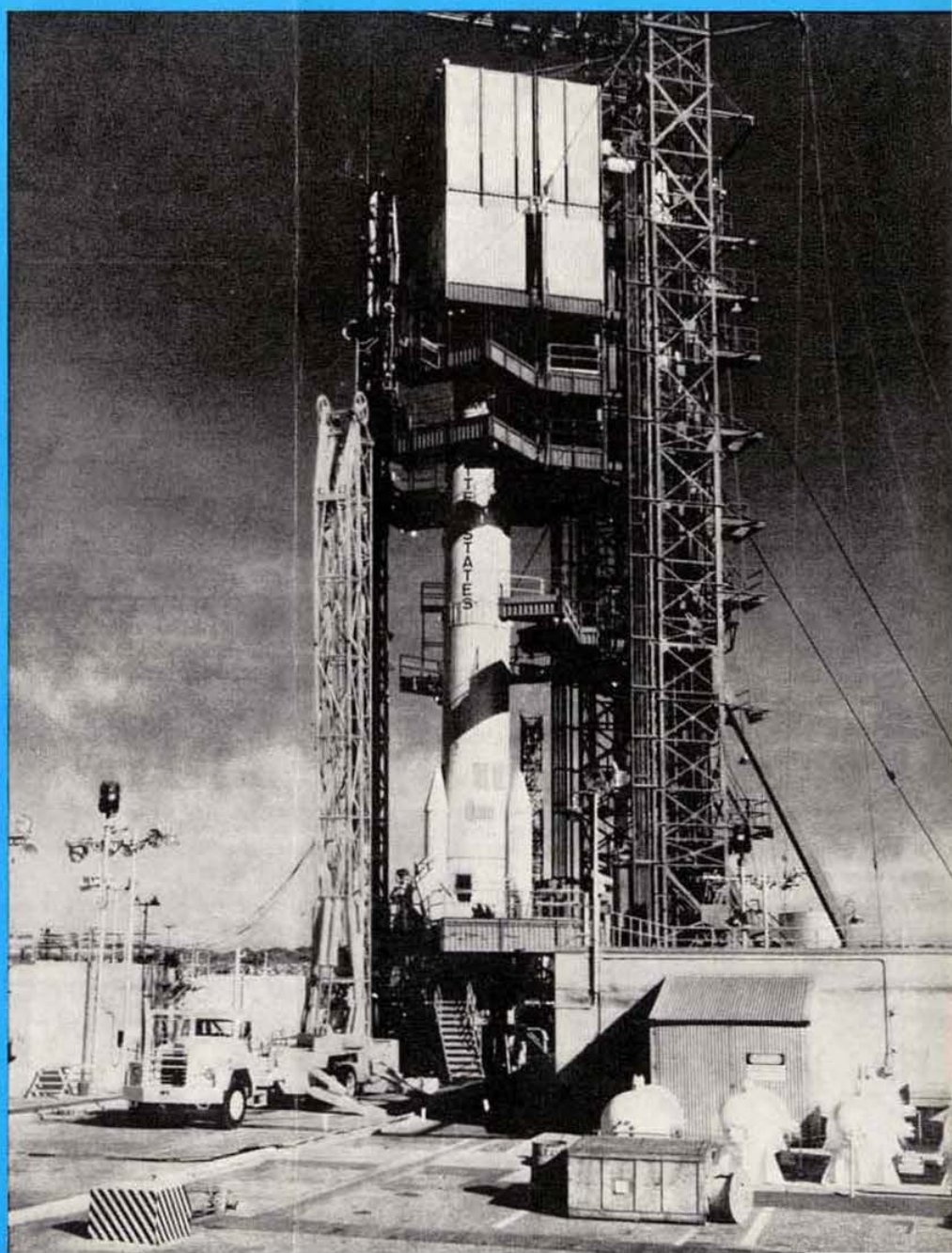
radio communication

April 1970

Journal of the Radio Society of Great Britain



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April 1970

radio communication

Volume 46 No 4 Price 4s

CONTENTS

FRONT COVER

The two-stage Delta-N launch vehicle which launched Australis-Oscar-5 into orbit on 23 January
Photo: NASA

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**

Contributions and all correspondence concerning *Radio Communication* should be addressed to: The Editor, *Radio Communication*, 35 Doughty Street, London WC1N 2AE. Tel 01-837 8688.
Closing date for contributions, unless otherwise notified: 7th of month preceding month of publication.

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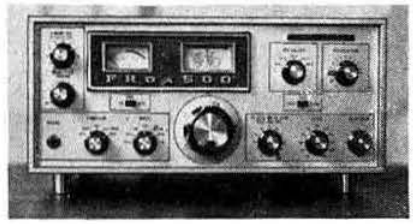

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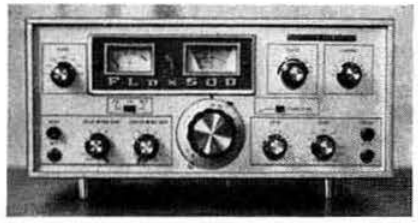

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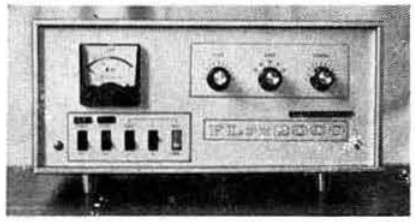

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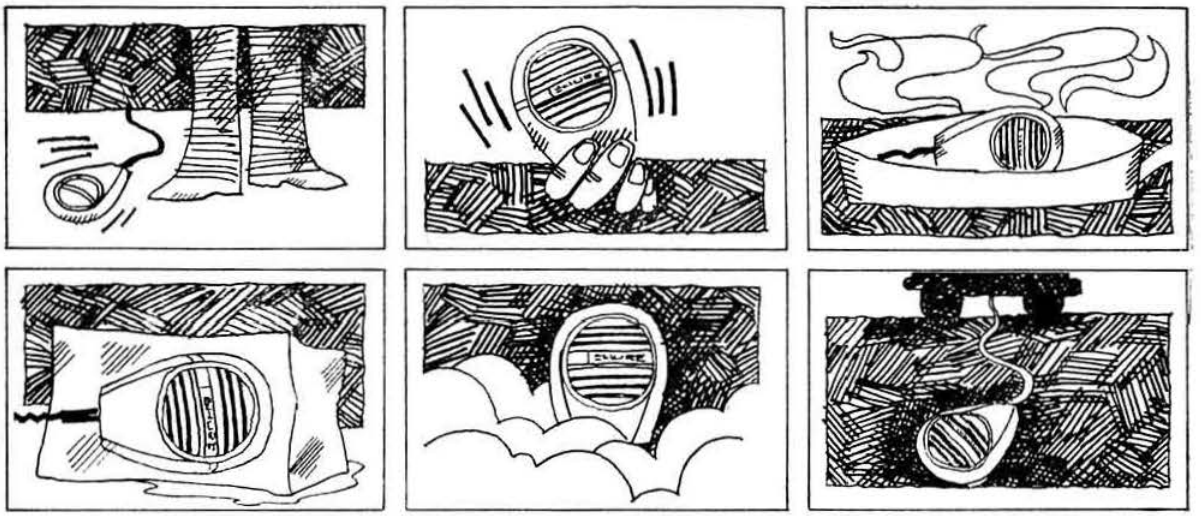

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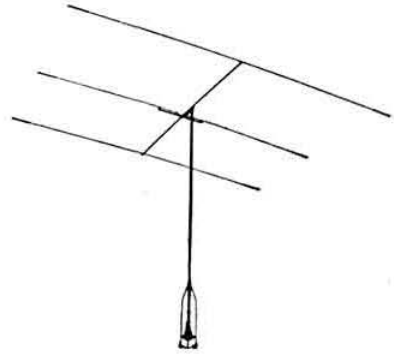

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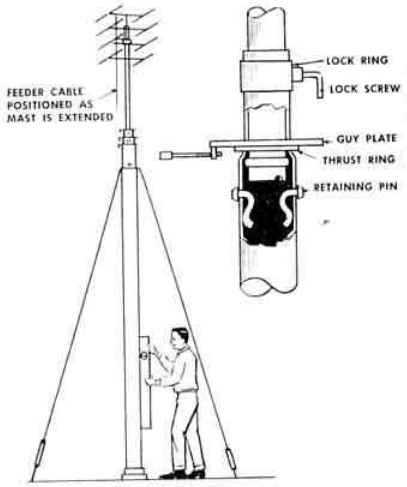

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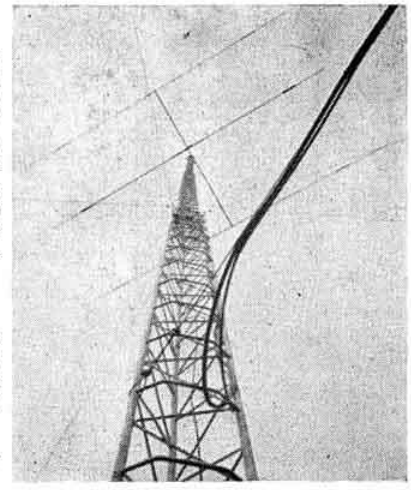
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Current Comment

Use or lose

IN preparation for the Space Communication Conference, which will commence in June 1971, the telecommunications authorities of the 137 member nations of the International Telecommunication Union are considering what steps are necessary to provide space communication facilities during the next ten years. Paragraph 3 of the agenda of the Conference reads: *to consider and provide as far as possible additional radio frequency allocations for the space radio service*. Where are these additional frequencies to be found? They cannot be produced out of a hat like the conjurer's rabbit, and it follows logically that existing services will have to surrender or share frequencies that they now hold. The nature and complexity of space communications means that the frequencies under review will be mainly those above 30MHz and particularly those allocations adjacent to bands already used for space communication.

Where does the amateur service stand in relation to this revision of frequencies? Ignoring the 70MHz band, which we are fortunate to have as a purely national allocation, there are amateur bands at 144, 425, 1,215, 2,300, 3,400, 5,650, 10,000 and 21,000MHz. Of these, only the first and last provide the amateur service with exclusive allocations. There is already a proposal which has been adopted by several administrations to alter the exclusive band at 21GHz to the secondary use of the band 24 to 24·25GHz with radiolocation as the primary user. This proposal came from the USA, and how can it be opposed on the basis of the existing amateur use of these frequencies?

As amateurs we are at present mainly concerned with the 144, 425 and 1,215MHz bands. All these lie in close proximity to frequencies now being used for space communication and are therefore sensitive areas for possible loss or sharing. In addition to the pressure from space communication interests, certain organizations supplying equipment for land mobile use have been raising questions regarding reallocation of the 425MHz band. One published phrase in this connection reads: *arrangements could still be made to accommodate the amateur tv and other present users of these frequencies without too much difficulty*. From this it would appear that amateur research and scientific investigation, which have played a vital part of the development of radio communication, are to be ever subordinated to the fancies of commercial interests whose basic reason for existence is to make money. Fortunately those who sit in judgement on these matters are aware of the existence of other considerations.

The UK Ministry of Posts and Telecommunications, which is the body responsible for formulating the national approach to the frequency allocation question, knows the extent of the additional facilities requested by the amateur service. Basically, these are (i) to extend the existing facility for space communication, now restricted to 144MHz, to all bands up to and including 24GHz, and (ii) to enlarge the present permission for the *use of artificial satellites* to include other space communication techniques such as the lunar transponder of Project Moonray. The RSGB, as the national representative of the amateur service, has been in negotiation with the Ministry since April 1969 on these matters.

This approach is part of a co-ordinated effort made throughout Region 1 by the member societies of the International Amateur Radio Union. Realizing the importance of having a common policy the Brussels 1969 IARU Conference charged all societies with the duty of an approach to each national telecommunications administration. It is important that the administrations should be aware of our wishes now while policies are still being formulated. To delay until the Space Conference is imminent could be disastrous. As a follow-up to the Brussels Conference there will be a meeting of all Region 1 vhf managers at Brussels on 1–2 May when space communication policy will be the main agenda item. This co-ordination of approach is not confined to Region 1 and there is close liaison with the Wireless Institute of Australia (representing Region 3) and IARU headquarters.

What arguments can be advanced to support the retention of existing frequencies and the acquisition of additional facilities? There could be many talking points, but finally they can all be condensed into the vital question—what use is the amateur service making of the bands at its disposal? The many and vital contributions made by amateurs to the science of radio communication are too well known to need repetition here. Can we now be sure that existing users of our bands are doing equally valuable work? The writer would need some convincing to register an unqualified yes. The radio frequency spectrum is exceedingly crowded and space is at a premium. If we expect to be allowed to continue our present occupation then it must be seen that the work carried on by amateurs is of value not only to themselves but to the remainder of the radio communication community.

At the present day the amateur may not easily make progress in new fields. There are, however, projects in which the amateur organizations can have considerable advantages, and propagation research is one such area. Controlled observation and reporting can produce valuable results and, indeed, the CCIR has already accepted material from the Society which was subsequently embodied in a technical report of ESSA. The effect of the aurora on radio communication and the investigation of the several types of E-layer propagation are two further instances where member participation would be invaluable. However, with the exception of a handful of members, these Society activities attract little support. One learns, with regret, that the number of reports received of the reception of Australis-Oscar 5 from the UK is proportionally very small when compared with other Region 1 countries, notably those in Scandinavia. Oscar 6 will deserve better support. The World Amateur Beacon Plan, launched at Brussels last year, is making slow but steady progress. The rate of progress is not due to any lack of enthusiasm but beacon projects obviously require both money and time. The stations established in accordance with the WAB will provide unique opportunities for observations over widely different paths. Who but the stations of the amateur service can provide not three or four, but 300 or 400, potential observers. When there is the possibility of participation in scientific projects, in addition to normal occupancy of the amateur bands, led us not overlook that these activities can help to ensure the future of our allocations.

The amateur service has no *right* to any frequencies. If we do not make good and proper use of our bands then our future tenancy will be in jeopardy. Let us heed the warnings while there is still time.

R. F. S.

QTC AMATEUR RADIO NEWS

European Conservation Year

During 1970 a number of countries under the guidance of the Council of Europe are making an effort to get people to care more for their environment. The aim of ECY 1970 is to agree on policies to conserve and improve the environment and to devise the best ways to implement them. As many members will be aware there is considerable pollution of the radio frequency environment and on the suggestion of Mr E. M. Wagner, G3BID, the following letter was sent on 30 January 1970 to the ECY 1970 secretariat.

The ECY 1970 Secretariat
The Nature Conservancy
19 Belgrave Square
London SW1

Environmental Pollution

We have studied the pamphlet "European Conservation Year" with great interest and note the interest which is at last being taken in preventing pollution of our environment in every form.

We note the conferences being organized to try and deal with the problems of water pollution, air pollution, land dereliction and pollution from pesticides and fertilisers.

We referred above to preventing pollution of our environment in every form, but we notice in the pamphlet, and as far as we have been able to ascertain in all other articles on this subject, one important omission. No mention appears to have been made of pollution of the radio frequency spectrum.

As you can see from the title of this Society, it is, of course, largely interested in the radio frequency spectrum and we, and many others, have noted the growing pollution of this part of our environment.

Because the radio frequency spectrum cannot be seen or smelt it does, nevertheless, form an integral part of our environment. Its destruction by pollution would have a very serious effect on life as we know it. Not only would national and commercial communications suffer, but it would have a disastrous effect on the leisure aspect of our lives, which the pamphlet "European Conservation Year" so wisely stresses. As the pamphlet points out, nine per cent of our national income is spent on recreation, and this is likely to increase.

The pollution of the radio frequency spectrum would have serious effects on television and sound broadcast reception, which today forms an important part of many millions of people's leisure, as well as on the more active and positive activities of amateur radio, model control and many other leisure pursuits.

It is therefore surprising to see that this aspect of environmental pollution has apparently been ignored by the various bodies now so earnestly engaged in trying to preserve our environment and in reducing pollution.

Pollution of the radio frequency spectrum arises from many sources such as contact devices, electric motors, overhead power lines and electric fences, especially when such devices are either badly designed or, more frequently, suffer from lack of adequate maintenance. Almost all these devices can be designed to cause no measurable pollution provided they are adequately maintained.

We are therefore writing to ask that the pollution of the radio frequency spectrum be included in the studies now being made of our environmental pollution and steps be taken to reduce this menace.

Northern Radio Societies' Annual Convention

On 26 April the Northern Radio Societies Association is again holding its Annual Convention and Exhibition in the joint Cumberland-Kendal suites, Belle Vue, Manchester.

Belle Vue is within easy reach of the city centre of Manchester, and is situated along Hyde Road a few hundred yards from the Ardwick Green roundabout. The roundabout is within 200 yards of the Mancunian Way.

The exhibition will be located in the North's biggest showground, with entertainments for the whole family, including a well-stocked zoo. Its doors will open at 10am bst, and among the attractions are: stands of topical interest by the member societies; Boy Scouts demonstration; RAEN mobile unit; many trade stands; film shows at regular intervals throughout the day; a demonstration station operating on the hf bands using all the latest gear and test equipment; BATC; and many others.

All are welcome. Refreshments will be available at a nominal charge, and a bar will be available for the thirsty.

Talk-in stations will be operating on 160m, 4m and 2m throughout the day, using the callsign GB2BVC.

Operation from small coastal vessels

Following the increase in the number of small sailing vessels used for recreational purposes the Society would be glad to hear from any owners of such vessels who would avail themselves of any operating facilities that might be arranged. Interested persons should write to Society headquarters giving details of their vessel, name and call.

Tvi groups

Amateurs living in the Wirral and South Wales are fortunate in having help near at hand when faced with tvi. G2AMV and GW3RWX have for some time now been helping amateurs in their regions with tvi problems.

Tvi groups have recently been formed to help members in Bristol, Echelford, Gravesend, Northampton, Peterborough and Swindon, and as from 1 April Scotland is setting up its own organization. There may well be other groups doing this very useful job who have not made themselves known. Secretaries are invited to write to G3XIW so that they can be included in the tvi mailing list.

If you live in any of these places and need help you should contact: G3XPJ in Bristol, G3TDR in Echelford, G3WAP in Gravesend, G3XJJ in Northampton, G3KPO in Peterborough, G3SIR in Swindon. They may not be able to help you personally but will probably be able to tell you who can.

By the way, all these good folk are, as usual, unpaid volunteers. so please do not abuse their generosity.

"Scientific Studies Bulletin"

This bulletin is published monthly and compiled by Ray Flavell, G3LTP. It contains a daily record of ionospheric and solar events together with details of beacon stations and reception reports. It is available without charge to Society members who are interested in the work of the Scientific Studies Committee and who are willing to provide reports on the various beacon stations in Region 1, particularly those operating on the 28 MHz band and forming part of the WAB network. Requests for the bulletin should be sent to the chairman of the Scientific Studies Committee, G. M. C. Stone, G3FZL, c/o Society headquarters.

USA licensing

The FCC has recently announced alterations to the amateur licensing rules to take effect from 23 March 1970. These allow an applicant for an extra class licence to take account of experience gained with a foreign licence when determining the two-year waiting period. Also, similar experience may be taken into account when considering applications for two-letter callsigns. This information comes from D. R. Hearsum, W8LUZ, President of the Ex-G Club, who submitted petitions to the FCC in May 1968 for such action.

Can you help?

Mr H. A. J. Gray, BRS23279/ISWL G12022, 11 Swanton Drive, East Dereham, Norfolk, wants the present address of Verloc Ltd which had an address in London N1 "many moons" ago. They marketed a lightning switch under patent applied for number 20982, and he wishes to obtain at least the two silver steel rotating connectors. He would be glad to hear from anyone who can supply these parts or a complete switch.

Mr C. J. Leal, G3ISX, 116 Bedonwell Road, Bexleyheath, Kent, wants information on the Minimitter version of the G4ZU Mini beam for 10 and 15 only. It is required for an overseas amateur who has lost part of the beam in transit.

RAE course at Oxford

Mr F. A. Blake has been advised by the Oxford College of Further Education that it will be pleased to run an RAE course if 12 entrants can be obtained. So far he has obtained the names of nine prospective pupils and he would be pleased to hear from any person of any age who would like to take an RAE course at Oxford. His address is "Fourfield," Lashford Lane, Dry Sandford, Abingdon, Bucks.

Unlicensed transmissions

Headquarters frequently receives reports of the many unlicensed stations that are now active around 6·5MHz. This activity is already the subject of representations to the Ministry of P & T, and such steps as the Society were able to take were implemented some considerable time ago. Members will no doubt have seen reports of court convictions for unlicensed activity and will have noted the heavy fines imposed in a number of cases.

World Telecommunication Day

The International Telecommunication Union has named 17 May 1970 as the second World Telecommunication Day. This year the theme is *telecommunications and education*. Special activity stations **GB2ITU** and **GB3ITU** will be operated on behalf of the RSGB. If conditions are suitable it is intended to cover all hf bands. **4U7ITU** will be active from ITU headquarters at Geneva.

Sender, please write

RSGB HQ has received a remittance for £2 10s from Staveley, near Kendal, Westmorland. Will the sender kindly identify himself so that the money can be credited correctly.

RAIBC calling all travellers

The Radio Amateur Invalid and Bedfast Club has a number of receivers which have to be moved to various parts of the country. For example:

From Gillingham, Kent; London and Stroud to Wigan; RAF Upavon to Cwmbran, S. Wales, and Angelsey; Minehead to Camelford, Cornwall.

The club would be most grateful if travellers who are willing to transport equipment would contact the hon. secretary, Mrs F. E. Woolley, 331 Wigan Lane, Wigan, Lancs, for details.

STAFF VACANCY

A vacancy exists at Society headquarters for an administrative assistant able to deal with correspondence and general queries from the membership.

Applicants, who must be licensed amateurs, should phone or write to:

The General Manager, RSGB, 35 Doughty Street, London WC1N 2AE.
Tel 01-837 8688.

RSGB Lecture

Radio research into propagation and radio meteorology

will be the subject of a lecture by

Dr J. A. Saxton, DSc, CEng, FIEE, FInstP,
President of the Radio Society of Great Britain

on 20 May 1970

at the Institution of Electrical Engineers, Savoy Place, London WC2.

Buffet tea 6pm Lecture 6.30pm

Members who will be attending this lecture are requested to advise Society HQ so that necessary catering arrangements can be made.

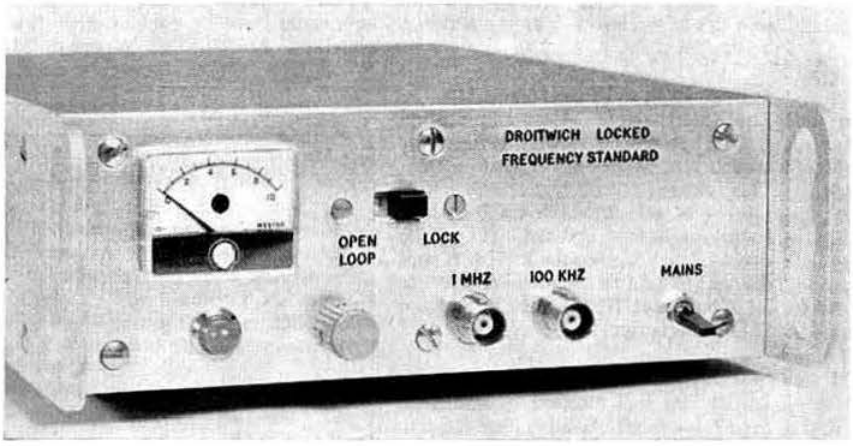
RSGB Show, 1970

The date of this year's International Radio Engineering and Communications Exhibition, better known to members as the RSGB Show, has, of necessity, had to be brought forward to August from the usual date in early October.

It will take place from **19 to 22 August** at the same venue as last year: The Royal Horticultural Society's New Hall, Greycoat Street, Westminster, London SW1.

More details will be given in future issues of *Radio Communication*.

A Droitwich-locked frequency standard



by
D. H. GUEST,
GM3TFY*

THE BBC transmitter at Droitwich on 200kHz has long been used as a frequency standard for the adjustment of crystal calibrators. The accuracy of the frequency has been steadily improved until it is now in the order of ± 2 parts in 10^{11}, and almost as good as that available in the world's standards laboratories from Caesium and Rubidium "atomic" beam standards. Some of the higher frequency standard transmissions, such as MSF and WWV, suffer from slight inaccuracies due to sky-wave doppler shifting of the transmitted signal if the listener is far from the transmitter. This doppler shift is likely to be less noticeable on the Droitwich signal since it will probably be received by ground-wave in most parts of the UK.

Such concern about accuracy of frequency measurement may seem to be of only academic interest to most amateurs, and admittedly at the present time it probably is. However, it should be borne in mind that our requirements for frequency measurement have become increasingly more exacting in recent years, and it would seem that as our experiments become more ambitious, so will our needs in the frequency measurement field.

This article describes a means of phase-locking a local quartz crystal oscillator to the Droitwich carrier frequency, and hence achieving (in the long-term at least) a local frequency standard of comparable accuracy to that of Droitwich. Obviously, if phase lock is not lost, the error will be zero if one is prepared to average the instantaneous error over a long enough period. In practice one is interested in short-term accuracy as well, and precautions have to be taken in the design of the phase-locked loop in order to ensure that short-term fluctuations of the oscillator from its mean frequency are reduced as much as possible. Listening to the author's oscillator harmonics in the 144MHz band, it has been noted that not more than about one and a half cycles are slipped (against an oven-controlled oscillator adjusted to "zero" beat with it) in any one-second period. This means that the frequency error in the phase-locked oscillator is a maximum of about ± 1 part in 10^8, averaged over one second. Averaged over a longer period, the accuracy would (apparently) be better. It is possible that in a stronger signal area than the author's QTH the performance may be better. Some small improvement can be effected by altering a time constant in the design, if desired, although this can be done only at the expense of increasing the likelihood of losing lock.

Principles of operation

The block diagram of the system is shown in Fig 1, and it will be seen that a number of additional facilities have been included which are not basic to the control loop.

The received signal from Droitwich is amplified at 200kHz in a tuned amplifier similar to that found in an i.f. strip. The output, at an amplitude of several volts, is applied to a Schmitt trigger circuit which provides a square-wave output at carrier frequency. The Droitwich signal modulation peaks appear to modulate the carrier to very nearly 100 per cent on occasions, and this is unfortunate because it makes complete removal of the effects of the modulation rather difficult. However, this is largely the purpose of the control loop.

* 4 Addiston Grove, Balerno, Midlothian

The signal which is phase locked is derived from a 1MHz crystal oscillator which can be pulled above and below its nominal frequency (by about 20Hz) by a voltage applied to a variable capacitance diode. The 1MHz signal is then passed through a buffer amplifier and squared in a Schmitt trigger. A pulse output at 1MHz is provided at a low impedance by an emitter-follower stage. The Schmitt trigger also drives a frequency divider of the step-counter charge-storage variety which gives a pulse output at 200kHz, and this is used to trigger a monostable multivibrator adjusted to give a 1:1 mark/space ratio.

The 200kHz signal from Droitwich and the nominal 200kHz signal from the monostable are fed to a phase-comparator circuit which gives a voltage output approximately proportional to the phase difference between the two signals. The phase comparator is essentially a diode AND gate, with its pulse output smoothed to give the mean dc level. This level operates a dc amplifier which drives a panel meter, giving the operator an immediate and very useful visual indication of the relative phase difference between the internal signal and Droitwich. Thus, correct operation of the equipment can be verified at a glance. Under open-loop or unlocked conditions the meter needle moves slowly up and down as the phase varies, and under closed-loop or phase-locked conditions the reading will remain steady.

Since the phase comparison is accomplished in a simple diode AND gate, the mean voltage output level will reach a maximum of only half the supply voltage if the input waveforms are square, and in order to increase the voltage swing the output is amplified by two in a single transistor dc amplifier. This dc level is fed through a very long time-constant RC filter before being fed back to control the frequency of the crystal oscillator, and thus completing the control-loop. Much of the performance of the equipment depends on the gain and phase response of this RC filter, and more will be said about this later. Some manual control of the frequency is provided by a front-panel potentiometer which allows the oscillator to be adjusted almost to zero beat with Droitwich before closing the phase-lock loop.

To provide an additional output at 100kHz, the output of the monostable at 200kHz is frequency-divided by two in a bistable circuit, with an emitter follower to provide a low impedance output.

The equipment is supplied by a series-stabilized and smoothed 12V mains power supply, using a differential amplifier to compare the output voltage with a zener-diode reference level.

Characteristics of the control loop

The salient parts of the control loop are the reference signal provided by Droitwich, the voltage-controlled oscillator, the phase comparator which compares these two, and the low-pass filter between the phase comparator and the oscillator.

Unfortunately, the reference signal at 200kHz will be contaminated to some extent by phase and/or amplitude jitter caused by remaining traces of modulation and perhaps interfering signals in areas of weak signal strength. If the reference was completely pure, then there would be no point in having the control loop at all! The control loop must be designed so that the oscillator frequency and phase follow long-term trends in the reference, but not any of the transient fluctuations which may occur. If this can be achieved, then the short-term accuracy of the oscillator will be almost as good as its long-term performance. In practice, this ideal may be approached by having an RC low-pass filter in the voltage feedback path to the oscillator. Care must be taken here, however.

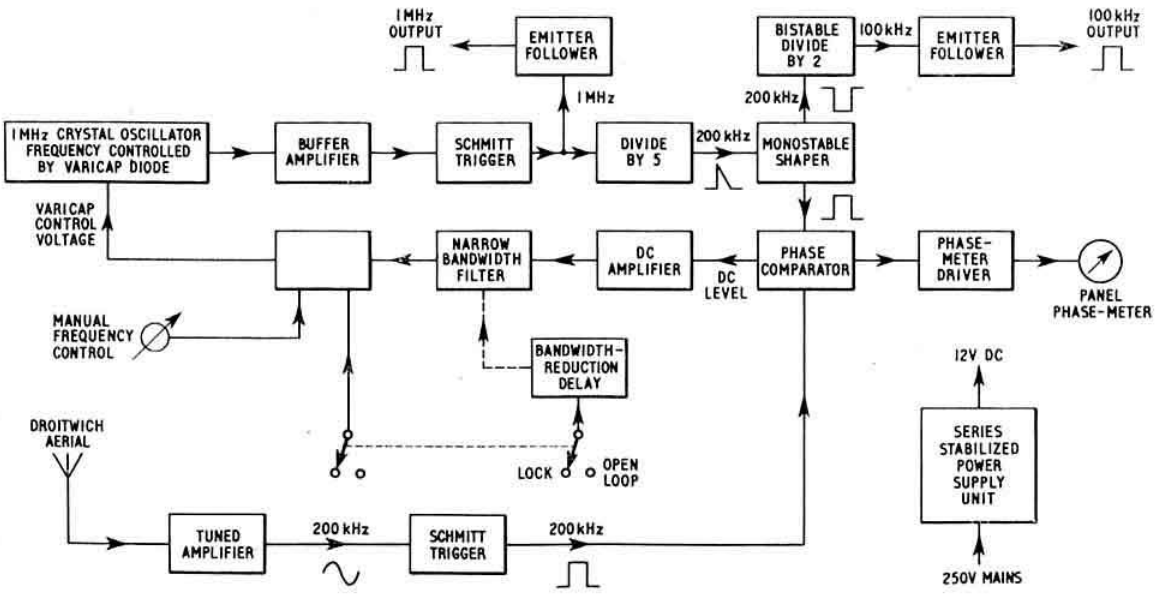


Fig 1. Block diagram

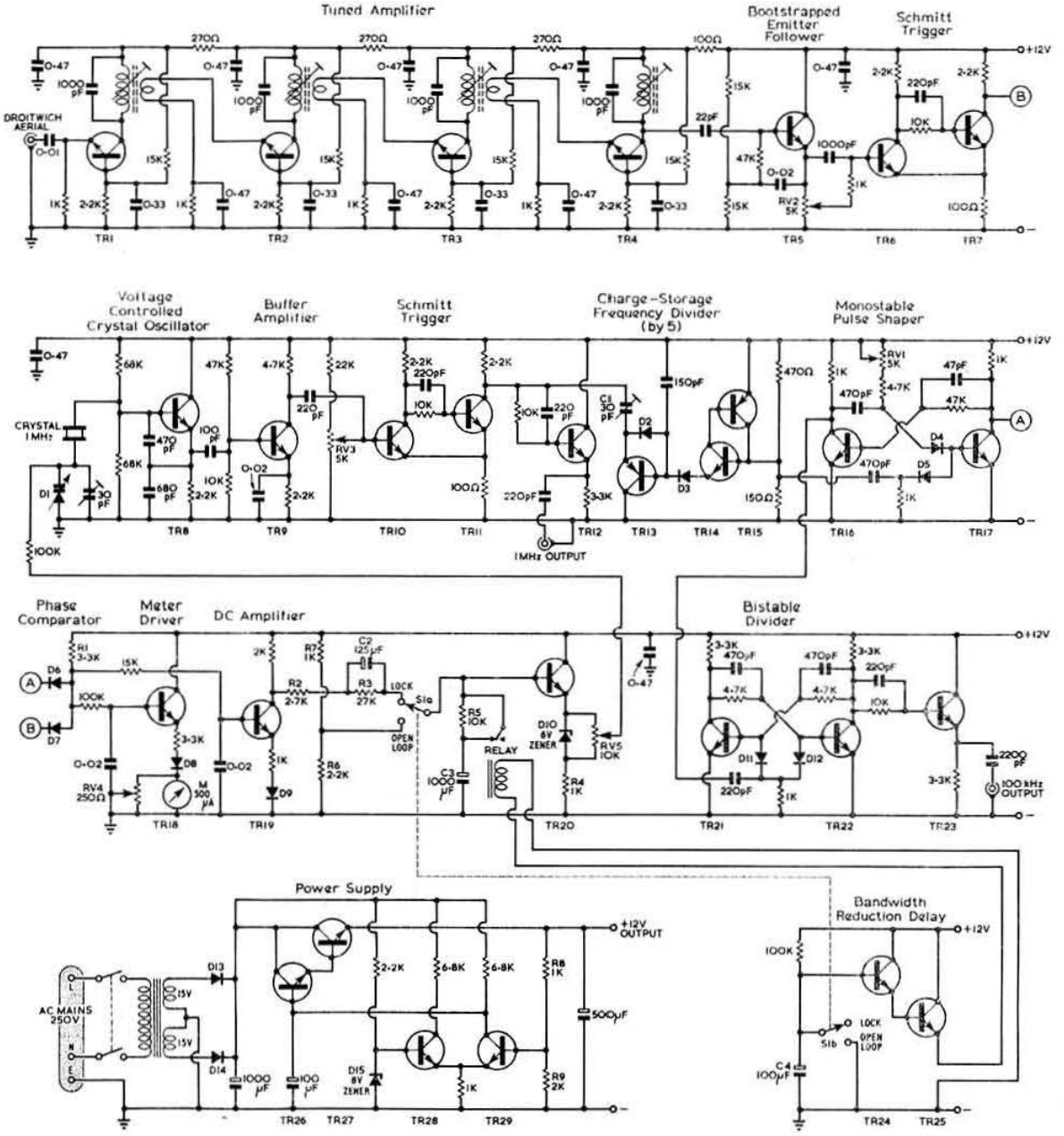


Fig 2. Circuit diagram (Note. The resistor in the emitter circuits of TR28 and TR29 should be 3·3k not 1k)

It might be thought that a simple RC integrating time constant, with a very large RC product, would do the trick—and as far as frequency response is concerned it does. However, its phase response is such that it introduces a phase lag of almost 90° into the feedback path, if the time constant is large. Now, there already exists another 90° phase lag in the control loop, although it is not so easily recognized. This is introduced by the voltage-controlled oscillator. The phase difference seen by the phase comparator will be the time integral of the error voltage applied to the voltage-controlled oscillator, and inherent in this integration is a phase lag of 90°. The combination of these two lags means that the negative feedback correction signal which we thought we had, is now in fact almost a positive one! The

system will not in fact go into uncontrolled oscillation, but if the equilibrium of the system is momentarily disturbed, the phase of the oscillator will go into a slow and lightly damped oscillation, taking a long while to settle down to static equilibrium again. Provided the disturbance was not too violent, however, the oscillator should not lose phase lock. It is desirable that the effects of any disturbance like this should die away as rapidly as possible, and for this reason an additional phase advance is introduced into the filter, at the control system's natural frequency, in order to damp the response.

If, at the moment of attempting lock, the error in the oscillator is large in comparison with the bandwidth of the loop, then it will not be possible to obtain lock, and for this reason it is a good idea to delay the reduction of the bandwidth of the filter until a short while after the front-panel switch has been thrown into the "lock" position. To remove the need for operator intervention, this is done automatically in the author's instrument by a reed relay closing, after a delay caused by a capacitor charging up. This refinement is not strictly necessary, since lock can still be achieved with a narrow bandwidth if the manual frequency control is adjusted carefully.

Circuit details

The circuit used by the author is shown in Fig 2. It is not anticipated that many constructors will wish to build an identical unit, since most people like to incorporate their own ideas into things they build, but parts of the circuit may be of interest. It should be pointed out that in the author's case the circuit grew and was tested stage by stage, and for this reason there are many places where simplification is possible when the circuit is viewed as a composite unit. For the home-constructor the author does not believe that this is much of a disadvantage since almost invariably the time spent building the unit is much more valuable than the cost of a few components—which may have come from the junk box anyway.

Fairly narrow bandwidth amplification of the 200kHz Droitwich signal is achieved in four stages of common-base tuned amplifier. This configuration was chosen in the hope that neutralization would not be necessary, and because the high collector output impedance has very little effect on the Q of the tuned circuits, thus keeping the bandwidth of the amplifier as narrow as possible. It is not vital that the bandwidth be very narrow, but this is desirable. The tuned circuit inductances were wound on LA2500 "Vinkor" pot-cores, giving an unloaded Q of about 150. Many other types of pot-core (suitable for the frequency) may be used, including, possibly, modified i.f. transformers. It seems likely that the LA2505 core will be capable of giving a higher Q than the LA2500, and this may be used in preference. 65 turns of wire will be required with either core, with 1½ turns to couple into the next stage. Enamelled wire of 30 swg is suitable.

If it is desired to use cores which have unknown characteristics, the arrangement shown in Fig 3 may be used to test the tuned circuits for correct resonant frequency and to measure the Q at the resonant frequency.

Monitor the voltage e_2 with a high impedance rf voltmeter (or an oscilloscope), and adjust the frequency of the signal generator until there is a large peak in e_2, indicating the resonant frequency of tuned circuit. Keeping at resonance, measure both e_1 and e_2. It is only the ratio of e_1 to e_2

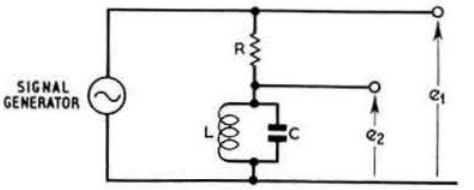


Fig 3.

which is important, so the absolute accuracy of the measuring device is not important. (The value of R should be adjusted in order to make e_1 in the region of twice e_2, for the best accuracy to be obtained). The Q of the tuned circuit (at this frequency) is given by:

$$Q = \frac{2\pi f\,CR}{\left[\frac{e_1}{e_2} - 1\right]}$$

C should be the same value as that to be used in the circuit. (1000pf in this case). Care should be taken to ensure that the voltmeter does not introduce appreciable additional capacitance across the tuned circuit.

The output of the final tuned amplifier stage is converted to a low impedance by an emitter-follower stage, which is boot-strapped to prevent the bias resistors loading the tuned circuit. (A fet source-follower could perhaps be used here instead). A Schmitt trigger circuit squares the waveform and gives an output voltage swing of nearly 12V. Since the Droitwich signal is quite deeply modulated at times, it is important that the carrier should produce a normal voltage swing of several volts at the collector of TR4 for correct operation of the Schmitt trigger.

Variation of the frequency of the crystal-oscillator is produced by the voltage on the variable-capacitance diode (D1), and the trimmer in parallel with it should be adjusted so that the frequency is exactly 1MHz when the voltage on the diode is about 5V. This means that a voltage swing of 0 to 12V will produce a corresponding frequency deviation of from —20 to +20Hz, approximately. Because of the way the capacitance of the diode varies with voltage, the frequency deviation produced by the diode will not bear a quite linear relationship to the applied voltage, but this is not important in this application. A special-purpose variable capacitance diode such as the BA111 could be used, but the author has found that small silicon power diodes perform very well. The important point is to ensure that a frequency swing of at least plus or minus 20Hz can be achieved. There is no reason why two diodes in parallel could not be used if necessary.

Buffer amplifier TR9 drives a Schmitt trigger (TR10 and TR11), and the 1MHz output from the unit is taken from the emitter follower (TR12). TR13, TR14 and TR15 form the charge-storage step-counter frequency divider, details of which can be found in Reference (1). Trimmer capacitor C1 should be adjusted so that the circuit divides reliably by five. This can be checked by listening on a receiver to see that "pips" occur only at 200kHz intervals, or alternatively the period of the waveform on the collector

of TR15 can be monitored on an oscilloscope. Negative-going transitions on this collector trigger the monostable (TR16 and TR17), which should have its pulse period adjusted by VR1 to give a mark/space ratio of one to one. Diode D4 prevents reverse base-emitter breakdown of TR17 altering the predicted pulse period. This is a very common reason for the malfunction of multivibrators.

The phase of the pulses on the collectors of TR7 and TR17 is compared in the phase comparator which is essentially the AND gate comprised of D6, D7 and R1. TR18 monitors the mean voltage level on the anodes of the diodes and operates the 500μA "phase" meter. VR4 should be adjusted to give full-scale deflection when the voltages are in phase. TR19 amplifies the mean dc level on the anodes of the diodes (by 2) to give a voltage swing of almost 12V for subsequent application to the variable capacitance diode. The 0.6V drop across silicon diodes D8 and D9 improves the voltage and current swings obtainable, and counteracts the effects of imperfections in the waveforms applied to the AND gate.

