radio communication

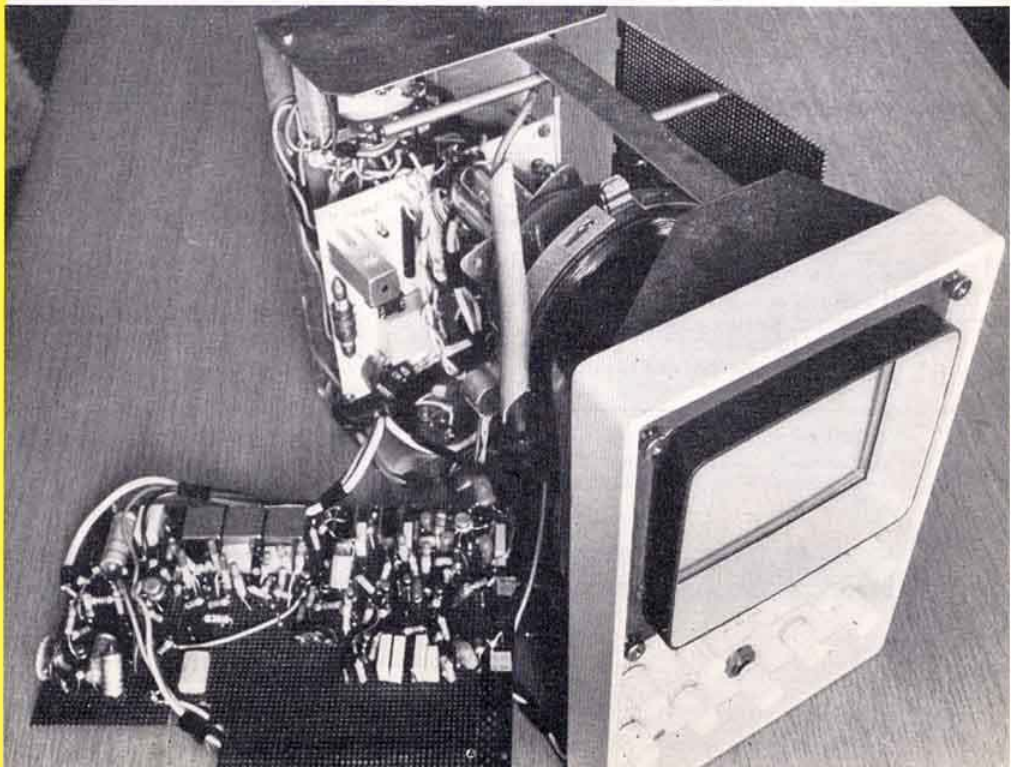
February 1971

Journal of the Radio Society of Great Britain

SLOW-SCAN TELEVISION

by A. Backmann, SM0BUO

page 84



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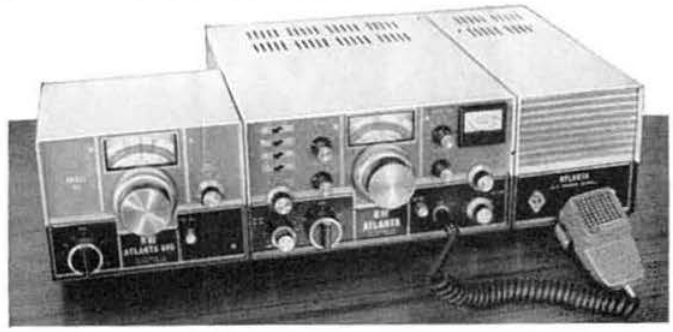

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CONTENTS

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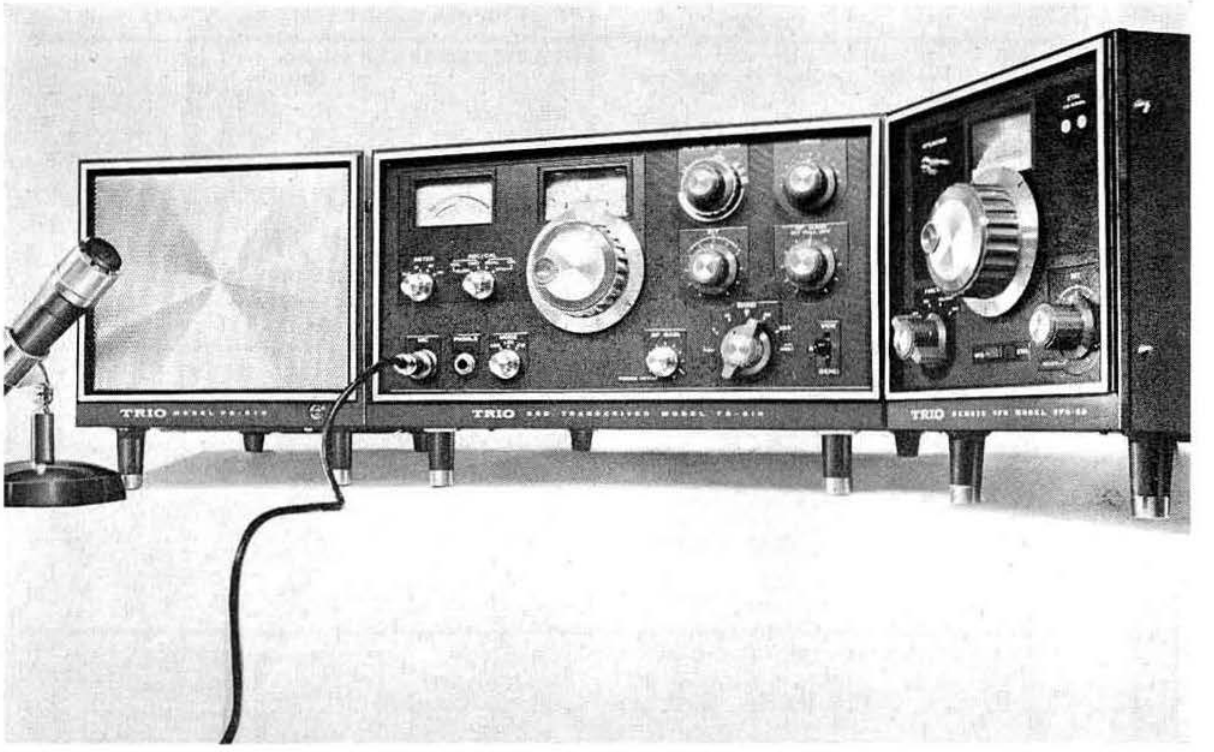

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QTC AMATEUR RADIO NEWS

Events Diary

The attention of all members, and particularly events organizers, is drawn to the existence of the Events Diary described on page 596 of the September 1970 issue of *Radio Communication.*

Members wishing to have coming events registered in this diary are asked to forward particulars to the diary keeper, E. W. Yeomanson, G3IIR, at his home address 32 Gaynesford Road, London, SE23, telephone 01-699 2661, and not to RSGB HQ.

"VHF-UHF Manual"

Members are asked to note that the *Manual* is now out of print. A second edition is in course of preparation and it is expected that this will appear in the spring of 1971. The new edition will be larger and will contain a considerable amount of new material, but, in accord with rising print costs, the price will also be higher. More than 10,000 copies of the first edition were sold, a large proportion of which reached USA amateurs through the Society's North American agents, Communications Technology Inc.

Despatch of publications

Because of staffing problems some delay has taken place recently in the despatch of publications ordered from RSGB HQ. This should be overcome within the next few weeks and in the meantime members are asked to allow a little longer for their orders to be fulfilled.

Radio Amateur's Examination

The next RAE will be held on 11 May 1971 and applications to sit this examination should be made to the candidate's local examination centre.

In London, the RSGB will provide an examination centre at University College, WC1, and applications to sit the examination at this centre should be sent to RSGB HQ together with a remittance of 35s (£1.75) for RSGB members or 45s (£2.25) for non-members.

Closing date for applications: 20 February 1971.

Licence figures

The Ministry of Posts and Telecommunications advises that the following numbers of amateur licences were in force at the end of November 1970:

Class A	13,667
Class B	2,513
Class A/M	2,594
Class B/M	350
Television	189
Model control	19,082

QSL Bureau

Callsigns in the series commencing with G8FAA will be issued soon, A new sub-manager has been appointed to deal with cards for this group: he is Mr R. E. Parkes, G3REP, 94 Canterbury Walk, Cheltenham, Glos, GL51 5HF.

TVI

It is reported by G3VCT that during the course of tvi investigation it was found that the performance of masthead preamplifiers was vastly different in so far as cross-modulation and overloading were concerned. Tests showed that the Philips masthead amplifier was considerably superior to other units that were used.

Aerial planning

Following the request made for members to report to G3EGK details of applications and appeals in connection with planning permission for aerial installations, Mr Bracewell has accumulated the material details of 55 cases. An analysis of these shows that consent was given in 56 per cent of initial applications and 57 per cent of the appeals were successful. This collation of information in relation to aerial planning is a valuable membership service and relevant details should be sent to G. S. Bracewell, G3EGK, Chevington Chase, Huncote Road, Croft, Leicester, LE9 6GU.

Can you help?

The 21st Hendon Scouts are starting an amateur radio group and would appreciate donations of books or inexpensive second-hand equipment for their shack. Contact Mr A. E. Trayling, The Scout Hut, Apex Corner, London NW7. Tel 01-959 5051.

John Stevens, a young blind man who is enthusiastic but has limited knowledge of amateur radio, wishes to contact any amateurs living near him at 9 Royal Oak Court, Pitfield Street, London N1.

Mr D. F. Pierce, G8AAJ, of Dulwich, London SE21, would welcome schedules for test purposes on 70cm and 23cm. He will be using varactor triplers (attempting to operate two in series for 23cm) and nbfm.

Des Clift, VK5CU (ex G3BAK), 36 Caris Avenue, Hope Valley, S Australia, 5090, would be grateful if any member could provide him with a circuit diagram and details of external inter-connections and controls of a Marconi radar transmit/receive unit 4364 10D/16953, and a circuit diagram of an AFC unit SA301, part of, RT258/AP43(AP2913D refers). He would be willing to refund any postage and expenses incurred.

Cheshire Homes Amateur Radio Network Fund

The committee governing this fund has decided to close it on 14 March 1971 and requests that all counterfoils and money due should be sent in by that date. In the meantime tickets are still available and applications for them would be welcome. Write to the secretary/treasurer, Mr W. M. Clarke, G3VUC, 66 Fillace Park, Horrabridge, Yelverton, Devon, PL20 7TE.

G3HBW's vhf fet dip oscillator

Intending constructors of the vhf fet dip oscillator described in the September 1970 issue of *Radio Communication* will be glad to know that H. L. Smith & Co, of 289 Edgware Road, London W2, now stock a suitable aluminium box (in three separate parts plus lid) and the 10-way tag-strip and tuning capacitor for the device.

Some difficulty may be experienced in obtaining the 13swg enamelled wire required for one coil and loop. This may be replaced with 14swg without any detrimental effects, although the sizes of the loop and coil will have to be changed slightly to realize the same resonant frequency.

The 15μH rf chokes specified may also be difficult to obtain at the moment. Other miniature chokes of similar inductance value will probably have different resonances. However, it is known that the Painton type 200-227 is satisfactory. A suitable component may be produced by winding 58 turns of 40swg enamelled copper wire on one of the miniature dust-iron choke cores ($\frac{1}{2}$in long, $\frac{1}{8}$in dia) available from Henry's Ltd of Edgware Road.

TVI Committee

For some years the MPT Liaison Committee has dealt with tvi problems raised by members. In this work the assistance of outside specialists has been sought, including for a time the TVI Clinic. With the increasing complexity of tvi and the need for more attention to be given to this aspect of the Society's work the Council has decided that in future there shall be a separate TVI Committee. The existing MPT Liaison Committee will continue to deal with matters of licensing, frequency allocations and planning permission in connection with aerial installations.

Recent approaches to Society representatives and tvi groups asking for co-operation have produced an almost total lack of response. This seems to be in direct contradiction to the number of problems which are known to exist, and unfortunately it seems that members are content to suffer restriction of their operating hours rather than deal with the problem. If there are members who would be interested to take part in the work of the new TVI Committee or who feel that they can form a tvi group in their own area, the Society will be most pleased to hear from them. Please write to the general manager at RSGB HQ.

Strumech Versatower offer

Strumech are offering to take their 60ft mobile tower to any rally or field day for the use of the talk-in station. It comes complete with a head unit, rotator and 5ft of 1 29/32in o/d tube to which vhf/hf beams may be fitted.

Any clubs wishing to take advantage of this offer should contact Mr G. N. Redfern at Strumech Engineering Ltd, Coppice Side, Brownhills, Staffs. Tel: Brownhills 3651.

YOUR OPINION

The Editor
Radio Communication

Sir—I object most strongly to the last paragraph of G3JGO's letter published in the January issue of *Radio Communication*.

Yes, I am one of those so called "plug-in appliance operators lacking in experience and knowledge". I also have a 20-month-old daughter, a long working day, a need for a rig that is extremely compact and presentable in the living area of our house (the third bedroom is shortly to be taken over by a 2nd harmonic!) and a wife who is not interested in radio.

Incidently, prior to buying any plug-in appliance I had built three ssb all-band transmitters, a transverter for 2m and a receiver.

Yours faithfully,
P. W. Waters, G3OJV

The Editor
Radio Communication

Sir—I heartily agree with Mr Watts' letter commending the slow morse practice transmissions operators. In this area I would particularly like to thank the Wednesday evening sender, G8QU of Wood Green, and the Thursday evening service from the Edgware and District Radio Society, G3ASR/A, operated by G3GC and G3SJE.

More power to their elbows, and again many thanks to them.

Yours faithfully,
H. S. Sharp, BRS31710

The Editor
Radio Communication

Sir—In September this year I had a contact with YO3TU, and his QSL card received later showed that he was previously licensed as YR5TI. Remembering that I had a card from him for a pre-war QSO I attached it to my present card and sent both cards to him through the bureau.

I was very surprised and pleased to have a letter from G3AAQ a few days ago saying that he had been in Bucharest with a trades exhibition and on contacting YO3RF was given the red carpet treatment and taken to the local radio club where he met many of the members. Later YO3TU/YR5TI came to his stand at the exhibition with my card confirming the QSO of 3 November 1937 and asked Jake to pass it on to me—which he did with the greatest pleasure.

I now have my 33-years-old QSL card back in almost mint condition, leaving the questions of where has it been all this time and what if anything has happened to it unanswered.

I feel that the returning of pre-war cards when making contact after so many years is something which should be encouraged.

Yours faithfully,
F. N. F. Bewley, G8HX

The Editor
Radio Communication

Sir—The following tv sets: Bush TV161, TV166 and Murphy V1910, V1913 and V2310 series, operating near to amateur radio transmitters may suffer from loss of picture during times when the transmitters are operating.

The fault is caused by breakthrough of a 3·5MHz signal; the agc lead from PS1/6 in the A633 tuner unit, and its associated capacitor, resonate at this frequency and a large 3·5MHz signal is applied to the base of the rf transistor.

The fault can be eliminated by connecting a choke, Part No CS42673, in series with the agc lead. The choke should be fitted close to capacitor IC5 which is a feedthrough type and brings the avc lead out of the tuner unit. The avc lead is purple and easily identified on removal of the tuner unit.

The choke may be obtained from the service department of Rank Bush Murphy, Drayton Road, Boreham Wood, Herts, price 6s (30p) including p and p.

I am indebted to the service manager of the above company for his assistance.

Yours faithfully,
F. E. Wyer, G8RY

Slow-scan television

by A. BACKMANN, SM0BUO*

SLOW-SCAN television (sstv) is an image transmission system with a very narrow bandwidth. Each picture, which requires a transmission time of 8s, is composed of a 120-line raster. It is now authorized in the USA for holders of Advanced and Extra Class licences and may be transmitted in the phone portions of the 80–10m bands as well as in the vhf and uhf segments.

In Sweden, as in the rest of Europe, there are so far only a few amateurs who are fully equipped for receiving and transmitting sstv and until further notice they work on temporary permits issued by their authorities. Almost every day pictures are exchanged between North America and Europe, New Zealand and Europe, and within these continents. The interest in this form of amateur radio is rapidly growing and it seems that a new era of international amateur communication activity can be expected.

SSB equipment suitable for sstv

It is important to understand that a slow-scan picture does not require a wider frequency range than a normal ssb signal.

The American rules demand ssb for the transmission of sstv between 80m and 10m, ie the occupied bandwidth may not exceed 3kHz. A normal ssb transmitter and receiver or a transceiver can therefore be used. In addition one would need an sstv monitor and some kind of sstv generator. The latter could in the simplest case be a conventional audio tape recorder with a recorded sstv-tape or a flying-spot scanner. In advanced cases a special slow-scan camera would be used. The monitor is simply connected to the audio output of the ssb receiver and the picture generator to the microphone input of the transmitter.

SSTV signal composition

Any television system must be able to transmit the two types of information:

(*a*) Sync signals to ensure that the received picture is in step with the picture being transmitted. (The sync signals are frame pulses that start each frame and line pulses that start each line), and

(*b*) Video information which gives a presentation of black, white and intermediate grey-scale on the scanning of each line.

The combination of sync and video information constitutes the composite television signal. With 120 lines and a frame time of 8s the line frequency will be 15Hz. Since an aspect ratio of 1 : 1 is used the basic video bandwidth will be approximately

$$120/2 \times 15 = 900\text{Hz}.$$

As the video information is very close to dc in frequency there must be some method of amplification and linear phase shift of these signals.

Early experiments used an amplitude modulated subcarrier that was placed in the middle of the available bandwidth. The sub-carrier was modulated with 900Hz video and the effective bandwidth consequently became 1800Hz. It was soon discovered, however, that if the subcarrier was frequency modulated one would obtain a more efficient elimination of fading, noise and other interference.

In the present method, therefore, the generated video signal will frequency modulate a multivibrator (the subcarrier oscillator) which normally oscillates at 1,500Hz, which will correspond to black. The sync signals will drive the subcarrier oscillator to 1,200Hz and the white signals to 2,300Hz. Frequencies between 1,500Hz and 2,300Hz will represent the grey-scale between black and white. The width of the sync pulses are 5ms (line pulse) and 30ms (frame pulse). The complete system parameters are shown in Table 1.

How a single line scans a grey-scale is shown schematically in Fig 1. At A there is a 5ms pulse with a frequency of 1,200Hz that starts the line. The video information ranges from white at B to grey in the middle at C, to black at D and back to white at E. F corresponds to the 1,200Hz pulse that will start the next line. Since the sync pulses will be on a level that is blacker than black they will not be seen during the retrace. With normal picture contents the variations of the video information will of course be more complex than shown.

The composite video signal is consequently an audio tone that is varied in frequency between 1,200Hz and 2,300Hz. The total frequency deviation will be 2,300Hz − 1,200Hz = 1,100Hz, whereas the required bandwidth when transmitting

*Ibsengatan 14 S-161 59 Bromma, Sweden.

Table 1. System standards

Sweep rates:
Horizontal 15Hz (in Europe 16⅔Hz with 50Hz mains)
Vertical ⅛Hz
Scanning lines: 120
Aspect ratio: 1 : 1
Scanning direction:
Horizontal left to right
Vertical top to bottom
Sync pulse duration:
Horizontal 5ms
Vertical 30ms
Subcarrier frequencies:
Sync 1,200Hz
Black 1,500Hz
White 2,300Hz
Required transmission band width: approximately 2·8kHz

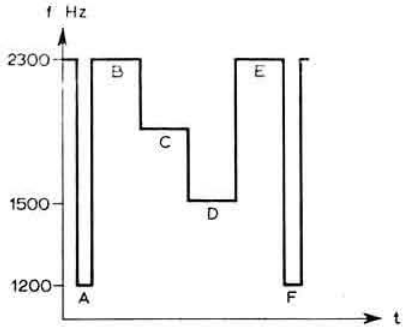

Fig 1. The subcarrier frequencies as functions of time

due to the frequency modulation will be approximately 2·8kHz.

The signal can be recorded on an ordinary audio tape recorder since we are working with frequencies in the audio range and not the complex wideband signal of a 625-line system.

Long-persistence monitor screens required

In all tv systems the display tube is of great importance. With sstv a screen phosphor termed P7 which has an afterglow of 8s or longer and an acceptable light output has become standard. It is of course possible to use a storage tube which has considerably better light output but possibly a poorer grey-scale. The aim is, however, to use a tube that from an economical viewpoint is within reach of the average amateur. If it is possible to diminish or screen off the ambient light, the light output of a P7 tube will be more than sufficient.

Another matter that had to be considered in the development of the present system was the choice of the direction of scan and the aspect ratio. A ratio of 1 : 1 was chosen to take full advantage of circular screens, and direction of scan became left to right and top to bottom to enable transmission of written messages.

