities and gain. C1 decouples the lower end of RV2 and prevents noise generated by the zener diode from reaching the mixer.

Crystal filters

In the interests of image rejection, a moderately high i.f. is essential in single-conversion receivers. As mechanical and ceramic filters are not available for centre-frequencies much above 500kHz, quartz crystal filters must be used. Manufactured filters are normally centred on 1·6 or 9MHz [23], and units such as the KVG-XF9B provide 6 : 60dB shape factors of better than 1·8 : 1, with ultimate stop-band attenuation in excess of 100dB. On the other hand the advantages of distributed selectivity have been pointed out, and the design of custom crystal filters is an interesting subject.

Zverev's comprehensive book on filter design [24] includes a valuable chapter on crystal filters, and Kosowsky [25] has simplified the subject by a process of double-normalization of the formulae. It is well known that the single-crystal

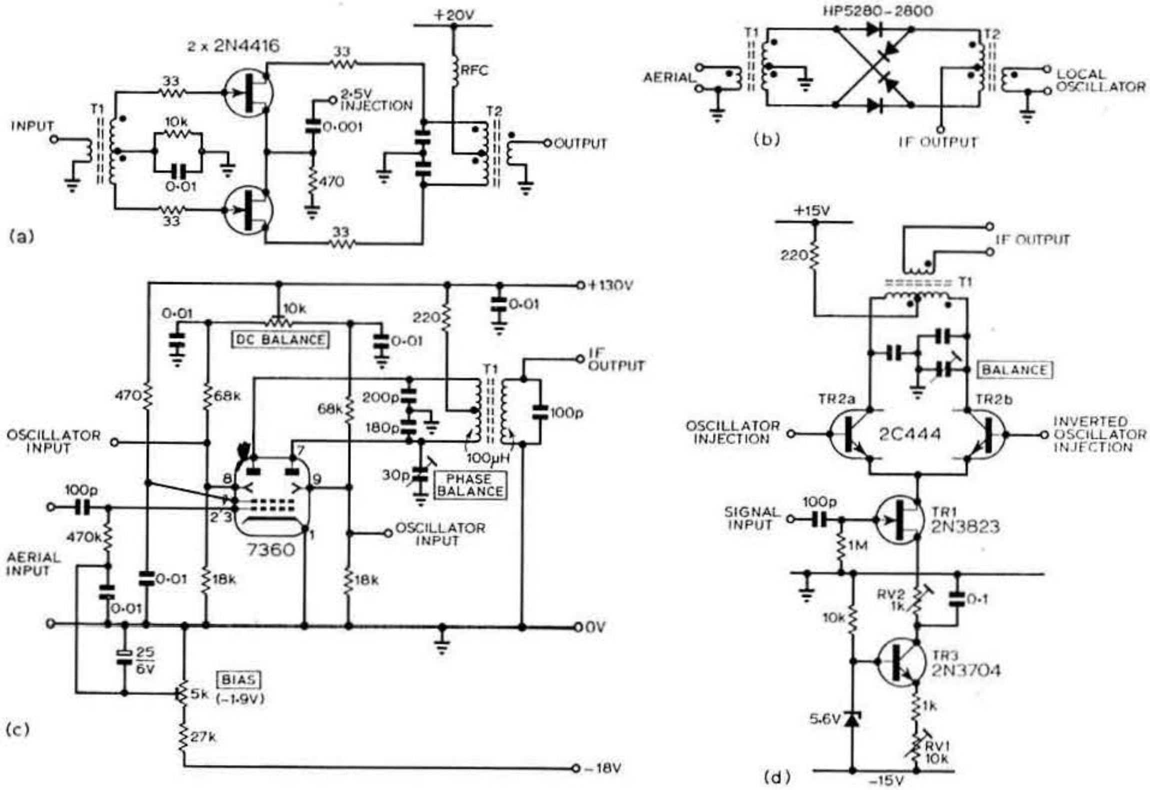

Fig 8. High performance mixers: (a) balanced fet circuit by Sabin; (b) double-balanced hot-carrier diode ring mixer; (c) balanced 7360 mixer; (d) semi-conductor equivalent of 7360 circuit. All transformers except T1 in (c) are trifilar wound

half-lattice filter (Fig 9(a)) has a response which depends on the relative values of the "phasing" capacitor C_b and the parallel crystal capacitance C_a. If the two capacitances are unequal, a frequency of infinite attenuation (f_∞) is created on one side of the passband. The position of this notch can be varied by means of C_b. If $C_a = C_b$, f_∞ is said to be at infinite frequency, and a symmetrical response is obtained. Responses for this basic filter section are given in Fig 9(c) (after Kosowsky). So that the data is valid for any filter bandwidth (B) or centre frequency (f_o), the horizontal scale is calibrated in units of:

$$\frac{\text{(deviation from centre frequency).}}{\text{(semibandwidth)}}$$

When a two-crystal half-lattice filter is used, two of the basic responses are added together. The two frequencies of infinite attenuation can be adjusted by a trimming capacitor across the higher frequency crystal, and a response of the form shown in Fig 9(b) is obtained.

If a receiver uses several half-lattice sections in the i.f. strip, it is normal for each to have different frequencies of infinite attenuation. A section with $x_\infty = \pm 1{\cdot}3$ will ensure a rapid increase of attenuation at the edge of the passband, but a section with $x_\infty = \infty$ is needed to give a high ultimate stop-band attenuation. A third section with $x_\infty = \pm 2$ or ± 3 would contribute usefully to both causes. When aligning several filter sections it is helpful to have them separated by amplifier stages so that interaction between adjustments is minimal. This is in line with the distributed selectivity approach recommended earlier. The effects of interaction between filter sections is discussed by Healey [26].

Variable bandwidth crystal filters

It is well known that the bandwidth of a simple phasing-type crystal filter can be varied by means of the load resistance R (Fig 9(a)). When R is low the passband is narrow: when R is high the passband is broad. There are two drawbacks, however. The insertion loss of the filter varies enormously with its bandwidth, and a front-panel control of R would be carrying rf voltages.

A circuit devised by Ranky and Schindall [27] gets round both problems (Fig 10(a)). A variable load resistance R2 is obtained by reflecting across the transformer T2 the dynamic resistance of the two forward-biased diodes D1, D2. Their impedance is controlled by defining the forward current by means of R4 and RV1, this current being varied over the highly curved part of the diode characteristic. R4 is a high resistance, so the front-panel selectivity control RV1 need only carry dc.

The rest of the circuit is concerned with keeping gain constant with respect to bandwidth. As the reflected R2 is decreased, the signal voltage across the tuned circuit drops and the current through it rises. R3 detects the current and winding N3 on T2 detects the voltage: these two signals are added in TR1 in such a way that the output signal across R5 has an amplitude independent of R2. The condition for constant gain involves the number of turns on the transformer, thus:

$$Z_3 = \frac{N_3}{N_2 - N_3}.R_s$$

where Z_3 is the parallel combination of R3 and the input impedance of TR1 at its emitter, and R_s is the sum of the source impedance (via T1) and the equivalent series resistance of the crystal.

The shape of the circuit response is no better than that of the basic crystal filter of Fig 9(a). For steep-sided selectivity, two or three of these circuits could be cascaded. With Fig 10(a), bandwidth is variable from about 0·008 per cent to 1·4 per cent of the crystal centre frequency (128Hz to 22kHz at 1·6MHz), and the originators of the circuit managed to keep filter gain constant over this range to within 3 per cent.

The second circuit (Fig 10(b)), is used in one of the Tektronix spectrum analysers [28], and is somewhat easier to set up. TR1 is a phase-splitter replacing T1 in Fig 10(a). TR2 has several functions: RV1 varies the input impedance of the stage by emitter follower action, thereby creating a variable load resistance for the filter. In addition the collector circuit gives a signal voltage proportional to the load current, which passes through the base-emitter junction of the transistor, and the emitter gives an output equal to the signal voltage across the tuned circuit. These two signals are summed at point X in a ratio set by VC2, which is adjusted

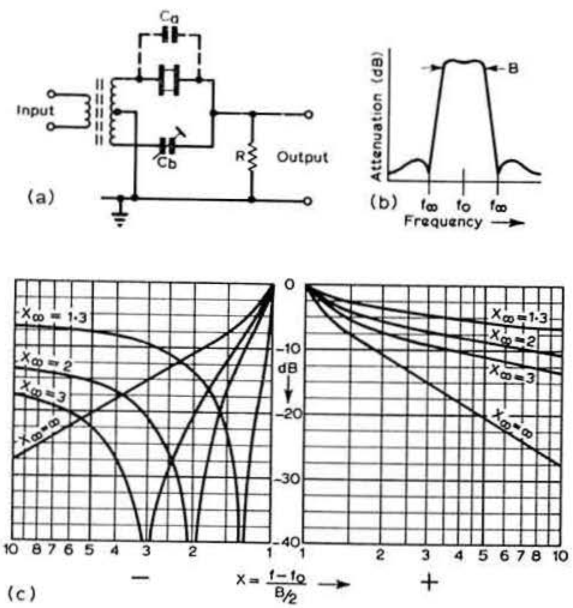

Fig 9. (a) Basic single-crystal half-lattice filter; (b) general response of two-crystal half-lattice; (c) normalized crystal filter responses by Kosowsky

for the required constant gain characteristic. With a 100kHz crystal, bandwidth is variable from 10 to 500Hz.

Gain-controlled i.f. amplifiers

To achieve a flat agc characteristic, it is normal for all i.f. stages of a receiver to be controlled. It is important that amplifier distortion should be low over the whole dynamic range of the control loop.

Although diode attenuators and controlled stages using bipolar transistors are common, it is beyond doubt that higher performance is attainable with FETS, valves and some integrated circuit amplifiers. Pappenfus *et al* [29] have found that varactor bridge attenuators give low intermodulation distortion.

The RCA-3N140 dual-gate mosfet, with reverse agc on gate 1 and partial forward agc on gate 2, has excellent cross-modulation properties [30], but the control range is limited to 35dB per stage.

Several integrated circuits which include high performance gain-controlled stages are available [31]. Most of these are based on the long-tailed pair circuit (Fig 11). If the base voltage of TR2 (V_{agc}) is less than the base voltage of TR3 (V_{ref}), TR2 is turned off and TR1, TR3 form a conventional cascode amplifier. If V_{agc} is increased, approaches V_{ref}, then exceeds it, the dc and signal currents are gradually diverted from the output transistor to the control transistor. Gain is therefore reduced to a level limited by stray capacitance. The Motorola MC1590P uses two interconnected long-tailed pairs to reduce changes in input and output impedances due to agc action. It has a 60dB agc range from dc to 60MHz, a maximum power gain of 50dB at 10MHz, and a noise figure of 5dB up to 30MHz.

Most valve circuits are capable of reasonable agc performance. Frame grid valves such as the EF183 have a control range of over 50dB and handle large signals in style.

Product detectors

Most of the active devices known to mankind have been used as product detectors, from valve diodes to Hall-effect modulators. Design considerations are similar to those for front-end mixers, and FETS are capable of high performance.

The 7360 valve has the advantage of its balanced structure, and is capable of providing an audio output in excess of 100V peak-to-peak. Third-order distortion is below −45dB. Self-excited 7360 product detectors are popular, and if the incoming signal is loosely coupled to the oscillator tank circuit the oscillator will phase-lock to an incoming carrier, giving synchronous detection of a.m. signals [21]. The 7360 has a reputation for microphony caused by deflection electrode vibration. This effect is not troublesome if moderate signal levels are used.

Diode ring modulator circuits give high detector performance. Hum and intermodulation levels are low.

The Motorola MC1596G integrated circuit is particularly recommended for product detector service (Fig 12). It has 10dB gain and third-order distortion products 55dB down. Input signal levels of 5 to 500mV are recommended, and a carrier insertion oscillator level of 300mV.

For normal ssb operation a crystal-controlled carrier insertion oscillator (cio) is preferable so that the inserted carrier frequency is correctly placed with respect to the i.f. passband. Normally two carrier crystals are used for sideband selection. If the product detector is followed by a

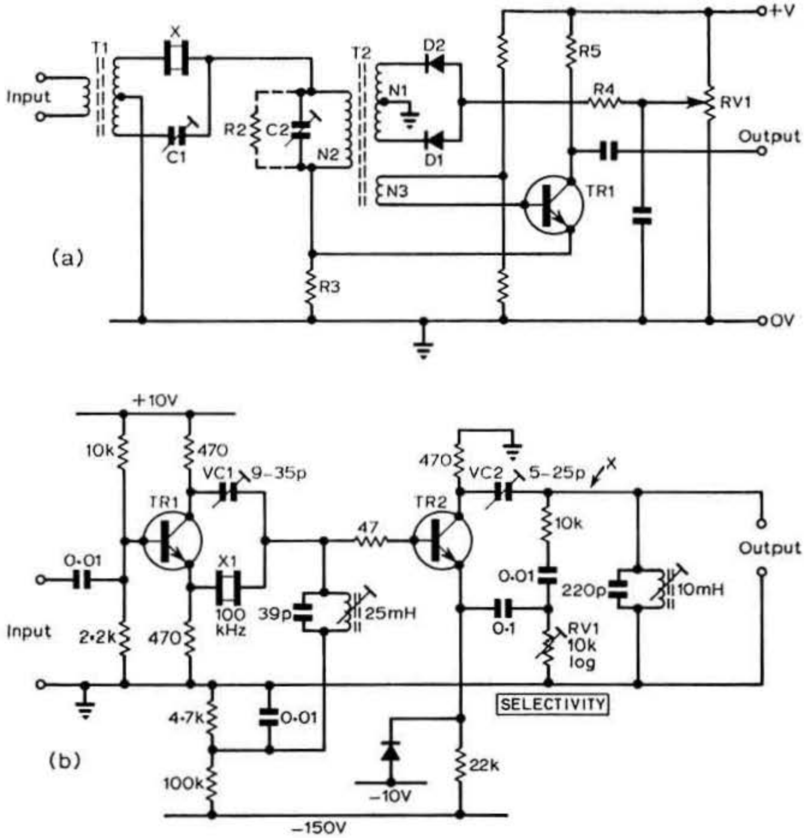

Fig 10. Variable bandwidth crystal filters by (a) Ranky and Schindall, and (b) Tektronix Inc

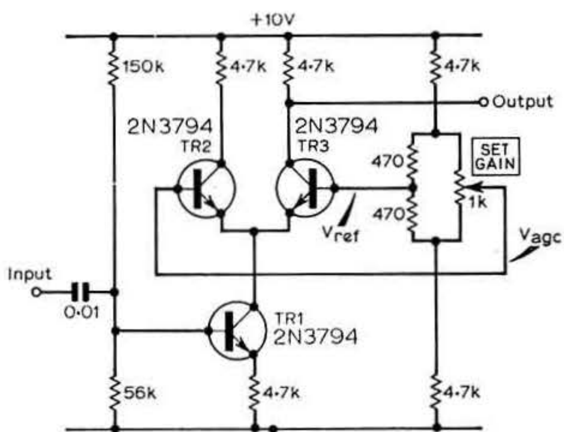

Fig 11. Experimental gain control stage. At 100kHz the control range is over 100dB, and signals from 10μV to 10V can be handled without distortion. The circuit is switched from maximum gain to minimum gain by a 400mV change in V_{agc}

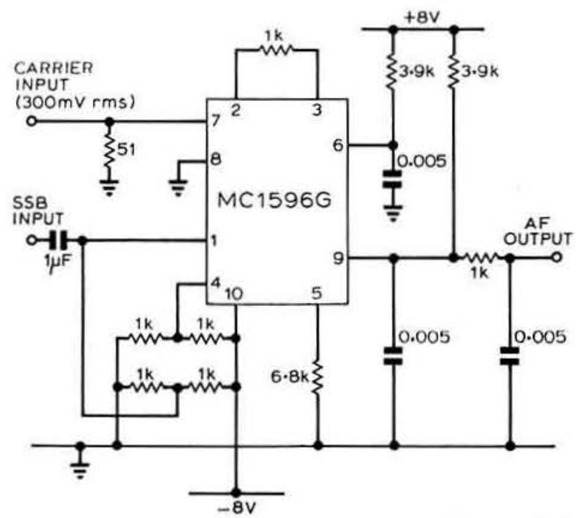

Fig 12. The Motorola MC1596G product detector in a practical circuit

narrowband audio filter for cw reception, tuned to a frequency equal to half the carrier crystal separation, a crystal-controlled oscillator is again helpful and an LC oscillator is not needed.

Audio filters

Audio frequency bandpass filters will provide narrow passbands for cw or rtty reception, and lowpass filters improve overall receiver skirt selectivity. Filters may be passive, using inductors and capacitors, or active, with resistors and capacitors used in conjunction with operational amplifiers.

Fig 13(a) shows a passive lowpass filter with a cut-off frequency of 3·0kHz which was developed for a direct-conversion receiver [32], but which is now used to provide additional selectivity in the receiver described. The filter is of the elliptic function type, which gives the greatest design flexibility and the sharpest transition from passband to stopband. Filter tables have been published by Zverev [24] and, in abbreviated form, by Geffe [33]. For a given number of components there is a trade-off between passband ripple, shape factor and guaranteed stopband attentuation. Some of the options available with three inductors, seven capacitors and a 1·25dB passband ripple are given below:

Option	f_s (Hz)	A_s (dB)
(1)	3,540	60
(2)	4,860	90
(3)	7,680	120
(4)	12,390	150

Here f_s is the lowest frequency at which the guaranteed stopband attenuation (A_s) is achieved, with a filter cut-off frequency of 3,000Hz. Fig 13(a) shows option (1). The capacitor tolerances are ±1 per cent, but inductors on adjustable pot cores can be set to the correct values experimentally. L2, L4 and L6 are set for minimum output at frequencies of 6,480, 3,585 and 4,090Hz respectively. Provided inductor Qs are higher than about 100, the response obtained agrees closely with theory.

Fig 13(b) shows the principal components of a five-pole Butterworth active RC filter whose response is given in Fig 13(c).

The twin-T rejector circuit (Fig 14(a)) is well known for its ability to null out a specific frequency. Although versions of the network are known which can be tuned by a single component [34], their usefulness in receiver audio stages is limited. If a notch 60dB deep is required, it is necessary to reduce the harmonic distortion generated by the detector and any audio preamplifier to below this level, otherwise the residual harmonics of an interfering beat note will defeat the object of the filter.

If a twin-T filter is used in the feedback circuit of an active filter its characteristic is inverted to provide a high-Q peaked response. With careful component matching in the circuit of Fig 14(b), a bandwidth of 80Hz is obtained at 1kHz. Such a bandwidth is too narrow to be useful and skirt selectivity is poor, but two cascaded filters with slightly staggered centre frequencies can give a 6dB bandwidth of 180Hz and a 30dB bandwidth of 660Hz.

The theory of active RC networks is treated thoroughly by Huelsman [35], but the subject relies heavily on mathematical analysis and is not light reading.

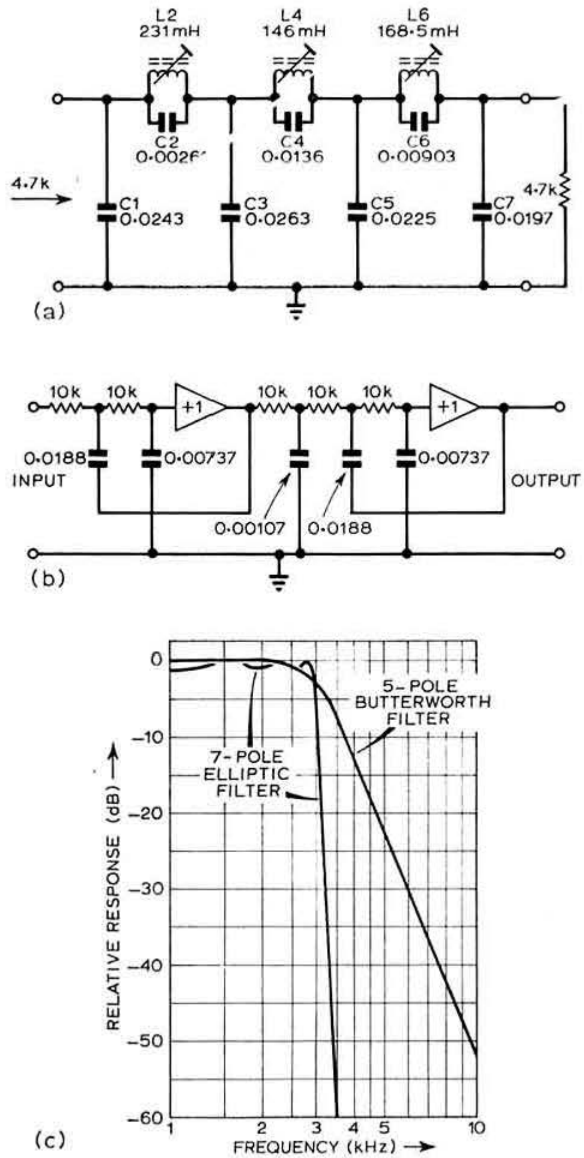

Fig 13. Audio low-pass filters. (a) Seventh-order passive elliptic function filter, (b) fifth-order active Butterworth filter, and (c) their response curves for a 3kHz cut-off frequency. In (b) the operational amplifiers have unity voltage gain

Audio power amplifiers

If a receiver intermodulation distortion figure of −45 or −60dB is not to be worsened by the audio amplifier, the circuit quality needed is comparable to the very best hi-fi equipment. Many published designs in this field have imd levels above one per cent (−40dB), although some sources claim figures down to −60dB [36]. The greatest sources of audio distortion in amateur stations are pre-war ex-government headphones and loudspeakers salvaged from old tv sets! A pair of high-quality monophonic headphones is often a wise investment.

IMD figures are not normally given for ic power amplifiers, but they are rarely better than −45dB for power levels in excess of 1W. This figure is adequate for many purposes.

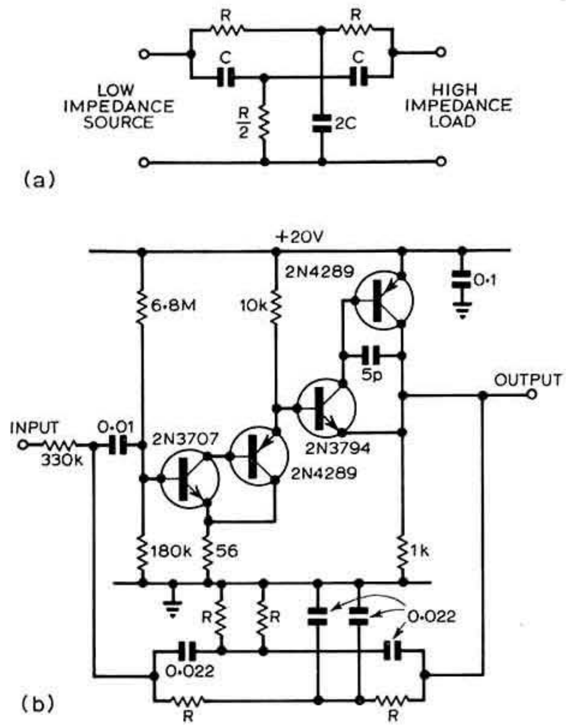

Fig 14. (a) The twin-T rejector circuit, with a notch frequency given by f = 1/4πCR. (b) Bandpass filter using a twin-T network and a simple operational amplifier

AGC generators

For ssb and cw operation an agc loop should have a fast attack time (20ms or less) and a long effective decay time (0·2–1·0s). Short rise times are obtained with low impedance agc detectors: long decay times are normally associated with a large capacitance across the control line. This practice has the disadvantage that untreated noise pulses can mute the receiver for periods of several seconds. "Hang" circuits have been devised which maintain a steady agc voltage for a definite time after the actuating signal has gone, then rapidly increase the receiver gain to a new equilibrium level (See Fig 15). Hang agc has the advantage that background noise does not increase during pauses in transmission.

The Plessey Company has introduced a highly effective ic agc generator (type SL621) intended for use with their ic rf and i.f. amplifiers in single-sideband equipment. The author has described a discrete-component version for receivers with valve i.f. amplifiers [37]. The behaviour of this type of circuit under various operating conditions is shown in Fig 16.

Consider the simpler discrete-component circuit (Fig 17). Audio signals from the receiver product detector are fed to two agc detectors (TR7, TR8) which have long and short rise times respectively. TR9 and TR10 form a dc amplifier which responds to the detector with the higher output level. A signal at the input establishes an agc level via TR8 in about 20ms. After about 200ms, the output of TR7 is slightly larger and takes control (Fig 16). If a noise burst occurs, the short time constant detector rapidly reduces the receiver gain, but the output of TR7 is virtually unchanged and C2 "remembers" the pre-noise agc level.

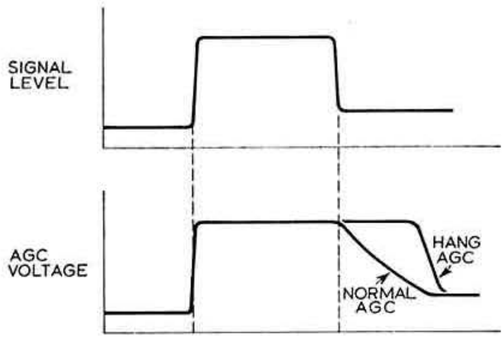

Fig 15. The action of "hang" agc compared to conventional agc with a long decay time

The audio input signal is also applied to a Schmitt trigger circuit (TR1, TR2 and TR3) which has two functions associated with discharging the long time-constant detector capacitor C2 through TR6.

If the incoming signal fades slowly (less than about 20dB per second) the pulses at the collector of TR3 will partly discharge C2 via TR6 on every positive half-cycle of the input signal, so that the receiver gain rises to hold the output level constant. If, however, the signal fades abruptly as in a pause in speech, TR1, TR2 and TR3 are not triggered and C2 holds its charge, effectively remembering the signal strength. The output of the short time-constant detector will fall to zero in about 200ms.

If the signal break lasts longer than about 1s, the hang circuit operates and discharges C2. The hang capacitor C3 is charged by the output pulses of TR3 when a signal is present. When a transmission break occurs, C3 discharges through R2, R3 and D1 until TR5 turns off and TR6 is turned on. R1 is added to increase the charging time of C3 so that the hang circuit is not actuated by noise pulses.

Note that TR7 and TR8 are germanium n-p-n transistors selected for their −40V base-emitter breakdown voltage rating. The time constants associated with the circuit are adjustable by means of C1, C2 and C3.

When tested with an i.f. amplifier using three frame-grid pentodes, the loop control range was 150dB for a 1dB change in product detector output!

A signal-strength meter can be placed in one of two points in an agc loop using Fig 17. In valve circuits the conventional approach is to measure the cathode current of one of the i.f. amplifiers, so that the meter is sensitive over the lower range of signal levels. The alternative is to monitor the agc voltage itself, so that the meter sensitivity is roughly logarithmic over the entire dynamic range of the receiver. This is achieved with a 1mA meter in series with the 18kΩ resistor R1. With a receiver dynamic range of 140dB (0·4μV to 4V), few amateur stations would deflect such an S-meter more

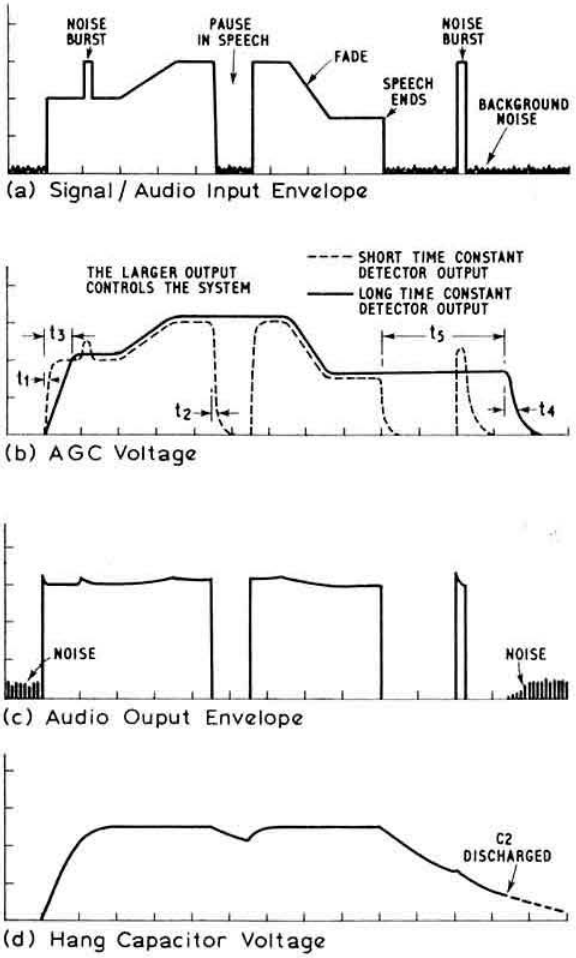

Fig 16. The behaviour of dual time-constant agc circuits under various operating conditions, where t_1 is the fast detector rise-time, t_2 the fast detector decay time, t_3 the slow detector rise-time, t_4 the slow detector fall time, and t_5 the hang time

than half of fsd, but the receiver would be capable of measuring some aspects of its own performance (in conjunction with a signal generator), and would be useful as a calibrated rf wave analyzer.

Any agc circuit constitutes a negative feedback system, and is therefore liable to be unstable. In particular, a badly-designed high-gain control loop might "ring" if the incoming signal level changed sharply, causing the receiver gain to oscillate about its ultimate level. Victor and Brockman [38] have derived formulae relating the various parameters of an agc loop to stability criteria.

Phase-lock frequency synthesis

The block diagram of a phase-lock synthesizer is shown in Fig 18, and typical operating frequencies are given.

A 7360 main receiver mixer requires a push-pull local oscillator injection level of 7·5V rms per deflecting electrode. This can be provided by a modified Kalitron oscillator [39]. A valve circuit is needed to minimize oscillator noise and to ensure sufficient output voltage swing. The oscillator has switched coils to give the appropriate frequency coverage, and is tuned by four varactor diodes associated with the phase-lock loop. A band-switched crystal oscillator is used to translate the local oscillator tuning range down to that of a stable reference oscillator. The frequencies and phases of the synthesizer i.f. output and the reference signal are compared in a phase-sensitive detector (psd). In the steady state (when phase-lock has been achieved), the psd output is nominally a dc voltage proportional to the phase difference between the reference oscillator output and the synthesizer i.f. signal. A dc amplifier boosts the psd output and controls the bias on the varactor diodes in the push-pull oscillator. When phase-lock is lost, as when switching from one band to another, a sawtooth waveform generator sweeps the local oscillator across its full tuning range until phase-lock is achieved.

If phase-lock is maintained, the local oscillator frequency will be exactly equal to the differences between the crystal and reference oscillator frequencies. If the reference oscillator is tuned, the local oscillator will follow. If the local oscillator attempts to drift or has spurious frequency modulation, correcting signals will be generated in the psd and applied to the varactor diodes.