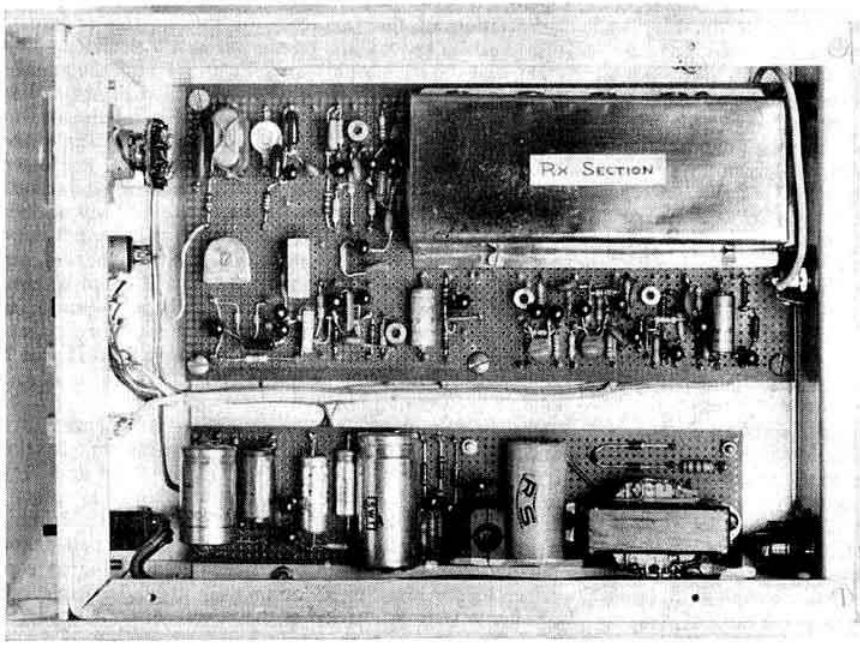
The low-pass filter is comprised principally of R2, R3, R4, C2 and C3. Under open-loop conditions, the voltage applied to the variable capacitance diode is dependent on the potential divider R6 and R7, and the setting of the front panel frequency control VR5. Prior to switching to "lock", this control should be adjusted until the beat of the phase-meter needle indicates that the internally generated "200kHz" is within about 2Hz of Droitwich. When switched to "open loop" the base of TR24 is grounded and the relay contacts held open, thus effectively open-circuiting C3. Upon switching to "lock", the relay contacts will remain open until C4 has charged up. This means that while C3 is effectively out of circuit, the bandwidth is comparatively wide, ensuring that lock is easily found. A short time after locking, the bandwidth is reduced to give the instrument its good short-term frequency accuracy. This delay provision may be omitted if desired, since lock can be obtained even under narrow bandwidth conditions provided that VR5 is adjusted carefully enough.

Negative-going transitions on the monostable collector TR16 trigger the bistable frequency divider (TR21 and TR22) and the 100kHz pulse output is taken from the emitter follower TR23. If a 100kHz output is not desired then this section may be omitted.

Power for the instrument is provided by a conventional series-stabilized power supply in which the series element is TR27. The output voltage is dependent on the 8V zener diode and the potential divider R8 and R9. If a diode of other than 8V is used, then the ratio of R8 to R9 may be adjusted to give 12V output from the supply.

Component notes

Almost all of the transistors may be of a type intended for high-speed pulse switching, with a few provisions. There are dozens of suitable ones currently being advertised on the surplus market and it should be possible to obtain these at very low cost. TRs 1, 2, 3 and 4 should have an h_{fe} of about 100, otherwise enough gain may not be obtained in the tuned amplifier. Trs 5, 16, 17, 18, 19, 20, 24 and 25 should have as high an h_{fe} as possible, and preferably greater than 100. A simple dc current gain test will be good enough to check that the small signal current gain is adequate. Note that all the transistors are npn except TR13 and TR15 which are pnp. The series-stabilizing transistor TR27 should be capable of dissipating about 1W. A 2N3053 with heat-sink would be suitable. All the transistors should



Internal layout

be silicon, since in a few positions leakage current could mar the performance.

Diodes D13 and D14 may be any silicon rectifier diodes with a piv of 50V or more. Except for the two zeners, all the other diodes may be almost any silicon small-signal high-speed switching diodes, such as the 1N914 or 1N916.

Take care that electrolytic capacitors C3 and C4 are not leaky.

The reed relay should be capable of operating on about 10V and should have a resistance of about 1kΩ.

Checking the control loop

It is unfortunate that the instrument cannot very easily be checked for correct operation without an oscilloscope, since it depends largely on pulse circuits. The stages should be checked for correct operation and adjustment in logical order. The tuned amplifier should be peaked "on the nose" for maximum output on the collector of TR4. In the author's QTH, several volts' swing can be obtained with a few feet of wire as an antenna.

If everything is functioning correctly, the phase meter should move slowly up and down, with switch S1 in the "open-loop" position, indicating that the internal "200kHz" signal is going in and out of phase with Droitwich. It should be possible to adjust the oscillator a few Hz either side of "zero beat" with VR5. If the beat is less than about 2 or 3Hz, then closure of the switch S1 to the "lock" position should bring the meter needle to a standstill somewhere near the middle of the scale, indicating phase lock. After about 20 seconds the relay should close, reducing the bandwidth of the loop.

The exact performance of the control loop will depend to some extent on particular circuit constants, such as the gain of TR20 and the voltage-to-frequency-deviation gain achieved in the voltage-controlled oscillator. With C2 removed from circuit it will be noticed that if the control system is suddenly disturbed, such as by a slight adjustment of VR5, then the resultant slow oscillation in phase takes a long while to die away. In other words, the system is lightly damped. The damping can be altered by changing the value of C2. The best arrangement is to allow a phase overshoot of about 20 per cent after a disturbance. The undamped natural frequency of the loop should be in the order of 0.07Hz. The short-term accuracy of the phase-locked output will be improved if the value of C3 is increased; but C2 will need to be increased also, to maintain the same damping factor. There is a limit to the amount of increase, however, since as the natural period becomes longer there will be an increased tendency for a disturbance to push the oscillator out of lock.

Some things to watch

Care should be taken with the lay-out of the tuned amplifier since it provides a very high gain, and instability could easily occur. Some screening solved this problem in the author's case, but it is recommended that the amplifier be put in a metal box with the input and first stage well screened from the rest. It is also important to ensure that none of the internally-generated 200kHz finds its way into the front-end of the amplifier, otherwise the instrument may try to lock on to itself instead of Droitwich. This condition is quite easily recognized since the phase-meter needle will refuse to move up and down under open-loop conditions. Remember that the 100kHz output will contain its second harmonic, so this could also give trouble if it is brought near to the aerial. The use of ordinary co-axial leads will prevent any trouble external to the instrument.

Conclusions

The unit would appear to be able to give an accuracy of at least 1 part in 10^8, with the error averaged over one second, even at a range of some 300 miles from the transmitter.

Harmonics of both the 1MHz and 100kHz outputs are easily audible in the 144MHz band, and this is not surprising since even a mediocre modern pulse-switching transistor can provide a collector fall time of better than 20 nanoseconds, in the simplest of bistable or Schmitt trigger circuits, thus giving a rich harmonic spectrum.

The circuit can undoubtedly be simplified, and if tackling the problem again the author would be inclined to do much of the pulse-switching circuits with integrated circuits. The author knows that the optimum performance has probably not been obtained from most of the circuits, but this is not of great consequence.

If an off-air standard is required to give a 24-hour service, then Droitwich is of no use because the transmitter closes down for a few hours during the night. A possible alternative is the 60kHz MSF transmission, although this will probably not be as strong a signal.

Reference

(1) "The G3LQR Crystal Calibrator" (G3LQR)
RSGB Bulletin December 1965.

The RSGB News Bulletin Service

Every Sunday morning the RSGB News Bulletin, GB2RS, is broadcast. This news bulletin can be received on either vhf or hf, which gives almost complete coverage of the British Isles. It keeps radio amateurs informed about the latest happenings in the world of amateur radio and gives notice of future events.

The schedule for the RSGB News Bulletin is as follows:

Time (bst)	Frequency (MHz)	Location of station
0930	3·6	SE England
1000	3·6	Severn area
	145·1	SE England (beaming N)
	145·8	Aberdeen (beaming W)
1015	145·8	Belfast
	145·8	Belfast (beaming S)
1030	3·6	N Midlands
	145·8	Aberdeen (beaming SW)
	145·3	Birmingham area (beaming NW)
1100	3·6	NW England
	145·3	Birmingham area (beaming SW)
1130	3·6	SW Scotland
	145·5	Leeds (beaming N)
1200	3·6	NE Scotland
	145·5	Leeds (beaming E)

Exhibitions—Beacons—Conventions—Contests—Local events Rallies — Scientific projects — Meetings — Licensing — Clubs Propagation reports—Lectures—Field days—Expeditions

LIVING WITH SILICON

A survey of linear integrated circuits and their applications

by P. G. Martin, BSc, G3PDM*

Introduction

Silicon technology has emerged from an initial period of novelty into the current realization that against circuit integration, discrete transistor systems cannot be competitive. Superior performance, higher reliability and now lower costs have led to the possibility of communications equipment built almost entirely of integrated circuits. This survey is concerned primarily with low-cost linear ICs having potential usefulness in the amateur radio field.

The cost of an integrated circuit is related to the size of the minute chip of silicon into which the transistors, diodes, resistors and capacitors are diffused. Improvements in processing tolerances have allowed high circuit complexity on small chips, while new circuit design techniques reduce the number of ic package leads needed. Present day state-of-the-art is best illustrated by the National Semiconductor Corporation LM373, the most complex communications microcircuit currently available†. A standard 10-lead package houses four rf/i.f. amplifier stages, a wide range agc circuit, a detector for cw, ssb or fm, and a separate detector for agc and a.m. The circuit also performs well as a mixer, ssb balanced modulator with self-contained cio and alc, or as an amplitude-controlled oscillator. Most of the stages of the circuit are balanced: the multi-mode detector is double-balanced.

Survey outline

The survey is broken down into sections according to circuit functions, and each section contains a representative list of types available, with their main characteristics, and a discussion of some aspects of circuit design. In selecting ICs for inclusion in the tables, the author has avoided, where possible, devices costing more than £3: most of the circuits are priced at 10s to £2. Many manufacturers offer ICs of the same basic type, but graded according to detailed specifications. In most cases the units with the loosest specifications are entirely satisfactory for amateur purposes, and they are normally many times cheaper.

Further simplification of the tables was made possible by some popular circuits being marketed by several firms. In such cases the more expensive varieties have been omitted.

Prices quoted are manufacturers' one-off prices, and are correct at the time of going to press. Price variations are announced by one manufacturer or another on average once a fortnight, but the present trend is for prices to be reduced. Some sources of supply are also listed, as most manufacturers do not handle small orders direct. None of the distributors listed have shown reluctance to supply amateurs with small quantities of ICs, and those who expressed definite enthusiasm are appropriately marked.

Space does not permit listing in the tables all the information on the data sheets of the ICs described. The main aim of the survey is to provide sufficient information for a tentative

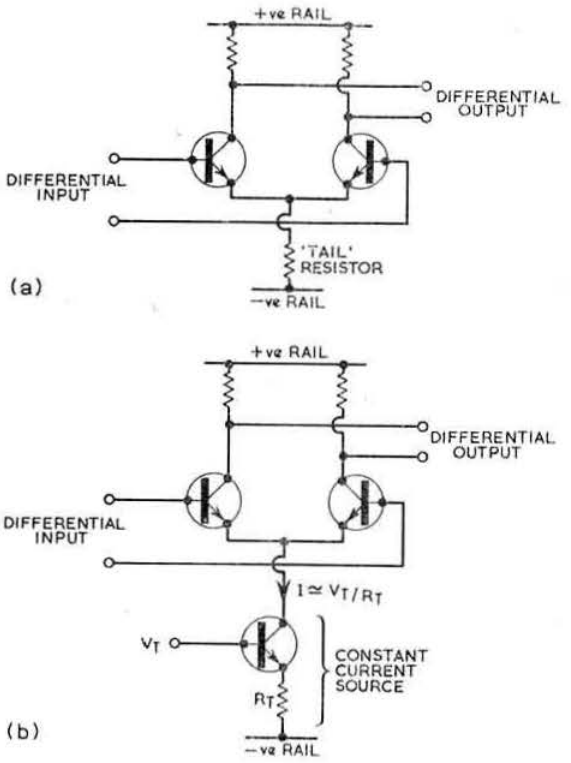


Fig 1. (a) Basic long-tailed pair circuit with differential input and output; (b) Long-tailed pair with constant current source to improve common-mode rejection and circuit flexibility

* Oak Cottage, Witton Gilbert, Durham.
† Not on sale in the UK until May or June 1970.

choice to be made when planning new equipment. Full data sheets are of course available from manufacturers and distributors.

Circuit parameters given in the tables are variously minimum, typical or maximum values, but figures in any one column are consistent in form. The list of symbols used indicates how the various characteristics are presented.

The long-tailed pair

One of the advantages of integrated circuit processing is the close matching achieved between diodes and transistors on the same silicon chip. This feature suggests the use of the long-tailed pair* circuit for a wide range of circuit functions, and few linear ICs are made without exploiting the properties of this configuration.

The basic ltp circuit is shown in Fig 1(a). Its most important property is that in the ideal case the differential output taken across the collectors depends only on the *difference* between the voltages applied to the two bases. Thus a differential (push-pull) input signal is amplified, whereas a signal appearing equally on both inputs (common mode signal) is rejected. Common mode rejection of the basic circuit is 30–50dB in practice, depending on transistor matching and some circuit values. If the tail resistor is replaced by a constant-current source as in Fig 1(b) this figure can be improved to 60–100dB.

The constant current tail also adds versatility to the circuit, which will perform as agc stage, mixer, product detector, balanced modulator, etc. In these applications, signals are applied to the base of the tail transistor and the sympathetic changes in tail current are shared between the differential transistors according to their relative base voltages.

RF AND IF AMPLIFIERS

Table 1 divides rf and i.f. amplifiers into two groups: circuits with and without built-in detectors or demodulators. All circuits contain the transistors, diodes and resistors necessary for making up a practical high frequency amplifier, but exclude tuned circuits. Some circuits require external supply-line bypass capacitors, but others include simple voltage stabilizer circuits. The ICs are also characterized by the output circuit details: the collector of the final stage may include a load resistance or may be left open circuit for an external load such as a tuned circuit.

Of the basic circuits without demodulators, the RCA and National Semiconductor devices are based on a single long-tailed pair with constant current tail. The remaining circuits are complex, consisting of special agc stages and more than one gain stage. Exceptions are the Mullard TAA350, which is a limiting i.f. amplifier for fm made up of several cascaded long-tailed pairs without agc.

Fig 2 shows the National Semiconductor LM371 connected for agc action, for differential and cascode configurations. The mutual conductance of the differential amplifier depends linearly on the tail current, so agc action is obtained by externally varying the bias chain current. Because of monolithic matching, the tail current is approximately equal to the bias chain current.

In the cascode case, signals are applied to the tail transistor, and for full gain V_{agc} is held below the bias on the output

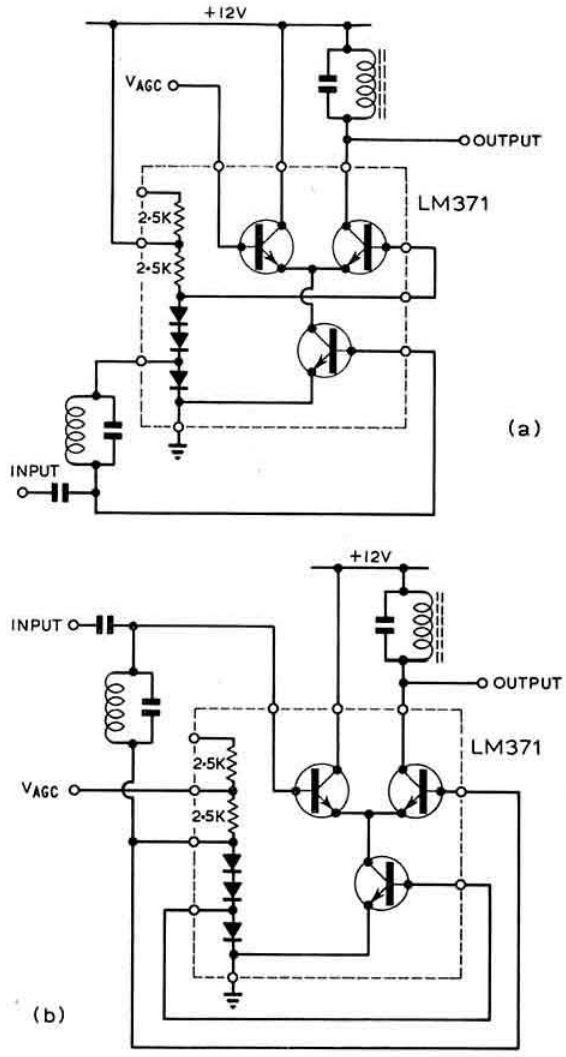


Fig 2. (a) National Semiconductor LM371 rf/i.f. amp connected for cascode operation with agc; (b) LM371 connected for differential operation with agc

transistor, which therefore passes all the dc and signal currents. The circuit acts as a conventional cascode amplifier with its excellent stability. As V_{agc} approaches the output transistor bias, and 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 MC1350P and MC1590P use a more sophisticated approach to agc control, based on two interconnected LTPs (Fig 3). The circuit reduces changes in input and output impedances due to agc action, and eliminates changes in differential dc output voltage level. The National Semiconductor LM373 uses the same circuit for agc control, and a cross-coupled variant as a demodulator or mixer.

* Also known as the emitter-coupled or differential pair.

Table 1. IF and RF Amplifiers

Type	Vs (v)	Av (dB)	Ap (dB)	gm (m℧)	NF (dB)	B (MHz)	Ri (Ω)	Ro (Ω)	AGCR (dB)	XML (mV)	AMRej (dB)	S (μV)	Cost (s d)	Remarks
BASIC CIRCUITS														
Motorola MC1350P	+12		58 (10)	160	9 (60)	30	3k	220k	68				33s 8d	Const. Ri and Ro over AGCR. Push-pull output.
Motorola MC1550G	+6	25 (0·5)	25 (60)	22 (30)	4·5 (50)	22	1k8	100k					9s 10d	Const. Ri over AGCR. Low feedback. Gain-bandwidth product 2GHz.
Motorola MC1590G	+12	45 (10)	45 (60)	150	6 (60)	40	2k5	20k	68				50s 4d	Low feedback. Useful as mixer and speech compressor.
Mullard TAA350	+6	65				12	2k5	80			50	100	32s	Limiting fm i.f. amp, based on cascaded LTPs.
Nat Semi LM371	+12		25 (200)	37 (5)	7 (100)		1k2	100k	25				41s	Data for cascode use. Ltp circuit with transistor tail.
Nat Semi LM703E	+12		28 (100)	33 (10)	6 (10)	30	3k	30k					41s	Rf amp for a.m. or fm. Ltp circuit.
Plessey SL610C	+6	20 (30)			4 (30)	140	high	—10	50	100[1] 250[2]			24s	Wideband low-distortion rf amps
Plessey SL611C	+6	26 (30)			4 (30)	100	high	—10	50	50[1] 250[2]			24s	High Ri.
Plessey SL612C	+6	34 (1·75)			3 (1·75)	15	3k	30	70	20[1] 250[2]			24s	Low noise, low distortion i.f. amp with high AGCR.
RCA CA3028A	+9		32 (10)	99	6·7 (100)	8	2k		62				14s 9d	Data for differential mode. CA3053 recommended for i.f. amps.
RCA CA3053[3]													9s 3d	CA3028A useful to 120MHz as amp/mixer.
RCA CA3004	+6, —6		12 (100)		6·3 (100)	4	1k2	2k2	60				36s	High linearity and wide dynamic range. Low cross-modulation.
RCA CA3005	+6, —6			16 (100)	7·8 (100)		1k4	2k					23s 6d	Also useful as mixer/modulator.
Fairchild μA703E	+12			35	6 (30)		3k	20k					32s 1d	Useful to 150MHz.
Fairchild μA733C	+6, —6	52				40	250k	20					59s	Internal compensation. Operation selectable by ic connections; (i) Av = 52dB, B = 40MHz, Ri = 4k; (ii) Av = 40dB; B = 90MHz, Ri = 30k; (iii) Av = 20dB, B = 120MHz, Ri = 250k.
COMPLEX CIRCUITS, INCLUDING DEMODULATORS														
Fairchild μA719C	+12	60 (10·7)		1400 (10)	7 (10)		3k	8k	40			1500	35s 6d	A.m.-fm i.f. amp with agc; fm det; af preamp (32dB gain).
SGS(UK) μA719C													39s	
Mullard TAD100	+9								62				48s 5d	Mixer; osc; i.f. amp; a.m.-agc det; af preamp. For MW BC sets.
Mullard TAD110	+9				9	30			56			2		Mixer; osc; a.m.-fm i.f. amp; a.m. det; af preamp. For xtal-controlled equipment up to 30MHz.
G.E. PA189	+12	80 (4·5)				5	500	10k				70		fm i.f. amp; fm det. Also useful as phase det, and in colour tv.
Nat Semi LM372	+6					2	4k	1k9	69 (0·5)				37s 6d	A.m. i.f. amp/det. 800mV of output. Agc threshold 50μV. Active det circuit.
Nat Semi LM373						12			80					I.f. amp, det, for a.m., cw, fm, ssb. Agc det, threshold 40μV. Also useful as first i.f./mixer, bal mod with cio, or oscillator.
Plessey SL432A	+18	65				11	1k4	5k			52	150		fm i.f. amp, discriminator. 800mV af output at 1 per cent THD Vs 6-24V.
RCA CA3013	+7·5	60 (10·7)			8·7 (4·5)	4	3k	32k			50	300	22s	Limiting fm i.f. amp/fm det/af preamp. THD = 1·8 per cent.
RCA CA3042		67 (4·5)					11k	100k					21s 9d	Limiting fm i.f. amp/fm det/af preamp/driver. 8V rms output at THD = 1·5 per cent.
RCA CA3043	+30[4]	80 (10·7)					7k					50	27s 6d	Limiting fm i.f. amp/fm det/af preamp. 100mV output at THD = 1 per cent.

Notes: [1] No agc applied. [2] Agc applied. [3] Like CA3028A but NF/AGCR unspecified. [4] Through 75Ω.

Several of the devices including a demodulator are intended for fm applications. The demodulator is normally of the quadrature type, requiring an external signal phase-shift circuit. The National Semiconductor LM372 includes an "active detector" for a.m., based on the same principles as the wide-range detector outlined later (see **Automatic response plotting**). The LM373 includes detectors for all modes.

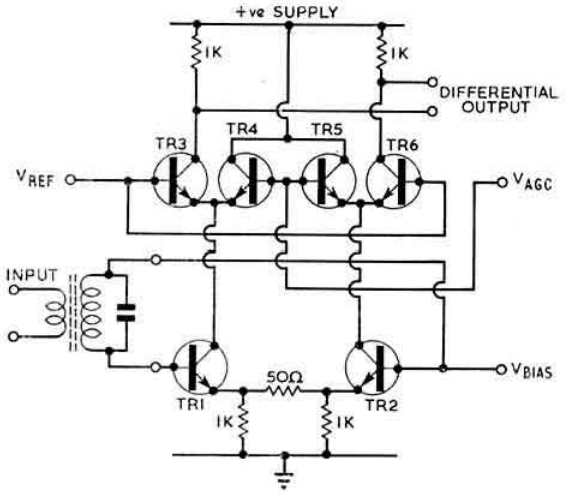
The Mullard TAD100 and TAD110 consist of mixer, oscillator, i.f. amplifier, detector and af preamplifier. The TAD100 is designed for medium-wave broadcast receivers, and includes an agc detector. The TAD110 is intended for crystal controlled equipment for a.m. and fm up to 30MHz.

MIXERS, MODULATORS AND DEMODULATORS

Most of the basic ltp, rf and i.f. amplifier ics are also suitable for mixer, modulator and demodulator applications. Signals are fed to the base of the constant-current tail transistor, and oscillator injection (push-pull or single-ended) is applied to the differential transistors. In addition, more complex circuits are available (see Table 2).

Table 2. Mixers, Modulators, Demodulators

Type	Vs (V)	Avs (dB)	gc (mℑ)	B (MHz)	Ris (Ω)	Ric (Ω)	Ro (Ω)	Vism (mV)	Vcmm (V)	DSBo (mV)	Vcs (dB)	Vss (dB)	IMD (dB)	CMRej (dB)	Cost (s d)	Remarks
Motorola MC1445G	+5, −5	19		75	10k		25		±2·5					85 (0·05)	53s 6d	Gate-controlled two-channel amplifier, product det, bal mod. Push-pull output.
Motorola MC1596G	+12, −8	11		300	200k		10k		±2·5	600	50 (10)		−60	85	64s 2d	Bal mod, mixer, prod det, phase-sensitive det, freq doubler, amplitude modulator/del.
Mullard TAB101		−0·75									3nW				14s	Four-transistor ring modulator array.
Mullard TAD100/101 Nat Semi LM373																See under complex i.f. amps. Bal mod and clo, with alc, for ssb generation. Also first i.f. and second mixer for receivers.
Plessey SL640C	+6	0		75	500	1k	350	210			40	40	−45 (30)		44s	Bal. mod for ssb. Single-ended inputs and low drive level.
Plessey SL641C	+6		2·5		1k	1k	high	250			25	18	−45 (30)		44s	Low noise receiver mixer. Single-ended inputs, low power consumption.



◀ **Fig 3. Simplified dual-ltp circuit in Motorola MC1350P high-performance agc stage. The 50 Ω resistor between the emitters of Tr1 and Tr2 increase linearity and dynamic range**

The Plessey SL640 and SL641 circuits provide balanced or double-balanced mixers or modulators with single-ended inputs, making centre-tapped i.f. transformers unnecessary. The SL640 is intended for higher level applications such as ssb generation, and yields a 40dB carrier suppression. The SL641 has a low noise figure and useful conversion gain for receiver mixers.

The National Semiconductor LM373, mentioned earlier, operates as a balanced modulator and carrier oscillator with alc facilities. It is also recommended for use as a first i.f. amplifier and second mixer in double-conversion receivers.

The Motorola MC1596G is specifically designed for balanced modulator and demodulator service. Fig 4 shows the device connected as a product detector and as a simple balanced modulator. Fig 5 shows the MC1590G used as a vhf mixer. The MC1445G circuit is based on the cross-coupled ltp circuit, and provides two signal channels selectable by a gate circuit. This provides enormous flexibility in mixer, agc stage, balanced modulator, amplitude modulator and frequency-shift keyer functions. Fig 6 shows the MC1445G as balanced modulator and frequency-shift keyer (multiplexer) for rtty.

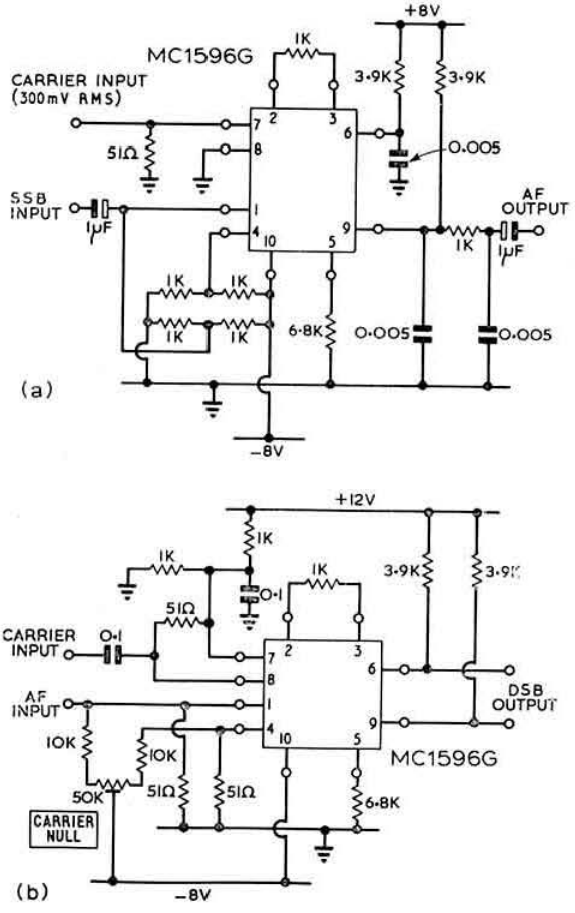


Fig 4. Motorola MC1596G used as (a) product detector and (b) dsb balanced modulator. A carrier balance control is provided for fine adjustment of carrier suppression

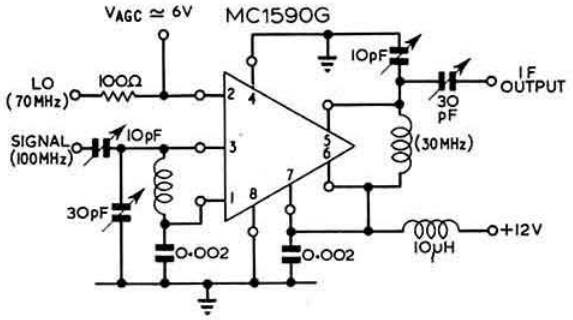


Fig 5. Motorola MC1590G in a 100MHz mixer circuit with 30MHz i.f. output

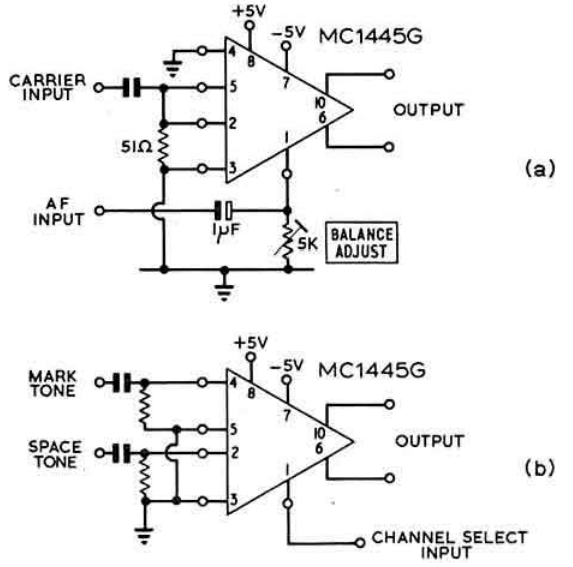


Fig 6. Motorola MC1445G in (a) balanced modulator and (b) multiplexer modes. In (b), switching the channel selection input between 0 and +5V will pass "mark" or "space" tones to the output.

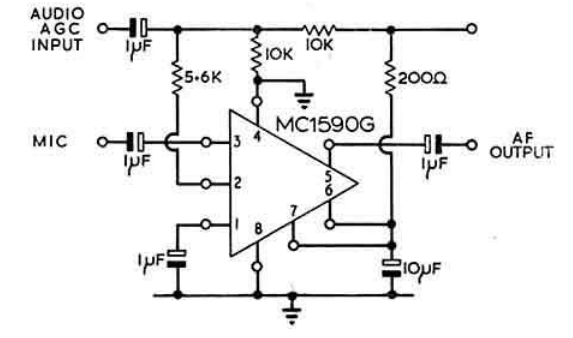


Fig 7. Motorola MC1590G in a speech amplifier circuit with agc facility, suitable for compressor or alc operation

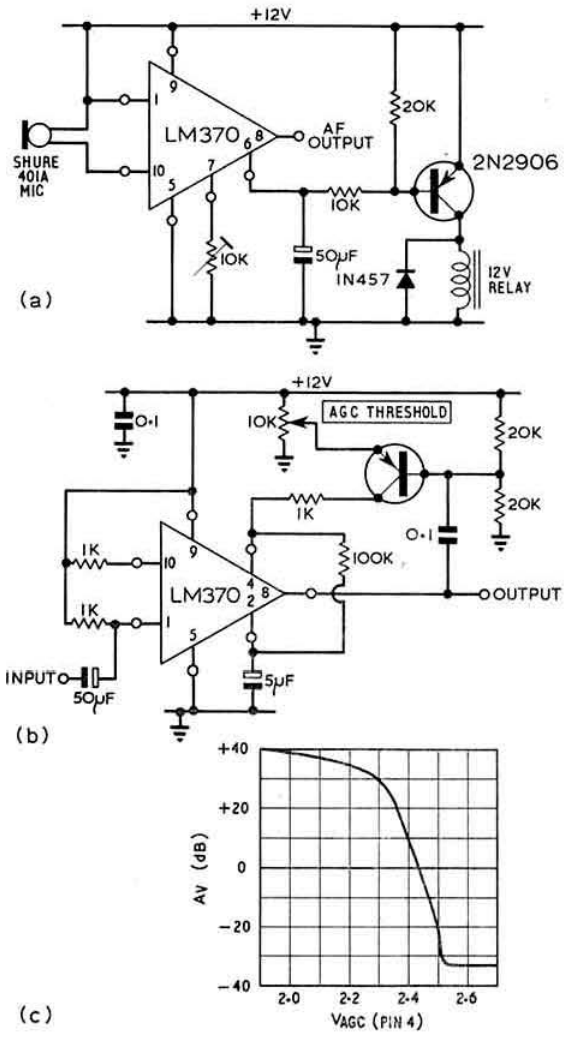


Fig 8. (a) The National Semiconductor LM370 agc/squelch amplifier used as a microphone amplifier and vox driver. The 10kΩ potentiometer from pin 7 to earth sets the vox threshold level; (b) The LM370 as an agc controlled microphone amplifier, with an agc characteristic as shown in (c)

AUDIO PREAMPLIFIERS

While some of the audio power amplifiers described in the next section include simple preamplifier circuits, several ICs are available for audio applications requiring tone control or equalization circuits, or agc or compressor facilities.

The Mullard TAA320 consists of a mosfet/bipolar hybrid circuit providing an input resistance of 100,000MΩ. Other Mullard circuits consist of arrays of basic common emitter stages.

The Motorola MC1590G and Plessey SL630 include agc control for compressor or alc applications. Fig 7 shows the

Table 3. Audio Preamplifiers

Type	Vs (V)	Av (dB)	gm (m℧)	NF (dB)	B (Hz)	THD (%)	Ri (Ω)	Ro (Ω)	Cost (s d)	Remarks
GE PA230	+12	77		2μV[4]	500k	1	35k	100	16s 3d	Short-circuit protection. Useful for tone-control and tape recording circuits.
Motorola MC1303P		80							48s 9d	Dual preamp for stereo, 70dB channel separation.
Motorola MC1590G	+12	45[2]	150	5	10M		2k5	20k	50s 4d	60dB AGCR. Suitable for speech compressor.
Motorola MFC4010		70		1mV[3]					16s 10d	
Mullard TAA263	+6	77	11,000	5	600k		50k	17k	10s 2d	
Mullard TAA293	+6	80		6	600k				13s 1d	
Mullard TAA310	+7	100		2·5	15k	0·5	20k		21s 9d	
Mullard TAA320	+20		75	25μV[3]			100G	1k6	9s 10d	Mos/bipolar input stage. Cin = 8pF.
Nat Semi LM370	+12	40			1·7M	0·5	30k	5k	45s	Agc/squelch amp with 80dB AGCR. Useful as const amplitude audio osc. Three gain control lines.
Plessey SL630	+12	46				0·5	1k	1·5	23s	Microphone amp with 100dB AGCR.
RCA CA3007	+6, −6	22[1]			20k	0·28	4k	60	52s 6d	Includes driver stage.
Texas SN777		72			10k	2·1				Mic preamp.

Notes: [1] Ap. [2] With Rl = 1k. [3] Vn at output in 20kHz bandwidth. [4] Vn referred to input, 20kHz bandwidth.

Table 4. Audio Power Amplifiers

Type	Vs (V)	RL (Ω)	Po (W)	THD (%)	SNR (dB)	S (mV)	Ri (Ω)	Ro Ω)	B (Hz)	Cost (s d)	Remarks
Fairchild μA716C	+21		0·15	0·1			11k	1·0	2M	38s 2d	
G.E. PA222	+22	22	1	3	65	52	55k	1·0	15k	79s 6d	Printed circuit board used as heat sink.
G.E. PA234	+22	22	1	3	80	600[1]	100k	2·0	100k	17s 6d	Few ext components. Gain set by ext resistors. 8-22 Ω load.
G.E. PA237	+24	16	2	2	75	8[1]	40k	0·85	56k	31s	Printed circuit board used as heat sink.
G.E. PA246	+34	16	5	0·7	70	180[1]	100k	0·6	100k	57s	10W peak Po. Gain set by ext resistors.
Motorola MC1306P	+9	16	0·25	0·8	55	3[2]	—[1]	0·5	—[1]	26s 2d	Preamp included. Low zero-signal current drain. Gain set by ext resistors.
Motorola MC1454G	+16	16	1	0·4	80	400	10k	0·4	270k	29s 10d	High temp stab. Gain selectable by i.c. connections (Av=10, 18 or 36).
Motorola MFC4000			0·35	0·7						19s 3d	Designed for battery portable radios.
Mullard TAA300	+9	8	1	0·7	75	8·5	15k		20k	36s	
Plessey SL402A	+14	7·5	2	0·5	75	100	100M	0·2	30k	36s	Preamp included, with Ri = 20M Ω, Av = 24dB, THD = 0·1 per cent. Preamp biases power amp.
Plessey SL403A	+18	7·5	3	0·5	75	110	100M	0·2	30k	39s	
Plessey SL630	+12	40	0·19	0·5		14	1k	1·5		23s	Headphone amp with 100dB AGCR.
RCA CA3020	+9, −3		0·55	3·1	70	35	55k		8M	25s 3d	Squelch facilities. High or low impedance inputs. High bandwidth. Useful as servo amplifier and high level mixer.
RCA CA3020A	+12		1	3·3	66	50	55k		8M	32s	Total power gain 75dB.
Sinclair IC-10	+18	3	5	1	75	5[3]	100M	0·2	100k	59s 6d	Preamp included (see Plessey SL402A/SL403A). 10W peak Po.
Texas SN1220	+1·5		0·003	5							Heading aid/headphone amp.
BHA0001	+16		2						180K		Manufacturer not known. Available from Rastra Electronics.

Notes: [1] Depend on gain. [2] Including preamp.

MC1590G connected as a microphone amplifier. Plessey also produce an agc generator for the SL630 (SL620).

The RCA CA3007 includes a driver stage, and the Motorola MC1303P consists of two separate preamplifiers for stereo. The National Semiconductor LM370 is a versatile circuit with agc facilities, readily adapted as a voice-control unit (see Fig 8).

AUDIO POWER AMPLIFIERS

Audio power amplifiers provided the means for the first large-scale attack on the consumer market by the integrated circuit manufacturers, and a wide range of devices is now available with power outputs up to 5W rms. Distortion figures are not as low as those possible with discrete-component circuits, but for communications applications they are entirely satisfactory.

The Sinclair IC-10, Motorola MC1306P and Plessey SL402A and SL403A circuits include a preamplifier which increases the circuit sensitivity to a few millivolts for full power output. With most circuits, overall gain can be varied by means of external or internal resistor networks, with corresponding changes in distortion levels and sensitivity.

The RCA CA3020 devices include squelch circuits for vhf radio.

Fig 9 shows the Plessey SL402A or SL403A connected in basic power amplifier circuits, with and without tone control networks.

OSCILLATORS

The temperature coefficients of ic resistors and other components preclude the use of monolithic circuits for stable LC oscillator applications. Ic oscillators based on digital frequency synthesis are in vogue, when stability is provided by quartz crystal oscillators.

Most of the wideband ic amplifier circuits are usable as oscillators. Fig 10 shows the Motorola MC1550G as a 5MHz LC oscillator, but its poor temperature stability would not normally be tolerated. Fig 11 shows a 50–100MHz overtone crystal oscillator based on the Motorola MC1023—a digital ic.

For digital frequency synthesisers, the most economic logic circuits are the transistor-transistor logic (TTL) 7400 series, pioneered by Texas Instruments. Full decade counters are available in a single package (7490), as well as combined

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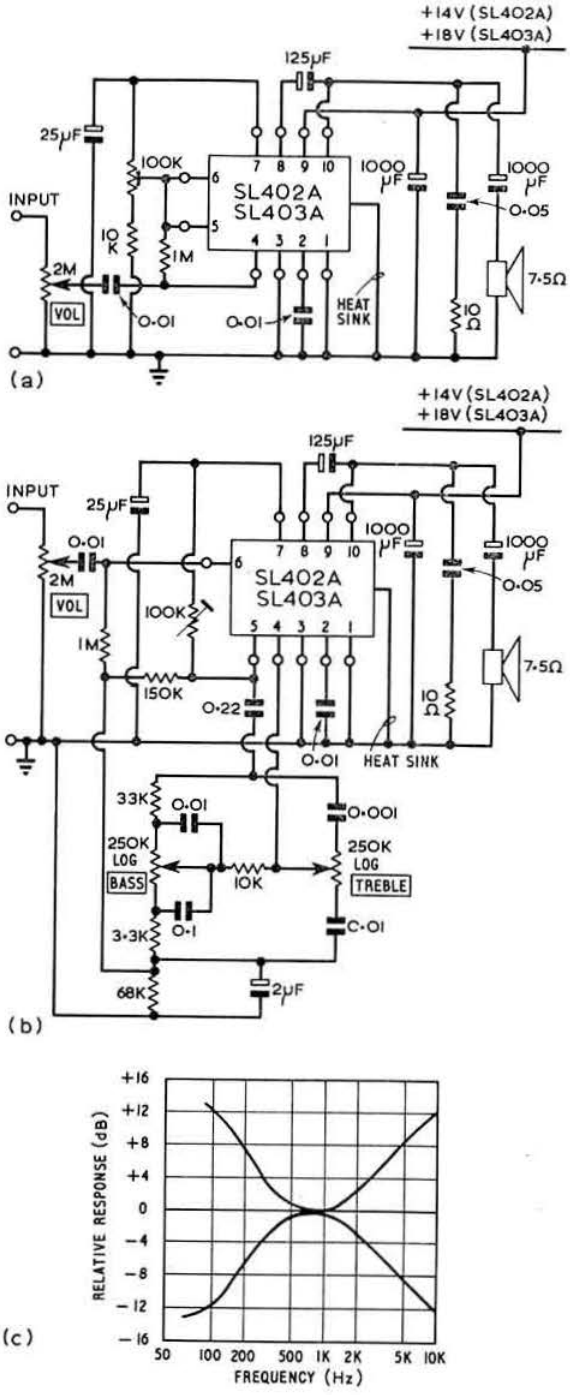


Fig 9. The Plessey SL402A/SL403A audio power amplifiers in (a) a basic circuit and (b) a versatile circuit with tone control networks. (c) shows the response of the tone control circuit with potentiometers at maximum and minimum values. The 100kΩ preset potentiometers are used to adjust the amplifier quiescent dc output voltage to equal half the supply voltage

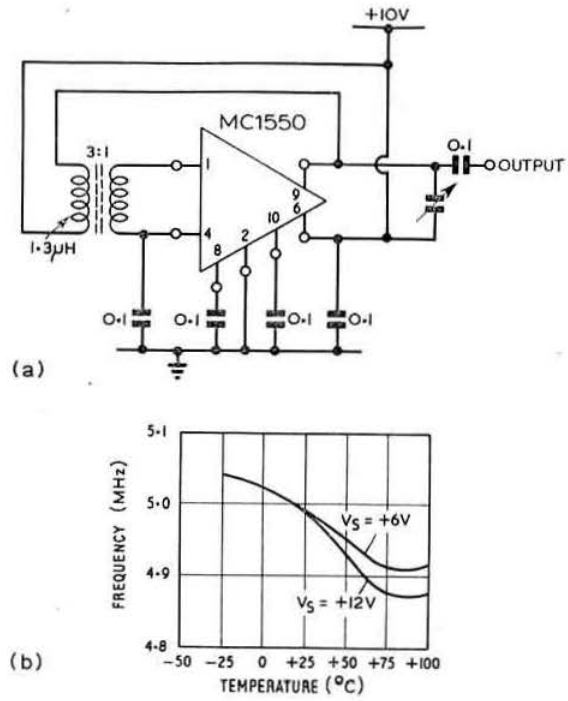


Fig 10. (a) The Motorola MC1550 as a 5MHz LC oscillator. The high temperature dependence of the oscillation frequency is shown in (b)

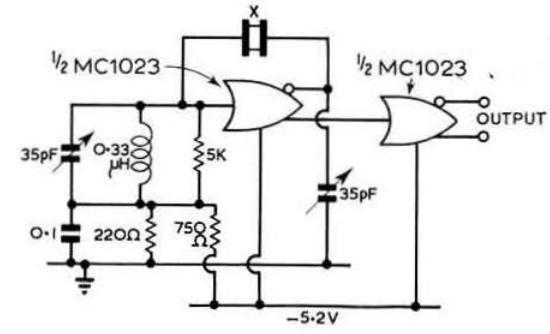


Fig 11. The Motorola MC1023 emitter-coupled logic circuit used as a stable 50–100MHz overtone crystal oscillator

decoders and Nixie tube drivers (7441). The maximum counting speed for TTL is about 20MHz, but Motorola's emitter-coupled logic (MECL II) will function up to 120 MHz.