Resolution

The most frequently-used monitor tube has a screen diameter of 125mm. The slow-scan frame will consequently be rather small at maximum raster size, ie not larger than 85mm². The size of the moving spot will therefore be the principle limiting factor of the resolution.

After comprehensive studies it was decided that horizontal resolution should be 120 lines. With this number of lines the total number of visible picture elements will be approximately

$N = 2\,BK/f$; $N = 2 \times 900 \times 0{\cdot}87/0{\cdot}125 = 13{,}000$

where B = video bandwidth
K = factor for visible scan
f = frame frequency.

Fig 2 will give an idea of the resolution that can be expected of a slow-scan picture under favourable conditions. In addition, Table 2 compares the resolution of various film and television systems.

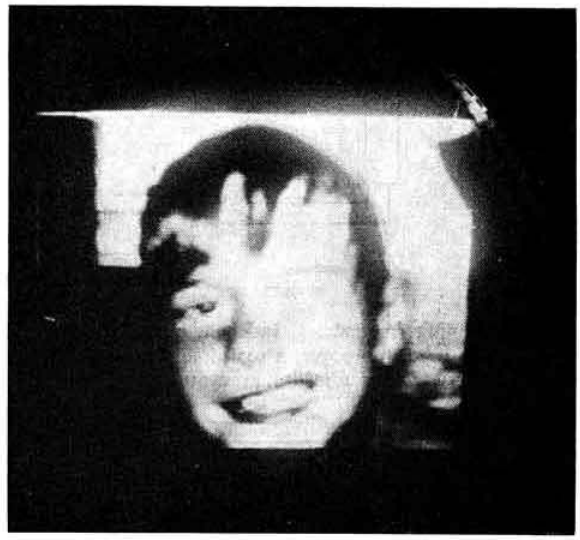

Fig 2. Photograph of a slow-scan picture

Table 2. Resolution of various film and tv systems

Picture	Number of visible elements
35mm film, professional	1,000,000
16mm film	250,000
TV picture, 625 lines	230,000
16mm film, amateur	200,000
8mm film, amateur	50,000
TV picture, 120 lines (sstv)	13,000

Several camera systems in use

The simplest and least expensive camera is no doubt the flying spot scanner (fss); Fig 3 shows a block diagram of a typical scanner. A properly adjusted fss using the method in which the light passes through transparent negatives will give as good quality pictures as the best sstv camera, but it is of course not as flexible as a camera.

The first slow-scan camera employed a special vidicon that could store the picture for several seconds. An electro-mechanical shutter exposed the vidicon sensitive layer for a fraction of a second at each frame start, and after the shutter had closed motion in the scene was permissible and the "frozen" momentary picture could be seen on the monitor.

This type of vidicon is rather expensive and perhaps accessible to only a few amateurs. Experiments with conventional vidicons in real-time unshuttered slow-scan cameras have also been carried out, but with rather disappointing results due to the high dark current of these tubes

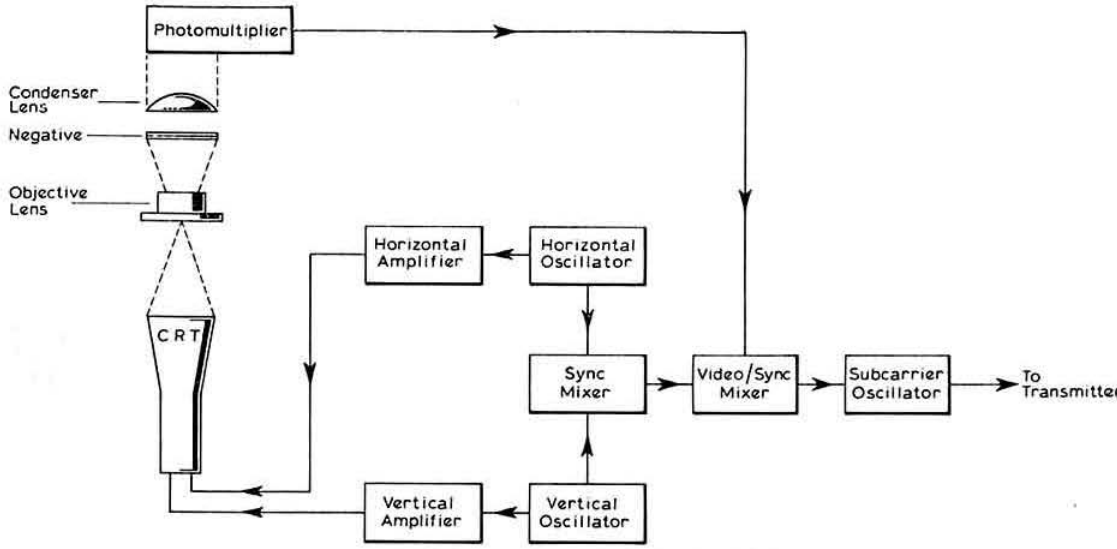

Fig 3. Block diagram of a flying-spot scanner

at low scanning frequencies. Independent of the type of camera tube used, moreover, a real-time slow-scan camera requires a very tedious adjusting procedure.

Sampling method simplifies camera adjustment

On the electronic market there are many varieties of conventional closed-circuit tv cameras. Experimenters began to think about the possibilities of using these cameras in a slow-scan mode. If the advantage of fast-scan focus, contrast adjustment etc could be carried over into the slow-scan mode, the disadvantages of the slow-scan camera could be overcome.

The vertical deflection coil in the fast-scan camera is made switchable so that the scanning frequency will be 15Hz in the sstv position. If it is assumed that the scene being televised is stationary for 8s it is possible to sample a few elements from each fast-scan frame and put them together to produce one slow-scan frame over the 8s period.

In order to understand how the system works, consider the raster shown in Fig 4. The line frequency is 15kHz and the frame frequency 15Hz. A sample is taken at the upper left corner of the raster. Samples are taken continuously at each fast-scan horizontal line intersection of the vertical slow-scan sampling line. After one fast-scan frame the cross-scan function returns to the top of the raster and starts the sampling over again. This time the samples are taken slightly to the right of the previous samples.

To produce this sliding function a comparator is used that is fed with 15kHz and 1/8Hz ramps, Figs 5 and 6. The addition of the low frequency ramp causes the comparator to give an output pulse at a slightly different time of the 15kHz waveform. The result is that a succession of pulses with a constantly changing period is generated. These pulses are then used to open an fet, the source of which is fed with 15kHz video. The video is therefore gated through the fet for the time of the comparator pulse and is fed to the subcarrier oscillator.

Those who have a conventional camera and monitor

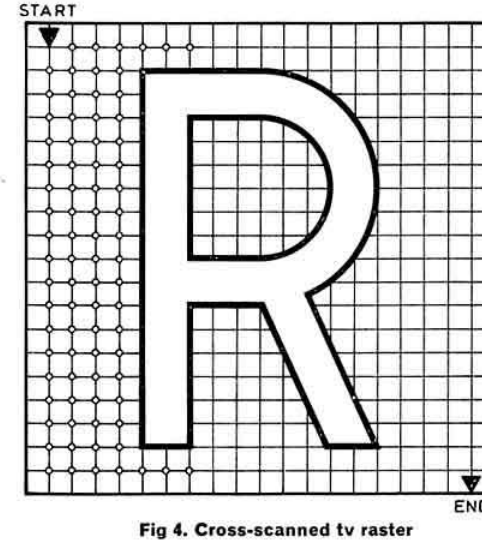

Fig 4. Cross-scanned tv raster

could, therefore, easily make a sampling system and still be able to use the equipment for its original purpose. However, one disadvantage with this arrangement should be pointed out. With the switch in the slow-scan position it is no longer possible to see the picture on the fast-scan monitor. From an operational viewpoint it is a great advantage to be able to see both pictures simultaneously. The solution is either to add a 15Hz sweep circuit for the fast-scan monitor deflection coil or to build a separate fast-scan monitor with 15kHz and 15Hz scanning frequencies.

The camera and the monitor will consequently maintain their 15kHz line frequency and in the slow-scan mode the vertical coils in both units will be switched from the 50Hz to the 15Hz sweep amplifier. But, since the sampling method dictates a *line frequency* of 15Hz, both camera and monitor

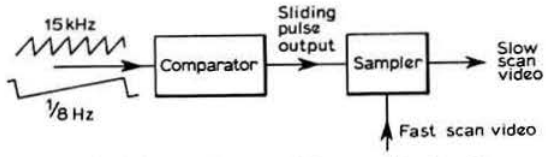

Fig 5. Block diagram of the sampling function

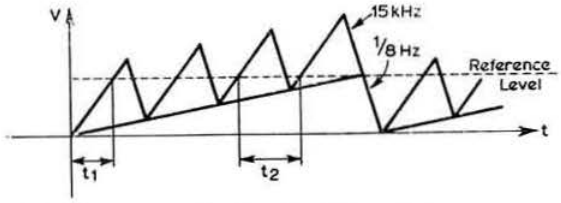

Fig 6. Waveform showing the addition of the two ramps

coils must be turned 90°. This arrangement permits observation of both pictures simultaneously, and rapid adjustments on the camera are possible when changing scenes.

A fully transistorized slow-scan monitor

A block diagram of the monitor to be described is shown in Fig 7. As mentioned previously, the video signal is modulated on a subcarrier. The signal comes in via the ssb receiver, the telephone, the camera or the audio tape recorder and passes heavy limiter stages in the monitor. It is demodulated and passes a heavy low-pass filter and is amplified in the video amplifier stages. The sync signals are picked out in the video stages, and are separated and used to trigger the horizontal and vertical sweep amplifiers.

On the monitor screen there will be a raster with a 1 : 1 ratio consisting of 120 lines. The raster will be rescanned every 8s. It is normal to transmit the same pictures four or five times. Due to the persistence of the monitor tube one will get the impression of a stationary picture. The only thing that moves will be the scanning line that slowly rolls from the top to the bottom.

It was mentioned earlier that the basic video bandwidth is 900Hz, ie the highest video frequency is 900Hz. Consequently there are only 300Hz between this frequency and the sync frequency of 1,200Hz. To improve on this interference situation an ic working as a limiter is used in the input stage, Fig 8. This ic has differential output and the output pulses will therefore have opposite polarity. They are used to drive two monostable multivibrators, the digital ic FCK101, which work as pulse counting detectors and give an output signal that has a frequency range that is twice the range of the input signal. The frequency range of the input signal is 1,200Hz—2,300Hz, and thus the output signal will have a range of 2,400Hz–4,600Hz. The difference between 900Hz and sync ($2 \times 1{,}200 = 2{,}400$Hz) is now considerably greater and a much cleaner video signal is obtained.

The input ic limits, according to data, at an input signal of 100μV, while in this circuit an input signal of about 50mV is needed for full limiting. The output of the multivibrators goes to a heavy low-pass filter with a flat characteristic from 0 to about 900Hz, and the quality of the desired video signal is closely connected with the design of this filter. All signals up to about 900Hz should pass through the filter unaffected while all higher frequencies should be heavily attenuated.

At first, transformer inductances were used in a common filter configuration with poor results, probably due to the stray capacitances of the transformer windings. Then m-derived end sections with an intermediate π-section were tried. Here each inductance has a parallel capacitor and therefore the stray capacitance will have little influence. It is difficult to measure inductances above 1H accurately and for this reason the indicated values should be considered as theoretical. If the type of ferrite core shown with the same number of windings and the same values of capacitors is used one should come close to optimum. Probably a still better result could be obtained using an active filter consisting of an operational amplifier.

The output signal from the filter, which should be about 400mV p-p, is fed to video stages TR1, TR2 and TR3. The

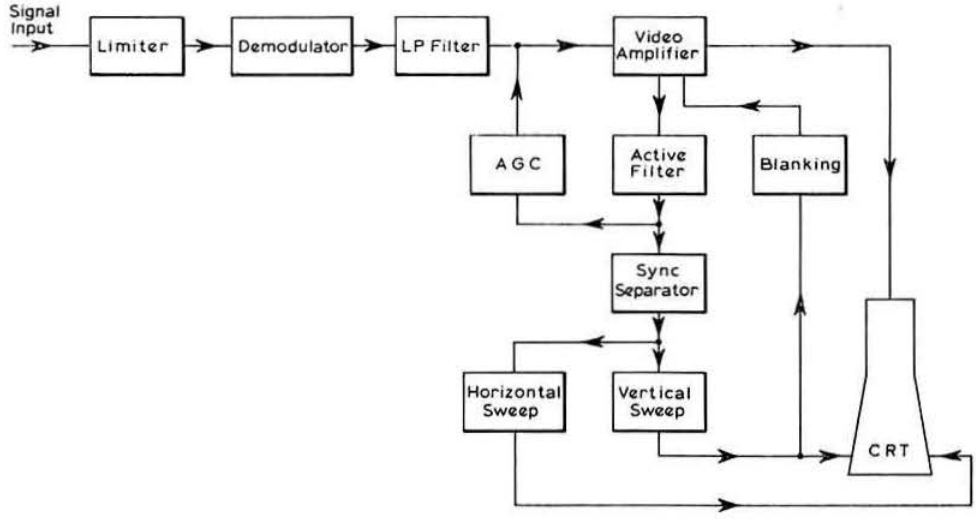

Fig 7. Block diagram of transistorized monitor

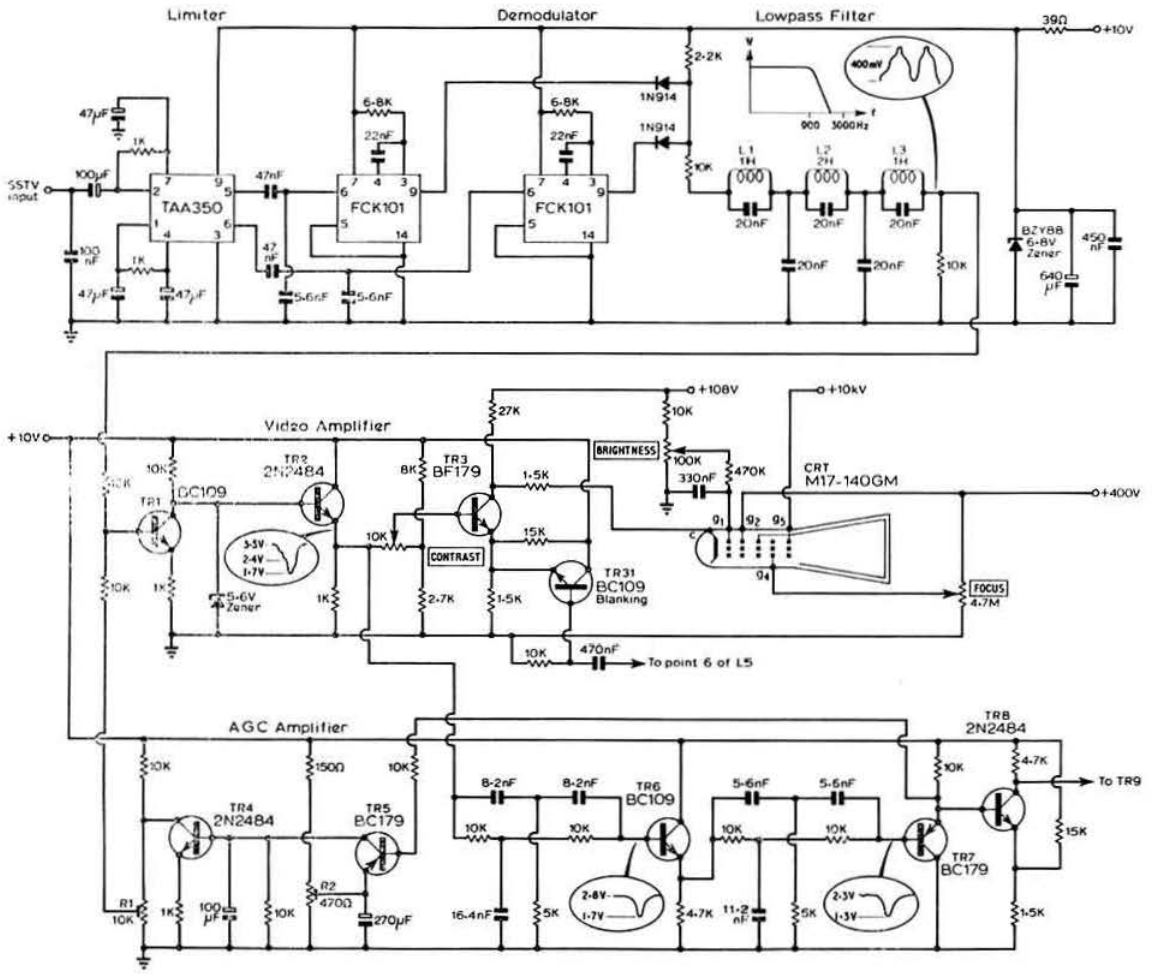

Fig 8(a). First part of three-part circuit diagram of sstv monitor

signal from TR3 intensity-modulates the cathode of the monitor tube, which is type M17-140GM by Philips. This is a very compact tube with a rectangular P7-screen measuring 93 by 124mm. The overall length is 227mm. The required acceleration voltage is approximately 10kV which may seem discouraging. However, we shall see that this problem is solved in a simple way.

Active filtering of the sync signal

From the emitter of TR2, the signal will be connected to the heavy active filter stages TR6 and TR7. Here all signals between approximately 2,000Hz and 3,000Hz will be strongly attenuated, ie noise and other interference will be considerably decreased. The attenuation will be about 60dB according to Fig 9.

Stabilizing the video level

From the emitter of TR7 the signal goes back to agc amplifiers TR5 and TR4 and further to the video input stage TR1. The level with respect to ground of the signal at TR7 emitter should be 1·9V. With trimpot R2 the voltage on TR5 base is set to 6·2V. R1 is adjusted so that the signal on the emitter of TR2 will be at 1·7V for peak sync and 2·4V for black. Maximum white will then be on 3·5–3·8V depending on the quality of the incoming video signal. By proper adjustment of the agc amplifier the frequency setting of the ssb receiver is no longer so critical.

Sync separation

From TR8 the signal is fed to TR9 where it is integrated by the 10kΩ resistor and the 27nF capacitor. The pulse measured at the collector of TR9 is set by trimpot R3 to about 5V p-p. On the base of TR11 there will now be a positive square pulse with a width of 3ms. This pulse is derivated in the next stage and will be a sawtooth on the collector of TR12, from where it is fed to the horizontal sweep stages.

Local sweep oscillators

Other features of this design are the increasing of the signal sensitivity and the decreasing of the sensitivity to interference.

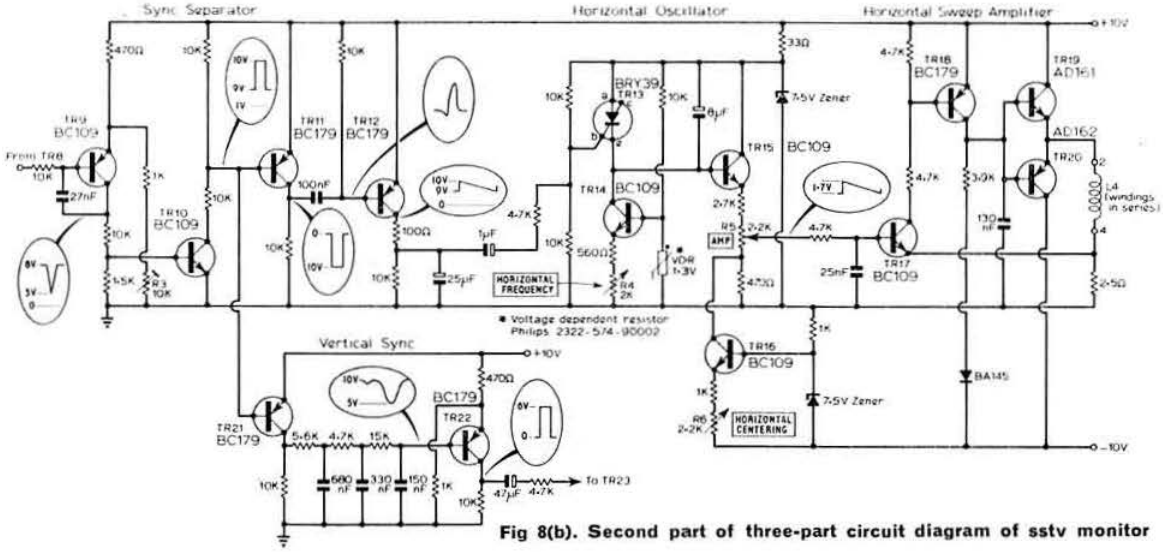

Fig 8(b). Second part of three-part circuit diagram of sstv monitor

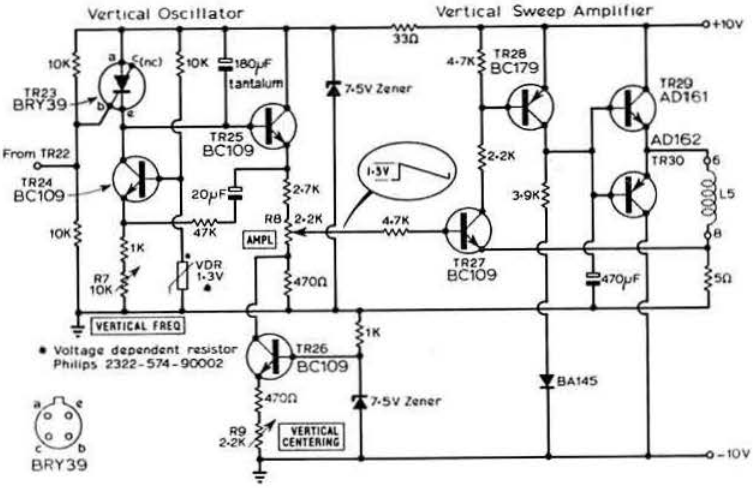

Fig 8(c). Third part of three-part circuit diagram of sstv monitor

Earlier, the method was used where the incoming sync pulse triggered the sweep oscillators. As the system could not differentiate between a sync pulse and an interference pulse the oscillator was triggered by any pulse that appeared at the input. At strong interference this could result in beam absence during long periods—it was consequently impossible to get the monitor to sync. At weak signals the sync was not big enough and the sweeps did not operate for that reason.