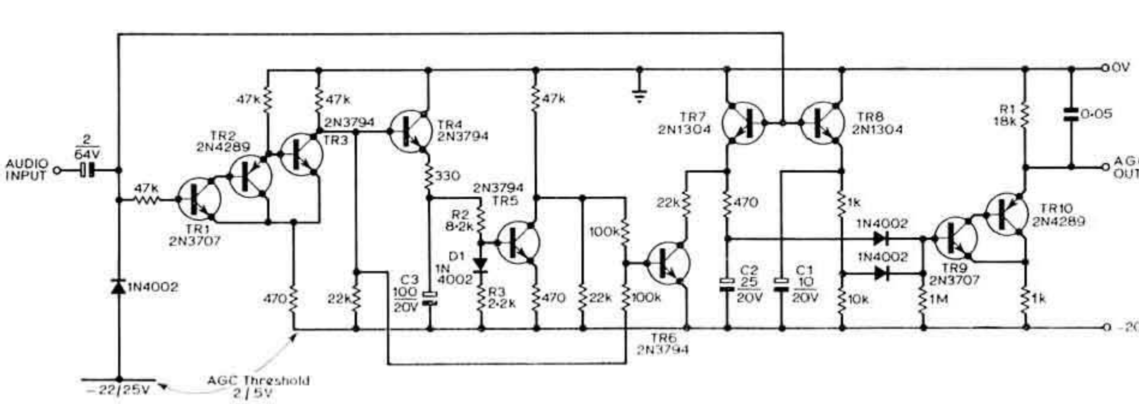

Fig 17. Discrete component agc generator derived from the Plessey SL621 ic

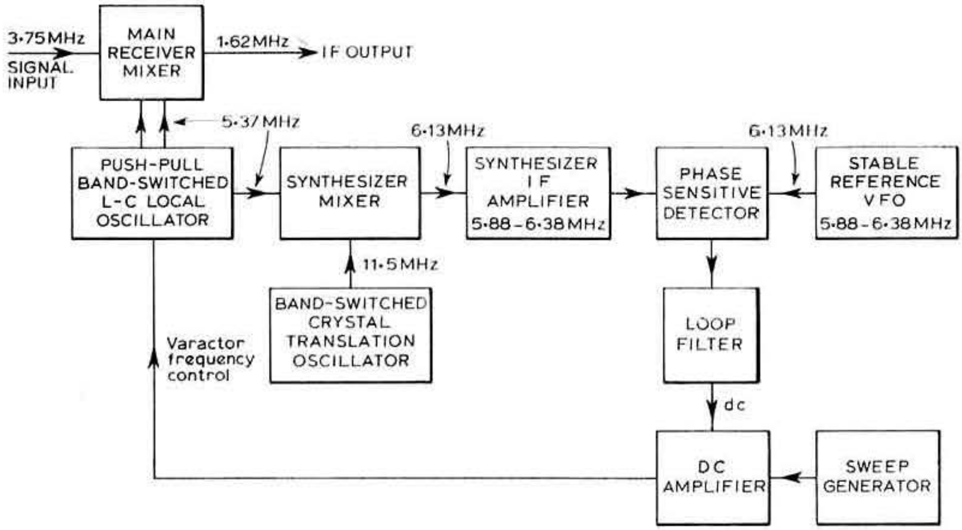

Fig 18. Phase-lock frequency synthesizer block diagram

The subject of phase-lock loops has been treated by Gardner [40]. Details of a digital frequency synthesizer have been published by Renschler and Welling [41], and by DeLaune [42].

A significant problem with varactor-tuned oscillators is that the rf voltage across a tuned circuit will modulate the varactor bias and cause amplitude distortion of the output waveform. This effect can be greatly reduced by using balanced varactor circuits in a push-pull oscillator. Fig 19 shows the extent of the problem with a 10V peak-to-peak signal voltage superimposed on a Clevite BA111 varactor diode biased to 8V.

When selecting a frequency mixing scheme for a phase-lock synthesizer, various types of spurious products must be considered. For example, strong spurious outputs from the synthesizer mixer should not fall within the synthesizer i.f. passband, and the fundamental or harmonics of the crystal oscillator and reference vfo should not fall inside an amateur band. Spurious response charts can be drawn up with the aid of published graphs and tables (43, 44).

Inspection of spurious response charts shows that for a receiver with a main signal i.f. of 1·62MHz, the only synthesizer i.f. frequency range wider than 500kHz and free of spurii is 5·65-6·82MHz. By using the range 5·88-6·38MHz, the crystal frequencies needed for amateur band coverage are exact multiples of 0·5MHz. The fifth harmonic of the reference oscillator tunes 29·4-31·9MHz, but with normal screening and good oscillator design this signal will not be audible when tuning the 10m band.

The reference oscillator must be a tunable LC vfo. High stability can be achieved with an fet in the true Vackar configuration, by temperature compensation, and by sound mechanical design. Medium-term stabilities of ±2Hz at room temperatures have been achieved [45].

Noise silencers

The recommended noise silencer uses a fet gate pulsed by signals derived from a three-stage wideband noise amplifier. The noise gate couples tuned circuits between the receiver

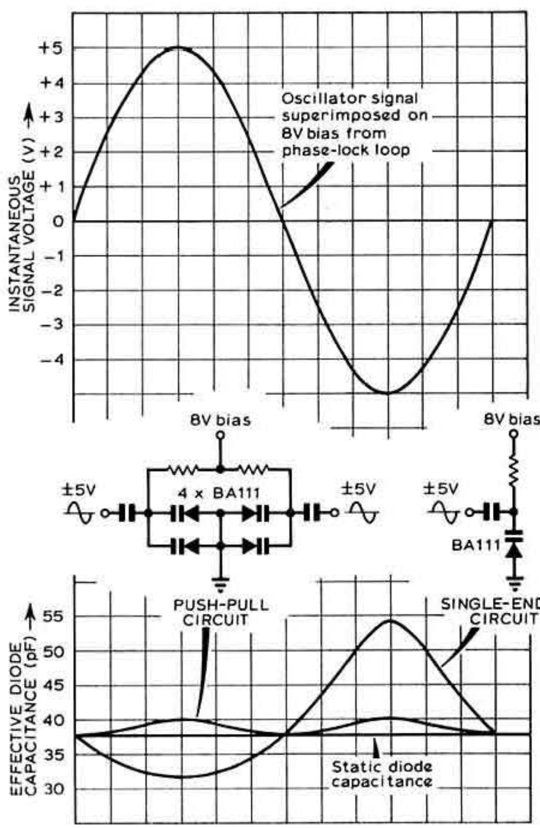

Fig 19. The effects of signal voltages on push-pull and single-ended varactor-tuned circuits

mixer and the first crystal filter. The two tuned circuits must be resistively damped to prevent over-coupling of the network and subsequent loss of gain. The component values shown in Fig 3 match the ON-resistance of a 2N3819 (about 150Ω) to the requirement for a coupling coefficient between 0·5 and 1·0 times the critical value.

A Schmitt trigger circuit can be used to square the noise pulses produced by the noise envelope detector. This must be followed by a phase-splitter to provide inverted blanking pulses for the elimination of switching transients in the noise gate.

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To be continued

designing paraboloids

by T. C. JONES, G3OAD*

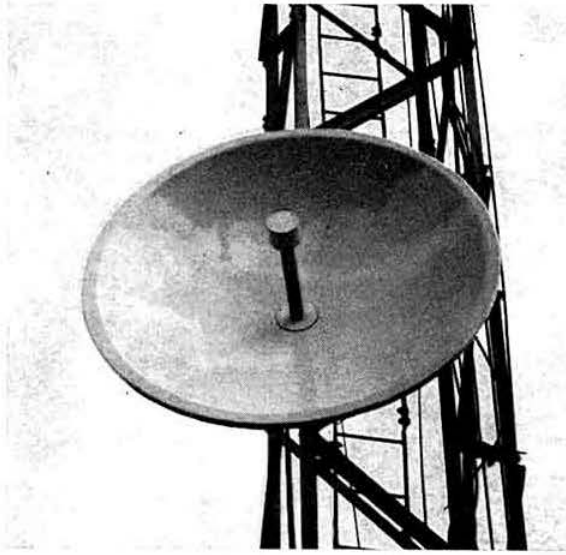

Photo 1. The author's 4ft solid dish

IT is surprising, considering its importance, what little information there is concerning the design and construction of the paraboloid aerial. At frequencies above 1GHz it is doubtless the optimum aerial for the type of usage put to it by radio amateurs.

The main reason for this is the easily obtained high *efficiency*; ie the ratio of power in the far-field main lobe to that in the feeder. (See Fig 1). In this context it must be compared to a Yagi, a stacked dipole array or a corner reflector—with these aerials, excellent though the first two are at lower frequencies, power is lost in various ways due to the mechanics of the structure. *Efficiency* is thus lower for a great many designs which attempt to scale these aerials down for use at higher frequencies. Table 1 compares the gains of typical aerials for 70cm and above. To some extent the question of aerial gain is subjective in the amateur sense, since few have access to equipment which will discriminate to within 2dB or so at 1,300MHz, but it has been concluded on this basis that the parabola emerges far ahead of its rivals for 1,296MHz and above.

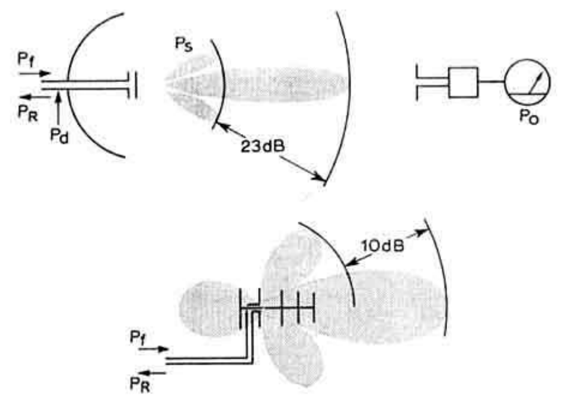

Fig 1. Comparing sources of power loss in a dish and a Yagi. For the Yagi, Pr, Pd and Ps will be large and so Po will be lower than hoped for

The gain of a dish, as a working guide, is

$$G = 10 \log_{10}\left(\frac{k\pi^2 D^2}{\lambda^2}\right) dB \qquad \ldots \quad (1)$$

where k lies between 0·6 and 0·7, D is the diameter and λ is the wavelength. This formula was used to obtain the gain figures shown in Table 1. One point about this expression which is made in (1) is that this gives a gain 2dB down on an ideal stacked collinear of the same area. The emphasis here of course, is on the word "ideal".

Inevitably when designing a dish, resort must be made to a formula or two.

$$y^2 = 4.f.x = 4.(f/D).D.x \qquad \ldots \quad (2)$$

are two very important ones. They relate distance along a radius to distance along the focal axis, as shown in Fig 2. It is clear from these that the focal length, f, is a critical factor in the design, although it is not clear what influences its choice. The chief influence is the feed to be used. This point is shown in Fig 3.

The curvature of the profile is usually specified by a parameter f/D, which is the ratio of focal length to diameter. For this reason it has been incorporated into equation 2. In effect this specifies the angle subtended by the rim at the focus, where the feed is situated. The two are related through the formula

$$f/D = \tfrac{1}{4}.\cot an(\phi/4) \qquad \ldots \quad (3)$$

It is immaterial what gain (and, thus, beamwidth) the feed has, provided that the appropriate choice of f/D is made to suit it. If this is done, the best compromise level of

* St Chloe House, Amberley, Stroud, Glos.

Table 1. Aerial gain comparison

AERIAL	70cm	23cm	13cm	9cm	3cm
Yagi, 14-el	16dB	13dB	—	—	—
Horn/trough	10dB	14dB	18dB	20dB	25dB
32-el stack	15dB	13dB	—	—	—
4ft dish	—	22dB	27dB	30dB	40dB

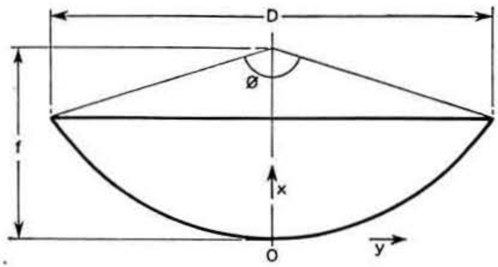

Fig 2. Diagram showing the directions of X and Y as well as the subtended angle

radiation will be intercepted and reflected by the dish. The level which is intercepted by the rim is expressed relative to the main lobe maximum of the feed, and is called "edge illumination". The level chosen is generally about −10dB below peak level, below which power is allowed to "spill over". If too much is allowed to spill (f/D too large, dish too shallow) then the front to back ratio suffers. Power is lost from the main lobe, and efficiency falls. If too much is intercepted, (f/D too small, dish too deep) then, due to excess curvature, cross-polarization and defocusing occur. The forward gain, and, thus, efficiency, decreases again. The f/D ratios for typical feeds are shown in Fig 3.

The optimum subtended angle is shown in [1] to be 100° to 120°, and from equation 3 this means a ratio of $f/D = 0{\cdot}48$. An eminently suitable feed would be that given in [2] providing three-band coverage (23 to 9cm) and near optimum directivity for the optimum of f/D ratio. With an edge illumination level of −10dB, the expected side-lobe level for a well-constructed dish is about −23dB — assuming a perfect paraboloid contour.

Amateur construction will generally fall rather short of the ideal. This not only causes side-lobes to bristle, which can be good, but also causes gain to fall, which is bad. The tolerance thought to be adequate for amateur purposes is $\frac{1}{8}\lambda$ at the highest frequency of operation.

Construction techniques are many and varied. For small dishes about 3ft in diameter, or those for occasional use, a solid reflector is practicable. For permanent use, portable use in typical VHF NFD weather, or for moon-bounce, a mesh reflector is desirable. It reduces weight, windage and cost. A design not often seen is a skeleton reflector (see *Four Metres and Down*, July 1970) although for 23cm this is a simple, light-weight design.

Two types of construction which the author has successfully used will now be described in some detail.

Solid reflector

By far the most versatile material used has been glass fibre reinforced with polyester resin. It does require, however, a certain amount of panache and a fairly deep pocket. Trials with small quantities are strongly recommended. A mould of some sort is essential and one short cut is to use someone else's solid dish as the mould. Failing this, sand for th purpose is cheap, easy to handle and readily available. (See Fig 4.)

Support a central axle in the sand, using whatever method ingenuity suggests. Pivot a beam supporting a profile cut using either formula (2) or the device shown in Fig 5. Rotate this profile around the axis, either adding or cutting away sand as necessary. This should leave a beautiful paraboloid shape. Remove the beam and profile. Allow the top surface to dry thoroughly, and apply sufficient paint from a spray-on tin to fix the surface firmly enough to work on.

Now lay up the glass fibre and resin, preferably pre-impregnating the glass fibre before laying up. Continue this until the required thickness is achieved, which, as a guide, is about ¼in for a 4ft design. Cut eight ribs to the same parabolic profile in ¼in or ⅜in plywood and use these to reinforce the structure by bonding onto the back of the dish with resin and glass fibre.

Allow a week for hardening, and do not allow any moisture to settle on the surface. A heater nearby is a good idea during this time, provided it is kept away from resin and cellulose thinners. When the resin is hard remove the shell from the sand by twisting and lifting. Leave the inside face exposed for a day or two to ensure complete setting, and then, with the aid of a wire brush and cellulose thinners (NO SMOKING, PLEASE!), remove as much of the sand adhering as enthusiasm dictates. Clean off all thinners and leave for another day. Next apply resin to the surface and brush on pre-cut sections of aluminium kitchen foil. Allow this to set, and paint to taste.

Photo 1 shows the author's 4ft solid dish. Table 2 shows the profile used to cut the mould.

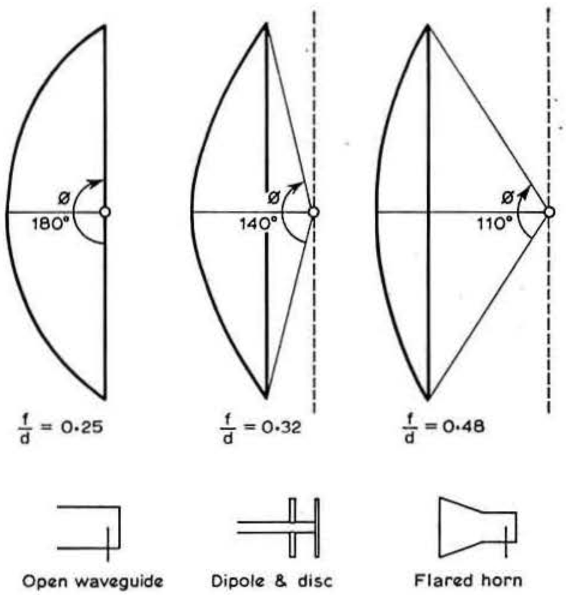

Fig 3. Three dish profiles with appropriate feed for each

Table 2. Profile values in inches for a 4ft dish, f/D = 0.31

X	0·16	0·63	0·14	0·25	0·39	0·57	0·77	1·01	1·28	1·58	1·91	2·27	2·67	3·09	3·55	4·04	4·56	5·11	5·70	6·31	6·96	7·64	8·35	9·09
Y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

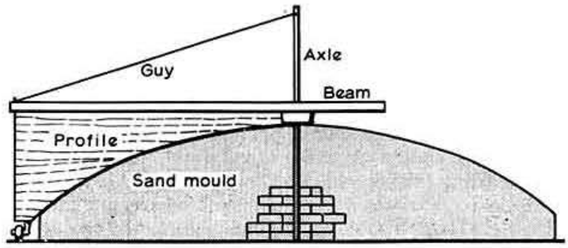

Fig 4. The preparation of the sand mould for a solid dish

Mesh reflector

The mesh normally used is chicken wire. The hole size should be less than 0·1λ diagonally at the highest frequency of operation. The mesh must be supported by ribs, either of wood or of steel-angle for larger structures. If wood is employed, the ribs can be cut using formula (2), or use can be made of the draughting device shown in Fig 5. Usually eight ribs will be necessary, although this depends to some extent on dish diameter. A suitable rib material for diameters up to 8 ft is Contiboard, but for diameters less than 4 ft ⅜in ply is adequate.

Using the draughting device draw a line AB, shown also as "axis" on Fig 5. Cut a length of twine slightly over twice the focal length of the dish and pin one end to the baseboard spacer block at A. Loop the twine round a cotton reel and pin the other end to the T-square at C. Run the square out from the axis to position D, where AD is equal to the dish radius. Position the rib-board so that the edge coincides with the hole in the cotton reel. Put a pencil through the hole and run the T-square back towards the axis, keeping the twine taut and the reel against the T. Mark in the back line of the rib with a free-hand line which indicates enough strength for the material in use. Cut-outs can be incorporated to reduce weight, but beware of decreasing the strength. Cut the rib out using an electric drill jig-saw attachment, using the first profile to draw the subsequent ones.

Fig 6 shows how the ribs are assembled in a spider, and Photo 2 is a photograph of the author's 6ft dish which was made in two halves for easy transportation. The circles were made from Pyrotenax cable, the rim being reinforced with resin-bonded paper rope. Ordinary rope should suffice, but the resin must be worked well in. Sections of chicken wire were cut when the spider had been assembled and were clipped onto the circles at appropriate intervals using 22 swg tinned copper wire. A coat of paint completed the job.

Summary

Briefly, the steps in design are:

1. Decide what gain or beamwidth suits the application;
2. Decide what type of feed is suitable for the job;
3. From its design estimate the width, to −10dB, of the main lobe;

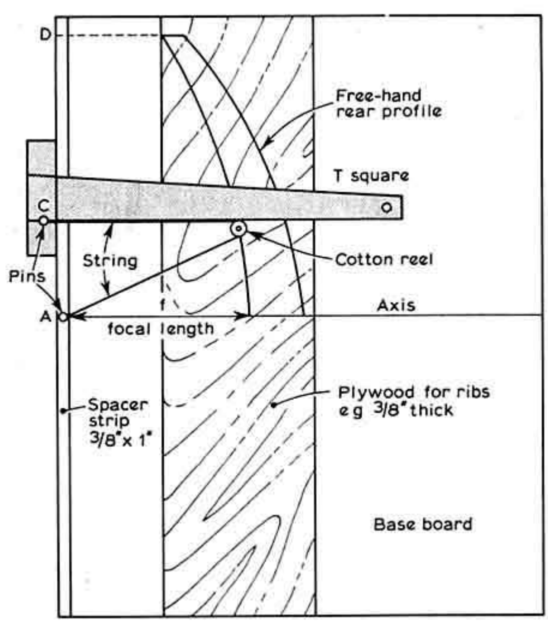

Fig 5. Draughting device for drawing dish profiles

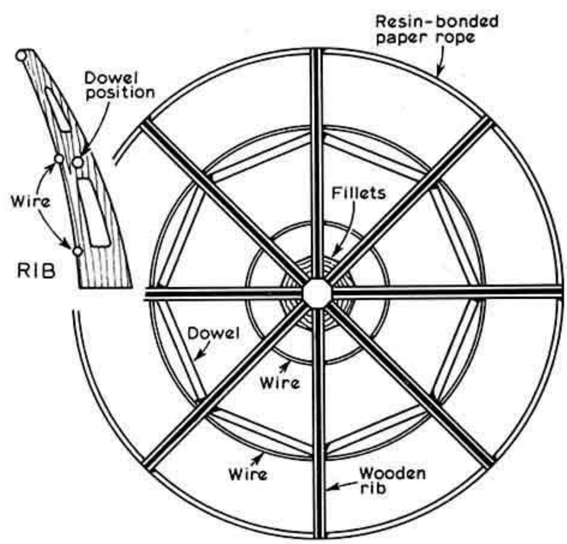

Fig 6. Framework for an open mesh reflector

4. Use formula (3) to calculate the f/D ratio;
5. Use formula (2) to compute the profile, or use Fig 6;
6. Decide on solid or mesh, and consult appropriate section.

Conclusion

The increased use of the amateur microwave frequencies has led to a demand for practical aerial designs for amateur use, but the designs described have one serious drawback, the signal is not only concentrated in the vertical plane but also in the azimuth plane. Some thought by those who are concerned to see these bands more effectively used will show what a serious limitation this is to their widespread use. A far more useful design would give a wide fan beam in the horizontal plane, while still restricting radiation as much as possible in the vertical. An aerial of this type is currently being developed, and it is hoped that a report will appear in due course.

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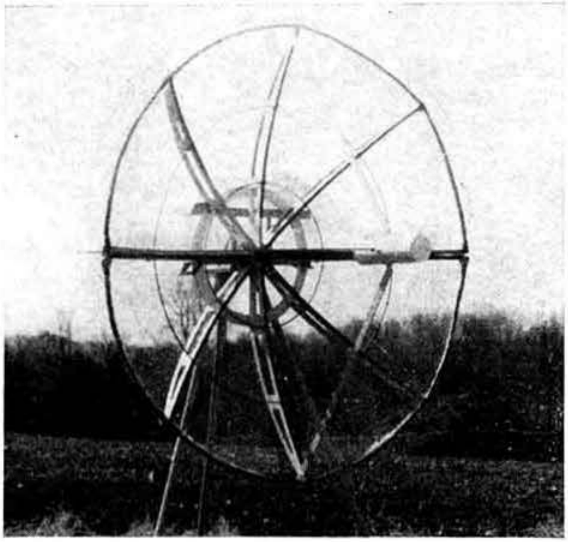

Photo 2. The author's 6ft mesh dish

An S-meter for the AR88

by I. Childs and G. K. Laycock, G3XFZ*

Scanning the *Members Ads* section of *Radio Communication* regularly, one is constantly aware of a large number of requests for original AR88 S-meters. This, no doubt, has been precipitated by the almost unlimited availability on the surplus market in recent years of new and secondhand AR88s, most of which are supplied without meters.

It was decided, therefore, to investigate the requirements of such meters in the hope that a standard one could be modified. From the AR88 manual it can be seen that a 5mA meter with a right-hand zero is specified, and as the original was back-illuminated it was considered that this illumination should be provided in the replacement to preserve the appearance of the receiver. A special order could have been sent to one of the many meter manufacturers, but at a cost of several pounds such action was considered to be unjustified.

Several surplus meter movements are available, and modification of such devices provides an inexpensive and acceptable solution to the problem. The task can be split conveniently into three main sections: modification of the basic movement to produce a right-hand zero; modification of the scaling to provide a back-illuminated "S" reading scale, and modification of the receiver fixing arrangements.

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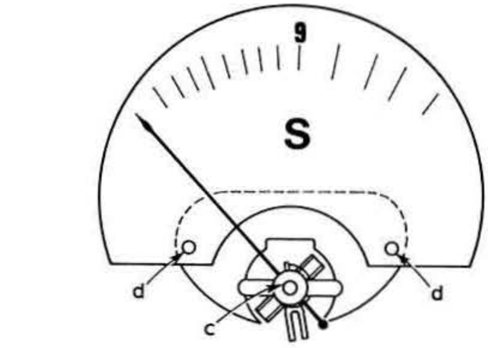
Modification for right-hand zero

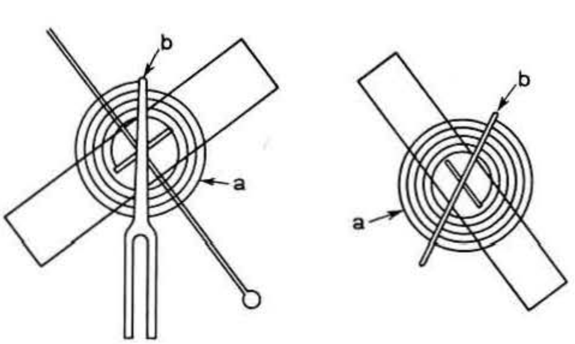
Fig 1 shows the arrangement most likely to be found inside a surplus moving-coil meter. Each hairspring (*a*) should be carefully unsoldered from its support (*b*) in turn, and resoldered about 4mm from the free end of the spring. The coarse and fine "zero set" controls should then be adjusted to see whether full scale deflection (to the right) is possible. If not, the hairsprings should be secured a little further away from their ends, and the test repeated.

The securing posts (*b*) may be bent slightly to increase spring tension and hence produce greater deflection to the right. Care must be taken not to tangle the hairsprings, which may be positioned by the careful use of a pair of non-magnetic tweezers. The bearing adjustment (*c*) should not be tampered with, as this will have been carefully set up during manufacture and should not require attention; although, should the "zero set" controls prove stiff to operate, the clamping nut may be loosened *slightly*.

When a steady deflection to the right has been obtained, the movement should be tested by putting it in series with a multimeter set to the ohms range, and a suitable variable resistor (starting with a high value of perhaps 100kΩ). By adjusting the resistor it should be possible to cause the adjusted movement to swing smoothly over the entire range from right to left. If the pointer sticks during its travel it is likely that either the pointer is touching the scale, or that the hairspring is tangled with itself or with the connections to the coil. With care, and a very small amount of force, the pointer can be bent away from the surface of the scale. When a completely free movement is obtained, the new scale can be made.



The basic movement



Top hairspring

Lower hairspring

Fig 1

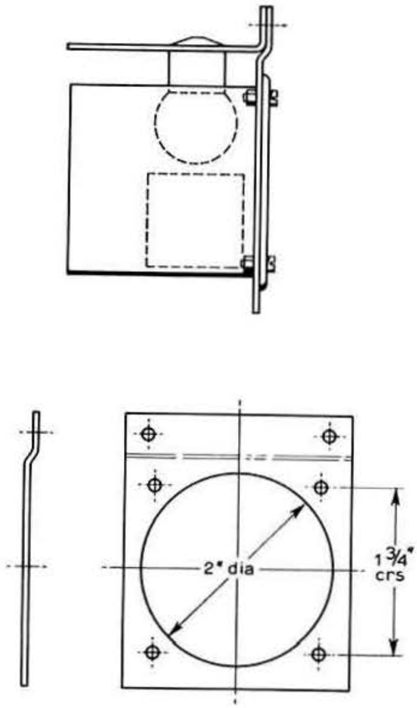


Fig 2

Scale modification

The old scale is removed by taking out the fixing bolts (*d*), care being taken not to damage the pointer. The new scale can be constructed from one of two possible materials. If the original blanking sheet bearing the motifs "AR88" and "RCA" is still to hand, the markings may easily be removed from it with very fine sandpaper, leaving a piece of tinted plastic material matching exactly the colour of the frequency scale. Otherwise white Perspex would be ideal, but clear Perspex rendered translucent by removing the polished surface with fine sandpaper can be used. The thickness of the material should be $\frac{1}{16}$in, and from this cut a new scale of the same size as the original, using the discarded scale as a template.

A hole of $\frac{1}{2}$in diameter is cut in the top of the meter case to take the panel light and its holder, care being taken not to shatter the rather brittle case. The bulb should then just fit behind the new scale and just in front of the back face of the meter case. A grommet may be used to provide a better fit for the bulb if it tends to move about in the hole. The scale is secured on its mounting and the unit is ready for calibration.

Fixing arrangements

Unmodified AR88D receivers have a pair of wires which emerge from underneath the chassis between T8 and the front panel and are secured to the latter. These will be found to be strapped together on the base of V5, and this link is cut and the leads attached to the meter terminals; a low-value shorting resistor being connected in parallel with the meter to avoid damage.

Switch on the receiver and tune to a quiet part of the range, when the meter should give a deflection to the left. If a right-hand deflection is obtained under no-signal conditions, the connections to the meter are the wrong way round and should be interchanged. The rf gain control should, of course, be turned fully clockwise. When a small deflection to the left is obtained, the resistor across the terminals may gradually be increased in value until the full scale deflection to the left is obtained, still under no-signal conditions. If, now, a strong broadcast station is tuned in, the pointer should move almost completely to the right. The scale can now be calibrated as shown in Fig 1.

After reassembling the meter it may be necessary to cut down the terminals on the back of the case, to avoid contact with the casing of T8. A suitable mounting plate may be made from 20swg aluminium, fitted flush with the back of the front panel and secured with the two American-threaded bolts which originally held the lamp bracket (Fig 2). The lamp is positioned in the hole in the top of the meter case and adjusted until the scale is evenly illuminated.

Conclusion

The total cost of such an S-meter should be less than 50p. All that is required is a steady hand and lots of patience, and the meter should be carefully examined before any adjustments are made. Suitably fitted the meter can do much to enhance the looks and operation of a fine receiver.

The "Classic" — a grounded-grid 813 linear amplifier

by C. F. ATKINS, G3HCV*

THIS equipment is intended as a companion amplifier for any ssb transceiver in the nominal 50 to 100W output range and is designed to increase signal level to the maximum allowed in the terms of the amateur (sound) licence. The factors deciding the choice of valves and circuit for this particular application are summarized as follows:

1. Conventional grid-driven Class AB tetrode linears do not adequately load transceivers (exciters) in this power range, and a matched resistive pad must be connected in the input line to the pa. Separate bias packs and regulated screen supplies are necessary and neutralization is essential, which involves complication and expense.
2. Passive grid AB1 stages readily accommodate high drive and do not require neutralizing, but they still retain the other disadvantages.
3. Over the last decade or so, several original designs have done much to overcome these problems and some have deservedly become very popular. Nevertheless, grounded grid linear amplifiers have retained their attraction for the following reasons:

   (*a*) zero-bias operation of high-mu triodes and certain triode-connected tetrodes in Class B mode eliminates the need for grid bias packs and screen supplies;
   (*b*) adequate exciter loading due to the "feedthrough" property of grounded grid stages—the exciter contributes to amplifier output;
   (*c*) highly degenerative circuit ensuring good linearity and often making neutralization unnecessary;
   (*d*) few critical operating parameters; will perform satisfactorily over wide range of ht voltage.