An interesting development would be the use of ic rf amplifiers with agc facilities as dip oscillators. In many cases the low impedance agc line, used for oscillator amplitude control, is suitable for driving a meter directly, and absorption of oscillator energy by an external tuned circuit would be clearly indicated.

Table 5. Voltage Regulators

Type	Ptot (W)	Ilm (mA)	Vi (V)	Vo (V)	Vi-o(min) (V)	Vn	Temp. Coefft. (%/°C)	Line Reg.[2] (%/V)	Load Reg.	Ripple Rej. (dB)	Cost (s d)	Remarks
Fairchild μA723C SGS(UK) μA723C	0·8	150	9·5–40	2–37	3	2·5μV	0·003	0·01	0·03%	86	48s 9d 63s 9d	
Motorola MC1460G[3]	1·8[1]	250	9–20	2·5–17	2·1	150μV	0·002	0·003	0·5mV		48s	10A I_L with ext pass transistor. Electronic shut-down 20ns load transient recovery time. Variable short-circuit current limiting.
Nat Semi LM300	0·3	20	8–30	2–20	3	0·002%	0·3	0·05	0·1%		54s	5A I_L with ext pass transistor.
Transitron TVR2002V	0·8	200	8·5–30	3–27·5	2·5	40μV	0·003	0·02			56s 6d	

Notes: [1] Case temp. 25°C. [2] Change in Vo for 1V change in Vi. [3] MC1460R has higher power rating.

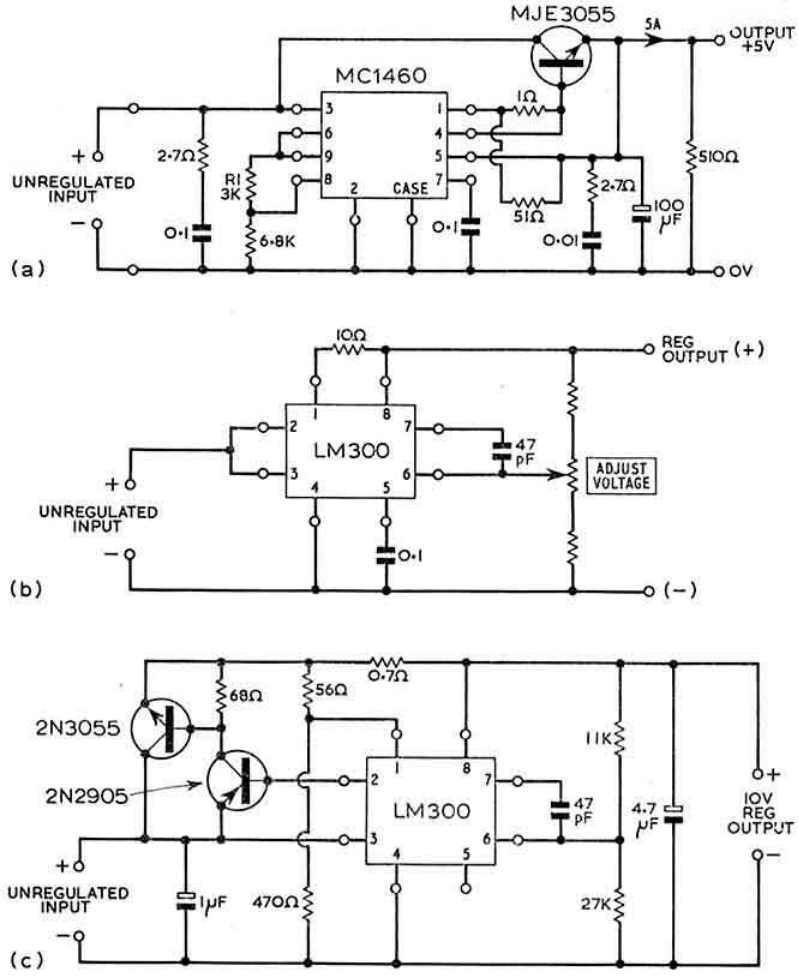


Fig 12. (a) The Motorola MC1460G with an MJE3055 (13s 9d) pass transistor as a 5A +5V stabilized power supply. The output voltage is determined by R1. (b) The National Semiconductor LM300 as a basic variable stabilized supply. The feedback sense voltage at pin 6 is 1·8V. (c) the LM300 in a 2A circuit with pass transistor and foldback current limiting. Output is +10V

VOLTAGE REGULATORS

Because of the complexity of current integrated circuits, it is often important to provide systems with well-regulated supplies. Voltage regulator ICs are available which reduce ripple and changes in supply voltage due to load and line variations down to the 100μV level. Because of the limited power handling capabilities of most ic packages, regulators will normally provide load currents up to only 100mA or so. However, a single "pass" transistor can be used to increase current capability up to 10A or more.

Apart from operating in conventional positive or negative supplies, several circuits are suitable for switching-type regulators. All types include current-limiting for short-circuit protection; some go further and provide "fold-back" current limiting, which reduces device dissipation under short-circuit conditions.

Fig 12 shows the Motorola MC1460 in a 5A circuit with external "pass" transistor, and the LM300 by National Semiconductor in a basic circuit and a 2A circuit with "fold-back" current limiting.

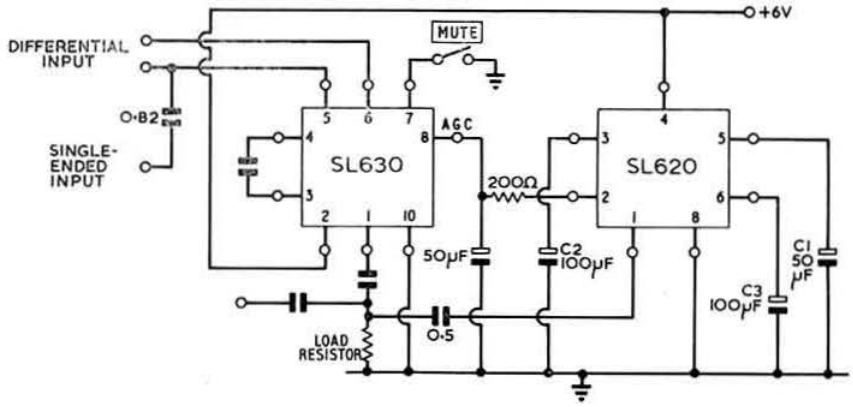


Fig 13. The Plessey SL630 microphone/headphone amplifier and SL620 agc generator interconnected to form an advanced speech compressor circuit for communications applications

AGC GENERATORS

Plessey offer two interesting circuits, the principles of which have been discussed earlier [1]. The SL620C agc generator is for use with the SL630C microphone amplifier for compressor functions, and the SL621C with the series of rf and i.f. amplifiers in receivers. Fig 13 shows the SL620C and SL630C used together, and Fig 14 the block diagram of a complete communications receiver using the SL621C for overall agc control.

Both agc generators use complex circuits to provide separate fast and slow agc detectors, with a special hang circuit which will follow slow variations in signal strength, but which ignores signal transients and noise pulses, and "remembers" the pre-transient agc level. Both ICs are priced at 36s 3d.

A few of the complex i.f. amplifier circuits described earlier include a single agc detector with fast attack and slow release characteristics.

SPECIAL COMPLEX FUNCTIONS

Several linear ICs are available which are not readily classified into the previous groups, but which will be of interest to the specialist amateur.

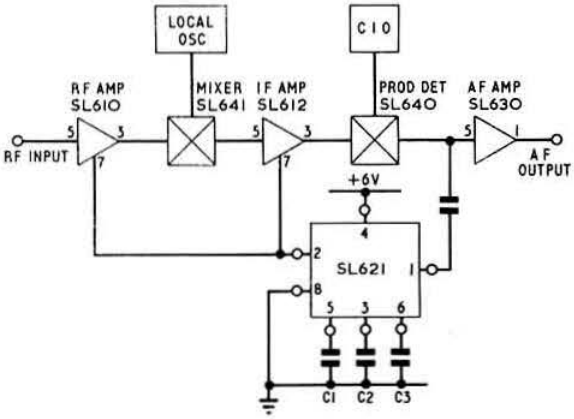


Fig 14. The Plessey SL621 agc generator controlling the overall gain of a communications receiver based on the SL600 series integrated circuits. C1, C2 and C3 determine the agc time constants

Motorola and Fairchild offer chroma demodulators for colour tv (NTSC or PAL systems) under codes MC1325 (34s 3d) and μA737E (38s 2d), respectively. The Plessey SL435B has similar characteristics. For broadcast fm stereo transmissions, Motorola offer ic multiplex demodulators which derive left- and right-hand channels from the composite signal. Channel separation is 30–42dB, and automatic stereo/mono switching is provided with an indicator lamp driver. The MC1304P costs 65s 6d, and the MC1305P (64s 3d) permits the use of an external channel separation control. Also for broadcast receivers, Motorola market the MC1335P (36s 8d), a tuning indicator which drives a lamp circuit. Applications include fine tuning of fm radios and colour tv sets.

The RCA CA3044 (24s) consists of a wideband amplifier and phase sensitive detector for automatic frequency control applications. It is suitable for use in synthesizer phase-lock loops. The companion CA3034 has been withdrawn.

The GE PA424 (45s) is a "zero voltage" triac controller. It is designed to pulse the gate of a triac at the point of zero voltage, thereby eliminating rf interference. It is suitable for direct ac line operation.

Several manufacturers offer dual wideband or operational amplifiers in a single package. The RCA CA3035 (24s 6d) houses three wideband amplifiers, with a cascaded gain of 129dB at 40kHz. 1kHz noise figure is 6dB. The RCA CA3048 (40s 9d) contains four independent differential amplifiers, each with a 58dB voltage gain, 90kΩ input resistance, and 2dB 1kHz noise figure. Bandwidth is 300kHz, and channel separation 45dB.

The Texas SNX1304 opto-electronic pulse amplifier consists of a gallium arsenide light emitter optically coupled to an integrated silicon photo-detector and amplifier. Applications include the transmission of signals from one unit to another where circulating currents prevent the interconnection of earth rails.

OPERATIONAL AMPLIFIERS

The ideal operational amplifier has infinite gain, bandwidth and input impedance, and zero output impedance. If these conditions are approximated to, it becomes possible to design a wide variety of circuits whose characteristics depend only on external components or networks, and not at all on the parameters of the op amp itself. Applications include precision adders, subtractors, integrators, differentiators,

Table 6. Operational Amplifiers

Type	Vs (V)	Avol (dB)	Bol (Hz)	Ri (Ω)	Ro (Ω)	Vio (mV)	Ib (μA)	Iio (μA)	Vom (V)	CMRej (dB)	Vcmm (V)	Ripple Rej. (dB)	Cost (s d)	Remarks
Fairchild μA709C	+15, −15	92		250k	150	2	0·3	0·1		90	±10	90	21s	
Fairchild μA741C	+15, −15	100		1M		2	0·2	0·03	±14	90	±13		49s 4d	
G.E. PA223	+12, −12	76	500k	2M5	100	6	0·08	0·008	±10	100	±3		155s	Short-circuit protected.
G.E. PA238	+6, −6	76	500k	35k	100	2	2		±5	90	±1·5		70s	Short-circuit protected.
Motorola MC1433G	+15, −15	96		600k	100	1			±12	100	±9		25s	
Motorola MC1439G		100							±14	110			23s 2d	
Motorla MC1709CG	+15, −15	92		250k	150	2			±14	90	±10		25s	Equiv μA709C.
Motorola MC1712CG	+12, −6	70		35k	200	1·5			±5·3	95	±0·5		25s	Equiv μA702C
Motorola MC1741CG	+15, −15	100							±13	90			43s 8d	Equiv μA741C
Mullard TAA812	+15, −15	102		800k						90				Equiv μA741C
Nat Semi LM302	+15, −15	0	10k	1M	0·8	15	0·03		±10		±10	60	45s	Voltage follower op amp. Av 0·9985—1·0000. Internally compensated and short-circuit protected. Single-ended input.
Nat Semi LM307	+15, −15	82		500k		7·5	0·25	0·05					60s	Internally compensated and short-circuit protected.
Nat Semi LM308	+15, −15	110	30	40M	300	2	0·0015	0·0002	±14	100	±14	96		Short-circuit protected. Wide Vs range: ±2 to ±15V. Drain current only 300μA. Very high Ri.
Nat Semi LM709C	+15, −15	92	20k	50k	150	7·5	1·5	0·5	±14	90	±8	90	26s	Equiv μA709C
Philco-Ford PA7709-39	+15, −15	92		250k	150	2	0·3	0·1	±14	90	±10		30s 3d	Equiv μA709C
Plessey SL701B	+12, −12	70	500k	100k	100	5[1]	1[1]	0·3[1]	±4·3	80		70	36s 6d	
Plessey SL701C	+12, −12	70	500k	100k	100	20[1]	3[1]	1·8[1]	±4·3	80		70	17s 9d	
RCA CA3029	+6, −6	60	300k	20k	160	0·9	2·5	0·3	±3·3	94	±0·5		17s 6d	NF 8·3dB for Vs +6, −6
RCA CA3030	+12, −12	70	320k	7k8	92	1·37	9·6	0·5	±14	103	±0·7		27s 6d	NF 11dB for Vs +12, −12
RCA CA3033	+12, −12	90		1M5		2·6	0·08		±10	100			50s 6d	
Texas SN7511N		70	3M	5k	800	1	10	0·6	±2·5	95	±2·6		65s	
Transitron TOA2709V	+15, −15	92	10k	250k	150	2	0·3	0·1	±14	90	±10	90	23s 10d	Equiv μA709C
Transitron TOA2741V		106	10	1M		1	0·2	0·03	±14	90	±13	90	49s	Equiv μA741C
Transitron TOA7709V		92		10M	150	1	0·01	0·002	±14	90	±10	90	192s	Very high Ri.

Notes: [1] Maximum values.

active filters, logarithmic amplifiers, wide range detectors and voltage followers.

Fig 15 shows the basic op amp principle, using a feedback resistor R_f and an input resistor R_i (in general these components will be complex networks with impedances Z_f and Z_i). If the gain of the op amp in infinite, the signal voltage at its input must be zero. Therefore, the input terminals are at "virtual earth" potential, and the input current is given simply by:

$$I_i = V_i/R_i \quad . \quad . \quad . \quad . \quad (1)$$

As the input impedance of the op amp is infinite, all of the input current must pass through R_f. Thus the voltage across R_f, which is the output voltage, is given by:

$$V_o = I_i.R_f \quad . \quad . \quad . \quad . \quad (2)$$

But $I_i = V_i/R_i$, therefore,

$$V_o = \frac{R_f}{R_i}.V_i \quad . \quad . \quad . \quad . \quad (3)$$

which is independent of any op amp characteristics. If R_f is 100kΩ and R_i 10kΩ, it follows that the overall circuit gain is 10, and that the input impedance is 10kΩ. Note that if V_i is positive, V_o is negative.

In practice, the best op amp parameters achievable at present are an input impedance of 10MΩ, a gain of 200,000, and an output impedance of 10Ω. In Table 6 a selection of low cost op amps in ic form is given. Note that in data sheets some characteristics are given for the "open loop" case (no feedback components connected), and some for specific "closed loop" cases.

Normally op amp input biasing circuits are based at zero voltage, but a current (I_b) must be provided. With a differential input the two input currents will not be exactly equal, so an input offset current (I_{io}) is also specified. Furthermore there will be slight differences in the input bias voltage, specified in terms of an offset voltage (V_{io}). Most op amps require both positive and negative supplies.

Differential amplifiers usually have their inputs marked + and —. These correspond to non-inverting input (output voltage in phase with input voltage) and inverting input (output voltage in anti-phase to input voltage), respectively. In circuits using feedback components it is important that the correct input terminal is used, so that positive or negative feedback is created, as desired.

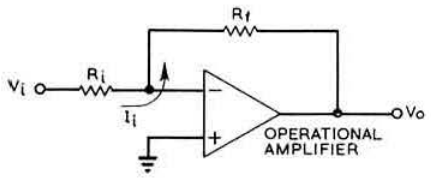


Fig 15. Basic operational amplifier configuration. Gain is determined by R_i and R_f rather than the characteristics of the op amp itself (see text)

Application of op amps

With frequency selective feedback networks, op amps make up the group of circuits known as active filters. These may be

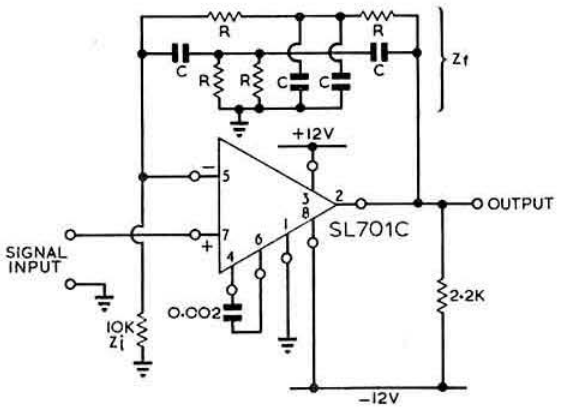


Fig 16. The Plessey SL701C in an active RC filter circuit providing a sharp response in the audio range. For a centre-frequency of 1kHz, R=6·8kΩ and C=0·022μF. The various frequency determining components should be accurately matched

of the simple low-pass or high-pass type, but high performance band-pass or band-stop responses are also realizable. Fig 16 shows an af filter for cw reception, based on a twin-tee filter in place of R_f. Note that the twin-tee filter alone is a rejector type, but the feedback arrangement inverts its response to provide a very sharp peak centred on 1kHz. With accurate component matching, the bandwidth is 6Hz.

Automatic response plotting

Plotting filter responses point-by-point during alignment procedures is a tedious business, but integrated circuit op amps have made it practical to display automatically swept filter responses with decibel scales on an oscilloscope. Problems associated with this are designing a detector and logarithmic compressor with a wide dynamic range (60–80dB). The dynamic range of a conventional diode detector is limited at the lower end by its forward voltage drop, and at

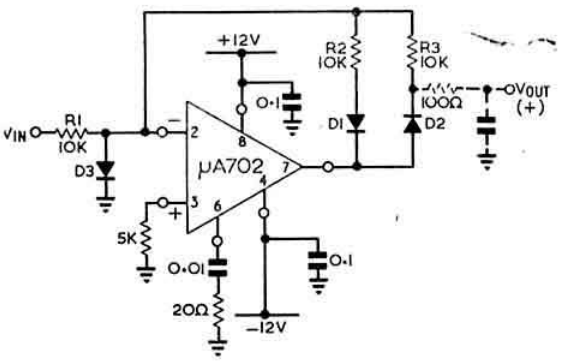


Fig 17. The SGS (UK) μA702 op amp in a wide-range detector circuit. The CR network at pin 6 is for stabilization, and diode D3 prevents "hang-up". The diodes are small silicon junction types. The voltages of the junctions of D1/R2 and D2/R3 are V_a V_b, respectively

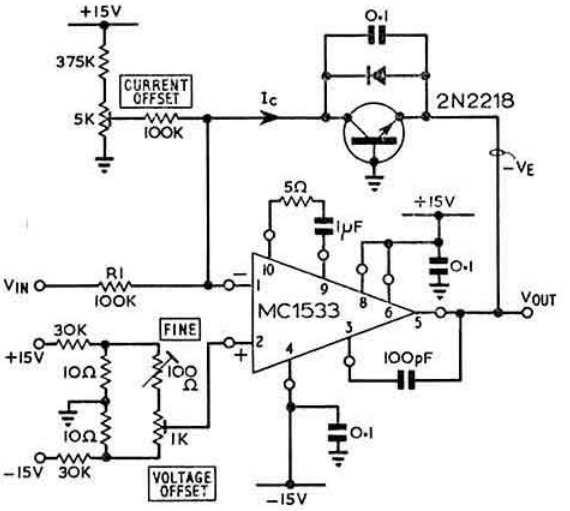


Fig 18. The Motorola MC1533 used as a dc logarithmic converter. The RC network between pins 9 and 10, the capacitor between pins 3 and 5, and the capacitor across the 2N2218 transistor are for stabilization. Input offset current and offset voltage adjustments are provided

the higher end by breakdown. By using an op amp as shown in Fig 17 the lower limit is avoided.

If the incoming signal is positive, the output of the op amp goes negative, D1 conducts, and from equation (3),

$$V_a = -V_i \cdot \frac{R_2}{R_1}$$

Similarly, if V_i is negative, D_2 conducts and

$$V_b = -V_i \cdot \frac{R_3}{R_1}$$

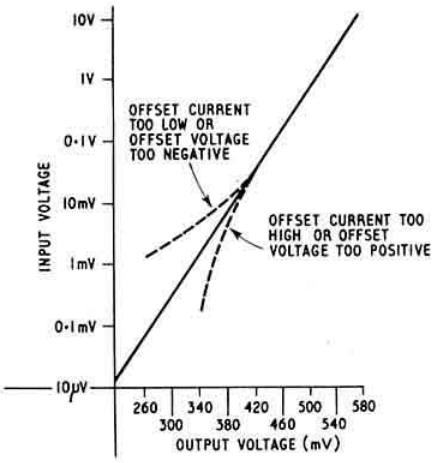


Fig 19. Performance of the logarithmic converter of Fig 18, showing the effect of over-compensating the input circuit

Table 7. Transistor Arrays

Type	Circuit (see Fig 22)	BVce (V)	ft (MHz)	hfe	Vio (mV)	Iio (μA)	NF (dB)	Ap (dB)	gm (mℑ)	Cost (s d)	Remarks
Plessey SL301B	A(2)	12		25–250	12					9s	
Plessey SL303B	A(3)	12		25–250	12					16s 4d	
Plessey SL305B	B(2)	12		1500[1]	7	0·6				32s 6d	
Plessey SL354B	A(4)	12		25–250	12					16s 4d	
Plessey SL3045	A(3) & C(1)	15	300	40	5	2				16s	
RCA CA3046	A(3) & C(1)	15	550	100	0·45	0·3	3·2[2]			16s 3d	Useful up to 120MHz. Wide operating current range.
RCA CA3049	D(2)	15	1300				4·6[3]	23 (200)	10	32s	Useful to 200MHz. Wide range of applications (see text).
RCA CA3051	E(2)	15	600		1·5	0·007			9	26s 9d	For dual amplifiers or Schmitt triggers, or double-balanced mixers/detectors.

Notes: [1] For each Darlington pair. [2] At 1kHz. [3] At 200MHz.

The op amp automatically makes good the forward voltage drop of the diodes, so the circuit can be used to rectify very small signals (about 10mV peak). The upper limit of the rectified output is set by the available output voltage swing from the op amp, typically ±10V. This corresponds to a dynamic range of 60dB. Peak detection may be achieved by adding a simple RC smoothing circuit, shown dotted. The dynamic range of the detector can be increased a further 20 or 40dB by providing input offset compensation.

Motorola application note AN-261 describes a dc logarithmic compressor with a 110dB range suitable for processing the detector output (Fig 18). Although the op amp specified is the MC1533 (116s 8d), the MC1433G (25s) with reduced temperature capabilities should be equally suitable. The 2N2218 transistor (6s 11d) is a diffused base type, chosen for its good logarithmic properties.

The operation of the circuit depends on the logarithmic relationship between the current flowing into the collector and the base-emitter voltage, which holds good over 8 or 10 decades of current [3]. The output voltage is given by

$$V_{out} = 0{\cdot}06 \log_{10} V_{in} + K$$

where K is a constant depending on R_1 and some transistor parameters. With the values given K = 0·450.

Input offset adjustments are essential, and should be carried out with a 500kΩ resistor in place of the 2N2218. The ratio V_{out}/V_{in} should equal five over the range of input voltages to be used. The performance of the logarithmic compressor is shown in Fig 19, which also indicates the effect of incorrect offset adjustments. A suitable experimental set-up for examining an i.f. amplifier response is shown in Fig 20.

Stabilization and protection of op amps

Although some ic op amps are internally compensated, most types require a small number of external components to prevent high frequency instability. For many applications it is sufficient to add a single compensation capacitor—recommended values are given on data sheets—and a good disc-ceramic bypass capacitor from each supply line to earth. Both should be mounted close to the ic package. Without these simple precautions, instability is almost a certainty in view of the high gains associated with op amps and the high f_T of the ic transistors (often over 1GHz).

Integrated circuits are moderately sensitive to excessive supply voltages and input voltages, and to output short circuiting. While supply voltages should not normally cause trouble, it is sometimes worthwhile protecting an ic against the latter two points. Fig 21 shows methods of achieving this protection.

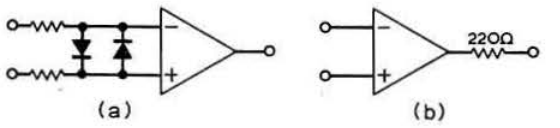


Fig 21. Protection circuits for op amps: (a) input overload protection; and (b) output short-circuit protection

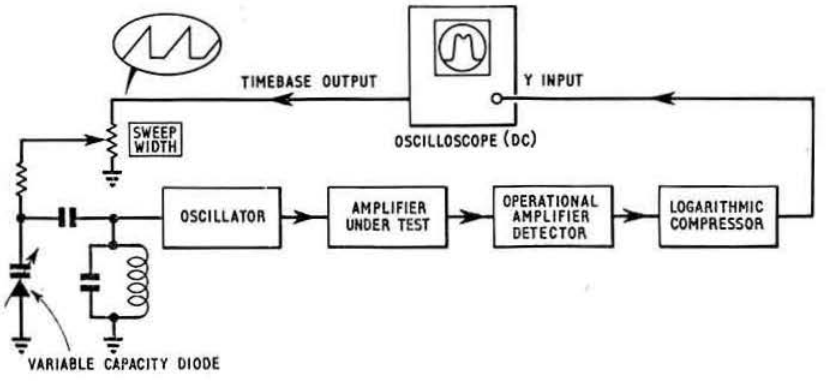


Fig 20. Experimental set-up suggested for automatic plotting of filter or amplifier response curves, using the sweep output of an oscilloscope to modulate the oscillator frequency with a variable-capacity diode. Several modern oscilloscopes have timebase output voltages sweeping between 0 and +25V (Cossor CDU110, Solartron CD1400, etc)

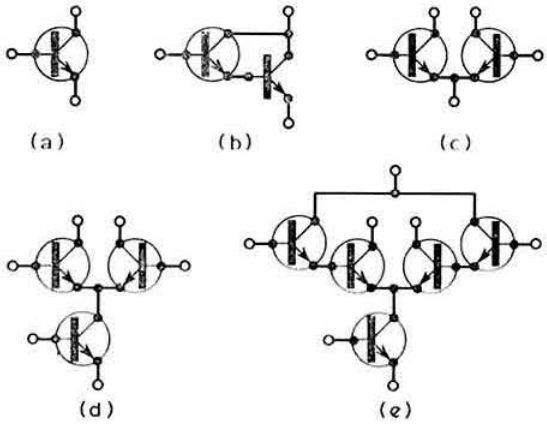


Fig 22. Circuit configurations used to make up the transistor arrays described in Table 7: (a) single isolated transistors; (b) Darlington pair; (c) differential pair; (d) differential pair with tail transistor; (e) differential pair with tail transistor and Darlington inputs

TRANSISTOR ARRAYS

Integrated circuits are available which contain arrays of matched transistors, either isolated from each other or interconnected to form differential or Darlington configurations (Fig 22). Table 7 lists some of the types available.

The main advantage of transistor arrays is that one achieves maximum circuit design flexibility while maintaining the benefits of monolithic matching. It introduces the possibility of special high-performance balanced circuits, such as double-balanced mixers for receiver front-ends.

The flexibility of the arrays is well illustrated by the RCA CA3049, which is recommended for service as a vhf amplifier, mixer or oscillator, i.f. amplifiers, product detector, double-balanced mixer or demodulator, balanced quadrature detector, cascade limiter for fm, synchronous detector, wideband push-pull amplifier, and so on.

It is probable that circuits like the CA3049 will soon provide hf mixers with cross-modulation and noise performance approaching that of the RCA 7360 valve. At present no semiconductor device can compete with the 7360.

Low-cost arrays of mosfets are also available, particularly from Plessey. Most types are intended for mos logic applications, but are suitable for some linear applications. The MT102 matched pair costs 10s 9d.

Surplus integrated circuits

During the last year two firms have offered reject integrated circuits for truly nominal prices. Although one does not get anything for nothing in this world, there is always a temptation to buy a small sample of these bargains and try your luck. It is not feasible to carry out exhaustive tests on these devices to discover where they fall out of line with the manufacturers' specification, but simple go/no-go tests are often adequate for amateur purposes.

The first sample was a collection of TTL digital circuits which appear to be of Texas Instruments origin. At 4s each, these included gates, flip-flops and decade counters. About 60 per cent were usable provided one accepted the odd gate with a disabled input, or a counter with no reset facilities. Unfortunately supplies from the firm dried up in a matter of days.

The second sample was from a wide range of devices currently offered by J. Birkett of Lincoln, which appear to be mainly Plessey types. The "dc to 15MHz amplifiers" were all good, as were 60 per cent of the SL630 microphone amplifiers, provided the supply rail was held below 8V, and only one input was required.

Prices of new integrated circuits continue to fall, and in a few years' time manufacturers will be undercutting the surplus dealers. Today it is rumoured that some manufacturers make more money out of rejects than good devices!

Conclusions

This review has attempted to show the variety of ic devices currently available, and their great flexibility in circuit

List of symbols used

Parameters are referred to by typical values in the tables, unless otherwise indicated below.

AGCR	Automatic gain control range.
AMR_{ej}	a.m. rejection.
A_P	power gain*.
A_V	voltage gain*.
A_{VOL}	open-loop voltage gain.
B	bandwidth (3dB).
B_{OL}	open-loop bandwidth.
BV_{ce}	min collector-emitter break-down voltage.
CMR_{ej}	common-mode rejection.
DSB_o	double-sideband output.
f_T	gain-bandwidth product of individual transistors.
g_c	conversion conductance.
g_m	mutual conductance.
h_{FE}	d.c. current gain of individual transistors at Ic = 1mA
I_b	input bias current.
I_{io}	input offset current.
I_{LM}	maximum load current.
IMD	intermodulation distortion.
NF	noise figure*.
P_o	minimum output power.
P_{TOT}	maximum device dissipation.
R_f	feedback resistor.
R_i	Input resistance or resistor.
R_{ic}	input resistance (carrier input).
R_{is}	input resistance (signal input).
R_L	load resistance.
R_o	output resistance.
S	sensitivity for full output (af power amps) or for limiting (fm i.f. amps).
SNR	signal/noise ratio.
THD	total harmonic distortion.
V_{CMM}	maximum common-mode input voltage.
V_{cs}	carrier suppression.
V_i	input voltage.
V_{io}	input offset voltage.
$V_{Lo\ (min)}$	minimum input-output voltage differential.
V_{ism}	maximum input signal voltage.
V_n	noise voltage.
V_o	output voltage.
V_{OM}	maximum output voltage swing.
V_s	test supply voltage.
V_{ss}	signal suppression.
XML	signal level for 1 per cent cross-modulation.

* Test frequency may be given in tables, in parenthesis.

design. Correspondence from manufacturers has indicated that several new circuits will be appearing on the market very shortly, with an even higher degree of design complexity. This is typical of the dynamic semiconductor industry.

Although many distributors are keen to supply amateurs with small quantities of integrated circuits, they would probably not take too kindly to being inundated with indiscriminate requests for literature. With the information presented in the tables, it should be possible to make selective applications for data, with a reasonable chance of these being backed up by small orders.

It is hoped that the survey will encourage more amateurs to adopt state-of-the-art techniques. Integrated circuits are cheap and offer excellent value for money.

To those who are still building valved equipment, a warning that it will not be long before the transistor is out of date too.

References

[1] Martin, P. G., "The integrated circuit approach to AGC", *Radio Communication*, December 1969.

[2] "Applications of linear microcircuits", SGS (UK) Ltd.

[3] Paterson, W. L., "Multiplication and logarithmic conversion by operational amplifier—transistor circuits", *Rev Sci Instr*, Vol 34, No 12, December 1963.

Table 8. List of distributors of integrated circuits

Firms marked * have expressed willingness to supply small quantities to amateurs, or have been recommended by manufacturers on the same grounds. In addition to the companies listed, several retail firms advertising in the radio press handle integrated circuits, although prices are often higher than in the Tables.

*Farnell Electronic Components Ltd, Canal Road, Leeds LS12 2TU

A. M. Lock & Co Ltd, Peel Street, Chedderton, Oldham, Lancs. (Motorola).

*Athena Semiconductor Marketing Co Ltd, 140 High Street, Egham, Surrey. (National Semiconductor).

Celdis Ltd, 37/39 Loverock Road, Reading, Berks. (Transitron).

*Elcomatic Limited, Kirktonfield Road, Neilston, Glasgow. (Motorola.)

GDS Sales Ltd, St. Michaelmas House, Salt Hill, Bath Road, Slough, Bucks. (Transitron.)

†*Jermyn Industries, Vestry Estate, Sevenoaks, Kent. (Motorola, GE.)

Macro-Marketing Ltd, 390/394 Bath Road, Slough, Bucks. (Fairchild.)

Quarndon Electronics Ltd, Slack Lane, Derby. (SGS (UK), Texas, Sprague.)

Rastra Electronics Limited, 275 King Street, Hammersmith, London W6. (National Semiconductor. Some Mullard, GE and Philco-Ford.)

Roberts Electronics Limited, Hermitage Road, Hitchin, Herts. (RCA.)

*SDS Limited, Hillsea Industrial Estate, Hillsea, Portsmouth. (Plessey.)

Semicomps Limited, Station Wharf, Alperton, Wembley, Middx. (Motorola.)

*Semicomps Limited, The Square, Kelso, Roxburghshire. (RCA.)

*Sinclair Radionics Limited, 22 Newmarket Road, Cambridge. (Sinclair.)

† Add 2s 6d postage and packing on each order.

OBITUARIES

Tony N. W. Willis, ex VS6FS, 9J2NW, and Anne Willis

It is with deepest regret that we report the untimely passing of Mr Tony Willis, ex VS6FS, and his young wife, Anne. The tragic news was passed to us in Hong Kong, via ham radio from ZL, that Tony and his xyl were both killed in a motor accident in Kampala, Uganda, on 23 February 1970.

Tony obtained his amateur licence in New Zealand in 1947 as ZL3GI. After completing his studies he joined the international staff of the Shell Petroleum Co Ltd in 1955 and, during his first assignment in Africa, he operated ZD2NWW and ZD1NWW. After two years of silence while in Indonesia, he was posted to Aden where he operated VS9ANW, and on transfer to Port Sudan he activated ST2AZ. During a spell at Shell headquarters in London he obtained G3TKY.

He was transferred to Hong Kong in late 1965, and as VS6FS he had his most active period and made many friends not only over the air but also through his work for HARTS, serving as secretary until his departure late in 1967. Tony was a fine example of the true ham spirit, always available to lend a hand, to give advice or to encourage a newcomer. His hospitality in his home on Mt Kellett was legendary.

In early 1968, Tony was posted to Ndola, Zambia, where he operated as 9J2NW and maintained contact with his many friends all over the world through numerous skeds. It was in Zambia that Tony met Annie, who became his beloved wife in February 1969. After a honeymoon round-the-world trip, during which they also visited Hong Kong, they both went to Kampala where Tony became operations manager with Uganda Shell. He was a member of RSEA and was awaiting the issue of a 5X5 call.

It is impossible to express in words the loss of Annie, who was such a good wife to Tony, and the loss of Tony, who was not only one of the finest hams but also a real friend to so many.

H.A.

Mrs Mary I. Shaw, AMInstE, G3OMM

It is with sorrow that we report the death of Mrs Mary Shaw, G3OMM, on 15 February 1970 after a protracted illness courageously borne.

Mary was well known in West Yorkshire radio circles and was a founder member of the Northern Heights Amateur Radio Society, being assistant secretary for a number of years. In addition to being a keen top band operator, she was always willing to devote time and energy in furthering the cause of amateur radio such as club demonstration and JOTA stations.

Her other wide range of interests included philately and a love of the outdoors, and as an ardent rock climber she was a volunteer member of the Northern Rescue Organization. She will be missed by many sections of the community.

A.R.

Victor Walker, G8BL

We record with deep regret the death of Victor Walker, G8BL. Licensed in the 'thirties, Victor was active on all bands, including 70 and 144MHz. Sturdy and uncompromising, his ready repartee was well-known in Yorkshire.

In 1947, realising that amateur radio was a joy to be spread, Victor invited local enthusiasts to join him, and so the Spen Valley Amateur Radio Society was formed with Vic as the first chairman, a position he held until ill-health forced him to resign. His service to the SVARS was recognized in later years when he was elected the one and only life member of the society. He will be missed.

N.P.

TECHNICAL TOPICS

A monthly feature by PAT HAWKER, G3VA

EVER since the mid-'thirties there has been a continuing debate on whether the amateur should eschew factory-built equipments and build all his or her own gear. Before then, of course, the argument could hardly arise since only a bare minimum of complete amateur equipment could be purchased—though even in the earliest days it was not unknown for some amateurs to have at least some of their equipment built for them by others.

During the 'sixties the fully home-designed and home-built station was used by only a small minority of amateurs—even the construction-minded vhf/uhf enthusiasts were usually prepared to utilize factory-built hf receivers behind their converters. Perhaps the final tip to the scales came with the development of ssb transmitters and transceivers, and the packaged kits from which the amateur may assemble his own units but opts out of any responsibility for design.

Now it would be patently absurd to suggest that every amateur should always design and build all his own equipment. Where would it stop? Would we turn the clock back to the days when (I am told) amateurs constructed their own variable capacitors, wound all their own transformers, constructed electrolytic rectifiers and even their own grid leaks? The amateur with factory-built equipment may equally be technically and experimentally minded; interested in constructing some special sections of his station, his aerials or in propagation.

And yet . . . most of us regret the widespread overshadowing of home-construction. Some degree of home-brewing seems inherent in the concept of amateur radio. The purchase and operation of plug-in appliances can seldom contribute much to the advancement of the art and science of radio communication unless somewhere along the line such action has at least been preceded by a spell of home-construction or extensive modification of surplus gear. In other words an essential part of the self-training and technical investigations aspects of amateur radio consists of finding out how things work by making them work. There is a big difference between understanding the theory of radio and actually ironing out the bugs of a piece of apparatus. One is tempted to suggest that one form of incentive licensing might be to limit every amateur initially to bands and modes for which he has successfully built a rig—although afterwards leaving him the choice of building or buying.

Certainly, it has always been accepted by groups and societies that do-it-yourself is an important part of the amateur scene. Even if, as the years go by, we spend less time reading the articles at the front of the journals and skip to the topical items, the contest results, the society activities and the ads!

Can anything be done to increase interest in home-construction?

Al Bry, W2MEL, (whose call must appear in innumerable British logs) believes that there is. He notes the effectiveness of the more responsible operating certificates and awards which have a substantial influence in determining the interests and activities of the newer generations of amateurs, and he considers that operating awards recognize and encourage many types of achievement and establish what is fashionable in our hobby.

He wonders whether there is not an ethical responsibility for amateur societies to address in similar manner the technical investigations function of the amateur service. Why not similarly recognize the embryo equipment builder? In concentrating on operating awards, the societies could be compared to a sports organization which seeks to build up a first-rate track team by awarding trophies only for the swimming events.

Before dismissing the idea of technical awards as impracticable, it is worth noting that W2MEL's ideas are backed by his four years' experience of the "World Institute of Home Brewers", of which he is secretary. He considers that WIHB, which is dedicated to the preservation of the experimental amateur radio concept, has proved beyond question that technical awards are feasible. WIHB issues certificates of merit bestowing membership to amateurs using entirely home-built stations.

It could be argued that the RSGB and many local societies already encourage home construction by sponsoring exhibition awards for home-constructed gear—but this is rather like saying that because societies run contests there is no need for proficiency awards. W2MEL (RD Nr 6, Wappingers Falls, New York, 12590) is prepared to supply any society with information on the experiences of WIHB in sponsoring technical awards.

While some of us may feel that home-construction is one of those things which should ideally be pursued for its own intrinsic interest rather than for the collection of wallpaper, it is difficult not to agree with the logic of W2MEL's contentions. His ideas deserve to be considered very carefully indeed.

Home-built receivers

A few years ago it seemed as if home-construction of communications receivers was rapidly becoming a lost art—and it must be admitted that even in these days of modules and tuner units the building of a multi-band high-performance receiver is not to be tackled lightly. But there are definite applications for receivers covering just one or two bands but with sufficient stability and ease of tuning to cope effectively with ssb. One approach is the homodyne—but the superhet still has a role.

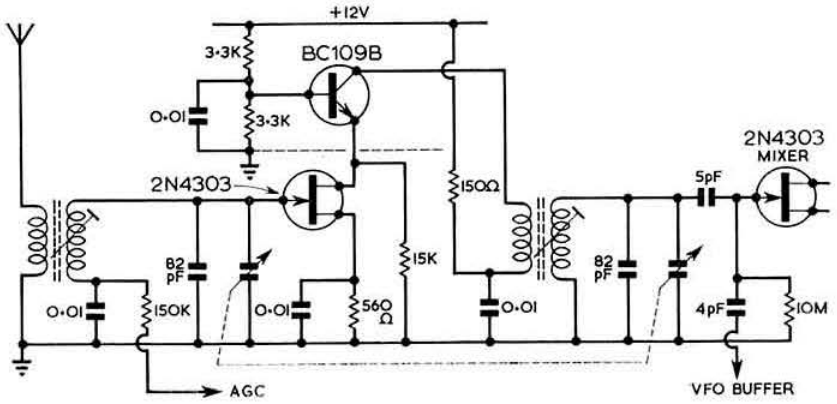


Fig 1. The rf amplifier of PA0PRW's 3·5MHz ssb receiver showing use of fet/bipolar cascode (*Wireless World*)

A straightforward single-conversion receiver for 3·5MHz ssb/cw is described by W. B. de Ruyter, PA0PRW, in *Wireless World*, March 1970, using a type 31 cabinet and other parts. The use of bipolar transistors and fets provides a receiver working from about 12V at 35mA. With a frequency shift of only about 50Hz per volt, it can be run straight from a car battery or mains unit. Both the rf amplifier (needed to reduce image with the 470kHz i.f.) and the first i.f. stage are based on an interesting combination of fet/bipolar devices in a cascode configuration: see Fig 1. Provided care is taken, neutralization should be unnecessary.