In this design local horizontal and vertical oscillators are used through which there will be a raster on the screen continuously irrespective of a signal coming in or not. Together with the action of the active filter stages, TR6 and TR7, the result now will be such that it is possible to receive signals under rather strong interference and weak signals under fading.

The sawtooth pulse from TR12 will consequently control the frequency of the sawtooth oscillator T13, the basic frequency of which is adjusted to a somewhat lower frequency by potentiometer R4 on the front panel. This setting is not critical but is necessary as the sweep frequencies from various stations can differ.

The sweep amplifiers

From the emitter of TR15 the sawtooth pulse is picked out through potentiometer R5 which controls the sweep amplitude. To the same emitter is also connected transistor TR16 which centres the sweep on the screen. This setting is made by potentiometer R6.

The sawtooth pulse is amplified in TR17 and TR18 and will drive the complementary stage TR19-TR20 which brings about a sawtooth sweep in the deflection coil. To improve the linearity a small signal is fed back to TR17.

The vertical sync stages

From the base of TR11 the square pulse is fed to the vertical sync stage TR21 and is integrated in that collector circuit. In the collector of TR22 there will be a square pulse that

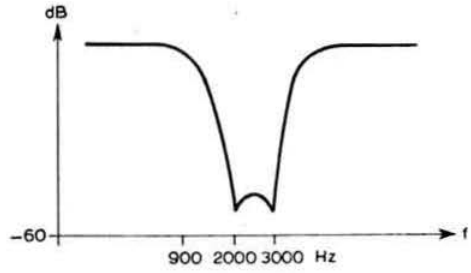

Fig 9. Frequency characteristics of active filter stages TR6-TR7

controls the local oscillator TR23. The function of the vertical sweep stages are similar to that of the horizontal stages.

Between the emitters of the final amplifier stage and ground there should be a sweep of 15V p-p for the horizontal stage and 13V p-p for the vertical stage. Between emitters of TR24 and TR25 there is a resistor of 47kΩ and a capacitor of 20μF for improving the linearity of the vertical sweep.

The capacitors on TR17 base and TR18 collector serve to decouple the vertical sweep which could be superimposed on the horizontal sweep. The capacitor on TR28 collector decouples the horizontal sweep from the vertical sweep.

Transistor TR31 is a stage for blanking the beam during vertical retrace.

An amber filter such as Tektronix 378-0567-00 or Strand Electric Cinemoid should be used in front of the crt screen in order to separate the long-decay component from the blue-white short-decay component of the phosphor. This amber filter will at the same time enhance the slow component.

The power supply

The following voltages are needed for the monitor:

10kV acceleration voltage;
400V for focus and first acceleration anode;
100V for control grid and final video stage;
10V and −10V for the transistor stages;
−11V for the high voltage stages.

The high voltage is obtained in the same way as in a conventional tv receiver, Fig 10. A 15kHz signal is generated in a Hartley oscillator and this pulse is amplified in the driver stage, which switches TR34. TR34 collector is connected to the resonance circuit T2-C1-L7 and booster diode BY118 with its parallel capacitor. On the collector will be a voltage pulse of approximately 80V which on the secondary of T2 will be approximately 10kV. This voltage is half-wave rectified and connected to the high-voltage contact of the monitor tube.

The drive pulse to TR34 should have the same appearance as indicated on the diagram for proper function of this stage. L7, which in a normal tv receiver will be the line deflection coil, is here represented by a dummy coil of corresponding inductance.

It is important to stabilize the −11V as otherwise the waveform on the screen will be deteriorated in white parts of the picture. The 10V and −10V should also be stabilized in order to maintain good linearity, Fig 11. The transformer used should have a current rating of 5A. Only the horizontal deflection coil requires a current of about 500mA p-p and the vertical coil about 300mA p-p.

Mechanical design

The electronic and high-voltage circuits can be housed in a cabinet measuring 160mm wide by 240mm high by 300mm deep. The monitor tube is clamped against the front panel by angle stock. The transistor circuits are mounted on two Vector boards measuring 130 by 220mm; the input stages, TR1—TR12 and TR21-TR22 on one of them. The boards are placed vertically on both sides of the monitor tube and fixed to small distance tubes, Fig 12.

The board for the high-voltage part measures 130 by 140mm and is fixed with 25mm distance tubes to the rear of the cabinet.

To avoid corona and flash-over the high-voltage diode should be mounted on 30mm ceramic stand-offs. The distance between the diode and any metallic part should be at least 30-40mm. Extreme care should be taken not to touch the high-voltage wiring as otherwise your slow-scan career will come to an abrupt end.

Many thanks go to Arthur Lambriex, PA0LAM, who designed this monitor circuit and thus made this article possible.

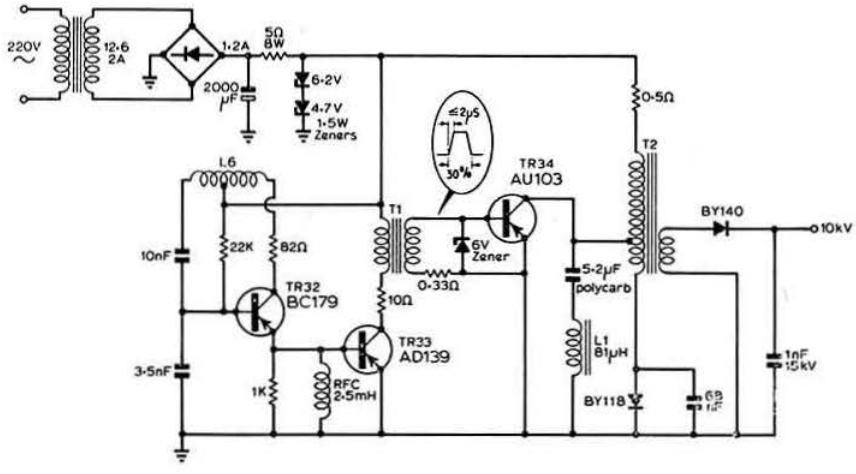

Fig 10. 10kV power supply

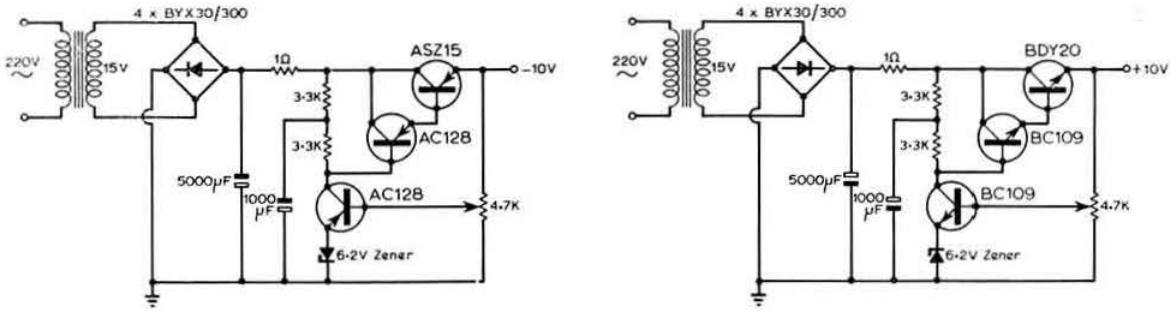

Fig 11. Low-voltage supplies

Parts list

The following are all of Philips* manufacture:

L1, L3 — H-core, type H-20, catalogue number 4322-020-33000, 400 turns 0·15 EE = 34awg.
L2—Ditto, 550 turns 0·15EE.

L1, L2 and L3
This is a core for small transformers to be used on printed wiring boards. The material grade is FXC3E2.
Type H-20 has the following data:

$A_e = 0{\cdot}47cm^2$ $\Sigma l_e/A_e = 8{\cdot}8cm^{-1}$ $V_e = 1{\cdot}93cm^3$
$/U_e = \geq 3850$ $A_L = \geq 5500^e nH$

L4, L5—Deflection coil, type AT1030 or AT1040.

Deflection coil AT1030

Line defl. coils	(parallel connected)
Inductance per coil	2·9mH
Resistance per coil	4·6Ω
Frame defl. coils	(series connected)
Inductance	82mH
Resistance	38Ω

L6—15kHz line oscillator coil.
L7—Pot core P26/16 3H1. 9 turns 0·7 EE = 22 awg 0·85μH.

L7 is a pre-adjusted pot core with an approximate frequency range from 0·1 — 200kHz and $\mu_e = 220$. The diameter is 25·5mm and the total height of the two halves together is 16mm.

T1—E-core type 4322-020-34550. Primary turns 150, 0·1 EE = 38 awg, secondary turns 40 0·4 EE = 26 awg.

T1 is a transformer core for use up to some megahertz. Two halves are needed. The ferroxcube grade is 3E1 and the airgap 0·15mm.

T2—Line output transformer type AT2042/01

Line output transformer AT2042/01
This is a transformer intended for use with 11in 90° picture tubes, and in conjunction with line-output transistor AU103 (or AU104) and the parallel diode BY118. If a similar transformer is not obtainable from Mullard they should be able to supply a transformer intended for 12in tubes and the relevant line-output transistor type. Please bear in mind that the transformer is used only to generate the high tension for the picture tube.

* (N.V. Philips Gloeilampenfabrieken, Elcoma, Eindhoven, Holland.)

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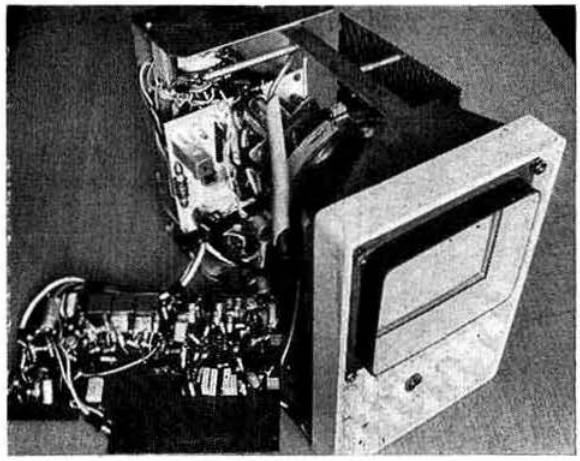

Fig 12. Interior of monitor showing the input circuit board flapped out. The high-voltage board can be seen at the rear

FLARE-SPOT

A radio-detective story in three parts by Rev P. W. Sollom, OSB, BSc(Eng), PhD, G3BGL*

PART 3. TRIAL BY LAMPLIGHT

Chapter 10. The benefit of the doubt? No!

The case for the defence of the nine aircraft standing trial for causing steam-train interference was presented in Chapter 8. Three attacks were made in an endeavour to obtain for the aircraft at least the benefit of the doubt: (i) the seriousness of the "crimes" was minimized, (ii) an attempt was made to discredit the evidence on the grounds of errors in measurements, and (iii) alternative explanations for the interference were suggested. The first two points made for the defence concerned the particulars of the Lille transmission, and these have already been discussed. Something will now be said in answer to the remaining points.

re 3. The seriousness of radio interference depends on many factors: technical, psychological, circumstantial and economic. This is not the place to elaborate this topic as most readers will be only too familiar with tvi and will know how real a problem that is. Steam-train interference can be minimized by using a suitably directive receiving aerial, but it remains a great nuisance, as anyone living near an airport knows when watching his tv picture "go in and out".

re 4. If the conditions for enhancement of the signal can be predicted, the reflection from an aircraft may be exploited for communication purposes. The peak signals which can arise from this cause are, however, of great concern to CCIR and to propagation statisticians. Designers of space communication systems need to know possible interference levels as the reliability of a space link may depend on this—and the lives of astronauts, too.

re 5. It must be emphasized that the aircraft cannot help causing the interference! They are passive reflectors. But the purpose of this investigation is to draw attention to the scale of the interference before it reaches an intolerable level as the sky fills with super-Jumbo jets. If the mechanism of the interference is properly understood it may be possible to eliminate it effectively when this is really necessary.

re 6. With regard to the errors in measurement inherent in the reconstruction of the air traffic situation, it should be noted that an aircraft's nominal cruising or climbing speed can be checked against a time interval long enough to keep the error to a few per cent, even if there is a minute or so error in any one particular reporting time. The time at a particular position is corrected by considering all the reporting times along the route, and spacing them according to the overall average speed. Thus there is no question of large errors arising from the difference between two times very close together.

In order to check the matching of fingerprints more easily, the time at which the aircraft crossed the radio path *has* been adjusted, within the margin of ± 1min so as to agree with the zero beat time on the radio analysis, which is known with rather greater precision. This involves a small lateral shift of the entire theoretical Doppler-shift graph without changing its shape.

Some details like the discontinuity in the curve for "D" at 1406gmt (Figs 6 and 9) are somewhat conjectural, but the fact of the discontinuity, which was due to the change of course at Woodley from Green One to Amber One, is not in doubt and is amply supported by the signal analysis.

Speeds in descent are the most difficult to estimate as the procedures adopted by pilots may differ considerably depending upon the need to fit in with a given order of landing. For example the 1-11 pilots may do a normal high-speed descent at a constant 280knots *indicated* air speed at all heights. Allowance must be made for height and temperature to obtain true air speed before applying wind vector corrections. Alternatively a maximum speed descent may be made—330knots at FL240 decreasing to 318knots at sea level—*indicated* air speeds again—the rate of decrease being nominally linear.

There is no need to labour the points in reply to the defence, but it should be mentioned that there is no lack of circumstantial evidence which helps to resolve doubts in many cases. For example there is the height restriction that requires all traffic on Amber One to be above 6,000ft just about the point where it would cross the radio path. There are well-established arrival and departure procedures which vary according to the runway in use, and hence according to the wind direction. And in the case of the DC-8 and VC-10 there was Long-Tom's evidence in support. The wind vector was quite small on this occasion, and errors in neglecting it altogether would have been hardly noticeable on the graphs.

The ideal way of obtaining the actual routes taken by aircraft, and their positions at any time, is by photographing a radar plan position indicator display. This was done on one occasion to determine the usefulness and limitations of the method. It gives no information as to the heights of the aircraft or what type they are, and for various reasons it is doubtful whether the accuracy would be better than with the method of reconstructing the traffic situation which has been adopted. Certainly the aircraft in the dock in this case cannot be given any benefit of the doubt in respect of the fact that their Doppler shift fingerprints match perfectly with those found on the tape.

re 7. Meteorological "blobs", travelling with typical wind velocity across the radio path near the transmitter or receiver, could cause Doppler shifts of a few hertz similar to aircraft crossing at Lydd. No conceivable meteorological phenomena

* Douai Abbey, Upper Woolhampton, Reading, RG7 5TH

could produce frequencies of 200–300Hz as these require both the transmitter-aircraft and receiver-aircraft rays to be simultaneously lengthening or shortening at some 500knots. Cyclic fading of almost constant frequency or very small slope is sometimes observed, and although a simple explanation in terms of aircraft can be offered, a meteorological explanation is not easily eliminated. The amplitude of an aircraft effect in this case would not be likely to persist for more than a few minutes at the most, whereas a meteorological effect might last for very much longer, or at least be frequently repeated.

re 8. The suggestion that an aircraft just above the horizon shadow and very close to the receiver would give the strongest signals was tested by flying an aircraft of the Meteorological Research Flight on a racecourse flight plan passing vertically over the receiver at successive heights up to 15,000ft. This was repeated a few kilometres towards the transmitter. Neither experiment resulted in any high peaks of signal related to the flight plan, but random peaks were recorded. Cyclic fading occurred as expected when the aircraft passed overhead or crossed the radio path. The experiments did confirm that the aircraft must be above the horizon shadow if it is to give a significant reflection, and that this shadow was about the expected height.

It was not possible at the time to record in the aircraft the vertical distribution of the illumination from Lille, which might have revealed the ground reflection nulls in the vertical pattern. From observation of the reflected signal at the 500ft height intervals it would seem that the nulls are not sharply defined. It must be concluded that the higher peaks of general signal level result from some factor which overrides the "distance factor" based on the radar equation. This factor must, however, help to determine the combination of circumstances which make a large peak in signal likely. It is set out as a scale along the top of Fig 12.

Some further evidence will now be presented to conclude the case for the prosecution: call in the model maker!

Chapter 11. The model maker's story

"Having heard that a number of aircraft were on trial for causing a certain radio interference, I decided to try a little experiment, a trial by lamplight. I built scale models of several of the types, using the plastic 1/144 scale kits available in every toy shop which are remarkably inexpensive and their accuracy and detail very impressive. Painted them with gloss paint in smart colours, mounted them one at a time on a camera tripod head (for easy adjustment of "flight" attitude) in a darkroom, and arranged a powerful beam of light (26V 340W lamp, concave mirror, convex lens 6in dia.) to aim at the model through a letter-box hole in the darkroom door—beam firing upwards about 3·5° to the horizontal simulating Lille illuminating Amber One traffic. Placed screens to intercept the light reflected off the gloss paint, and a screen for the projection of the letterbox hole and shadow of the model. Fig 13 is a photograph of the VC-10 model in an attitude which illustrates several features of the geometry of its reflections; it is shown climbing and flying towards the transmitter. At all attitudes there are three major contributions to the pattern of the reflections, and these appear as curves of light on the screens.

"In this photograph the fuselage is producing the small semi-circular streak. The axis of the fuselage points to the centre of this circle. It is being formed by a cone of light rays, and the angle of the cone depends only on the angle between the light beam and the fuselage axis. The curved streak which disappears off the left of the picture is caused by the starboard wing, and is part of a cone of very wide angle. The curve towards the bottom of the picture is due to the port wing and is symmetrical with that for the starboard wing only because the flight path is aligned with the beam of light, and the aircraft is not banking.

"All the models produce curves of reflection on the screens —always three dominant features associated with the fuselage and wings. The tail-planes usually have angles very

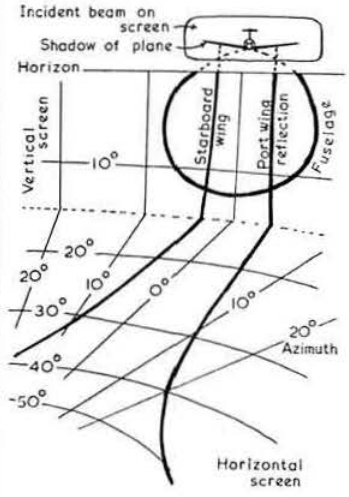

Fig 13. A model VC-10 in climbing attitude, 4° to the horizontal, illuminated from below along its flight path, has its fuselage inclined upwards 7·5° from the incident beam. The shadow is 3·5° above the top of the vertical screen, which is level with the model and represents the horizon. The screens are marked every 10° in azimuth and declination from the model.

The fuselage reflection casts a circular pattern on the vertical screen, with its centre 4° below the horizon (angle of climb). The reflections from the two wings form curves on the flat ground screen, with greatest intensity at 10°-15° downwards, becoming fainter towards the bottom and left of the picture.

The fuselage reflection intersects those from the wings at about 11° below the horizon. The most powerful flare-spot would be caused by the coinc dence of such an intersection with regions of greatest intensity on each curve.

The tail fin projects reflections upwards unless the aircraft is banking. The tail-plane reflections merge with those of the wings as the angles of sweep-back are similar

similar to those of the wings, and their reflections merge with those of the wings. The vertical tail-fin produces a reflection which always lies above the horizon unless the aircraft is banking. Engine pods and rounded surfaces like the nose contribute to a general scattering in all directions. Viewing the model from any direction (such as the camera position for this photo) reveals small bright glints of reflection. But viewing the model along a ray in one of the cones of reflected light produces a completely dazzling effect from the flare-spot responsible.