It is unfortunate that many valves suitable for operation at the power level envisaged are rather expensive, but the 813 is still reasonably priced and is capable of exemplary performance as a zero-bias triode. A pair are capable of dissipating 250W and will deliver 400W p.e.p. output on 28MHz with excellent linearity; third order distortion products being better than −30dB below maximum output.

With such large numbers of these valves in the possession of UK amateurs, it is hoped that this article will prompt some of their owners to give them a new lease of life.

Constructional features

Photograph 1 shows the chassis layout. The pa and power supply are combined on a 17in by 16in by 2½in deep aluminium chassis in an assembly with detachable panels of top, bottom and rear, the bottom panel being equipped with castors. The top cover is finely perforated over the rf section and an air filter is attached to the rear panel in line with the valves. A hole 5in in diameter is cut in the partition which divides the interior to allow a fan to play on the valves from immediately inside the power supply section. The ht bleeder resistors R4 and R5 are positioned on a perforated metal panel placed behind the fan in the path of cool air drawn through the filter. A safety interlock switch, S7, is let into the upper lip of the partition at the opposite end.

Photograph 2 shows T2 mounted on a shallow channel which also lends support to the bottom cover. Rectifier and smoothing components associated with T2 are supported on a terminal strip to the rear.

The valve socket filament contacts are interconnected by a pair of 12swg copper buss wires and the filament choke is suspended between these wires and the filament transformer terminals.

The 17in by 10½in 12swg aluminium front panel is dressed with a 16swg sub-panel to mask the unsightly heads of screws which secure the tank circuit components to the inner panel.

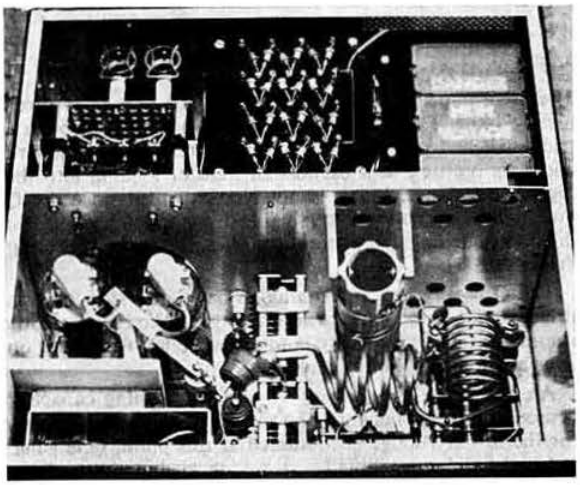


Photo 1.

Chassis top view. HT bridge rectifier and fuse are mounted on the power transformer. Bleeder resistors R4 and R5 are to the left, R1 is alongside but not visible. The anode choke is mounted on 1¼in insulators to level with the valve caps. Note the asbestos shield protecting the filament transformer

* "The Little Laurels", Bourton-on-the-Hill, Moreton-in-Marsh, Glos.

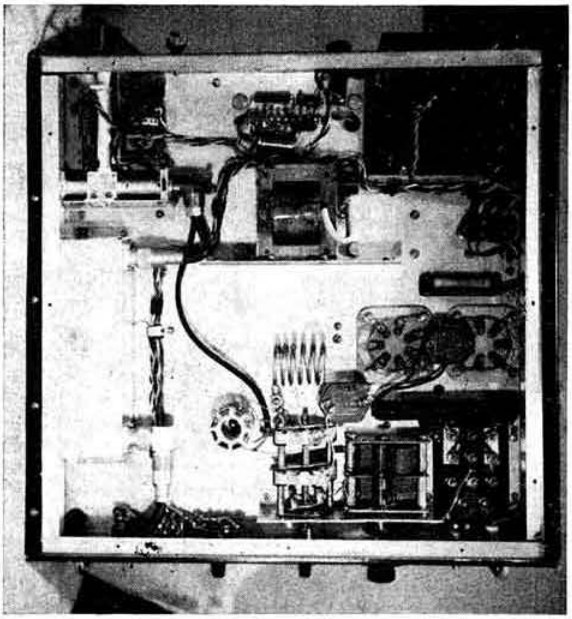


Photo 2.

Sub-chassis view. The aerial relay and MEDCO low pass filter are positioned along the left side with T2 near the centre. Input circuit L-net controls are grouped on a metal bracket near the front. L2 is mounted behind S1 on small ceramic insulators with L1 to the left. RFC1 is located between the filament transformer terminals and the valve bases. C4, C5 and R7 are also visible in the same area

A small box and a vertical channel are secured to the inner panel to shield the panel meters and wiring from the strong internal rf field.

RF circuit description

The drive impedance of the grounded-grid 813s is approximately 140Ω. This value is stepped down to 50Ω through a band-switched L network with manual tuning. This network could be omitted with exciters capable of loading into the higher impedance, but it is not recommended since the Q imparted by the network is valuable in suppressing waveform distortion arising from non-linear loading over the input drive cycle [1].

The Q is very low and tuning so flat that a slow motion drive is not essential. However, a graduated dial allows resonance to be set quickly, and it can be left for operation over a whole telephony band.

An ordinary 2-gang 500pF "broadcast" tuning capacitor is used to tune the network, the spacing being quite adequate for the low rf voltage encountered at this point. One gang, reduced to about 150pF by removing all but three of the moving vanes, is used on the 14—28MHz range; on the 3·5 and 7·0MHz bands the other gang is connected in parallel by the input bandswitch.

The filament choke, RFC1, consists of a 5in long ⅜in diameter ferrite rod close bi-filar wound with 12swg enamelled copper wire over its full length. Regrettably, the specification of the ferrite material is unknown and it might be advisable for the intending constructor to equip himself with one or two rods of various grade material and select that which provides the most satisfactory all-band performance. The choke is bound with adhesive tape and dipped in copal varnish to secure the core.

The filament transformer is situated in the pa enclosure close to the valves with the terminal panel facing downwards through a cut-out in the chassis. It is unavoidably subjected to a hot blast from the fan and is protected by a ⅜in-thick slab of asbestos secured to the exposed side.

The valves are orientated so that the filament pins face one another For maximum stability, the grids, screens and beam plates are earthed as directly as possible by soldering a "horseshoe" of copper braid around the relevant socket contacts and making direct connections to solder tags secured to each of the socket mounting bolts. Care should be taken to ensure that the ceramic material is not subjected to excessive compression, and the "double-nut" technique is advisable when securing the tags.

The metal shells surrounding the bottoms of the 813s are earthed in metal receptacles which are standard socket attachments. Should these items prove difficult to obtain, the spring clips found in certain types of fuse carrier may be put to good effect by bolting a number of them on to the chassis so that they butt firmly against the shells with the valves in situ.

The anode harness consists of short lengths of braid soldered to a ¾in wide copper strap secured to the top of the anode choke, RFC2.

The anode choke used is no longer manufactured, but it is very easily reproduced. A ⅝in former is wound with four sections of 34swg enamelled copper wire, the bottom section is 145 turns, followed by two sections of 30 turns each and a top section of 15 turns. The top winding is spaced $\frac{3}{16}$in from its neighbour and the others are spaced ⅛in apart.

The combined output capacitance of the 813s is almost 30pF, and strays are in excess of this figure. In an attempt to keep tank circuit Q within bounds on the higher frequencies, the minimum capacitance of the anode tuning capacitor is made as small as possible. To this end a twin-gang assembly was contrived by mating two 156pF variables taken from BC375 tuning units. One gang is reduced to approximately 60pF by removing eight rotor vanes, and it is used to cover all bands, except 3·5MHz when both gangs are used together.

To gang the capacitors remove the rotor bearing studs and bonding wipers, drill and tap each shaft 4BA then screw the rotors on to either end of a short length of studding. With a little patience it is possible to bring the moving vanes into radial alignment as the end plates meet, thus allowing the capacitors to be bolted together.

An aluminium bracket is secured at the junction of the two sections, the bonding wipers are replaced and connected to the bracket which serves as the main earth return, and additional support is provided by two pillars mounted inside the front panel.

The optimum anode load for the valves is 5,000Ω (R_L), and the desired output impedance 50Ω (Rout). A target loaded circuit Q of 20 was chosen, taking care to note that this value would be exceeded on the higher frequency ranges.

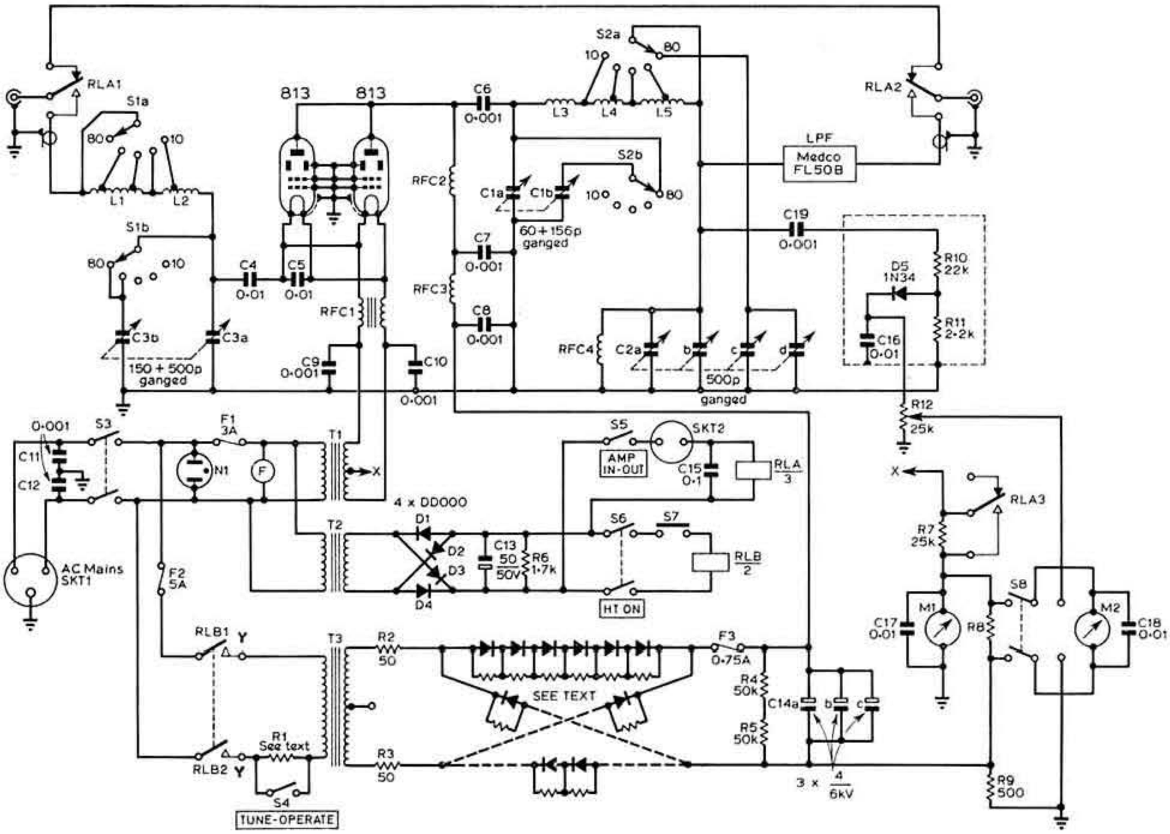


Fig 1. Circuit diagram

The ratio $\frac{R_L}{R_{out}} = 100$, and $\sqrt{100} = 10$, which is the reactance ratio of C1 to C2.

Now, $X_{C1} = \frac{R_L}{Q} = \frac{5{,}000}{20} = 250\Omega$

and, $X_{C2} = \frac{X_{C1}}{10} = \frac{250}{10} = 25\Omega$

The pi-tank capacitor values which equate these reactances are as follows:

Frequency	C1	C2
3·5MHz	180pF	1,800pF
3·8MHz	170pF	1,700pF
7MHz	90pF	900pF
14MHz	45pF	450pF
21MHz	30pF	300pF
28MHz	23pF	230pF

Bearing in mind the large extraneous capacitance shunting C1, it is evident from these figures that operating Q runs appreciably higher than datum on the 21 and 28MHz ranges. To minimize losses, large diameter coil material is employed and tank inductance is split into sections which are orientated to reduce undesirable absorption effects. Lengths of

Photo 3.

Power amplifier. HT enters via the insulator to the left of C1; C7 and C8 are mounted on the chassis and RFC3 is suspended between them. C1 (a) is the foremost gang. C6 and coil L3 are supported by an insulator mounted on C1 frame. L4 is supported off the rear end plate of C2 where it joins L5. The screening can to the right of L5 houses the rf output monitor; RFC4 may be observed nearby

Table 1. Coil details

L1—10 turns 18swg tinned copper on 1⅜in diameter ribbed ceramic former.* 10 tpi with taps at 2 turns and 6 turns from junction with L2.
L2—6 turns ⅛in copper tube, 1½in inside diameter, 1¾in long. Tapped 3¾ turns from cathode end.
L3—4¼ turns ¼in copper tube, 1⅜in inside diameter, 3in long.
L4—7¾ turns ⅛in copper tube, 1½in inside diameter, 2¼in long. Tapped 3 turns from junction with L3.
L5—9 turns plus 10½ turns 16swg tinned copper on 2in outside diameter ex-BC375 former. 10tpi ¼in space between sections.
* "non-standard" item.

Table 2

HT = 2·5kV   Output = 400W p.e.p. (Two-tone drive)

Freq MHz	Grid current (mA)	Anode current (mA)	Input tuning (0–10 div)	Anode tuning (0–100 div)	Output loading (0–100 div)
3·5	40	170	8	50	85
7	40	200	2	50	80
14	42	220	7	18	68
21	50	295	3	12	50
28	58	300	2	8	40

⅜in-wide copper strapping are used as coil taps on 21 and 28MHz, and 12swg copper wire for the lower frequencies. More detail of the assembly may be had by relating Table 1 to Photo 3.

The bandswitch is modified by filing extra indexing detents and adding fixed contacts to bring the number of positions up to five. The rear wafer is used to shunt the two sections of C1 on 3·5MHz, and, since the shaft is earthed, the back rotor contact ring is removed from this wafer to prevent arcing. Since this halves the contact area an extra wiping contact is added to mate with the front ring. This particular alteration could have been avoided by mounting the switch on insulators and using an insulated coupling to the front panel control.

Connection between the switch and C1 sections is effected by means of ½in-wide low-inductance copper straps. C2 gangs are connected in pairs which are marshalled by the bandswitch to provide a maximum capacity of 2,000pF on 3·5MHz and 1,000pF on 7–28MHz bands.

The aerial relay, $\frac{\text{RLA}}{3}$, was taken from an AM surplus "Switch type 78", and modified by removing the auxiliary contacts and replacing them with a normally open pair (RLA3). Since the relay is not energized during reception, R7 biases the pa to virtual cut-off to reduce temperature and prevent "diode noise" in the receiver; on SEND RLA3 contacts short out R7 and the valves draw 70mA of static anode current in zero-bias condition.

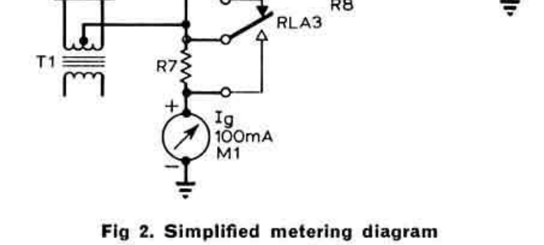


Fig 2. Simplified metering diagram

The 24V supply for $\frac{\text{RLA}}{3}$ is fed via SKT2 on the chassis back-apron to allow the transceiver send-receive relay to control the whole station; the transceiver may be operated "barefoot" by opening S5 (AMP IN-OUT), which inhibits the aerial change-over function and holds the pa cut-off. In both S5 positions the exciter "sees" the same impedance, therefore no retuning is needed and S5 behaves as an instant QRO/QRP selector.

It is appreciated that many intending constructors may find the surplus relay difficult to obtain, and in this case it is suggested that the range of aerial relays manufactured by the Dow Company may offer a suitable alternative.

Power supply and metering

The anode supply voltage may range from 1·5kV to 3kV with corresponding values of efficiency and output. The "Classic" ht voltage is 2·5kV on load and single tone efficiency ranges from 60 per cent on 3·5MHz to 50 per cent on 28MHz. On TUNE the anode voltage drops to 1·75kV or less, depending on loading.

The power transformer T3 is taken from a T1131 transmitter modulator supply which delivered 1,000V dc in a conventional full-wave centre tap circuit. A full-wave bridge comprising 24 BY100 silicon diodes is connected across the secondary in series with R2 and R3 for surge protection; each diode is shunted by a 150kΩ ½W resistor to even up inverse voltage.

The metal-cased smoothing capacitors are mounted above chassis on an insulating board so that any leakage to case does not appear across R9, M1, and possibly M2. Since the cases could assume high positive voltage under certain fault conditions, the tops are painted red to warn that a potential hazard exists. A HT ON panel neon has not been fitted, but one should be provided and connected at points Y-Y in Fig 1.

A 100mA meter, M1, reads combined grid and screen currents, while M2 is a 1mA instrument scaled 0–300mA which measures anode current when shunted across R8 by means of S8. In the alternate S8 position M2 monitors relative rf output, and to avoid personal risk and the possibility of meter insulation breakdown R8 is connected in the ht supply negative return rather than in the positive line.

Adjustment and tuning

WARNING. Before making any internal adjustment, switch off and disconnect the supply mains, then, using a well-insulated screwdriver, earth the ht line to confirm that the filter capacitors are discharged.

Components list

C1	60 + 156pF (ex-BC375, see text)
C2	4-gang 500pF, receiving type
C3	150 + 500pF, receiving type (see text)
C4, 5	0·01μF 600V dc wkg mica (ex-BC375)
C6, 7, 8	Erie Ceramicon 0·001μF 15kV dc wkg type CHU 410
C9, 10, 11, 12, 19	Disc ceramic 0·001μF 500V dc wkg
C13	Electrolytic 500μF 50V dc wkg
C14 (a, b, c)	Pyranol 4μF 6kV dc wkg (3 off)
C15	Paper 0·1μF 350V dc wkg
C16, 17, 18	Disc ceramic 0·01μF 350V dc wkg
D1, 2, 3, 4	Lucas DD000 or equivalent
D5	Diode, type 1N34 or similar
F1	3A Belling Lee 1¼in
F2	5A Belling Lee 1¼in
F3	0·75A Belling Lee 1¼in
LPF	Medco FL50B
R1	Bowl fire element 600W
R2, 3	Wirewound 50Ω 10W
R4, 5	50kΩ 85W wirewound
R6	Carbon 1·7kΩ 3W
R7	Wirewound 25kΩ 10W
R8	300mA shunt (see text)
R9	Wirewound 500Ω 10W
R10	Carbon 22kΩ 2W
R11	Carbon 2·2kΩ 1W
R12	Carbon variable 25kΩ

RFC1	Filament choke (see text)
RFC2	Labgear E5032
RFC3	2·5mH, 300mA
RFC4	1mH, 600mA (National R154U or similar)
S1	Ceramic 2-gang, 1-pole 5-way
S2	F and E. 2-gang 1-pole 5-way (modified)
S3	Dpst toggle 10A 250V ac
S4	Spst toggle 3A 250V ac
S5	Rotary wafer spst
S6	Dpdt toggle. 3A 250V ac
S7	Microswitch 1A dc
SKT1	mains connector 3-pole 5A
SKT2	2-pole connector, female, 1A
T1	Filament transformer 10V 10A, tapped primary 220–250V ac
T2	24V 1·5A, tapped primary 220–250V ac
T3	1200–0–1200V ac. 300mA tapped primary (representative values, see text)
RLA/3	Aerial relay, 24V dc coil (see text)
RLB/2	2-pole contactor, 10A at 230V ac, 24V dc coil
N1	Neon panel indicator 230V ac wkg

A two-tone audio source, monitoring oscilloscope, and a 50Ω load with p.e.p. reading output meter are necessary to assess satisfactorily the performance of the amplifier and also to ensure that the terms of the licence are not subsequently exceeded. Modus operandi and the characteristic display patterns to be expected have been thoroughly dealt with elsewhere and will not be repeated here [2].

Preliminary checks are necessary to confirm that the input circuit and pi-net resonate correctly on each band; they should be conducted at reduced power (S4 on TUNE), and with drive from the exciter held to a minimum. Anode circuit tuning and loading should be adjusted with the aid of the relative rf output monitor.

On 10m L3 should be deformed if necessary to ensure that C1 just begins to mesh at 29·7MHz. Dial readings should approximate the values given in Table 2.

Now, switch to OPERATE, apply two-tone audio to the exciter mic socket, and adjust pa tuning and loading to obtain 400W p.e.p. output with optimum linearity as shown by the familiar oscilloscope pattern. The related parameters to be expected are given in Table 2.

Speech may now be applied and level adjusted to ensure that speech peaks do not exceed the maximum amplitude of the two-tone oscilloscope pattern obtained at 400W p.e.p. output; grid and anode meters will kick up to approximately half the values shown in the table.

For the benefit of operators favouring an input impedance of 80Ω the procedure adopted in arriving at the L-net values is as follows:

Beginning with 28MHz, insert carrier and adjust the exciter into an 80Ω load with the aid of an swr bridge. Shift the load to the pa, apply ht and transfer the drive to the pa, retaining the bridge in circuit; make no further adjustment to the exciter except to regulate drive as necessary.

Now tune the L-net (C3) for maximum grid current and load the pa normally. Then, keeping C3 in tune, adjust the tap on L1 until maximum grid current coincides with minimum swr on the input line. (Remember to switch off pa ht and check for safety before each adjustment). Repeat the process on the remaining bands, tapping L2 as necessary.

This method should result in an swr of <1·5 : 1 on 28MHz and <1·25 : 1 on all other bands, without the L-net the figure may rise to as high as 3 : 1 on some bands.

References

[1] *Radio Communication Handbook*, 4th edition, p 10.33.
[2] *Radio Communication Handbook*, 4th edition, p 10.42.

"I can't give you an S-meter reading, but you're well over the nine"

A 24-hour digital clock

by R. WILSON, G3TBS*

A 24-HOUR digital clock using four Nixie tube digital read-out displays and operating from the domestic 230V 50Hz mains was successfully constructed by the author. The only major components used, apart from a mains transformer and a power pack, comprised three transistors and 13 low-cost integrated circuits (for gates, counter dividers and decoders) obtained from Bi-Pak of Ware. In the circuit description the logical level 0 is approximately 0·8V and the logic level 1 is a minimum of 2·4V.

The principle of operation is to use the 50Hz sine wave of the 230V ac mains and feed it via a stepdown transformer (to reduce the amplitude safely to a suitable level) to drive a squarer circuit comprising transistors TR1 and TR2 (Fig 1), forming an overdriven type of amplifier circuit. The output of this circuit consists of square waves with fast rise and fall times.

The trailing negative-going edge of the output square waveform operates the first of two divide-by-10 integrated circuits, IC1, the output from which drives the second divide-by-10 circuit, IC2. The output of IC2 drives IC3, a divide-by-5 circuit, and the output of IC3 drives IC4 which is a divide-by-6 circuit. It may be seen that the overall division ratio of the four stages is 10 by 10 by 5 by 6, so that for every 3,000 trigger pulses (each representing one cycle of the mains) fed into the first divider (IC1), one pulse is delivered from IC4. Thus one pulse is produced at the divider output per minute (ie 1ppm). A 0·4s pulse is taken from IC2 to enable the hours counter to be set rapidly in synchronization with a time signal while the clock is being set.

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The 1ppm pulse 'C' is fed to a units and tens of minutes counter (IC6 and IC7 Fig 3) and also to a reset circuit (Fig 2).

IC6 and IC7 form a divide-by-60 counter (divide-by-10 and divide-by-6) providing an output every 60 minutes to the 24-hour counter divider formed by IC8 and IC9. The units and tens of minutes are decoded by gates contained in IC12 and IC13. The 24-hour counter is decoded by gates contained in IC10 and IC11. The Nixie tubes are driven by the outputs from the gates as shown in Fig 3.

As soon as IC8 and IC9 reach the 24 counted state, the hours counters are reset to 00. The minutes counters IC6 and IC7 reset to 00 on reaching the 60 counted state.

Gating and reset, Fig 2

This is a simplified circuit of the gating counting and reset of Fig 1. The 1 pulse per minute output is taken to the input of IC6, which divides by 10, after which output D goes to logic '0' generating a negative-going pulse which is then transferred to the input of IC7. When outputs C and B are at logic '1' (ie at a count state of 60) both inputs to IC5c will go to logic '1' and the output will go to logic '0'. This generates a negative-going pulse which is transferred to the input of IC8. At the same time the input to IC5d goes to logic '0' and the output goes to logic '1'. This combined action operates the reset inputs of IC6 and IC7 to '1' and therefore a pulse is transferred on the hour and the minutes are reset to '0'.

IC8 will count hours and when output D goes to logic '0 the negative pulse is transferred to IC9 to count tens o. hours. However, when output C of IC8 and output B o

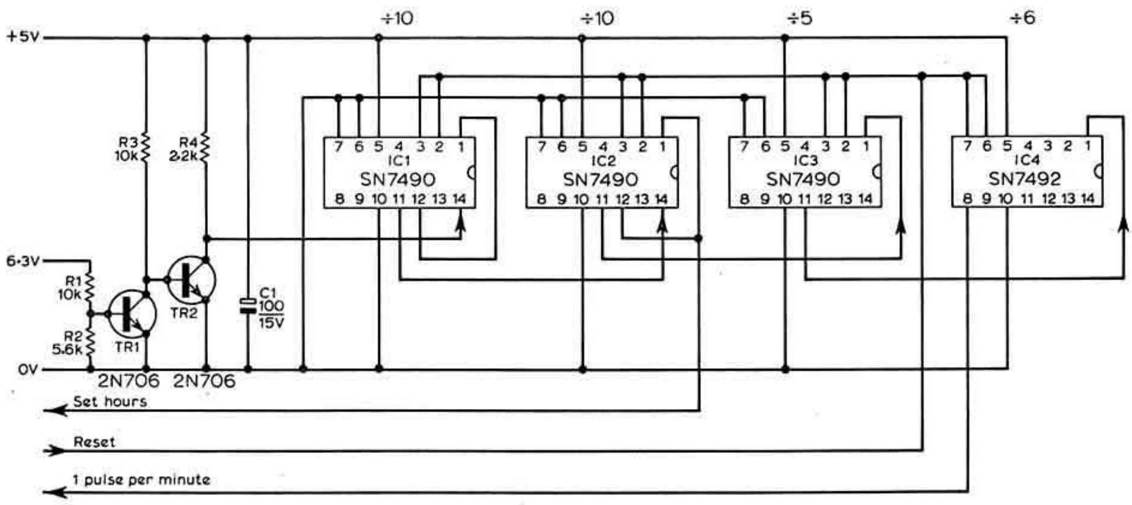


Fig 1. One pulse per minute from 50Hz

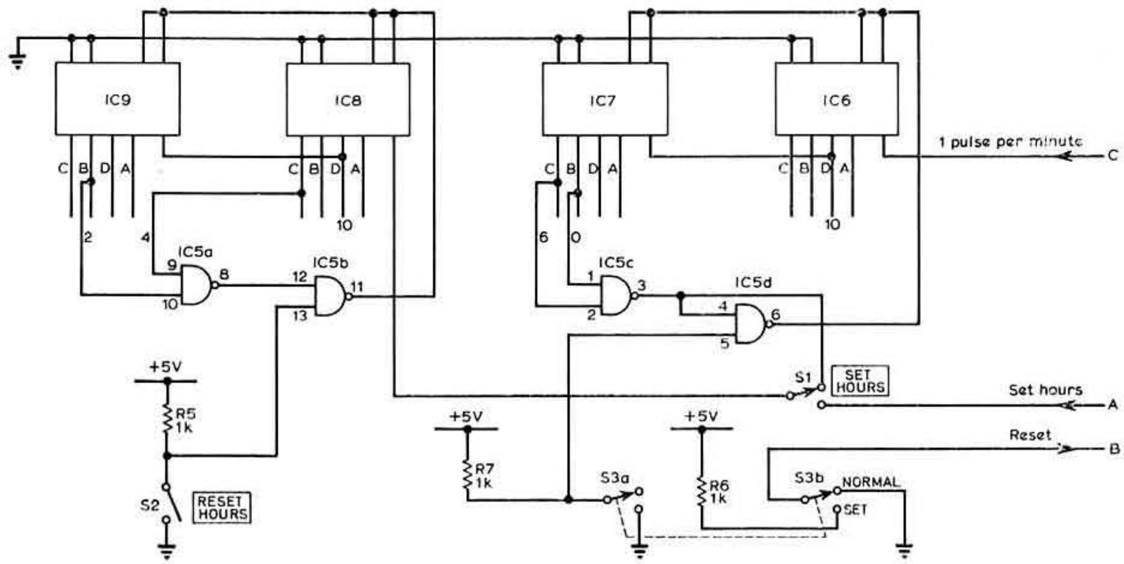


Fig 2. Gating and reset

IC9 are both at logic '1' (see Fig 6) the inputs to IC5a are at logic '1' and its output is at logic '0'. The input to IC5b, therefore, is at logic '0' and the output at logic '1' resetting IC8 and IC9 to 00 hours. All hours and minutes are then at 0000.

The operation of the reset facility, which allows the clock to be set up to a suitable time signal is shown in simplified form in Fig 2. The procedure is as follows: first set the hours to 00 by operating S2. This puts the input to IC5b at 0 state and the output at 1 state which resets IC8 and IC9 both to 0. Reset the minutes to 00 by operating S3; this puts the input to IC5d at '0' state and the output at 1 state which resets IC6 and IC7 both to 0. Section b of S3 simultaneously sets the 1ppm counter (ICs 1, 2, 3 and 4) to 0.

The clock is now ready for synchronization with a time signal. Set the hours as required by placing S3 in the NORMAL

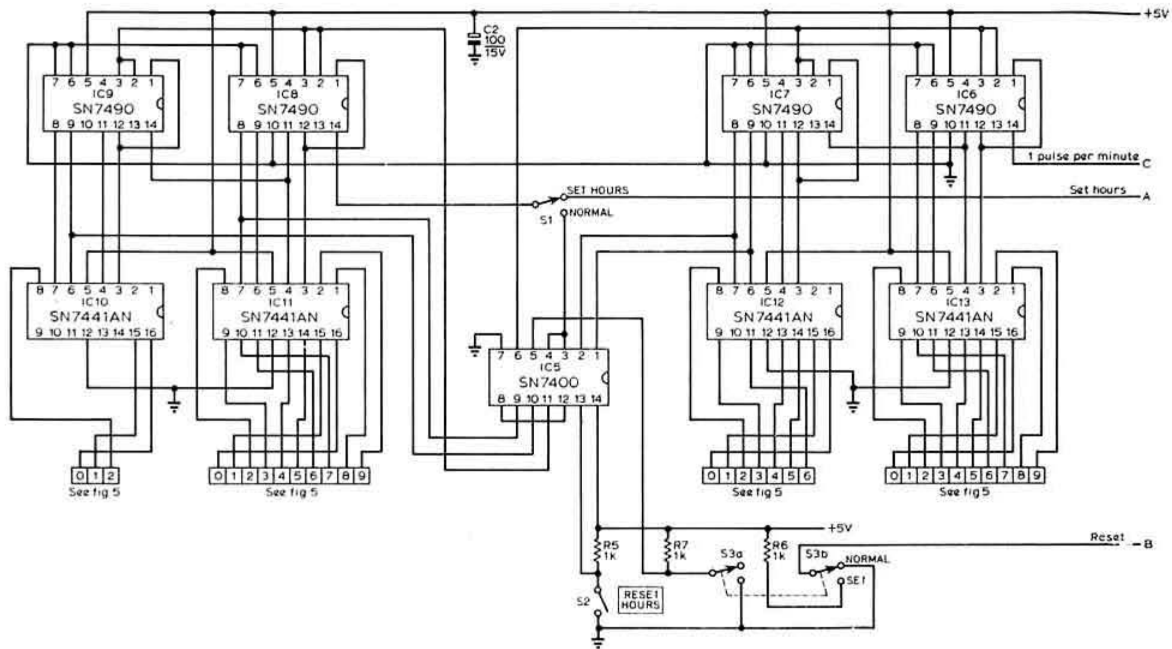


Fig 3. Main counter, 0000–2400 hours

position and press S1 to SET. This allows the 0·4s pulse from IC2 to set the hours counter rapidly by feeding the pulses into IC8. Release S1 when the Nixie read-outs reach the hour readings required.