A more ambitious and rather more unorthodox approach is taken by Jukka Vermasvuori, OH2GF, in a very compact two-band (3·5 and 14MHz) double-conversion receiver with separate 5 to 5·5MHz vfo. The front end of this receiver (described in *Radio-Amatööri* (No 1 1970))—Fig 2—comprises a double-tuned bandpass input followed immediately by a double-balanced mixer using four hot-carrier diodes (similar to the configuration used in the direct-conversion receiver reported in *TT* February 1969). The 9MHz i.f. starts with two BF245B fets in cascode and then an XF9B filter followed by two 3N140 dual-gate mosfet stages. Two separate mixers (to 475kHz) are incorporated, one with product detector and the other with envelope detector and amplified agc.

SIC electronic voltmeter

Clive Wallis, G3CWV, passes along details of a useful electronic voltmeter built around the μA709C semiconductor integrated circuit which is sometimes offered at around 5s 6d (alternatively, the SN72 709N dual in-line plastic device could be used—this is available from Texas Instruments for about 18s 6d). He notes that most of the electronic voltmeter circuits described recently have been based on fets, on account of their high input impedances. He considers, however, that fets have the following disadvantages: (1) not linear for large input swings, requiring the use of a constant current source to keep the gate-source voltage constant; (2) the output is always offset by a volt or so (gate

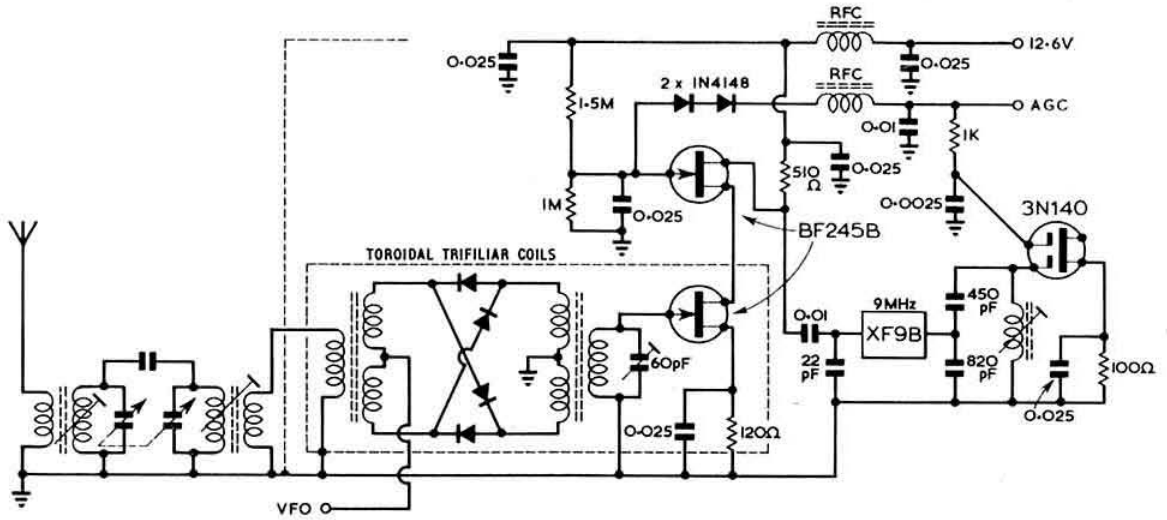


Fig 2. Balanced mixer and cascode first i.f. used in OH2GF's 3·5 and 14MHz receiver (*Radio-Amatööri*)

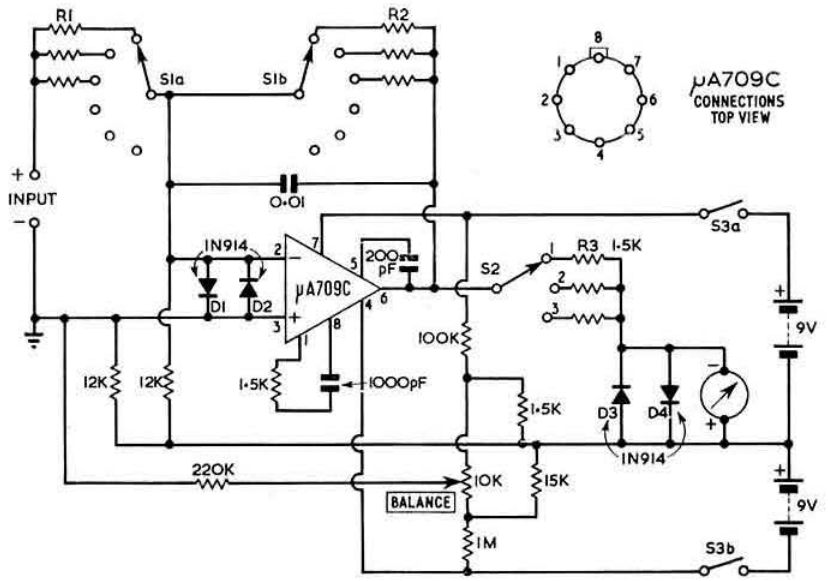


Fig 3. G3CWV's sic electronic voltmeter. S2 corrects meter scale for different input devices, eg 1 terminals; 2 dc probe; 3 ac probe. The values of the high-stability resistors for typical ranges are:

Range	R1	R2
5mV	100k	10M
10mV	200k	10M
50mV	1M	10M
100mV	2M	10M
500mV	10M	10M
1V	10M	5M
5V	10M	1M
10V	10M	500k
50V	10M	100k

bias) from the input, and this voltage is not very stable with temperature unless the device is operated at its own zero temperature coefficient point; (3) most of the circuits require a sensitive meter.

He thus much prefers the use of a μA709C which has a voltage gain of 40,000, a few millivolts of offset and an input impedance of 400,000Ω; it is satisfactorily stable with temperature and relatively insensitive to supply voltage changes. By applying negative feedback the gain of the amplifier can be controlled over a wide range.

The arrangement which G3CWV uses is shown in Fig 3. The battery current is only 2 to 3mA. The input impedance is about 20MΩ per volt up to 500mV, and 10MΩ thereafter. The diodes D1 and D2 protect the amplifier, while D3 and D4 protect the meter which can have a full scale deflection of up to 1mA. R3 is selected to suit the meter and the input device. It may be necessary to experiment with the balancing control, or possibly add an extra control for current balancing if particularly interested in the lowest ranges or extending the range downwards.

G3CWV also indicates that impedances of 1000MΩ are possible if a lower impedance voltmeter is preceded by an LM302 sic voltage follower: see Fig 4. The LM302 is manufactured by National Semiconductors Corporation and is available for about £2 5s from Athena Semiconductor Marketing Company, 140 High Street, Egham, Surrey. The gain of the device is approximately unity, the output impedance about 1Ω and input better than 1000MΩ. However, the LM302 is rather thirsty on power, requiring about 5mA at ±15V.

Positive and negative voltage supply

Quite a number of the circuits involving sic devices require the use of both positive and negative voltages. Saul Ritterman in *Electronic Design* (18 January 1970) shows a simple method of meeting this requirement with a single transformer winding. The idea is indeed so simple that many readers may consider it hardly deserves reprinting—but it may save some head scratching: see Fig 5. The two zeners placed in series provide the means of obtaining the two voltages; where unsymmetrical voltages are required zeners of different voltage ratings can be used. The presence of the resistors means that the supply is safe from the effects of short-circuits.

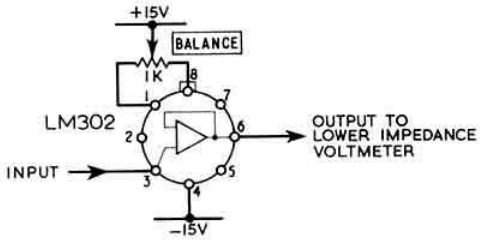


Fig 4. Use of an LM302 voltage follower integrated circuit to provide an extremely high input impedance voltmeter

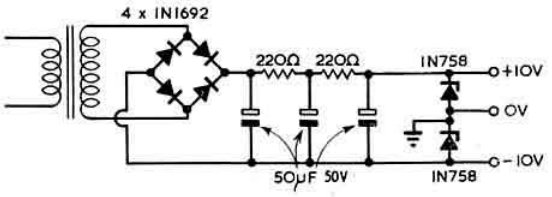


Fig 5. Single transformer winding used to provide positive and negative voltages for sic and similar applications

Solid-state regulated supply

The availability of fairly high voltage silicon power transistors and zeners makes it possible to build useful solid-state regulated supplies at voltages which still usually tend to be associated with thermionic regulators. J. W. Herbert, ZL2BDB, in *CQ* (December 1969) discusses in detail the design considerations for such supplies and also presents a complete design for a 250V supply which, it is claimed, will show only a barely discernable twitch of a voltmeter when a 200mA load is applied. Despite the use of a series stabilizer this unit can also be subjected to a temporary short-circuit without qualms since the 180Ω resistor limits the current to a safe value. If a 750mA fuse is incorporated in the mains input, the unit should cope with long term short-circuits (alternatively the wattage rating of the resistor could be increased).

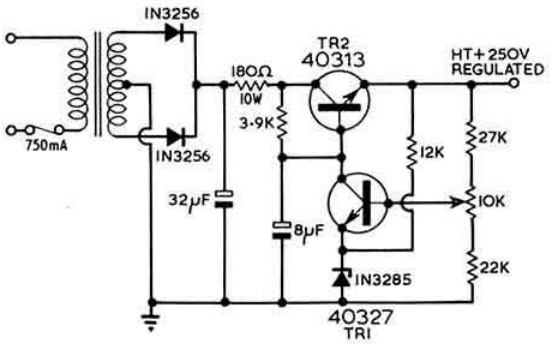


Fig 6. ZL2BDB's design for a 250V solid-state regulated power supply suitable for use between 0 and 200mA

Fig 6 indicates that a straightforward circuit is used incorporating two RCA high-voltage transistors and a high-voltage zener. All the resistors are 1W unless otherwise indicated.

ZL2BDB suggests that the only important constructional feature is that TR2 must be mounted on one side of the chassis wall using the insulators provided, together with a layer of silicon grease to improve thermal conductivity. A thick-walled aluminium chassis is preferable to ensure both mechanical strength and its effectiveness as a heat sink. One of the many applications for such a supply would be to minimize voltage changes in transceivers in receive and transmit modes.

Aerialite "Supreme" uhf array

The requirements of uhf television have proved an encouragement to aerial manufacturers to look again into ways of improving the performance of multi-channel aerials for use in fringe or multi-path situations. Various uhf log-periodics, the J-Beam multi-beam and other configurations are being seen on more and more roof tops (to the satisfaction of those who suffer from tvi on the vhf tv transmissions). Various multi-director type arrays, in which the aim is to provide more than one array structure on a single boom, have also appeared on the Continent.

The latest aerial of this genre to appear is the new Aerialite "Supreme". Since the technical manager of this firm is Alec Hodgkinson, G3LLJ, it seems likely that the dimensions will soon emerge for this type of array on 70cm. The aerial, it should be stressed, is protected by patents pending and registered designs.

The basic aim of this array is to increase the capture area so that a single array can provide the characteristics of two stacked arrays (in practice a stacked Supreme is also being produced for extreme fringe areas). The array comprises two planar folded dipole elements positioned in front of the relatively large mesh reflector plate. The main novelty is the use of what are described as triple folded directors, each having a total electrical length of about $1\frac{1}{2}\lambda$, in appearance rather like a squared-up S, fixed to the boom at the mid-point of the S. The makers claim that this configuration of the directors not only increases gain but also the total bandwidth of the array. Matching of the planar folded dipoles to the feeder is achieved by means of a quarter-wave matching transformer using Aerialite No 385 cable. The commercial tv aerial has a claimed gain (reference dipole) of over 17dB using 16 of the S-type directors. None of the minor lobes are greater than 10 per cent of maximum gain. Over the bandwidths needed for three-channel uhf tv reception the swr remains below 1·5.

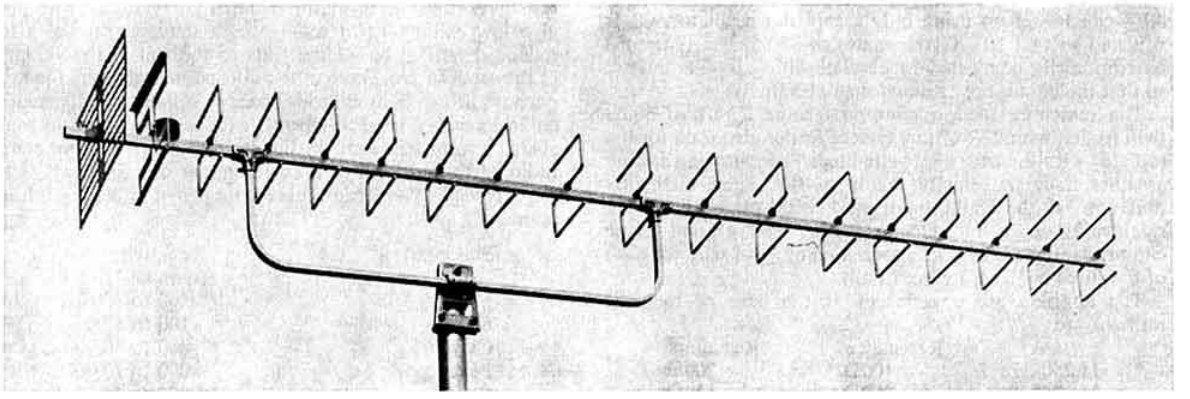


Fig 7. The Aerialite "Supreme" uhf array with two driven folded dipoles and the new "S" directors

The various notes which the company has put together on the array (see Fig 7) also underline once more the importance of using low-loss co-axial cables where signals are weak and where appreciable cable runs are involved. Many amateurs still do not appreciate how much of their power can be lost in the feeder. Aerialite points out that the difference in the signal delivered to the receiver from an aerial delivering 1,000mV could easily be 730μV with the best low-loss cable compared with 550μV with a cable which would be considered good on Band 3. Much the same frequency relationship exists between 144MHz and 432MHz. The company's own cables include the No 500 with a loss of only 2·7dB/100ft at 850MHz. Smaller diameter cables can easily mean over 6dB/100ft attenuation at uhf.

Triband vertical

In *QST* (December 1969) Frank Regier, OD5CG, describes a simple triband vertical for 14, 21 and 28MHz avoiding the use of traps and providing the effective $\frac{5}{8}\lambda$ radiator (22ft) on 28MHz (Fig 8). A single matching section brings all the resistive impedances close enough to a 75Ω line, while a non-switched matching unit takes reasonable care of the reactive components which occur only on 14 and 28MHz.

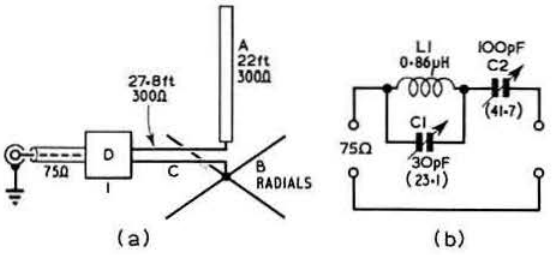


Fig 8. The OD5CG triband vertical aerial for 14, 21 and 28MHz. The radiator (A) comprises 22ft of 300Ω feeder shorted at each end. The ground plane (B) comprises quarter-wave radials for each band (12 wires in all). The matching section (C) is 27·8ft of 300Ω feeder. The reactance matching section (D) is shown in detail in (b), the coil L1 comprises 7 turns of No 16 wire 1in in diameter and 1in winding length

OD5CG indicates that the reactance matching unit (Fig 8(b)) can be set up using only a grid dip oscillator. C1 is adjusted so that L1—C1 resonates to 35·85MHz. Then C2 is temporarily connected in parallel with L1—C1 and set so that the circuit now resonates at 21·37MHz.

The matching section comprises some 27·8ft of 300Ω twin feeder, with 22ft of this type of feeder also used for the radiator with the ends short-circuited. The matching section assumes a cable velocity factor of 0·82, and a slightly different length would be needed with cables having a significantly different velocity factor. The ground plane comprises four radials each consisting of $\frac{1}{4}\lambda$ of wire for each of the three bands (12 wires in all).

The approximate impedances at the base of the 22ft radiator are:

	Resistance	Reactance
14,250kHz	100Ω	200Ω
21,375kHz	1,200Ω	−500Ω
28,500kHz	60Ω	−220Ω

The effect of the matching section is to transform these to:

	Resistance	Reactance
14,250kHz	93Ω	177Ω
21,375kHz	63Ω	0
28,500kHz	75Ω	−282Ω

Variable length monopole

Clearly, the problems of matching and the elimination of the reactive components would vanish if one had an effective means of varying as required the length of the radiating element. Such an approach can be found in a new medium power variable length monopole aerial (type AE3062) which is being introduced by Racal for commercial and military applications and which has been brought to my notice by D. G. Pinnock, G3HVA. In its most ambitious form (covering all frequencies from 2 to 30MHz) the mast (6in diameter glass-fibre sections) is 125ft high; for 4—30MHz the height becomes 65ft.

At the base are two motor-driven spools. On one spool is wound a flat silver-coated copper tape; on the other a flat melinex (insulator) tape. Both tapes are joined to form one complete tape running up the mast and through a spring-supported sheave at the top. This allows any required amount of the copper tape to be run up the mast. Various arrangements are used to adjust the tape to represent a quarter-wavelength at the desired frequency (in one version a frequency discriminating bridge provides a sensor for an automatically tuned servo-system). The monopole thus operates against a ground screen as a $\frac{1}{4}\lambda$ vertical. With 125ft available one wonders whether it might have been worth trying to utilize the radiator as $\frac{5}{8}\lambda$ or the useful 113°, but presumably a major part of the object was to achieve similar radiation characteristics at all frequencies. Some elements of the system might well be possible to duplicate more simply for amateur operation.

Another feature of this aerial is the emphasis placed on the ground screen. This consists of 60 radials either 120ft long for the 2—30MHz version or 60ft for the 4—30MHz unit. The radials are copper weld 12 gauge wire attached at one end to the base plate and at the other end to earth spikes at 12° intervals right round the mast.

Those interested in earths will find some useful notes in an article "The siting of earths for telecommunication installations" in *Point-to-Point Telecommunications* (January 1969). One hint is that at sites having such high earth-resistivity that even multiple electrode systems will not give low enough earth resistance, it may be necessary to reduce resistivity by adding salts to the soil in the vicinity of the earth spikes. Some of the salts commonly used for this purpose are sodium chloride, copper sulphate and calcium chloride, with a need to repeat treatments every one to four years. I seem to recall, in the 'thirties, that a proprietary radio earth consisted of a small copper cup in which salts were placed. The article also contains a table useful in appraising sites:

Soil type	Resistivity (ohm-cm)
Marsh	100 to 300
Loams	100 to 5,000
Clays	200 to 16,000
Peat	4,000 to 20,000
Chalk	5,000 to 15,000
Rock	10,000 upwards

Voltage tripler

The always lively *Australian EEB* (December 1969) reprints an article from *73 Magazine* (December 1965) which, after exploding the myth of a certain so-called "full-wave tripler" circuit, presents what might well prove an attractive and practical tripler arrangement. The circuit is given as a transformerless arrangement for 117V 60Hz ac mains but has both positive and negative rails differing in potential from either side of the mains supply, so I have taken the step of adding a transformer: Fig 9. The voltage ratings etc are those associated with a 117V input. With silicon diodes, the regulation is by no means as bad as might be anticipated from a tripler configuration: in the transformerless version this is given as 520V no load; 490V 100mA; and 460V at 220mA. The author of the original article, Murray Baird, W6LWE, calls it a three-quarter wave tripler since the output contains both 60 and 120Hz components.

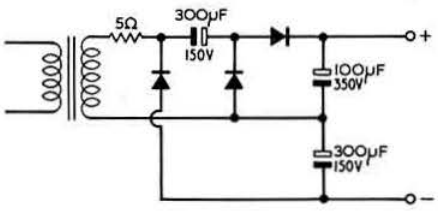


Fig 9. The W6LWE voltage tripler arrangement. For 117V input all diodes are 750mA 400 piv rating

HF facsimile?

The recent notes on slow-scan tv (*TT* February 1970) has encouraged B. E. Cook, G3IYG, to put in a plea for hf facsimile (fax). At present the only bands available to British amateurs for fax transmission appear to be (A4) 425 to 450MHz and (F4) 1,213 to 1,325MHz with 6kHz bandwidth, but he is hoping that the powers-that-be will authorize enthusiasts to use the 14MHz band. With, say, 800Hz shift, the bandwidth would be only about 1·6kHz, far less than A3 or A3J transmission.

G3IYG, personally, is more interested in true fax rather than the use of photographic processing techniques and he passes on the information that several references to fax have appeared in the *BARTG Newsletter*: he also feels that this mode comes closer to the BARTG sphere than amateur television. He is equipped to receive weather maps using a Creed T200 and R300 continuous recorder with speed change via a standard tape recorder. He mentions that amateur rtty equipment doubles nicely for fax, while GM3BST has shown that it is possible to build quite a lot of fax equipment from Meccano parts. A monthly article on APT (automatic picture transmission as used by the weather satellites—see *TT* November 1968) appears in the Italian magazine *CQ Elettronica*, with main emphasis on the sstv type of fax.

G3IYG sees a great potential for fax in amateur operation: interference would have relatively little effect and messages could be transmitted about as fast as they could be read. Most of us would agree that such modes as sstv and fax are very much the type of experimental and do-it-yourself activities that should be encouraged—and should certainly qualify for one of the technical awards advocated by W2MEL.

Harmful interference to the amateur service

The function of the RSGB Intruder Watch

by C. J. THOMAS, GW3PSM, honorary organiser, RSGB Intruder Watch

Introduction

This year sees the 11th anniversary of the formation of the RSGB Intruder Watch, and the past ten years have shown a slow but gradual increase of activity on these lines in other countries with a large population of radio amateurs and an active amateur organization. Also, apart from a small number of well-known exceptions, many administrations responsible for telecommunications throughout the world have shown an awareness that groups of amateurs are constantly on the alert against any harmful interference being caused to the amateur service (1).

The hf bands allocated to the amateur service at the 1959 Administrative Radio Conference at Geneva are as follows:

Region I	*Region II*	*Region III*
kHz	kHz	kHz
(2)	1,800– 2,000 (shared)	1,800– 2,000 (shared
3,500– 3,800 (shared)	3,500– 4,000 (shared)	3,500– 3,900 (shared)
7,000– 7,100	7,000– 7,300	7,000– 7,100
14,000–14,350	14,000–14,350	14,000–14,350
21,000–21,450	21,000–21,450	21,000–21,450
28,000–29,700	28,000–29,700	28,000–29,700

However, the bands amateurs are most interested in are the 7, 14, 21 and 28MHz bands. In Regions I and III, apart from two exceptions, the portion 7,000–7,100kHz is allocated exclusively to the amateur service. The exceptions are the Republic of South Africa and the Territory of South West Africa which are allocated 7,000–7,150kHz. In Region II the portion 7,000–7,300kHz is allocated exclusively

to the amateur service. This means that under Radio Regulation 117 (3) any broadcast station in Regions I and III that creates harmful interference to amateur stations in Region II should be treated as an intruder. Moreover, a broadcast station in Regions I and III specifically beaming its transmissions to countries in the other Region is deliberately contravening this radio regulation.

The portion of 14MHz exclusively allocated to the amateur service is 14,000–14,250kHz. Although not widely known, Radio Regulation 218 permits fixed stations within the USSR to operate in the portion 14,250–14,350kHz, and theoretically interference to amateur stations outside the USSR should not occur.

The two remaining high frequency bands, 21,000—21,450 kHz and 28,000–29,700kHz, are allocated exclusively to the amateur service, and stations of other services should not be present on these frequencies at any time.

Reports of harmful interference

What then, can be done if a non-amateur station is found to be operating in the amateur bands, and therefore causing harmful interference to the amateur service?

Basically the initial action is taken by the radio amateur who hears the station causing the harmful interference. He should, if the transmission is by Morse code, take a sample of traffic together with callsigns or procedure that may be sent. If the transmission is by voice or a type of emission that cannot be identified, ie facsimile, teleprinter, etc, this should be recorded on magnetic tape if such equipment is available. Following this procedure, the logs and/or tapes should be sent to RSGB headquarters, which will in turn pass the information to the Ministry of Posts and Telecommunications. It is then the responsibility of the Ministry to check reports and advise the administration having jurisdiction over the station causing the harmful interference. If satisfactory results are not achieved by this procedure, the Ministry should notify the International Frequency Registration Board, forwarding full details of the infringement. This action will usually result in the interference ceasing.

Unfortunately, in many cases a large number of the point-to-point fixed stations only utilize a frequency for a short period of time, and by the time the reports are filed and passed through the various channels it is quite possible the stations will have changed frequency. It is estimated that only 20 per cent of reports submitted to a national administration will be actionable by them, and most of these will probably be broadcast stations radiating harmonics or spurious transmissions.

It can be seen that a lot of useful information can be wasted due to the delays caused by passing reports from one authority to another. Various suggestions have been made to streamline the reporting system, and these are being investigated at the time of writing.

Filing of reports

Copies of all reports of harmful interference are kept on file, and in the UK alone over 600 reports have been placed on file during the past 10 years. Of these, about 300 were heard three or more times, and at the time of writing 22 stations are known to be persistently causing interference. It is interesting to note that 12 of these are broadcast transmitters operated by administrations in four countries within Region I and one country in Region III.

Successful reporting

Although in many cases it cannot be confirmed that stations have ceased transmitting in the amateur bands due to action taken by various intruder watch organizations, the following is a list of a few of the stations which used to be persistent intruders but have now moved out of the bands:

kHz	
7,010	Broadcast—Radio Pakistan, Karachi.
7,010	Fixed aeronautical—EPD, Teheran.
7,019	Fixed—UMS.
7,097	Met—ZAG1, Tirana.
14,024	Coast—UTS, Archangel.
21,010	Coast—UAT, Moscow.
21,050	Fixed—HGT28, Budapest.
21,120	Met—RJL/RFU7, Rostov-on-Don.
21,400	Fixed—ULV, Moscow.
21,440	Broadcast—Radio Cairo, The Voice of Africa.

Conclusion

What can the RSGB do towards a more efficient intruder watch organization? As an initial step it was agreed at the 1969 Brussels IARU Region I Conference that societies with an active intruder watch would exchange information at monthly intervals, and the RSGB is willing to act as the co-ordinator.

The society has also agreed to accept reports from countries that do not have their own organization, and also to assist in the formation of national organizations.

Amateurs in the UK who feel that they can assist the Intruder Watch are invited to write to the honorary organiser at headquarters for further information.

Finally, it is stressed that the future of the high frequency bands depends entirely on the radio amateur himself. A band devoid of amateur activity is an open invitation for commercial stations to step in.

Notes:

(1) Radio Regulation 78: Amateur Service: A service of self training, intercommunication and technical investigation carried on by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.

(2) Radio Regulation 194: In Austria, Denmark, Finland, Ireland, Netherlands, F.R. of Germany, Rhodesia and Nyasaland, United Kingdom, Switzerland, Czechoslovakia and the Union of South Africa and Territory of South West Africa, administrations may allocate up to 200kHz to their amateur service within the 1,715—2,000kHz band. However, when allocating bands within this range to their amateur service, administrations shall, after prior consultation with administrations of neighbouring countries, take such steps as may be necessary to prevent harmful interference from their amateur service to the fixed and mobile services of other countries. The mean power of any amateur station shall not exceed 10 watts.

(3) Radio Regulation 117: Where, in adjacent Regions or sub-Regions, a band of frequencies is allocated to different services of the same category, the basic principle is the equality of right to operate. Accordingly, the stations of each service in one Region or sub-Region must operate so as not to cause harmful interference to services in the other Regions or sub-Regions.

TVI TIPS

by B. Priestley, G3JGO.

Testing the new transmitter

"Put the transmitter on dummy load"—first problem, catch your dummy load! Fortunately for tvi testing, the important thing is that the load absorbs the transmitter output without radiating it; linearity or a perfect swr are of secondary importance. A 110V 150W bulb in a can fitted with a coax socket and with dull paint or ⅛in ventilating holes to keep it cool will serve quite well in the hf range.

Having done this, it is possible to see if leakage from the new tx causes tvi. If this is the case (and modern commercial equipment can give trouble even within sight of a tv mast!) then the tv set can be brought into the shack and used to find the "hot" leads or holes in the cabinet as shown in Fig 1.

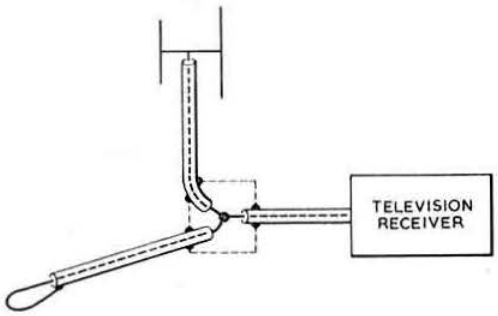


Fig 1. With the addition of a search loop a tv can be used to find hot spots of harmonic radiation from a transmitter on dummy load. The length of coaxial cable between the search loop and the junction may need adjusting if the mismatch attenuates the tv signal seriously

Hot leads need filtering, but the selection of components is rather critical. All capacitors have inductance, so that a bypass capacitor is in fact a series resonant circuit. Near the resonant frequency the bypassing is very effective, but at higher frequencies the effectiveness falls off again. Since the inductance is not easy to control accurately it is desirable to make the resonance as broad as possible. This is done by keeping the inductance down with minimum lead lengths, or better still using feed-through bypass capacitors and keeping the capacitance fairly high. Fig 2 (adapted from the ARRL *VHF Manual*) shows how the resonant frequency varies with lead length and capacitance. By the same token, chokes should have the minimum self capacitance, although a high Q is undesirable as it can make the filter act as a matching section so that a lossy ferrite may be the most suitable core.

Filter components should of course be suitable for the proper service of the lead in question, ie capacitors of

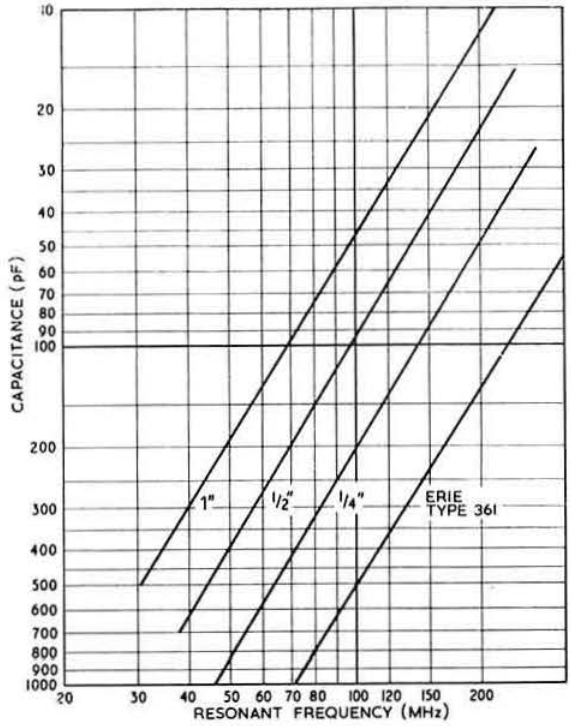


Fig 2. Self resonant frequency vs capacitance with various lead lengths for ceramic capacitors compared with a feed-through bypass

adequate voltage rating and chokes of a suitable dc resistance. Microphone leads present the additional problem of the frequency response, but fortunately they are often adequately rf filtered to prevent rf feedback into the speech amplifier. When the bypass capacitor is located at the amplifier remote from the microphone socket it may be necessary to add a capacitor at the socket and reduce the value of the existing one to keep the total capacitance the same.

The cabinet lid, although very convenient for access to the equipment, often forms a slot aerial of a length comparable with the tv wavelengths. This needs breaking up into short lengths. Sometimes just removing some paint round the screws will be adequate, but the tried and tested standard for critical equipment was one screw every half inch, and in a fringe area this may be absolutely necessary. Also do not overlook the (electrical) hole in the cabinet formed by output plugs and meters.

Having satisfied ourselves that transmitter radiation is now negligible we can try the acid test and connect the aerial via a suitable lpf while the test transmission is being radiated. The result should be a clean screen on at least some bands, and the others may respond to a hpf and/or braid filter at the tv receiver since, after all, yours is the nearest tv set. However, if the trouble persists check if it is harmonic radiation by transmitting a steady carrier and estimating the number of beats horizontally across the screen. Having done this, see if the pattern changes as the fine tuning of the tv set is adjusted slightly. Divide the number of beats by 80 for 405

lines or 50 for 625 lines to get the frequency difference between the vision carrier and the interference in MHz. If this is in the tv band the pattern will not change with the fine tuning, but i.f., image or video interference will change. This can be confirmed by connecting a calibrated wavetrap in the tv feeder so that the offending frequencies can be attenuated. If the interference is attenuated (not necessarily eliminated) as the trap is tuned through the amateur band then clearly fundamental overload is the problem, while attenuation of picture and interference together indicates interference in the tv band. The wavetrap is not a precision frequency meter, but can be calibrated well enough to distinguish between 29, 35 or 43MHz.

Taking this information and the more accurate frequency difference from the beat pattern it is possible to find the frequency which is causing trouble, and to attenuate it as necessary at the transmitter or tv receiver. Taking a specific example, suppose we had 70 beats across the screen which varied with the fine tuning, and the wavetrap considerably reduced their effect when set to "36MHz". Then clearly the beat is 70/80MHz = 0.875MHz, and as the standard vision i.f. carrier is 34·65MHz with modulation +2·75 and −0·75 MHz it seems probable that the offending frequency is 34·65 + 0·875 = 35·525MHz or possibly 34·65 − 0.875 = 33·775MHz. The operating frequency of the transmitter is 14·150kHz with the vfo at half this frequency, 7,075kHz. Now 5 × 7,075 = 35,375kHz which is close enough to 35·525 particularly when the herringbone is floating about on the screen, and the tv could be 100kHz off nominal. So the doubler stage is generating a fifth harmonic which is not attenuated sufficiently later in the transmitter. Possibly the drive levels or tuning are not quite correct—after all, you have not tuned it up that many times.

If there is no interference with carrier only, this indicates that harmonic radiation is pretty low. If a herringbone becomes visible in stripes when keyed or modulated the transmitter needs little more treatment, say another 10dB to go.

If strong interference occurs, like sound on vision with or without a herringbone only when the trasnmitter is modulated, this suggests fundamental overload which should be curable with a hpf/braid filter at the tv receiver. However, the fault may be in the transmitter installation, injecting excess fundamental into the mains, earth or tv feeder.

When the happy state of "all clear 160 thru 10" is reached, one can make a suitable entry in the log, polish one's halo and go after the dx!

QSL CORNER

by A. O. Milne, G2MI*

There seems to be confusion in some people's minds about CT3AS. Hal asks for cards to be sent to G2MI not G3MI who has been receiving quite a few. G2MI is not his QSL manager and has no access to his logs. He does his own QSLing and does so 100 per cent. *QST* please copy.

We have a lot of cards for PX1UT and VP8JF. Can anyone provide addresses?

Many members now sort their cards before sending them to the bureau, for which we are most grateful as it is a great help in clearing the vast quantities of cards expeditiously. Please do not tie them round separately, separate them with markers or put each country into an envelope marked with a prefix. All this gives the bureau extra work. Above all, please do not turn each country upside down with respect to the previous one. This can do much to drive the poor sorter up the proverbial wall.

We are still having trouble with the way in which people make the letters U, V and W. Some Ws are like Us with a faint ripple at the bottom of the letter; however, many people make their Us like this so please make these letters clearly so that there can be no mistake. D and O are another problem.

Quite a lot of envelopes sent for the collection of cards are too small, even for normal-sized cards. We have even had envelopes which will not take the sender's own card! Do not forget the callsign, A or BRS number in the *top left-hand corner* please.

Talking of envelopes being too small brings us to today's number one problem, the growing use of outsize cards. These usually have to be individually folded because they just do not fit the system. This makes for extra work at the bureau or for damaged cards. Surely it is possible to get all the relevant information on a card not more than 5½in by 3½in and still have an attractive design. We appeal especially to the organizers of special events stations, large companies who seem to provide cards for their amateur radio employees and, in fact, everyone, please to conform.

Why do some people promise to QSL during a contact and then remain deaf to all subsequent entreaty? If you operate in a "rare" area, surely it is a heaven-sent opportunity to spread a little happiness at not very great cost.

Some people are honest and straightforward and say they are not interested in cards. G6ZY, for example, does not want cards but QSLs all contacts. Incidentally another station which wants no cards is the Society's own—GB3RS. QSOs made are always QSLd but incoming cards are just an added burden for an already overloaded headquarters, so here are two chances to save sending out those expensive but unwanted cards.

A word to our listener members. Cards bearing GSWL with no "A" or "BRS" numbers are a waste of paper. We wish the printers would withdraw this design. Cards coming into the bureau addressed merely to GSWL have to be returned to the sender.

May we recommend listening to GB2RS. A lot of unnecessary correspondence could be avoided on queries such as "who is QSL sub-manager for the G3Z series. It has been on the news bulletin several times. The G3Z series QSL submanager is Mr P. R. Cheeseman, 10 Nursery Road, Hook End, Brentwood, Essex.

Finally, remember the letter postage rate is 4d for 4oz. We often get two or three envelopes from the same person, by the same post, each containing about 1oz of cards. The whole lot could have come in one envelope for 4d—or 5d.

* 29 Kechill Gardens, Bromley, Kent.

FOUR METRES AND DOWN

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

"Trident" and microwaves lead at Convention

The enthusiasm which has been ignited by the "Trident" project is compounded of a strong desire for British amateurs to be involved in space communications, plus a very considerable admiration for the work done by the South Coast VHF Group under the leadership of Fred Robins, G3GVM, in evolving the design study that must precede the hardware.

Fittingly, Project Trident will be the opening item in the lecture session. It is expected that the discussion, which may well take into account other contemporary amateur radio space activities in the light of the recent Australis Oscar success, will go on for at least three-quarters of an hour. The following lecture, timed for 2.45pm, and again in the main hall, will be on developments in the amateur microwave bands, and is to be given by Les Sharrock, G3BNL, whose recent work in this area in conjunction with G3EEZ will be fresh in members' minds. At both of these major lectures, Geoff Stone, G3FZL, chairman of the VHF Committee, will preside.

From 3.45pm to 4.15pm there will be the tea-break. After that the lecture-session divides into two streams, in accordance with last year's much-liked innovation. Here are details:

Stream A (Chairman, G2UJ). Main hall:

4.15pm to 5.15pm. "Narrow band fm techniques", by G3FZL and G3OOU.

Stream B (Chairman, G3BPT). Auxiliary hall:

4.15pm to 4.45pm. "VHF propagation by trans-equatorial scatter", by G3JHM.

4.45pm to 5.15pm. "Digital beam aerial control", by G8AOL.

Between the lecture session and the dinner (7 for 7.30) there will be virtually two hours to enable visitors to take a look, at leisure, at the trade stands, the home construction exhibits, and at the G8AXA bring and buy stand. For the latter bring along any items of equipment you wish to dispose of, put a price tag on them (allowing 10 per cent for Convention funds) and hand them to Mike Wallace to go on his stand.

Also during the lectures-to-dinner period, the grand raffle will be conducted (buy your tickets when you arrive at The Winning Post to avoid a last minute rush for them), and the home constructed entries will be judged. Bring your latest-built creation: it might win the 1962 VHF Committee Trophy for you.

At the dinner the guest of honour will be Mr F. Howard Steele, director of engineering, Independent Television Authority, who will propose the toast to "The RSGB" to which the President, Dr J. A. Saxton, will reply. Later the President will hand the 1962 VHF Committee Trophy to the winner of this year's constructors' competition.

Other distinguished guests will be Dr R. L. Smith-Rose; Mike Dormer, G3DAH, and Fred Lambeth, G2AIW, who is Europe's "VHF Sec."

Getting your tickets

The VHF Committee, in planning Convention 1970, has managed to hold admission prices, in spite of the inevitabel steep increases in the cost of everything, to the following:

All day (11am to end of dinner): 35s
Morning and afternoon: 7s
Dinner only (popular with the ladies): 28s

Cheques now, please, to Convention Secretary Frank Green, G3GMY, 48 Borough Way, Potters Bar, Herts. The event is little more than a fortnight away—Saturday 25 April.

How to get to the Convention venue

The Winning Post Hotel is on the northern side of A316, 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 5 minutes' walk from the hotel.

Operational at 10 Gigs

Any new breakthrough in the amateur microwave field never fails to bring a spate of requests from members keen to know how it was done and, especially, with what. Since the 3cm cross-Channel QSO by G3RPE/P and F2FO/P of last autumn, and the Clee-to-Cleeve 45-mile contact on this band between G3BNL/P and G3EEZ/P in February, the band has been earning itself an increasing amount of attention.

Members contemplating activity on 10GHz will no doubt like to have the following BNL/EEZ equipment details, sent in just after the February contact had been made.

At the G3EEZ/P end there was a 10,070MHz transmitter-receiver using 723A/B klystrons persuaded into the band, and built jointly by G3EEZ and G3OAD. The aerial dish was a 2ft parabola with Cutler feed.

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

Alan Wakeman, G3EEZ, adjusts the 3cm dish on the Clee Hill site from which he worked G3BNL/P over a 45-mile path

AURORAL OPENING 8 MARCH

The Society's Scientific Studies Committee wishes to make a special study of the auroral opening which occurred on 8 March. Details in log form are required from as many people as possible (including listeners) who took part in the intense activity. Times, station callsign, signal strength, beam heading (or headings) and general remarks are required.

Special SSC log forms are available on request with sae to: The VHF Manager, 11 Liphook Crescent, London SE23, but logs need not be on the forms—we would rather have as much data as possible.

Reporting should not be confined to dx, either—the total picture is being studied against theories being developed and studied by the committee at present. Complementary reports of unusual occurrences in any other bands on that day may also prove of value.

G. M. C. Stone, G3FZL
VHF manager

The transmit klystron was pulsed at an ht voltage of about 1,100V using the same pulse modulator that was used for the earlier 13cm and 9cm work. Some development work was done to find the best voltage and output in this mode. The receiver used a balanced mixer with IN23 diodes and ferrite isolator between transmitter and receiver.

During the Clee-to-Cleeve contact in February the dish was only a matter of 2ft from the ground; the wind was so rough that it almost destroyed the dish in its normal position on top of the car! The unit to be seen in the illustration herewith includes the transmitter with pulse transformer and the receiver with transistor head amplifier which is fed to the main i.f. strip in the car. This i.f. strip contains i.f. amplifier, video amplifier and gating, audio and filter, again as used on 13cm and 9cm. The pulse modulator and power supplies are also inside the car.