"A cylindrical rod (a first approximation to a fuselage) was placed in the beam to investigate the geometry of these reflections. A photograph of this experiment is given in Fig 14. A flat strip was also investigated—a rudimentary wing. The following observations may be made:

1. The main conical reflection pattern is independent of the diameter of the rod or the thickness or breadth of a strip, fuselage or wing. It depends only on the angle of the light with respect to the length-axis of the reflector. To a first approximation, a tapering wing may be considered to have an axis along the centre of its length.
2. The intensity of a particular ray forming part of a cone of reflection depends on the radius of curvature of the reflecting surface. Thus a round fuselage gives a similar intensity all round its cone, but a wing gives small intensity to those parts of the cone formed by rays from its edges, and a very large intensity from the underside.
3. The parts of the surfaces which are in shadow contribute nothing to any part of the cones of reflection. This would not be quite true for radio waves, but a first approximation.
4. The reflected rays may be obstructed by another part of the structure thus reducing or suppressing them over part of the cone. A wing without engine pods is particularly free from obstructions.
5. The geometrical angles of the aircraft structure determine the angle between the incident light and the cylindrical axis for a given flight direction. In particular, the angle between the wings and fuselage, and the dihedral angle of the wings are characteristic of a particular type of aircraft. The swept-wing class of aircraft has wing angles which are closely similar, so the VC-10, DC-8, 707 and Coronado will all behave very similarly when on the same route. Straight wing types like the Viscount and Vanguard have only one axis effectively common to both wings, though the small dihedral angle broadens the reflection pattern.

"In relation to the Amber One airway, all swept-wing aircraft will have one wing almost aligned with the Lille-Douai path—a condition that intensifies the reflection, optically at least. Cones of reflection from two major flare-spots may then intersect giving much enhanced intensity."

Chapter 12. A question of principle

Optical ray theory indicates (and experiments with models confirm) that the maximum intensity of scattering will occur from a flare-spot which gives specular reflection in a certain direction. The beam widths of the associated lobes at metre wavelengths depend on the dimensions of the aircraft, in λ-units, and can be expected to be narrowest in the plane containing the greatest dimension. It is Babinet's Principle that scattering from a plane conductor is equivalent to diffraction through a hole of the same size and shape in a conducting screen (eg that a dipole aerial is equivalent to a slot aerial of the same size). The aircraft can be considered as a window through which radiation from an image-transmitter passes to the receiver—the image being formed by the flare-spot surface as by a mirror. The size of the window depends on the obliquity with which it is viewed, and this will control both the total energy passing through the window and the radiation pattern beyond it. The smaller the window, the less the energy and the broader the pattern. If the window is virtually a slit, the pattern in the width-plane will be very broad, ie a large portion of the cone will be within the "beamwidth", but the length-plane pattern will be narrow, ie small spread in the cone angle. The half-power

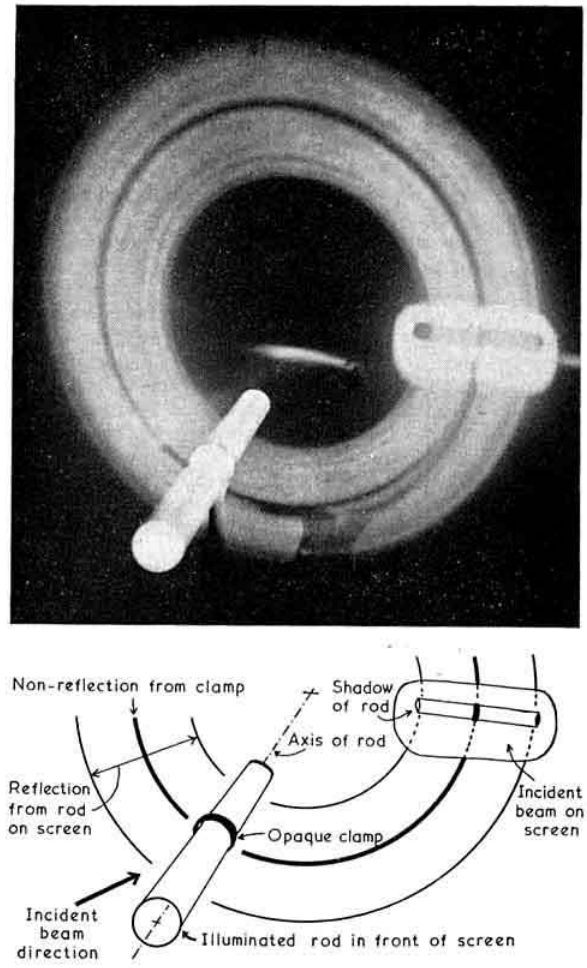

Fig 14. A cylindrical rod illuminated by a parallel beam of light has around its axis a conical radiation pattern of reflected light. This forms a circular pattern on a screen normal to the axis of the rod. At other screen angles the various conic sections are formed.

The angle between the rod axis and the light beam is the half-angle of the cone. The circular pattern on the screen passes through the shadow of the rod which is formed in the illuminated rectangle of the incident beam. A conical pattern is formed whatever the cross-section shape of the rod, but the intensity around the pattern depends on this shape

beamwidth due to a long slit is about $115/l$ degrees, l being the length of the slit in wavelengths. The portion of a wing or fuselage that is simultaneously visible from transmitter and receiver, ie usable as a mirror, is effectively a slit.

In event "C," Fig 3, the mean curve of the peak in signal strength has half power (0·7 voltage) points about 30sec apart. At 260knots the Viscount, "C" cruising along Amber One at 47° to the radio path, and 14 nautical miles distant from the receiver, changes in azimuth by 7° in this time while covering a distance of 2·2 nautical miles. With a wing span of $16\frac{1}{2}$ λ and a length of 15 λ the flare spots might be expected to have a beamwidth of 115/16°, ie about 7°, which would seem to be in close agreement with the observed peak. In this case the flight path causes the narrow dimension of the flare-spot lobe to be swept through the receiving position as the aircraft crosses the radio path.

As the diameter of the cylindrical fuselage is only about 2λ, it is, perhaps, not permissible to regard the narrow dimension of the "slit" merely in terms of its physical size due to possible resonance effects. Some currents will flow in the shadow sides of wings and fuselage, and will modify the general scattering pattern, but have little effect on the flare-spot geometry.

It should be noted that the condition for zero-beat is that the bounce-path length should shorten to a minimum and then lengthen again. At the shortest point, the flight path is a tangent for an ellipse, in three dimensions, which has transmitter and receiver positions as foci. This condition is illustrated in Fig 7. At Z the angles α, $180-\beta$, γ are all equal, as was stated previously, but this means that i = r, which is the law of reflection: the angle of incidence equals the angle of reflection. A flare-spot peak can, therefore, be expected to be associated with a zero beat at the peak when the flight path is parallel with the plane of the flare-spot surface, eg when the fuselage is involved. If the aircraft is crabbing along due to winds, the zero beat will be off peak.

In many cases the wings will give flare-spot peaks in the signal when the Doppler shift is considerable, and no steam-train effect will be observed to help recognize the cause of the peak. On the other hand, many steam-train events will occur when the conditions for maximum intensity glint are not fulfilled, and the ground-wave signal exceeds that from the aircraft throughout the event.

Chapter 13. The real crime

The case has centred around 11 particular instances of steam-train interference which have each been attributed to the behaviour of one or more aircraft. This is only a small manifestation of the real crime of every aircraft: that of sweeping flashes of interference, on each and every frequency that illuminates it, all over the country. No place and no frequency is immune from this unless there is no aircraft above the horizon in any direction. It is crime on the grand scale, and a new factor will have to be admitted to propagation theory to allow for it—an aircraft density factor, perhaps—if the troposphere is to be considered realistically.

When the cone of rays reflected by wings or fuselage strikes the ground a conic section is produced, so the glints illuminate the countryside with curved hyperbolae whose shape and positions depend upon the aircraft attitude and the direction of illumination. A data chart for this effect is given in Fig 15. For a given aircraft attitude, three curves must be selected (by interpolation, as necessary) corresponding to the geometry of wings and fuselage, The scale of the map of the ground on which the curves lie depends upon the height of the aircraft which, in the figure, is one H-unit. If the fuselage is oblique to the flight path due to wind vector, a fourth curve must be selected to indicate the locus of the zero-beat points. All points on this locus will have zero-beat fading simultaneously. All points on each glint line will see a flare-spot, the brightness of which will depend on the curvature of the reflecting surface towards each point.

An example may be made of the VC-10. The detail of its major event, "D," reveals a broad peak in signal level, with the zero beat offset from the centre by 13 seconds—Fig 16. At the time of the centre of the peak, the aircraft was climbing at 380knots, and so was 2·6km (distance travelled in 13s) north-west from the point of crossing the radio path. With easterly winds its heading would be a little east of the flight path. At a climbing attitude the angles are modified slightly, and allowing for Lille illuminating the aircraft from below the resulting map can be constructed as in Fig 17.

In this figure all four arms of the hyperbolae, Z_1, F_1, P_1, S_1, are asymptotic to the ray from Lille which passes through the aircraft position. The other arms of the hyperbolae lie

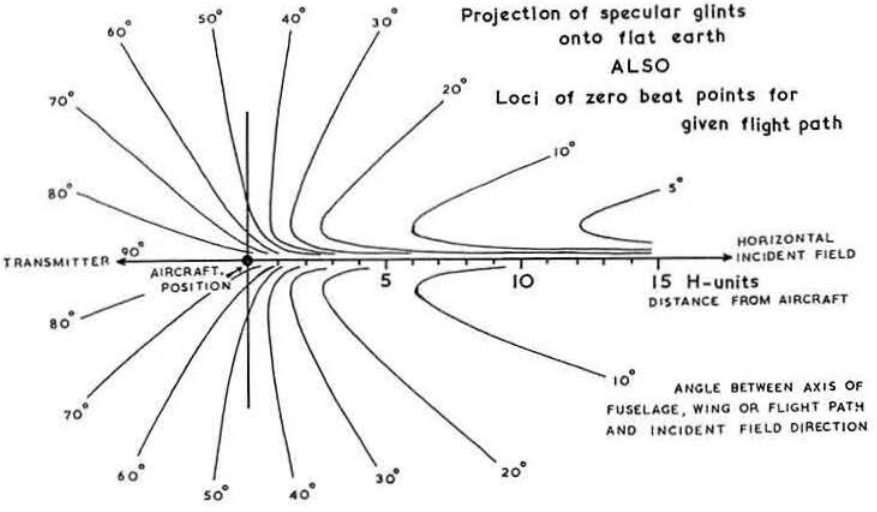

Fig 15. When the earth intercepts a conical reflection pattern, the locus of maximum intensity is, in general, a hyperbola. One asymptote is always the incident field direction; the other is at twice the angle of the axis of wing or fuselage with respect to the incident field. The scale of the ground-map depends on the aircraft height, which is taken as one H-unit for the radial scale.

The geometry of zero-beat is the same as that for specular reflection where the cylindrical axis is defined by the direction of the flight path, and is almost identical with the fuselage axis in the absence of wind vector

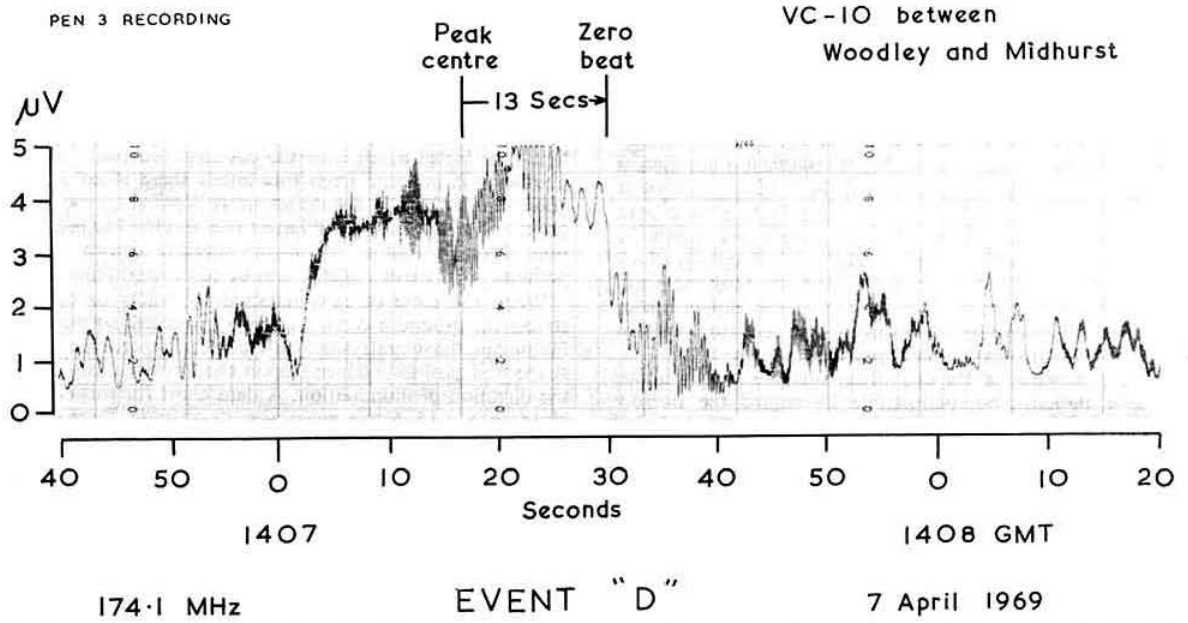

Fig 16. In event "D" zero-beat occurred 13s after the centre of the general rise in signal. Therefore, at the centre of the rise, the VC-10 was 2·5km from the point of crossing the radio path. This event may be contrasted with event "C" which was caused by a Viscount on the same route (Fig 3)

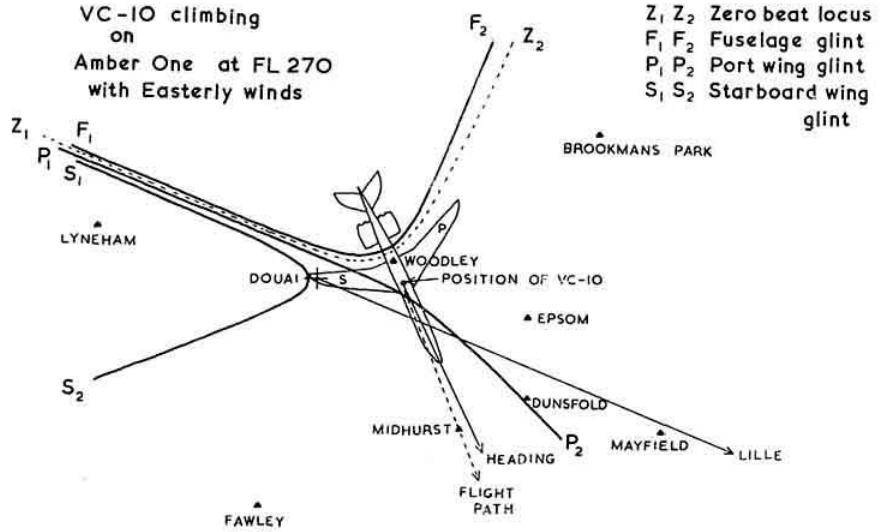

Fig 17. The swept-wing angle of the VC-10 with respect to the fuselage causes the starboard wing to lie almost along the incident field direction as it flies from Woodley to Midhurst. The glint from this wing precedes the zero-beat position by about 2·5km, and the climbing attitude causes the greatest intensity to appear at the point on the hyperbola nearest the receiver at this moment

in positions which are characteristic of the aircraft and flight geometry, In particular the starboard wing glint passes through the receiving position at this moment. The greatest intensity of glint is also seen at this part of the hyperbola because of the climbing attitude which tilts the mirror flare-spot surface. The offset of the zero beat in this case is, therefore, explained by flare-spot geometry rather than by drifting due to wind vector. The aerial patterns and associated ground reflections at both transmitter and receiver must play their part, but it is probable that the dominant factor is the flare-spot geometry.

A receiver north-east of the VC-10 might receive a peak after the zero beat point, since the Z_2 line would pass before F_2. The aircraft carries its whole pattern along with it, and the pattern only changes its character slowly if the transmitter is very remote, like Lille in this case.

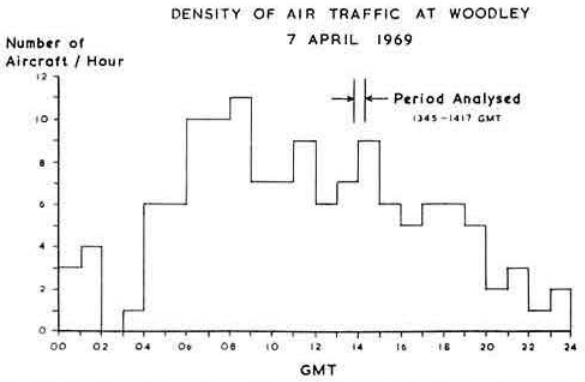

Fig 18. The major events in the signal recording were caused by aircraft routed via Woodley. The statistics of the day's traffic at Woodley show that the period analysed is not at all exceptional

Chapter 14. Closing the case

The nine aircraft described in this case have been held up as an example of the influence they have on vhf propagation in the real troposphere. The half hour examined is typical of the air traffic throughout most of the day, as may be seen from Fig 18. Rather more than half the period is smeared with their interference in Fig 2, and this is only the civil air traffic. But on Easter Bank Holiday Monday, it probably represents the bulk of the air activity at altitudes which are important in this case, and it has been sufficient to explain every event in Fig 2. In the case of other paths and other times, military and test flights must add their quota of interference.

For a communication mechanism, the air traffic density in south-east England is probably sufficient to provide a reliable service by passive reflection, given adequate information as to the whereabouts of the aircraft and suitable aerial equipment at the terminals. As an interference mechanism, the nuisance value of passive reflections can be minimized by (i) using a sharp transmitting beam, not illuminating the aircraft, (ii) using a special receiving aerial designed to have a null in its vertical pattern towards the aircraft—probably about 10° elevation for the path discussed, but each path will have its own characteristics, (iii) siting the transmitter in relation to air traffic routes so that intense flare-spot situations are not of frequent occurrence for the service concerned.

Acknowledgment is gratefully made to all who have helped in this investigation, and in particular:
The Director, Radio and Space Research Station of the Science Research Council; The Centre Superintendent, London Air Traffic Control Centre; The Meteorological Research Flight, RAE, Farnborough; The Engineer-in-Chief, RTF, Lille; The Abbot of Douai Abbey, Woolhampton; and the boys of the Douai School Radio Society. The work was carried out in collaboration with Mr J. A. Lane of the Radio and Space Research Station as part of the station's programme of research in tropospheric propagation, and is published with the permission of the station's director.

Ensuring transistor stability in rf power amplifiers

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Engineers frequently find that rf power development work with new products results in the destruction of transistors, due to instability.

Here, Terry Roeves, G3RKF, explains the cause and effect of these instabilities and suggests ways to eliminate or reduce them to an acceptable level.

SIGNIFICANT advances are continually being made in the battle to make transistors indestructible. TRW Semiconductors now test many of their devices at all phases of mismatch—greatly minimizing one problem, but not necessarily ensuring that instabilities do not remain present.

Since instability can result in almost instantaneous destruction of the transistor—or at least increase the overall emitted power tremendously—it is essential that the condition should be understood and controlled.

Instabilities may be defined as undesired frequencies present in the output of an amplifier and dictated by components which are not harmonically related to the input frequency. These undesired frequencies may range anywhere between several hundred kilohertz to a few hundred megahertz and they may or may not be self-sustaining (that is, instability induced by rf drive power may remain after removal of the drive). In fact, just forward biasing the device to some current level is sometimes sufficient to produce instabilities.

These instabilities seldom occur when the amplifier is precisely tuned, but rather when some change is made in the normal operating conditions or when trying to tune a circuit which is not fully optimised.

As far as the transistor is concerned, the most serious problem is variation of load impedance, as it is under these mismatched conditions that destruction is most likely.

Instability sources

A bipolar transistor consists of two p-n diodes. Instabilities occurring in p-n diodes which are non-linearly operated as

varactor multipliers are difficult to explain. Briefly, varactor instability can be due to:

1. parametric subharmonic oscillations;
2. thermal feedback, or thermal relaxation oscillations;
3. biasing oscillations in a single stage;
4. chain oscillations due to high-order propagation resonances.

All of these varactor effects may also cause instabilities in Class C operated power amplifiers. However, the transistor is more than just a combination of two diodes—it is an active device, whereas a diode is not, excepting special parametric applications.