When the time signal is heard, switch S3 to SET and then back to NORMAL to start the clock in synchronization with the commencement of the hour.

Power pack

The circuit used is shown at Fig 4, and consists of a mains transformer with fused and switched primary. The secondary windings provide 6·3V ac to drive the squarer TR1 and TR2, a 150-0-150V output operating a full-wave rectifier giving a +200V dc supply to the Nixie tubes, and a 12-0-12V output winding operating a full-wave rectifier giving a final stabilized +5V dc output to operate the ICS. This is nominal output, the limits are +4·75 to +5·25V dc for correct operation of the ICS.

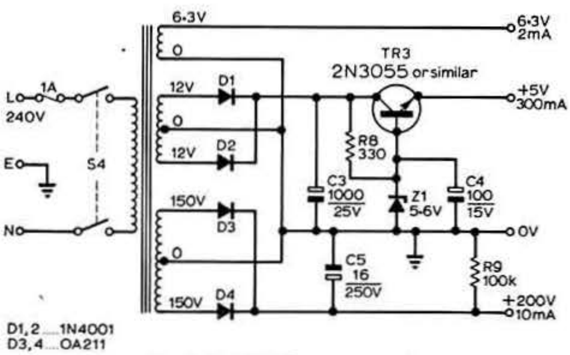


Fig 4. Suitable power supply

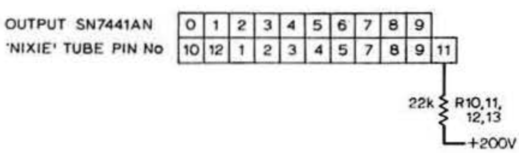


Fig 5.

General notes

The numbers shown in the ic outline diagrams are pin numbers of the terminals. In Fig 5 the correct connections between the SN7441AN decoders and Nixie tubes base pins are shown for the Burroughs B59956.

To check the one-pulse-per-minute divider, isolate the lead to pin 14 of IC1, make a new connection to the collector of TR2 and apply the output pulses to the input of IC2 (Fig 1) and check the time taken for the Nixie tube minutes units read-out to change (using a watch or stopwatch). Connecting the pulse to the input of IC1 should result in a 6s interval. Knowing thus that IC2, IC3 and IC4 are operating correctly, any incorrect solution is attributed to IC1. Connection to the output of IC2 should change the minute unit at 0·6s intervals, this confirming correct operation of IC3 and IC4. Application to the output of IC3 should give a fast (about eight times a second) change, which will enable testing without the need for an oscilloscope.

S1 and S2 in Fig 3 are biased push-switches, S3 and S4 in Fig 4 are double-pole toggle switches.

COUNT	OUTPUT			
	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Fig 6. SN7490 Logic table

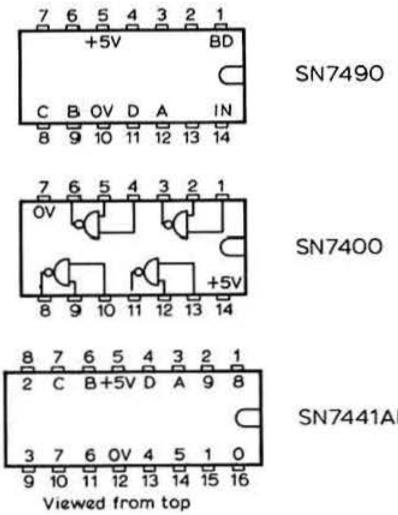


Fig 7. Top view of ic connections

Components list

R1	6·8kΩ	¼W 5 per cent	R8	330Ω	¼W 5 per cent
R2	5·6kΩ		R9	100kΩ	
R3	10kΩ		R10	22kΩ	
R4	2·2kΩ		R11	22kΩ	
R5	1kΩ		R12	22kΩ	
R6	1k'Ω		R13	22kΩ	
R7	1kΩ				

C1 100μF
C2 100μF
C3 1,000μF
C4 100μF
C5 16μF

IC1, 2, 3, 6, 7, 8, 9	SN7490
IC4	SN7492
IC5	SN7400
IC10, 11, 12, 13	SN7441AN

Z1 5·6V ± 5 per cent 400mW

D1, 2	IN4001	D3, 4	OA211
TR1, 2	2N706	TR3	2N3055
S1, S2	SPCO biased	S3, S4	DPCO

Nixie tubes—Burroughs B59956
Suitable sockets—DTV Ltd

The G3MHQ "allsorter" tester

by E. W. HOLT. G3MHQ*

THIS project started as a quest to build an instrument for reading insulation resistance, using only a low voltage supply; and to test such items as low voltage capacitors etc without fear of breaking down the insulation. A range of about 1 to 30MΩ was required. The tester ended up as an insulation tester, cum field strength indicator, high-resistance voltmeter, resonance indicator, modulation monitor, signal generator, crystal activity tester, capacitor tester and hetrodyne monitor.

Construction

Each separate circuit is built on a standard tag strip and is tested before proceeding to the next stage.

Fig 1 shows the circuit of the insulation tester and high-resistance meter (Stage 1). This stage should be bolted to the metal front panel to complete the circuit between the earth tags, but if an insulated front panel is used all earth tags must be connected together. TR1 and TR2, selected for high current gain, are arranged as a Darlington pair having a very high input impedance. R2 biases TR1 to current cut-off point, and TR1 prevents TR2 from conducting. When a test resistor is inserted between points X and Y, the cut-off bias is reduced by the ratio of the test resistance plus R1 in series to R2. R1 is necessary to prevent excessive base current flowing when the test points are short-circuited.

To test Stage 1, short-circuit the test points X and Y, and adjust RV1 to just full-scale deflection. Remove short-circuit and test with a known 1MΩ resistor across the test points, when nearly full-scale deflection should be achieved. A 10MΩ resistor will indicate about 100mA deflection. As the scale is not linear near the lower end, due to the transistors' characteristics when biased to cut-off, the scale is best calibrated by trying known resistors of values between 1MΩ and 30MΩ and noting the deflection.

This circuit will also function as a very sensitive voltmeter for ac or dc, the voltage being applied between points Y and Z; negative to Y and positive to Z for dc. It has a deflection sensitivity of approximately 400,000Ω/V, and full-scale deflection is about 5V. By adding extra resistance in series with R1 the voltage range can be increased: a total resistance (including R1) of 20MΩ will give a 50V range, and 200MΩ a 500V range. These scales are also non-linear and should be calibrated against known voltages.

Stage 2 (Fig 2) consists of a pair of OA81 crystal diodes arranged as a voltage doubler and connected to point "B" on the switch. Input from the aerial is connected via a capacitor to the junction of the diodes, and the signal produces a negative voltage proportional to the received signal to the base of TR1. The instrument now becomes an untuned but fairly sensitive field-strength meter. RF can either be picked up via a short aerial, or by a coaxial cable and a wire loop.

Stage 3 (Fig 3) is a switchable crystal oscillator and buffer amplifier. Various crystal oscillators were tried, as it was hoped to obtain oscillators that would function on all frequencies from 100kHz to about 30MHz. However, a compromise was necessary when it was found that the components required for lf would not work at hf, and vice versa. HF was chosen, as most crystals in the junk box were hf types.

This circuit oscillates quite happily from about 800kHz to 30MHz. Overtone crystals can be tested on their fundamental frequencies. The crystal holders for the various types

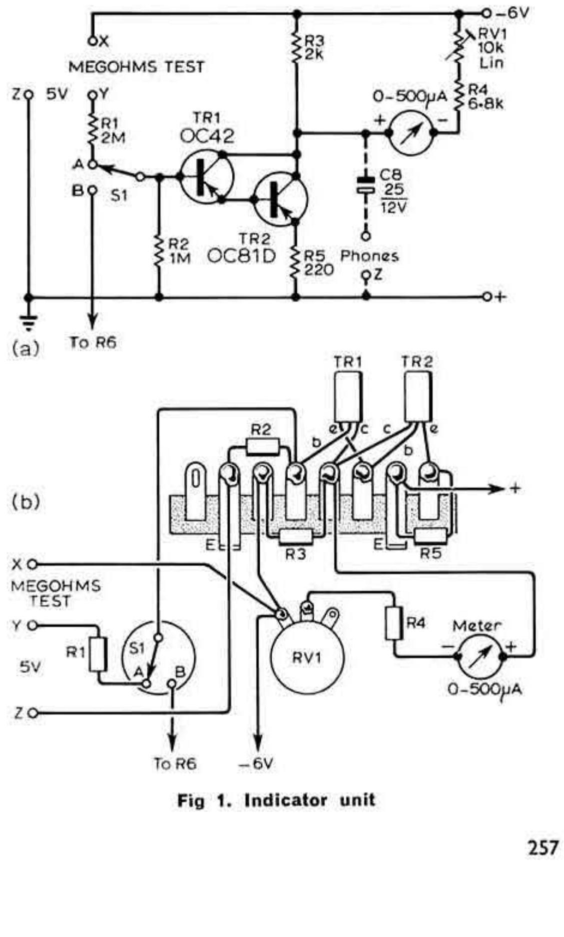


Fig 1. Indicator unit

*34 Lee Road, Greenford, Middlesex.

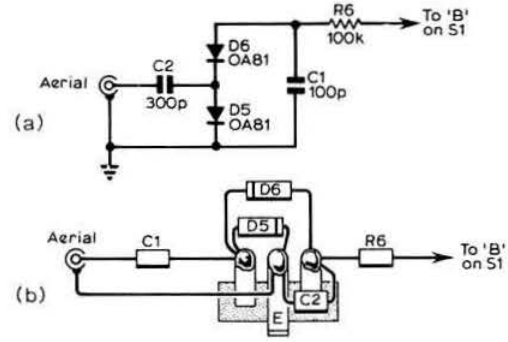


Fig 2. RF unit

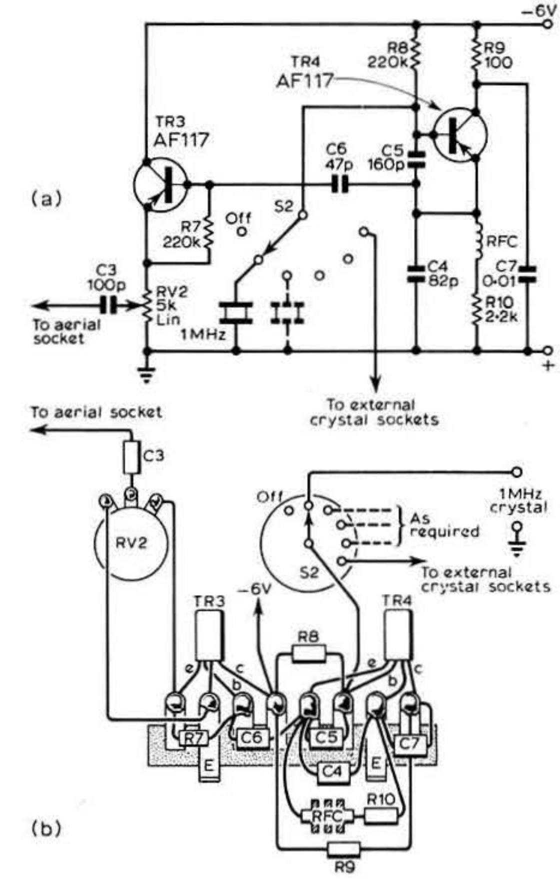


Fig 3. Crystal oscillator and buffer amplifier

of crystals to be tested are all wired in parallel and fitted on the front panel. The reference crystals for calibrating are mounted inside the instrument and can be switched in as required. Switch S2 can have as many positions as the available internal crystals, or all crystals can be plugged in externally if desired, the switch being bypassed by connecting the base lead of TR4 directly to the external crystal sockets. In the original model, internal crystals of 1MHz, 3·5MHz, 5MHz and 10MHz were included, mainly because they were available and were useful marker frequencies.

With Stage 3 completed, the tester can now be used as a crystal-controlled signal generator; the output level being controlled by RV2, the attenuator, and registered on the meter. Crystals can be tested in the appropriate external socket, the meter deflection indicating their activity.

As a bonus it was discovered that if the tester is linked by a coaxial cable and looped to a tuned circuit, a sharp indication of resonance can be observed on the meter when the circuit is tuned to the crystal frequency.

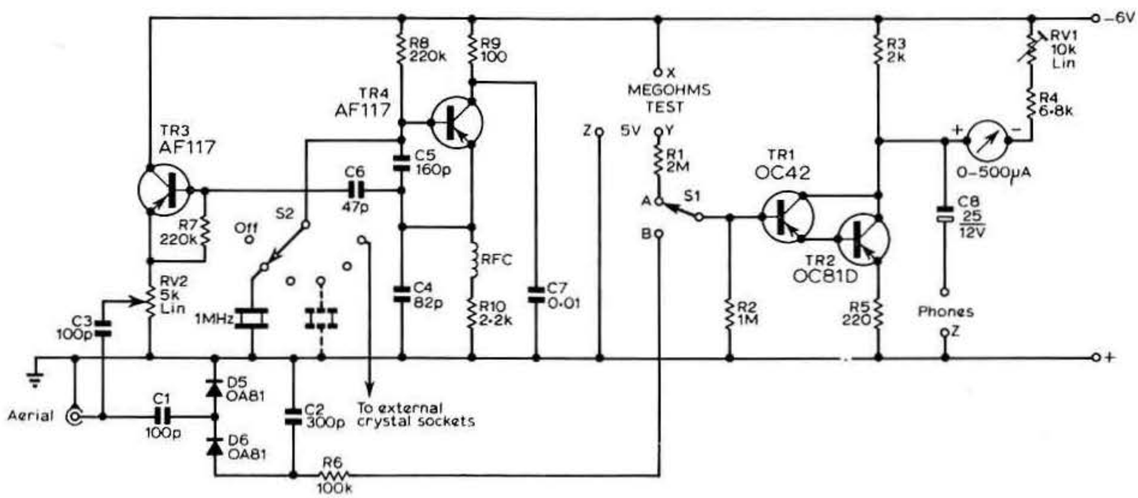


Fig 4. Complete circuit

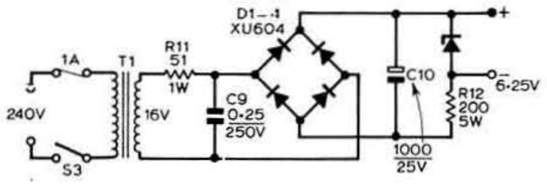


Fig 5. Mains power unit

Small capacitors of about 10 to 500pF can be tested by adjusting RV2 to just full-scale deflection and connecting the capacitor across the aerial socket. The meter will dip relative to the ratio of the value of the capacitor under test to that of C3. The scale can be calibrated by observing the deflection for capacitor values between 10 and 500pF. The 1MHz crystal is used for this test. Small capacitors can be checked without removal from circuit by using a length of coaxial cable to connect them to the aerial socket, after balancing out the capacitance of the cable by adjusting RV2 to full scale deflection.

By connecting an electrolytic capacitor, C8, and a pair of high-resistance phones between the collector of TR2 and earth, the instrument becomes a modulation monitor and hetrodyne monitor. A sample of the transmitter output is picked up via a short aerial, or coaxial cable and loop, and the signal is detected by D6 and D5, the audio signal being amplified by TR1 and TR2. The meter will register the increase in signal strength as the modulation percentage increases. By switching on the crystal oscillator a hetrodyne note will be heard as the transmitter frequency approaches that of the crystal. If harmonics of the crystal are to be used, extra af amplification may be required.

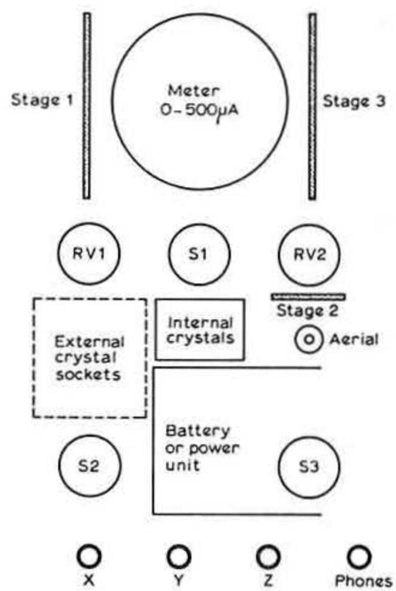


Fig 6. Proposed layout

To obtain the best hetrodyne note, only a small amount of rf from the transmitter and crystal oscillator is required. Too much signal from either source will over-bias TR1. The best note was found when the meter was reading 100μA. The crystal output is controlled by RV2.

There are many other possible uses for this little unit, such as a tuning indicator, or "S" meter, by feeding the i.f. of the receiver into the aerial socket and calibrating the meter in "S" points. It could also be used as an output meter by connecting Y and Z across the speech winding of the loud-speaker and calibrating the meter in watts—(V^2/r) where r is the dynamic resistance of the speaker.

Power supply

The unit can be powered from a 6V battery or from a suitably stabilized mains unit. If operated from a battery, S3 will have to be connected in series with the negative battery lead. A small 16V transformer was used in the original model but a 12V transformer would work equally as well by reducing the value of R12 to about 150Ω. The output is stabilized to 6·25V by the zener diode (VR625), and sufficient current is available to operate other equipment from the same power unit if required.

Fig 4 shows the complete circuit; Fig 5 the mains power unit.

Components list

R1	2MΩ	C1	100pF
R2	1MΩ	C2	300pF
R3	2kΩ	C3	100pF
R4	6·8kΩ	C4	82pF
R5	220Ω	C5	160pF
R6	100kΩ	C6	47pF
R7	220kΩ	C7	0·01μF
R8	220kΩ	C8	25μF 12V
R9	100Ω	C9	0·25μF 250V
R10	2·2kΩ	C10	1,000μF 25V
R11	51Ω 1W	D1, D2, D3, D4	XU604
R12	200Ω 5W	D5, D6	OA81
RV1	10kΩ linear	TR1	OC42
RV2	5kΩ linear	TR2	OC81D
T1	see text	TR3, TR4	AF117

BOOK REVIEW

Dictionary of Telecommunications. 199 pages. Author: Dr R. A. Bones. Published by the Butterworth Group. Price £2.25.

The author, who is a member of the STC technical directorate, has included in this dictionary a wide range of definitions, including many based on British Standards. There are several useful appendices containing explanations of symbols. A book of this size cannot be exhaustive and it is not difficult to note omissions. However, the dictionary should be of value to all whose interest or occupation is connected with telecommunications.

TECHNICAL TOPICS

A monthly feature by PAT HAWKER, G3VA

SEMICONDUCTOR integrated circuits are turning up increasingly in amateur designs and as a talking point—though we recognize that a few people still have some reservations about the role these ingenious packaged circuits should play in amateur construction. But to most of us they represent a useful method of easing the construction of the relatively sophisticated equipment that is called for in the 'seventies. Incidentally, a recent definition of "sophisticated" as applied to electronic equipment is that this usually means that the writer does not really understand how it all works and hopes no one will ask awkward questions.

Using ICs

But if we are to get used to these devices we must be aware that, as with all semiconductors, some simple precautions in handling and usage are advisable. For example, the following recommendations stem from an article by K. C. Griffith, ZL2BGP, (*Break-In*, June 1970) on the construction of a useful-looking digital frequency counter—the type of equipment which, with decade counter ICs now available at reasonable prices, is becoming of real practical interest to amateur constructors.

ZL2BGP points out that it should always be remembered, despite the deceptive appearance to the contrary, that ICs are extremely complex devices. They can very easily be damaged if manufacturers ratings are exceeded or recommendations ignored. He quotes a typical decoder/driver unit of the type used in frequency counters as containing, say, 30 transistors, 10 zener diodes and 21 resistors plus all interconnections. Once functioning in an equipment, experience so far suggests that ICs are generally more reliable than the equivalent number of discrete components, but it should always be noted that careful handling is required in the assembly and testing of equipment containing them.

He provides a number of recommendations having particular reference to digital types of equipment:

(1) Do not use excessive soldering heat, and make sure that the tip of the soldering iron is not carrying any significant (mains leakage) potential to earth; miniature irons are likely to prove the least dangerous.

(2) Check and recheck the completed circuits several times before applying any voltages—you may not get a second chance since "ICs can easily be destroyed in a sudden, silent, costly split second" (this reminds me of the disastrous moment when, as a newcomer, I connected the ht battery across the filament of one of the old 2V battery valves just purchased at the then princely figure of 5s 6d—so the need for wiring checks is nothing new!).

(3) Keep ICs away from strong rf fields.

(4) If sine waves are fed into a decade counter type ic, the negative-going portions of the signal usually have to be suppressed, and in some cases (eg Fairchild CuL9958) the positive half must be shaped into a pulse.

(5) Note maximum and minimum operating temperatures (some linear devices come much cheaper for those willing to accept limited temperature ranges—fortunately the limitation is more on low temperatures than normal room temperatures).

(6) Supply voltages should be kept within $\pm$ 10 per cent. Any significant hum on the supply line is liable to present problems (on a counter it may give spurious counts).

A special problem arises where, for example, ICs are to be used in connection with indicator (Nixie-type) tubes. ZL2BGP says: "Never switch on a decoder/driver ic until all its outputs are fully wired to the Nixie tube. Always switch the low tension to the ic and ht to the Nixie tube simultaneously; if low tension is applied to the decoder/driver without ht being supplied to the tube it can destroy the ic. On no account try switching off the Nixie display by simply turning off the ht and never unplug a Nixie tube while the counter is switched on."

When dealing with equipment containing one or more ICs which has worked satisfactorily in the past but develops a fault, the problem arises of how to check the ICs. In some cases this may call for oscilloscope techniques to examine the waveforms at various points, but often simple voltage checks are sufficient to pinpoint the trouble. The most likely cause of malfunction in an ic is that some external component has developed a fault which has resulted in excessive potentials across one or more sections of the ic. Fault tracing is greatly facilitated by having a note of the correct operating potentials measured at the ic connections while the equipment is working. As with all semiconductor equipment, it is important not to introduce faults during service checks, for example by shorting across blocking capacitors with meter probes, or by leakage potentials on soldering irons or any other tools or probes; we have already referred to this problem.

In case all this sounds too off-putting, it is well to remember that the use of ICs can provide extra facilities in a manner unrivalled in simplicity by any other approach. For example, the by-no-means-expensive decade divider digital ic can readily be incorporated in a 1MHz crystal calibrator to provide 100kHz pips, and, if two are used, to give also 10kHz pips without the need for any additional components. Fig 1 shows the key parts of a crystal calibrator of this type from a circuit given by Glen Benskin in *QST* December 1970. The BSX20 would probably provide a suitable European type for the driver transistor. It is also worth noting that the

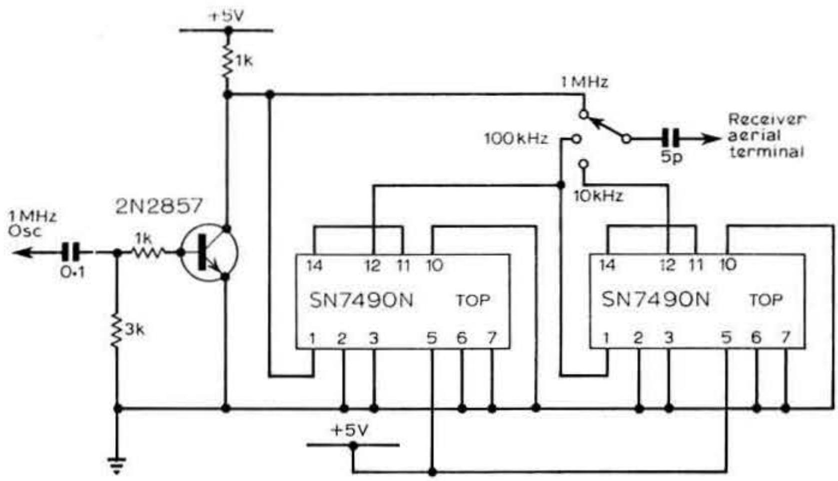


Fig 1. Use of decade dividers to provide 100kHz and 10kHz marker pips in conjunction with a 1MHz oscillator. A 7·5V zener (not normally conducting) is connected across the 5V supply line to protect the integrated circuits. Shielded wire should be used between the switch and SN7490Ns. Since there is no warm-up time, it is useful to have both a conventional on/off switch and a push button for making quick checks

SN7490N divider ic can also be used as either a "divide by two" or a "divide by five" unit so that other useful frequencies can be obtained; though for British applications 1MHz, 100kHz and 10kHz are probably the most useful. A more elaborate calibrator using this type of ic was described by D. A. Hollingsbee, G3TDT, in *Radio Communication* August 1970.

Load-sharing in linear amplifiers

In *TT* (July 1969) and *ART3* (pages 130-131), we noted W1CER's suggestions on providing separate adjustment of the operating point when two or more valves are used in parallel in linear amplifiers. This overcomes the problem which can arise when replacing valves without going to the trouble or expense of carefully matching the valves. This applies particularly to the many current linears based on the popular "sweep" (television line-output) valves.

This question is further considered by G. T. Hudson, ZL1AFO, (*Break-In*, September 1970) who presents a series of measurements taken on an amplifier using two 6JE6A valves. He shows convincingly that, with some samples, the two valves provide very different shares of the total output unless separate adjustment is incorporated: for example a total cathode current of 255mA may be split into 105mA and 150mA. Considerable improvement can be effected simply by adjusting the quiescent or resting currents of the valves, though for most accurate load sharing it is better to adjust for balance at full output even though this may mean some unbalance at resting currents. He sums up his work as: "It would appear that where matched tubes are available, and are working well within their ratings, separate bias voltages are not necessary. If, on the other hand, the dynamic characteristics are different, and in addition the tubes are required to work hard, some form of balancing will result in better efficiency and longer tube life." Fig 2 shows the adjustments now incorporated in his amplifier.

It may be worth drawing attention to a fairly recent American sweep tube, the type 6LF6. This is the most powerful of this genre and a single valve amplifier can provide 175W p.e.p. for ssb and 175W cw. With a maximum anode dissipation of 40W, it can handle a temporary 200W.

Diode can help "linear" reliability

Barry Priestley, G3JGO, has recently drawn attention to a circuit dodge described in the book *SSB Principles & Circuits* by Pappenfus, Bruene and Schoenike (McGraw Hill, 1964). This can be useful in safeguarding and extending valve life in linear amplifiers having substantial dc resistance between grid and earth (for example to facilitate the incorporation of automatic level control). The amplifier in the book uses the high power 4CX1000A but there seems no reason why the idea should not be applied to other lower power valves; for instance G3JGO points out that the dc resistance with a 6146 should be limited to under 30,000Ω. The following are the relevant passages from the book:

"Some 4CX1000A tubes exhibit a slight negative grid current due to grid emission. It increases with the amount of plate current flowing. If there is a high value of dc resistance in the grid current path, such as 40,000Ω, a runaway condition may develop. The flow of negative grid current through the grid-circuit resistance develops a positive grid voltage. This increases plate current, leading to the runaway condition . . . this tube characteristic seems to increase with age. One solution is to provide a low dc resistance (less than 2000Ω) in the grid-current path, including the bias supply. In this amplifier, which generates the alc voltage from small positive grid-current peaks, it is necessary to have a fairly high impedance in series with the grid so enough alc voltage can be developed from a small amount of grid current. The requirement of low resistance for negative grid current and high impedance for positive grid current is satisfied by using a small semiconductor diode across the circuit . . . cw and fm transmitters using this tube have a diode across a high value of grid leak resistance, so the tube operates just into the verge of grid current but is protected from runaway due to small negative currents which may exist under certain conditions during keying or turning on. . . ."

Ferrite rf level control

There are a number of applications in communications equipment for rf level controls which can provide a continuously variable output level with absence of waveform

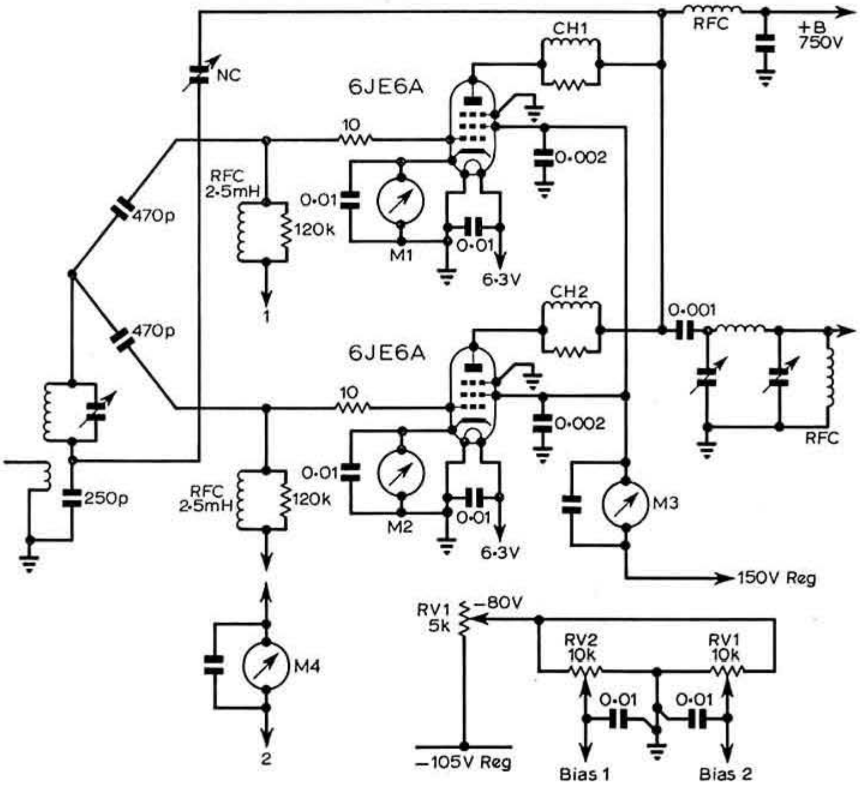


Fig 2. ZL1AFO linear amplifier incorporating separate bias adjustment. Meters: M1 and M2 250mA fsd; M3 50mA; M4 5mA (optional in one grid). Neutralizing capacitor consists of two aluminium plates 2in in diameter with top plate adjustable

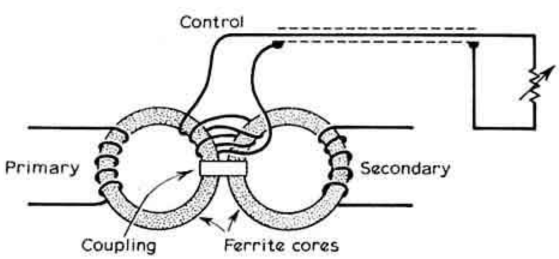


Fig 3. Cachia rf level control using two toroidal ferrite cores

distortion—as we have noted in recent months in discussing diode and fet attenuators. A rather different type of control has been developed in Australia by Laurence Cachia (patented by Philips Industries); it was described in *Electronic Engineering* (October 1970) and is sometimes termed a Cachia control. This technique is claimed to provide high level control variable over 50dB with a frequency response of more than two octaves. Control is effected by a variable resistor which can be located remote from the unit.