At the Cotswold end G3BNL/P tried a 10in dish with rear feed to produce an S9 pulse signal from G3EEZ/P. A 4ft dish with frontal feed improved the signal and produced a narrower beam. There was nothing to choose between vertical and horizontal polarization.

On the transmit side a 732A/B klystron was used, once again "bent" to 10,070MHz, modulated either with 1kHz pulse to reflector or a 1kHz pulse (width 1μs) to reflector, switchable. The device is mounted on an 8in length of WG16 waveguide choke-flange coupled to the aerial feed.

The receiver has 8in of waveguide stepped to match a CV2154 crystal with probe insertion from the output of the local oscillator, another 732A/B. From the crystal the i.f. is taken to a head amplifier (mosfet 3N140 and BF180) co-ax linked to the receiver. Separate strips are used for fm or pulse:

For fm: three EF91s and Foster Seeley discriminator at 30MHz into an active filter using three BC108s topped up by a transistor audio amplifier delivering 1W.

For pulse: three 6AK5s into a diode detector, followed by a video-amp into a one-shot multivibrator detector and pulse filter, with a final audio amplifier using a toroid to give 1kHz boost.

Tone "A"—by the ton!

As the 144MHz Open Contest neared its close on the afternoon of Sunday 8 March, many participants had already "done the ton" in the sense of having worked a hundred or more stations. Little did they suspect that an Aurora was about to assert itself, to give them a sporting chance to aim for another ton! And there *was* a chance, for as the Aurora began to provide a stupendous lift, and the contest still two hours to go, hundreds of stations throughout Europe came into rasping Tone "A" audibility. Swift two-minute QSOs developed to squeeze the maximum value from the phenomenon while it held up.

By occurring when it did, the 8 March Aurora exhibited superb timing that contrasted markedly with earlier occurrences notable for showing themselves when few operators were about. Not this one. Says Bill Scarr, G2WS, "What a turn up for the book that the auroral manifestation appeared just as the contest was beginning to get tedious. What a scoop for the cw boys—long live the brass pounders!" And truly there never was QRM like it in the bottom 150kHz of "Two" where most of the Tone "A" contacts were made.

Yet strangely enough this was an occasion when, not at all according to form, amplitude modulated telephony was actually workable off the auroral curtain. Not far from Bill Scarr, G8ANZ of Minehead heard A3 from G8ANQ in Durham, the latter beaming north, and a contact resulted. G8ANQ followed this with several other a.m. contacts with most of the prefix divisions of the UK, with much comment by all on the "sore throat effect" characteristic of auroral-returned A3.

As always with Aurora, signals came out of the north. Way down south at Crawley, G2DP ("... my first ever report to Four Metres and Down") noted that GI stations 5AJ, 5SJ and 5ALP were lost if the beam was deviated as little as 10 degrees either side of true north. A neighbour, G5MA, only 14 miles away, could not be heard direct but was 533 from out of the north. Another neighbour, Ron Ham, BRS15744, could barely hear G3JHM at three miles

by direct path, but strongly via the curtain. Both "Don Pip" and Ron Ham found the phenomenon cut out sharply at 1648gmt.

And as the Aurora folded, the feeling of "Well, that's that" compounded with contest fatigue persuaded many operators to pull the master switch. Those who did not were rewarded by a return of the phenomenon at about 1815gmt. As Ron Ham puts it, "It ebbed and flowed until 2130gmt. . . . on the 4m band the Continental broadcast stations were audible about S3-4 with auroral tone." He adds that solar storms had been intense on his radio telescope during the days preceding the 8 March appearance.

At Scunthorpe, G3CCH, too, noted 2130gmt as being the hour of the decline of the second phase. Although he stayed up until midnight nothing further was heard. By then his log showed 19 contacts in 12 countries, including two Swiss and a Czech. "I certainly think it was the longest duration Aurora I've ever heard," says Johnny Stace. As for G3LTF of Chelmsford, the auroral total was 85 stations heard.

Over at Keele in Staffordshire G3USF makes the amusedly wry comment: "This particular opening will go down in my memory as the time I heard two LX stations in one session and was not in a position to work them!" All the same, Martin Harrison was able to turn in to the Scientific Studies Committee a very detailed reception log complete with beam headings moving perceptibly from NE through N to NW, exactly in accordance with earlier auroral happenings.

If the 8 March auroral occurrence runs true to cycle it may well produce a repeat performance 27 days afterwards. This suggests that the date of Saturday 4 April, allowing a day or two either side, should be put down in the diary as a possible one for a return of auroral conditions (emphasis on possible rather than probable!). And what ranges may be expected? Here are three typicals, taken at random from the 8 March experience: G3NEO into SM7, 640 miles; G2WS to GM3UAG, 470 miles; G3CCH into Czechoslovakia, 750 miles; and many others like them, all on the key.

New on "Two"

As one of the newer comers to the ranks of the "Eight-Threes", John Wardle of Beeston in Nottingham (he received the callsign G8DKZ in February) endorses the suggestion made here that people ex-callbook should announce their identity frequently when sending. He comments, "The new calls are not in the book and so nobody knows the QTH and other details of a newcomer until he is firmly established on the air. So any publicity can be a great help in getting going."

Until 26 April G8DKZ will be operating from his home at Beeston only about 60ft asl, with a "Snowflake" transmitter running 1W. With his 4-over-4 he hopes to lift the signal out of the Trent Valley. Look for him in zone on 145·5MHz.

After 26 April the little transmitter will be slipped into a suitcase for carrying back to Cranmer Hall, St Johns, Durham, to be operated behind a "Stroke A" call. Yes, its location will be frequently stated over the air, says 'DKZ.

* * *

Very much at the other end of the callsign spectrum from 'DKZ, but also new on "Two", is G2DRT, Francis Rose of High Wycombe, holder of those venerable call-letters since way back in 1938. Some nice things he has to say about the newer licensees will be echoed by a large proportion of vhf operators. For example: "Being a 'new boy' on 2m I must say how pleased I am to have chosen to operate on this band. I like the enthusiasm of the G8s, most of them going strong with little pocket money. They put out wonderful signals with the transmitters they have made with limited resources. Takes me back a while!"

* * *

Less new on "Two", but ex-callbook until the next edition, is G8CYK, Bill Poel, of "Little Croft", Mill Hill, Shenfield, Brentwood, Essex. He has a fine 375ft site with the six-element beam another 15ft above it, fed with 100W of series gate a.m. A home-built converter that performs exceptionally well will be the subject of a "Tech corner" note later. This should pull in those Hampshire and West Country stations he is eager to work from his East Anglian site. Suggestions for schedules will be welcomed by him.

Much enjoying life on "Two", he has as his *bête noire* the people who call dx out of zone (which is all right) but fail to move back into zone when they have connected (which is all wrong).

Xtal Xchange

G3QP, J. Brindle, 406A The Spa, Melksham, Wilts, requires crystals of any type between 8 and 8·01MHz and can offer in exchange 100kHz bar, 2500kHz octal, and 3311 and 3525kHz QCC P5 type.

BRS G. R. Goldsmith, "Roseleigh," St Peter, Jersey, has a miscellany of crystals available at 5s each plus 1s p. and p. List on application to G5UM by sending an sae. He requires 9·5, 11·5, 15, 22, 29, 36, 35·5, 37 and 37·5 crystals, as well as i.f. filter crystals 1618·4 (three off) and 1620·2 (three off).

If visiting EI

From what we hear, many UK members will be following in the car-tracks of G3BA/G3BHT to the Republic of Ireland during the next few months (see page 167 last month, by the way, for details of the 'BA/BHT tour from 23 to 30 May). Much 2m operation by radio-active tourists may be expected, though it would make a nice change if someone would have a go on "Four" as well—but remember that in the Republic the allocation here is limited to 70·2 to 70·4MHz.

Bill McIlwaine, EI9F, hon sec of the IRTS, says the licensing authority views sympathetically applications for visitors' licences (they are generally in the EI2V—series, V for visitor), and it will grant permits for up to 30 days' operation per year free of charge. Applications should be addressed to: Department of Posts and Telegraphs, (G.B.) Radio Section, Hammam Buildings, O'Connell Street, Dublin 1, and should be made at least one month before the proposed visit.

The following information should be given:
- date of commencement, and duration of visit;
- band or bands to be used;
- type or types of emission to be used;
- brief details of equipment;
- if mobile, give make and registration number of vehicle if known;
- for fixed operation, give QTH.

Holders of UK licences should send a photostat copy of the *first page only* of their licence and/or their mobile licence.

Visiting amateurs will only be afforded those facilities to which their home licence ordinarily entitles them.

Contest news

Trying to please most of the public most of the time goes without saying in the deliberations of the VHF Contests Committee. On occasion also it needs to invoke a dash of Solomon's judgment.

Here is a case in point: if the rules for this month's 70MHz Open had required a start at midnight instead of 6pm, there would have been complaints that the event was too short. So it starts at 6pm—and there are cries that it is too long. There are additional disappointments because it terminates at 10am "... just when the usual Sunday morning crowd are coming on the air" (Yes, but will they not come on the previous night, knowing the contest is in action?). Still others in tvi-prone areas feel the rules debar them from coming on for the first six hours.

And so on, *et seq*. Good candid stuff—and the VHF Contests Committee welcomes it. Any comment which is constructive offers guide lines to the committee to help make a contest even more acceptable next time.

Be sure that as always the "Friends of Four" will be there on 11-12 April to show what the band is capable of producing.

As for that tvi hazard, a further comment appears below.

* * *

By now the fifth and final round of the 432MHz Cumulatives will have been played off, the overall turnout by 70cm operators having well justified the VHF Contests Committee's decision to restore this event into the calendar. Reminder to all who participated: have you got your Cumulative scores into the post to G3LAS?

* * *

Snow lay round about and the weather was foul for the 144MHz Open on 7-8 March, producing localized contacts for much of the time to the ordinarily sited (meaning most of us). The high turnout was notable for the presence of G8C-- and G8D-- men in profusion, most of them operating magnificently, or if not, then learning quickly. Some messily modulated signals damaged the image ("reputation" in more traditional language) of a certain number of callsigns, by no means all of them Class Bs. Just because this condition seems to be endemic is no reason for not trying to cure it. If the VHF Contests Committee smartly invoke rule 17 in two or three cases the trouble will stop: and they can do this if persistent offenders' callsigns show up in other contestants' logs.

Localized though the 144MHz Open may have been, there was a *frisson* of excitement in the last few hours when some signals went auroral. Key pounders were quick to seize the opportunity to work dx so presented. More about this above.

* * *

It is but five months to VHF National Field Day, and less than one to the 144MHz Portable Contest of 2–3 May. From G3JKY, hon sec of the VHF Contests Committee, come a few words in season.

About VHF NFD, "Jakey" explains the thinking behind the decision to exclude 13cm and down. "Most clubs were stretched to run three stations on the four important bands of 70, 144, 432 and 1296MHz," he says; adding the reminder that there will be a special uhf/shf contest on 3–4 October next, timed to coincide with an IARU one, which should be interesting for its possibilities for international communication on the centimetre wavelengths. Note also very specially the Microwave Contest scheduled for 14 June—very near now.

A number of experienced operators are disappointed that 2300MHz and up will not feature in Field Day this year, and they have submitted a cogent case to the committee for its restoration—if not this year (for the rules are now out) then certainly next.

Commenting on next month's 2m portable event, G3JKY in drawing attention to the innovation of running this as a long and short sectioned event remarks: "The comparison of the number of entries in each event will tell us which is the more popular." A good shot at pleasing most of the public most of the time, we guess! Take a look at the rules printed on page 182 last month to decide whether you prefer to go out just for the Sunday jaunt of eight hours or to pitch the tent for the whole 24.

Coming back now to the remark above about 4m contests and the tvi situation. . .

"Four" and tvi

What in hard fact is the size of the tvi problem on "Four"? Does it seriously inhibit contest operating (or non-contest operating for that matter) during television programme hours?

There are, we know, people in Channel 4 and 5 areas who, being tvi-proof, are prepared to use 4m on weekday evenings if others will be there to talk to them. In a fringy area in north Notts G3FDW has virtually nailed the problem; in south Notts G3EGE using a dipole in the roof space induces no tvi into his adjacent television aerials, though he points out that plenty of selectivity built into the 4m transmitter is a must: some of the ex-business radio heaps are shocking QRM-producers.

On "Two" interference to television, infrequent though it is, comes more often as not in the form of sound breakthrough (though we well recall one recalcitrant case where a member's 24MHz multiplier stage was putting patterns on the neighbour's 19in the other side of the party wall). But on "Four" it seems that video interference is the more likely cause of carpet eating in the neighbourhood. Members' palliatives, expressed either to this column or to the G3JGO/G3XIW TVI Clinic, would be welcome. Taking the easy way out by quitting "Four" is no answer when there is in fact a lot to be worked on the band if you dig—especially on cw—and if in the first place the rig is clean.

Example: G3WWF in Leeds reports that Monday evenings are being built up into quite a busy activity period on 4m in the West Riding, and as he so rightly remarks ". . . the activity is self multiplying." He says all concerned frequently tune the band while in QSO to see if any breakers are about—and they will be welcome indeed.

"If you dig . . .". Someone who does, habitually, is G3WBQ, Trevor Brook of Leatherhead, whose month by month monitoring of television frequencies adjoining our 4m band discloses fleeting auroral manifestations on far northerly signals. By and large, though, no worthwhile auroral lift has occurred from October until that which popped up at the end of 2m contest weekend 7–8 March.

Both the G3WBQ findings and those of Ron Ham, BRS15744, are fed regularly to the RSGB Scientific Studies Committee to help build a unique dossier of anomalous

propagation events. At Storrington, Ron Ham now has a second radio telescope at 95MHz, six-element J-Beam on a 6ft by 6ft reflector spaced one metre from the existing 136MHz telescope. "Some interesting results are coming up—so is the urge to build a third instrument for 300MHz," he says. Although lately much solar noise in violent peaks has been recorded at Storrington, this did not show any auroral effects on amateur vhf emissions until 8 March.

Two more seniors

When the VHF Committee looked at the certificate applications before them at the February meeting they were encouraged to see that TWO more members had claimed Senior Awards. G3OHH, that "beacon station" on 4m, gets the seventh "Senior" for 70MHz; G8AUE, equally beacon-like on 70cm, is now No 6 in the exclusive list of operators who have overcome the formidable hurdles that lie ahead of those seeking the 432MHz Senior.

Gradually, these more difficult brackets of achievement are being filled by new applicants: but one of the most difficult and prestigious of any, the 23cm slot, still carries G3MCS in solitary state. Will 1970 see additional claimants for 1,296MHz certificates awards? The state of the art is such that this ought to be happening soon.

Other "Four Metres and Down" Certificates claims ratified by the VHF Committee in February were:

70MHz transmitting: No 75 to G3VNQ.
144MHz transmitting: No 150 to G3WUW/P.
No 151 to G8BQX/P.
No 152 to G8BPY.
No 153 to G8CMB/P.
No 154 to G5UM (new QTH).
No 155 to G8AEL.
432MHz transmitting: No 66 to G8APZ.

Thus G8CMB/P becomes the first of the G8C--men to attain to certificate status, though it should be added that G3YUA, whose callsign went into the table printed here in February, secured a considerable number of the required QSLs under his previous callsign of G8CJU: which gives us the opportunity to iterate that where a member changes callsign, cards collected under the original Class B callsign still count for RSGB vhf awards, so long as he remains at the same QTH.

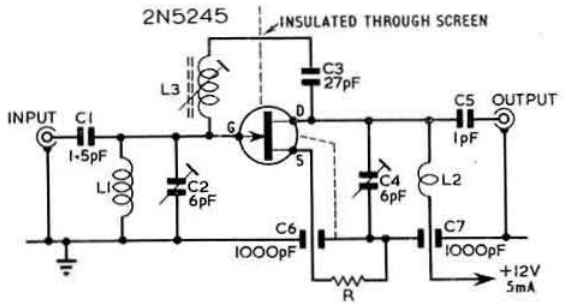
But specially note: Where a member changes QTH he is required to start from scratch in accumulating cards for "Four Metres and Down" awards.

Tech corner

From G8AVX (Bill Williams, Birmingham 24)
Here are details of a fet preamplifier for 432MHz.

Circuit description. A 2N5245 low-cost plastic fet is used in a neutralised grounded source circuit. About 12dB of gain with a noise factor of 2·5dB may be expected from a typical transistor when the circuit is correctly neutralised.

Constructional details. The amplifier is built on a piece of copper laminate fitted to a die-cast box in place of the normal lid. A second piece of double-sided copper laminate is soldered across this panel at right angles so that when the unit is assembled the box is divided into two screened compartments. The fet is fitted into a hole in the screen, source by-passed to ground by a discoidal capacitor; gate and drain connections project on opposite sides of the screen. It is important that the source lead to C6 be as short as possible (⅛in). Double-sided board allows the screen to be



The G8AVX 70cm preamplifier, using a 2N5245 fet. Component values are: C1 1·5pF, C2 6pF, C3 27pF, C4 6pF, C5 1pF, all tubular ceramic. C6, C7 1000pF discoidal. R: select to give 5mA drain current (try 300Ω). L1, 1¼t 22in id by ⅛in long. L2, half a turn at ⅛in id. L3, 3¼t closewound, on 22in mini coil former with purple grade slug, disposed to place 22ths of coil on left hand side of screen, remainder on right hand side

soldered to the chassis on both sides in the interests of stability.

For best noise performance feed the gate from a source of 1kΩ impedance. The circuit C1, L1 C2 is designed to present this impedance to the gate when resonated at 432MHz by means of C2. It is therefore important that the proportions of L1 be strictly observed. Any coil which resonates at 432MHz will not necessarily give optimum noise performance.

Alignment procedure. Select the source auto bias resistor to give a drain current of about 5mA. Beware of self oscillation when the unit is un-neutralized. If the drain current falls when L2 is touched, oscillation is taking place. The resistor is selected with the fet not oscillating.

Set the neutralizing coil core so that its end is just entering the coil and assemble the unit with its box.

Find a fairly strong signal on the converter and then insert the pre-amp between the aerial and the converter. Now adjust the trimmers C2 and C4 until the signal is heard. Slowly screw in the neutralizing coil core, periodically peaking up C2 and C4 until about 12dB of stable low noise gain is obtained. Any trace of instability means that the neutralizing requires further adjustment.

Behaviour on test. Two versions were constructed and their performances were almost identical. It was found that the neutralizing was sensitive to supply voltage. This is to be expected because the gate capacity is a function of the gate-to-drain voltage. With optimum neutralization at 12V the supply could be varied between 9V and 15V before instability or serious loss of gain resulted. A 10 per cent variation in supply voltage does, however, produce a detectable loss in performance.

Several grades of core were tried in the neutralizing coil. No difference in performance was noted although lower frequency cores were more difficult to adjust.

Compared with a bi-polar pre-amp the noise factor was at least as good—the gain about 6dB lower, but the cross-modulation performance outstanding. Weak signals could be separated from the local BBC/ITA intermodulation product which occurs at 433·5MHz.

From G8AOL (B. W. Godwin of Bexleyheath, Kent.)
I read with interest the G3YJC comments on scaling down a Multibeam for 23cm ("What they say", p100).

If the claimed gain for this aerial on 70cm can be realized

on 23cm, I would put its performance superiority over a 3ft parabola at more like 5 or 6dB.

According to Terman the gain of a 90° parabola over an isotropic is given by the expression

$$10 \log_{10} N \left(\frac{\pi D}{\lambda}\right)^2$$

This gives a gain of 20dB over an isotropic radiator, where N is the illumination factor, typically 0·65.

The point most experimenters ignore is that this assumes a point source feed at the focal point. As most dishes use a dipole feed system, the length of which is not insignificant with a 3ft dish, this means that the illumination factor will be reduced even further due to the rf feed not being at the focal point, and reducing the gain probably by another 2dB.

After taking off a further 3dB when comparing with a dipole, this produces a rather optimistic gain of 15dB over a dipole.

Assume that the contour of the parabola is reasonable. Otherwise knock off a further couple of dB.

Net result. An efficient wind break but little more.

This explains why the gain chart (Fig 9.44 on page 926 of the RSGB *VHF-UHF Manual*) does not give the gain for a dish less than 4ft diameter at 1,296MHz.

I am not suggesting that a 3ft dish will not work at 23cm, but anybody expecting huge gain figures from dishes of this size are deluding themselves. Only with dishes greater than six wavelengths in diameter does the parabola start to work properly and produce gain figures greater than can be easily realized with yagi systems, due to the matching and phasing problems involved with stacking.

As regards scaling down 70cm arrays for 23cm, a danger to avoid is a negative gain in the forward direction. Scaling down all dimensions can produce a disproportionately high capacitance loading on the ends of adjacent directors, resulting in an effectively longer director system, which, acting as reflectors, fires the rf backwards.

Nevertheless, I feel that a multi-element aerial system for 1,296MHz is required, as many would-be operators are unable to put up proper parabolas.

Here and there

Interested in some space communication frequencies? G3WBQ provides the following: NASA command module to earth, lunar module to command module, and local moon use, all 259·7MHz. Voice between astronauts in space suits on the moon is conducted on 279·0MHz, while 296·8MHz is given as the frequency for astronauts in space suits to use to earth, voice and telemetry. And Russian Soyuz 3 is said to have used 15·008MHz and 20·008MHz.

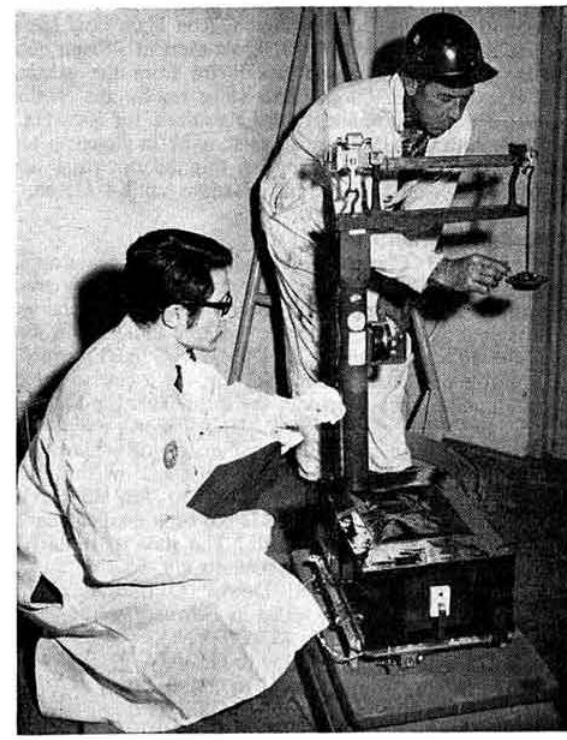
* * *

One way around tvi: when an MP in the House urged that tv sets should be adequately screened to obviate interference from local vhf transmitters, the Minister, Mr John Stonehouse, replied that the remedy was often aerial rather than set modification.

Go tell *that* to the man next door with his picture rail aerial!

* * *

GB2BVC, the talk-in station of the Northern Radio Societies Association's Convention and Exhibition, will be operating on 2m on Sunday, 26 April from 10am bst, all contacts QSLd.



Australis-Oscar-5 being weighed prior to launching
Photo: NASA

Just a reminder to any Seventy Centimental who has not already spotted it: GB3GEC is now on its new frequency of 433·45MHz, fsk by 2kHz. Its aerials, by the way, beam east and north from west London.

* * *

April is Lyrids month. Members engaged in meteor scatter observations will already have 19–23 April down in diaries as the dates when this meteor shower will be around. It will be worth checking the cw end of "Two" then even though the Lyrids are rated as a shower of only moderate intensity.

What they say

"Why don't more stations have a tone control to adjust for different microphones and conditions?"—G8CYK, Brentwood.

* * *

"Heard GM3UAG during his notable meteor scatter contact on 4m with G3JVL. Gdansk was coming in on m/s at the same time. M/s QRM on m/s!"—G6HD.

* * *

"The solar yagis, while collecting a noise storm from the sun, are at the same time being bathed in a terrestrial blizzard. Sitting in the warm radio room watching the pens on the solar recorders dancing to the outburst of energy 93 million miles away, while snow and wind hammer at the window, one wonders what else nature can hold in store for us"—BRS15744.

THE MONTH ON THE AIR

A monthly feature by JOHN ALLAWAY, G3FKM*

THE subject of QSL returns received in reply to listener reports has been studied by BRS25172, who has carried out a survey of just over 1,000 reports sent out to stations outside the UK during 1967-68. Only 12.9 per cent have so far replied and among the lowest percentage of replies came those from the USA (8 per cent) and USSR (6 per cent). The latter figure is perhaps surprising in view of the great interest taken by Russian listeners in acquiring QSLs from outside their country. At the other end of the scale, Hungary (90 per cent) and Canada and Australia (over 50 per cent) each proved to be the most helpful. It should be noted that many of the reports sent out were of cw signals and on all bands, and that the low returns were not due to the fact that strong ssb signals were being logged. It seems to be an unfortunate fact of present day living that even the most humble QSL card costs quite a lot of money and that many stations who formerly QSLd all contacts and reports now do so only when supplied with a sae. The idea of a listener card which has space for the dx operator to sign or stamp a confirmation on and return to its sender seems to be one possible solution.

G3WUD reports that his callsign is being used on 160m and that he has never operated on the band, nor is there any likelihood of his doing so in the near future.

Further to last month's comments concerning the deliberate interference which is taking place in the 3,790 to 3,800 kHz dx band, readers will be pleased to know that the callsigns of some of the chief offenders are now known and will be handed over to the authorities in Germany, Denmark, Poland and the UK unless the stations concerned cease their activities immediately.

News from overseas

Brian Harris, VS9MB, will be returning to the UK on 24 March and will once more be using his G3XGY callsign. During his stay he has made over 1,500 QSOs and many new friends. Brian's task as secretary of the ARC RAF Gan has now been taken over by Sgt Cyril Warren, Sgt's Mess, RAF Gan, BFPO 180. The club station equipment consists of an HQ170A receiver and HX50 transmitter with 60W input. Aerials consist of a beam for 10 and 15m and dipoles for 15, 20 and 40m. Club membership in February 1970 was five.

K6JAJ now has all the logs from SV0WMM and 9M2PZ, both stations were operated by Paul Zukin who has now returned to Los Angeles. Those wishing for airmail QSLs are asked to send two IRCs and sae please. Logs from KR6BD have not been received for over three years and Gary suggests that anyone needing a KR6BD QSL applies direct to Okinawa.

A letter from Mrs Margaret Swire, hon secretary of the Malta Amateur Radio Society, draws attention to the Malta Independence Day Award—this is a pennant presented each year to the amateur making the most contacts with Malta on 21 September. The 1969 winner was OH2BBR. This year's officers include 9H1U (president), 9H1BW (hon chairman), 9H1BX (hon treasurer) and 9H1BB (swl rep).

G3UOF should now be operating /MM from the mv *British Beech* on 7,010, 7,085, 14,230 and 21,320kHz. He has a Sommerkampf FT-DX 150 and a vertical antenna. Operations should continue for six months or so.

GM3IAA has forwarded details of a transmission by TA2E addressed to a European station who persisted in calling him out of turn—"I will not QSO any station who calls me during a contact with another station and what is more will add your call to my lid list, a copy of which is sent to my QSL manager so that he will not QSL should I in error QSO you." Haci went on to say that he does not acknowledge such callers but just puts them on his list. Judging by recent listening around the bands this policy could be adopted with benefit by many more stations with sought-after calls.

Alf Wilson, GI3PGG (ex-ZD1AW), is currently in Teheran and writes to say that he has been issued with the call EP2TW. He is the fifth new licensee and there are quite a few others awaiting their turn. In addition, existing licences are being renewed. The position changed in mid-December when a written appeal on behalf of the amateur movement was presented to His Imperial Majesty the Shahanshah. Alf had waited 21 months for permission to operate and

G3VOU, Jim Barlow, (right) a visitor from ss *Masirah*, in the shack of VS9MB on Gan in December 1969. G3XGY, Brian Harris, (left) has now returned to the UK and is no longer secretary of the ARC, RAF Gan

* 10 Knightlow Road, Birmingham 17.

says that there should now be more EPs on the air than ever before. He has checked "EP2RG/MM" (who has been on 80 and 160m) with the PTT and they confirm that no such call has ever been issued.

Awards

The Diplome de Geneva

USKA PO Box 524, CH-1211 Geneva 3, Switzerland

Requires contacts with six different stations in the Republic and Canton of Geneva since 1 January 1970. Stickers are issued for two further QSOs or two personal contacts (which must be confirmed by QSL). A log extract showing date, time, callsign, mode, band, reports exchanged, and the Geneva operator's name should be sent to the address above with 7 IRCs or $1. Listeners may also apply. There is no charge to blind or invalid amateurs.

The Royal Boroughs and Burghs Award

As from 1 January 1970 three Caernarvonshire stations may be worked in place of one in Caernarvon. A VHF Class 1 award is now issued to those working any one Royal Borough and two Scottish Royal Burghs. Further details from G3TBS, the *Directory of Certificates and Awards* (K6BX) or July 1969 *MOTA*. Profits go to the British Diabetic Research Fund.

The Helvetia XXII Award

Henri Bulliard, HB9RK, PO Box 384, 1701 Fribourg, Switzerland.

Awarded for confirmed contacts with all 22 Swiss cantons since 15 April 1948 on any mode or bands. QSL cards plus a check list and adequate return postage should be sent to HB9RK at the address given above. It is believed that this award is also available to listeners.

The WAB Century Club Certificate

Requires a certified list of contacts with 100 holders of WAB record books since 1 July 1969, stickers being issued for each extra 100 worked (539 books had been issued by early February). Please log WAB numbers against claimed contacts. The certificate costs 5s and may be obtained from Cannock Chase ARS, 24 Walhouse Street, Cannock, Staffs. Current WAB nets are on Mondays at 1930 on 1,880kHz, Tuesdays at 1900 on 1,860kHz, Fridays at 2100 on 3,760kHz, Saturdays at 1700 on 3,560kHz (cw only) and Sundays at 1400 on 3,760kHz. Lists of record book holders may be obtained from the above address.

The Manitoba Centennial Award

VE4JK, PO Box 365, Carman, Manitoba, Canada

Applicants need 100 points for working Manitoba stations after 31 December 1969. W/K, XE and VE stations count two points per QSO, everyone else five points. Stations may be worked on each band, and on each mode for credit but cross-mode contacts are not allowed. Two different members of the ARL of Manitoba will be designated "bonus stations" each month and will carry double point credit. Applicants should send a copy of their log and two IRCs to VE4JK.

Contests

The 1970 PACC Contest

1200 25 April to 1800 26 April

All bands 1·8 to 28MHz. Cross-band/cross-mode contacts are not valid. PA stations may only use 1,825 to 1,835kHz and will only use cw on this band. Exchanges consist of RS/T plus serial number of QSO (starting from 001), PA/PE/PI stations will also give two letters indicating their province. Each contact confirmed by "R" or "OK" counts three points, two points may be claimed for correct reception of the control number and one for receiving confirmation that the number sent has been received. Each station may be worked only once per band, either on phone or cw. A multiplier of one per province worked on each band (maximum 8 × 11 = 88) is used to arrive at the final score. Logs should be sent to Mr W. J. M. Paas, PA0ABM, Contest Manager, Zwerfruststraat 1, Middleburg, Netherlands, postmarked no later than 15 June. Fully descriptive leaflets on this contest are available from G3FKM.

The Helvetia XXII Contest 1970

1500 18 April to 1700 19 April

All bands 1·8 to 28MHz, all modes but no cross-band/cross-mode allowed. Each station may be contacted only once per band. Participants exchange RS/T plus aerial QSO number (starting from 001), additionally Swiss stations indicate their canton by a two letter suffix. Each contact counts three points, incomplete ones count one-and-a-half points, and a multiplier of the total number of cantons worked on each band added together is used to arrive at the final score. Logs should be kept separately for each band and must be recorded on one side of the entry sheet only. They should be sent within 30 days of the contest to: Marius Roschy, HB9SR, Chemin Grenadiers 8, 1700 Fribourg, Switzerland. Note that only single-operator entries are permitted. This contest is an excellent way of working stations for the Helvetia XXII Award—one of the most beautiful certificates known to the writer.

In the 1969 contest overall winner was OH2MK (18,762 points). UK scores were **GM3SDZ** (5,115 points), **G3ESF** (3,696 points), G8QZ (1,500 points) and GM5AMS (1,080 points).

In the 1969 VERON Contest **G3ESF** scored 3,366 points, and **GM3KLA** 4,446 points. These were the only two UK entries.

The Peace to Peace 1970 Contest

2100 9 May to 1500 10 May

This contest is organized by the Radio Sports Federation of the USSR and contestants gain one point by QSOs with their own country (but only if with stations more than 100km distant) and three with those in other countries.

"Countries" in this case means those on the "R-100-S" list (obtainable from PO Box 88, Moscow). This is a phone only test and covers 3·5 to 28MHz. Stations outside the USSR send RS plus serial number of QSO, Russian stations send RS and *oblast* number. Only one contact per band is permitted with any station and the multiplier is the number of different "countries" worked irrespective of band. Listeners may enter and gain one point for recording one half of a QSO, three for hearing both stations. Entries may be single-operator, single or multi-band, and multi-operator single transmitter. Mail logs before 25 May to PO Box 88, Moscow. Note that only 12 hours operating time may be counted for scoring.

Dxpeditions

The Victoria Division of WIA will be operating from Cape Hicks (the first point on the Australian mainland sighted by Captain Cook in 1770) from 18 to 20 April. The callsign will be AX3AWI/portable and they will operate on 15, 20, 40 and 80m. A special certificate and QSL will be awarded to those who contact the station—applications may go via the WIA QSL Bureau or to Russell Kelly, AX3BAG, PO Box 36, East Melbourne, Vic 3002, Australia.

Latest reports say that DL7FT's expedition to Albania is still likely to take place as planned. It is now said that in addition to the 14MHz frequency already given there will be 21MHz operation on 21,235kHz and 21,245kHz (listening up the band). No cw operation is planned.

ZK1AJ will be travelling in the Manihiki/Niue/Tokelau Is area in the near future and may operate from each place.

According to the *West Coast DX Bulletin* 5U7AI is reported to be going to Guinea and also possibly to Dahomey.

G3NMR and G3UML will once again activate GC3UML from the Forest Hotel, Guernsey, during April. The operating period will be from about 8 April to 13 April with activity centred on the WPX Contest. All bands 10 to 80m will be covered using Drake, Heath and Hy-Gain equipment, and willing attempts will be made to help those after the 5BDXCC and WAE awards. QSLs should be sent via G3UML (see *QTH Corner*); if direct reply is desired include sae.

It is rumoured that there will be another visit to St Peter and Paul Rocks by a group of Brazilians early in July.

The previously mentioned trip to Franz Josef Land by UA1CK and others is now said to be due to materialize about 7 or 15 April and to be likely to use the callsign UK1A/UA1.

Noggy, TI8NAM, was recently in the vicinity of Clipperton Is while working with Jacques Costeau and a landing was made with little difficulty. It seems that some aerials used by a French expedition on the island several years ago are still in place.

EA8HA, who speaks good English, says that he will be visiting Rio de Oro and Equatorial Guinea sometime in November and hopes to be on the air from both places operating on all bands.

The further expedition by Gus Browning, W4BPD, to the Indian Ocean area may already be on the way by the time this appears in print, as a possible starting date of 23 March was given. In his *DX'ers Magazine* Gus mentioned that he is interested in visiting at least some of the following countries—Mali (TZ), Upper Volta (XT), Comoro Is (FH8), Juan de Nova Is (FR7/J), Geyser Reef (no official prefix issued), Glorieuse Is (FR7/G), Aldabra (VQ9), Farquhar Is (VQ9/F), Blenheim Reef (no prefix) and Agalega Is (VQ8/B or 3B6). Gus strongly recommends that those who use transceivers call him off his own frequency and say "transceive", he promises to slow down proceedings to allow time for them to move frequency. He also suggests that to use the frequency of the last station who made contact is bad practice—choose what appears to be a clear spot. The equipment is largely Drake and all bands will be covered, including 160m. QSLs for the whole trip will be sent out by W2MZV (see *QTH Corner*).

ZM2AFZ is reported to be interested in the possibility of a trip to the ZM7-Tokelau Is area if he can find someone to go with him. The equipment which ZK1AJ hopes to use from Manihiki Is (ZK1) is en route from W3RLY to KH6GLU who will be sending it on to ZK1. John will not operate in ZM7 or ZK2.

KA9JC is planning an expedition to Minami Torishima (formerly Marcus Is) to last from 1 to 10 July. A 24-hours-per-day operation is aimed for on 10, 15 and 20m, and the callsign used will probably be KA1B.

Top band news

HR2HH has now made contact with his first UK station on 160m—with G2PL on 2 January. Hal's aerial is 400ft long supported 50ft above ground 250ft from one end and sloping from this point towards ground in both directions. G3OLI also worked HR2HH on 15 January.

A summary of the activities of G3IGW and G4MH (as GM3IGW/A) during the CQ 160m contest shows that they had 284 QSOs with 18 countries. 38 transatlantic QSOs included KV4FZ, W4BRB/VP7 and W3JXS/5 (Texas). G3IGW reports that George Allen heard DL9KRA in VK6 during the contest but that he was the only European positively identified. HS5ABD was active and is reported to have worked W6KWE and W7RM but no Europeans. VK6CW and VK6IZ have now joined VK6NK on the band.

The latest W1BB *160 Meter DX Bulletin* reports "firsts" in the form of QSOs between VS9OC and G3SVK and DL9KRA on 21 December, and between G3RFS and 5Z4LE/HZ. Stew also says that the station at EXPO 70 in Tokyo will have 1kW input to a vertical aerial. He also reports the possibility of a visit by W5QPX and WB9BUV to YN0 about 15 April. The Transatlantic Tests, apart from the first, all appear to have hit below par conditions.

PJ2VD is looking for European contacts and has a Viking transmitter crystal controlled on 1,807, 1,826 and 1,805kHz. His receiver is a 75A4 and he has already heard PA0PN and DL9KRA.

DX news

The HO prefix was used by stations in Panama during the period 20 February to 14 March to celebrate the occasion of the 11th Pan American Games.

ZS2MI, Marion Is, says that he will be on between 1300 and 1600 on Tuesdays, Thursdays, Saturdays and Sundays and should be found on 14,195kHz. CR3KD, Portuguese

Guinea, likewise is reported to be regularly active on Mondays, Wednesdays and Fridays at 2200 on 14,300kHz—in this case working to a list prepared by WA3HUP.

February *QST* lists the first nine winners of the 5BDXCC who are as follows: W4QCW, DL7AA, W1EVT, W8GZ, W8BT, W4IC, W1AX, W4BRB and K2BZT. W1AX has also achieved the distinction of being awarded the first five-band WAS.

The recent short burst of activity from SV0WI/JY may be connected with the fact that HM King Hussein is interested in amateur radio and has, in fact, recently joined RSGB.

A new station has been reported active from the Gilbert Is in the form of VR1V who has been heard on 14MHz ssb in the mornings.

Long Skip reports that QSL cards from Gus Browning at VQ9/A/BC, VQ9/A/EC and VQ9/A/BR will count as cards from Seychelles for DXCC purposes. "VQ1AM" who claimed to be in Zanzibar, appears to have been located elsewhere. A Portuguese group is making enquiries concerning the possible country status of the Salvage Is, a collection of islands about 200 miles south of Madeira.

W3HNK says that he is unable to help with QSL cards from KR6JT for whom he had arranged to act as QSL manager. He has never received any logs and asks everyone to QSL direct in future.

ZD9BN, Gough Is, is to be found on 14MHz ssb frequently during the evening hours. CR8AI advises QSL applicants to address envelopes to PO Box 60, Dili, Portuguese Timor, *via Darwin, Australia*—otherwise they do not arrive intact.

Peterborough's civic QSL card

QTH Corner

A2CAZ	via VE1ASJ, G. A. Mclellan, PO Box 41, E. Riverside, Kings, NB, Canada.
EP2TW	via GI3HXV, R. R. Parsons, 45 Erinvale Avenue, Finaghy, Belfast.
FL8FR	PO Box 49, Djibouti, French Territory of the Afars and Issas.
FR7ZW	BP 753, St Denis, Reunion Is.
GC3UML	via G3UML, 95 Collinwood Gardens, Clayhall, Ilford, Essex.
HS1ACH	A. L. Greend, 157 Soi 21, Sukhumwit Rd, Bangkok, Thailand.
JD1YAA	via JA1WU, T. Kurauchi, 1113-17 Higashifukai, Nagareyama City, Chiba, Japan.
JW3XK	via LA6RL, Jon Olsen, 7166 Tarva, Norway.
KC4USP	via K2BPP, David Porter, Mountainside Rd, Mendham, NJ, 07945, USA.
KC6YA	R. H. Garman, Box 185, Yap Is, Western Carolines, 96943.
KH6EDY	via KH6BZF, Lee Wical, 45-601 Luluku Rd, Kaneohe, Hawaii, 96744.
W9FIU/KS4	via W9FIU, R. Ries, 1707 W. Clark St, Champaign, Ill, USA.
KZ5NR	via WA9PZU, Mel Amidzich, 5711 W. Brooklyn Place, Milwaukee, Wis, 53216, USA.
M1I	I1BNZ, R. Carignano, Via Silvestri 221, Rome, Italy.
OJ0MI	via OH2ER, Erkki Viertola, Ulvilantie 17-H-93, Helsinki 35, Finland.
OX3FD	via WB8ABN, R. Dorsch Jr, 1745 Dakstone Dr, Rochester, Mich, 48063, USA.
PA6AA	PO Box 400, Rotterdam, Netherlands.
ex-VP1DW	Capt D. White, 16 Stour Rd, Blandford, Dorset.
VP2GRN	via W4YHB, Box 1909 Hebron Road, Hendersonville, NC, USA.
VP2SG	PO Box 94, St Vincent, BWI.
W2MZV	Hermann Bohning, PO Box 102, Yonkers, NY, 10702, USA.
ZB2BV	via G3RSJ, 2 Maltings Garth, Thurston, Bury St Edmunds, Suffolk.
ZB2BX	via GW3PSM Colin Thomas, 59 Maendy Way, Cwmbran, Mon, NP4 1HW.
4S7AB	via W2CTN, 159 Ketcham Av, Amityville, NY, 11701, USA.
5H3KJ/A	via W7VRO, Box 981, Bellingham, Wash, 98225, USA.
5H3LV/A	via VE3ODX PO Box 717, Stn "Q", Toronto 290, Ont, Canada.
8R1U	via VE3DLC, R. J. Kreger, 30 Zenith Drive, Scarborough, Ont, Canada.
9M2PZ	via K6JAJ, 4645 Oakwood Place, Riverside, Cal, 92506, USA.
9M8FMF	Box 78, Sibu, Sarawak, E. Malaysia.
9N1RA	Mrs Jinny Beyer, c/o Ford Foundation, Box 81, Katmandu, Nepal.
ex-9V1OG	M. V. Kathrens, 1 Boyle Avenue, Stanmore, Middlesex, HA7 3SL.

RSGB QSL Bureau, G2MI, Bromley, Kent.