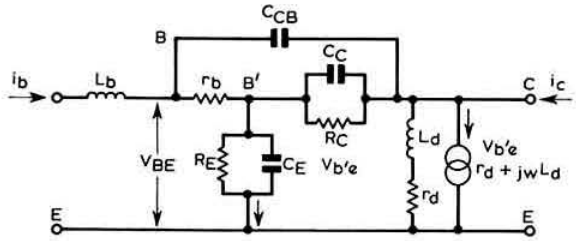

Fig 1. Small signal linear equivalent circuit

If one considers even the small signal linear equivalent circuit shown in Fig 1, it is evident that for the common configuration the instability problem will be complicated in the large signal mode.

For large signal operation each of these intrinsic functions has to be considered as highly non-linear. While the four (positive) non-linear resistors (admittances, really) cannot produce any sub-harmonics, the four non-linear "varactors" C_e, C_c, C_b and L_d can do so extremely successfully.

Additionally, these capacitances, classically C_{cb}, result in the transistor behaving as a feedback amplifier, so that feedback related instabilities can occur.

By the complexity of an individual design problem, the engineer is sometimes induced to look for some exotic parametric mode, or other strange effect, as an explanation of his problem. If this is the case, logical thought on the engineer's part will probably find the cause.

Consideration should be given to the Class C amplifier, primarily as a non-linear operated amplifier, plus a linear Class A amplifier as soon as current flows. The function of dc biasing is fulfilled by the input ac drive power which is partially rectified by the base emitter diode.

With these two separate considerations in mind, the following classification of instabilities can be made:

1. Linear instabilities in a Class A amplifier—
a. low frequency oscillations produced by thermal feedback effects,
b. oscillation due to internal feedback,
c. negative resistance or conductance induced instabilities, due to transit time effect, and
d. oscillation due to external feedback (eg insufficient decoupling of the dc supply);
2. non-linear instabilities due to the Class C operation—
a. parametric generation of harmonics, and
b. parametric generation of sub-harmonics.

Linear instabilities

Possible linear instabilities can occur over an extremely broad range, and some correlation with the frequency capability of the device is helpful. The different frequency ranges of a transistor are shown in Fig 2.

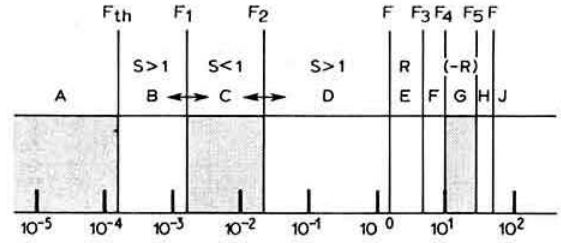

Fig 2. The different frequency ranges of a transistor ($F = f/f_t$ is the frequency normalized on the current gain-bandwidth product f_t where $/h_{21e}/$ becomes unity)

Range A ($O > F < F_{th}$) defines the region of possible instabilities due to thermal feedback where the collector junction temperature T_c becomes frequency dependent. F_{th} is determined by the smallest effective thermal time constant of the transistor, it can be 10^{-3} to 10^{-4}. For the 2N4431, f_T = 600MHz, F_{th} 600kHz to 60kHz. This effect is very problematic in common base operation. Intrinsic emitter stabilization and differential temperature coefficients of materials will help to minimize this.

In range B the transistor is unconditionally stable.

The biggest problems lie within range C, in which potential instability exists due to internal feedback in the transistor. For common emitter configuration equals approximately half the device cut-off frequency

$$\left(F_{2e} \doteq \frac{Ft}{2}\right).$$

Most rf amplifiers are operating in the frequency range D, where S>1, unconditionally stable as in range B.

In region E, above the maximum frequency of oscillation, F_{max}, where the power gain becomes unity, the device is passive. The same applies to region J to $F = f/f_t$. However, in regions F and H, the transistor represents again an active stable four-pole and in region G, negative resistance predominates due to transit time effects.

Other linear instabilities can be produced by negative resistances caused by avalanching in the collector junction

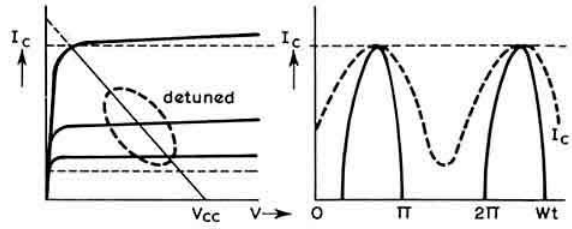

Fig 3. A reactive component, giving an elliptical load line, introduced by slightly detuning an amplifier

(second breakdown). There are other still unexplained negative conductance regions in the output characteristics.*

Non-linear parametric effects can generate harmonics and sub-harmonics. The latter can be explained by the parametric varactor action of the emitter and/or collector capacity (junction and diffusion).

The effects of these will be very similar to the internal feedback mechanism of a Class A amplifier and should be investigated as such.

Internal feedback

In range C of Fig 2, MAG is undefined, and "Class A" is potentially unstable. That means it is possible to find input and output load and source impedances for which the amplifier can oscillate without the application of external feedback

$$F_{1E} \propto I_C \text{ and } F_{2E} \propto \frac{1}{IC}.$$

Therefore, range C is large at low collector direct currents, and small or missing at high currents.

One may ask, what is the effective collector direct current I_{CA} for the Class A part of the amplifier in question?

If the transistor is working into the correct load resistance and C_{OB} is tuned out, the I_C falls to zero once for a certain time in each cycle. In this ideal case I_{CA} would be zero, the Class A theory is not effective and it is a waste of time to pursue the point. *But*, at higher frequencies the transistor cannot respond fast enough and, therefore, never has time to turn off completely (non-saturating switching is poor in rf power devices). Then I_{CA} is finite. Now if the amplifier is slightly detuned, a reactive component is introduced. This gives an elliptical load line.

This is the set of circumstances that leads to our problems. The frequency of oscillations is in most cases somewhat in range C, with MAG tending towards a very large value.

Engineers have also found that a pa sometimes will start to oscillate if the drive power is reduced. This can be understood if one considers that for a decreasing I_{CA} range C increases.

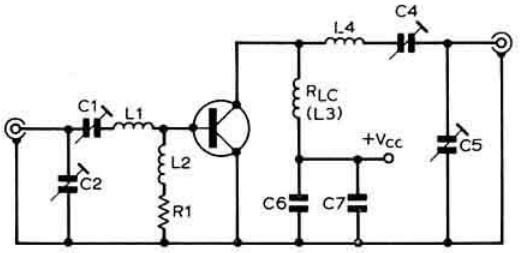

Fig 4. A typical pa. The lumped series LC circuits at input and output cut off the loading effect of load and source resistances at low frequencies, making oscillations possible

Fig 4 is a typical pa. The lumped series LC circuits at input and output cut off the loading effect of load and source resistances at low frequencies (range C). Thus, oscillations are possible. If they occur, they generally modulate the carrier, or vice versa, depending on amplitude. Again, for low collector currents the upper limit F_2 of range C can be relatively high and close to the signal frequency. Mixing will then occur.

Instability may be reduced by the following design criteria:

1. conductive loading of input and output by increasing G_S and/or G_L in the critical frequency range C, and
2. reactive loading of input and output by increasing the imaginary parts of the load, so that the probability of S falling below 1 is decreased.

An example of this would be to make R_{LC} (L3) as small as possible, thereby making the output more predominantly capacitive. But this is not true for the emitter base inductance. It should be noted that a very low inductance, even a short between emitter and base, can produce strong oscillations in region C. This is because the imaginary parts of source and load impedances (a and jb notation) have the relationship

$$\frac{b1}{b2} = \frac{G1}{G2} \text{ where } G1 = G11 + G_S$$

and $G2 = G22 + G_L$, b1 and b2 are determined largely by L2 and L3.

Similarly, reflected impedances, from stage to preceding stage suggest that interstage coupling should be relatively small in order to avoid oscillations, (10pF—50pF).

The use of common base offers some advantages, because of higher power gain at higher frequencies and higher efficiencies due to higher output resistance. (Note that an increase of efficiency from 50 per cent to 60 per cent results in a 30 per cent decrease in power dissipation.)

However, the stability problem is even more complex because of the inherent combination of parallel feedback produced by the collector emitter network branch and the series feedback caused by the base resistance rbb.

Conclusions

It can be concluded that before worrying about non-linear parametric effects in the design of Class C power amplifiers, one should eliminate linear instabilities. These possible linear instabilities are caused by a superimposed Class A amplifier as soon as dc flows in a Class C amplifier. Hence all that has been stated here applies equally to ssb, linear Class A amplifiers.

Consideration should be given to range C, particularly where an engineer designs a circuit for use beyond the specified region of operation. The top limit of range C may be much smaller than the operating frequency.

Finally, it is regretted that more clarity cannot be thrown on the subject of the best parameter notation currently available. Similarly, equivalent circuits are not without fault and no doubt the one used here could be bettered. However, it is hoped that it has served its purpose.

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Modifications to the HW100 transceiver

by C. T. STAGG, G3KPW*

WHILE being well satisfied with the performance of the HW100 transceiver the author felt that in certain respects improvements, which could not be expected in an economically priced piece of equipment, could be made.

To correct a certain amount of play between the shafts of the preselector and final controls, a couple of bushes were made from the outer polythene of a piece of low-loss coaxial cable. These were filed to suit, and with a little silicone grease between the bush and shaft they stopped the play and considerably improved the "feel".

When tuning the PRESELECTOR control there was a tendency for one of the capacitors to lag, or lead, depending on direction of rotation—this being due to uneven tension of the rubber drive bands. Replacing these with nylon drive cord with small spring tensioners was the answer to this, although perhaps the use of Meccano wheels would have made a better job of it.

The difference in dynamic loading of V7 between transmit and receive was quite pronounced, particularly on the hf bands, so it was decided to put in switching diodes. The small board carrying these components was fitted to the chassis side upright, adjacent to the preselector variables. On receive the diodes are switched on by the relay controlled ht line, bringing extra adjustable "C" into circuit across the capacitors C421B and C422B. It will be found necessary to retrim the circuits on transmit, after adjusting the two "beehives", so that when correct there is no difference between either mode. The extra capacitors are soldered directly onto the variables, with only an earth and one wire to connect on the adjacent panel.

TVI. A letter to Heathkit produced a supply of 0·01μF 500V discs which were fitted direct to the power input plug, with the exception of the 800V one, where a 0·01μF 1,500V one was used. A series trap was fitted across the aerial socket using 10 turns 18swg silver-plated wire $\frac{3}{8}$in inside diameter, with a 30pF ceramic variable mounted alongside the socket. This considerably reduced the small harmonic output.

Under certain circumstances it was noted that rf was getting in from the microphone lead, so a miniature rfc was put in series with the hot lead and a 0·0001μF to deck and a 0·001μF from the control switch lead to deck—these being placed as close as possible to the socket.

A disadvantage during multiway QSOs was that the netting left much to be desired, as various people do not agree on the frequency, so it was decided to add incremental receiver tuning facilities. The main components were put together on a small tag board and fixed to the rear of the aerial relay. A $\frac{1}{4}$in hole was drilled in the side screen near the underside of the relay on which spare contacts were available. The wiring was carried out with three-way screened cable to the board, via a hole already in the chassis in which a grommet was fitted. The 0·002μF ceramics being put in to stop any chance of rf leakage. The vfo unit was removed and one of the 56pF capacitors (C947 or C948) substituted for a 47pF—this being necessary to keep calibration tracking, this capacitor must be a NPO—a good quality silvered mica being used. The two capacitors were spaced well apart.

Some experimentation was necessary with the series capacitor to the diode, a ceramic turret tag being used as an anchor point for this and the rfc, the other end of which is

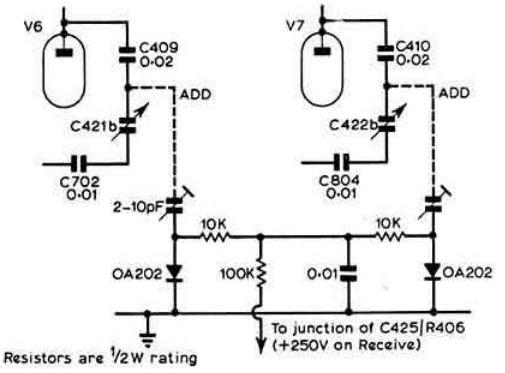


Fig 1. Modification to preselector

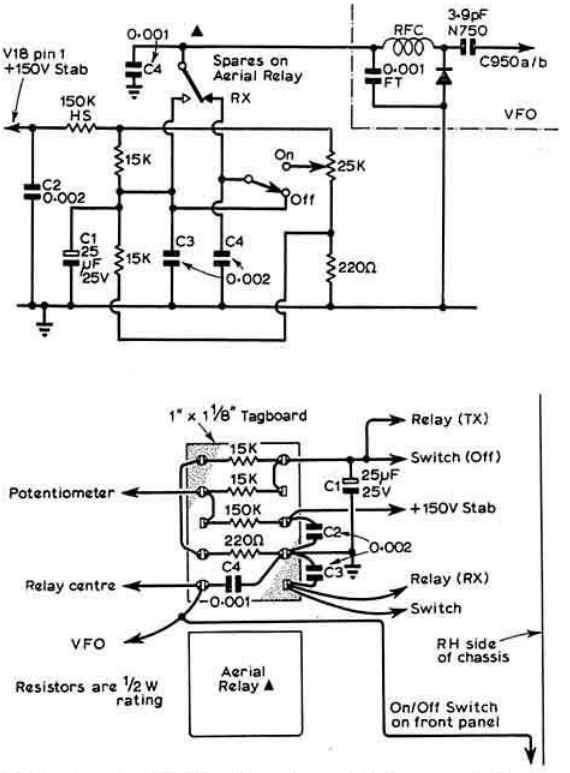


Fig 2. (a and b) Modifications to provide incremental tuning

*62 Prospect Place, Grays, Essex

fixed to a 0·001pF bolt-on feedthrough capacitor. The series C was found to be 3·9pF N 750, a compromise on stability and frequency coverage—giving an average of +2/−3kHz of the operating frequency—an extension of this was not warranted. The varicap used was a Siemens equivalent to IN954, but there appears no reason against an OA202 being used. It must be emphasized that mechanical stability and clearance are essential.

Having done a dummy run, relining vfo calibration, stability etc; the front panel was drilled, the variable resistor mounted to the left of the S meter, a miniature slide dpdt switch mounted to the right, and a flange type miniature bulb-holder placed below it. The latter was wired to light when the incremental receiver tuning is "On," the supplies being taken from the S meter lamp. If an identical knob is purchased the appearance will be enhanced, as it will with identifying transfers.

Note that the frequency shift is not constant from each end of the vfo, so only the centre (transmit) frequency was marked.

As far as can be ascertained this modification in no way detracts from the excellent performance of the equipment, but provides an additional function.

In connection with these modifications, Heath (Gloucester) Ltd. state that while they have no objection to them they must point out that any modifications to the standard circuitry of the HW100 will invalidate any warrantry stated or implied by them for this product.

NBFM discriminator for 455kHz

by H. L. GIBSON, G8CGA*

THE limiter is fed from the same point as the a.m. detector, the final i.f. transformer being re-trimmed if necessary. The discriminator uses the standard Foster-Seeley arrangement with a centre-tapped secondary winding. A small amount of pre-emphasis is applied (100kΩ and 47pF). If pre-emphasis were a standard feature of nbfm transmissions, values nearer to broadcast practice (100kΩ and 1000pF) would be more appropriate. The performance of the discriminator is shown in the attached curve and is substantially linear up to ±4kHz deviation. At 2·5kHz deviation, audio output up to 5V peak may be expected. The limiter performance is given in the table.

The noise limiter is in no way an essential part of the fm discriminator. It just happened to be developed at the same time and was built into the discriminator chassis. The diodes are biased into conduction by the negative voltage derived from the a.m. detector. If point A were earthed, the diodes would be cut-off until the negative bias reached about 0·5V and would severely clip speech. This condition might be acceptable for extremely noisy situations. Under normal conditions clipping can be avoided by applying several volts of additional bias derived fom the ht rail. Switch S1 selects the amount of bias from this source.

* 132 Pine Gardens, Ruislip, Middlesex HA4 9TH

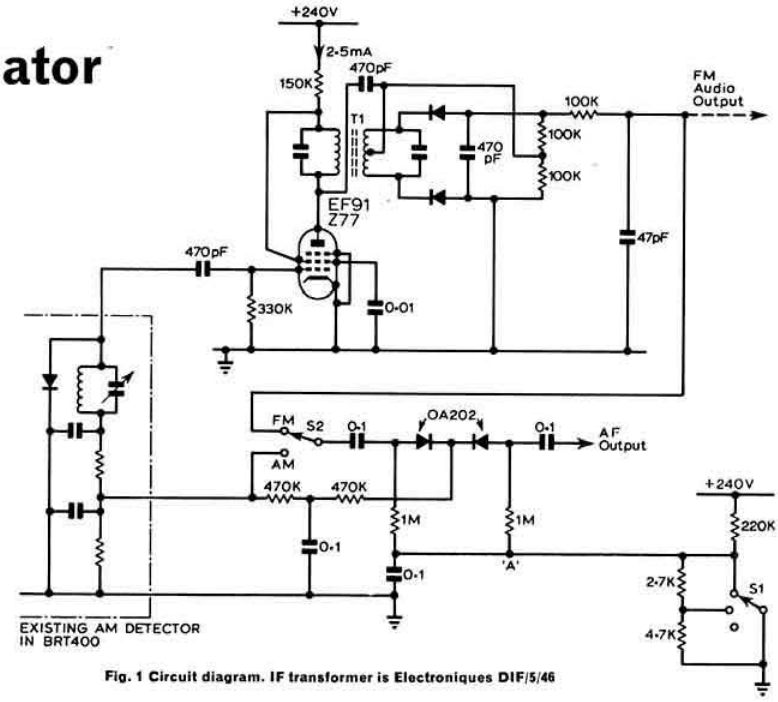


Fig. 1 Circuit diagram. IF transformer is Electroniques DIF/5/46

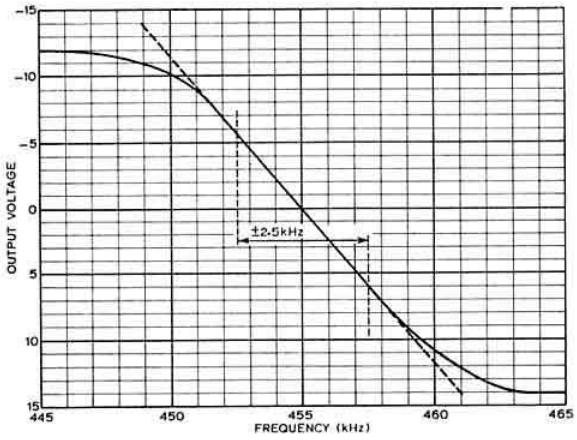


Fig 2. Curve taken with 4V peak at limiter grid.

At reduced signal of	Output at 5kHz deviation
4V	10·1V
1V	9·8V
0·5V	8·9V
0·2V	5·7V
0·1V	3·0V
0·05V	1·5V

Using SL610, SL611 and SL612 rf amplifiers

by J. M. BRYANT, linear applications engineer, The Plessey Company Ltd.

THE Plessey SL600 series of transceiver integrated circuits consists of three rf and i.f. amplifiers, two agc generators, an audio amplifier and two double-balanced modulators. This note describes the use of the two rf amplifiers, the SL610 and the SL611; and the i.f. amplifier, the SL612.

The SL610, SL611 and SL612 are very similar devices. Typically they have voltage gains of 10, 20 and 50 and upper 3dB gain points at 140MHz, 100MHz and 15MHz, respectively. The first two draw a supply current of about 15mA at 6V and have some 50dB agc range, while the SL612 draws 3·5mA and has 70dB of agc. All three are intended for use with +6V supplies and have internal decoupling. They will deliver an output signal of about 1V rms.

The cross-modulation of the circuits is 40dB down on signal at 1V rms output with no agc, and at 250mV rms input with full agc. The input and output admittances of the circuits are not greatly affected by agc level.

There are seven connections to each circuit: an input, an input bias point, an agc input, the output, the positive supply pin and two earths—for input and output, respectively. These connections will be dealt with separately.

The positive supply should be 6V, but most devices will work at supplies of up to 9V. Since the devices have internal hf supply decoupling, a certain amount of hf ripple can be tolerated in the supply; lf ripple should be kept down as it can cause intermodulation—especially at large hf signal levels—and 10mV rms of lf ripple should be considered a maximum.

The agc characteristic is shown in Fig 1. It is temperature dependent, so that while a potentiometer may be used to provide a gain control voltage the gain so defined will not be temperature stable. The agc terminal will draw about 200μA at 5V—in some SL610 and SL611 devices this may be as high as 600μA.