The system is shown in Fig 3 and the method of operation was explained in *Electronic Engineering* as follows:

Two windings, a primary and a secondary, are wound on two separate toroidal ferrite cores. A tertiary winding in the form of a short-circuited turn through both cores effectively couples primary and secondary windings (ie as in two tuned circuits coupled by a link). A fourth winding, again through both cores but in the reverse direction to the tertiary winding, forms the control winding.

When an rf voltage is applied to the primary with the control winding virtually open-circuited, there is a maximum degree of coupling between primary and secondary; but as the resistance is decreased the current induced in the control winding by the primary opposes the coupling through the single-turn link. A variable resistor across the level control winding thus provides a means of adjusting the output level from the secondary winding; this resistor is connected across the control winding via a length of coaxial cable.

Several possible variations are discussed in the original article, including the possibility of putting the primary and secondary windings on the same toroidal core in diametrically opposite positions with two control windings connected in series wound between primary and secondary windings. It is also noted that if dc is passed through the control winding the permeability of the core is reduced so that coupling between the primary and secondary can be further reduced. A third possibility is to omit the single-turn link and then govern the coupling by a resistor in the tertiary winding.

This interesting looking technique was brought to my notice by D. W. Wright, G3UUY, who suggests that one possible application might be as a receiver attenuator to reduce cross-modulation from strong signals. However, he has asked me to make it clear that his only connection with this device was in spotting the description in *Electronic Engineering*.

9MHz bilateral amplifier

The development of transceivers has brought about the need for bilateral amplifiers in which the input and output circuits of an amplifier can be easily interchanged. Trevor Wiltshire, G8AKA, has drawn attention to an amplifier of this type in a summary of fet applications ("RF fet data packet", Siliconix Ltd, Station Approach, Cherry Tree Rise, Buckhurst Hill, Essex, 01-504 9123). The circuit diagram is reproduced in Fig 4. Signal amplification may be switched from forward (ie left to right) to reverse (right to left) by means of extremely simple switching. The isolation is stated to be greater than 40dB from input to output in either direction. Among the other useful circuits included in the Siliconix notes are several relating to the use of FETS at up to 450MHz; including a common-source amplifier, common-gate amplifier and common-source mixer.

Low-angle operation

From time to time we have referred in *TT* and *ART* to the growing appreciation in recent years that useful hf communication modes exist which can be utilized by stations able to transmit and receive at extremely low angles to the horizon. These ionospheric propagation modes are often additional to the conventional single- and multi-hop modes which have for so long been used to good effect on hf. It seems an appropriate time to tie together some of the ideas which are now becoming established.

1. The bulk of wanted long-distance signals arrive at angles below 10° with a median value of around 7–8°. There is some variation of the angle with season.

2. Aerials which are effective at angles below 5° (and preferably below 2·5°) allow difficult dx paths to be maintained even during severe fade-out conditions (for example on the unreliable North Atlantic path).

3. Aerials which are effective at extremely low angles allow contacts to be made at times when, for those with more conventional aerials, the band has either not yet opened or has closed for the night. Such extended times of "openings" appear to be progressively more important on the lower frequency bands such as 3·5 and 7MHz and rather less significant on 21 and 28MHz (although the work on Oscar-5 shows that even on 28MHz it can be considerable).

If we accept these statements (and they are all based on solid experimental evidence in the literature), then we should be considering how amateurs can best exploit this new knowledge. Rather understandably, the commercial point-to-point people, although increasingly recognizing the validity of these low-angle modes, tend to be reluctant to do anything very much about them, mainly on economic grounds (the cost of putting rhombics up a lot higher is not insignificant) but also because the alternative Intelsat space communications systems are confidently expected to take over more and more of the long-haul traffic in the coming decade.

How then can radiation and reception angles be forced down?

(*a*) By the use of beam aerials: the vertical radiation pattern of Yagi and quad aerials, for example, is concentrated in the vertical plane to much the same extent as in the horizontal plane (although the full benefit may be lost due to ground interference).

(*b*) By increasing the height of any horizontally-polarized aerial (but only a lucky few amateurs can reach the sort of heights which are really called for).

(*c*) By making use of the *theoretical* low angle of radiation of vertically polarized aerials and preferably by enhancing this by using array techniques (Dr John Kraus of W8JK fame recently described a versatile five-band vertically polarized rotary array—*QST*, July 1970—with 24ft elements and providing 3·4dB gain at 7MHz to 7·6dB at 28MHz.)

(*d*) By utilizing the benefits of real or induced good ground conductivity, remembering that ground conductivity right out to about 100λ in the target direction affects radiation angle.

(*e*) By utilizing ground slope towards the target area (see G6XN's article in *Wireless World*, (April 1970).

(*f*) By noting that very low take-off angles are more likely to be achieved from a very high site than a low one (one thinks of the good signals put out by stations in Nairobi and Asmara). An exception is the seaside site which can make use of nature's best ground-plane—the sea.

An interesting feature of this list is that it throws open again the old controversy of horizontal versus vertical polarization for hf aerials. This can be further complicated by our recent suggestion (*TT*, March) that polarization coupling losses may occur even on ionospheric communication, so that some of the benefits of using vertical polarization could be lost if the vast majority of stations use horizontal polarization.

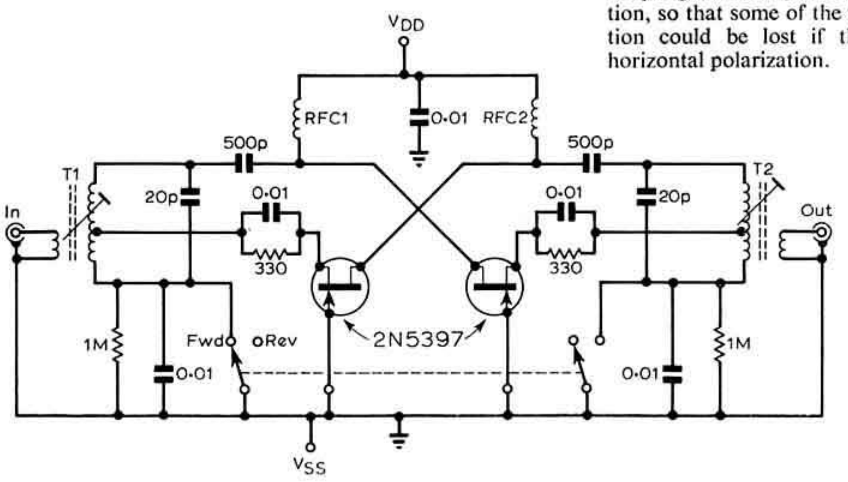


Fig 4. 9MHz bilateral amplifier in which action of the switch is to change signal amplification from forward (left to right) to reverse (right to left). RFC1, 2 100μH (Delevan type 1537-76); T1, 2 Formvar, closewound on ¼in Cambion type 10-361S-2-02 former with primary 53 turns tapped 8 turns from bottom; secondary 4 turns

Fig 5 indicates the theoretical vertical radiation patterns of a number of vertical aerials, and this highlights the usefulness of the $\frac{5}{8}\lambda$ aerial. Some years ago George Barrett, G8IP, ZC4IP etc, pointed out the value of vertical radiators 110° and 220° in length (in which 360° represents the *physical* wavelength of 984/*f* feet). He also gave what we believe is a most valuable hint: in designing hf vertical aerials a lot of valuable information can be gleaned from standard engineering texts (such as Laporte) on *broadcast-type medium-wave aerials.* It must be remembered that mf broadcast engineers regard any radiation above about 3° as useless for ground-wave service and make considerable use of T aerials and elevated feed aerials to increase ground-wave coverage. Unfortunately it seems a common fallacy to divide aerials quite arbitrarily into those suitable for mf, hf or vhf. Recent use of a T aerial not more than about 20ft high (see *TT*, July 1970) on 7MHz as well as on 14MHz has convinced me that such aerials have at least some application on hf.

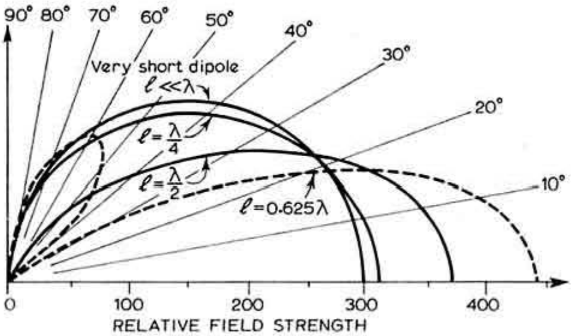


Fig 5. Theoretical vertical radiation patterns of vertical aerials of varying length indicating how, for base-fed systems, the 0·625λ aerial gives maximum low angle radiation. For some elevated-feed patterns see *ART2* or *3*

In general we are coming to believe that many of the old arguments against vertical polarization were based, understandably enough, on the idea that the aerial which lays down the strongest dx signal under normal conditions is necessarily the best. A better yardstick would be the time during which it can maintain a difficult circuit, and we shall be discussing techniques for measuring aerial gain and performance down to small fractions of a decibel later. Meanwhile, we would suggest that for amateur operation there is a great deal to be said for using vertical (or mixed) polarization on 1·8, 3·5 and 7MHz if the aim is dx; on 14MHz there is probably not a lot in it, unless you only have low supports (under, say, 30ft) in which case the choice should again go to the vertical; on 21 and 28MHz a horizontally polarized beam is probably the most sensible choice, though vertical radiators can be very effective.

For horizontal polarization do not be misled by the fallacy that some types of arrays, for example the quad, perform so well at low heights that it is not worth worrying about extra height. An attempt to assess the effect of height on practical dx performance was reported recently in *QST* by Wayne Overbeck, K6YNB, who compared results from a quad at 72ft with one at 34ft; "every single dx station reported a substantially better signal from the high quad than the low one". On 14MHz dx contacts, the mean advantage was as much as 2·1 S units. Only a small percentage of us can hope to get 14MHz aerials up more than a wavelength, and this is perhaps the main reason for the renewed interest recently in vertically polarized aerials.

The use of a number of monopole vertical aerials to form arrays has been mentioned on a number of occasions (for example, the electronically switched system described in *TT*, September 1970). Almost all systems of this type have been based on the use of quarter-wave monopoles, but it is worth noting a letter from R. J. F. Guertler recently published in *Proc IREE Australia* (September 1970) which starts: "Directional mf broadcast antenna arrays consist usually of two masts operating as base-driven monopoles. High masts, of the order of $\frac{1}{2}\lambda$, compared with short masts, give the advantage of increased gain and considerably reduced sky wave." However, he notes that the design of $\frac{1}{2}\lambda$ monopole arrays poses a number of problems.

Again, one must always emphasize that with any vertical radiator every effort should be made to improve the earth system. Multiple earth stakes and/or radials (even if not radial in shape) are always advisable: in effect use as much wire and as many earthstakes as possible, connecting them all together electrically. And if you have the ground available, run out some wires (which can be buried a few inches below the surface) as far as possible in the direction of the main dx target. Earth mats can be formed by the technique shown in Fig 6 (taken from a guide to vertical aerial installation issued some years ago by *Mosley Electronics*) provided that a good connection, soldered or brazed, is made at each junction. The same booklet points out that if it is not possible to form the earth system centrally about the aerial, it may be formed off-centre.

Sloping-V aerials

For those with space available, long-wire V beams have much to commend them, although these are often overlooked in favour of the rhombic. There is one form of V, however,

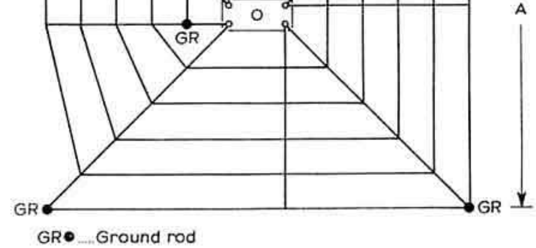


Fig 6. Where space is limited for full earth radials, this arrangement may be used. Dimension A should be not less than one-half the total aerial height. Solder or braze each junction. GR ground rods. Preferably, earth mats and radials should extend as far as possible, particularly towards main target areas

that appears to be little known to amateurs, although a professional system of this type was used by Cove Radio at Farnborough for its share of the Arctic Trek communications in 1968–69. This is the sloping-V with a single aerial-support mast (for the ambitious a considerable number of directions are possible by selection of any two of a large number of wires to one central mast, as at Cove). Fig 7 indicates the basic arrangement although for dimensions etc reference should be made to any of the handbooks covering standard V beams (for example *Radio Communication Handbook*). This particular illustration is taken from the CCIR's *Handbook on high-frequency directional antennae*, published by ITU, where it is stated: "The sloping-V antenna has received little attention in comparison with that given to the rhombic antenna. As a receiving antenna, however, it has virtues which could commend it in many situations." The system, of course, can be used for transmitting provided that the terminating resistors are of appropriate rating. One wonders whether on *vhf* it would be possible to set up a Cove Radio system in a small space?

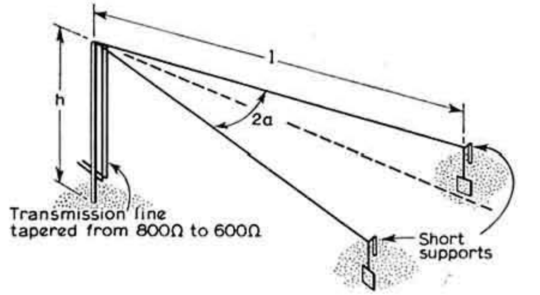


Fig 7. General arrangement of sloping-V aerial. The ends are connected to ground through 600Ω resistors. For transmission these resistors should be of suitable power rating (about one quarter transmitter power rating for a.m., but probably considerably lower rating will be satisfactory for ssb and cw). See also *Radio Communication Handbook*, page 13.61

More fm for amateurs?

One of the greatest engineer-inventors ever to have been closely associated with amateur radio was undoubtedly Howard Armstrong*. If he had not been so unfortunate in his long and painful patent litigation he would almost certainly today be recognized as the man who developed, at practical level, the regenerative receiver, the superhet receiver and the super-regenerative receiver. But at least he is universally honoured as the man who pioneered vhf/fm broadcasting and the enormous use made today of frequency modulation in all forms of communications. While the concept of fm was known for many years before he built his experimental station to show how it could be used, all modern usage of fm can be traced back directly to his work. He was indeed a true colossus of radio who started as an enthusiastic amateur operator and who retained his interest in the hobby. Unfortunately his connection with amateur radio often seems to be minimized—possibly because he was prominent in the "Radio Club of America" which may at one time have appeared as a potential rival to the ARRL. But to be fair to the League, Armstrong's work is featured in *200 metres and down*—their own history of the early days of amateur radio.

This is a rather rambling reference to a recent article in *CQ* (February 1971) by Fred Brown, W6HPH, (at present in England)—"An introduction to VHF-FM" which sets out to survey the merits of fm for "non-FMers", and advocates much greater use of narrow-band fm for vhf and uhf operation. Personally, I feel that, in one or two minor respects, W6HPH rather overstates his case, but there seems no doubt whatsoever that a very strong case indeed can be made for more fm on the grounds of simplicity, tvi and suitability for transistor amplifiers. A few years ago some of the military tests carried out on the Plessey A13 packset under jungle conditions showed the surprisingly good performance of nbfm on hf when received on a Weiss discriminator (*TT*, September 1969). W6HPH quotes several investigations to support his case. In summarizing his own results he writes: "FM has been used at W6HPH for many months and much on-the-air experience gained with both local and dx contacts. The most significant finding is that anything that could previously be worked on a.m. can still be worked with the same power on fm. The signal has been slope-detected by just about every type of receiver currently in use, from the broadest down to ssb sharpness. I've even been successfully copied on an ssb transceiver which had no provision for a.m. reception. It is sometimes necessary to readjust the deviation control to suit the receiver's bandwidth."

Among a number of circuits in the *CQ* article is a combination vxo/vfo (Fig 8) and a 455kHz fm receiving adaptor based on a discriminator circuit which does not require a special transformer and which, he says, can be aligned without specialized instruments "a fair job can be even done with nothing more than a received signal". He also states that the discriminator can be controlled in bandwith over a wide range from broadcast fm down to nbfm standards. For full information on the adaptor and on coupling signals out of the main receiver, it would be better to refer to the original article which extends to seven pages and thus can only be briefly abstracted here. In the case of the receiving adaptor, W6HPH has kindly provided a couple of small corrections to the article as originally published. On the combination vxo/vfo he points out that some crystals can be successfully "pulled" much further than others, being usually a minimum for FT243 and CR1A/AR type crystals and a maximum for the small HC6/U (one of which he can pull over more than 400kHz at 144MHz). Without the crystal the circuit provides sufficient stability for casual phone operation but is not recommended for cw or dx working.

W6HPH gives the principle of the receiver adaptor (Fig 9) as follows: a 455kHz signal from the receiver's first i.f. stage or mixer is amplified by TR4 and delivered to the limiter TR5. For simplicity and broad bandwidth both of these stages are *R-C* coupled. The R-C values were chosen for a flat frequency response in the neighbourhood of 455kHz and a roll-off in gain above and below this frequency. The f.m. signal from TR5 is demodulated by the diodes D1 and D2. The parallel tuned circuit, C3-L5, is adjusted to resonate at a frequency slightly above 455kHz. At resonance, C3-L5 is essentially an open circuit and the signal is rectified almost entirely by D1. Slightly below 455kHz C3-L5 becomes inductively reactive, and at some frequency will be series resonant with C4. At such a frequency a large

*An interesting biography is *Man of High Fidelity: Edwin Howard Armstrong* by Lawrence Lessing (Bantam Books).

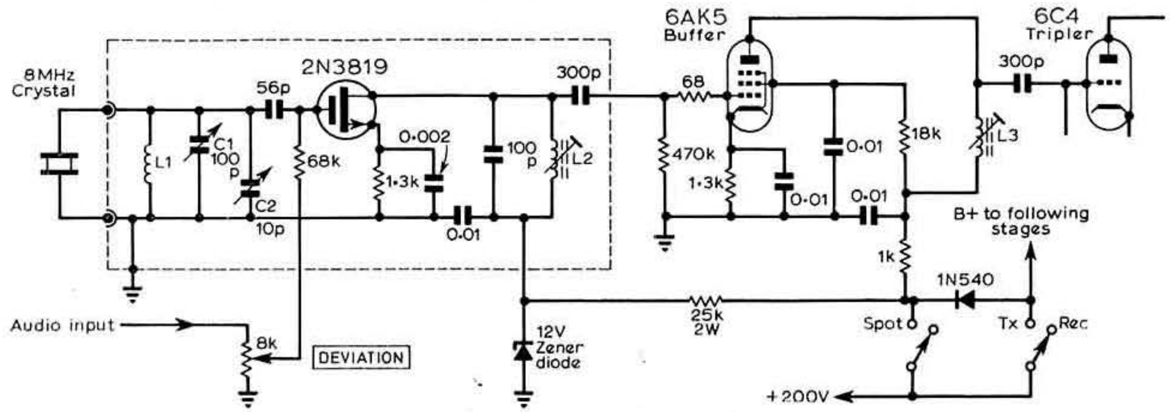


Fig 8. Combination vxo/vfo with fm capability for narrow-band deviation on 144MHz and higher. L1 10 turns No 16 on 1½in diameter ceramic former spaced over 1½in; L2 26 turns No 30 enam on ¼in diameter slug-tuned former; L3 43 turns No 30 on National XR-50 former

i.f. voltage will be developed across C4 and will be rectified by D2. The rectified i.f. voltage from D1 is developed across R2 and that from D2 across R3. These two voltages are equal and opposite and will cancel at exactly 455kHz. Below 455 the voltage from D2 predominates, giving a net negative output at S1; above 455 the rectified signal from D1 predominates, giving a positive dc output. The result is a familiar S-shaped discriminator curve. For good linearity, the discriminator must be driven from a source of correct impedance. In this case the source is TR5, and its output impedance is increased by R1. The value of R1 has significant influence on the linearity of the discriminator response curve. An adjustable de-emphasis circuit consists of R4, C5, C6 and S2. The fet differential amplifier feeds a microammeter tuning indicator. The af amplifier is a little unusual, being temperature compensated by TR8—and the 2N498 will probably in practice usually be replaced by any silicon npn transistor of more than ½W dissipation. An a.m. detector is included, and it is necessary to keep the gain below the limiting level when receiving a.m.

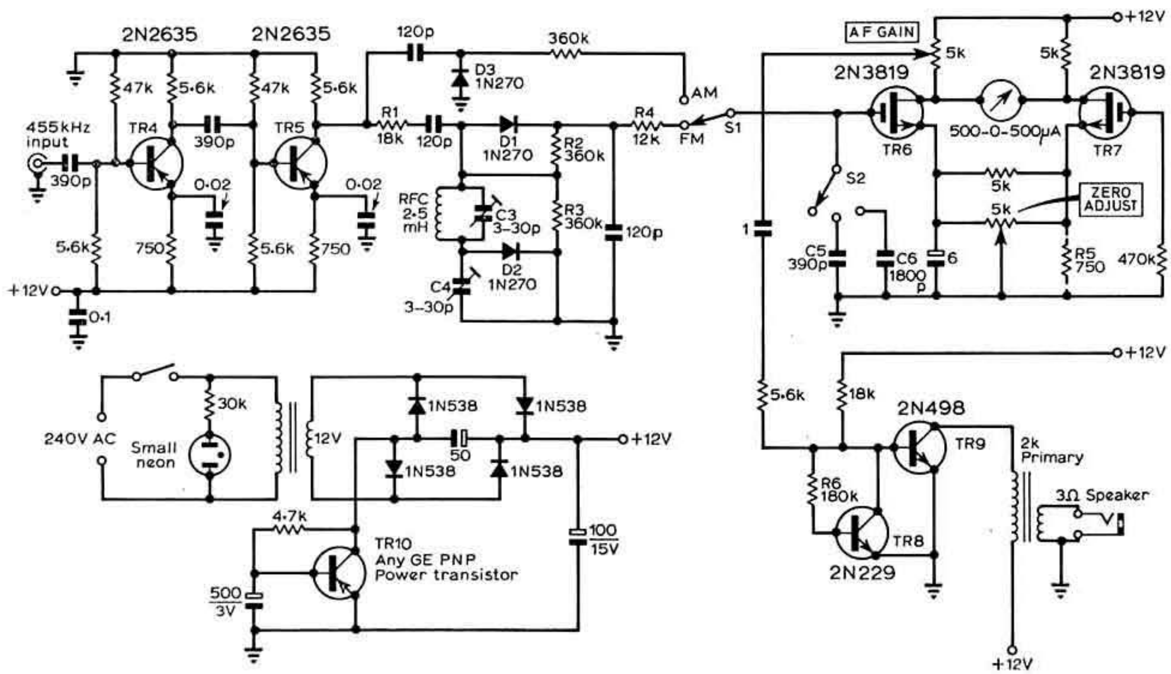


Fig 9. 455kHz fm receiving adaptor which does not require special discriminator transformer and offering simple alignment

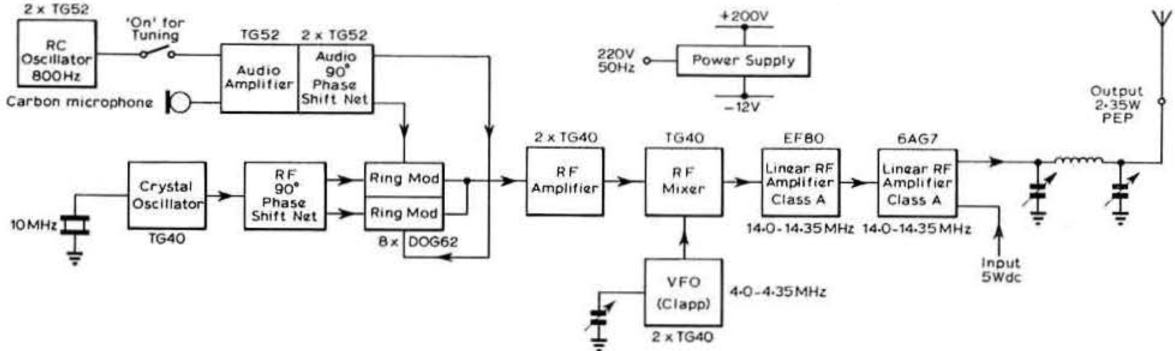


Fig 10. Block diagram of SP5QQ's low-power ssb transmitter

Low power ssb phasing rig

Roy Stevens, G2BVN, has passed along some interesting information he has received from R. Girulski, SP5QQ in Warsaw, one of whose main interests is low-power operation. He has developed a useful ssb rig which he runs at only 2·35 watts p.e.p. but which could well provide ideas for rigs of higher power. The block diagram is shown in Fig 10. Of general interest is the 10MHz phasing-type transistorized exciter using a pair of diode ring double-balanced modulators: Fig 11. SP5QQ admits that while this may not be the simplest possible circuit, the use of diode rings makes it very easy to adjust, eliminating as it does the need for any coil adjustments.

The transistor types are Polish-German but there should be little difficulty in building a similar rig with British or American devices.

Another unusual feature of SP5QQ's station is a broadband cage dipole. Each of the two $\frac{1}{4}\lambda$ sections consists of eight wires which are spread out cigar-fashion by means of a 28in dural bicycle wheel, one in each section. It is fed with a long length of 72Ω coaxial and indicates an swr of between 1·1 and 1·3 throughout the range 10 to 20MHz.

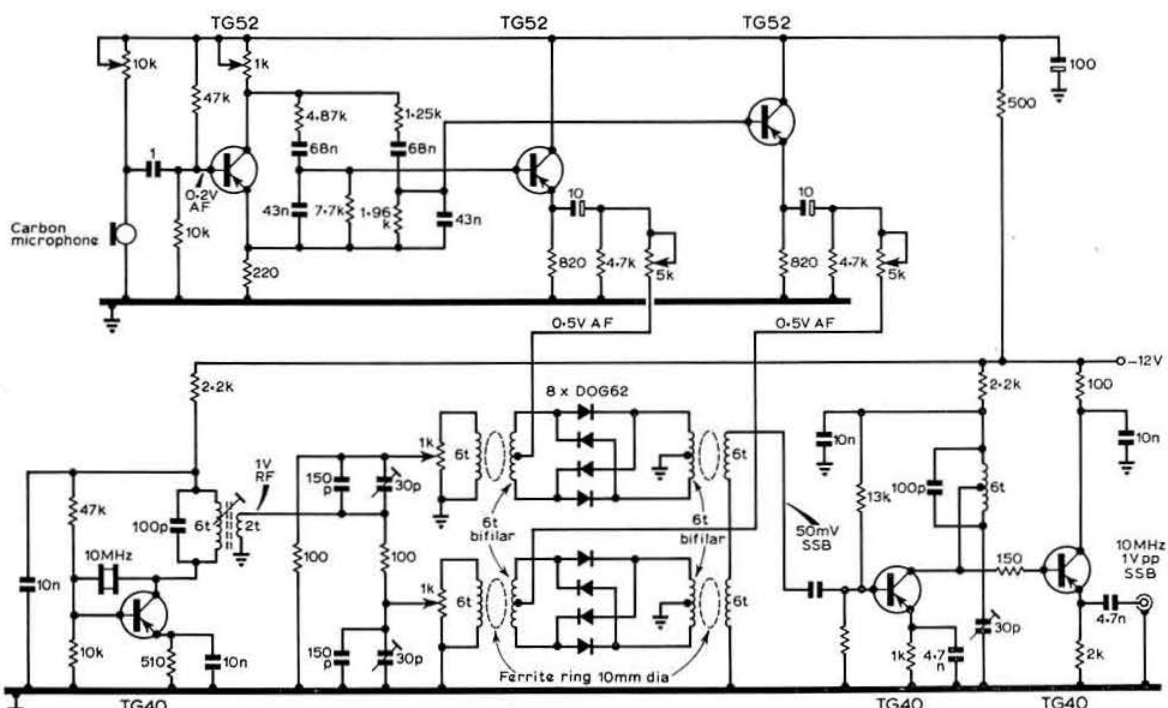


Fig 11. SP5QQ's phasing type ssb generator using two diode ring modulators

FOUR METRES AND DOWN

A monthly account of vhf news compiled by JACK HUM, G5UM*

RSGB 17th ANNUAL VHF/UHF CONVENTION

The Winning Post Hotel, Whitton, Twickenham, Middlesex

SATURDAY 17 APRIL 1971

THE PROGRAMME

1. "Amateur Microwaves Today"—a session to be conducted by Dr Dain Evans, G3RPE, contributor of the *Radio Communication* feature "Microwaves—1,000MHz and up". He will be assisted by Don Hayter, G3JHM. This will offer invaluable "how to get started" advice, and will include equipment to use and actual demonstrations.
2. Stream A: G2HIF will talk on matching networks. G3NNG will talk on vhf receiver design.
   Stream B: More about amateur television.
3. Dinner at 7.30. Guest of honour: Mr Harold Stanesby of the Ministry of Posts & Telecommunications.
4. All the usual attractions: Big raffle; trade stands; RSGB bookstall; bring and buy sale—and the usual opportunity to meet your metre-wave friends in person.

TICKETS

Please apply for tickets on the application form which will reach you at any moment now.

Convention and Dinner—£1.75.

Convention only: 35p. Dinner only: £1.40.

Tickets will be despatched to applicants from 27 March.

Convention secretary: Frank Green, G3GMY, 48 Borough Way, Potters Bar, Herts.

The Winning Post Hotel is on the northern side of A326, the Chertsey Road, at Whitton, Twickenham, Middlesex, AA Members' Handbook 1968/69 maps page 12, square TQ1473. A more precise reference is Ordnance Survey Map No 170, GR 140½ 703½.

As the A316 is a dual carriageway with few turning points you are advised to approach the main entrance of the hotel from the west end of A316—it terminates at the junction of A316 and A305—or into the back entrance via a minor road which passes Whitton station.

The hotel can also be reached from Waterloo, Southern Region, to Whitton station (approx 20 minutes) which is about five minutes' walk from the hotel.

Convention '71

"For a chap who has just got his transmitting licence, it should be just as simple to start up on microwaves as on One-Sixty."

The remark came from G3RPE at the February meeting of the Society's VHF Committee when the 1971 Convention lecture programme was being planned. Members will have seen that this programme has microwaves as the lead-lecture at the beginning of the afternoon's proceedings, and that Dr Dain Evans himself, contributor of *Radio Communication's* microwave feature and a leading authority in this field, will be its conductor.

To compare the gigacycle area with One-Sixty is by no means far-fetched. Among the things which successive VHF Conventions down the years have succeeded in doing is to encourage members to look anew at current techniques and to be persuaded that apparent difficulties lie more in the imagination than in actual fact. This can be demonstrated in respect of microwaves as it has been demonstrated with other techniques; and it will be the purpose of the first part of the convention lecture session to provide this demonstration.