Civic QSL cards

An outstanding example of civic co-operation with the radio amateur is instanced by the very fine QSL cards that have been provided free for Peterborough amateurs.

Forwarding one of the cards for reproduction, old-timer G2NJ (Nick Carter, of Peterborough) considers it to be about the best of its kind that he has seen. Measuring 5½ in by 4¼in, the card is superbly printed on a glossy surface and, portrayed in all its splendour, is the west front of Peterborough Cathedral, described as "the finest portico in Europe." The city's coat of arms is also shown.

Printed in black, the cards have the customary QSL data on the back (this to the design of G3KPO, Mr Douglas Byrne, RSGB area representative, who was responsible for approaching the local civic authorities for the provision of the cards).

Stations have their call-signs, names and addresses overset on the front, at their own expense, as illustrated.

Incidentally, G2NJ's first batch of these cards (60) went to Soviet stations contacted on 7MHz. "I thought they would appreciate the photograph of our beautiful minster in view of their interest in cultural matters and the arts," he says.

A footnote on the back states that further information about the city of Peterborough can be obtained from the town clerk, demonstrating that the authority is fully alive to the value of publicity through the medium of amateur radio.

Propagation Predictions

The F2 day MUFs continue to decrease during April, while at the same time the F2 night MUFs will increase. This will mainly affect 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 adversely affected 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 later afternoon until shortly after midnight and during the morning.

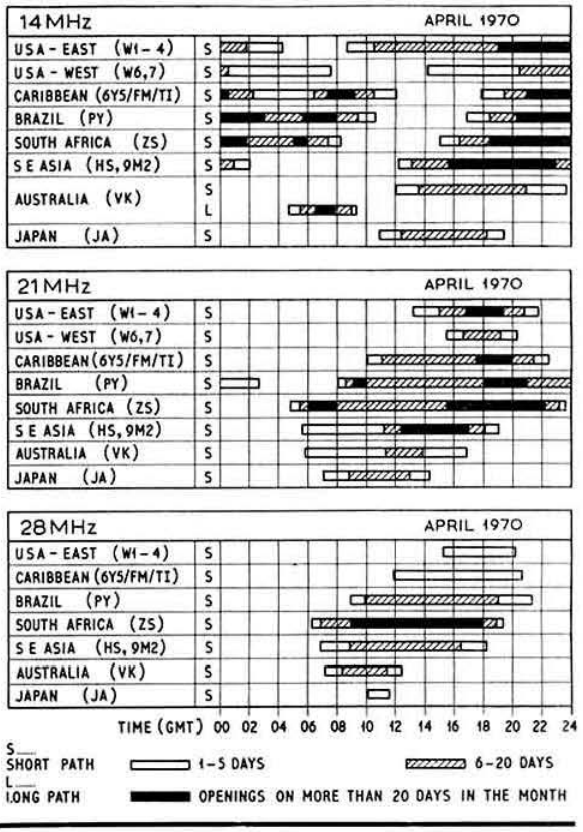
As result of the seasonal increase in static on 7 and 3·5MHz dx conditions will be markedly worse during the coming months. There will be suitable conditions for dx traffic on 7MHz during the night and at sunrise and sunset. Dx will also be possible on 3·5MHz at these times. Local traffic will seldom be interrupted by the dead zone.

The provisional sunspot number from the Swiss Federal Observatory for February 1970 was 129·8. There was considerable solar activity distributed throughout the month. Predicted smoothed sunspot numbers for June, July and August 1970 are 90, 88 and 87.

The sunspot numbers for 1969 are:

January	104	July	96
February	120	August	98
March	135	September	91
April	106	October	95
May	120	November	93
June	106	December	97

This gives a yearly mean of 105. The peak of the current sunspot cycle is now fixed at September 1968.



Euradio

Mr Lex Arnold, BRS31672, and Stephen Cole, A6148, advise the formation of this new swl dx association. Their journal *International Communications* will include much of interest to amateur and broadcast listeners. More details may be obtained from BRS31672 at 13 Little Road, Hemel Hempstead, Herts.

Band reports

Some very excellent reports are now being received by your scribe, who would like to take this opportunity of reminding reporters that if callsigns are listed in order of bands, time (to nearest hour gmt) and alphabetical order it very much lightens the task of preparing this paragraph. It seems a great pity that so much of the 28MHz band is not being used—there are large areas of space above 28.6MHz which could well be used for comparatively short-distance QSOs at a time when the band is not open for dx, thereby taking some of the load of the heavily overloaded lf bands. This month's "lid" is nominated by G3WCY who heard a European station calling "OJ0MI H/UP de . . . ."

Many thanks to the following for information submitted: G2BW, G2CDT, G2HKU, GW3AX, G3HB, GM3CSM, G3HCT, G3JVJ, G3WCY, GM4QK, G5JL, G8VG, BRS 2098, BRS17567, A6023, A6148, A6248, A6653, A6658, A6882 and A6904. Calls listed in italics were on cw, the others on ssb.

3.5MHz. **0000** EA9EJ, *UA0SA*. **0100** *EA9EJ*. **0200** VP2GLE, ZC4CV. **0300** *5H3KJ*. **0500** *CP1GN*, CT2AP. **0600** CR4BC, HK3WO, W9FIU/KS4, PJ8AA, *VP9FW*. **0700** 0A8Y, XE1CE, 9Y4CBG. **0800** HC4BS, VP2SY, ZM3s GQ/LE, ZM4s RJ/WH. **1600** KC6EJ, **1800** ZM3s GQ, 4NH. **2100** EA8HA, 9L1RP. **2200** CR4BB, EP2TW, UA0BP, VS6DR, K2RSR/VP9, ZD7SD, 6W8AL. **2300** HS5ABD, VS6s DO, DR, XW8BP, ZD3K, 4S7PB, 8P6CG, 9L1RL, 9M2FX, 9V1PB.

7MHz. **0100** EL2AK. **0500** EL2CB, CE3RR, HC8GS (QSL via HK3WO), *PJ8AA*. **0600** CP1GN, FO8BS, *HC2GG/1* HI7CAF, *KH6EFW*, *KL7JDO*, OA4NLA, TI2CAP, VP2MY VP2VI, *YS1XEE*, 5N2ABG. **0700** HR1ERB, *KJ6CD*, KZ5NR (QSL via WA9PZU), *W7HS* (Utah) *W7JLU/7* (Wash., will be on 3.5 in autumn with large aerial), YS2CEN. **0800** VK3ZL. **2000** *JA6ACZ*, *VK3MR*, *ZM3GQ*. **2200** *CX3AN*, *JX5CI*, *M1I*. **2400** *YS1O*.

14MHz. **0500** KC4USG, MP4QBK. **0600** KC4USE (QSL via K2BPP), KC4USP (Anvers Is), KH6EEU. **0700** FK8BB. **0800** FK8s AH, BH, FO8BO, KJ6BZ (Opr. Bill—, Box 924 ADS, APO, San Francisco, 96305), KW6AA, YK1AA, ZM1AAT/K. **0900** KL7BJW, KS6DH, TA1NC, VK9NI (Norfolk Is). **1000** AX0KW, UA0KIP (Wrangel Is. **1100** VK9NS (Norfolk Is). **1500** HS1ABU, 9N1MM. **1600** VK0HM, VQ8CI. **1800** *VS9MZ*, 801XA (Botswana), 9X5SP. **1900** VQ8CI, 9L1RP. **2000** FP8CS, VP2GBL, 7X0LOU, 9Y4PL. **2100** VP2s MY, VI, VJ, ZD3K, 5H3LV/A (Zanzibar). **2200** HR2WTA, SU1MA, *TA0AY*, ZD8OE, VP1RC (QSL via VE4SK). **2300** JW1CI, W9FIU/KS4, VE8GH, *ZP5AA* (QSL via ZP5CE).

21MHz. **0800** *FL8SR*, TJ1AT, YA1EXZ. **1200** HC2SW, 113TQ (? special station in Lebanon), *OJ0MI*. **1300** AP5HQ,

6Y5SR. **1400** CR8AI, *YB1AN* (Box 288, Bandung). **1500** TJ1AT. **1700** *TI9CF*. **1800** CE0TS (QSL via CE3TS), FR7ZW, JX4GN, ZD9BM, ZSs, ZS3D, 5H3KJ/A. **1900** FR7ZD, HC5EJ, KH6BB, KS6CZ, TT8AF, VP2AZ (QSL via W9HHA), 5H3MB, 5X5SL. **2000** XT2HV (QSL via K0OTU), ZF1ME (QSL to W8QQW), 7P8AB. **2100** FM7WQ, 4X4JS/OA4 (QSL to WA2CRD). **2200** OA4QN, *VE8ZZ*, W7s.

28MHz. 0900 *HS5ABD*, *ZL3IS*. **1000** AX9RY (PO Box 2073, Konedobu, Papua), *JA6AD*, KH6QR, *VK6RU*, 5N2AAF. **1100** *FL8MB*, MP4QBK, *VS9MB*, 3V8AL. **1200** EP2JP, KG6AAY, VP2LX, 5U7AI (QSL via DK3KB). **1300** VU2OLK, YA0CDRC, YS2CEN. **1400** EP2BI, HC1RM (QSL via WB8ADO), VQ8CW. **1500** *PJ9JT*, *TG4SR*, *VE8ZZ*, VP2VI, 6Y5GB. **1600** HC2HM, W9FIU/KS4. **1700** *CE8AA*, *EL2CB*, HO1JC, TR8MC, *VP2MR*. **1800** CE1LB, *KH6RS*, W5, 6, and 7, *YN1AA*.

Many thanks to all correspondents and especially to the following for items obtained from their publications: The **Ex-G Radio Club Bulletin** (*W3HQO*), **DX'press** (*PA0TO*,) **DX News Sheet** (*Geoff Watts*), the **DX'ers Magazine** (*W4BPD* the **Florida DX Report** (*W4FRO*), the **DX'er** (*K6YGS*), **NARS Newsletter** (*5N2AAF*), **Long Skip** (*VE3DID*), **On the Air** (*ON4AD*), and the **West Coast DX Bulletin** (*WA6AUD*). Please send all items for the **May** issue to **reach G3FKM** no later than **13 April,** for **June** issue by **11 May,** and for **July** issue by **8 June.**

1970 Countries Table

	1·8 MHz	3·5 MH	7 MHz	14 MHz	21 MHz	28 MHz	Total
G8VG	2	12	14	16	31	27	102
G3JVJ	4	38	10	17	14	12	95
A6248	3	54	45	101	92	62	357
ORS31427	—	8	6	159	88	70	331
A6904	10	21	30	109	92	45	307
A6148	3	66	8	37	28	39	181

(Next month's table will be in order of 1·8 plus 3·5MHz totals)

YOUR OPINION

The Editor
Radio Communication
Sir—Will you please print a correction to my letter on page 178 of the March issue of *Radio Communication*.

"I suggest a national channel of 70·375MHz with local RAEN channels in the band 70·350MHz to 70·675MHz."

Yours faithfully,
G. M. C. Stone, G3FZL

The Editor
Radio Communication
Sir—I note corrections in the February issue to the very interesting tx circuit by G3HVA in *Radio Communication* for January.

There are, however, two not noted on Fig 6 both the same error in that the 0·005 capacitors and resistors in the grids of the 12AT7 and 12BY7A shunt all rf to earth, the resistor being on the wrong side of the capacitor in each case.

I was very interested in this article and, possibly with many others, would be interested to see the circuit diagram of the harmonic monitor. This will not be known to those taking their licence out after 1962 and it is not in the *Amateur Radio Circuits Book*, Ed. 2, which I have.

Yours faithfully,
A. G. Thorburn, G3WBT

The Editor
Radio Communication
Sir—I wish to thank Mr Thorburn for locating two bad errors. The capacitors concerned should, of course, decouple on the muting side of the respective grid resistors.

Regarding the harmonic indicator, I cannot understand why it has never found a place in the *Radio Communication Handbook*. The circuit is not new, but it performs a very necessary function in the shack of any amateur aspiring to operate.

Mr Thorburn's reference to "many others" prompts me to mention the disturbing fact that so very few of these instruments have ever been made. Since they are the ultimate in simplicity this leads one to suspect two things:

1. That the majority of amateurs would rather sweep the tvi problem "under the carpet" and not operate on the bands they prefer.

2. That the commercial manufacture and widespread application of this type of test-gear to amateur equipment, whether homebrew or commercial, would be akin to showing a horror film to a small child.

Yours faithfully,
D. G. Pinnock, G3HVA

The Editor
Radio Communication
Sir—I am pleased to see that the letters feature has been restored to its former prominence.

This is European Conservation Year, and this is relevant to amateur radio in respect to our pollution problem. The lf bands are now a free-for-all. Teleprinters and jammers are everywhere, even on standard frequency transmissions, and on 2,182kHz. Never have things been so chaotic. What is so infuriating is that most of this QRM is just good old-fashioned dog-in-the-manger "keeping the channel open". On 160m it is now possible to tune right across the band on a receiver of reasonable selectivity, and the S-meter not to fall below S9+. Usually little or no information traffic is heard. I recently heard a well-known fish-phone carrying the same phone patch on three channels—all on 160m!

Never has the ratio of information to bandwidth been so low. I reckon that even spark was more efficient!

And what about tvi? Uhf should make tvi virtually impossible, but the modern set has open printed circuit construction, transistors, no screening, and no hpf on the input. Such a filter could easily replace the existing isolation capacitors (about the only British Standard that manufacturers seem to see fit to observe), giving safety plus a cut-off below 470MHz.

There is also no drive to get viewers to switch to uhf only. Brand new vhf-uhf arrays are going up around this area. All good business for the dealer, but not for us!

But may I ask what the RSGB is actively doing about this matter of bloody- (or simple?) minded behaviour. Are they hounding the appropriate authorities to abate needless non-use of amateur bands? Are they getting nasty with the tv industry? I think lots of RSGB members would like to know the answer.

Yours faithfully,
I. Jackson, G3OHX

Looking ahead

25 April—VHF Convention, Whitton, Twickenham, Mdx.

26 April—The Northern Radio Societies Association's Annual Convention and Exhibition, Belle Vue, Manchester.

10 May—Scout Rally Camp, Ampthill Park, Beds. Special event station by Bedford & District ARC.

20 May—Lecture at the IEE by Dr J. A. Saxton, President RSGB.

3–5 July—Exhibition station at the Willenhall Comprehensive School's Annual Garden Fete.

25–26 July—British Amateur Television Club Convention, Cambridge.

19–22 August—RSGB Exhibition, New Horticultural Hall, London.

11 October—RSGB Scottish VHF Convention, Dundee.

SOCIETY AFFAIRS

A brief report of the Council meeting held at Society HQ on 20 February 1970

Present: *Dr J. A. Saxton (President, in the Chair), Messrs B. Armstrong, R. J. Hughes, A. F. Hunter, G. R. Jessop, H. E. McNally, L. E. Newnham, C. H. Parsons, J. R. Petty, W. A. Scarr, R. F. Stevens, G. M. C. Stone, J. W. Swinnerton, F. C. Ward, E. W. Yeomanson (members of the Council), R. G. V. Vaughan (general manager) and A. W. Hutchinson (editor).*

Messrs J. O. Brown and A. C. Morris attended the meeting by invitation, to advise Council on financial matters.

Apologies for absence were received from Dr E. J. Allaway and Messrs Caws and Ingram.

Welcome to new member of Council

Dr Saxton welcomed Mr C. H. Parsons as a new member of Council and presented him with his Council member's badge.

Membership and affiliation

It was resolved:

(i) to elect 214 corporate members and 91 associate members;
(ii) to grant corporate membership to 21 associates;
(iii) to waive the subscription of seven members due to blindness or other disability;
(iv) to grant affiliation to the Darwen Grammar School Radio Club, the Greenford Amateur Radio Society, the Luqa Radio Club (9H1BA) Malta, the Queen Mary College Radio and Electronics Society (London) and the South Bucks VHF Club;
(v) to grant corporate membership to 145 applicants contained in block subscription applications received from various overseas organizations.

Accommodation for Maurice Child Collection

Mr Armstrong reported that he had visited Mr L. W. Jones, G5JO, and that arrangements for accommodation of the Maurice Child Collection appeared to be satisfactory. The exhibition was private, but access could be had at any convenient time by appointment with Mr Jones. After discussion, it was agreed that the Maurice Child Collection be transferred to Mr L. W Jones' exhibition, provided that suitable insurance and legal arrangements were made.

Committee recommendations

Council approved recommendations of the VHF Contests Committee, HF Contests Committee, Membership and Representation Committee, Finance and Staff Committee, and VHF Committee.

Council decided to approve a recommendation of the Membership and Representation Committee subject to the following amended wording:

"Subject to the approval of Council, where two or more members of the Society are related, family membership may be granted to a corporate member and those members of his family living with him, provided all such corporate and associate members appear in the Society's register of members as resident at the corporate member's address. The said corporate member shall be responsible for payment annually of one full subscription and half the normal rate for each member of the family membership. 'Family members' shall enjoy the rights and privileges set out in the Society's Articles of Association with the exception that only the said corporate member shall receive a copy of the Society's official journal."

Regional representative for Region 11

Council noted that Mr Williams, GW3LCQ, wished to relinquish the post of regional representative for Region 11. Council approved the appointment of Mr P. Hudson, GW3IEQ, as regional representative in place of Mr Williams.

Regional representative for Region 10

Council noted that the co-option of Mr C. H. Parsons, GW8NP, as zonal Council member for Zone E resulted in a vacancy for a regional representative for Region 10, and it approved the appointment of Mr D. M. Thomas, GW3RWX, to fill this vacancy.

Area representative for North Devon

Council approved the nomination of Mr H. G. Hughes, G4CG, as area representative for North Devon.

Society trophies

Council agreed in principle to a suggestion from the general manager that an honorary trophies manager be appointed to act as custodian of the Society's trophies.

Minutes of 1969 AGM

Council approved for publication in an early issue of *Radio Communication* an amended version of the draft minutes of the 1969 Annual General Meeting.

World Telecommunication Day, 17 May 1970

Mr R. F. Stevens said that he had received a letter from the Secretary-General of the ITU drawing attention to World Telecommunication Day, fixed as 17 May 1970. The Secretary-General had stated that the theme of World Telecommunication Day was to be telecommunications and education, and he hoped that the RSGB would be able to take steps to publicise the day.

Minutes of committee meetings

Council approved the minutes of the VHF Contests Committee (30.12.69) and (27.1.70), HF Contests Committee (22.1.70), Membership and Representation Committee (4.12.69), Finance and Staff Committee (22.1.70), Technical Committee (20.1.70), RAEN Committee (29.11.69), VHF Committee (19.1.70), Scientific Studies Committee (2.2.70) and Education Committee (10.1.70).

Other business

Mr Hunter reported that a Zone G meeting was due to be held shortly in Edinburgh. He hoped to be able to report the outcome of this meeting to Council in due course.

Mr Stevens drew attention to the valuable work carried out by Mr Bracewell, G3EGK, on collation of information concerning planning cases. Mr Bracewell had supplied a valuable summary of existing information. The President agreed to write a letter of thanks to Mr Bracewell.

Council was in session for 3¼ hours

COMMENT

The editor is advised that the letter from G3SBA (*Radio Communication* March 1970, p. 179) contains two incorrect assumptions.

Firstly, as was pointed out years ago by G5RV, there is no such thing as a tvi-proof transmitter. If a transmitter is well designed, constructed, installed and operated then it may have a very low level of harmonic or spurious radiation. However, by no magic at the transmitter can one have a guarantee against the blocking of a transistorized tv.

Secondly, on the "best" length of cable between the pa and the low pass filter, G3SBA's reasoning seems perfectly sound *if* all such filters started with a shunt section (the KW Electronics product does not), and *if* the cable does not radiate either from rf on the outside or leakage through the braid due to the large harmonic swr, and *if* operation is confined to the spot frequency corresponding to the best length.

The point is that tvi is a complex business and one should not draw all-embracing conclusions from isolated experiments. The medicine which does so much good for your headache will do no good at all for a sprained wrist!

CONTEST NEWS

The Eighth 7MHz Contest

CW Section 25–26 October 1969

The HF Contests Committee was very pleased to receive a greatly increased entry this year compared with the two previous years. There were 153 logs (with a multi-operator entry from YU3DUV with 790 points), an increase of 41 over 1968.

The overall winner, by a margin of 610 points, was A. J. Slater, G3FXB, who had 336 contacts, of which 48 were entitled to the bonus. He will be awarded the Thomas (G6QB) Memorial Trophy. The runner-up, M. A. Birch, G3KMO, had 328 contacts (42 bonus) for a total of 3,687 points. Third place went to D. H. Allerston, G5PQ, after a close fight, with 3,070 points from 263 contacts (45 bonus). The leading overseas entrant was V. B. Wakutjn, UA9WS, with 1,409 points from 40 contacts, of which nine ranked for a bonus.

There were 14 logs received in the receiving sub-section (an increase of three over last year). Of these, 11 came from overseas, including one from Japan. The winner, R. W. Thomas, BRS15822, with 1,840 points had over 1,000 points margin over his nearest rival, J. Motycka, OK1–11861, while UN1–08832 in Petrozavodsk was third with 785 points.

Telephony Section 8–9 November 1969

There was increased support in this event compared with last year but it was not up to the level of 1967. Once again the committee was disappointed that so few of the stations taking part did not trouble to send in entries. Only 11 of the 31 logs received were from UK stations.

The winner was J. Fish, G4MH, whose station was operated under supervision by G3WAH, with a score of 1,830 points from 152 contacts (35 bonus). W. K. Ginder, G3NAS, was second with 1,603 points from 112 contacts, and K. Wood, G3SME, third with 1,428 points from 116 contacts. The leading overseas entrant was UA9KAX with 1,225 points followed by F2QQ (1,085 points) and EP2BQ (900 points).

The receiving sub-section with 33 entries (27 UK and 6 overseas) showed an increase of 14 over 1968 but was still under the 1967 total. Once again, Joe Skidmore, BRS26431, headed the list with 1,863 points to repeat his successes in 1967 and 1968. A score of 1,548 for D. A. Whitaker, BRS25429, took him to second place, while S. Cole, GW–13149 was third with 1,405 points.

The leading overseas listener was R. Johansson, SM4–2825, with 865 points, followed by P. R. Ball, EI–221, (620 points).

Equipment

The leading cw station, G3FXB, used a KW Viceroy and SB301 with inverted Vee with apex at 50ft, while G3KMO had a KW Vespa Mark 2 with homebuilt receiver and two inverted Vees.

In the phone section, G4MH had a KW2000 plus KW600 with SX117 into inverted Vee and long wire. A Heathkit Marauder plus SB200 with HQ170 and inverted Vee was the line-up at G3NAS.

On the receiving side BRS15822 had a 60ft long wire to a JR500SE and HRO plus PR30X pre-selector, while BRS26431 now has a similar receiver with his 100 ft end-fed aerial.

Conditions

Conditions seem to have been much the same as last year, with very few contacts with VK and African stations, leaving the bulk of the scoring to inter-European contacts.

Comments—contestants

There were very few comments this year, so it must be assumed that the rules are satisfactory.

There were the usual complaints about broadcast stations in the band, in particular from entrants in the phone section.

Comments—committee

The logs were of a very good standard with only two in pencil and two others rather difficult to read. A few had to be re-scored, but there were too many claims for points on duplicate contacts.

There were two multi-operator entries in the phone section (G3VPS–1,235 points and LA2AB–1,058 points). Also two late entries in the cw section (G3GJO—1,455 points and W2LXK—1,660 points).

The committee gratefully acknowledges check-logs from the following: G3HCL, DM2DCH, DM2DLM, DM4ZWL, HA6KNB, HA8UF, SP4DCR, YO5AFJ, YO8FR, ZL1HV and 3Z5ATO.

CW SECTION, TRANSMITTING

Posn	Callsign	Points
1	G3FXB*	4297
2	G3KMO*	3687
3	G5PQ*	3070
4	GM3CFS	3057
5	GW3BQY	2993
6	G3KLH	2860
7	G3ESF	2790
8	GW3JI	2780
9	G3KZC	2660
10	G8PB	2515
11	G2QT	2487
12	G3VYI	2188
13	G3HZL	2180
14	G5RP	2087
15	G3KSH	1850
16	G3APN	1830
17	G3GKI	1575
18	G8KS	1470
19	G3UFW	1425
20	UA9WS*	1409
21	G3TBK	1330
22	UL7JG*	1300
23	G6TC	1225
24	G3SQX	1220
25	VO1AW*	1160
26	SM0CBC	1068
27	VE2LY	1065
28	WA1FHU	1060
29	UQ2KCR	1015
30	SM3EWB	1000
31	OK2BQB	978
32	SP2AVE/2	975
33	3Z2LV	950
34	G3WRR	900
35	G8KU	880
36	UA3LM	868
37	DM6SAK	855
	UB5KAW	855
39	UP2QA	840
40	UY5ZP	835
41	UW1CX	815
42	HB9AGH	810
	LA1OA	810
44	K4BBK	805
45	UA3QO	800
46	OK2BDE	790
47	K4JM	785
	SL0AX	785
	UA1DX	785
50	UR2QI	750
51	UA6KBS	745
	UB5NS	745
53	YU4AAW	743
54	UA1WJ	740
	3Z9ABE	740
56	OK2QX	730
57	G2GM	725
	UJ8KAA	725
	UL7GW	725
60	G3IGU	720
	HB9KC	720
62	F9LT	710
	OK2SFS	710
	YU1SF	710
65	SM7CGY	703
66	3Z9BNY	700
	OZ2UA	700
68	OK2PAE	695
	SP4DGS	695
	UQ2KAL	695
71	UA1FW	688
72	ON5WL	685
	UB5VK	685
74	UA4IM	675
	UT5DL	675
76	UR2BV	673
77	DM3ZIC	670
	UP2BU	670
79	DM2CCM	668
80	3Z8HR	665
81	G3JKY	660
	UA1TL	660
	UB5TR	660
	W3QOR	660
85	DM2BWG	655
86	HA3GA	653
87	YO2AVP	650
88	LA2Q	648
	UQ2CC	648
90	SP2BNJ	645
91	UT5NG	635
92	UA1KMD	630
	UB5MZ	630
94	SM5CMP	623
95	OH3NY	615
96	DM3BE	605
	YO9APK	605
98	OZ4H	600
	UA3RO	600
	3Z7CHR	600
101	YO2RA	598
102	OK2PAW	595
103	SM7CMV	590
	UA4KHP	590
	UQ2LP	590
	UW3UO	590
107	W7DI	585
108	UW3FW	575
109	SM4AZD	573
110	OH1LU	570
	OH3MM	570
	UC2RL	570
113	OH6ZJ	550
	UA9KHL	550
115	G5DZ	545
116	UA1KBC	543
117	W1FLN	540
118	UA1YR	525
119	OK2BBI	520
120	UP2SB	515
121	W4NM	505
122	UA3DU	495
123	UA1KUA	493
124	OH5VX	490
125	YU1NUF	478
126	OH1LX	465
127	3Z8CCO	460
128	OK1ACF	450
129	UP2AG	440
	YO5AVW	440
131	3Z2PAH	435
132	UP2BL	425
133	SP4CMY	405
134	OH4RB	400
135	UA3GO	390
136	3Z6DED	385
137	W8EY	375
138	UV3NG	370
	3Z6UK	370
140	UA4QM	365
141	YO7ARZ	363
142	G8QZ	315
	UA4KUB	315
144	LZ1KWF	305
	UP2AW	305
146	OK1FAF	300
147	UW9WB	275
148	EA3KI	265
149	UT5SY	255
150	UC2WG	253
151	SM5BTX	230
152	SM0BDS	185

PHONE SECTION, TRANSMITTING

Posn	Callsign	Points	Posn	Callsign	Points
1	G4MH*	1830	17	G5DZ	552
2	G3NAS*	1603	18	HA5CQ	475
3	G3SME*	1428	19	SM5CMP	450
4	G3KMA	1350	20	UA2KBD	423
5	UA9KAX*	1225	21	KZ5II	325
6	G3NYQ	1195		SM7DBA	325
7	F2QQ*	1085	23	LA6U	315
8	G2QT	925	24	OZ7DX	290
9	EP2BQ*	900	25	HB9UD	280
10	GD5APJ	800	26	UB5KWX	269
11	EA6BN	783	27	HB9DX	253
12	G2DC	740	28	UQ2KCR	240
13	G3KSH	640	29	OH8OA	115
14	I1PHN	585	30	YO4AKA	90
15	LA5QK	575	31	YO4CT	60
16	G3SNN	555			

CW SECTION, RECEIVING

Posn	Callsign	Points	Posn	Callsign	Points
1	BRS15822*	1840	8	UB5-065-5	495
2	OK1-11861*	805	9	A5821*	425
3	UN1-08832*	785	10	YO2-1047	405
4	OK1-12233*	755	11	UP2-038-83	375
5	UA4-133-21	705	12	SP8-1079	305
6	UC2-009-107	625	13	UQ2-037-10	300
7	BRS20240*	565	14	JA1-4876	150

PHONE SECTION, RECEIVING

Posn	Callsign	Points	Posn	Callsign	Points
1	BRS26431*	1863	18	G-6903	820
2	BRS25429*	1548	19	BRS29592	775
3	GW-13149*	1405	20	SWL Randall	760
4	BRS26003	1240	21	A6406	720
5	A6079	1231	22	BRS31172	625
6	A6003	1225		A6411	625
7	A5662	1220	24	EI-221*	620
8	A5956	1130	25	BRS30628	560
9	BRS25605	1080	26	A6075	550
10	A5489	1060	27	BRS29715	505
11	BRS28201	1035	28	BRS20249	495
12	A5154	1030		NL-455*	495
13	A5821	1010	30	OK1-15835	300
14	A6444	945	31	UB5-07325	295
15	BRS31341	935	32	SP8-1079	285
16	A6603	880	33	A6098	235
17	SM4-2825*	865			

* Certificate winners.

First results IARU Region 1 Contest 1969

Our Czechoslovakian friends, who organized the IARU Region 1 September contest in 1969, have sent us the following preliminary results:

Section I—145MHz Fixed Stations

			Points
1.	OZ1OZ	EP17e	100,765
2.	OZ6OL	FP50e	95,425
3.	G2JF	AL65d	86,558
4.	PD3HEB	DN75g	59,792
5.	DL0BR	EN75g	56,911

Section II—145MHz Portable Stations

			Points
1.	SK6AB/7	GP38j	153,497
2.	SM7BZX	GP49a	137,873
3.	OZ9SW/P	FP73a	106,935
4.	DK3GG/P	EK50c	89,867
5.	OZ3PU/P	GO03a	85,736

Section III—433MHz Fixed Stations

			Points
1.	PA0EZ	CM66b	7,478
2.	DC6QP	DK11g	6,510
3.	PA0JMS	CM72b	6,357
4.	DJ9PT	DL46c	5,922
5.	PA0HVA	CM53e	5,807

Section IV—433MHz Portable Stations

			Points
1.	GW3HAZ/P	YM25e	11,401
2.	DL7HR/P	FJ27a	10,690
3.	GD3WMS/P	XO77g	9,783
4.	DJ3ZU/P	DL52a	7,433
5.	PD3JNH/P	CM35f	7,033

Section V—1296MHz Fixed Stations

			Points
1.	DL6LM	GI72e	288
2.	DL6MHA	GJ75j	235
3.	DL1EI	FI78j	212
4.	F1XL	BI02d	28
5.	F1NC	BI22a	24

Section VI—1296 MHz Portable Stations

			Points
1.	OK3CDB/P	II19a	665
2.	GW3HAZ/P	YM25e	621
3.	DL2AS/P	GH23h	526
4.	OK1KIR/P	HI01h	507
5.	OK1BMW/P	HK52b	475

CRCC also received a 2,400MHz log from HB9RG, who made two ssb contacts: DJ4AU—335km and DJ3EN—90 km.

The full results of this contest will be sent to all competitors as soon as they are printed. Thanks to CRCC for an excellent and quick job.

January 144MHz CW Contest 1970

Although support for the January 144MHz CW Contest was again disappointing, the majority of the 22 contestants thoroughly enjoyed the event. Less than 90 stations were logged, and this regrettably small total reflects the ever diminishing proportion of Class A licences active on the band.

Two stations thought that the conditions were slightly above average, especially during the early hours, but the remainder were equally divided in describing propagation as being normal for January or decidedly poor.

The early start, which had been timed to take advantage of any dawn lift, was not an unqualified success; there being a two to one majority of opinion which thought that the better dawn conditions were insufficient to compensate for the effort of having to get up at such an unearthly hour.

The rules were considered to be simple and fair by G3JXN and GW3MFY, although G3NOH and G2WS were not alone in their condemnation of the need to exchange both QTH and QRA. G3BRK complained of few signals from the north, while G3NNG commented upon receiving consistently strong signals from G3JYP all through the contest.

Colin Desborough, G3NNG, operating from his home QTH, 400ft asl, was eventually ruled to be the winner with a score of 214 points. Congratulations, Des, in marking up another triumph for completely solid-state equipment!

The runner up was Philip Bagshaw, G3NEO, with 210 points. In contrast, Phil's equipment was more conventional, but the closeness of the final scores emphasizes the fact that operating skill remains a vital factor in the determination of all the top places.

Third place went to GW3MFY who, with considerably fewer contacts, gained his total of 173 points by being at one end of no less than a third of the best QSOs made by other contestants.

Check logs were gratefully received from G2DHV, GW3UUT/P, and from Ron Thomas, BRS15822, whose excellent copy of 33 contacts for the Listener Championship was most valuable in helping to resolve discrepancies in the competitors' log keeping.

Logs were also submitted by G3OXD/A and G3BRK who, as multi-operator stations representing clubs, failed to realize that under Rule 8b this was a contest for single-operator fixed stations only.

Posn	Call-sign	Score	QSOs	County	Best QSO km	Aerial	Power W	Ft asl
1	G3NNG	214	42	BE	G3JYP-332	6/6	25	400
2	G3NEO	210	31	YS	PA0AWN-380	5/5	150	380
3	GW3MFY	173	23	GM	G3DAH-330	6/6/6/6	100	190
4	G3JXN	165	40	LD	G3JYP-360	10 el	125	205
5	G3NOH	159	39	HF	PA0AWN-312	12 el	150	250
6	G3USB	128	27	CE	GW3UUT/P-295	10 el	150	100
7	G3BHT	108	31	WK	G3DAH-250	10 el	80	580
8	G2WS	103	21	ST	G3NEO-250	6 el	75	300
9	G3OHH	102	20	SD	G3DAH-295	4 el	50	1050
10	G3WSN	101	29	—	GW3MFY-283	12/12	75	140
11	G3FIJ	97	20	EX	GW3MFY-292	10 el	30	150
12	G3JYP	92	11	WD	G3JXN-375	6/6	100	550
13	GI5ALP	88	8	LY	G2JF-650	24 el	150	1300
14	G3NNK	82	26	EX	GW3MFY-280	6/6	100	85
15	G2HH	73	14	WE	GC2FZC-220	10 el	10	270
16	G2XV	68	18	CE	GW3UUT/P-280	3 Quad	100	50
17	G3BPM	66	20	MD	GW3MFY-225	5 el	25	—
18	G3WUW	61	18	CE	GW3VKL/P-280	8 el	30	50
19	=G3WDG	60	12	—	G3NEO-270	6 el	25	150
19	=GC2FZC	60	8	GY	G3NNG-255	8/8	60	170
21	GC3YIZ	18	3	GY	GW3MFY-235	8/8	12	25
22	G3VSZ	17	12	BS	G3KMT-90	5 el	15	550

G3OXD/A and G3BRK were disqualified under Rule 8b.

May 1970 144MHz Portable Contest

The rules for this contest published in the March issue of *Radio Communication* should have included the following General Rules: 1, 2, 4, 3a, 5a, 6a, 7a, 8c, 9a, 10, 11, 12, 13-24. In the address amend Renny to read Penny.

January 1970 144MHz SSB Contest

For once, opinion was unanimous that conditions were poor. This is generally born out although, as usual, some long-distance contacts were made. There is only one section in this contest for all classes of station and the first two places go to fixed stations. Only one portable station entered, which is not surprising considering the timing of the contest. The winner was Roger Taylor, G8BBB, with 245 points, followed by Tom Douglas, G3BA, with 192 points. Tom would rather see a reversion to a one-and-a-half hour contest as he does not feel the activity warrants more. However, others feel that the extra time provides the opportunity to search for weak dx. The longest distance contact was between G3GZJ and G3CCH at 485km.

Comments received included:

"Very few stations within range. . . . Rules are fine as they are"—G3GZJ.

"Very enjoyable . . . wish this was a monthly contest"—GI5ALP.

"Conditions grim"—G3OXD/A.

Posn	Callsign	Points	QSOs	Best dx	km	Power	Aerial
1	G8BBB	254	39	GI3GXP	445	350 O/P	10 element
2	G3BA	192	35	G3GZJ	348	400 O/P	Omni-Vee
3	G3OXD/A	181	33	G3GZJ	325	30	6/6 slot
4	G3GZJ	168	13	G3CCH	485	125 O/P	6/6 slot
5	G3DAH	135	20	G3GZJ	460	200	10 element
6	G3NEO	125	23	G3GZJ	435	150	2 × 5 element
7	GW3UCB/P	102	17	G8BBB	297	90	10 element
8	G8AJC	87	14	PA0DGH	310	100	8 element
9	G6VX	80	17	G3GZJ	327	100 O/P	6/6 slot
10	G3VKP	66	15	G3UDA	202	60 O/P	4/4 slot
11	G3EHM	50	19	G3DAH	220	400	10 element
12	G3VXK	45	12	G8BBB	247	50 O/P	10 element
13	GI5ALP	43	5	G3CCH	440	240	24 element collinear
14	G3TCG	38	10	G3BA	185	120	6/6 slot

May 1970 432MHz Open Contest

1800 gmt on 30 May to 1500gmt on 31 May.

All entries and checklogs must be sent to the adjudicator, addressed to: VHF Contests Committee, c/o G8AYN, 108 Gascoigne Rd, New Addington, Croydon, Surrey, CRO ONE.

The following general rules, as published in the January issue of *Radio Communication*, will apply: 1, 2, 3, 4a, 5a, 6a, 7a, 8a, 9a, 10, 11, 12a, 13-24.

Grafton's Annual G2AAN Top Band Contest

Dates: Phone AM only Section—11 April.
CW only Section—18 April
Phone SSB only Section—25 April

Times: 2130gmt to 2400gmt all sections.

Rules: As always before, one point per contact, any station may be worked only once in each section of the contest. RST (or RS) reports shall be exchanged followed by a serial number starting anywhere between 001 and 100 increasing by one throughout the whole contest.

All reports to be acknowledged, Competing stations shall call "CQ GRS" on cw, "CQ Grafton AM Contest" on phone, "CQ Grafton SSB Contest" on ssb phone.

Logs bearing the usual signed declaration should be sent to G3KEB at 23, Richmond House, East Street, London SE17, and must be postmarked not later than 6 May 1970. Blank log sheets and copies of the rules are available from G3KEB on receipt of an sae.

Certificates will be awarded to the two highest scores in the whole contest, and further certificates to the winners of each section.

DF Qualifying Event—Derby

Date: 26 April
Map: OS Sheet 111 (Buxton and Matlock)
Assembly: 1300bst for start at 1320bst.
Location: NGR 337464 seven miles north of Derby (approach from Hazelwood). Frequencies and callsigns will be announced at the start.

This event is being organized by Derby ARS, and intending competitors are asked to notify Alan Hitchcock of the numbers in their parties requiring tea (10s 6d a head). His address is: 38 West Road, Spondon, Derby DE2 7AB.

Please advise Alan Hitchcock as soon as possible, and in any case not later than 18 April.

DF Qualifying Event—Grimsby

Date: 10 May
Map: OS Sheet 105 (Grimsby).
Assembly: 1300bst for start at 1320bst.
Location: Waltham Aerodrome (on A16) NGR 284018. Frequencies and callsigns will be announced at the start.

This event is being organized by Grimsby ARS and intending competitors are asked to notify John Reynolds (G3RSD) of the numbers in their parties requiring tea. His address is: 91 Davenport Drive, Cleethorpes, Lincs.

Please advise G3RSD as soon as possible, and in any case not later than 4 May.

Contests calendar

11-12 April—70MHz Open
26 April—DF Qualifying Event, Derby
2-3 May*—144MHz Portable Long Section
3 May—144MHz Portable Short Section
10 May—DF Qualifying Event, Grimsby. **(New date)**
30-31 May—432MHz Open
6-7 June—HF NFD
14 June—Microwave Contest (1,296MHz and up)
14 June—DF Qualifying Event, Salisbury
21 June—70MHz Portable
28 June—DF Qualifying Event, High Wycombe
4-5 July—Summer 1·8MHz
4-5 July*—144MHz Open
11-12 July—High Power HF Field Day
19 July—DF Qualifying Event, Stratford
26 July—432MHz Open
9 August—DF Qualifying Event, Chelmsford
10 August—144MHz SSB
15-16 August—70MHz CW
5-6 September*—VHF NFD and IARU Region 1 VHF Contest
13 September—80m Field Day
20 September—DF National Final, Slade
3-4 October*—IARU Region 1 UHF/SHF Contest
10-11 October—28MHz
24-25 October—7MHz CW
7-8 November—7MHz Phone
7-8 November—144MHz CW
14-15 November—Second 1·8MHz
6 December—144MHz Fixed Station

* To coincide with IARU Contests

SPECIAL EVENT STATIONS

Cornish Societies' "Cuntelles Kernewick," 11-12 April

The Gloucester Amateur Radio Society will run a station at the Royal Agricultural College, Cirencester, on the occasion of this "Gathering of the Cornish." This event, at which delegates from Cornish societies throughout the country meet, takes place every two years and the host society this year is the Gloucester Cornish Association.

The callsign GB3CAG, "Cornish Association Gathering", has been applied for and the station hopes to be active on 3·5, 7, 14 and 21MHz from 11am 11 April until 5pm 12 April. It will be particularly on the look-out for contacts with Cornwall and Cornish amateurs overseas.

Scout Rally Camp, 10 May

The Bedford and District Amateur Radio Club will run a station at the Scout Rally Camp to be held at Ampthill Park, Bedfordshire, on 10 May which will be attended by the Chief Scout, Sir Charles MacLean, Bt.

The special callsign GB3BS has been obtained and operation will be on all bands using three transmitters. Frequencies 3,525 and 7,025kHz cw, 3,700 up and 7,025 ssb, and 144·79 vhf. A special QSL card will confirm all contacts from 10am onwards and, contacts with UK stations, especially Scout stations, will be welcome.

Willenhall, Staffs, 3-5 July

An exhibition station will be in operation at the Willenhall Comprehensive School's Annual Garden Fete from 3 to 5 July, inclusive. Bands in use are to be 160-80m and ssb, and 40-10m ssb. Requests for schedules and other information (with sae please) to: C. J. Pedley, G3YHN, 57 Temple Road, Willenhall, Staffs WV13 1ET.

MOBILE RALLY NEWS

North Midlands Mobile Rally, 19 April

At Drayton Manor Park, Drayton Bassett, nr Tamworth, on the A4091 south of the A5 which links the M1 and M6.