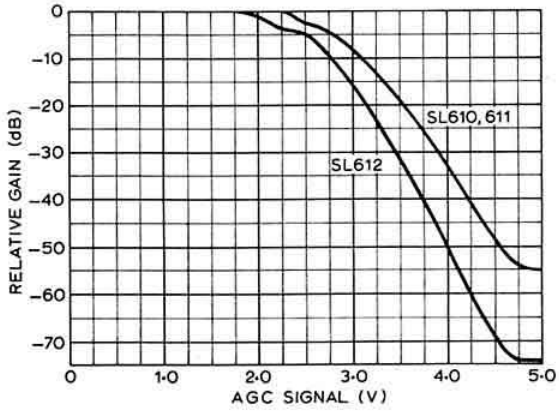


Fig 1. AGC characteristics

There are two earth connections: pin 4 is the input earth and pin 8 the output earth. When several devices are cascaded, pin 8 of one stage and pin 4 of the next should have a common earth point—also high common earth impedances to pin 4 and pin 8 of the same device should be avoided. Fig 2 (*a*) shows a circuit where common earth impedance could cause instability and Fig 2 (*b*) shows one where the input and output signals have correct point earthing. If extra supply decoupling is used the capacitor should ground to the output earth point.

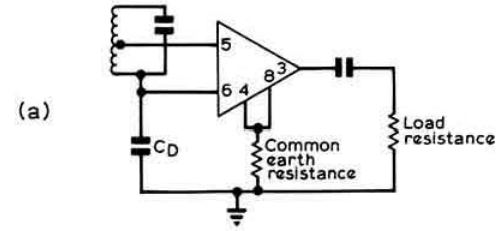


Fig 2(a). Incorrect connection of earths—high common impedance could cause instability

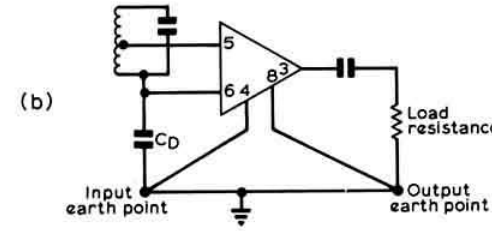


Fig 2(b). Correct connection of earths

The input bias point is normally connected directly to the input and the signal applied through a capacitor, but occasionally, when the signal is obtained from a tap on a coil, the arrangement in Fig 2 may be used to give slightly improved noise performance. CD is a decoupling capacitor.

Both the input admittance G_{11} and the output impedance G_{22} have negative real parts at certain frequencies. The equivalent circuits for input and output respectively are shown in Fig 3 (*a*) and (*b*) and the values of R_{in}, R_{out}, C_{in} and L_{out} may be determined for any particular frequency from the graphs Fig 4 (*a*) and (*b*). It will be seen that for the SL610 and the SL611 R_{in} is negative between 30 and 100-MHz, and R_{out} is negative over the whole operating frequency range. For the SL612 R_{in} is not negative and R_{out} is negative only below 700kHz.

Fig 3. Equivalent circuits. (a) Input circuit, (b) output circuit

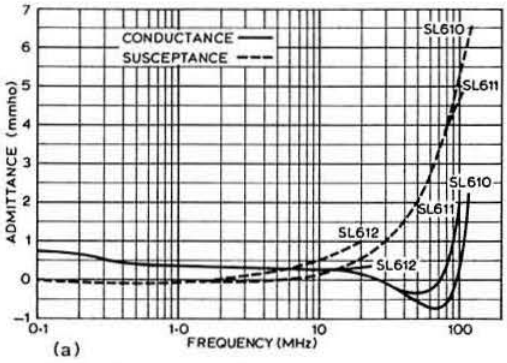


Fig 4 (a). Input admittance with o/c output G11

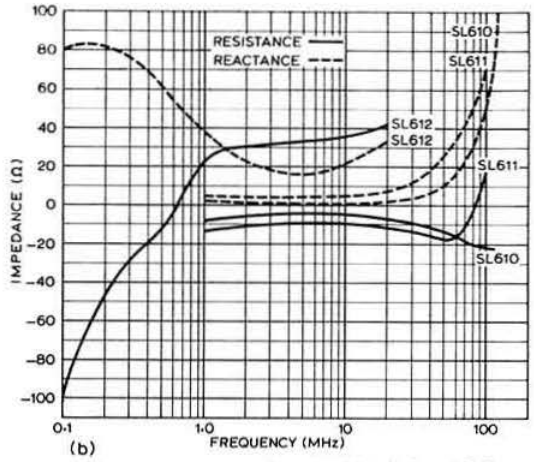


Fig 4 (b). Output impedance with s/c input G22

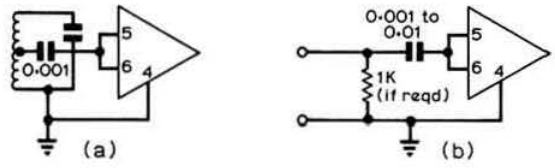


Fig 5 (a and b). Input circuits

It is evident that if an inductive element having inductance L1 and parallel resistance R1 is connected across the input, oscillation will occur if R_{in} is negative at the resonant frequency of C_{in} and L1 and R1 is higher than R_{in}. Similarly, if a capacitor C1 in series with a resistance R2 is connected across the output, oscillation will occur if, at the resonant frequency of L_{out} and C1, R_{out} has a negative resistance greater than the positive resistance R2. Where the input may be inductive, therefore, it may be shunted by a 1kΩ resistor and where the load may be capacitive 47Ω may be placed in series with the output.

Suitable input arrangements for the amplifiers are shown in Fig 2 and Fig 5. Fig 2, as already mentioned, shows the

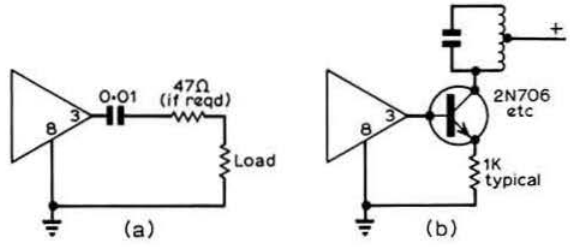


Fig 6. Output circuits (a) normal, (b) into a coil (current drive)

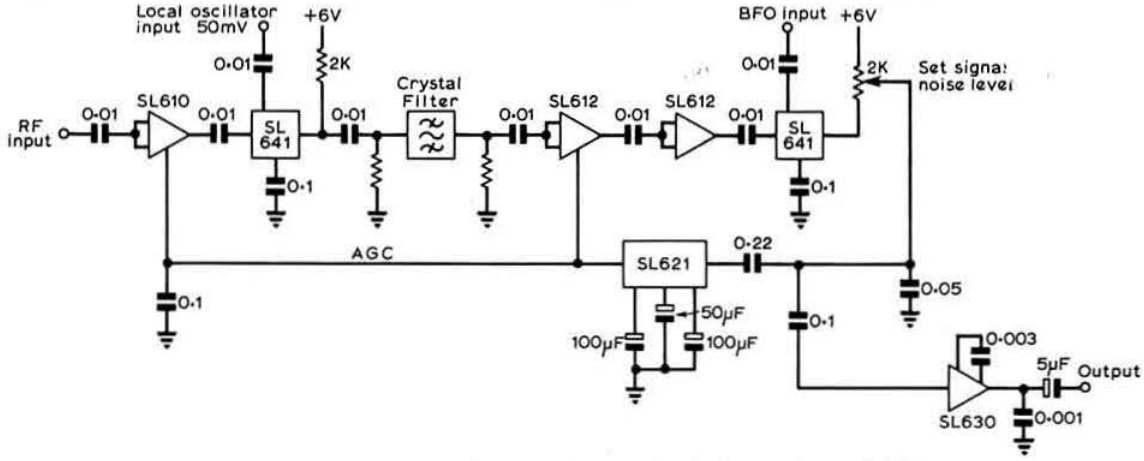


Fig 7. Essentials of ssb receiver using SL600 series devices and a crystal filter

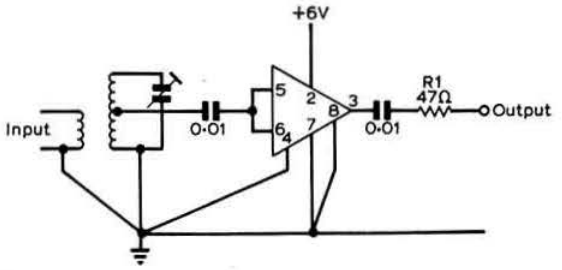


Fig 8. RF preamplifier. Up to 12MHz, use SL612; up to 70MHz, use SL611; up to 140MHz, use SL610. R1 may be omitted if the load is not capacitative or of very low impedance

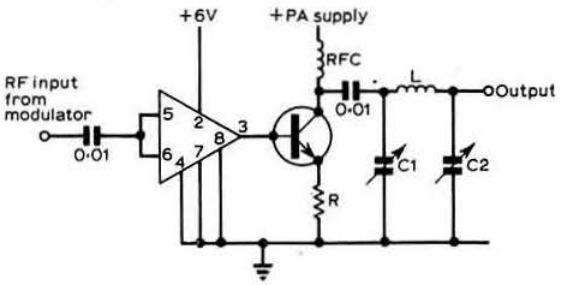


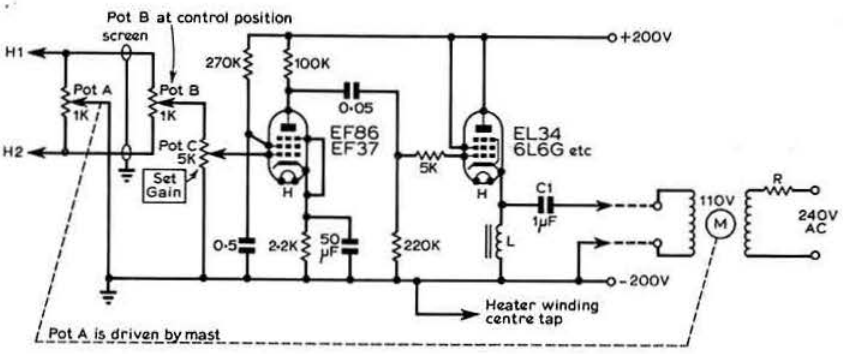
Fig 9. Linear power amplifier for low power ssb transceivers. L1, C1 and C2 is the output π tank circuit. The values of pa supply and R should be chosen for the transistor used

way of coupling a tuned circuit for lowest noise. The more usual way is shown in Fig 5 (*a*), this is representative of all inputs—the input and bias points are connected and the signal coupled in via a capacitor (Fig 5 (*b*)), if the input is inductive the 1kΩ resistor may be needed, although usually it can be left out. If a crystal filter is used and the terminating impedance of the ic is correct it may be connected directly to the circuit, otherwise the filter should be correctly terminated, allowing for the impedance of the ic, and coupling made via a capacitor.

The output is a voltage source, with the impedance characteristics mentioned above. Output coupling is via a capacitor with a series resistor if necessary to preserve stability (Fig 6 (*a*)). If a current output to a tuned circuit is required the arrangement in Fig 6 (*b*) is suitable, using almost any small signal npn transistor with an f_T of over 300MHz. If it is required to drive particularly low impedances, eg a 50Ω coaxial cable, this impedance should be increased somewhat by a series output resistor, say 100Ω, as, if the output is loaded directly by low impedances, most of the negative feedback will be removed with consequently poor linearity and constancy of gain.

Some examples of the use of these amplifiers are shown in Figs 7, 8 and 9.

A simple aerial rotator



by J. M. SMITH*

THIS inexpensive aerial rotator has been in use for a number of years and from the attached circuit it will be seen that the device is nothing more than an amplifier which feeds power to a motor winding so long as the bridge input circuit is out of balance. The other motor winding is permanently energized from the mains via a resistor whose value is chosen to allow the motor to run satisfactorily but reduces stall-current to an acceptable value.

Nothing in the system is in any way critical. The motor is a very cheap one, originally made for use in a tape recorder. It drives the aerial through an ex-WD gear box of approximately 1,000:1 ratio. The consequent rather slow rotation of the aerial has not been found detrimental. Almost any large OP valve will work. Choke L happens to have the correct dc resistance in the author's case; lower values would require an additional resistor, shunted by approximately 50mF. Correct phasing of H1 and H2 can be found by experiment; then the motor always runs in the right direction to zero the bridge. The leads to the remote potentiometer should be screened to minimize extraneous hum pick-up which will cause the device to "hunt" around zero. Potentiometer C should be backed off until this tendency disappears. C1 should be chosen to suit the particular motors used.

The author feels that the main advantage of this system is, apart from its extreme cheapness, the fact that there are no relay contacts to suppress and virtually no maintenance problems.

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LOCATE—A computer programme to calculate vhf/uhf contest scores

by R. J. BAKER, G3USB*

Introduction

As a member of the VHF Contests Committee, the author was intrigued to receive a 2m contest entry in which the distance calculations had been made by a computer, and in an accompanying letter the entrant offered to make the programme available to anyone who was interested. At the time the author had no access to a computer, but later access to a time-sharing computer terminal became available. After an introductory course to computer programming and a number of weeks' use of the computer, the author again considered the possibility of using the contestant's programme, and from him he received the complete programme plus a full set of punched cards.

There were, unfortunately, two snags The first was that the computer terminal used was a tape reader (ie the information was fed into it on punched paper tape) and so the cards could not be used. The second was that all the author's programming had been done in the language BASIC, while this programme used FORTRAN. This did not appear to be insurmountable as the time-sharing computer has a FORTRAN compiler also, but it was discovered that there are many different versions of FORTRAN and these two versions were not the same. Without the necessary knowledge to convert the programme, it was decided to start from scratch and write a programme as an exercise in BASIC programming. The aim was to write a programme that required for information only the QRA locators encountered in the contest to produce:

(*a*) The distance worked to each station (km);
(*b*) the score on the RSGB radial scoring system;
(*c*) the total score, and
(*d*) the longest distance contact.

The programme was duly written and after a lot of "debugging" was induced to work. This it did very well, fulfilling all the stated objectives. As an exercise in computer programming and logical thinking it was invaluable. While it is written in BASIC, which is a language commonly used with time-sharing computers, the programme can, of course, be re-written in different languages, and the following explanation will assist in the understanding of the logical steps involved.

It does not attempt to give a full explanation of the derivation of the QRA locator system. For a fuller understanding of this see [1] and [2]. Similarly, for a fuller explanation of the BASIC language see [3].

The programme

The text of the programme is shown in Fig 1. Its basis is the determination of the latitude and longitude of the base station and the stations contacted, using their QRA locators. This is done "manually" as follows, using the author's own locator AM61G as an example: The co-ordinates of the centre of the secondary square (Fig 3) are determined relative to the centre of the primary square (Fig 2), and the increments of latitude and longitude are added or subtracted as appropriate. Finally, the centre of the tertiary square is found by further increments to the previously determined co-ordinates (Fig 4). In the example below, the "X" co-ordinate is latitude and the "Y" co-ordinate is longitude.

	X	Y
Primary square—AM	1°E	52° 30′N
Secondary square—61	−54′	−18′ 45″
Tertiary square—G	−4′	0′
	2′E	52°11′ 15″N

For ease of calculation, minutes and seconds are taken as decimal parts of a degree.

In the detailed programme explanation, east and north are positive, and west and south are negative for calculation purposes. The numbers which precede each computer statement are "line numbers" and serve as identification. The programme starts at line 100:

```
100  FILES QRA
```

The main programme contains the instructions to the computer on how to process the information it is given. This information is contained in a separate part of the computer store called a "data file" which is called up by the statement "FILES QRA".

This data file contains:

(*a*) The contest title;
(*b*) the entrant's callsign;
(*c*) the entrant's QRA locator which is the reference point for all the distance calculations, and
(*d*) the QRA locator of all the stations contacted in the contest.

In addition to this information the file may contain the letters "NS". This is to cater for the situation where a serial number and report are sent but for various reasons neither are received and the contact is not completed. This allows the serial numbers in the computer print-out to correspond with the serial numbers in the contest log.

The last piece of information in the data file must be the word "END" which instructs the computer to print the total score and the longest distance contact.

The "$" suffix indicates that the group to which the symbol is designated contains an alphanumeric string.

To perform calculations the computer must use numbers. However, the QRA locator contains letters as well as

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Fig 1. Programme text *(Continued on facing page)*

```
100  FILES QRA
110  DIM N$(26)
120  FOR I=1 TO 26
130  READ N$(I)
140  NEXT I
150  DATA U,V,W,X,Y,Z,A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T
160  FOR I=1 TO 9
170  READ Q$(I),P(I),Q(I)
180  NEXT I
190  DATA A,0,0.0417,B,0.0667,0.0417,C,0.0667,0,D,0.0667,-0.0417,
200  DATA E,0,-0.0417,F,-0.0667,-0.0417,G,-0.0667,0,H,-0.0667,
210  DATA 0.0417,J,0,0
220  READ #1,A$,B,C$,D$
230  GOSUB 700
240  LET X0=X*0.0175
250  LET Y0=Y*0.0175
260  PRINT
270  PRINT A$;" 1970";B;"MHZ ";C$;" CONTEST"
280  PRINT "CONTEST ENTRY OF ";D$;" LOCATED AT ";M$;K$;C;F;R$
290  PRINT
300  PRINT "SERIAL NO.","QRA","DISTANCE(KMS)","POINTS"
310  PRINT "-----------------------------------------------------"
320  LET K=K+1
330  GOSUB 700
340  LET X1=X*0.0175
350  LET Y1=Y*0.0175
360  LET U1=ABS(X1-X0)
370  LET U2=(COS(Y0)*COS(Y1)*COS(U1))+(SIN(Y0)*SIN(Y1))
380  LET U3=ATN(SQR((1-(U2)↑2)/(U2)↑2))
390  LET Z=INT((6371*U3)+0.5)
400  IF Z<=200 THEN 440
410  IF Z<=1000 THEN 460
420  LET S=50
430  GOTO 470
440  LET S=(INT(Z/50.1)*2)+1
450  GOTO 470
460  LET S=(INT(Z/100.1)*4)+2
470  PRINT K,M$;K$;C;F;R$,Z,S
480  LET S1=S1+S
490  IF Z<=Z1 THEN 520
500  LET Z1=Z
510  LET K1=K
520  GOTO 320
530  PRINT K,"NON-SCORING CONTACT"
540  GOTO 320
550  PRINT
560  PRINT
570  PRINT "TOTAL SCORE =";S1
580  PRINT
590  PRINT "THE LONGEST DISTANCE CONTACT IS NO.";K1;"AT ";Z1;"KMS"
```

```
600  STOP
700  READ #1,M$
710  IF M$="NS" THEN 530
720  IF M$="END" THEN 550
730  READ #1,K$,C,F,R$
740  FOR J=1 TO 26
750  IF M$<>N$(J) THEN 770
760  LET X=(2*J)+(0.2*F)-14.1
770  IF K$<>N$(J) THEN 790
780  LET Y=J+33.9375-(0.125*C)
790  NEXT J
800  IF F<>0 THEN 830
810  LET Y=Y+0.125
820  LET X=X+2
830  FOR J=1 TO 9
840  IF R$=Q$(J) THEN 860
850  NEXT J
860  LET X=X+P(J)
870  LET Y=Y+Q(J)
880  RETURN
999  END
```

```
110  DIM N$(26)
120  FOR I=1 TO 26
130  READ N$(I)
140  NEXT I
150  DATA U,V,W,X,Y,Z,A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T
```

numbers and these must be coded with numbers to allow these numerical calculations to be performed. Line 110 reserves sufficient space in the computer store to accommodate the table which is about to be entered. Line 120 initially takes the value of 1 for I. Line 130 makes N$(I) equal to the first letter in the DATA line 150 which is "U". Line 140 switches the programme back to line 120 and takes the next value of I which is 2. Thus N$(2) = V, N$(3) = W, N$(4) = X . . . N$(24) = R, N$(25) = S, N$(26) = T. The reason for the first letter being "U" and not "A" will be apparent later. This code enables simple equations to be derived to calculate the co-ordinates of the primary square from the first two letters of the QRA locator.