Although this opening session will be given by G3RPE with G3JHM assisting, Dr Evans is anxious to engage the active participation of other workers in the microwave field. He was impressed by the suggestion made by G8AFN in *FMD* in January that what he called a "chat in" should be organized, at which like-minded experimenters could exchange views and pass round items of equipment they use in their stations. So there will be a microwave "chat-in" as part of the G3RPE discourse on 17 April. *People with equipment for 23cm and down are invited to bring it along to show around.* Remember, this is not a construction competition, and the items to be shown do not have to be impeccably finished. The whole object of the exercise is to find out what the other man is doing and how he gets his results. Therefore, microwave men (and if you work on "23" you are a microwave man), take this as an invitation to you *to contribute some hardware to the discussion.*

After the tea-break, at 1615 the lecture programme will divide into two streams, A and B. Stream A will show the faces of two operators well known to all who tune the western zone on "Two"—Cliff Sharpe, G2HIF (he will talk about matching networks at 1615); and "Des" Desborough, G3NNG, who will discuss his 23-70-2 receiver, an outstanding example of forward-looking technology. Members could prepare themselves for this lecture by re-reading the 'NNG *opus* in *Radio Communication* of August and September 1970, and "VHF Personalities—No 13" in the January 1970 issue.

* Houghton-on-the-Hill, Leicester LE7 9JJ.

Better late . . .

Besides depriving RSGB members of their copies of *Radio Communication* on the due dates, the postal strike exerted influences in many other directions to disrupt the normal pursuit of amateur radio.

There was concern among members who were unable to renew their licences as to whether they were legally entitled to go on transmitting, but this was resolved when the MPT said, in effect, "Transmit now, pay later."

The GB2RS service proved to be a veritable lifeline cast out every Sunday morning to enable members to maintain their hold on current Society activities. Because no scripts could be mailed to the regions for broadcasting locally on vhf, the newsreaders made sure the news went out as normal by copying or taping it on "Eighty" and retransmitting it on "Two".

This was of particular importance to all who had participated in the chain of vhf contests which occurred over several weeks from the beginning of this year. Would their entries be invalidated because they could not be got to the adjudicators by the stated closing dates? From GB2RS came the assurance that they would still be accepted if mailed within a fortnight after the end of the postal strike. (The extra work which falls on the shoulders of the VHF Contests Committee from the resultant avalanche of entries may well be imagined.)

And from GB2RS, too, came the rules for the 144/432MHz Fixed Station Contest scheduled for the first weekend of March but about which few knew because the info was immured in the strike-bound February *Radio Communication*. This contest, the first such two-bander open to all fixed stations (last year's two-bander was cw only), caught the enthusiasm of the vhf fraternity, and it spread by word of mouth over vhf from one end of the country to the other. We are writing before the event, but we would lay a small bet that this contest, postal strike or not, will aggregate a hefty final table when the results eventually come to be published.

Just a final point relevant to the postal delays: a sizeable clutch of Four Metres and Down Operators Certificates became immobilized in a mail bag somewhere or other; and several batches of cards relating to applications which have been approved by the VHF Committee could not be cleared as promptly as had been hoped.

"One five-up"—again

In the January *FMD* we mentioned the misuse of telephony in the telegraphy section of "Two", and in the February *FMD* John Patrick, G3TWG, suggested that more publicity should be given to the availability of the 144–144·15 slice for cw only.

"Bandplans" is an agenda item at every meeting of the Society's VHF Committee. Nearly always it is reported that a very satisfactory state of affairs prevails: all bandplans working well—except in respect of that one little *bête noire*, phone intruding below 144·15MHz, which persistently pops up. The primary problem here seems to be how to get through to those who take pleasure in being out of step with the rest of society (you meet them in all walks of life). To get the measure of their psychology requires no more than a few minutes' listening. Out come the tired old clichés, like ". . . I'm licensed to operate anywhere between 144 and 146 MHz and I'm jolly well going to do so," followed by the equally predictable "Oh, no, I'm not in the RSGB . . . I'm not going to be dictated to by them or have anything to do with their old bandplanning".

And so it goes on. When someone remarked that people like these must be unable to read he had a point, for the British amateur radio press has reiterated enough times to convince the dimmest brain that 144 to 144·15MHz is an *internationally agreed* area for cw use. As a matter of historical fact our Continental friends established it quite some time back. We British fell in line with the majority by amicable agreement some time later, via the accepted IARU channels.

Fortunately, phone-in-the-wrong-place is a diminishing problem that shows signs of solving itself. More cw at the bottom end, where the real dx can be worked, will help accelerate the process and perhaps convince the thoughtless that they really ought to get in line.

HALF EACH! When Leicester Radio Society held its annual constructors' competition on 8 March the judges (G3UGM and G5UM) awarded equal first place to a transistor amateur bands receiver by G3XKX and to a 160m table top pa unit by G3PBC. So each member will hold the "Captain Thomas Trophy" for six months. Right: Deryk Wills, G3XKX, (he is LRS chairman). Left: Cliff Craythorne, G3PBC. (Photo by G5UM).

What oscillator?

Further to bandplans, the use of variable frequency oscillators for co-channel working on "Two" has increased to a quite remarkable extent over the last three or four months. Almost everybody who employs co-channel techniques seems to be using one or other of the vfo designs which have appeared in *FMD* Tech Corner in the last year or so, modifications to suit personal preferences being the order of the day.

We detect a trend towards direct drive VFOs that function as crystal substitutes at 8MHz. This development might be thought to be instability prone: perhaps we have been lucky, but the several which we have heard have been indistinguishable from crystal. This may be a reflection of people's intention not to go vfo with a less than effective device. It certainly speaks volumes for the technical expertise which members bring to bear on their vfo construction, and their unwillingness to expose their callsigns to the candid comment which gets handed around on "Two" when standards fall.

BEACON STATIONS

Callsign	Location	Nominal frequency	Emission	Aerial direction
GB3ANG	Angus	145·95MHz	A1	SSE
GB3CTC	Redruth, Cornwall	144·13MHz	A1	ENE
GB3DM	Burnhope, Co Durham	145·975MHz	F1	N/S
GB3GW	Swansea	144·25MHz	A1	ENE
GB3GM	Thurso	70·305MHz	A1	N/S
GB3GM	Thurso	145·995MHz	A1	N/S
GB3GEC	W. London	433·45MHz	F1	N/W
GB3SC	Sutton Coldfield	433·50MHz	F1	N/S
GB3SU	Sheffield (temporary location)	70·695MHz	A1/F1*	Omni
GB3SX	Crowborough Sussex	28·185MHz	A1	E/Omni
GB3SX	Crowborough	70·699MHz	A1	N
GB3VHF	Wrotham, Kent	144·500MHz	F1	NW

* Callsign on F1 continuously, on A1 once a minute. When on A1, F1 is suppressed

Brain-picking sessions to discover what vfo circuit the other man is using can be rewarding, and certainly helpful to the operator as yet undecided what to settle for. In some quarters, for example, it is held that the wide scatter of transistor parameters prevents FETS from giving optimum performance as master oscillators, or in practical terms ". . . there's not enough drive". This has meant that valves are by no means "out" in spite of the fact that semiconductors have predominated in recent vfo designs. Thus at G8DVV, Nottingham, an elegant hybrid configuration has a 2N3819 driving an EF91 buffer amplifier producing 8MHz to go straight into the crystal socket.

From Nuneaton, G8CVD reports that the G3MNQ fet design (*Radio Communication* August 1970) has been working magnificently, a buffer-amp having been added to increase the "urge" into the 8MHz transmitter first stage.

At Sutton Coldfield, G3ZOY (his father is G3MZP) favours the mixer type vfo using valves, and has built a Hartley for 6·5MHz (EF91) driving an EL83 doubler, along with a crystal chain coming out at 131MHz. The two frequencies meet at the input of a QQV03/10 to produce 144MHz. Nearby, G2DCI has operated a similar mixer-vfo system for a number of years to give move-around capability at 70cm as well as on 2m.

From G3ZPZ, now well elevated at a superb site at Bolsover (quite a change from "Death Valley" at Sheffield when he was G8CMB: see "VHF Personalities—No 15" May 1970) comes a comment on the relative merits of crystal substitute VFOS and mixer types. Having tried both, he scrapped the "straight in at eight megs" device for a good and basic reason: the annoying S5 signal from the transistor oscillator left running all the time. He found that this militated against netting with wanted stations. To switch off the oscillator between overs invited drift on switching on again. The replacement mixer design offers the dual advantages of "vfo-on throughout" and being "sideband ready" against the time when that ssb generator reaches completion.

Yet another drive source used at G3ZPZ is a vxo which covers the whole 2MHz of the 2m band, with some fall-off at the edges. Ken Robinson makes the point that FT243 crystals are useless in this service (see also G3JGO, *FMD*, November 1970), and that when ordering a crystal for the vxo the supplier should be told the use to which it will be put. He adds that a very stable psu is important.

All of the above "move around" devices were self-constructed. By now there must be a few hundred more either in use or on the way. For club and vhf group secretaries all this vhf vfo proliferation offers potential material for a symposium at a forthcoming meeting with the title "What oscillator?". And for every metre-wave operator it emphasizes once again that today's operating techniques mean "Checking this frequency first before tuning".

Here and there

Not February Fill-dyke, but fantastic February weatherwise. One "high" after another processed across the UK and vhf men began to lose count of the number of openings that occurred, mini and not-so-mini. And even Tone-A obliged: at least two Aurorae were registered at EI6AS and several GMs worked on "Two". Was it a coincidence that the second Ar happened on 25 February, the day of the solar eclipse?

* * *

Still *in re* EI6AS, if you want to collect Ireland on "Four" lie in wait for Albert Latham after his schedule with G3XMG of Liverpool, Sunday 1030gmt, on 70·208MHz sideband, just inside the Irish 4m allocation.

* * *

But do *not* listen for G3ZST. Hardly had he transferred from Class B G8DJJ in Northumberland to Class A G3ZST than he was posted to Ascension Island, but he squeezed in a few 2m contacts before he went.

* * *

Back to 4m activity—two others to lie in wait for are G3ZCJ of North Notts and G3KQM of Essex. They are brothers, and keep in telegraphy touch on "Four" every Sunday morning. Perhaps it will soon develop into a three-way; their father is G3OIA of Surrey.

* * *

The nightly sideband schedule G6CW to PA0PCD is approaching the 200-without-a-miss mark. Last summer 'PCD, a student at Delft University, was a welcome visitor at the G6CW QTH at Nottingham (he was G5ART during his UK holiday). On his return the sked was initiated on 145·41 and has been kept ever since; 75W out from 'PCD, 140W out from Nottingham.

* * *

As secretary for the British Amateur Radio Teleprinter Group, Graham Shirville, G3VZV, says: "If any vhf operator would like more information on this mode, which is now gaining in popularity, and will write to me, I will send him full information on the group." We imagine that a large sae would be a common courtesy when writing to him at 2 Bradford Way, Toddington, Dunstable, Beds.

* * *

Members with 6m converters will doubtless have kept watch by now for VE2BYG, the new beacon on 50·065MHz 250 miles NW of Montreal. It is to be in continuous operation for about six months. Reports to *FMD* or to G3FZL, Scientific Studies Committee.

* * *

There are three rounds to go in the Dunstable Downs Radio Club Cumulative Contest: Thursday 8 April on 2m, Saturday 17 April on 70cm and Sunday 25 April on 2m. Times 8.30pm to 9.30pm. Club members will score one point per contact on "Two" and three per contact on 70cm, and will be looking especially for stations well beyond their catchment area to help pile up the pointage.

MICROWAVES–1,000MHz and up

by Dr D. S. EVANS, G3RPE*

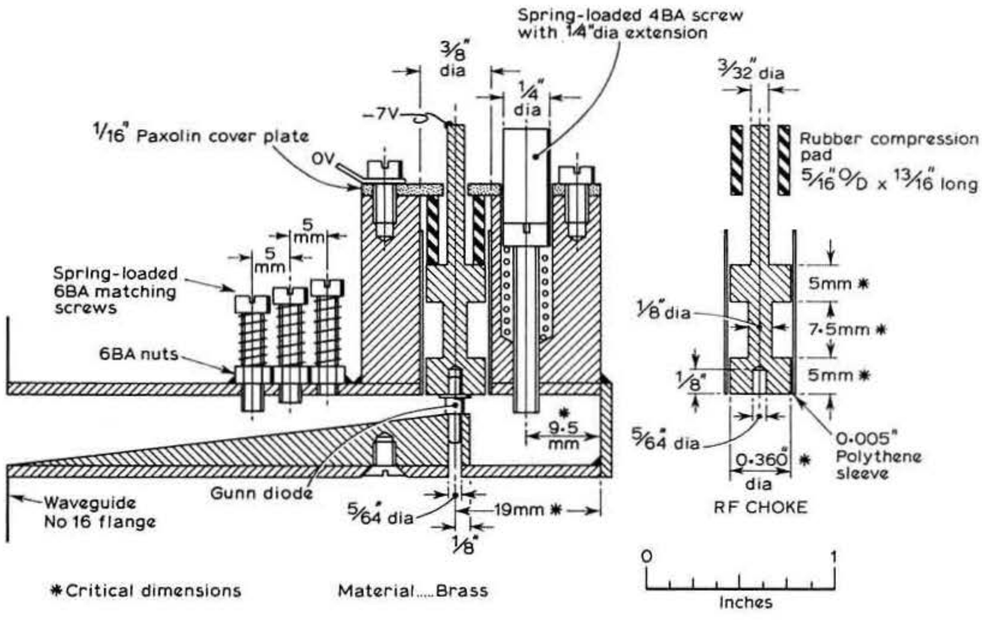
Gunn diodes at 10,000MHz

Prompted by readers' reactions to the advertising of "surplus" Gunn diodes in recent editions of *Radio Communication*, the writer offers his initial experiences in using similar devices.

Gunn diodes (or more precisely Gunn devices since they have no rectifying characteristics) consist of a thin layer of gallium arsenide (10μm for a 10GHz device) to which are connected appropriate electrodes. The application of about 7V of the correct polarity causes a direct current to flow, typically 120 to 150mA, superimposed on which are current spikes occurring at intervals of about 10^{-10}s. If such a device is fitted into a cavity resonant at about 10GHz, then useful amounts of rf will be generated continuously: for small devices the output is between 5 and 20mW. These power levels are similar to those obtained from small klystrons in current use, which require a much more elaborate power supply.

The most effective cavity investigated by the author is shown in the figure. It consists of a length of waveguide 16 (0·9in by 0·4in inside dimensions), closed at one end and fitted with a flange at the other. A block at the closed end contains the rf choke associated with the dc feed, and supports the tuning mechanism, a 4BA screw. The diode is mounted across the narrow width of the waveguide at a distance of 1·9cm from the closed end, which corresponds approximately to $\lambda/2$ in waveguide. Note that λ in waveguide (λg) is 3·97cm *not* 3·00cm as in air. The diode is mounted on a wedge 0·9in wide in an attempt to improve matching. The length of the wedge is not critical but preferably greater than $3\lambda g/2$. The dc feed to the diode is via an rf choke which consists of two sections $\lambda/4$ long in polythene separated by a thin section $\lambda/4$ long in air: in hf terms this choke could be thought to consist of a low-inductance high-capacitance section, a high-inductance low-capacitance section, followed by a low-inductance high-capacitance section, ie a conventional π-filter broadly tuned to 10GHz. The diode is held in place by slight pressure exerted by a short length of rubber tubing which also helps to absorb any rf leaking past the rf choke. Three 6BA screws spaced $\lambda g/8$ apart are set into the waveguide to provide a better match to the output port. These should be mounted as near to the diode as convenient.

Fabrication is simplified by brazing on the end plate. If the wedge is located by a 5/64in drill and clamped (to stop



* 4 Upper Sales, Chauldren, Hemel Hempstead, Herts.

it floating on solder), the block located by a 3/8in drill, and the 6BA nuts held in place by chrome-plated screws, then they may be soldered in one operation without difficulty.

The power supply required may be zener-controlled or preferably a simple variable stabilized supply. The voltage regulation required is not critical as frequency dependence is roughly 10MHz/V.

In setting up the original units, the oscillator was connected via a 10dB attenuator into a diode mixer fitted with a wavemeter. By trial and error the matching screws and battery voltage were adjusted to give the best compromise between power output, immediate starting of oscillation and the range of tuning required. The minimum penetration of matching and tuning screws was aimed for. On any particular frequency stability was of a high order: the drift on switching on was not detected on a wavemeter having a resolution of 1MHz. This compares with the drift of 10 to 20MHz observed in switching on small klystrons also used by the writer.

The several diodes tested in four similar cavities all showed a common defect in performance. When operated into other than a well-matched broadband load, there was a tendency to frequency "hop" by typically 10 to 50MHz when a small change was made at critical points in the settings of the tuning screw, the matching screws, or the voltage applied to the diode. When operated into a matched load, these problems virtually disappeared and reliable tuning over a range of 100 to 200MHz was obtained.

When used as the local oscillator of a receiver, good matching can easily be achieved, since only a small proportion of the power generated (5 to 20mW) is required to operate the mixer (0·5 to 1mW), the rest being dissipated in a matched load. The oscillator may feed the mixer either through a 10 to 15dB attenuator, or via a directional coupler into a dummy load.

This dependence of frequency on load makes the application of Gunn diodes to transmitters rather more difficult. Thus, when connected to a dish and feed of moderate match (vswr 1·5:1), quite erratic results were obtained. Even when connected directly to a well-matched horn, it was found difficult to tune reliably over more than 10 to 20MHz: while usable with care, such transmitters could not be used with the confidence with which one likes to operate transmitters.

For those interested in experimenting with these devices, a useful initial guide using the Mullard CXY11 series of devices is *A Gunn device transmitter (10GHz)*, which may be obtained from Educational Services, Mullard Ltd, Mullard House, Torrington Place, London, WC1.

Microwave standards

Over the last few months this column has discussed possible standards to be used on the microwave bands, the most important of which are signal polarization and the intermediate frequency to be used in common i.f. working. Although much correspondence has been received, some comments may have been delayed due to the late circulation of *Radio Communication*.

As the VHF Committee wishes to establish provisional standards before the contest season begins, can any further comments be made as soon as possible, please? The VHF Convention would be an ideal place for exchanging these ideas.

VHF Personalities—No 20 **by G5UM**

G3MNQ (Eric Goodwin of Dunton Bassett, Leicestershire)

SOME of the projects on which Eric Goodwin has worked have turned out to be important advances in the art of amateur radio when he has been persuaded to commit them to print. Two, published in *Radio Communication*, were "A 2m ssb phasing exciter using FETs" (June 1968) and "Long term observations of meteor scatter on 70MHz" (August 1969).

The Council of the RSGB awarded G3MNQ the Wortley Talbot Trophy for each of these papers—and to win this trophy twice is a distinction which came as a surprise to G3MNQ but paid due recognition to his work.

Something which might be remarked on in respect of the meteor scatter article was the almost nonchalant and incidental description of a converter for 70MHz which readers could construct for meteor scatter observation. In the opinion of those who built this converter it was—and remains—one of the "hottest rods" there is for use on "Four". To G3MNQ it was spin-off from the main purpose of his thesis.

In another area, members can hear for 24 hours a day the results of work done by G3MNQ. The London and Durham beacons on "Two" each uses a digital keyer designed and built by him in integrated circuit form. The job of beacon keepers G3BPT and G8ANQ is made that much lighter by the reliability and absence of moving parts which these devices offer, and by the knowledge that they were subjected to pre-installation extremes of heat and cold.

Although scientific application plays a major part in Eric Goodwin's outlook on amateur radio, he relishes the lighter side of the art, especially where portable operation is concerned. He can tell some amusing stories of the hazards of finding good vhf sites and, what is more, of staying on them when either bogged down, frozen out or nearly blown flat. In a former job that took him around the country a great deal on power station instrumentation he put in more hours Stroke P from Suffolk to Somerset than at home.

Today, although the published results of his work on meteor scatter are now behind him, he acknowledges that there is still much to be done in this area of amateur radio. With another pioneer of MS, G3CCH, he maintains regular 2m schedules to compare notes on very long range amateur communication at vhf. No human hand—well, not many—could rap out the machine-gun morse that leaves the G3CCH aerial for the Arctic Circle; it is a G3MNQ digital keyer doing another good job of work.

THE MONTH ON THE AIR

A monthly feature by John Allaway, G3FKM*

WITH the postal strike now mercifully over, correspondence is arriving in quantity but your scribe would like to take this opportunity of thanking all those (especially WA6AUD) who made special efforts to supply him with news during the six-week blackout.

Details of the FCC's proposals for changes in USA frequency allocations are given below. It is pointed out that these have **not** come about as a result of ARRL representations, and that they will not come into force for an unspecified period even if they are finally approved. The Society has already been in touch with other Region 1 IARU societies and ARRL and has put forward its views.

(a) All 25kHz Extra Class cw segments would be reduced to 10kHz.
(b) Other sub-allocations on the various bands, all for voice emission (except of course the Novice segments) would be rearranged as follows:

80m—3,750–3,775, Extra Class.
3,775–3,875, Advanced and Extra.
3,875–4,000, General/Conditional.
40m—7,075–7,100, Advanced and Extra, inter-regional contacts only.
7,100–7,150, Novice.
7,150–7,175, Extra.
7,175–7,225, Advanced and Extra.
7,225–7,300, Conditional/General.
20m—14,150–14,175, Extra.
14,175–14,250, Advanced and Extra.
14,250–14,350, Conditional/General.
15m—21,100–21,200, Novice.
21,200–21,225, Extra.
21,225–21,325, Advanced and Extra.
21,325–21,450, Conditional/General.
10m—28,150–28,250, Novice.
28,350–28,375, Extra.
28,375–28,500, Advanced and Extra.
28,500–29,700, Conditional/General.

The writer feels that the proposals for 3·5 and 7MHz will have no effect when seen from Europe other than legalize phone contacts with the USA on 7MHz. The increased occupancy of the 7,075–7,100kHz sector may also discourage some of the present intruding broadcasting stations.

The effect on 14MHz is particularly serious for our Canadian friends, but the presence of high-power W signals below 14,200kHz will certainly increase the difficulty with weak dx signals in that segment and may well result in some non-USA phone stations moving down into the cw band.

The 28MHz novice allocation is a retrograde step as it covers the frequencies currently being used by the beacon project and interference from novice signals may well destroy the scientific value of the beacons. FCC invites comment (which is not restricted to USA nationals) but this should be made as detailed on page 84 of *QST* for October 1970 and sent to the Secretary of FCC, Washington DC, 20554, no later than 1 June.

*10 Knightlow Road, Birmingham B17 8QB

Top Band news

A delayed letter from Alan, VK6PG (formerly G3PHG), says that regretfully QSL returns from UK stations to whom listener reports from Western Australia have been submitted have been abysmally low. Alan says that this recalls the old overseas saying that the Gs are the world's worst QSLers. It seems strange to your scribe that anyone whose signals have been heard in Australia on 160m should not be very delighted to confirm reports. The *29 DX Club News Letter* gives the news that VK6NK was received at RST579 by GM3YCB during their contact on 4 January.

The *W1BB 160 Meter DX Bulletin* dated 31 January says that conditions on 160m have been very good this winter prior to the date of its publication. Stew draws readers' attention to the fact that the greatest problem on the band is pollution by man-made electrical noises, and reminds us of the "dx window" between 1,825 and 1,830kHz. The co-operation of all band users in endeavouring to avoid this segment during dx openings would be greatly appreciated. The 10 January transatlantic test resulted in the reception in the USA of good signals from GM3YCB, G3RKJ, G3OLI, GM3OXX, G3PU and OK1AMP. The ARRL 160m Contest seems to have attracted considerable support, but as was pointed out previously, with its rules as at present it is of little practical use to non-USA stations. Those of us with small gardens will be interested to know that K5TFG now has a two-element fixed 160m beam—this consists of two dipoles spaced 1/10th wavelength apart and 50ft off the ground. With this he has worked KH6 and a number of Europeans. K8IUA/KL7 has *heard* signals from G3RCE/A, G3RKJ and G3ZDY, as well as from KH6, VK and from all over the USA.

News from overseas

Readers who have noticed the absence of 9M2DQ from the bands will be pleased to have up-to-date news of him. In a letter to G2MI, James says that he was about to erect towers for a rhombic aerial on the estate in Perak where he was living when he was taken ill and admitted to hospital. This resulted in his resignation from the estate and the purchase of a bungalow on Penang Is which overlooks the sea and palm trees and has a good take off for the UK and USA but is screened in other directions. James should be on the air again by this time and may be reached at the address in *QTH Corner*.

G3HCT draws attention to a QSL card received from JA3QEV who is a member of the "Zuikoo Relation Club" (JA3YWR). This consists of six members of the same family who all hold transmitting licenses—JA3QEV, his mother and father (JA3s FEO and XMA), brother (JA3XMB), sister (JA3XMC) and cousin (JA3KXF)! Is this a world record?

Dave, VR1O, is now QRT and has left the Gilbert and Ellis Is for good, having made 4,180 QSOs during his stay. He says that there are now no stations on VR1 or VR3 as Bob, VR1L, has gone to live in Vila, New Hebrides. The only other VR1 call—VR1U—is held by VR2EY who only occasionally visits the islands. VR1KZ, who was on the air recently and claimed to be on the Phoenix Is, was a pirate—the islands are uninhabited and the callsign has not been issued. Dave is returning to the UK via ZL and 9V1 and should be on with his G3NRA call later this year.

Frank Angelo, VP9GR, is now operating slow-scan television on 14MHz and would like to arrange skeds with UK stations. He built the equipment himself and was all set to go when he realized that he had no taped material to test with! On his way to work he contacted FG7XT who was talking about sstv to a W and told him about his difficulty. FG7XT then offered to put some material over which Frank was able to tape on his log-keeping tape recorder in the car and these pictures were successfully re-transmitted to '7XT on sked on the following day.

VP9MI will be leaving Bermuda on 4 July and hopes to resume activity as G3UMI later in the year from Eccleshall, Staffs.

Dave Hardy, VP8HJ, is due to arrive in the UK soon and may be reached via G3AAE. (75 Roundmead Avenue, Loughton, Essex.)

The "Banned List"

It seems that the letter sent out to the various administrations by the ITU in Geneva has in fact been misinterpreted in some quarters, and readers will be pleased to learn that the responsible authorities in Burundi and Greece have already amended their instructions and now officially permit their amateur stations to communicate with those in other countries. The situation in 9U5 was rectified by 9U5AC's personal approach to the King of Burundi.

DXCC

The ARRL has announced that the Kuwait/Saudi Arabia Neutral Zone (8Z5, 9K3) has been deleted from the country list as from 18 December 1969. Contacts before that date will count for "all time" credit. Maximum countries score is now 321. The DXCC Advisory Committee now consists of W1RAN, WA2FQG, W4QCW, W6RGG, W7LFA, W8BF, W9KN, W0ELA, VE3ACD and W4DQS.

DX news

Latest information on the amateur population in the Falkland Islands and Dependencies is that several changes are about to take place. Brian, VP8JV, now has his linear in operation and is often to be found around 14,220kHz in contact with his QSL manager, W3DJZ. He will be closing down about 1 May and his place as sole amateur in South Georgia will be taken by another VP8 whose callsign is not known at the time of writing. VP8JH and VP8LN may be active by now from South Orkney, the former was due to open up around 15 February. The South Shetlands seem to have no current VP8 licence holder and their sole representative is CE9AT. VP8KD will leave Port Stanley on 7 May and

JA3XPO, part of Expo 70 in Osaka, Japan, with operator JA3GOK

intends to visit Eva, PY2PE, on his return journey to the UK where he is due on 20 May. He is looking forward to meeting on his return many of the friends he has made over the air.

W1YRC has all the logs for 6O1GB's activities during 1967-1969, and also acts as manager for VK9KS, 9M8FME, 9M8FMF and 9X5AA.

INDXA membership now exceeds 1,100 and includes representatives from more than 65 countries. Information on the association may be obtained from K3RLY, Box 125, Simpsonville, Md, 21150, USA, or from the net frequency (14,218kHz) around 2200.

The recent operation by Girard (who was formerly on the air from FB8XX) using the callsign VK0HM from Heard Is seems to have been the source of some confusion. The VK0HM call was a personal one issued to Hugh Milburn. Girard is on a geological survey and should be on Heard for about six months.

WA1ARF/KS4 is often to be found on the YL-SSB system frequency. He is active on all bands 7 to 28MHz and hopes to be on 3·5MHz soon. Bob's stay on Swan Is should last until the end of the year. Logs for the period 5 October to 20 November 1970 have been lost en route to WA6MWG.

XV5HH is apparently in Vietnam but not licensed and therefore contacts with him do not count for DXCC credit. W9JT, who is given as his QSL manager, is returning all QSLs received to their senders. George, W9JT, is said to be so upset over this affair that he is now refusing to reply to late cards for CP1GN contacts.

W4AQW is cruising around the world on the m/s *Sagafjord* and will be trying to operate from a number of unusual places. QSLs for any of these attempts which materialize should be sent to Box 73, Hollywood, Fla, 33022, USA.

A new operator was due to arrive on Canton Is during February together with a KWM2 transceiver. KX6DC, who was formerly W3KVQ, says that the present level of activity from the island is very low and that he has not heard any cw at all. VR1L will only be on the air for a few weeks longer and will then move to the New Hebrides (YJ8).

VK9XK and VK9XX are now on from Christmas Is and their QSLs are being attended to by DOTM. Stu, W2GHK, has received some further back logs from VK9XI and VK9DR. VK7KJ expects to return to Macquarie Is this autumn. C21GB is likely to have left Nauru by now and will be on from VR2 by mid-April. ZK1CE, an electronic technician working on the installation of radar at the new Rarotonga airport, is a new amateur on Cook Is. His name is Kevin and he has a Yaesu 400 transceiver and a dipole. George, ZL2AFZ, is rumoured to be interested in a visit to Christmas Is (VR3) sometime this year.

QSL cards are already being received from VU5KV but it seems that some of the mail addressed to Box 3031 has been tampered with and Venkat asks that if cards are not received after a reasonable time second applications should be sent as follows: stations with suffixes beginning with A-H to 26 Jorbagh, New Delhi 3, I-P to 102 Jorbagh, New Delhi 3, and Q-Z to 161 Jorbagh, New Delhi 3.

ZL2GX reports that Lin, ZL4OL/A, is anxious to give out as many Campbell Is QSOs as possible and has been having considerable success even on 3·5MHz. He is disgusted, however, to hear such practices as reports being relayed to stations who consider that they are in contact with him even when they are not hearing him well enough to copy what he is saying! Lin is married and keeps a weekly sked with his wife in Christchurch via amateur radio.

VK6HD says that there are at present three stations active from Niue—ZK2AF, ZK2AG and ZK2AH. In addition to ZK1CE (mentioned previously) there are three other active Cook Is stations which are ZK1s AA, AJ and CD.

On the Air reports that contacts with ON4JL/AP2 and ON5DO/AP2 are not being counted for DXCC purposes as the /AP2 suffix was not officially issued. It is understood that OR4CR/E.Pakistan is a valid callsign and will count.