Official opening at noon. Talk-in stations on 2, 4 and 160m bands. For the xyl and junior ops there will be a large pool, zoo, model railway, and plenty of space for picnics. For those who do not bring food with them there will be a licensed restaurant, self-service restaurant and snack bars.

Spalding Tulip Time Rally, 3rd May

At the picnic site at Surfleet, four miles north of Spalding on the A16. Talk-in station G3VPR/P on top band 1,980kHz, and possibly on 2m.

Further details, maps and information on the tulip fields from R. Harrison, G3VPR, QTHR.

GB3EAL Mobile Rally, 10 May

At Hanwell Community Centre, Westcott Crescent, Hanwell, London W7.

The rally will be opened by the Mayor of Ealing at 1pm. The AA will be putting up signposts at the main road junctions around Hanwell, and there will be talk-in stations on 160, 4 and 2m.

There will be raffles, surplus equipment and component sales, a bring and buy stall, and trade stalls. Some 15 companies, some of them of especial interest to the ladies, will be exhibiting in the main hall. Refreshments and ample parking facilities will also be available.

Mobile rallies calendar

19 April—North Midlands Mobile Rally.

3 May—Spalding Tulip Time Rally.

3 May—Thanet Radio Society Mobile Rally, King George 6th Memorial Park, Ramsgate, Kent.

10 May—Ealing and District Amateur Radio Society Rally.

17 May—Northern Mobile Rally. Organised by the Northern Amateur Radio Mobile Society.

14 June—1st Elvaston Castle Mobile Rally, Elvaston, Derby. Organized by the Nunsfield House Community Association Amateur Radio Group. G3EEO. Further information from P. Neal, G3WFU, QTHR.

14 June—Tenth Anniversary Rally at HMS *Mercury* organized by RNARS and the Portsmouth and Fareham Radio Clubs. Further information from J. Allen, G3DOT, QTHR.

20–21 June—Anglian Mobile Radio Rally, Suffolk Showground, Ipswich. Further information from D. W. N. Thomas, G8BVE, QTHR.

21 June—University College of Swansea Amateur Radio Society's Annual Rally, Singleton Park, Swansea.

28 June—Longleat Safari Mobile Rally, Longleat House, Near Warminster. Organized by the City & County of Bristol RSGB Group.

5 July—1970 South Shields Mobile Rally.

5 July—Cornish Radio Amateur Club Rally. Further information from J. Farrar, G3UCQ, QTHR.

5 July—Amateur Radio Mobile Society's Annual Rally and Carnival, RAF/USAF Air Base, Alconbury, Hunts.

12 July—Worcester and District Amateur Radio Club Rally.

12 July—WADARC Mobile Rally, Hill County Secondary School, Upton-upon-Severn, Worcestershire.

19 July—Scarborough Amateur Radio Society Rally, Burnlston Road Barracks, Scarborough.

26 July—White Rose Mobile Rally, Allerton High School, King Lane, Leeds 17. Organized by the Pudsey & District Radio Club. Further information from K. Wells, G3WIX, QTHR.

9 August—Woburn Abbey Mobile Rally.

20 September—Peterborough Mobile Rally.

Mid-September—RSGB Scottish Mobile Rally, Region 14.

RADIO AMATEUR EMERGENCY NETWORK

By S. W. LAW, G3PAZ*

This column certainly gets around! In the December 1969 issue we gave a little news from New Zealand about the Amateur Radio Emergency Corps. Now a very welcome letter from the editor of *Break-In*, the official organ of the New Zealand Association of Radio Transmitters, encloses a whole page feature from *The Christchurch Star* dealing with the men of the Search and Rescue Organisation and how they operate. The item naturally includes the Amateur Radio Emergency Corps and the whole gives a fascinating account, with pictures and text, of the type of work which is carried out.

As a make-weight, Don Mackay, ZL3RW/ZL3EX (the editor of *Break-In*), who is also AREC representative on the SAR Committee (a government department), informs us that already this year the Christchurch AREC has supplied communications for three search and rescue operations. Also Don has kindly provided a block diagram of a model exercise, AREC style, complete with typical frequencies used. We note the use of the letter E in the emergency call-signs, which would appear to be a special provision in ZL. We wonder how the UK authorities would view this here?

One impressive point that emerges in a perusal of the material is the close-knit liaison between so many bodies of voluntary workers, each with its own brand of expertise, which operate together to the one end—search and rescue. Truly a set-up to be proud of by any standard.

Incidentally, for the night-owls, you may hear AREC on 40m but you may have to push it a bit on your rx for their 3·9MHz channel; unless you have general coverage, in which case look around 5·68-MHz for the SAR, 3·261MHz for Mountain Safety or 3·336 for the Park Boards (a modest title, we think, by UK standards!).

Group items

Surrey, now at a strength of 50, is pushing along under the firm hand of G3MFB, and the message-handling exercise on 15 February and the well-organized work on 22 March (Zulu 2) have done much to keep this well-established group to the fore. Sussex, as might be expected, is by no means idle, while Kent is often to be heard at work. The Lewisham (GLC) Group is still paying great attention to the special hazards in its area. (What will it do when the Thames Barrage becomes a reality?) Liverpool and South-west Lancs Group tried out a small scheme on 21 March to check on mobile propagation on 70·38MHz around the Rufford, Ormskirk and Parbold area, with some interesting results. By their *Newsletter* it would seem that solid-state gear is well to the fore up there. We must hear more of this.

Blurred image?

In the UK we pride ourselves on our attitude toward minorities. True, in a population of some 50 million the tiny proportion of radio amateurs is sometimes hard put to preserve a dignified image in the face of the inexorable pressure of commercial entertainment, but when it is considered that, of the 15,000 or so amateurs some 10 per cent endeavour to place their time and skill at the disposal of the authorities for the public good it seems a little odd that there are those of our ilk who still object to our use of certain frequencies. As you are no doubt aware, there have been published "protests" (not in *Radio Communication*) that RAEN "hogs" certain frequencies. Without enlarging on this point, we will only comment that a "live and let live" attitude would be a great help to all concerned and we trust that we hear no more of this petty controversy.

Honorary Registrations Secretary:
Mrs. Jane Balestrini, "Merrivale", Willow Walk, Culverstone, Gravesend, Kent.
Honorary Secretary, RAEN Committee:
Mr. E. R. L. Bassett, 57 Upper St. Helens Road, Hedge End, Southampton. SO3 4LG.

* 130 Alexandra Road, Croydon, Surrey, CRO 6EW

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 events:
Sunday, 26 April; Belle Vue Convention at Manchester.
28 June; Region 1 VHF Contest.
13 September; Region 1 Field Day.
Details for the two contests will be circularised in due course to local representatives and ASRS.

Merseyside Luncheon Club—First Monday in every month, 12.30 for 12.45, HMS *Landfall*. Please advise G3VQT or G2AMV of attendance.

Ainsdale (ARC)—1 April (G3VNQ quiz), 15 April (to be announced), 29 April (Part 2 on Aerials, by G2DQX), 8pm, The Morris Dancers, Scarisbrick.

Allerton (Liverpool) Scout Amateur Radio Society, North-West Region—First and third Thursdays each month, 8pm, Liverpool County Scout Headquarters, Richmond Street, Liverpool.

Blackburn (East Lancashire ARC)—2 April (Printed circuits—a practical demonstration, by A. E. Critchley, G3SXC), 29 April ("SSB," talk by A. Talbot, G3ORK). 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.

Bury (B & RRS)—Second Tuesday in each month with an informal meeting on the fourth Tuesday, 8pm, The George Hotel, Private Room, Market Street, Bury. Club secretary: *G3VVQ*, 411 Holcombe Road, Greenmount, Bury.

Cheshire (Mid-Cheshire ARC)—Every Wednesday. 7–8pm, RAE course by Ken Starnes, G3JWK, Alan Rigby, G3FGI and Brian Moore, G8CFY. 1 April. (Club closed due to school holidays), 8 April (Grand junk sale). Technical Activities Centre, Winsford Verdin Grammar School, Grange Lane, Winsford.

Chester (C & DARS)—2 April (Club dinner at Queens Hotel, Chester). 7 April (Net night), 14 April (Surprise demonstration), 21 April (Surplus equipment sale), 28 April (G3ATZ on to square two). 8pm, YMCA, Chester. Further details from *G8AYW*.

Douglas (D & DARS)—Second and fourth Wednesdays each month, 7pm, 19 Rosemount, Douglas. Further information from W. T. McEvoy at the same address. Telephone Douglas 6146.

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

Leyland Hundred Amateur Radio Group—Thursday night net at 2000gmt on 1·915MHz.

Liverpool (L & DARS)—Tuesdays, 8pm, Conservative Association Rooms, Church Road, Wavertree. Secretary: H. James, *G3MCN*, 448 East Prescot Road, Knotty Ash, Liverpool 14.

Liverpool (NLRC)—10, 24 April, 8 May, 8pm, Labour Party Headquarters, 13 Crosby Road South, Liverpool 22. Secretary: Peter Jeffs, 38 College Road North, Liverpool 23. Telephone 051-924 3020.

Manchester (M & DARS)—Wednesdays, 7.30pm, 203 Droylesden Road, Newton Heath, Manchester 10. Further details from *G3IOA*.

Manchester (SMRC)—Fridays, 8pm, Conservative Association Divisional Office, 449 Palatine Road, Northenden, Manchester.

North-West VHF Group—Mondays, 8pm, in the Club Caravan, Greeba, Shady Lane, Manchester 23.

Preston (PARS)—2, 16, 30 April, 7.30pm, (Private room) "Windsor Castle", St Paul's Square. Secretary: George Windsor, 26 St Gregory's Road, Preston.

Salford (Dial House Radio Society)—A society formed by GPO Engineers meets Wednesdays, 6pm, 8th Floor, River end of Dial House. Any GPO engineer who is interested should contact the secretary at Dial House, Chapel Street, Salford 3.

Southport (SRS)—Wednesdays at 8pm, Sundays at 2.30pm, The Esplanade. Please note new secretary: A. White, 91 Portland Street, Southport.

Southport (73 SSB Society)—Thursdays, 8pm. All meetings start with a talk on part of the RAE syllabus and are at 73 Avondale Road, Southport.

Stockport (SRS)—1, 15, 29 April, 8pm, Brookfield Hotel, Wellington Road South, Stockport. New or ex-members will be especially welcome to any meeting in this our fiftieth year as a society. Secretary; P. Taylor, 2 Columbia Avenue, Gorton, Manchester.

Thornton Cleveleys (TCARS)—1, 15, 29 April, 8pm, St John's Ambulance Brigade Hall, Fleetwood Road North, Thornton, Near Blackpool.

Warrington, Culcheth (CARC)—Fridays, 7.30pm, Chat Moss Hotel, Glazebury. All visitors welcome. Secretary: K. Bulgess, 32 Hendon Street, Leigh.

Westmorland—Fridays, 7.30pm, 24 Park Road, Milnthorpe. Secretary; Jim Forrester, 44 New Street, Carnforth.

Wirral (WARS)—First and third Wednesday each month, 7.30pm, Former Civil Defence Headquarters, Upton Road, Bidston, Birkenhead. Secretary: Alf Fisher, *G3WSD*, 34 Glenmore Road, Oxton, Birkenhead.

Wirral (Wirral DX Association)—Please note that meetings have been moved to the last Thursday in each month. 30 April at G3YSM (Talk on expedition to Hilbre Island). New faces are welcome but please contact the secretary, *G3OKA*, first. The association has purchased a QSL card printing machine and anticipate an increase in outgoing cards.

REGION 2 RR K. Sketheway, BRS20185

Barnsley (B & DARC)—10 April ("DX antennae", by H. Eyre, G5KM), 24 April ("Four metres", by R. Smith, G3DHU), 7.30pm, King George Hotel, Peel St, Barnsley. *G6LRP*.

Bradford (BRS)—7 April (Surprise night), 24 April (NFD arrangements), 5 May (Grand auction, 7.30pm, 10 Southbrook Terrace, Gt Horton Rd, Bradford.

Durham (DCARS)—9 April ("Scientific instrumentation", by Ted Nice), 23 April ("Plastics for radio and electronics", by Nina Martin), 7pm, Durham University's Elvet Riverside Arts Block, New Elvet, Durham.

Halifax (NHARS)—8 April (AGM), 22 April ("RAEN", by Mr Scarborough, G3MBQ), 6 May (Visit to Emley Moor tv station to view colour equipment), 17 June (Sale of surplus equipment), 7.45pm, Peat Pitts Inn, Ogden, Nr Halifax. *G3MDW*.

Meetings of the club are still fairly well attended in spite of the bad weather conditions and are still held at the Peat Pitts Inn, Ogden. It looks as though this will be the regular meeting place in the future.

Hull (H & DARS)—3 April (Practical demonstration on semi-conductors, part 2, by G3SSA and G3AGX), 10 April (Construction night), 17 April (Open night and junk sale), 24 April (Practical demonstration on semi-conductors, part 3, by G3SSA and G3AGX) 8 April (Visit to Hull telephone house), 7.45pm, Unity Hall, 592 Hessle Road, Hull. Friday 13 February was the date of the annual dinner which was held at the Beverley Arms Hotel, Beverley. 42 members and xyls attended, including amateurs from Bridlington and Driffield. Entertainment after dinner was arranged by the chairman, Mr L. D. Colley, G3AGX, and a very enjoyable evening was had by all.

Otley (ORS)—14 April (RSGB slide show about the ARRL HQ). For further details on club activities contact the chairman, Mr T. Powell, *G3NNO*, 82 Forest Avenue, Harrogate. Membership has

increased and this club has now moved to new and larger premises in the centre of Otley. This increased space will enable the club to hold lectures, slide shows etc which was not practical before due to shortage of room. On Thursday 19 March there was a visit to the Yorkshire Television Studios in Leeds. *G3NNO.*

Scarborough (SARS)—Thursdays, 7.30pm, c/o RAF Association, Fulbeck House, 3 Westover Rd, Scarborough.

Sheffield (SARC)—28 April (AGM), 8pm, Crosse Scythes Hotel, Totley. *G8NN.*

South Shields (SS & DARC)—3 April (Bring and buy sale), 10 April ("Post office tower and datal systems", by Mr Colin Forster), 8pm, Trinity House Social Centre, Laygate, South Shields.

Spen Valley (SVARS)—16 April (Swindon Cup), 23 April (Lasers at Bradford University), 30 April ("Radio and tv interference", by L. W. Burkitt), 7.30pm, The Grammar School, High St, Heckmondwike.

Sunderland (SARS)—17 April (NFD war council), 7pm, Sunderland Technical College. A warm welcome extended to all. *G3XID.*

York (YARS)—Thursdays, 7.30pm, in the British Legion, 61 Micklegate, York.

REGION 3 RR R. W. Fisher, G3PWJ

Mobile Rallies: North Midlands Mobile Rally organized jointly by the Midlands Amateur Radio Society and the Stoke-on-Trent Amateur Radio Society, 19 April, Drayton Manor Park, Nr Tamworth, Staffs. *G8ASW.*

Upton Mobile Rally organized by Worcester and District Amateur Radio Club, with many competitions and games for the children, 12 July, Hill County Secondary School, Upton-upon-Severn. *G3VJN.*

Birmingham (MARS)—14 April ("A hf band linear amplifier", by B. Palmer, G5PP), 7.45pm, Midland Institute, Margaret Street, Birmingham 3. *G8BHE.*

Bromsgrove (B & DARC)—Second Friday of each month, The Royal Oak, Barley Mow Lane, Catshill, Bromsgrove.

Coventry (CARS)—3 April (Night on the air), 10 April ("Apollo space probes", by Mr H. Miles), 17 April (Night on the air). 24 April ("ARRL HQ"—tape and slide lecture), Scout HQ, 121 St Nicholas Road, Radford, Coventry.

Dudley (DARC)—7, 21 April, 8pm, Central Library, St James' Road, Dudley. Club station: Old Windmill, Vale St, Upper Gornal, Dudley, Worcs. *G3PWJ.*

Hereford (HARS)—Every Friday, Civil Defence HQ, Goal St, Hereford. *G3RJB.*

Leamington (MWARE & RS)—6 April ("Antennas"—J Beam Engineering Ltd), 13 April (Open meeting), 20 April ("Two years as VS6AL"), 27 April (Sale of surplus equipment), 8pm, 28 Hamilton Terrace, Leamington Spa.

Lichfield (LARS)—First and third Friday of each month, The Swan Hotel, Lichfield. *G3NAS.*

Nuneaton (NARC)—2 April ("Preparing for the mobile season"). Meetings fortnightly Thursday evening, 8pm, The Grange, Caldecote, Nuneaton. *G2HAO.*

Solihull (SARS)—2 April (Club station), 9 April (Sale of surplus equipment), 16 April (Club station), 23 April (Construction competition), 7.30pm, Shrewsbury School Signals Hut. *G3UDA.*

Stoke-on-Trent (NSARS)—Every Monday evening, 7.30pm, new venue, Harold Clowes Community Association Centre, Bentilee, Stoke-on-Trent.

Stourbridge (STARS)—7 April ("VHF Contests", talk by Mr H. Parkes, G3NZS), 7.45pm, Longlands School, Stourbridge. *G8CVK.*

Stratford (SoA & DRC)—17 April (Visit to GPO, Bearley), 1 May (Home construction alignment evening), 7.30pm, Halls Croft, Old Town, Stratford. *G3RPJ.*

Sutton Coldfield (SCRS)—Second and fourth Monday of each month, Sutton Town Football Club. *G3XXJ.*

Wolverhampton (WARS)—6 April ("Talking books for the blind") 8pm, Neachells Cottage, Stockwell Road, Tettenhall, Wolverhampton. *G3UBX.*

Worcester (W & DARC)—Every Wednesday and Saturday evening, 7.30pm, Perdiswell Park, Droitwich Road. *G3VJN.*

REGION 4 RR T. Darn, G3FGY

Chesterfield (CADRS)—Second and fourth Wednesday in the month, 7pm, Hunloke Adult Education Centre, off Derby Road, Chesterfield. On the other Wednesday evenings, Morse instruction and practical work is carried out.

Derby (D & DARS)—8 April (Discussion on NFD 1970), 15 April (Direction finding practice, No 1), 22 April ("My visit to Canada", by T. Beamond, G3VLF), 26 April (National direction finding qualifying event), 29 April (Problems in bci and tvi). All meetings take place at 7.30pm, in the Society's Clubroom, 119 Green Lane, Derby.

Derby (NHCAARG)—10 April (Night on the air, ssb and cw), 17 April (SSB for beginners), 24 April (Open evening). All meetings take place on Friday evenings in Room 7, Nunsfield House, Boulton Lane, Alvaston, Derby. All are welcome.

Grimsby (GARS)—16 April (Aerials), 30 April (Problems night and preliminary NFD arrangements). All meetings on Thursdays at 8pm, The North Lincs Photograph Clubroom, rear of 50 Welholme Rd, Grimsby.

Heanor (SEDARS)—14 April (The transistor and how it works), 21 April ("Direction finding", by A. Hitchcock, G3ESB), 28 April (Sale of members surplus equipment), 5 May (Forum, questions and answers).

Leicester (LRS)—6 April (RSGB tape lecture), 13 April (Projects evening, transistor grid dip oscillator and df rx), 20 April (Installation of amateur station GB3LRS at the "Leisure 70" Exhibition at Granby Halls, Leicester, Exhibition from 22 to 25 April), 27 April (2m nigth on the air). Recent activities have included a sponsored "Listen in" event for 12hrs by a party of swls on their half term holiday. Most of the amateur bands were logged over this period and sponsors have paid up at pre-arranged rates between ½d and 6d per hour. This will help to swell the club's equipment fund.

Lincoln (LSWC)—7 April (Talk on ssb), 14 April (1969 HK0TU dxpedition to Malpelo Island. First showing in the UK), 21 April (Construction evening), 28 April (Open night). All meetings take place at 7.30pm in the Club HQ, No 2 Guardroom, Sabraon Barracks, Breadon Drive, off Burton Rd, Lincoln.

Melton Mowbray (MMARS)—17 April (Shack visit to A. Scudamore, G3YEV).

Nottingham (ARCOT)—9 April (Film show, commencing 8.15pm), 16 April (AGM. This will start promptly at 7.45pm. Observers are welcome), 23 April (Committee meeting to discuss future events. Open night for other members), 30 April (Discussion on tvi featuring guest speaker Mr F. C. Ward, G2CVV. This meeting will commence at 7.30pm).

Skegness (S & DG)—17 April (Hamfest and junk sale, including refreshments and a trade stand by John Birkett of Lincoln), 7pm, the Bull Hotel, Halton Road, Spilsby.

REGION 5 RR S. J. Granfield, G5BQ

Bedford (B & DARC)—Thursdays, 8pm (Morse classes at 7.30pm), Dolphin Inn, Broadway, Bedford. Details from J. Bennett, *G3FWA*, 47 Ibbett Close, Kempston, Bedford. Tel Kempston 2427.

The Bedford club is operating a station using the callsign GB3BS on Sunday 10 May from the Scout Rally at Ampthill Park, Bedfordshire, when the Chief Scout will attend.

Bishops Stortford (BS & DARC)—20 April (Talk by Lewis Schnurr, G5AAN), 8pm, British Legion Club, Windhill, Bishop's Stortford, Hertfordshire. Friends and visitors are welcome. Hon Sec: P. J. Toynton, *G3RGA*, Wildhern, Old Mead Lane, Henham, Herts.

Cambridge (C & DARC)—Fridays, 7.30pm, Club Headquarters, Corporation Yard, Victoria Road, Cambridge. RAE classes on Wednesdays at 7.30pm, Hon Sec: L. A. Luff, *G3XAK*, 17 Campkin Road, Cambridge.

Dunstable Downs (DDRC)—Friday evenings, Chews House, High St, Dunstable, Bedfordshire. Hon Sec: A. C. Don, *G8BWZ*, 51 Manor Park, Houghton Regis, Dunstable.

March (M & DARS)—Tuesday evenings, Old Police Headquarters, High St, March, Isle of Ely.

Peterborough (P & DARS)—Meetings are held on the first Friday in each month, 7.30pm, Electronics Section of Peterborough Technical College, Eastfield Road. Other Friday evenings they meet at the club HQ and station in the Old Windmill, behind the Peacock Inn, London Road.

Shefford (S & DARC)—2 April (Simple circuits—RAE examination refresher by G3VMI), 9 April ("Portable power supplies", by G3ROL), 16 April (Surplus sale. Checking and testing gear. Club members), 23 April ("Transistor perambulation", by G3XTQ), 30 April (Planning a portable station and vhf field day planning—club members). Hon Sec: B. Stedman, *G3XWS*, 10 Wynchwood Ave, Luton, Bedfordshire

REGION 6 RR L. W. Lewis, G8ML

Cheltenham (RSGB Group)—First Thursday, 8pm, Great Western Hotel, Clarence Street, Cheltenham.
Cheltenham (Govt Communications ARC)—Friday, 24 April (Open night 1970), 8pm, Benhall Canteen, Gloucester Road, Cheltenham. All invited, new equipment, ideas, aerials and gadgets etc on display light refreshments available. Directions and details from Hon Sec, c/o *G3SSO*.
Gloucester (GRS)—Meetings on second and fourth Thursday, 7.30pm, RAFA Club, 6 Spa Road, Gloucester.
South Bucks VHF Club—7 April (AGM), 18 April (Field exercise), 8pm, Bassetbury Manor, High Wycombe.

REGION 7 RR P. A. Thorogood, G4KD

Come and see satellites, radio and electronic equipment, Royal Signals, Royal Navy etc at the Electrical Engineers ASEE Exhibition, 8-15 April, Earls Court. Admission free by trade card or society's membership badge.
Acton, Brentford & Chiswick (ABCRC)—21 April (Sweep generators & wobbulators—theory, construction and use), 7.30pm, Chiswick Trades and Social Club, 66 High Road, Chiswick.
Addiscombe (AARC)—Second and fourth Tuesdays, 7.30pm, Toc H Hall, 158 Lower Addiscombe Road.
Ashford, Echelford (ARS)—Second and fourth Thursdays, 7.30pm, St Martins Court, Kingston Crescent, Ashford, Middx. At the last meeting over 60 members and guests listened to a talk on quality control, by Mr Smillie of RCA.
Barking (B & DREC)—Tuesdays and Thursdays, 7.30pm, Gascoigne Recreation Centre, Gascoigne School, Morley Road, Barking.
Bexleyheath (NKRS)—Second and fourth Thursdays. 9 April ("Modern electronic engine tuning," by Crypton Triangle), 32 April ("PLA communications," by G3BPT). 7.30pm, Congregational Church Hall, Chapel Road, Bexleyheath. Last meeting, 26 members and four guests heard Geoff Stone. G3FZL, give an interesting talk on the work and problems of RSGB.
Cheshunt (CDRC)—First Friday of month, 7.30pm, Methodist Church Hall, opposite Theobalds Station, Cheshunt.
Chingford (RSGB Group)—Fridays. Telephone 01-524 0308 for further information.
Chingford (SRC)—Fridays, 8pm, Friday Hill House, Simmons Lane Chingford, E4.
Civil Service (CSRS)—First and third Tuesdays. 21 April ("The Joystick, its operation, adaption for local requirements, and some modifications tried out," by D. Maclennan). 6.30pm, Civil Service Recreation Centre, Monck Street, Westminster.
Croydon (SRCC)—Third Tuesdays, 7.30pm, Swan & Sugarloaf, South Croydon.
Crystal Palace (CP & DRC)—18 April ("Amateur communications satellites," by Geoff Stone, G3FZL, also "Simple test equipment"—No 1, GDO and 'sniffers,' by Bob Burns, G3OOU, and Charlie Newton G2FKZ). February club annual awards night: Barrie Arundel for chairman's services for years 1963/69; Ann Trophy to John Townsend, G8CSC, first member to get this year's tx licence, now on 2m. 8pm, Emmanuel Church Hall, Barry Road, SE22.
Dorking (DR & DRS)—Second and fourth Tuesdays. 14 April (Fitting up gear in club shack), 28 April ("i/c frequency counter," by G3LBA), 8pm, "Wheatshaft."
Ealing (E & DARS)—Tuesdays, 7.30pm, Northfields Community Centre, Northcroft Road, W13.
East London—19 April. 2.30 for 3pm, Wanstead House, The Green, Wanstead, E11.
Edgware & Hendon (E & DRS)—13, 27 April, 8pm, St Georges' Hall, Flower Lane, Mill Hill, NW7.
Farnham, Bucks (Burnham Beeches RC)—Fortnightly Mondays, Farnham Common, Village Hall, Victoria Road.
Gravesend (GRS)—Mondays, 8pm, Community Centre, Cedar Avenue, Kings Farm Estate, Gravesend.
Guildford (G & DRS)—Second and fourth Fridays. 10 April (AGM), 7.30pm, Guildford Engineering Society, Stoke Park.
Hampton Court (TVARTS)—First Wednesday, 7.30pm, The Three Pigeons, Portsmouth Road, Surbiton.
Harlow (DRS)—Tuesdays (General), Thursdays (CW practice), Fridays (Junior), 7.30pm, Mark Hall Barn, First Avenue.
Harrow (RSH)—Every Friday. 3 April (No meeting), 10 April (Talk by G3PRR), 17 April (Practice night), 24 April (Junk sale). 8pm, Roxeth Manor School, Eastcote Lane, Harrow.

Now projects are: FET dip oscillator for VHF; FET voltmeter; swr bridge. Arnold Mynett, G3HBW, will design, and Errol Walling, G3RZK, will prepare kits for this year's projects of modular constructed transistor RXs covering tunable i.f. of 1·8 to 4MHz plus convertors for 4 and 2 metres. All in one cabinet.
Havering (H & DARC)—Fortnightly, 8pm, British Legion House, Western Road, Romford.
Hemel Hempstead (HH & DARS)—First and third Fridays, 7.30 pm, "Addmult" Sports Club, Hemel Hempstead.
Holloway (GRS)—Fridays (Club), 7.30pm. Grafton Radio Society has moved to a new headquarters at Whittington School, Highgate Hill, N19. Old and new members welcome. Grafton Top band contest, 11 April, a.m.; 18 April, cw; 25 April, ssb. Details from club secretary, Tom Coleman, at 14 Norman Court, Stapleton Hall Road, N4.
Ilford—Every Thursday, 8pm, 50 Mortlake Road, (off Ilford Lane), Ilford.
Kingston (K & DARS)—Second Wednesday. 8 April ("Construction of df receivers," by Dave Beakhurst, G3OSQ. Also discussion in which members will be able to participate in the field at a df hunt), 8pm, Penguin Lounge, 37 Brighton Road, Surbiton.
Leyton & Walthamstow—Tuesdays, 7.30pm, Leyton Senior Institute, Essex Road, E10.
London (UHF Group)—9 April (Visit to satellites stand at Earls Court Show. Meet on Royal Signals stand and see stand EE11), 7.30pm.
Loughton—Fortnightly Fridays, Loughton Hall, Rectory Lane, (near Debden Station).
Maidenhead (N & DARC)—Third Tuesday of month, 7.30pm, Victoria Hall, Cox Green, Maidenhead.
New Cross—Wednesday 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, Railwaymans Hall, Side Entrance, 58 Whytecliffe Road, Purley.
Reigate (RATS)—First Wednesday in month. 1 April (AGM), 17 April (Annual dinner, 7.30pm, at the Whyte Hart, High Street, Bletchingley. Tickets are 32/6 each. 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. 16 April (AGM and junk sale), 7.30pm, Baden Powell House, Queensgate, South Kensington, SW7.
Sidcup (CVRS)—2 April (AGM), 16 April (Surplus sale), 7 May ("Recent developments in vhf techniques," by G. M. C. Stone, G3FZL), 8pm, Congregational Church Hall, Court Road, Eltham, SE9. At the last meeting 25 listened to an interesting talk on colour tv on uhf.
Slough (SDR Group)—First Wednesday, 7.30pm, United Services Club, Wellington Street.
Southgate (SRC)—Second Thursday of month, 7.30pm, Civil Defence Hut, Bowes Road, N11.
St Albans (Verulam ARC)—15 April ("Integrated circuits, practical," by R. Joyce, G3WLM), 13 May ("Short wave communications, past, present and future," by C. Gordon, FIEE, Post Office), 7.30pm, Town Hall, St Peters Street, St Albans. All clubs welcome.
Sutton & Cheam (SCRS)—Third Tuesday. 2 April (Committee meeting—any club members can attend and would be welcome), 21 April (AGM), 7 May (Committee meeting), 8pm, The Harrow Inn, High Street, Cheam. Last meeting, when Bob Tillin gave "Antenna noise bridge" talk and demonstration, the hall was packed to capacity and a large number of visitors attended.
Welwyn (Mid-Herts ARS)—Second Thursday of month, 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 276 1262 for details).

REGION 8 RR D. N. T. Williams, G3MDO

Canterbury (EKRS)—Details of meetings from *G3MDO*.
Crawley (CARC)—Formal meeting on 22 April, at Trinity Congregational Church. Ifield, Crawley, at 8pm. Visitors and prospective members very welcome. Annual dinner and dance on 8 May, at Airport Hotel, Crawley—tickets from G3FRV or the hon sec, G3YVR.
Dover (SEKYMCAARS)—Meetings held every Thursday, 7.30pm,

YMCA Leybourne Road, Dover. Details of future meetings from *G3YQR*.

Eastbourne (SARS)—6 April ("North American tour", a talk with illustrated colour slides by Arthur Milne, G2MI), 7.30pm, The Victoria Hotel, Latimer Road, Eastbourne.

Maidstone (MYMCAARS)—Tuesdays and Fridays, 10 April (AGM), 7.30 for 7.45pm, "Y" Sports Centre, Melrose Close, Loose, Maidstone.

Mid-Sussex (MSARS)—Meetings and club station at Marle Place, Leylands Road, Burgess Hill.

Thanet (TRS)—3 April ("Visit to Bermuda", illustrated talk by G2MI. Xyls and yls invited), 4 April (Annual dinner and dance).

Tunbridge Wells (WKARS)—10 April (AGM). All meetings at the Adult Education Centre, Monson Road, Tunbridge Wells.

Worthing (W & DARC)—10 May (Top Band direction finding contest, details from G6KFH/T. Meetings held every Tuesday, 8pm, the Clubroom, Rose Wilmot Youth Centre, Littlehampton Road, Worthing.

Worthing Schools (WSRS)—17 April (Ragchew and Morse class) 24 April ("The world at your fingertips", RSGB). Meetings held Fridays during term at 4.30pm in Room 17, High School for Boys, Bolsover Road, Worthing. Further details from J. Watson, 43 Clive Avenue, Worthing.

REGION 9 RR J. Thorn, G3PQE

Barnstable & District—The new club has now been formed and named the North Devon Amateur Radio Club with G3VNM as chairman, G3EDW as treasurer, and G4CG as secretary. Meetings on second and fourth Wednesdays in each month. 7.30pm, "Grinnis" High Wall, Old Sticklepath Hill, Barnstable. *G4CG*.

Bristol City & County (BARC)—Every Tuesday and Thursday. 2 April ("Contest operating," by G3SWH), 23 April (Business meeting), 30 April ("Fm principles and techniques," by A. S. Hawker, G8CJZ). 7.30pm at the club HQ, G3TAD, University Settlement, 41 Ducie Road, Barton Hill, Bristol 5. *G3SXY*.

Bristol City & County (RSGB Group)—27 April ("RTTY," by Ken Otway, G8AGT), 7.30pm, Becket Hall, St Thomas Street, off Victoria Street, Bristol 1. *G3ULJ*.

Bristol, Shirehampton (SRC)—Every Friday at Twyford House, Shirehampton. *G3YIQ*.

University of Bristol (ARC)—Every Saturday, 2.30pm, Dept of Physics, Royal Fort, Woodland Road, Bristol. *G8ADP*,

Burnham-on-Sea (BOSARS)—Contact *G3GIW*.

Cornish (CRAC)—2 April (AGM with presentation of awards), 7.30pm, SWEB club room, Pool, Camborne. *G3UCQ*.

Falmouth Group—14, 28 April, Laburnham Drive Mission Hall. *G3OJN*.

Newquay Group—1, 15, 29 April, Treviglas School. *G3THT*.

Exeter (EARS)—7 April, YMCA, St David's Hill, Exeter. *G3HMY*.

Plymouth (PRC)—7 April (Tape lecture), 21 April (Sale of equipment presented by G3FRX and auctioned by G3LMG), 7.30pm, Club HQ, G3PRC, Virginia House, Bretonside. *G3SPI*.

Saltash (S & DARC)—3 April (Surplus Sale—to be held at Burraton Toc H Hall, Warraton Road, Saltash), 17 April (Visit to ITA transmitters, Caradon Hill, tickets obtainable from G3XWA).

South Dorset (SDARS)—3 April, Room E2, South Dorset Technical College, Newstead Road, Weymouth. *G3RZG*.

Taunton (T & DARS)—Every Friday, SEVO HQ, The Mount, Taunton Barracks. *G3WPJ*.

Torbay (TARS)—Every Tuesday and Friday. 25 April (AGM), The Club HQ, G3NJA, Bath Lane, rear 94 Belgrave Road, Torquay. *G3NQD*.

Wells (EMI Social Club)—Contact *G3MVA*.

Weston-super-Mare (WSMRS)—3 April (Discussion on entry for NFD, and RSGB film), 7.30pm, Westhaven School, Ellesmere Road, Uphill, WSM. Eric Gaukrodger. G6GU, and Ken Harvey, G5KT, paid a second visit to Weston to continue their lucid accounts of the old days of radio, with museum pieces of great interest, to a large gathering. *G3GNS*.

Yeovil (YARS)—Wednesdays, The Lodge, The Park, Yeovil. The AGM has passed and the officers continue. It was agreed to publish a news and events sheet, and talks will be given throughout the year. *G3NOF*.

REGION 10 RR D. M. Thomas, GW3RWX

Blackwood (ARC)—Fridays, 7pm, Blanche Cottage, off High St, Blackwood, Mon.

Barry College of Further Education (ARS)—Thursdays, 7pm, College of Further Education, Calcot Road, Barry, Glam. *GW3VPB*.

Cardiff (RSGB Group)—Monday 13 April (Film Show), 7.30pm, TA Centre, Park St, Cardiff. *GW3GHC*.

East Glamorgan Raynet Group—First Tuesday in each month, 7.30pm, Cardiff Emergency Services HQ, Womanby St, Cardiff. *GW3VNO*.

Hoover (ARC)—Mondays, 7.30pm, Hoover Social Club, Hoover Works, Pentrebach, Nr Merthyr, Glam. Secretary: *Mr Tribe*.

Port Talbot (ARC)—Meets on the second Tuesday of each month, 7.30pm, Trefelin Club and Institute, Port Talbot. The annual social will be held on 14 April to which all Welsh clubs and societies will be invited. An innovation this year is that ladies are included in the invitation and the event promises to exceed the high standard which we are accustomed to expect. *GW5VX*.

Pontypool (ARC)—Meets on Tuesdays at 7.30pm, during school terms at the Educational Settlement, Rockhill Road, Pontypool, Mon. *GW3JBH*.

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

Rhondda (ARS)—Meets at the Rhondda Transport Employees Club and Institute, Porth, Rhondda, Glam. Full details of meetings from *GW3PHH*.

Sully and District Short-Wave Club—Tuesdays, 7pm, at the Annexe, Sully Bowls and Social Club, 59 South Road, Sully, Glam. *GW3SLA*.

Swansea Telephone Area (ARS)—Fridays, 7.30pm, Telephone Engineering Centre, Gors Road, Townhill, Swansea, Glam. The RAE course is proving popular as also are the lectures and constructional projects. Full details from Mr M. D. E. Connor, 54 Talley Road, Penlan, Swansea.

University College, Cardiff (ARS)—Meetings in the Geology Dept, Main College, on Tuesdays at 8pm. Secretary: c/o Students Union, Dumfries Place, Cardiff.

University College, Swansea (ARS)—Details and times of meetings available from Robert Wilcox, *GW3TSH*, 520 Neuadd Lewis Jones, University College, Singleton Park, Swansea.

REGION 11 RR P. Hudson, GW3IEQ

Conway Valley Amateur Radio Club—16 April (Modern electronics, by J. Lawrence of the University of N. Wales, Bangor), 7.45pm for 8pm start, Parade Hotel, Llandudno. Once again they invite all amateurs within reasonable distance to be guests for the evening.

Rhyl and District Amateur Radio Club—10 March (Transmitters by B. Clark, GW3HGL), 7.45pm for 8pm start, Mona Hotel, Market St, Rhyl. The hon sec/treasurer, Alan Cobb, GW3YIH, has left hospital and is now at home. his leg being in plaster from hip to toe, but it will be some weeks before he will be able to return to his normal work. Should any RSGB member hear him on the air he will be more than grateful to receive a call.

REGION 12 RR A. W. Smith, GM3AEL

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

Dundee (RSGB Group)—Thursdays, 8pm, 3 Magdalen Place, (off Roseangle), Dundee. *GM3KYI*.

Lerwick Radio Club (Shetland)—Tuesdays and Thursdays, 8pm, Annsbrae House, Lerwick. *GM3XPQ*, telephone Bixter 249.

Lhanbryde (MFARS)—Mondays, 7.30pm, St Andrews School, Llanbryde, by Elgin, Morayshire. *GM3UKG*, telephone Clochan 225.

REGION 13 RR V. W. Stewart, GM3OWU

Glenrothes (Glenrothes and District ARC)—First Sunday in each month, 7.30pm, Old Nursery Buildings, Leslie, Fife. For further information contact GM3YBQ, QTHR.

Lothians Radio Society—9 April (Visit as arranged, limited to 20), 23 April (RAE preparation), 7.30pm, YMCA, St Andrew Street, Edinburgh.

REGION 14 RR N. G. Cox, GM3MUY

Ayrshire (Ardeer Recreation Club ARC)—2, 7, 9, 14, 16, 21, 23, 28, 30 April, 7.30pm, Ardeer Recreation Club, Amateur Radio Section, Stevenston, Ayrshire. For details contact J. F. McCreight, *GM3DJS*, 10 Auchenharvie Road, Saltcoats, Ayrshire.
Ayrshire (AARG)—5, 19 April, 7.30pm, ATC HQ, Kilmarnock.
Glasgow University (GURC)—17 April (Club night), 24 April (RAEN night), 7.30pm, George Service, 11 University Gardens, Glasgow W2.
Greenock (G & DARC)—3, 10, 17, 24 April, 7.30pm, Watt Library, Union Street, Greenock.
Mid-Lanark (RSGB Group)—17 April, 7.30pm, YMCA, Brandon Street, Mildenhall.

REGION 15 RR J. Thompson, GI3ILV

City of Belfast YMCA Radio Club—Mondays (Morse practice class and operating procedure), Wednesdays and Saturdays (Club night), Fridays (Tape recording group). All meetings at 8pm, City YMCA, 3rd floor, 12 Wellington Place, Belfast BT1 6GE. Further information from YMCA general office.

REGION 16 RR W. J. Green, G3FBA

Basildon (VARS)—Vange ARS meetings every Thursday, 7.30pm, The Scout Hall, Fairview Road, Basildon. *G3VOP*.
Chelmsford (CARS)—First Tuesday in each month, 7.30pm, Marconi College, Arbour Lane, Chelmsford. *G3OZF*
Colchester (CARS)—Wednesdays, 7pm, NE Essex Technical College, Colchester. Further details from R. C. Greenleaf, 27 Ernest Road, Wivenhoe, Essex.
Gt Yarmouth (YRC)—This Club now has the callsign G3YRC and meets on alternate Fridays, 7.30pm, 98 South Market Road, Gt Yarmouth. *G3HPR*, telephone Gt Yarmouth 62008.
Ipswich (IRC)—Meetings in the Red Cross HQ, Gippeswyk Avenue Ipswich. For further details contact *G3UJR*.
Maldon, Essex (NYGRG)—Thursdays, 7.30pm, The Friary, Chequers Lane, Maldon, Essex.
Norwich (NARC)—6 April ("My panadaptor", by G8AWZ), 13 April (informal meeting), 20 April (NFD discussion), 27 April (Digital clocks), 18 May (Aerial lecture, by Dud Charman, G6CJ, to be held at the Assembly House, Norwich), 7.30pm, The Brickmakers Arms, Sprowston, Norwich. Club officers for the current year are: Chairman, G2CDX; Secretary, G. Purcell, BRS30869, of 29 Seton Road, Taverham, Norwich, telephone Drayton 459.
Southend (SDRS)—Fortnightly, The Canteen, EKCO Electronics. *G8BSB*.