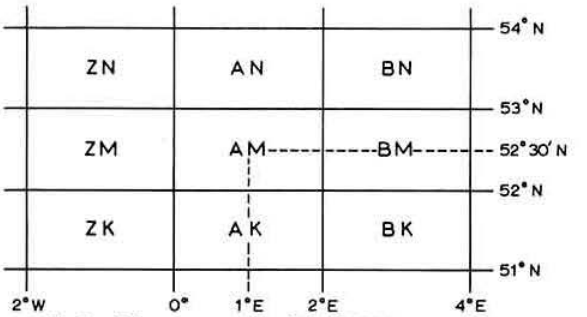


Fig 2. Primary squares of the QRA locator system

```
160  FOR I=1 TO 9
170  READ Q$(I),P(I),Q(I)
180  NEXT I
190  DATA A,0,0.0417,B,0.0667,0.0417,C,0.0667,0,D,0.0667,-0.0417,
200  DATA E,0,-0.0417,F,-0.0667,-0.0417,G,-0.0667,0,H,-0.0667,
210  DATA 0.0417,J,0,0
```

Unfortunately it is not easy to derive equations to determine mathematically the increments to latitude and longitude designated by the last letter of the QRA locator. Thus for simplicity the actual values are entered into the computer as a table. For example, "G": Increment to X = −0·0667°, increment to Y = 0°. That is, Q$(7) = G, P(7) = −0·0667, Q(7) = 0.

```
220  READ #1,A$,B,C$,D$
```

This line reads from the data file:
A$—The month of the contest;
B—the frequency band;
C$—the type of contest (eg open, portable etc);
P$—the entrant's callsign.

```
230  GOSUB 700
```

This line routes the programme to a subroutine which takes the QRA locator and calculates its latitude and longitude as

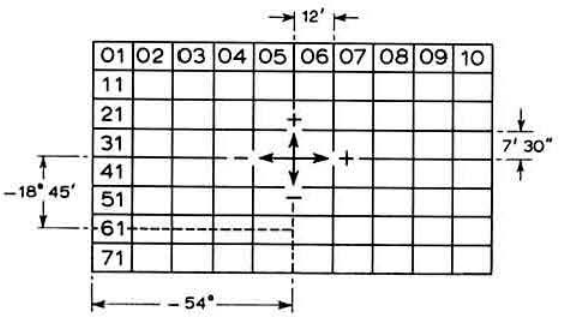


Fig 3. Secondary squares

X and Y co-ordinates. At the end of the subroutine the programme is routed back to the line after the GOSUB statement.

```
240   LET X0=X*0.0175
250   LET Y0=Y*0.0175
```

The co-ordinates which have been derived in degrees in the subroutine are converted into radians since the computer can only work in radial co-ordinates.

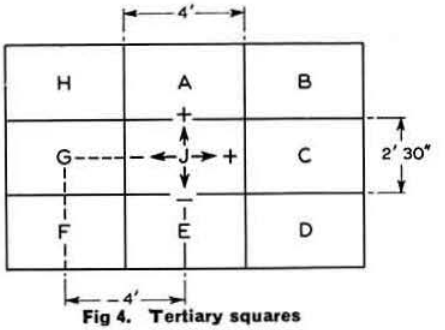


Fig 4. Tertiary squares

```
260   PRINT
270   PRINT A$;" 1970";B;"MHZ ";C$;" CONTEST"
280   PRINT "CONTEST ENTRY OF ";D$;" LOCATED AT ";M$;K$;C;F;R$
```

On a line containing only the command PRINT as in 260, the computer steps a line without printing anything. In lines 270 and 280 the titles are printed, containing the information specific to the contest. M$, K$, C, F and R$ are the alpha-numerics of the QRA locator and are read from the data file in the subroutine.

```
290   PRINT
300   PRINT "SERIAL NO.","QRA","DISTANCE(KMS)","POINTS"
310   PRINT "-------------------------------------------------------"
```

Line 300 prints the headings and line 310 improves the presentation by underlining the headings.

```
320   LET K=K+1
```

K is the serial number. This line increases the previous serial number by 1 to provide the serial number sequence.

```
330   GOSUB 700
```

This performs the same function as line 230.

```
340   LET X1=X*0.0175
350   LET Y1=Y*0.0175
```

As in lines 240 and 250, the co-ordinates of the station contacted are converted into radial co-ordinates.

```
360   LET U1=ABS(X1-X0)
370   LET U2=(COS(Y0)*COS(Y1)*COS(U1))+(SIN(Y0)*SIN(Y1))
380   LET U3=ATN(SQR((1-(U2)↑2)/(U2)↑2))
390   LET Z=INT((6371*U3)+0.5)
```

The initial calculation to find the distance to the station contacted is to find the angle subtended at the centre of the earth (which is assumed to be a sphere) by the two stations (θ). The equation to determine this is:

$$\theta = \cos^{-1}\Big[(\cos(Y0)\times\cos(Y1)\times\cos[X1-X0])+(\sin(Y0)\times\sin(Y1))\Big] \quad \ldots(1)$$

where Y0 = Y co-ordinates of the base station
Y1 = Y co-ordinates of the other station
X0 = X co-ordinates of the base station
X1 = X co-ordinates of the other station.

The equation used in the programme is altered sothat θ can be determined by taking $\tan^{-1}(f)$, since the computer used by the author only calculates Arctan.

The length of the arc between the two stations = $R\theta$ where R = radius of the earth.

For the earth, R = 6,371km (average) or 3,959 miles.

$\therefore$ Distance (Z) = 6,371. θ km or 3,959. θ miles.

The value of Z is rounded to the nearest kilometre since the locator system itself and the approximation of R do not warrant greater accuracy.

```
400   IF Z<=200 THEN 440
410   IF Z<=1000 THEN 460
420   LET S=50
430   GOTO 470
440   LET S=(INT(Z/50.1)*2)+1
450   GOTO 470
460   LET S=(INT(Z/100.1)*4)+2
```

These lines calculate the score on the RSGB radial scoring system. There are three conditions, each requiring a different equation to calculate the score (S):

(*a*) Z $\leq$ 200km. The score advances by 2 at 50km intervals starting at 1 (0–50km). This is expressed in the equation on line 440;

(*b*) 200km $<$Z $\leq$1,000km. The score advances by 4 at 100km intervals starting at 10 (200–300km). This is expressed in the equation on line 460. To ensure that Rule 5(a) of the 1970 VHF/UHF Contest Rules is complied with, the radial rings for the purposes of scoring are at multiples of 50·1km up to 200km, and multiples of 100·1km from 200 to 1,000km. Thus contacts on borders will score low;

(*c*) above 1,000km the score is 50.

```
470   PRINT K,M$;K$;C;F;R$,Z,S
```

The information for the specific QRA locator is now complete and the information is printed under the appropriate headings:

K is the serial number;
M$, K$, C, F, R$ is the QRA locator;
Z is the distance;
S is the score.

```
480  LET S1=S1+S
```

This equation compiles the score. Although the equation appears to be mathematically wrong, its meaning is: the new value of S1 is the sum of the calculated score and the previous value of S1. In this way the score is compiled. The function of the equation is explained in the following example: The first three scores in a contest are 3, 14 and 5:
after the first contact, S1 = 0 + 3 = 3;
after the second contact, S1 = 3 + 14 = 17;
after the third contact, S1 = 17 + 5 = 22.
The total score is printed at the end of the results table.
These lines pick out the longest distance contact and store the distance and serial number for printing out at the end of the results table.

```
490  IF Z<=Z1 THEN 520
500  LET Z1=Z
510  LET K1=K
520  GOTO 320
```

Line 490 tests whether the value of Z is less than or equal to the previous longest distance. If it is, the programme jumps to line 520 and the value of Z1 is not changed. If Z is greater than Z1 the programme proceeds to line 500. Here Z1 is assigned the value of Z. Also K1 is assigned the value of K, the serial number, so that the longest distance contact can be identified. This completes all the processing necessary on the QRA locator and line 520 returns the programme to line 320 where the sequence starts again with the next QRA locator.

```
530  PRINT K,"NON-SCORING CONTACT"
540  GOTO 320
```

As was explained earlier, "NS" is entered in the data file when a contact cannot be counted for scoring purposes. In the subroutine, as will be seen, there is a line which looks for "NS". When it finds it, the programme jumps to line 530 and prints the serial number and the words "Non-scoring contact" in place of the normal format contained in line 470. Having done this, line 540 instructs the programme to jump to line 320 where the sequence starts again with the next QRA locator.

```
550 ,PRINT
560  PRINT
570  PRINT "TOTAL SCORE =";S1
580  PRINT
590  PRINT "THE LONGEST DISTANCE CONTACT IS NO.";K1;"AT ";Z1;"KMS"
```

In the subroutine there is a line looking for the word "END" in the data file. When it encounters this, the programme jumps to line 550 above. Lines 550 and 560 leave two blank lines, 570 prints the total score, 580 leaves a blank line, and 590 prints the longest distance contact.

```
600  STOP
```

This is self-explanatory and signifies the end of the programme.

The subroutine occurs at the end of the programme since it is used many times during the course of the programme's execution.

```
700  READ #1,M$
710  IF M$="NS" THEN 530
720  IF M$="END" THEN 550
```

Line 700 calls up the first letter of the QRA locator from the data file and assigns it the symbol "M$". Line 710 checks to see if this letter is the group "NS". If it is, the programme jumps to line 520 and proceeds as indicated previously. If "M$" is not "NS" then the programme proceeds to line 720 where it is checked whether it is the group "END". If it is, the programme jumps to line 540 and the programme is completed as shown previously.

```
730  READ #1,K$,C,F,R$
```

If M$ is neither "NS" or "END" the programme continues to line 730 where the remaining symbols of the QRA locator are read from the file and are assigned the symbols:
Second letter of the locator: K$
First number of the locator: C
Second number of the locator: F
Last letter of the locator: R$

```
740  FOR J=1 TO 26
750  IF M$<>N$(J) THEN 770
760  LET X=(2*J)+(0.2*F)-14.1
```

The computer now refers back to the table compiled in lines 110–150. It scans the table from N$(1) to N$(26) looking for the letter that is the same as M$. When M$ does not equal (<>) N$(J) the programme jumps to line 770 where it is checked to see if N$(J) is the same as the second letter of the QRA locator. When the same letter in the table as M$ is found, the value of J is used in the equation in line 760. The equation is derived as follows:

Inspection of a QRA locator map will show that the most westerly locator likely to be encountered (on the west coast of Eire) will contain the first letter "U". This letter denotes a segment covering 10° West to 12° West. The centre of this segment is 11° West. The next segment to the east has the letter "V" and its centre is 9° West. The segments continue to the east at 2° intervals in alphabetical order. When "Z" is reached, the next segment is "A" (see Fig 2). Thus a simple equation can be derived, since in the table, in lines 110–150, the letters were coded U = 1, V = 2, etc.

$$\therefore \quad A = [2J - 13]^\circ \qquad \ldots (2)$$

where A = Longitude of the centre of the primary square, and J = Position of the first letter of the QRA locator in the table. The second *number* of the QRA locator also relates to the longitude. From Fig 3 it can be seen that numbers 1 to 5 are west of centre and numbers 6 to 0 are east of centre of the primary square. Each square is 12′ (0·2°) wide. Thus the difference in longitude between the centre of the primary square and the centre of the secondary square is:

$$L = \left[(0{\cdot}2 \,.\, F) - 1{\cdot}1\right]^\circ \qquad \ldots (3)$$

This equation is not correct when F = 0 as will be shown later.

Equations (2) and (3) can be combined to give the longitude of the centre of the secondary square (X).

$$X = (2 \,.\, J) + (0{\cdot}2 \,.\, F) - 14{\cdot}1 \qquad \ldots (4)$$

```
10  JANUARY 144 OPEN
20  G3USB A M 6 1 G
30  A L 6 5 D A M 6 1 D C M 6 2 C D L 7 6 A A M 6 1 B Y L 0 5 J
40  X K 6 4 C A M 5 8 F N S B L 4 8 C Z N 5 4 B C J 5 1 F A D 7 1 B
50  A M 5 2 H END
```

Fig 5.

This is the equation in line 760.

```
770  IF K$<>N$(J) THEN 790
780  LET Y=J+33.9375-(0.125*C)
790  NEXT J
```

While the table is being scanned, each letter in turn is also compared with the second letter of the QRA locator (K$). If K$ is the same as N$(J), the programme jumps to line 790 and the next value of J. If K$ is the same as N$(J), the value of J is used in the equation in line 780. The equation is derived as follows:

The primary squares advance in latitude steps of 1°, as can be seen in Fig 2. By inspection, the equation for the latitude of the primary square (B) is

$$B = (J + 33{\cdot}5)^\circ \qquad \ldots (5)$$

where J = The position of the second letter of the QRA locator in the table.

The first *number* also relates to the latitude. From Fig 3 it can be seen that, apart from the column to the far right, numbers 0 to 3 are north of the centre of the primary square, and numbers 4 to 7 are south.

The width of each segment is 7′ 30″ = 0·125°.

Thus the difference in latitude between the centre of the primary square and the centre of the secondary square (M) is

$$M = (0{\cdot}4375 - 0{\cdot}125 \,.\, C)^\circ \qquad \ldots (6)$$

where C = The first number of the locator.

As with equation (2), the equation is not correct when F = 0.

Equations (4) and (5) can be combined to give the equation

$$Y = (J + 33{\cdot}9375 - 0{\cdot}125 \,.\, C)^\circ \qquad \ldots (7)$$

This is the equation in line 780. Thus the latitude of the centre of the secondary square is derived. Taking again the example AM61G;

$$Y = 19 + 33{\cdot}9375 - (0{\cdot}125 \times 6)$$
$$= 52{\cdot}1875^\circ \text{ or } 52^\circ\ 11'\ 15'' \text{ North}$$

```
800  IF F<>0 THEN 830
810  LET Y=Y+0.125
820  LET X=X+2
```

It can be seen from Fig 3 that when the second number of the QRA locator (F) is zero, the first number is not the same as the other squares at the same latitude. It is, in fact, always 1 greater. For instance, square 20 is at the same latitude as square 19 However, equation (7) would calculate that square 20 was at the same latitude as squares 21–29 whereas it is in fact 7′ 30″ further north. When F = 0, the condition in line 800 is not fulfilled and the programme proceeds to line 810. On this line, 7′ 30″ (0·125°) is added to the latitude, thus correcting the error.

Equation (3) calculates that a secondary square with zero for its second number is west of a square with 1 for its second number, whereas it comes after 9 and is, for calculation purposes, 10. Thus equations (3) and (4) will calculate the longitude to be 10 squares (ie 2°) west of where it actually is. Thus when F = 0, line 820 adds 2° to the longitude and corrects the error.

```
830  FOR J=1 TO 9
840  IF R$=Q$(J) THEN 860
850  NEXT J
860  LET X=X+P(J)
870  LET Y=Y+Q(J)
```

The final increments to the latitude and longitude are determined by the last letter of the QRA locator (R$). The computer scans the second table (lines 160 – 210) until the letter in the table is the same as the last letter of the QRA locator being processed. The increments to X and Y are taken from the table and added to X and Y in lines 860 and 870 respectively. In the example AM61G, the final co-ordinates are:

X = (0·1 − 0·667)° = 0·0333° or *2′ East*
Y = (52·1875 + 0)° = 52·1875° or *52° 11′ 15″ North*

```
880  RETURN
999  END
```

The "RETURN" command is used to determine the subroutine and literally return the programme to the line immediately after the "GOSUB" statement that initiated the use of the subroutine.

The "END" statement is not really necessary but is good BASIC grammar.

Example

To show how the programme works in practice, a contest log for an imaginary contest which the author has entered is given below.

January 1970 144MHz Open Contest

Callsign: G3USB — QRA locator: AM61G

Serial number	Station contacted	QRA locator
1	G2JF	AL65D
2	G2XV	AM61D
3	PA0CML	CM62C
4	DJ9DL	DL76A
5	G8DDU	AM61B
6	GW3NUE/P	YLO5J
7	G3GZJ	XK64C
8	G3LQR	AM58F
9	OZ? (lost in QSB)	—
10	PA0NAP	BL48C
11	G3NEO	ZN54B
12	F9FT	CJ5IF
13	F9NL	AD71B
14	G8CDE	AM52H

The data file is prepared on punched paper tape in the following order:

(*a*) The contest title;
(*b*) Callsign of the entrant;
(*c*) QRA locator of the entrant;
(*d*) QRA locators of all stations contacted.
(*e*) The file must be finished with the word "END".

JANUARY 1970 144 MHZ OPEN CONTEST
CONTEST ENTRY OF G3USB LOCATED AT AM 6 1 G

SERIAL NO.	QRA	DISTANCE(KMS)	POINTS
1	AL 6 5 D	133	5
2	AM 6 1 D	10	1
3	CM 6 2 C	295	10
4	DL 7 6 A	502	22
5	AM 6 1 B	10	1
6	YL 0 5 J	216	10
7	XK 6 4 C	429	18
8	AM 5 8 F	96	3
9	NON-SCORING CONTACT		
10	BL 4 8 C	257	10
11	ZN 5 4 B	155	7
12	CJ 5 1 F	430	18
13	AD 7 1 B	1013	50
14	AM 5 2 H	23	1

Fig 6.

TOTAL SCORE = 156

THE LONGEST DISTANCE CONTACT IS NO. 13 AT 1013 KMS

This information is fed into the computer memory in the form shown in Fig 5 using the data file name "QRA". Having done this it is saved ready for use with the main programme. The main programme, which is also on punched paper tape, is then fed in. On the command "RUN" the programme execution takes place, producing the result shown in Fig 6.

The actual time taken to do the various operations was:
(*a*) To prepare the data punched tape—4min;
(*b*) To feed the data tape into the computer—20s;
(*c*) To feed the main programme tape into the computer—approximately 3min 30s;
(*d*) Time to print out the results—2min 15s.

The total time is thus approximately 10min 5sec. Of these times (*c*) is constant but (*a*), (*b*) and (*d*) vary according to the number of stations worked in a contest.

Conclusion

The author hopes that this article is of direct value to the reader, but if it is not he hopes that it gives an insight into the logical processes involved in writing a computer programme and how the use of a computer can take a lot of the tedious work and potential inaccuracy out of scoring a vhf/uhf contest.

References

[1] R. C. Hills—"QRA locatormanship", *RSGB Bulletin*—March 1965, p162.

[2] A. J. Gould—"Using the QRA locator", *Radio Communication*—March 1969, p173.

[3] G.E.I.S. Ltd—"An introduction to programming in BASIC".

The RSGB News Bulletin Service

The RSGB News Bulletin, callsign GB2RS, is broadcast every Sunday morning. This bulletin can be received on either vhf or hf, which gives almost complete coverage of the British Isles. It keeps radio amateurs up-to-date about happenings in the world of amateur radio and gives information on coming events, supplementing and bridging the gap between successive issues of *Radio Communication*.

SCHEDULE

Time (bst)	Frequency (MHz)	Location of station
0930	3·6	SE England
1000	3·6	Severn area
	145·1	SE England (Farnham, Surrey, beaming NE)
	145·8	Aberdeen (beaming W)
1015	3·6	Belfast
	145·8	Belfast
	145·8	Belfast (beaming S)
1030	3·6	N Midlands
	145·1	SE England (Farnham, Surrey, beaming SW)
	145·89	NE England (Bishop Auckland, beaming N)
	145·8	Aberdeen (beaming SW)
	145·3	Birmingham area (beaming NW)
	145·5	Bradford (beaming NE)
1045	145·89	NE England (Bishop Auckland, beaming E)
1100	3·6	NW England
	145·3	Birmingham area (beaming SW)
	145·5	Bradford (beaming SE)
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

TECHNICAL TOPICS

A monthly feature by PAT HAWKER, G3VA

TO judge from the postbag, there is one subject above most others that interests the majority of hf operators: the assessment, comparison and development of aerials. It might be thought that by now just about every conceivable configuration has been tried; yet in practice useful ideas continue to emerge. This is not to say that some simple new arrangement is likely to come along which will displace a three- or four-element Yagi, a quad or a rhombic. Nor can one easily eliminate the need for either high masts or, alternatively, good earth connections and conductivity. But one of the attractions of amateur hf operation is that it is possible to work the world reasonably regularly with even simple and inexpensive aerials.

There can be few domestic sites from which interesting operation is entirely out of the question—a fact which encourages the development of a large variety of systems if we are to make optimum use of whatever space and supports are readily available. Amateur operation should not be confused with commercial point-to-point circuits, and it will be a sad day if it ever comes to be felt that there is no place for aerial systems consisting of a few yards of wire, a few insulators and an expenditure not of pounds but only of new pence.

Triangular (delta) loops

A simple system that has received only limited attention, yet offers a degree of aerial gain and can fit into various types of locations, is the single-element triangular loop. The use of this configuration has been hinted at in the earlier references to triangular loop hf/vhf/uhf arrays (*TT* May-June 1969 and *ART3*). But just as the single-element "quad" full-wave loop is often overlooked, so equally is the triangular form. Basically the performance of these two configurations should be closely similar—but it is felt that the triangular loop is the easier to implement without a framework.

Two horizontally-polarized forms of this loop are shown in Fig 1. The single-support system of Fig 1(*a*) has been described by Edward Noll, W3FQJ, (*Radio-amatööri*, Nr 10, 1969) as an hf aerial not unlike the inverted-V but without the need to take the feeder up the mast. The twin-support system of Fig 1(*b*) is one of many other possible arrangements and also features a feed-point at the base of the aerial. Both K8ANV and G3ENI have indicated that further configurations could be devised. W3FQJ indicates how, by disconnecting the feeder and closing the loop with a small 1-2 turn coil, the length of the loop can be adjusted to resonance using a grid-dip oscillator. Theoretically, I suppose the feed-point impedance must be of the order of 100-120Ω or so, but in practice it should be possible to achieve a reasonably good match with 75Ω coaxial or twin feeder. It might also be possible to achieve 7MHz operation by connecting a 28ft 9in length of 300Ω twin lead, shorted at the far end across the feed point as suggested for the single-loop quad aerial (*ART2* and *3*).