Dxpeditions

Reports from Martin, OH2BH, suggest that OH2BH/ZA may be on the air again around the middle of June. DL7FT also reports that he will be returning to **Albania** this year and hoping to put ZA2RPS on the air from 16 to 30 June. Frank says that he has exclusive permission for June 1971 and will be able to take a beam with him this time. Both cw and ssb will be used and financial assistance would be greatly appreciated and should be sent to Franz Turek, Petunienweg 99, 1 Berlin 47, Germany.

The Amateur Radio Society of India is sponsoring an expedition to the **Laccadive Is** to operate during the period 10 to 16 April. The party will be led by Lt-Gen K. Umrao Singh, VU2US, and the callsign will be VU7US. Others taking part will include VU2CK, VU2KM, VU2QM and VU2RK. QSLs accompanied by IRCS will be mailed direct, others will be despatched via the bureaux. The announcement of this expedition stated that no strings will be attached to QSLing and pointed out that the sending of currency in mail to India is illegal. Operating frequencies for VU7US are likely to be as follows: 14,040, 14,190, 21,200, 21,320, 28,050 and 28,550kHz (or near).

Possible activity from the **Jaza'ir az Zubayr Is** (150 miles NW of the Straits of Bab al Mandab in the Red Sea) is mentioned in the *West Coast DX Bulletin*. The ownership of the islands is said to be uncertain and they may possibly qualify for DXCC status. Aldo, ET3ZU, is said to service the lighthouses on these and other islands between Somalia and Yemen, and Renault, F5QQ, is also mentioned as being interested in operating from the area.

It seems that the long awaited activity from **Spratly Is** may materialize this summer. A group at present in the Philippines has a boat available and may attempt the trip during March or April. HS3DR is also reported to be making plans to visit the islands and it seems that there are other islands in the same area which may qualify for DXCC status and are currently under consideration.

VU2PJ is said to be planning a visit to the **Andaman Is** for late March. VU2KV is also reported to be making a visit to the Nicobar and Andaman Is during April and his callsign will be VU1IKV.

Gus, W4BPD, will be operating from **Bhutan** during April. He is scheduled to leave Calcutta by air on 31 March for AC5, and he hopes to move on to **Sikkim** to operate AC3PT's equipment for a while before returning to the USA. Mention of a few days' stop in the **Iraq/Saudi Arabia Neutral Zone** (8Z4) is also being made, but the whole trip is not expected to last for more than 30 days.

Garth, 5H3LV, hopes to operate from **Zanizbar** as 5H1LV for two days during Easter. He will be located on Latham Is as on his previous trip and it is possible that he may be using a prefix other than 5H1.

Attempts are still being made to activate the **Tokelau Islands.** INDXA is trying to supply equipment to the islands via the supply ship which is due in the area about April. A New Zealand school teacher who works in ZM7 is rumoured to be interested in obtaining an amateur licence.

3B7DA hopes to be on the air from **Rodriguez Is** as 3B9DA during May. XW8AX is likewise interested in operating from **Cambodia** (XU) although the present situation in the area would seem to be unfavourable for amateur radio!

A group of Colombian amateurs hopes to visit **Bajo Nuevo** (HK0) this spring.

An expedition to **St Kilda** will set out on 12 April and will operate from some rare WAB areas in Skye, Benbecula etc en route. GM3MTH will be in the group and the callsign used from St Kilda will be GB3SK. Operation should cover the period 14 to 28 April.

Latest rumours concerning Clipperton Is include a report that FG7XT has arranged to accompany Jacques Costeau to the island this spring and to take along a KWM2 and beam. The *Calypso* was in the area last spring. Richard, F2QQ, is also supposed to have permission to operate from FO8 and to be interested in visiting the island in April. One report says that there are at present some French scientists studying telemetry problems with the aid of high altitude balloons on the island and this would seem to exclude the possibility of any amateur activity there until April at the earliest.

INDXA is reported to be attempting to organize activity from British Phoenix (VR1) and Fanning Is (VR3) in the near future.

"DX News Sheet"

The introduction of new postage rates has necessitated increases in the prices quoted for the supply of this newsletter. In future, UK rates will be as follows: First-class mail—54 issues £3, 18 issues £1, 9 sample issues 50p. Second-class mail—50 issues £2.50, 30 issues £1.30, sample ten issues 50p. Orders should be sent to Geoff Watts, 62 Belmore Rd, Norwich, NOR 72T, Norfolk.

Contests

The YL-ISSB QSO Party

Begins at 2300 21 May and finishes at 2400 23 May.

Full rules may be obtained from YL-ISSB President, Marcia Guest, WB4SBK, 1351 Tanglewood Parkway, Fort Myers, Fla, 33901, USA.

The New York State QSO Party

1900 1 May to 0600 2 May, and 1200 to 2359 2 May.

Stations may be worked on phone and cw and should exchange QSO No, RS/T and QTH. Each QSO counts one point and the multiplier is the number of different NY counties worked (maximum 62). Logs should show date, time, band, mode, station worked, numbers exchanged and QTHs. Indicate new multipliers. They should be sent to: LERA ARC Contest Committee, WA2FBI, 6 Howard Drive, Spring Valley, NY, 10977, USA, before 1 June. Frequencies to watch are 7,060, 14,060, 21,060, 28,060, 14,285, 21,275 and 28,875kHz.

The "CQ-M" Contest 1971

2100 8 May to 2100 9 May—cw only.

USSR stations give RST plus their oblast number, others RST plus serial QSO number. Multipliers are countries listed in the "R-150-S" list. Contacts between stations in the same country do not count, those between stations in the same continent count one point, and between stations in different continents three points. Listeners score one point for hearing one end of a QSO and two for hearing both. Final score is the sum of QSO points multiplied by the sum of country multipliers. There are single-operator single- or multi-band, multi-operator single-transmitter and listener categories. Participants may use contacts in this contest in lieu of QSL cards to obtain USSR awards. Logs should be posted to PO Box 88, Moscow, USSR, before 1 June.

The OZ-CCA Contest 1971

1200 1 May to 2400 2 May.

CW only—all bands 3·5 to 28MHz.

There are single- and multi-operator classes and the former must only be active for 30 hours. The six-hour rest period may be divided into not more than two parts and must be clearly indicated in the log. Exchanges consist of RST and QSO number (starting from 001). QSOs with same continent count two points, with other continents three points, and count double with OX/OY/OZ. The multiplier is the total of DXCC countries worked on each band added together. W, VE, VO, PY, LU, VK, ZL, JA, OZ and OY call districts all count as countries for the purpose of this contest.

Logs should be postmarked not later than 15 June and sent to: E. D. R. Contest Committee, Box 335, 9100 Aalborg, Denmark. They should be accompanied by the statement "I certify on my honour that I have observed all regulations and rules established for amateur radio and for this present contest, and that I agree with the decision of the contest committee whose decisions will be final." The UK winner in the 1970 event was **G3ESF** who scored 69,255 points from 270 contacts.

CHC QSO Parties

2300 4 June to 0600 7 June.

This contest is open to CHC, FHC, SWL-CHC and HTH members, as well as to all others. There are awards for first, second and third place holders in world, continent, country etc in each category. Full details together with an official entry form may be obtained from G3FKM in exchange for an sae.

QTH Corner

FR7AE	Roger Augugliaro, Meteo Chaudron, PO Box 4, St Clotilde, Mauritius.
GD5ATG	via K6TWT, 643 Cedar St, Vallejo, Calif, 94593, USA.
JD1ABX	via JA1KSO, PO Box 7, Aobadai, Yokohama 227, Japan.
W0EXD/KC4	via W4OHP, John Bowman, RFD 2—Box 56-R, Pensacola, Fla, 32506, USA.
KC6RS	via W6MMG, 2712 Belmont Canyon Rd, Belmont, Calif, 94002, USA.
WA1ARF/KS4	via WA6MWG, 4040 Via Opata, Palos Verd Est, Calif, USA.
KX6DC	via WA5UCT, 707 Cottonwood Drive, Richardson, Texas, 75080, USA.
MP4TDU	via G2MI.
OR4CR/AP	via ON5KL, 150 de Villegas Street, Strombeek Bever 1820, Belgium
PZ1AV	via W2CTN, 159 Ketcham Av, Amityville, NY, 11701, USA.
TA6JB	via DJ9ZB, Franz Langner, Carl Kistner Str. 19, 78 Freiburg, W. Germany.
TI9CF	via W4VPD, Enos Schera Jr, 8254 SW 37th St, Miami, Fla, USA.
TT8AD	via F2MO, Michel Dort, Maison Heldu, St Pierre D. Irube, B-P, France.
VK0HM	via F2MO (see TT8AD).
VP2EE	via W9ZTD, 7008 W. 71st St, Indianapolis, Ind, USA.
VP2EZ	via WA9VOL, 4324 N Newcastle St, Harwood Heights, Ill, 60634, USA.
VP2MY	via W1IXL, James Hawkes, RFD 1, Goffstown, NH, 03045, USA.
VP5JA	via K4DSN, 6563 Sapphire Drive, Jacksonville, Fla, 32208, USA.
VP8JV	via W3DJZ, Arden Hopple, RFD 1—Box 331, New Cumberland, Pa, 17070, USA.
VQ9RK	via W9VNG, 346 Normandy Lane, Grayslake, Ill, 60030, USA.
VU5KV	(see text).
VU7US	PO Box 534, New Delhi, India.
VR5DK	824 Bell Avenue, Sacramento, Calif 95838, USA.
ZK1CE	Box 90, Rarotonga, Cook Is.
5N2AAU	1106 S. Sprucewood, Mount Prospect, Ill, 60056, USA.
WA4OVP/8R1	Box 25, Georgetown, Guyana.
9H6HM	via K6ZIF, 6107 Hargis St, Los Angeles, Calif, 90034, USA.
9M2DQ	J. C. Pershouse, 93 Tanjong Bungah Park, Penang, Malaysia.
9N1JK	via DJ9KR, Ulrich Bihlmayer, Klopstokweg 9, 74 Tuebingen, Germany.
9X5WJ	via W1MIJ, 58 Felch Rd, North Natick, Mass, 01762, USA.
	RSGB QSL Bureau, G2MI, Bromley, Kent, BR2 7NH.

WAB area numbers

W8GUZ, who is working for the WAB Award, has forwarded a plea for more UK stations to look up their area number so that they can provide them when asked. Fred finds that the newer licensees seem to be more aware of the identification of the 10km square in which they are located. The National Grid system of the Ordnance Survey divides the British Isles into large squares (100 by 100km) and these are identified by two letters (eg SP). Each large square contains 100 small squares and these are further identified by a two figure number. The first figure is known as an "Easting" and gives the position on the vertical scale. The second is the "Northing" and shows the position on the horizontal scale. The number should be given as two separate units—ie 92 should be 'nine two" and not "ninety two".

Band reports

Mixed conditions on all bands seems to have been the general impression during the last month. The exceptional propagation in the late afternoon on 80m has ceased, but signals from ZL are now very good in the mornings. Signals seem to be edging ever closer to the band edge at 3,800kHz, and one G3 was heard on 3,843kHz one morning in contact with a group of Ws.

Many thanks to all who have provided information by post and telephone, with special thanks to the following: G2BOZ, G3AAE, G3GVV, G3HCT, G3KWK, G3UKH,

Propagation Predictions

The decrease of the F2 day MUFs which occurred during March will continue in April at a faster rate. At the same time the F2 night MUFs will increase. This will affect mainly 28MHz, the general dx conditions on this band being worse during summer than during winter.

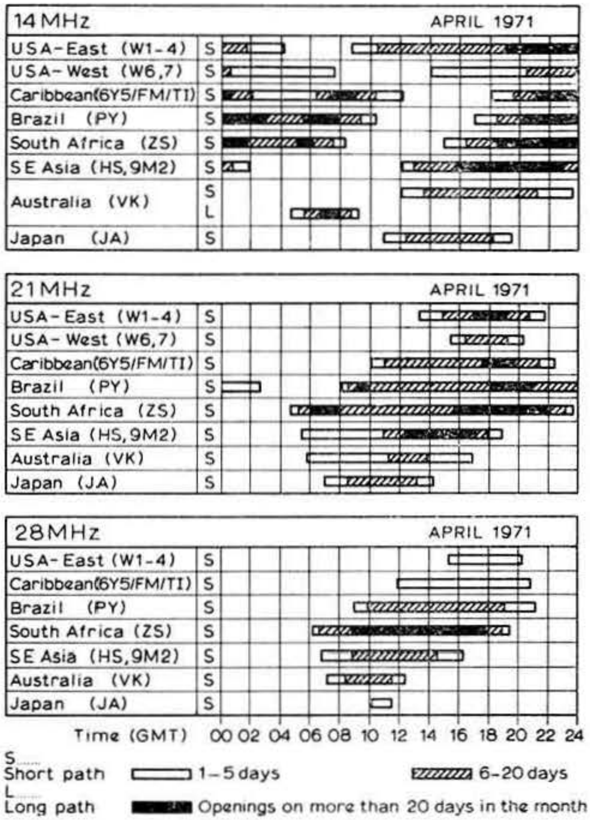
On **28MHz** it is probable that only traffic with Africa and South America will be possible. Better conditions on this band for traffic with North America and Japan will not occur until October/November.

21MHz will also be affected adversely by the lower daytime MUFs. Traffic to Western North America, Australia and Japan will not be reliable towards the end of the month.

The shorter nights will lead to a further improvement for night-time dx on **14MHz**. Towards the end of the month the band will probably remain open for all-night traffic with South America and Africa. On the whole the most favourable times for dx on 14MHz will be from late afternoon until shortly after midnight and during the morning.

As a result of a seasonal increase in static on **7** and **3·5MHz,** dx conditions will be markedly worse during the coming months. There will be suitable conditions for dx on 7MHz during the night, at sunrise and sunset, but not to North America. DX will also be possible on 3·5MHz at these times. Local traffic will seldom be interrupted by the dead zone.

The provisional sunspot number for January 1971 from the Swiss Federal Observatory was 77·9 with the greatest activity occurring during the second half of the month. The predicted smoothed sunspot numbers for May, June and July 1971 are 75, 73 and 71 respectively.



G5JL, G6GH, BRS2098, BRS17567, BRS19682 and A7217. Stations listed in italics were logged on cw, the others on ssb.

3·5MHz. 0500 *8P6DR.* **0600** HR2GH, TI9CF, VP1ST, *K4BZH/VP7*, VP9GE, 9G1DY, 9Y4MM. **0700** HP1JC, OA4OS, *VE8RX*, *YN1CN*, XE1KB, ZLs, ZL4OL/A. **0800** ZLs, OX3WQ. **2000** EP2BQ. **2200** EA8GZ, JX4GN, ZC4TR. **2300** ZD9BM.

7MHz. 0500 *TI9J*, *VP2AGA*, *VP2ES* (QSL via W2BBK). **0600** PYs, *ZC4CB.* **0700** *CN8DW*, *CT3AS*, *HI3PC*, *JX4RI*, *OY9LV*, *TA1ST*, TI9CF, *W7JLU/7* (40W), *YN1CP*, *ZB2AV*. **0800** VKs. **1800** *DU1PB*, *EP2BQ*, *JX8IL.* **1900** *JW8MI*, 6W8DY. **2000** *FL8BQ*, *TA2IE*, *VK2BKM*, *ZB2CB*, 3V8AH. **2100** *KV4CI*, *4U1ITU*, *9V1AC.* **2200** *PZ1AV*, *9Y4VU.* **2300** *JA3AA*, PY0AD, *6Y5SR* (7,003kHz most nights), *9Y4NN*. JA and VK signals most mornings and evenings.

14MHz. 0000 VP8JV. **0500** KC4USP, *KW6DT.* **0600** FO8BS, ST2SA, YK1AA. **0700** JY1, *KX6DC*, VR2CC, ZD8AB, *5U7AR.* **0800** EA9EJ, JD1ABX, SM0ERO/KL7 (on Arctic expedition), **0900** M1D. **1000** 3A2CP. **1200** TI9CF. **1300** 5A4TB. **1500** TA6JB, VQ9RK. **1700** FB8WW, FB8XX, SU1MA. **1800** KH6OR, ZS2MI. **1900** FR7AF, JY1/A, OR4CR/E.Pakistan. **2000** FP8CS, VP2DAA, PY0AD, ZD9BR. **2100** FG7TD, PJ3RR, TT8AD. **2200** CR3AD, ZD7ZD, ZD8CS. **2300** K5KPL/HR1, M1I, XT2AA (14,200kHz regularly).

21MHz. 0800 JAs, 7Q7AA (Box 380, Blantyre), 9C9WB (Iran). **0900** 9N1MM. **1000** EA9EA, 5N2AAE, 5X5FB. **1100** AP2KS, HL9KA, KX6IP, KC6RS, PZ2AC, VS9MB. **1200** CE7EI, YA1GJM. **1300** *HS1ACS*, YB0AAO. **1400** *HH2MC*, *XW8BP*, JY1B. **1500** CE0TS, *SU1IM*, 9U5AC. **1600** OX3LP. **1700** TJ1AR, TU2CH, TY1ABE. **1800** ET3DS, *7P8AB*. **1900** CT3AS, VQ9RK, 8AGC. **2000** HC1ME.

28MHz. 0800 FH8CY, *VK3MR.* **0900** OR4CR/E. Pakistan, VU5KV. **1000** FH8s CE, CG. **1000** FR7ZW, UK8JAD, VK6s, VU2REG, VK9XX. **1100** CR8AG, HS4ABL, MP4BIO, 5V4JS, 9X5AA. 1200 AP2MR, ST2SA, VU2IRA. **1300** KV4AD, ZD7BB (QSL via WA0WKW). **1400** OB8V, VP8KD. **1500** TI9CF, ZD5F. **1600** JY2. **1800** CE3AE, LU5AH, VP8KL. All W districts around 1700.

Many thanks to the following for information extracted from their publications: The **West Coast DX Bulletin** (*WA6AUD*), the **DX'ers Magazine** (*W4BPD*), **Long Skip** (*VE3DID*), **DX News Sheet** (*Geoff Watts*), **QUAX** (*G3DME*), and **On the Air** (*ON4AD*). Please send all items for **May** issue **to reach G3FKM** by **12 April,** for **June** issue by **12 May,** and for **July** issue by **5 June (please note this early date).**

SPECIAL EVENT STATIONS

Open day at Battersea

The Battersea Adult Education Institute, Latchmere Road, Lavender Hill, London SW11, is holding an open day on 24 April 1971 at which G3HAB will organize and help to operate GB2CLR (Central London Radio) from 2 to 8.30pm on 7 and 21MHz. Special QSL Cards.

Hanover Fair

A special station, DL0MH, will be operating during the period of the Hanover Fair from 22 to 30 April. The meeting place for radio amateurs is stand 121-148 in Hall 9a. Visitors may operate the Fair station or obtain a German licence free of charge. For the latter a photocopy of the applicant's home licence is required.

SOCIETY AFFAIRS

A brief report of the Council meeting held at Society HQ on 15 February 1971.

Present: *Mr F. C. Ward (President, in the Chair), Dr E. J. Allaway, Messrs J. Bazley, R. J. Hughes, G. R. Jessop, W. F. McGonigle, A. C. Morris, L. E. Newnham, C. H. Parsons, W. A. Scarr, A. W. Smith, R. F. Stevens, G. M. C. Stone, E. W. Yeomanson (members of Council), D. A. Findlay, general manager, and A. W. Hutchinson, editor.*

Apologies for absence were received from Dr J. A. Saxton, Mr E. G. Ingram and Mr J. R. Petty.

Before formally opening the meeting the President introduced Mr John Bazley, G3HCT, the member appointed by Council to represent Zone B.

Representation on external bodies
Mr Stone reported that Mr R. G. Flavell had accepted the Council's invitation to represent the Society on UK CCIR Study Group 5.

Accounts
The income and expenditure account for the six months to 31 December was considered by Council.

Membership and affiliation
It was resolved:
- (i) to elect 50 corporate and 15 associate members;
- (ii) to grant corporate membership to eight associate members;
- (iii) to reduce the subscriptions of three members;
- (iv) to grant affiliation to the St Peter's School Radio & Electronics Club, Huntingdon; Horsham Amateur Radio Club; Rugby Amateur Transmitting Society; and the George Kent Group Amateur Radio & Electronics Society.

Exhibition 1971
After very considerable discussion it was resolved: "That the Council does not this year support an exhibition to be held on the same lines as in previous years."

It was agreed that an alternative function was necessary and that this matter should be considered by Council at its next meeting.

RSGB's Diamond Jubilee 1973
It was agreed to appoint an *ad hoc* committee to put forward proposals regarding the form the Diamond Jubilee Celebrations should take, and the following members agreed to serve: Messrs W. A. Scarr, L. E. Newnham, R. F. Stevens, J. Bazley and D. A. Findlay.

Roll of Honour
Mr Jessop stated that he felt that there should be in headquarters a display showing the names of the Past Presidents of the Society. He thought that there should also be a similar display giving the names of Vice-Presidents and Honorary Members.

It was agreed that this matter should be considered at the September meeting.

Mullard Award
It was agreed that the conditions governing the Mullard Award should be re-drafted and submitted to Mullard Ltd.

Committee minutes and recommendations
Council approved the minutes of the following committee meetings: RAEN Committee (12.12.70); VHF Contests Committee (6.1.71); Scientific Studies Committee (1.2.71); Exhibition Committee (27.1.71) —Informal meeting, minutes adopted at meeting on 12 February 1971.

Council accepted the recommendations of the VHF Contests Committee (6.1.71) (VHF Listeners Championship 1970).

World Telecommunication Day
Mr Stevens reported that World Telecommunication Day, sponsored by the ITU, would be 17 May 1971. It was hoped that a station, callsign GB2ITU, would be in operation, and possibly a further station, GB3ITU, would be active on vhf.

HF Contests Committee
Council confirmed the chairman's invitation to Mr S. V. Knowles, G3UFY, to serve on the HF Contests Committee.

Bristol meeting
Mr Newnham reported that he had attended, on behalf of the Council, a very successful meeting at Bristol. The Bristol members had been very complimentary about the Society and Mr Newnham thought his visit was much appreciated.

Regional Representative—Region 12
Mr Smith pointed out that the position of Regional Representative for Region 12 (North-East Scotland) was vacant.

Council resolved that Mr George Grant, GM3UKG, be appointed Regional Representative for Region 12.

Edgware & District Radio Society
Mr Yeomanson reported that he had visited the Edgware & District Radio Society on Monday 8 February and had given a talk on the RSGB.

IARU Region 1 News
Mr Yeomanson enquired whether the Region 1 News could be made available to members generally. Mr Stevens said that there were difficulties, as publication was quarterly and payment would have to be by individual copies rather than a subscription for a period.

OBITUARIES

Mr Ronald Harris, G3GGX
Ron Harris, who died on 6 February 1971, became interested in radio when he lost his sight at the age of 16. In addition to operating, he maintained his own equipment. He was one of the first members to lecture to the Cornish ARC on the subject of ssb.

Mr A. E. Moon, G3KBM
Ted Moon, of Saltburn, died on 11 January 1971. He was well known on all bands from 160m to 10m, and 15 radio amateurs attended his funeral.

We have also been advised of the deaths of:

Mr E. H. L. Cooper, of Southampton;
Mr P. Crisp, G3BNC, of Southsea, Hants;
Mr H. C. Wing, W1AOF/W1CDP, on 17 July 1970.

YOUR OPINION

The Editor
Radio Communication

Sir—Dr A. Gschwindt's approach to a.m. speech clipping seems to me unnecessarily complicated. He is, of course, quite correct in pointing out the necessity for good low-frequency response following a low-level clipper-filter and his method of overcoming this problem is interesting, but why use low-level clipping in the first place?

Dr Gschwindt argues that clipping obtained by overdriving the modulator will cause interference in adjacent channels but he seems to have completely overlooked the fact that the conventional high-level clipping system uses a low-pass filter between the modulator and the rf amplifier precisely to prevent this. Although, in the case of a high-power broadcast transmitter, a suitable filter would probably be more expensive than Dr Gschwindt's approach, this is surely not the case at amateur power levels? Suitable filters are described in the *Radio Communication Handbook*, which gives a very adequate discussion of the whole question of a.m. speech clipping.

Yours faithfully,
D. T. K. Price, BSc (Hons), ZS6ZL

The Editor
Radio Communication
Sir—Caustic comment has appeared recently in *Radio Communication* regarding the abilities of licensees who employ commercially-built transmitting equipment. No doubt there is much truth in these arguments but it should also be said that charges of poor operating and impure signals can be levelled at many stations that are entirely or partially home constructed.

It appears that the critics are so mightily engaged in persuading the untutored and inexperienced on the evils of communication, that they overlook a substantial portion of the amateur community which has a straight choice between becoming inactive or purchasing a commercial rig. I refer to those of us who, against the apparent national trend, work long hours, have substantial business responsibilities, and frequently travel away; add a growing family and other normal distractions and the pattern emerges of a licence holder who, living a full and productive life, does not find it possible to apportion, say, 10 to 20 hours a week to the pursuit of his hobby and intricate construction. Indeed, judging from personal log entries, a figure of four hours a month is remembered with wistful pleasure, following periods of intensive business commitment.

Were it not for the availability of "ready-made" rigs, such members of the RSGB and similar bodies would fall by the wayside, thus robbing the fraternity of experienced people who are expected to maintain the "balance of power" in years to come. Certainly the purpose of my own course of action is to maintain at least a minimum standard of knowledge, so that I may more easily return to a full involvement upon reaching the age when this highly competitive world puts me out to grass.

For me, amateur radio is a hobby, a relief from the pressures of business. It is not a way of life!

Yours faithfully,
Victor E. Brand, G3JNB

MOBILE RALLY NEWS

Southport RS Steam Party, 10–12 April
This annual event will take place at Hoole Lane, Banks, near Southport. There will be a 2m station, a 160m station, a talk-in station and a radio exhibition. Other attractions will include steam traction engines and an amateur railway.

There will be a free car park, and refreshments will be available.

Spalding ARC Tulip Time Rally, 2 May
This will be held at the picnic site at Surfleet, four miles north of Spalding on the A16 Spalding–Boston road. The site is immediately south of the bridge and on the east side of the road, and overnight camping and caravan facilities will be available.

Talk-in stations will be operational from 10am on 1,980kHz, G3VPR/P, and 145·8MHz, G3XBS/P, and there will be the usual trade stands, bring and buy stalls and raffles. For maps of the tulip fields and other information contact Mr Harrison, G3VPR, 38 Park Avenue, Spalding, Lincs.

Hanworth Mobile Rally, 27 June
In association with Hanworth Carnival Committee, the Echelford ARS of Ashford, Middlesex, will be organizing this rally at Hanworth Airpark.

Further details can be obtained from Mr A. G. Wheeler, 32 Feltham Hill Road, Ashford, Middlesex.

RADIO AMATEURS' EMERGENCY NETWORK

by S. W. LAW, G3PAZ*

WE trust that the recent hiatus in postal communications will not have lost members' desires to air their views and spread their news at the first opportunity. For example, why no peevish comments about the Raynet award of late! Here and now we forestall the issue by pointing out that, with due respect to the hard work put in by certain groups, the Raynet Committee has not been able to formulate a true picture for some time past owing to the overall lack of news of group activities. So, while we acknowledge with gratitude those indefatigable controllers who keep us so well informed, it is to those others whose light is so well hidden under the proverbial bushel that these remarks apply.

Raynet Committee
At a meeting on 13 February the committee was reconstituted as in the previous year. Council member G3IIR supervised the proceedings and agreed to serve in his previous capacity for a further period. Representing Kent on this occasion was T. I. Lundegard ("Smudge"), G3GJW, who agreed to undertake the compilation of a complete list of frequencies currently in use by all Raynet groups in the UK. Group controllers are asked to note that G3GJW is QTHR. "Smudge" also made an extremely generous offer in connection with photographic records and was thanked by the chairman on behalf of the committee. Controllers will be notified of this offer in due course.

The chairman, G3BPT, expressed satisfaction on behalf of the committee that the decisions reached last year with respect to the use of crystal frequencies for Raynet had been agreed to by the south-east controllers meeting later in 1970.

The hon registrations secretary announced 89 re-registrations and 11 new ones in the last period. All existing controllers were confirmed for 1971 in accordance with the registrations list, and the appointment of G3GGH as Kent controller (due to the resignation of G3ODB) was confirmed. A discussion took place concerning the new handbook and also a possible change in the type of future registration cards.

After a session of over five hours the committee dispersed until the next meeting on Saturday 17 April.

New groups
East-coast amateurs who are interested in Raynet should contact G3OOG who is forming a new group in the Grimsby area. We also understand that there is some interest in the Torbay area in the west. Much further afield we understand that LA9BL is in the process of organizing an amateur emergency network in Norway on the lines of our UK Raynet. As a point of courtesy they have asked if they may use our badge design for their RANN, but coloured blue.

Honorary registrations secretary: **Mrs Jane Balestrini, "Merrivale", Willow Walk, Culverstone, Gravesend, Kent.**

Honorary secretary, RAEN Committee: **Mr. E. R. L. Bassett, 57 Upper St Helen's Road, Hedge End, Southampton, SO3 4LG. Tel Botley 4462**

* 130 Alexandra Road, Croydon, Surrey CR0 6EW

Mobile Rallies Calendar

10-12 April	Southport Steam Party. Hoole Lane, Banks, Nr Southport.
18 April	N Midlands. Drayton Park.
2 May	Spalding Tulip Time Rally. Surfleet.
30 May	Maidstone YMCA.
27 June	Echelford. Hanworth Airpark.
27 June	Longleat Safari. Longleat House, Nr Warminster.
11 July	Worcester. Upton on Severn.
8 August	Woburn Abbey.
15 August	Derby.
22 August	Swindon. Wroughton Aerodrome.
29 August	Stratford-on-Avon.

CONTEST NEWS

RSGB DF Contests 1971

Eleven groups are available to run qualifying events during 1971 and this has made it possible to increase the total number of events from seven to eight. However it is impracticable to provide additional dates, so it is proposed that some groups, who are relatively close to each other, should co-operate to run events in their own name in alternate years and support each other during the intervening year. The three pairs of groups that are in the best position to co-operate with each other are Chelmsford and Dartford Heath, Oxford and High Wycombe, and Rugby and Stratford. This will then permit eight groups to run the seven qualifying rounds and the final.

With an additional qualifying round, 21 competitors would qualify under the old rules, which would be an unwieldy number and perhaps less selective than is desirable for the final. Therefore, this year only the first and second places of those not previously qualified in each qualifying event send the competitor forward to the final, thus reducing the total entry to 14.

No other change in the existing rules is contemplated for 1971.

The following dates for qualifying events have been allocated to the groups shown:

25 April—Slade.
16 May —Rugby.
13 June—S. Manchester.
27 June—Grimsby
18 July —Derby.
8 August —Salisbury.
5 September—Dartford Heath.

The date and location of the final has not yet been decided.

First DF Qualifying Round—Slade

Date: 25 April 1971.
Map: OS Sheet 120 (Burton on Trent)
Assembly: 1300bst for start at 1320bst.
Location: MT Park, Whittington Barracks, on the north side of the Lichfield-Tamworth road NGR 151069. Frequencies and callsigns will be announced at the start.

Intending competitors are asked to notify Mr P. M. Williams, 20 George Road, Water Orton, Birmingham B46 1TE, of the numbers in their parties requiring tea. Please advise him as soon as possible and in any case not later than 10 April.