REGION 17 RR C. Sharpe, G2HIF

Basingstoke (BARC)—4 April (Beginner's evening), 18 April ("RTTY", by Dennis Goacher, G3LLZ), 7.30pm, Chineham House, Popley Way, Basingstoke. *G3CBU*.
Chippenham (CDARC)—14 April (First mini df hunt), 7.15pm, 28 April (AGM), 7.30pm, Boys High School, Hardenhuish Lane, Chippenham. *G3UTO*.
Fareham (FDARC)—5 April ("How receivers work", by G8BLQ), 12 April (Txers turn), 19 April ("The trouble is . . ." ask a panel of experts), 26 April (Listeners' ladder, round 4), 7.30pm, Porchester Community Centre, Porchester, Fareham, Hants. *G3XIV*.
Maidenhead (MDARC)—6 April ("Audio effects", talk and demonstration by R. Gilks), 21 April (Informal, G3WYK, club station on the air), 7.30pm, Victory Hall, Cox Green Lane, Maidenhead, Berks. *G3VMR*.
N. Berks (AERE, Harwell, ARC)—Meetings on the third Tuesday in each month, 7.30pm, Social Club, AERE, Harwell. Visitors and new members always welcome. *G3NNG*.

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 post-card similarly laid out. Each must be accompanied by a recent *Radio Communication* wrapper addressed to the advertiser, as proof of membership.

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 equipment offered for sale.

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

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. No correspondence concerning this free service can be entered into.

See the current order form for further details.

FOR SALE

SR200 ham band rx, 6 mnths old, slight mod for Q mult, £34. Heathkit Q mult, 1·6MHz i.f., £4. CR45 RB, coils for 550kHz-30MHz, as new, £9. Buyer coll. Watson, Beulah, Dartford Rd, Horton Kirby, Dartford, Kent. Tel Farningham 2239.

Heathkit Mohican rx in gd wkg order and recently re-aligned. Absolutely complete with batts and hndbk, £25 inc carr. G. Batten, Uplands, Salisbury Road, Marlborough, Wilts. Tel Marlborough 2562.

40W six band cw tx, full break-in, £12 10s. GM4QK, QTHR. Tel Strathaven 3332.

Lafayette HA350 rx, ex cond with xtal calib and spkr, £40. B44 Mk2, new case, mains psu part completed, £4. G8AWV, QTHR. Tel 794 9934.

Valves: 832, QQVO6-40 (3), 866A (5), 807 (3), EBF80, ECC85, PCF80, 6AK5 (4), 6AL5, 6C4, 6A8, 6AB7M, 6F6G (4), 6H6M (3), 6J5, 6J7, 6K6GT, 6K7 (2), 6SL7GT (2), 6SN7GT, 6SQ7M, 6SS7M, 12A6M (2), EF50 (7), 5R4GY (2), 5U4G (2), U50, UU5. Fair offers. G2DZ, QTHR.

22 set with shop built psu. Also hdphns, mic, two spare valves, additional top coverage. All in wrkg order, £6 comp. N. Bishop, 33 Hodes Lane, Ramsgate, Kent. Tel Thanet 54812.

Avo electronic test unit, £6. Jap multimeter, £2 10s. Mark Heliwhip for 2m and single hole mount, £5. 12177·5kHz xtal for KW2000A/B, 30s. All above new. Grampian DP4H mic, mint, £6. G3UFU, QTHR. Tel 405 7336.

1155 rx, built in psu, £5. Eagle rx 160m to 10m, £10. Tilling, 74 Campfield Road, St Albans, Herts.

KW2000 with ac psu, FL1000, mic and swr bridge. £170 ono. G3IBW, 15 Hood Way, Norwich Road, Thetford, Norfolk.

Creed 7B teleprinter, exc cond, including both carriages, £17 including carriage. G3OUF, c/o G3XPU, RSGB HQ. Write or telephone 01-837 8688.

Heathkit DX4OU, £15, or exchange for GC-1U. Wanted: R1084. G2BZQ, Flat 20, Fairview, Norreys Drive, Maidenhead, Berks. Tel Maidenhead 31902.

BC453 (Q5er), BC433, 0·5-1·5MHz, £4 each. BC454-B, 3-6MHz, new, £2 10s. BC455, 6-9MHz, mod, £2. Lot, £12 with 3 mountings. 810 two 813s, £2. Standard radio absorption wavemeter, 0·18-87MHz, £3 10s.

Two 38 Sets, £3 pair. G2HCJ, QTHR.

40ft tilt-over mast, winch, mains rotator indicator system, Labgear quad. Offers. G3PJM, QTHR, Tel Walsall 21014.

Swop 5 band am/cw tx (Geloso vfo, TT21 pa, 50W, nice grey case) for working Pye Ranger or similar for 2m. Does not matter if not converted to 2m. Stockley, 6 Vulcan Close, Whitstable, Kent.

Swan 350+ac psu, xtal calib, vox. New 6HF5, £175 ono. GM8AT, QTHR.

AR88LF, gd cond, comp with manual etc. Deliver 50 miles, £28. 6 off 5·200MHz 10X etchable type xtals, 15s. Class D w/meter xtal, £1. Eddystone bug-key, £1. Post extra. G3IUV, QTHR. Tel Bristol 692995.

Sommerkamp FR100B, £85. FL200B, £90. Both exc cond. G3VSW, QTHR. Tel Beaconsfield 2077.

DX4OU and VF1U with both manuals and in very gd cond, £20, or part exchange for HW32A and mains psu. G3YFG, 11 Clarendon St, Accrington, Lancs.

Hallicrafters HT32 tx and rx SX101A, ssb/am/cw with cal, notch filt etc. 10-80m comp station with mic and key. All in nice cond, £145, may split. Also Collins KWS1 tx, capable 1,000W ssb/cw or 300W am. Has two 4X250s in final. Needs psu, £225. Want mags and hndbks to start library. G3ODT, Station Cottage, Bampton Tiverton, Devon.

HW17 and dc psu, £45 ono. Rx insensitive. G8BWH, QTHR. Tel Dton 3436 during office hours.

EC10, both psus, mint, £35. Part built lin amp for 4-400 with two 4-400s, £25. Home brew rx, electroniques coil pack, 2·1kHz mech filter, usb/lsb xtals in KW cab, offers, why. G3NXQ, QTHR.

Tavasu whip with 160/80/20m coils, £7 5s. Will split. Labgear/M 160/80m twin miniature tx, £12. Labgear /M psu, £6. 80m transistor convtr, tunes on car radio, 50s. All circuits and hdbks. G3VCJ, QTHR.

Rtty paper packs, 2-ply carbon duplicator copies, 2/6 each. Box of 4, 7/6 post free. 2 + 1 carrier telephone terminals, 240V ac 12V dc, hndbk, spares, 70s each, £5 pair. Carriage extra. Dial lamps, 6-8V, mbc, 6s doz. G3GDT, Aerial Radio Group, c/o B. A. Toms, 38 Ashbourne Ave., South Woodford, London E18.

Exc Brush xtal mic, £2. Heavy duty smoothing chokes. Foot operated change over switch. All cheap. G3KH, 133 Station Rd, Cropston, Leicester. LE7 7HH.

R1392, 100-156MHz, £10 or would swap communications rx or tape recorder or why. G8DAN, 61 West St Tavistock, Devon. PL19 8JZ. Tel Tavistock 2827.

Choke, 9-60H, 400mA, 30s. Dynometer, unused, 12/350V dc, 180mA, £1. Vibrators, 6V, non-sync Plessey 614, 3/6 each. Valves: 807 (7), 1625 (1), 5s each, 25s the lot. 6AC7s, VR136s, E1148, 6N7, 6SJ7, 6A67, all free. Buyer coll. G3JNM, QTHR. Tel Macclesfield 2668.

T28 rx, 160-80m, perf, only 12 hours use, £12. B40 rx, no mods, perf wkg order, £16. Joystick VFA and 3A tuner, £6. Farman, 266 Old Church Rd, Clevedon, Somerset. Tel 4270.

B40 rx, exc cond, gen cover 650kHz-30MHz, inc xtal filt, £20. Buyer coll. GW3YQM, 4 Green Park, Pentlepoir, Saundersfoot, Pembs. Tel Saundersfoot 3351.

131 *SWMs*, March 1952 to June 1963, gd cond, £3. 34 *QST* used cond, 30s. Varley 20W multi ratio hifi output trnsfmr, 30s. All carr paid. G3JMO, QTHR.

RT-18/ARC-1 100-156MHz tx/rx, 23 valves, 2 × 832, 12 × 6AK5, 2 × 6V6, dynamotor, xtal, £8 with valves, £3 without. TS250/APN 70cm test tx, 7 valves, £3. 75MHz beacon rx, 5 min valves, 30s. G3IEE, 14 Leewood Way, Effingham, Surrey. Tel Bookham 5439.

SR550 ham bnd rx, £20 ono. Minimitter /M tx 160, 80, 40m, comp with dc psu and all leads etc plus 160m transistor rx, total cost, £25. G3VQL, QTHR. Tel Shrewsbury 51733.

Permalux 240V ac reversible motor, 15in and 1in Picador V pulley,

2-1½ Picador plummer bearings, never used, £7 10s. G3XOM, QTHR.

2m station: 15W tx, £2. Transistor convtr + valve rx, £12 ono. Large ht/lt psu, £2 10s. Will exch for HW30 trnscvr. Lots of other vhf/lf comps. Pref buyer coll. G8BXG, QTHR.

AT5 with /M psu and control unit, £16. T28 for spares, £2. E-Z match, £9. Eagle TE-188 sig gen, £8. Eddystone transmitting type split stator, 50pF each section, 25s. G4HU, 34 Birch Ave, Rimiley, Cheshire, SK6 4DG. Tel 061-430 3858.

V-4-6 ant with 80m loading coil, £8 10s. G3VXZ, QTHR. Tel Maidenhead 27350.

BC221 with psu and charts, no case, spare xtal, and headphones supplied, £16. G8AKA, QTHR. Tel Broadstone 5297.

KW Valiant, am/cw, 10-160m, ac relay controlled psu. Works fb all bands, £25. Barry, 47 Gerald Road, Wollaston, Stourbridge, Worcs.

2m tx, well built, QQVO6-4OA final, up to 150W input, £25. Modulator; pp 807s for same with mod trnsfmr, £7. Psu's for above, £10. 2m trnscvr, transistor pp. G3JGJ, QTHR.

Lektrokit cab kits, 17in × 5in × 5in, brand new parts, 30s. 9in × 5in × 5in, 20s. Chassis plates 1/6d, pins 3/6d per 100. Trnsfmrs: 3 × 12·6V 3A, 0-4-6V 3A, 25s; 1,000V ct 120mA, 3 × 6·3V 2A, 30s. 1mA meters, 3½in, 20s; 2½in, 10s. Sae list. Kilner-Smith, 101 Oxford Rd, Marlow, Bucks.

Yaesu FTDX400 500W pep trnscvr, cost £250, open offers. Using 7-3·6MHz daily 0900 to 1030 gmt. G5ZT, QTHR. Tel Plymouth 76552.

Mullard 4W transistor amps, two make high quality stereo rig. Very slight print damage but units brand new. Limited number only, £1 each or 2 for 30s (connections supplied). G3UPV, QTHR.

Eddystone 888A and hndbk, most spare valves, ldspkr, £55. Panda Cub tx, hndbk and spares, £25. Both good cond. G3NXK, QTHR. Tel Tiptree 6265.

Heathkit 14MHz trnscvr and neat mains psu, spkr unit, Shure ceramic mic, lpf. Perf cond, £60. G3SJI, QTHR. Tel Bristol 623321.

One set Morse records and record player, £5. Beckley, 32 Hillside, Totteridge Hill, High Wycombe, Bucks. Tel HW 23444.

R1155, £4. R1224A, £2 10s. Mini analog computer, £2. Carr ex. Talmage, 33 Atherton Cres, Hungerford, Berks.

19 Set Mk3, brand new 807, rx tested, £4 ono. Buyer coll or post ex. Also 38 Set afv at £2. Black, 9 Broad Lane, Hampton, Middx. Tel 01-979 4955.

2m/P station, includes Heathkit Mohican rx, tx (5W), convtr, ant, attached to a 1958 A35, traveller type car, good cond, no snags, recent new clutch, two 12V batts, transistor psu, £125. G3IUL, QTHR. Tel 890 7091.

NCX3 trnscvr, comp, £95. 160-80m tx comp, £5. Details sae. G2ANB, QTHR. Tel Hockley (Essex) 3278.

Lafayette KT340 rx, 550kHz-30MHz, mint cond, + manual, £18 ono. G3WPI, QTHR. Tel 01-303 6681.

Pye fm dash Ranger, comp and wkg. Wanted: Hi-band am units; Jan 69 *Radio Communication*. G8BXO, QTHR.

Tannoy amp AB 24/AC/60 for spares or repair, 2 × KT66 pp output, 3 heavy duty trnsfmrs, size 16in × 14in × 9in, weighty, pref coll. Exchange rx or why. G3SUP, 9 Lower Way, Chickerell, Weymouth, Dorset.

DX100 tx, exc cond, factory tested, £55. Will deliver 40 mile radius of Bedford. RAE correspondence course, £4. Onione, 61 Maulden Rd, Flitwick, Beds. Tel Bedford 50292 (8am-5pm).

Eddystone 840C rx, £40 ono. Slater, 24 Church St, Paignton, Devon. Tel 59018.

HRO + 7 coils, mods include product detector, very clean, buyer coll, £17. Pattullo, 1 St Michaels Close, Aylsham, Norwich. Tel Aylsham 2305.

/M psu and control unit for Codar AT5, nearly new, £11 15s inc post. G3YJI, 17 Meadowside, Walton on Thames, Sy. Tel 23228.

Heathkit Mohican rx, gd wkg order, comp with batts and manual, best offer over £20. Buyer pays carr. Knowles, 24 Friars Way, Tunbridge Wells, Kent.

AR88LF, no case, offers. G3XVV, 15 Raleigh Hall, Eccleshall, Stafford. Tel Eccleshall 605.

DX100U, perf cond, £40. G3UDA, QTHR. Tel Shrewsbury 51733.

Comp 650W audio amp, 2 × 813s, (brand new), details on request, will consider selling components separately, £25. McLeod, 30 Norman Road, Ripley, Derbyshire. DE5 3GL.

KW Viceroy Mk3A, extra ½ lattice filter, £90. SR550 rx, 160-10m, £35. G2DAF Mk2, 160-10m, less psu, £30. G3UCS, 19 The Patios, Franche Rd, Kidderminster, Worcs.

CR300 and psu, needs attention, £5 10s, buyer coll. G3PEM, QTHR.

Swan 350, £175 ovno. G5AJS, QTHR.

Practical Electronics from No 1 issue to March 1970, 65 copies. Any reasonable offer. Lloy, 52 Lees Terrace, Bradley, Bilston, Staffs. WV14 8DR.

Nikkon hard leather case, new, boxed, £4. ASB8 convted to 70cms with audio, £3. Hi fi reflex cab. W.B., two spkrs, crossover, £8 ono. 240V to 115V trnsfmr, 1kW, £3. Wanted: STD 8mm camera. G8APS, QTHR. Tel 021-308 3044.

Marine radio telephone, 50W output, 24V psu, tx 1·4-8MHz, spkr, and headset, 17in × 15in × 10in, £30. G3TJY, QTHR. Tel Lytchett Minster 142.

R1475, wkg but needs attention, £5 comp with psu. 19 Set, wkg and comp with useful psu, £5. Carr by arrangement. Wanted: FL8 audio filter. G3YLL, QTHR. Tel Melton Mowbray 4714.

BC221, mint, unmod with carrying case, £22. Another well used but with ac psu, £15. Both with calib books. G3UI, QTHR.

AR88D with "S" meter, £40. Pye transistor Ranger with mic, £5. Camm, 25 Sunnyhurst Lane, Darwen, Lancs. Tel Darwen 7690 (after 6.30pm).

Sphinx ssb tx with Delta control unit. Must sell at £40 ono. Pye Ranger, dash mounting, vib psu, partly convrted 2m, £10. G3UWK, QTHR. Tel 021-553 1705.

EC10, no mods, very gd cond, hndbk, £35 ono. Clarke, 4 Highfield Rd, Stowupland, Stowmarket, Suffolk.

230V 50Hz 300W pe generator, gd cond, ok nfd. Can help with transport, £20. Green & Davies 2m convtr, 28-30MHz i.f., as new, offers. G3SME, "Windrush", Hail Weston, Hunts.

HRO 5T, gd cond, psu, 10 coils, spkr, manual, £22. Stella tape recorder, cost £64, sell £20. G3VLV, QTHR.

KW Vanguard Mk2, 80-10m, mint, £30 ono. Hamgear pre-selector and atu, mains operated, mint, £4 10s why. Andreang, 10 Vermont St, Beverley Rd, Hull, E Yorks. Tel 45140.

3ft dia met balloons, 11s each. 275ft reels, of aluminium wire, 11s each post included. Ideal for erection of balloon supported aerials. G3XKV, c/o Alcuin College, University of York, Heslington, York, YO1 5DD. Tel 01-560 8671.

R107 rx, wkg order, with hndbk, £10. 48in sloping front cab, £2. Prototype ATK1 2m tx, 10W rf output, with hndbk, £5. Valve voltmeter as per *Handbook*, gd cond, professionally made, £5. G8ATK, QTHR. Tel Farnham 5765.

2m convtr, 3 6J6s, £3 10 pp. 2m trnscvr, £15 pp. HRO rx, £12 10s. 2m tx, QQVO6-40A pa, 100W, £25. 70cm tripler, QQVO6-40A, 3 meters, £5. G3JGJ, QTHR. Tel Moretonhampstead 578.

R209 rx, vgc, 6V dc, £7. Class D wavemeter, 240V ac, £4. Nombrex sig gen, 150kHz-350MHz, as new, £6. J. Clark, Greengates, Tytherington Park Road Macclesfield, Cheshire. Tel Macclesfield 3889.

CR100 with S meter, rf and i.f. gains, £12. Del 50 miles. C. Kimble, 23 Heol Illtyd, Crewern, Neath, Glam. Tel 98 3197.

Modified CR100 with manual, £15. Xtal calib No 10, £3. G3SAV, QTHR.

500pF variable tx capacitors with knobs, dials, 10s each. 2A rf meters, 8s each. Pair 6JS6A, new, £2 10s pp extra. G3BSW, QTHR. Tel Ascot 20992.

Exchange mint HW12A trnscvr, comp with psu and mic, for HW32A or sim 20m trnscvr and psu in like cond. G3KNF, 458 Alum Rock Road, Birmingham 8. Tel 021-327 0398.

CR300 spkr calib, £10. Aircraft convtr, new, £2. Sinclair IC10, £1. Class D wavemeter with spares, £6. Pair 12V /M uhf tx/rx, comp, £3 each. Carr extra. GM3BQA, Woodlands, North Berwick. Tel N. Berwick 2519.

BRT 400, fb cond with 2m convtr, £50. Morse record book oscillator, £4. Man on BC625 tx. AP71295 tx/rx psu equip, £4, phone for description. Nombrex CR bridge, new, £8. TW 2m convtr, £8. 2m homebrew tx, £10. EA12, new, under guarantee, £170. G. Hill, 19 Station Road, Tadcaster, Tel 2253.

160m 10W tx. Needs EF91 vfo, OA2, EF91, 5763, 12AX7, 6BW6 and case, £3 post paid. Wanted: HRO for sightless amateur. G3OGR, QTHR.

A number of 3in, 5in and 8in ldspkrs, all in wkg cond, 5s each or offers. Two telephone handsets, wkg, 5s each ono. S. Allen, Rosswan, Dimmocks Lane, Sarratt, Rickmansworth, Herts. Tel Kings Langley 62438.

Joystick 4RF tuner and /M mounts, £5. Eddystone 898 dial, £3. G3XXE, 55 Dolphin Court Road, Paignton, S. Devon.

Cantenna tx dummy load, 50Ω, £5 10s inc post, with trnsfmr oil if coll. GW8CGH, QTHR. Tel Pencoed 444.

DX100U, vy gd cond, £40. G3TCJ, QTHR.

HRO coils, spkr, psu, spares etc, £9 buyer coll. G8WN, QTHR.

DST 100 gen cover rx to 30MHz in 6 bnds. Double conversion with xtal cont 2nd osc, £10. Tinning, 58 Coxwold View, Wetherby, Yorks. Tel Wetherby 2099.

Valves: QVO4/7 (3), M8083 (8)—(SQ EF91), 3/6 each. Vhf/uhf tv diplexer, 4s. B76 xtal units; 12373·3, 12612·5, 12879·16kHz, all at 4s each, tested and post free. *Better Short Wave Reception* by W6SAI, mint cond, 6s. Cole, 10 Stocks Green Road, Hildenborough, Kent.

Joystick, £3. Mullard 510, slim line model, requires pre-amp, excellent, £5. Pair Peaksound PA 12-15 transistor hi-fi amps, mint, £9. PS45K power comps ditto, £3. G3KGB, Luzern, Sellicks Green, Taunton, Somerset.

Unit cont two 5FP7 4½in crts, assoc focusing gear and other sundries, 25s ono the lot. Single tubes, offers. Buyer coll or pays post. Fellows, 10 North St, Burwell, Cambs, CB5 OBA.

CR100 in gd wkg order, £15 ono. G8CVK, 14 Wynall Lane, Wollescote, Stourbridge, Worcestershire. Tel Lye 3608.

Coax sp c/o relays type M REF 10F/166 in tropical sealed cartons. Unused, 12/6 each plus 4/6 post. Metrovick rf thermo-couple 0-350mA meters, 2in round, plug-in, unused in makers sealed cartons, 11/6 each post paid. G3XJJ, QTHR. Tel Northampton 39196.

Comp Codar/M rig; AT5, T28, 12MS, 12RC, + Halson/M whip. All mint, used one season only, £33. GM3DJT, QTHR.

Unica UNR-30 gen cover rx, ex cond, £10 ono. Taylor, 22 St Patricks Road. Yeovil, Somerset.

Shack: Eccles caravan, 14ft, 4 berth, fitted sink, wardrobe, int w.c., 10 years old, gd cond with orig paintwork, £90 ono. Newham, 154 Allan Moss Road, Loughborough. Tel (Loughboro) 05093 3711.

KVG XF-9B xtal filt with 9MHz 3 transistor i.f. strip on pc. Inc fast attack/slow delay avc, diode switched transistor xtal insertion osc and prod detect, £18. G6TA, QTHR. Tel 01-769 1038.

KW 2000A, mint, two years old, £150 buyer coll or pay post. G3TFN, 1 Barker St, Bury, Lancs.

LG500 comp with companion modulator, psu, all circs and operating instructions, perf cond. Tvi proof all bands at this QTH. Will demo when buyer colls, £60. G4FN, Broadwater House, Clifton Terrace, Southend-on-Sea, Essex.

Marconi sig gen TF144G, not perf but wkg, £3 10s ono. Wanted: Avo 8 and small scope. G3XSO, QTHR. Tel Slough 24760.

12V 25W transistor modulator, £4. 4m tx, transistor driver, QQVO3-10 pa, £5. 4X150A, £1 10s. 4X250B, £2. G3MEH, QTHR. Tel 01-660 6263.

Minimitter MR44 Mk2 with spkr, £22 ono. GM3UKG, QTHR.

R107T, ex performer, good internal and external cond, 1·2-17·5MHz, S meter, £10 carr extra. Wanted: AR88D tuning knob. Barnott, 13 Rudham Ave, Grimsby, Lincs. Tel 0472 78495.

New metal-cased xtals. Wire-in HC6U; 1MHz, 12/6 .FT243; 6, 6·06625, 6·923888, 7·23958MHz, 7/6 each post paid. Many other freqs, send postcard. G3NXT, QTHR.

HW32A, HP23E, GH12. All in gd order, bargain at £50. G3OBW, QTHR.

Stereo/mono headphones 8-16Ω, US manufacture with chamois earmuffs, mint, £1 15s. Small cab spkr, 5in unit, £1 5s. Beamecho stereo preamp model STEP21, mint £3 10s 6d. Hi-fi spkr re-entrant cabinet fitted with wooffer, tweeter, X-over, £7 10s 6d. D. Byrne, G3KPO, Jersey House, Eye, Peterborough, Tel Eye 351.

Free: radio magazines—*QST* 1961, 1962, 1963, 1964. *SWM*, volumes 16, 17, 18, 19, 20, 21. *Bulletin*, volume 34, 35, 36, 37, 38, 39, 40. Most issues. Callers only. GI3JIM, QTHR. Tel Belfast 653736.

SB200 lin, perf, £60. 898 dial, unused, £3 10s. Webster Big K whip with bumper mount and coils for 160, 20, 15m, £16. Lucas blocking diode unit -ve earth to charge two batt, £7. G3TLV, QTHR.

Trio 9R59DE rx, new in orig case, perf tested only, first £32 secures. G3APH, QTHR.

Telequipment S31 scope, manufacturer overhaul, £25. V-4-6-vert ant and radials, 100ft coax, £12. Wanted: tri-band 2 ele beam; BCC base tx for 2m. G3WDY, QTHR. Tel 01-653 4738.

Lambda stock, £100, will split. Offers to G3KHA, QTHR.

160m Cannonball ssb tx. Vibroplex. Stab Variac psus. Marconi vhf gens. Two 4X150s on sub-chassis. Large quantity new comps inc transistors, diodes. TCS rx. Avo comps bridge. Sae list G3SKR, QTHR. Tel 01-902 1517 (weekends only).

Textbooks; *Computer Hdbk* (Huskey-Korn), cost 10gns as new, 30s. *Radio Communication* (Reyner), 7/6. *Radio*, Vol 1 and Vol 3, 5s each. *Solution problems in Telecommunications and Electronics* (Henson) 10s, please add postage. Bell, 55 Belvedere Road, Hessle, E. Yorks. Tel 0482-645724.

Heathkit Apache with SB-10, £50 ono. RA1, £27. G3YJE, QTHR. Tel 01-349 9060.

NCX5 transcvr, ac psu, dc psu, /M whips, remote controlled, offers please. G3SRZ, QTHR. Tel 01-272 2539.

CR100, ex mech and elec cond, £20. Minimitter MR44/11, needs align, £15. BC221 comp with charts, £20. Sae for list of other items. G3LLX, QTHR.

Homebuilt amateur transistor rx using Electoniques i.f. and rf modules, xtal filt, prod detec, S meter, 4W af, illum split-gear, slide-rule dial. Less than rf and i.f. alone, £28. DX100U tx, good, £28. G3XJM, QTHR. Tel Guildford (0483) 61116.

2m FT243: 8025, 40, 50, 75, 100, 7/6 each. FT241: channels 325, 327, 41, 42, 43, 44, also other channels. Fibre glass pc board, high quality, 10 × 4, 6s each. Post free. G3PDT, 239 Hagley Rd, Birmingham 16.

KW2000, ac psu, Shure 401A mic, hdbk, looks new, £140. G3OMY, QTHR. Tel Corby 5552.

Wavemeter G56, 15 to 24000kHz, brand new with calib book, £7 10s. TS253, 25 to 90MHz, £5. Type CLR4201 tropicalised wire-wound potentiometers, 100Ω, 5KΩ, 25KΩ etc, new, 2/6 each. Sae enquiries. G3IUD, QTHR.

DX100U, £40. Stab psu, £17 10s. Geloso vfo, half built tx. 1000V psu. offers. G3TAP, QTHR. Tel Long Eaton 2929 office hours.

Sphinx tx, ex cond, overhauled by manufacturer, £45. Prefer buyer inspects and coll. G3WWL, 271 Blackberry Lane, Four Oaks, Sutton Coldfield, Warks.

4m xtals: 3645, 7090kHz and 30 other xtal freqs. Wearite P coils, xtal contolled RF24, 10, 15 and 20m convtr, hdphones, TU5B, etc. Sae for list. G3NNO, QTHR.

Lafayette HA700, mint cond, £29 ono. Codar PR30, £5 ono. RQ10X, £6 ono. *How to build tv antennas and improve tv reception*, mint cond, 12s. Jones, 113 Bentley Road, Bramley, Rotherham, Yorkshire.

Eddystone EC10 Mk 1, all transistor, gen cover 550kHz-30MHz, perf cond, £35 ono. G3MP, QTHR. Tel Nottingham 246393.

Noise diodes for the *Rad Comm Hdbk* noise gen. New boxed CV2398 (several available), £1 each. Wanted, TA31JR. G3UYD, QTHR.

Save £18; HW100 kit, brand new in orig unopened packing, £120. Will deliver 100 miles. G8BAK, QTHR.

Heavy psu, rack mounting 2 × 300V 400V stab plus lts, £6. SCR522, 2m tx/rx, £5. RTTY: Creed 5060, Loop psu, £3 or exchange for T.D. Wanted: RTTY afc/bfo unit FRS 4·1 or sim; beam rotator. G3YLQ, QTHR. Tel Luton 25595.

KW 160 top band am/cw tx, as new, £16, buyer coll. G3WXT, QTHR.

J Beam 2m halo, as new, £1. Also 4·5 cu ft Teak reflex enclosure, Goodmans Axion 201 bass unit, Midax horn, Trebax hf unit, cost £60, offers? G3HKH, QTHR. Tel Weybridge 47112.

CR100, £14. PCR3, £7 10s. Gd cond mains psu. Homebrew tx, 80-10m, Geloso vfo, 120W cw, 80W am, built in AR88 case, comp, £15, in good working order, inspection invited. G3WMB, QTHR. Tel Much Hadham 2405 before calling.

CDR AR22 rotator, all new gears, perf order, £20 ono. Joystick deluxe with tuner, £5 10s. G8TY, QTHR. Tel 368 3219.

Bendix RA1B rx with psu and handbk, £14. Collins TCS12 tx, £9.

Heathkit vfo, uncalib, £5. 1154 tx, offers? G3MLN, QTHR. Tel Gerrards Cross 84230.

HRO MX with 7 coils, hndbk, psu, spkr and phones. Spares include valves, atu, multi amateur dipole aerial, xtal calib. Must sell, offers. Lamb, 70 Dudsbury Road, Ferndown, Dorset.

Heathkit Mohican, very gd order and cond, batts, and manual, £25. G8BIH, QTHR. Tel Brookwood 2523.

RA1 rx and Qmult, xtal calib, spkr. First class cond, £30. G2YC, 15 Hendale Ave, NW4. Tel 01-203 4257.

Codar equip: AT5, T28, /M psu, control unit, mic, + 160m 3FIF coil and whip, £35 ono. G5ND, QTHR.

Gear of late G3UCO: DX40 and VFO1U, £20. R209 rx, £10. G3ELO, 18 Chasewater Cres, Worcester. Tel Worcester 51805.

R1497 clean r/t, £5 plus carr. 24200kHz HC6/U xtal, Jan, 18/6d pp. G8BDB, QTHR.

Mast; single section, triangular tubular. Height: sixty feet base, five feet ladder to platform, three element beam in situ with atu, presently erected New Forest, photo available. G3WSF. QTHR.

Eddystone EC10 with mains and batt supplies, surplus to requirement, little used mint cond, nearest offer to £32. GW3MPA, QTHR. Tel Mancot 253 after 6pm.

Swan 500C and ac psu. Eddystone S870. Heathkit DX4OU and vfo. Heathkit scope 10–12U. 813 valves. GM3OFV, 172 Abbotsford Drive, Glenrothes, Fife.

BC342. KW Valiant tx and psu. B44. Offers? Sae for list. G3MCA, QTHR. Tel Orpington 28790.

80m ssb trnscvr, £20. Psu and linear, £5. Double conv rx, 80–10m, £12 10s. Bendix TA12, £5. Hallicrafters S20R, £9 10s. Car radios, 12V Philips, £5. Carr ex. Other items, sae. GW3EJR, Mayfield, Cardigan. Tel Cardigan 2331.

Eddystone "Edometer", model 902 Mk 2. Versatile instrument: wavemeter, gdo, sig-gen, code practice oscillator, with many other applications. New unwanted gift, cost £27 10s, £17 with instructions. Avo "8" Mk 2, as new, £16 + manual. Buyer coll. G3SIJ, QTHR.

Free instruction book for NCX-3 trnscvr, send large sae. do you need xtals for 2m, 4m or 70cms. Send sae for huge list of all types and freqs. G5AGX, QTHR. Tel 01-894 6880.

UM2 mod trnsfmr and two KT88 valves on chassis, £4. *SWM* Jan 1963 to Dec 1963, Jan 1964 to Dec 1964—2 missing, Jan 1965 to Dec 1965, Jan 1966 to Dec 1966, 10s per set. All carr extra. GM3VXR, 70 Leven Street, Motherwell, Lanark. Tel M'well 66597.

2m fet convtr, 28–30MHz, i.f., £3. Also Newmarket PC5+ audio amp, 3W to 3Ω spkr, £2 10s. G3WAR, QTHR.

Mosley TA33Jr tri-band beam, £10. GW3IMQ, QTHR.

DX100, £30. All bands ok, reasonable appearance, carr ex. G3URG, QTHR. Tel Nottingham 291985.

Eddystone 840A, professionally overhauled, new valves, ex cond, £29. G3MNQ, 4 Elfin Grove, Dunton Bassett, Rugby, Warks.

Sommerkamp FR100B rx, £60. Sommerkamp FL200B tx, £65. Avo all wave osc, £4 10s. Geloso vfo, £5 10s. UM2 mod trnsfmr, £2 15s. Psu: 250V 70mA, 6V 2A, £3. G3VWE, QTHR. Tel 0272 556759.

Sphinx tx, ex cond with circuit etc, £45. Pref buyer inspect and coll. G3WWL, 27 Blackberry Lane, Four Oaks, Sutton Coldfield.

Sommerkamp FT150. G3UAA, 28 Loxley Road, Glenfield, Leicester.

Collins TCS6 rx + psu with spkr inside, £6 10s. HRO with nine coils, £12. Codar comp /M rig, 160–80m, with 2 whips and coils, £28 ono. Comp sale, £40. Will del up to 20 miles, or buyer coll. G3WCN, 33 Atherton St, St Helens, Lancs.

Minimitter Mercury 200 tx, 80–10m cw, am, nbfm, fb cond, 2 new TT21s, spares, £35. G3KGM, QTHR. Tel 01–300 0767.

Heathkit HD-10 electronic keyer in exc cond, £15. Crutchfield, 32 Eldorado Rd, Cheltenham, Glos.

S36A, 28–143MHz, £25. 12V 300W pe gen, BSA, £15. G3BHT, QTHR. Tel 021-308 4764.

Cw/am tx, 3·5–21MHz, 6146 pa, sep 3·5MHz vfo, ok non-tvi, £5. Geloso 4/104 3·5-28MHz driver for 801/6146, unused with instructions, £4. Deliver East Midlands. G3KZR, 13 Hall Drive, Burton-on-the-Wolds, Nr Loughborough, Leics. Tel Wymeswold 576.

KW 500W linear, spare 813, £45. G3IBG, 19 Shillingford Rd, Alphington, Exeter. Tel Exeter 74607 after 5.30pm.

Mosley TA33, 10, 15, 20m, gd cond. Also 30ft dural mast with guys, strainers, etc. Offers please. G2DLX, QTHR.

15, 20, 80m ssb trnscvr, two 6146s, grey/green, 898 dial, + lpf, psu, two tone osc, £35 ono. Full pwr linear, two 4X250, self contained, £30. Wanted: X band gear. G3NVB, QTHR. Tel Stubbington 3220.

Exchange Sommerkamp FR100B in mint cond, for good gen cover rx. Sell bandspanner /M whip, coils for 160, 20, 15m, £7 10s. G3LNG, QTHR. Tel 051-236 0481.

CR100 rx, comp with man, exc cond, £20. BC221 + charts, stabilised psu, £20. Minimitter MR44/11 rx, £15. Needs re-alignment. Mod trnsfmrs, psu trnsfmrs, and many other amateur items, sae for lists. G3LLX, QTHR.

HW32A with psu and mic, Inoue rx. Both immac cond, £60 each or offers. KW trapped dipole ant just overhauled by manufacturer, £6. Sae further details, take RA1 part exchange, working or faulty. G3RTN, QTHR.

Exc xtal mic, £2. Heavy duty smoothing chokes. GU50 rectifiers. All cheap. Wanted: 6·5MHz xtals; small mains trnsfmr, 100V 50mA; aerial staywire strainers. G3KH, 133 Station Road, Cropston, Leicester. LE7 7HH.

Bulletins, Radio Constructors, Philips "Electronics Engineer" EE8 beginners kit, 45s. Offers for Eagle SA-80 stereo amp, working well, immac cond. Wanted: RA1, T28, fm tuner, 2m fet convtr. Price, The Hall, Uppingham, Rutland.

W1191A wavemeter convtd to mains, no charts, £5. GEC CR-bridge, £4. 70cm 24 ele yagi, 30s. 117V ac pe gen, £8. 3cm test set with 723AB klystron, 117V ac psu, buyer coll. G8ABB, QTHR.

Gen cov rx with electronics coilpack and 898 dial, £10. PCR2 with S meter, bfo, psu etc, £5. Wanted: 455kHz mech filt with xtals, 2·5kHz bandwidth. G3WPB, 76 Southfield Rd, Hinckley, Leics.

WANTED

Eddystone 770-R, must be gd cond. G3UQR, QTHR.

Ex-T1131 1000-0–1000V, power trnsfmr. G3HCV, QTHR.

DX40, any cond. Also cw end xtals for 160 to 7MHz. Stampton, 67 Medhurst Crescent, Gravesend, Kent. Tel 63284.

Collins TCS12 tx. Also psu 12/250/400V, manual and key reasonable to volunteer naval training unit please. Lewis, 33 Osborne Park, Helston, Cornwall.

Xtals—45MHz, 30MHz. Cab for CR100. Hanson swr bridge, 75Ω. GM3UCI, QTHR. Tel Wishaw 76261.

Avo model 8 or 9 at reasonable price. Also couple of burnt out 350 mA thermocouple ammeters. G3TON, QTHR.

Induction coil parts for early xtal set. Model dynamo steam engine. G2FXA, QTHR.

Pye high-band or why. Sale: Lowband, offers. G8BXO, QTHR.

Good Eddystone 750, state price required. GW8BOX, QTHR. Tel Llanelli 5422.

Swop new RS 250W auto trnsfmr or sim 250W or 500W isolating trnsfmr. G3YBK, QTHR. Tel Exeter 78710.

RAE correspondence course. Sisson, 139 Marldon Rd, Paignton, Devon.

Wanted urgently: *SWM* Jan 1966. HRO coils 1·8–4MHz and 3·5–7·3MHz. G3NBU, QTHR.

Taylor T55 triode, and DST100 rx. GW8AIB, QTHR.

Sommerkamp FR100B, QTHR.

2m tx, 75–100W, 75W mod, psu to match. Will coll within reason. G2VB, QTHR.

HRO bandspread coils for 80, 40, 20, 10m. G3ZBZ, 176 Outwood Rd, Heald Green, Cheadle, Cheshire.

Radio Communication August 1968—July 1969. Offer £1. K6DDO, 4747 Ambrose, Hollywood 90027, USA.

One 24V selsyn motor, quarter inch spindle. G4JW, QTHR.

Heathkit HA-14 Kompact linear amp, built or kit, rf unit only required

Margolis, G3NMR, 95 Collinwood Gdns, Clayhall, Ilford, Essex. Tel 01-550 0882.

Early Wireless books, mags, QSLs, parts, valves, catalogues, before 1925. Buy or swop. K8IKO, Box 222, Worthington, Ohio 43085, USA.

Required by recently formed school society: Surplus type amateur band rxs suit for ssb if poss. Will buy or borrow. Limited cash available. D. Bevan, 7 Drayton Drive, Heald Green, Cheshire. Tel 061–437 9584.

Any copies *QST* 1915–1921, *Radio* July 1935, *R/9* December 1932–November 1933. G3IDG, QTHR.

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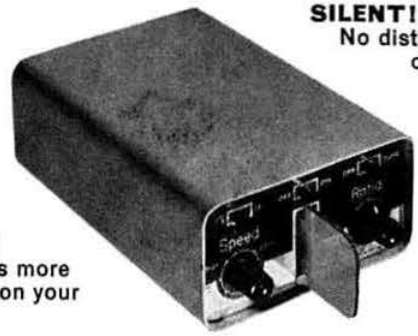

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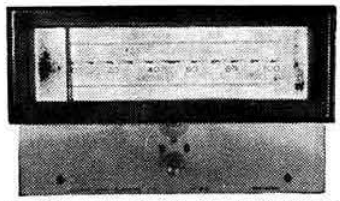

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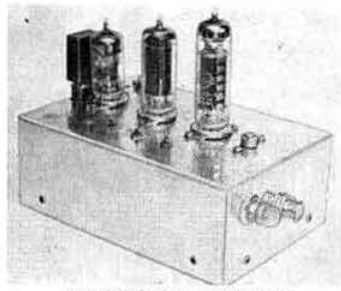

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800 p.i.v. at 750mA .. **3/- ea.**

Also untested HT types, marked 2EX, unknown p.i.v. but useable on 240v AC up to about ¼ amp. No guarantees but useful to have around. (Two **free** surge-limiting resistors with every 4 diodes.) .. **only 7/6 doz.**

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NEW LISTS now available, large SAE please.

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Please type or print clearly in block letters

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Wanted ☐

Callsign or Name and Address

QTHR

Telephone number

DATE ..... *SIGNED* ..... *CALLSIGN, BRS or A No.* .....

The number of words in each advertisement must not exceed 32, not including name and address or callsign and QTHR or telephone number Four pages of each issue are allocated to Members' Ads at present, and in order to include as many advertisements as possible licensed members are requested to give their callsign and QTHR instead of their name and address. (QTHR means: "My address in the current call book is correct").

Also to conserve space, please keep advertisements as brief as possible consistent with a clear basic description of the equipment. Advertisements will be edited to conform to a set style of abbreviations, so it is unnecessary to submit them in abbreviated form.

Conditions under which Members' Ads are accepted are published on the first Members' Ads page of each issue.

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INDEX TO ADVERTISERS

Radio Society of Great Britain

FOUNDED 1913
INCORPORATED 1926

PATRON H.R.H. THE PRINCE PHILIP
DUKE OF EDINBURGH, KG

APPLICATION FOR CORPORATE* OR ASSOCIATE* MEMBERSHIP

RADIO SOCIETY OF GREAT BRITAIN,
35 DOUGHTY STREET,
LONDON WC1N 2AE
01-837 8688

* I hereby apply for election as a Corporate Member of the Society and enclose a remittance for £2/10/- being the amount of my first annual subscription.

* Being under 21 years of age and not holding a current Amateur Radio Transmitting Licence I hereby apply for election as a Non-Corporate (Associate) Member of the Society and enclose herewith a remittance of £1/5/- being the amount of my first annual subscription.

I, the undersigned, agree that in the event of my election to Membership of the Radio Society of Great Britain, I will be governed by the Memorandum and Articles of Association of the Society and the rules and regulations thereof as they now are or as they may hereafter be altered; and that I will advance the objects of the Society as far as may be in my power; providing that whenever I shall signify in writing to the Society addressed to the Secretary that I am desirous of withdrawing from the Society I shall at the end of one year thereafter after the payment of any arrears which may be due by me at that period to be free from my undertaking to contribute to the assets of the Society in accordance with Clause 8 of the Memorandum of Association of the Society.

Date _____

Signed _____

PERSONAL DETAILS TO BE COMPLETED BY APPLICANT

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* Please delete where inapplicable.

† If the applicant is not acquainted with a Corporate Member willing to propose him for election he may submit a suitable reference in writing as to his interest in Amateur Radio.

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