Second DF Qualifying Round—Rugby

Date: 16 May 1971.
Map: OS Sheet 132 (Coventry and Rugby)
Assembly: 1300bst for start at 1320bst.
Location: At the side of a disused airfield NGR 655820. Frequencies and callsigns will be announced at the start.

Intending competitors are asked to notify Mr D. Newman, Marina Cottage, Watford Top Lock, Watford Village, Rugby, of the numbers in their parties requiring tea. Please advise him as soon as possible, and in any case not later than 8 May.

June 1971 Microwave Contest

0900gmt to 1800gmt 20 June.
All entries and checklogs must be sent to the adjudicator addressed to VHF Contests Committee c/o G3VPK, "Maple Leaf", Great Braxted, Witham, Essex, CM8 3EJ.

1. Scoring contacts may be made on any amateur frequency above 1GHz but lower frequencies may be used for setting up contacts.
2. Contest exchanges will be as follows:
   On the 1·3GHz band—RS or RST report followed by a serial number, QRA locator and QTH.
   On other bands—RS or RST report followed by a serial number and brief details of equipment in use (eg 2C39, S1M2, 20-ele Yagi). Serial numbers begin at 001 on each band. This information may only be passed on the band for which points are claimed. It should all be logged.
3. Scoring will be as follows:
   On the 1·3GHz band—2 points per kilometre
   On the 2·3GHz band—3 points per kilometre
   On other bands—5 points per kilometre
4. The same callsign must be used on all bands for all scoring contacts. Unless superseded by the above, the following **General Rules**, as published in the January 1971 issue of *Radio Communication*, will apply: 1, 2, 3, 4b, 6b, 7b, 8d, 9a, 10a, 11–24.

June 1971 70MHz Portable Contest

0900gmt to 1700gmt on 27 June.
All entries and checklogs must be sent to the adjudicator addressed to: VHF Contests Committee, c/o G8AYN, 108 Gascoigne Road, New Addington, Croydon, Surrey CR0 0NE.
The following **General Rules**, as published in the January issue of *Radio Communication*, will apply: 1, 2, 3, 4b, 5a, 6a, 7a, 8c, 9a, 10a, 11–24.

May 1971 144MHz Portable Station Contest Amendment

In the details of Section 2 published in the March issue, the time and date of commencement should have read 0900gmt 2 May.

NFD 71

Rules for NFD 1971 were published on page 130 of the February 1971 issue of *Radio Communication*. Each year the HF Contests Committee is obliged to disqualify a number of entrants who have neglected to comply with the rules. Please get your club contest organizer to read the rules carefully **now.**

Contests calendar

11 April—WAB LF CW Contest
25 April—First DF Qualifying Round—Slade (Rules in this issue)
1-2 May—144MHz Portable (Rules in March and this issue)
16 May—Second DF Qualifying Round—Rugby (Rules in this issue)
21-23 May—YL ISSB QSO Party
22-23 May—432MHz Open (Rules in March issue)
5-6 June—NFD (Rules in February issue)
5-7 June—CHC/FHC (phone and cw)
20 June—WAB VHF Phone Contest
20 June—Microwave (Rules in this issue)
27 June—70MHz Portable (Rules in this issue)
3-4 July—Summer 1·8MHz
3-4 July—144MHz Open
3-4 July—144MHz Listeners Contest
10-11 July—HP FD (Rules in March issue)
18 July—432MHz Open
18 July—432MHz Listeners Contest
9 August—144MHz SSB
14-15 August—70MHz CW
4-5 September—VHF NFD (Rules in March issue)
12 September—80m FD
2-3 October—UHF NFD
9 Oct-30 Dec—70MHz Cumulative
9-10 October—21/28MHz
23-24 October—7MHz (cw)
30-31 October—432MHz Fixed
6-7 November—144/432MHz CW
6-7 November—7MHz (phone)
6-8 November—CHC/FHC (phone and cw)
13-14 November—2nd 1·8MHz
5 December—144MHz Fixed

Looking ahead

17 April—VHF Convention, Whitton.
23 April—RSGB Dinner Club, Kingsley Hotel, London WC1.
7 May—RAOTA Reunion.
9 May—NRSA Convention.
17 May—World Telecommunication Day.
25-27 June—IARC Convention, Geneva.

CLUB NEWS

Items for inclusion in this section should be sent to regional representatives on the first of each month for inclusion in the following month's issue. They should not be sent direct to the editor.

The date of publication of the following month's issue, first Tuesday in the month, should be borne in mind so that events are not, in fact, history when the details are published. While regional representatives are pleased to receive clubs' events calendars for several months ahead, they still require monthly events lists so that entries can be confirmed or amended.

REGION 1 **RR B. O'Brien, G2AMV**

Special regional event:

9 May, 1971 Belle Vue Convention.

Merseyside Luncheon Club—First Monday each month, 12.30 for 12.45 pm, HMS *Landfall*. Please advise G3VQT or G2AMV beforehand if you wish to attend.
Ainsdale (ARC)—14, 28 April, 8 pm, "The Morris Dancers", Scarisbrick.
Allerton (Liverpool) Scout ARS North West Region—Thursdays, 8pm, 1st Allerton Group headquarters, Aigburth Vale, Liverpool 17. All Scouts interested in amateur radio are welcome.
Blackburn (East Lancs ARC)—First Thursday each month, 7.30pm, Edinburgh House, Shearbank Road, Blackburn. Further details from G4JS.
Blackpool (B & FARS)—Mondays, 8pm, Pontins Holiday Camp, Squires Gate. Morse tuition at 7.30pm.
Bolton (B & DARS)—Please note new meeting place. Clarence Hotel, 176 Bradshawgate, Bolton. Meetings will in future be held on alternate Wednesdays, 7, 21 April, 5 May.
Bury (B & RRS)—Meetings take place once a month on the second Tuesday at 8pm, in the George Hotel, Market Street, Bury. Secretary, A. Cooper, G3VVQ, 411 Holcombe Road, Greenmount, Bury.
Carlisle (C & DARS)—Mondays, 7.30pm, Currock House, Lediard Avenue, Currock. Secretary, A. Harper 23 Roman Way, Carlisle.
Cheshire (Mid-Cheshire ARC)—Wednesdays, 7pm, Technical Activities Centre, Winsford Verdin Grammar School, Grange Lane, Winsford. All meetings begin with a morse class, the main feature is at 8pm.
Chester (C & DARS)—Tuesdays, except the first Tuesday in the month which is net night, 8pm, YMCA, Chester.

Crewe—Local members continue to meet at the QTH of R. Owen, 10 Circle Avenue, Willaston, Nantwich, from whom further details may be obtained.

Douglas (D & DARS)—Second and fourth Wednesdays in the month, 7pm, Douglas Holiday Camp, Victoria Road, Douglas, Isle of Man. Secretary, J. Parnell, Upper Cronkbane Farm, Quines Hill, Port Soderick, Braddan, Isle of Man.

Eccles (E & DRC)—Tuesdays, 8pm, Bridgewater School, Worsley, Lancs. Thursdays—Club top-band net, 2030gmt.

Leyland Hundred (LHARG)—Net nights: Thursdays at 2000gmt, 1,915kHz. Saturdays at 1900gmt, 145·8MHz.

Liverpool (L & DARS)—Tuesdays, 8pm, Conservative Association Rooms, Church Road, Wavertree. Secretary: G3WCS, Ken Wood, 90 Childwall Valley Road, Liverpool 16.

Liverpool (NLRC)—9, 23 April, 7 May, 8pm, Labour Party HQ, 13 Crosby Road South, Liverpool 22. Secretary, M. Graham, G3XMG, 14 Albert Road, Waterloo, Liverpool 22.

Manchester (M & DARS)—Wednesdays, 7.30pm, 203 Droylesden Road, Newton Heath, Manchester 10.

Manchester (SMRC)—The vhf section of the club (G3UHF) meets Mondays at 8pm, at the club shack, "Greeba", Shady Lane, Manchester 23. Visitors are welcome on both Mondays and Fridays. Main club meetings at Conservative Association Divisional Office, 449 Palatine Road, Northenden, Manchester 22, at 8pm.

Preston (PARS)—15, 29 April, 7.30pm, "Windsor Castle" (private room), St Paul's Square, Secretary, G. Windsor, 26 St Gregory's Road, Preston.
Salford (Dial House Radio Society)—A society of GPO Engineers. Wednesdays, 6pm, 8th floor (river end), Dial House, Chapel Street, Salford 3. Further details from secretary at the same address.
Stockport (SRS)—Second and fourth Wednesdays, 8pm, The Blossoms Hotel, Buxton Road, Stockport. Further details from the secretary G8BCG.
Thorton Cleveleys (TCARS)—First and third Wednesdays each month, 8pm, St John Ambulance Brigade Hall, Fleetwood Road North, Thorton, Blackpool. Secretary, G3YWH. ASR, G3ZBO.
Warrington (Culcheth ARC)—Fridays, 7.30pm, Chat Moss Hotel, Glazebury. All visitors are welcome. Secretary, K. Bulgess, 32 Hendon Street, Leigh.
Westmorland—Fridays, 7.30pm, 24 Park Road, Milnthorpe. All visitors are welcome. Secretary, J. Forrester, 44 New Street, Carnforth.
Windscale—Cumberland (WAR & ES)—Fridays, 7pm, c/o Falcon Club, Falcon Field, Egremont. Further details from N. Ramsden, G3RHE.
Wirral (WARS)—First and third Wednesdays in the month, 7.45pm, Scouts HQ, Harding House, Park Road West, Claughton, Birkenhead. Secretary, A. Fisher, G3WSD, 34 Glenmore Road, Oxton, Birkenhead.
Wirral (Wirral DX Association)—Last Thursday each month at members' homes. Secretary, J. Share, G3OKA.

REGION 3 **RR R. W. Fisher, G3PWJ**

Birmingham (MARS)—20 April, 8pm, Midland Institute, Margaret Street, Birmingham 3. *G8BHE*.
Cannock (CCARS)—Meetings monthly on the first Thursday, but a natter night every Thursday, 8pm, Bridgtown Social Club, Walsall Road, Bridgtown.
Dudley (DARC)—13, 27 April, 8pm, Central Library, St James' Road, *G3PWJ*.
Hereford (HARS)—Every Friday evening, Civil Defence HQ, Gaol Street, Hereford.
Lichfield (LARCS)—First Monday and third Tuesday of each month, The Swan Hotel, Lichfield. *G8CNB*.
Nuneaton (NARC)—First Friday of each month, Caldecote Grange. D. Smith, 2 Niton Road, Nuneaton.
Rugby (R & DAR & EC)—First Tuesday in the month, 10 Drury Lane, Rugby. *G3YQC*.
Solihull (SARS)—20 April (Shacks "colour slides"), 7.30pm, Manor House, High Street, Solihull. 4 May (Informal), 9pm, Malt Shovel. *G3ZXO, ex G8BYM*.
Sutton Coldfield (SCRS)—12 April ("Hints on mobile operation" tape), 26 April (Natternite), Clubhouse, Sutton Town Football Club, Coles Lane. *G8CZM*.
Telford (WARS)—Every Wednesday, 8pm, Ketley Bank Youth Club, Main Road, Ketley Bank, Telford, Salop. (First Wednesday each month during college terms held at Walker Technical College, Wellington). *G3UKV*.
Worcester (W & DARC)—17 April (Constructional contest), 7.30pm, Crown Hotel, Broad Street. *G3WUI*.

REGION 5 **RR S. J. Granfield, G5BQ**

Cambridge (C & DARC)—Every Friday, 7.30pm. The AGM was held on 12 March at the Club HQ, Corporation Yard, Victoria Road, Cambridge. Visitors are always welcome.
March (M & DRAS)—Tuesdays, Club HQ, Old Police HQ, High Street, March, Isle of Ely.
Shefford (S & DRS)—Meetings held on Thursdays. 1 April (Short lectures—any subject), 8 April (No meeting), 15 April (NFD planning and junk sale), 22 April (RAE revision), 29 April ("Lf aerials and ATUs", by Doug, G3UMI), 8pm, Church Hall, Ampthill Road, Shefford, Beds.

It is with regret that we announce the retirement as hon secretary of "Bill" Steadman, owing to ill health, and we all wish him a speedy recovery. His place has been taken by Arthur Sullivan, G2DGF, 12 Glebe Road, Letchworth, tel. Letchworth 6441.

REGION 7 **RR P. A. Thorogood, G4KD**

Members in this region are asked to request their clubs, societies and groups to consider holding a regional meeting in September or October on a Saturday. In addition to the regional meeting there could be an exhibition, film show, ladies show, lecture, tea and supper. **RSVP G4KD**

Attention is drawn to the talk to be given to the Verulam ARC on 21 April by Brian Armstrong, G3EDD. Visitors will be welcome.

Acton, Brentford & Chiswick (ABCRC)—20 April ("2m", by G8DLK), 7.30pm, Chiswick Trades & Social Club, 66 High Road, Chiswick.
Addiscombe (AARC)—Second and fourth Tuesdays, 8pm, "The George", High Street, Thornton Heath.
Ashford, Echelford (ARS)—Second Monday and last Thursday of month. 12 April (Still open time), 29 April ("Radio astronomy for amateurs", by G. Sweet, G3OZY), 7.30pm, St Martin's Court, Kingston Crescent, Ashford, Middx.
Barking (B & DREC)—Tuesdays and Thursdays. 22 April ("Impirical approach to synoptic meteorology and vhf" by J. Johnson, G2HR) 8pm, Gascoigne Recreation Centre, Gascoigne School, Morley Road, Barking.
Bexleyheath (NKRS)—Second and fourth Thursdays. 8 April ("Rtty", by G3PDG), 22 April (Junk sale), 7.30pm, Congregational Church Hall, Chapel Road, Bexleyheath.
Cheshunt (CDRC)—First Friday of month, 7.30pm, Methodist Church Hall, opp Theobalds Station, Cheshunt.
Chingford (RSGB Group)—Fridays. Telephone 01-524 0308.
Chingford (SRC)—Fridays, 7.30pm, Friday Hill House, Simmons Lane, Chingford, E4.
Croydon (SRCC)—Third Tuesdays, 7.30pm, "Swan & Sugarloaf", South Croydon.
Crystal Palace (CP & DRC)—Saturdays 8pm, Emmanuel Church Hall, Barry Road, SE22.
Dorking (DR & DRS)—Second and fourth Tuesdays, 8pm, "Wheatsheaf", Dorking.
Ealing (E & DARS)—Tuesdays, 7.30pm, Northfields Community Centre, Northcroft Road, W13.
East London—18 April ("Construction snags", by R. Brown, G3SKJ), 2.30 for 3pm, Wanstead House, The Green, Wanstead, E11. (200 yards Wanstead Station, Central Line).
Edgware & Hendon (E & DRS)—26 April (Lecture night), 8pm, St George's Hall, 51 Flower Lane, Mill Hill, NW7.
Farnham, Bucks (Burnham Beeches RC)—Fortnightly on Mondays, Public house by Village Hall, Victoria Road, Farnham Common.
Gravesend (GRS)—Mondays, 8pm, Northfleet Recreation Centre, Springhead Road, Northfleet, Kent.
Guildford (G & DRS)—Second and fourth Fridays. 9 April (AGM), 8pm, Guildford Engineering Society, Stoke Park.
Hampton Court (TVARTS)—First Wednesday in the month, 7.30pm, "The Three Pigeons", Portsmouth Road, Surbiton.
Harlow (DRS)—Tuesdays (General and cw practice); Fridays (Junior), 7.30pm, Mark Hall Barn, First Avenue.
Harrow (RSH)—Every Friday, 8pm, Harrow County School for Boys, Sheepcote Road, Harrow.
Havering (H & DARC)—Fortnightly, 8pm, British Legion House, Western Road, Romford.
Hemel Hempstead (HH & DARS)—First and third Fridays, 7.30pm, "Addmult" Sports Club, Hemel Hempstead.
Holloway (GRS)—Mondays (RAE), 7pm; Wednesdays (Morse), 7.30pm; Fridays (Club), 7.30pm, Archway School Annex, Whittington School, Highgate, N19.
Ilford—Every Thursday, 8pm, 50 Mortlake Road (off Ilford Lane) Ilford.
Kingston (K & DARS)—Second Wednesday in each month. 14 April ("Introduction to ICs", by R. S. Babbs, G3GVL), 8pm, Penguin Lounge, 37 Brighton Road, Surbiton.
London Group—G4KD. Telephone 01-959 3528.
Loughton—Fortnightly on Fridays, Loughton Hall, Rectory Lane (nr Debden Station).
New Cross—Wednesdays and Fridays, 8pm, 225 New Cross Road, SE14.
Paddington (P & DARS)—Thursdays, 7.30pm, Beauchamp Lodge, 2 Warwick Crescent, W2.
Purley (P & DRS)—First and third Fridays, 8pm, Railwaymen's Hall, side entrance, 58 Whytecliffe Road, Purley.
Reigate (RATS)—First Wednesday, 7.45pm, "George and Dragon", Cromwell Road, Redhill.
Romford (R & DRS)—Tuesdays, 8.15pm, RAFTA House, 18 Carlton Road.
Scouts (ARS)—Third Thursday of month, 7.30pm, Baden Powell House, Queensgate, South Kensington, SW7.
Sidcup (CVRS)—First and third Thursdays, 8pm, Congregational Church Hall, Court Road, Eltham, SE9.
Southgate (SRC)—Second Thursday of month, 7.30pm, Civil Defence Hut, Bowes Road, N11.
St Albans (Verulam ARC)—21 April (Brian Armstrong, G3EDD, talk with demonstration on "Reviewing equipment" based on reviews which have appeared in *Radio Communication*. Visitors welcome) 7.30 for 7.45pm, Council Chamber, Town Hall, St Peter's Street, St Albans.
Sutton & Cheam (SCRS)—Third Tuesday, 20 April (AGM), 8pm, "The Harrow Inn", High Street, Cheam.
Welwyn (Mid-Herts ARS)—Second Thursday in month. 8 April ("Twenty-five years of Mid-Herts amateur radio", by Jack Hum, G5UM), 8pm, Welwyn Civic Centre, Welwyn.
Wimbledon (W & DRS)—Second and last Fridays, 8pm, St John Hall, 124 Kingston Road, South Wimbledon, SW19.
Wembley (GECARS)—Thursdays, 7pm, Sports Club, St Augustin Avenue, North Wembley. (This club is open to non-GEC employees by invitation. Telephone Dain Evans, G3RPE, 01-904 1262, for details).

REGION 9 **RR J. Thorn, G3PQE**

A regional meeting and convention will be held in Weston-super-Mare Technical College on Saturday 19 September.

Bristol, City & County (BARC)—Tuesdays and Thursdays. Club meets at 7.30pm, Club HQ, G3TAD, 41 Ducie Road, Barton Hill, Bristol 5. *G3RKH*.
(RSGB Group)—26 April (Potted lectures by G3JMY, G3VBH, G3XTJ and G8BIY), 7.30pm, Becket Hall, St Thomas Street, Bristol 1. *G3ULJ*.
(Shirehampton)—Every Friday, Twyford House. Change of secretary from G3YIQ to Eddie Davis, G3SXY. An RAE course is running under the tutorship of Maurice Wilkins.
(University)—Every Saturday afternoon, Dept of Physics, Royal Fort, Tyndall Park Road, Bristol 8. *G8ADP*.
Cornwall (CRAC)—Meetings at SWEB Social Club, Pool, Camborne. *G3UCQ*.
(Falmouth)—G3OJN.
(Newquay)—G3THT.
Exeter (EARS)—6 April. Meetings at the Community Centre, 17 St David's Hill, Exeter. *G3TXG*.
North Devon (NDARC)—14 April (Lecture), 28 April (Ragchew). RAE at 7pm on each date. Club meets at "Grinnis", High Wall, Sticklepath, Barnstaple. *G4CG*.
Plymouth (PRC)—6, 20 April, Virginia House, Bretonside, Plymouth, *G3SPI*.
Saltash (S & DARC)—16 April, 7.30pm, Burraton Toc H, Warraton Road, Saltash. *G3XWA*.
South Dorset (SDRS)—Meetings at Technical College on the first Friday in month. *G3EAT*.
Taunton (T & DARC)—Every Friday club meets at its HQ (the old SEVO Conference Room), The Barracks, The Mount, Taunton. *G8CWD*.
Torbay (TARS)—Every Friday and Saturday. 24 April (Business meeting). Club meets at its HQ, rear of 94 Belgrave Road. *G3NQD*.
Weston-super-Mare (WSMRS)—2 April (Amateur tv talk and demonstration by R. J. Robson, G8AGI and R. Harris), 7.30pm,

Small Lecture Theatre, Ground Floor, New Technical College. *G3GNS.*
Yeovil (YARS)—Wednesdays, The Park Lodge. *G3NOF.*

REGION 10 **RR D. M. Thomas, GW3RWX**

Blackwood (ARC)—Fridays, 7pm, Blanche Cottage, off High Street, Blackwood, Mon. The club recently suffered a sad loss by the death of Mr W. T. Forbes, GW3VSM. Sightless from birth, he was a good operator and an inspiration to more fortunate people. The deep sympathy of the club is extended to surviving relatives.

Barry College of Further Education (ARS)—Thursdays, 7pm, Barry College of Further Education, Colcot Road, Barry, Glam. The annual Marconi commemoration of the transmissions from Flat Holm Island to Lavernock Point will again take the form of portable operation from 0001 to 2359 on 23 May. The island callsign will be GB3FI and that of Lavernock Point GW3VKL/A. A social will be held on the evening of 22 May at the social club located at the Lavernock Caravan Site, to which all local members are invited.

Cardiff (RSGB Group)—Since the usual meeting night on the second Monday of the month falls on Easter Monday, the April meeting will be held in the Department of Geology, University College, Park Place, Cardiff, on Monday 19th at 7.30pm. A talk and demonstrations on "Crystals, including quartz" will be given by Dr G. Lemon; demonstrations will include diamond saw techniques used in the cutting of quartz crystals, and crystal identification using polarized light microscopy.

Glamorgan Raynet Group—Full training programmes are now in operation, using nbfm equipment, and the efficiency of the group is now of a high order. Details of activities from GW3ZFG, Cardiff 62411.

Haverfordwest (ARS)—Tuesdays, 7.30pm, New HQ, Rosemary Lane, Haverfordwest, Pembs. Club callsign, GW3XCT. Secretary, GW3YBB.

Hoover (ARC)—Mondays, 7.30pm, Hoover Social Club, Hoover Works, Pentrebach. Secretary, Mr F. E. Tribe.

Port Talbot (ARC)—Second Tuesday of each month, 7.30pm, Trefelin Club & Institute, Port Talbot, Glam. GW5VX.

Pontypool (ARC)—Tuesdays, 7pm, Educational Settlement, Rockhill Road, Pontypool, Mon. *GW3JBH.*

Pembroke (ARC)—Last Friday of each month, 7.30pm, Defensible Barracks, Pembroke Dock. *GW3LXI.*

Sully & District Shortwave Club—Tuesdays, 7pm, The Annexe, Sully Bowls & Social Club, 59 South Road, Sully, Glam. Secretary: Mr Glyn Maggs, 3 Thorley Close, Cyncoed, Cardiff.

Rhondda (ARS)—Meets at Rhondda Transport Employees Club & Institute, Porth, Rhondda, Glam. *GW3PHH.*

Swansea Telephone Area (ARS)—Tuesdays, 7.30pm, Telephone Engineering Centre, Gors Road, Swansea. Callsign, GW3ZTK. Secretary: Mr D. E. Connor, 7 Glanmon Park Road, Sketty, Swansea.

University College, Cardiff (ARS)—Details of meetings and future activities from the secretary, c/o Students Union, Dumfries Place, Cardiff. Callsign, GW3UWC.

University College, Swansea (ARS)—Details from the Secretary c/o Students Union, University College, Singleton Park, Swansea, Glam. A meeting of the combined Welsh University Radio Societies was held at Aberystwyth on 24 February. The meeting was very successful, and included talks by Mr G. Salter, Head of Engineering, BBC (Wales), on "Broadcasting in the Seventies", and Mr A. Hemming, GW3SWQ/ZD9BE, on "Tristan da Cunha".

REGION 12 **RR G. M. Grant, GM3UKG**

Aberdeen (AARS)—Fridays, 7.45pm, 6 Blenheim Lane, Aberdeen. *GM3HGA.* Tel Aberdeen 33838.

Dundee (DARS)—Thursdays, 7.30pm, 3 Magdalen Place (off Roseangle), Dundee. *GM3KYI.*

Inverness (IRS)—Thursdays, 7.30pm, 4 Falcon Square (nr railway station), Inverness. *Mr Norris* (QTH as per January *Radio Communication*).

Lerwick (LRC)—Tuesdays and Thursdays, 8pm, Annsbrae House, Lerwick. *GM3XPQ.* Tel Bixter 249.

Lhanbryde (MFARS)—Wednesdays, 7.30pm, St Andrews School, Lhanbryde, by Elgin, Morayshire. *GM3UKG.* Tel Clochan 225.

Thurso (CARS)—Second Tuesday in each month, 7.30pm, Thurso Technical College. *GM3JUD.*

REGION 14 **RR N. G. Cox, GM3MUY**

Ayrshire (AARG)—19 April, 7.30pm, YMCA, Howard Street, Kilmarnock.

Ayrshire (Ardeer Recreation ARC)—6, 8, 13, 15, 20, 22, 27, 29 April, 7.30pm, Ardeer Recreation Club, Amateur Radio Section, Stevenston. Details from J. F. McCreight, GM3DJS, 10 Auchenharvie Road, Stevenston, Ayrshire.

Falkirk & District RSGB Group—30 April, 7.30pm, Temperance Cafe, Lint Riggs, Falkirk.

Glasgow University (GURC)—2, 23, 30 April, 7.30pm, George Service House, University Gardens, Glasgow W2.

Greenock & District (G & DARC)—2, 9, 16, 23, 30 April, 7.30pm, James Watt Library, Union Street, Greenock.

Mid-Lanark RSGB Group—16 April, 7.30pm, YMCA Brandon Street, Motherwell.

West Scotland (ARS)—2, 9, 16, 23, 30 April, 7.30pm, Royal Signals Lowland HQ, 21 Jardine Street, Glasgow W2.

REGION 17 **RR C. Sharpe, G2HIF**

Basingstoke (BARC)—Meetings on the first and third Saturdays in each month, 7pm, Chineham House, Shakespeare Road, Popley, Basingstoke, Hants. *G3CBU.*

Newbury (N & DARC)—Meetings on the first Monday in each month, 7.30pm, South Berkshire Technical College, Newbury, Berks. *G3KJC.*

N. Berks (AERE, Harwell, ARC)—Meetings on the third Tuesday in each month. Also informal meetings and junk sales every Friday lunchtime. 20 April (Basic semiconductor circuit design), 7.30pm, Social Club, AERE, Harwell, Didcot, Berks. *G3NNG.*

Swindon (S & DARC)—Meetings on alternate Wednesdays. 7 April (Informal), 21 April (Operating awards—the G3JO Cup), 7.30pm, Penhill Junior School, Swindon, Wilts. *G3JAP.*

MEMBERS' ADS

These advertisements are accepted free of charge as a service to members of RSGB. They must be submitted on the Members' Ads order form printed on the penultimate page of each issue of *Radio Communication*, or on a postcard similarly laid out. Each must be accompanied by a recent *Radio Communication* wrapper addressed to the advertiser, as proof of membership.

The closing date for each issue is the 7th of the preceding month, but no guarantee of inclusion in a specific issue can be given. Valid advertisements not published in the issue following receipt will be held over until the next issue and should not be resubmitted.

Trade or business advertisements, even from members, will not be accepted for Members' Ads but should be submitted as classified or display advertisements in the usual way. The RSGB reserves the right to refuse advertisements, and accepts no responsibility for errors or omissions or for the quality of goods offered for sale.

Members are advised to enclose a stamped addressed envelope when replying to advertisements.

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Sommerkamp FL200B, £95. BC221 with charts, less psu, £20. 24V blower, £1. 2½in diam ceramic coil former with sockets, 25p. 500V 500mA and heater windings, £1. 18 Set, £1. Buyer coll. G3WJN, QTHR. Tel Redditch 63817.

Inoue IC–700 series, comp stn rx/tx, psu and mic, exc cond, £150. G3PFH, 7 Shere Road, Gants Hill, Ilford, Essex.

Eddystone 640 rx, £9.50. ZC1 Mk 2, less psu, £9.50. 160m trnscvr with 6V /M psu, beautifully made, £14. All band 6HF5 linear, rough, less valves, £4.50. 70cm cavity wavemeter, £2.50. R1475, wkg, £4.50. G3KWK, QTHR. Tel Redditch 63817.

Labgear topbander, fine cond, £10 buyer coll. G8LG, QTHR. Tel Ascot 22017.

Canonball 160m ssb tx, £22. Pair QY8–100, new, offers. Advance sig gen, £5. CR300 + psu, offers. Wanted: KW2000 with psu, pref ac and /M. G3DCS, QTHR.

KW2000A, late model, £150. Heath SB301 rx £110. Both gd cond, prof aligned, with spare tubes. GM3UMW, QTHR. Tel 041–776 6627.

Hammarlund HQ129X rx, 54–31MHz, no b/s 160m, £28. Buyer coll. Algate, 18 Florence Road, Wimbledon SW19. Tel 01-542 3553.

Loran indicator stripped gd tube, £2. Miniature waveform monitor 2¾in tube, no psu, £3.50. Spares for CT38 not meter. Collect. Cook Old Lodge, Seven Hills Road, Cobham, Surrey. Tel Cobham 3117.

Hallicrafters SX133 with mtchg spkr, brand new, £80. Swan 500c new valves, £250. Shure 444T mic, as new, £10. G3YQE, QTHR. Tel 01-592 7800.

52 Set psu, phones, orig manual, gd, £12. Hamgear PM2, new, £5. Wanted: tuning meter AR88D 5mA zero deflection to the right. Your price. Bovingdon, 6 Roberts Lane, Chalfont St Peter, Bucks.

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Heathkit DX4OU tx, vgc, £17 ono. Transport arranged. G8AAL. QTHR. Tel Stourbridge 6846.

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LG300 rf unit spare 813 perf, £25. LG300 psu/mod fault in h/v line, £10. KW160, exc cond, £20. PC330 70MHz tx, £18. G3RHF 70MHz cnvtr, 4MHz if, £5. Haylock, Bowyers, Steepmarsh, Petersfield, Hants. Tel Liss 3314.

EC10, splendid cond, £36. Collins mech filt, unused 455kHz Whitewater Electronics P405 S/ID 248861A cylindrical 3in by ½in, £5. Post extra. G3BRW, 17 Harbour View Road, Parkstone, Poole, Dorset. Tel Parkstone 2368.

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Eddystone EA12 rx. G8DYY, 106 Goldthorn Hill, Wolverhampton.

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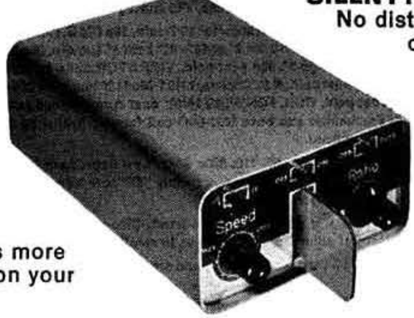

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PATRON H.R.H. THE PRINCE PHILIP
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