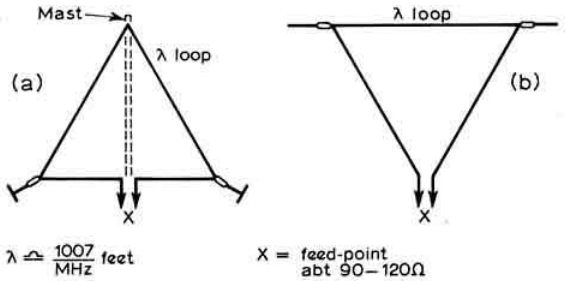


Fig 1. Two forms of the single-element triangular loop aerial. (a) Suitable for single support; (b) Simple twin-support system. Main lobe of radiation towards and away from reader

Inverted-L or semi-vertical trap aerials

Another technique which seems to be attracting increased attention is the use of inverted-L aerials to provide mainly vertically-polarized radiation. By incorporating a resonant trap at the top of the vertical section, a multi-band system can be achieved. This arrangement was described (and its good performance on 7MHz emphasized) in an article by Brian Watling, G3RNL, "Which aerial?" (*Radio Communication*, March 1968) and a more recent note on the technique is given by G3BID in an article on portable operation for mobile operators in the current issue of *Mercury* (Journal of the Royal Signals ARS). We have also received recent letters from G3VYF and G3CDR describing related systems.

M. R. Lee, G3VYF, has been making very effective use of one of those half-trap dipole arrangements on 3·5 and 7MHz. In his case the 7MHz radiator is a guyed, surplus telescopic mast (this could equally be a dural self-supporting radiator): Fig 2. At the top of this 32ft section is placed the 7·1MHz trap, with a flat top wire section about 21ft long which, in conjunction with the trap, results in resonance on 3·5MHz, and providing a useful bandwidth of about 100kHz and minimum swr of about 1·2 : 1. The aerial is fed directly with 52Ω coaxial cable. He goes to some trouble to provide a good earth mat, using multiple parallel earth stakes over an area of about 20ft by 20ft. On 7MHz the vertical section forms a full-size ¼λ vertical. Results include North and South America on 3·5MHz ssb, North America and Australia on 7MHz cw using a Swan 500C.

He points out that on 7MHz the low angle properties of the vertical can be "felt" by the improvement of dx/European signal ratio compared with a dipole. On 3·5MHz, the top-loading plus the vertical radiator gives a useful aerial, working well also for inter-G operation. It all fits into small gardens and should give good results to anyone prepared to take care to provide a really good earth system. G3VYF

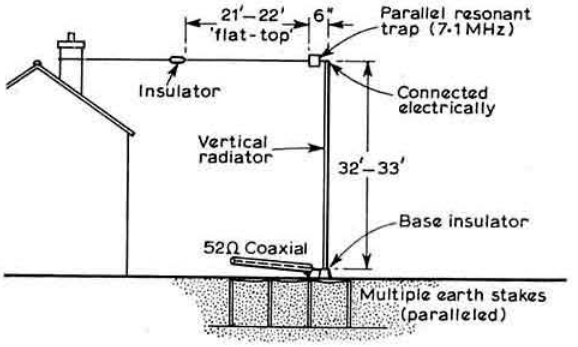
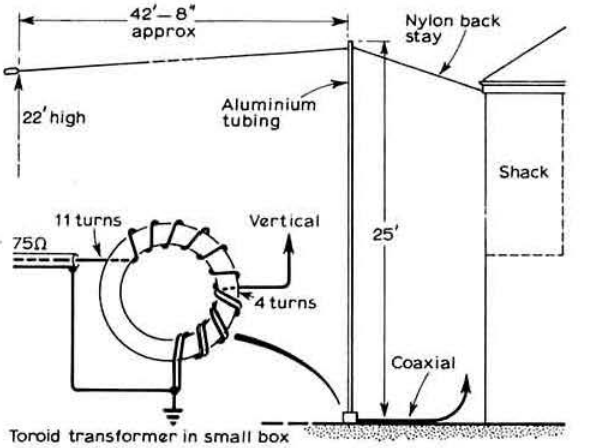


Fig 2. The G3VYF suggestions for the semi-vertical half-trap aerial. For optimum results a very good earth connection is needed



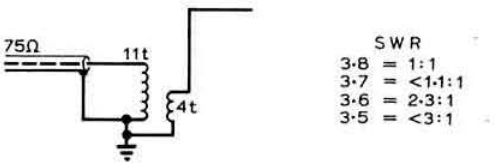


Fig 3. Single-band inverted-L aerial for 3·5MHz by G3CDR. Coaxial fed through a toroid matching transformer at base of radiator. Again, the better the earth connection, the better the results

also suggests that this type of approach could be used to turn a trapped vertical such as the 12AVQ or similar chimney-mounted vertical into a useful five-band two-aerial system.

G3CDR inverted-L

Geoff Scholey, G3CDR, has also been using an inverted-L aerial for about 2½ years on 3·5MHz, and this has attracted sufficient interest to convince him that other readers may like details. He feels that the 25ft vertical section has been instrumental in putting good signals into ZL and elsewhere, while for short-haul work the aerial works as well as a dipole. The 25ft vertical "happened" when a 28MHz beam superseded an 0·78λ vertical though this length has since proved a happy proportion of the complete ¼λ. The top-loading section was adjusted with the help of a receiver and aerial noise bridge at the base of the aerial to achieve resonance at 3·75MHz (impedance turned out to be about 28–30Ω).

The base matching unit is simple and compact using a toroidal transformer as shown in Fig 3. The toroid material is unknown but is believed to be suitable for use up to 20MHz and measures about 1¼in with ¼in cross-section. Starting at the common earthy end, the two wires are wound side by side (bifiliar fashion) both windings being tapped for experimental purposes. The wire is 16 gauge with 11 turns primary and 4 turns secondary to give an approximate 1 : 1 swr (he points out that a similar technique might be used with a trapped system for multi-band working). To prove that the coaxial line really was flat, he checked by varying its length with no change in swr. A different turns ratio would be used for 52Ω coaxial cable.

G3CDR rightly again emphasizes the importance of the earth connection. In his case, various pieces of coaxial cable stripped to the braiding are buried, together with a couple of pieces of copper piping, around the foot of the aerial; four 30ft lengths of copper strip are also laid out beneath the turf. Some tests have been carried out on 7MHz by lengthening the loading wire to form a ¾λ without changing the transformer; this seemed to work fairly well but in his case was not required for long.

Both trapped and non-trapped versions of the inverted-L seem to fit well into typical garden spaces. Trap construction has been described in most of the journals. Fig 4 shows the suggestions made by G3BID in *Mercury* for a 7,100kHz trap:

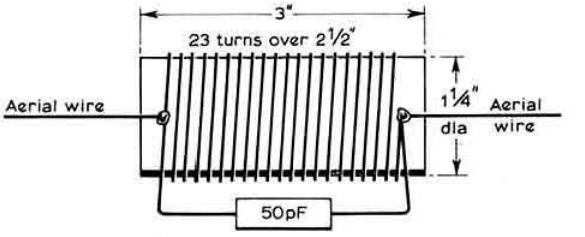


Fig 4. 7·1MHz trap as described by G3BID in *Mercury*

the former is about 1½in diameter, about 3in long and wound with about 23 turns of 18swg wire (adjusted to resonance using a grid-dip oscillator). The capacitor must have a high voltage rating suitable for the power used, and the 18swg wire should be sufficiently well spaced to avoid arcing. The whole unit, for a fixed aerial, can be contained in a sealed plastics container from domestic surplus.

Twin-diode nbfm

A number of circuits have been given in *TT* and elsewhere showing how it is possible to achieve nbfm by means of a variable capacitance diode across the tuned circuit of a vfo. While this is often quite satisfactory, a problem with such single diode systems is that the voltage swing across the tuned circuit may be sufficient to run the reverse-biased diode into

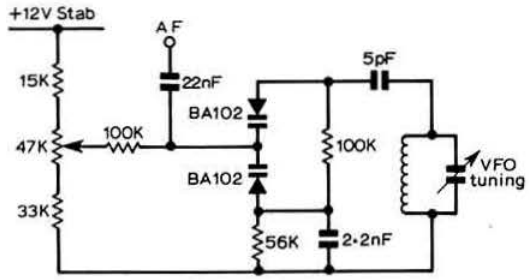


Fig 5. Use of two voltage variable capacitance diodes to provide nbfm from vfo as suggested by F8TD

conduction. Fig 5, from a note by G. Didelot, F8TD, in *Radio-REF* (Nrl/1970), shows a way of overcoming this difficulty by using two diodes. Only about 1 or 2V of audio is required.

A similar twin-diode arrangement has previously been suggested in *TT* for electronic tuning of receivers, since this can reduce the tendency for the tuning diode to introduce cross-modulation. We note that some of the recent electronically-tuned uhf tuners in television receivers use single diodes in the signal-frequency circuits but a twin diode arrangement for the oscillator tuning. In the absence of special varactor or voltage variable capacitance diodes, conventional diodes can often be used (see *ART2* or *3*).

Extending relays with reeds

Bert Allen, G2UJ, points out that there is a simple way of adding additional contacts to existing relays; this is by employing the existing energizing coil to operate one or more reed switches in addition to the normal spring-set.

He points out that compact reed relay switches are readily obtainable as separate items at the present time at surplus prices. All that is necessary is to fix one or more of these reed switches on the outside of the relay coil, parallel to the core. They can be fixed in position using adhesive tape.

G2UJ gives as an example that a 100Ω relay coil operating at 6V will actuate as many reed switches as can be placed around the outside of the centre of the coil, other than close to the metal framework; and all this, it should be noted, without interfering in any way with the normal operation of the relay.

This ingenious idea is thought to be a G2UJ original—but there may also be some readers who do not realize that these little reed switches can readily be actuated by the physical movement of a small permanent magnet. This approach has in the past been used in such applications as burglar alarms (the opening of a window, removal of an object etc causing an alarm circuit to be actuated) and also for interlock systems. The only difficulty with some of these applications is that if a reed switch is held closed over a very long period there is always some slight danger that a cold weld may cause the contacts to stick and remain closed.

On this general subject of using reed contacts, Peter Chadwick, G3RZP, recently drew attention to the important limitation when used for switching *rf* due to skin-resistance effects. He considers that when used, for example, in aerial change-over applications (as in the G3SJE coaxial relay, *TT* November 1970) the real limitation is in the power handling. His own experiences suggest that about 1·7A of two-tone ssb represents the practical limit; although on speech transmission it may be possible to push up the power a little further. It is important to appreciate that this limitation stems from the effect of *skin resistance*—a point which we underlined back in 1966 (*TT* January 1966) following discussions in Stuttgart with Heinz Rensch, the reed-relay expert of SEL. At that time we suggested a typical figure of up to about 1Ω skin resistance when using the fairly large H80 reeds at hf.

G3RZP considers that the skin resistance depends on the conductor permeability and he puts this as about 10,000 for typical reeds. Even with heavy gold plating, he finds the reed can get so hot that the material either passes its Curie temperature or the glass distorts and the reed opens. He has known this to result in an up to 30s "cycling time" on 3·5-MHz. None of the currently available low-cost reeds, including mercury-wetted types, appear to overcome this problem. Even reeds rated at 15A, 440V ac suffer from this difficulty when handling rf, proving that the basic cause is skin resistance rather than contact resistance. Indeed, quite a few communications firms would be keenly interested in finding reeds which overcome this power limitation. But, as we wrote in 1966, "there seems to be plenty of scope for experimenting with these reed contacts"—both for high-speed rf switching and for innumerable control applications, and now, thanks to G2UJ, for expanding conventional relays.

Crystal checker

Compact "go-no/go" testers of various types are becoming quite popular these days—for example the transistor tester given in *TT* October 1970. Another useful-looking checker of this type (Fig 6) has been described in *Electronic Design* (25 October, 1970) by Mike Kaufman of Hughes Aircraft. The tester, he writes, has been used with crystals ranging from 3·5MHz to 90MHz; it could probably also be extended to crystals below 3·5MHz. Simply insert the crystal into the test socket, close the push-switch, S1, and if the crystal is good the pilot lamp will glow; if it will not oscillate then the bulb remains off. The original was built in a package 2in by 4in by 1¼in.

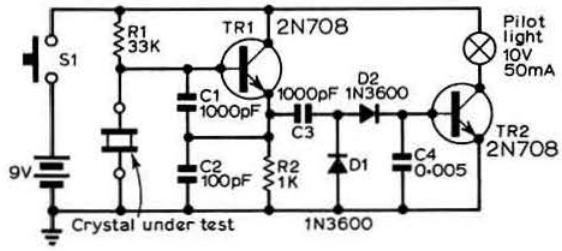


Fig 6. Simple "go-no/go" crystal checker—a useful gadget when sorting through "surplus" crystals

TR1 is an untuned Colpitts oscillator; when it is working, several volts peak-to-peak appear across R2. D1 and D2 detect this output and provide forward bias to TR2, the collector current from which then energizes the pilot bulb. A "no-go" crystal provides no forward bias on TR2 and the bulb stays off.

Phase-lock fm detection

The January *FMD* included G3FKL's recommendations on the use of the Mullard TAA570 integrated circuit as a quadrature-type nbfm detector. Another integrated circuit technique which potentially offers even more advantages is becoming available in the form of complete linear integrated circuit modules providing a phase-locked loop. This form of fm detection has until recently been confined largely to such complex receivers as those used for professional space-tracking and similar applications. Now, however, the 30-year-old phase-locked loop technique is being adapted to enable integrated circuit designers to achieve the type of results normally associated with large numbers of precision components. For example, in 1969 Signetics introduced pll units such as the NE560B, though one must add a word of warning—the price in small quantities is (or was until recently) of the order of £12.

To understand how this type of unit works reference should be made to *Electronics* (28 April, 1969): "Phase locking: integrated tuned circuits made easy". Practical details are also given in the notes supplied with the units by LST Electronic Components Ltd, 7 Coptfold Road, Brentwood, Essex. For some time we have been wondering whether amateur enthusiasts would crash through the cost barrier and come up with any reports on using these devices.

Now a letter from W. M. N. Burridge of South Devon recounts some interesting experiences using an NE560B as an fm detector for television sound (unlike the 405-line system, British 625-line television uses fm sound). Initially he used the NE560B to follow a conventional fm tuner and a little i.f. amplification at 33·5MHz. Even at this high i.f. (above the maximum frequency recommended by the makers) he found the unit would lock-in a signal and cope with oscillator drift; though the audio output and the signal/noise ratio was low. Subsequently he changed the input i.f. down to 7MHz, and sure enough the signal-noise ratio became quite satisfactory on both local and distant stations—"providing there is a signal there, it works". He now feeds the output from the phase-lock-loop detector into his hi-fi set-up and says that "tv sound never sounded better". It all works on a whiff of a signal, reduces the usual fm threshold problems and gives a similar s/n ratio on weak and strong signals—he has received London Crystal Palace signals down in South Devon.

Now he is beginning to wonder whether such integrated circuits could not be applied to direct-conversion and to superhet ssb and a.m. receivers. He believes there is an NE560A intended for a.m. applications at even greater cost, but suggests that it might be possible to combine the fm NE560B with, say, an MC1596G product detector to get locked on results on a.m. and ssb—although this idea has not been tried yet. He would be interested (address: Pavannon, Vicarage Road, Stoke Gabriel, Totnes, Devon) to know if anyone else has experimented with these advanced pll devices. Meanwhile he regrets that fm is "sadly neglected by the amateur transmitting fraternity."

The NE560B is usually described as a monolithic signal conditioner and demodulator system comprising a voltage-controlled-oscillator, phase comparator, amplifier and low-pass filter: Fig 7. It allows fm demodulation without *any* external tuned circuits. To quote the *Electronics* article: "Phase locking has several interesting features. The vco frequency need not be particularly precise or stable, since once it moves close to an input frequency it is drawn towards that level and held there. For fm, the phase-locked loop performs the function of a demodulator, eliminating the ratio detector, Foster-Seeley or quadrature detector . . . it is a highly selective circuit, a simple large-tolerance RC low-pass filter produces a selectivity comparable to that of three i.f. transformers . . . only one external element is needed for tuning . . . the level of the input signal doesn't matter as long as it exceeds a certain threshold and is below a certain maximum that would saturate the input stage."

90° phase-shift by ttl ?

Another possible application for integrated circuits, this time of the more conventional digital types, is suggested by Jim Evans, GI/G3VDB. While experimenting with some ttl (transistor-transistor-logic) circuits, he hit upon an idea which would seem to offer the opportunity for a single ttl package to be used to give square-wave output at exactly 90° phase-shift. This might be of interest to anyone contemplating a phasing-type ssb exciter or possibly a phasing-type direct conversion receiver.

In Fig 8, A and B are 5V square-wave outputs spaced at 90° derived from a carrier at double the required frequency. He suggests that the only snag would be the 2f carrier and any delay differences in the gates which might give problems

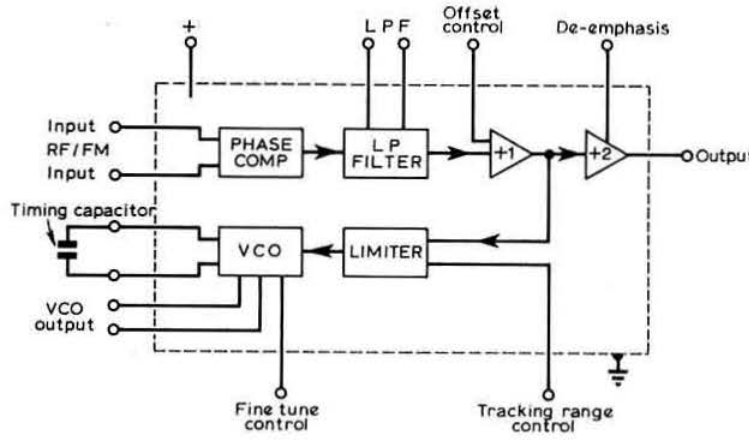


Fig 7. Block outline of the Signetics NE560B phase-lock-loop fm demodulator linear integrated circuit

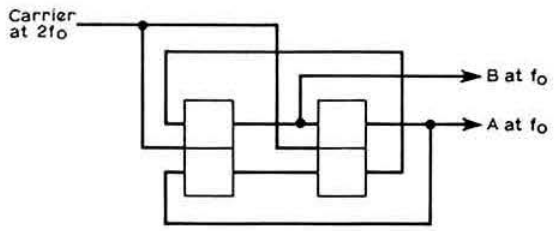


Fig 8. GI3VDB's proposal for obtaining 90° phase shift with ttl integrated circuit

above a "clock" frequency of about 1MHz. But he feels that if something like an SN7473 was used this would give a "cheap, no adjustment, bang-any-frequency-you-like-in system". He would be interested to hear from anyone who follows up this suggestion.

Nostalgia corner

A couple of months ago, I mentioned some of the vintage components still pressed into regular or occasional service at G3VA. A colleague promptly chaffed me for making it sound as though I were really one of the pioneers of the 'twenties. Since I acquired my present call in 1938, at the then minimum age of 16 (having held 2BUH from 1936), I suppose I must be one of a small number of British "two-letter" amateurs who were actually born *after* the first successful transatlantic reception of amateur signals by Paul Godley in Scotland and by a number of English amateurs.

But then most schoolboy enthusiasts of the mid-thirties grew up on the discarded components of the early 'twenties, becoming late connoisseurs of horn loudspeakers, crystal sets, variometers, filament rheostats and the ubiquitous audio transformers—not to mention the then still current indoor "spring" aerials for which Mr Woolworth charged a tanner (2·5p) and which I fancy would come in useful now to form helically-wound short aerials for 3·5 or 7MHz.

Another amateur who still uses quite a lot of vintage bits and pieces is Ted Cook, ZS6BT (formerly 2AVR/G6UO/ZU1J so he genuinely goes back to the 'twenties!). For example, he has a batten-mounted Sifam 50mA meter bought in 1922 and another panel-mounting one of the same type acquired in 1927, both still in use (the latter having been built into every one of his "radiating" transmitters). Then he has a couple of 1932 slow-motion dials which have been in and out of innumerable equipments and are still working without any sign of slip in his 1·8MHz transmitter and his current receiver; and four of those plain black "Ormond" dials (some of these are around G3VA). Even a factory-built receiver—an early Hallicrafters "Sky Buddy"is often used on 1·8MHz: my records suggest these began to reach the UK market about 1936–37 at £9! What with a hand-key of unknown vintage, but almost certainly more than 30 years old, he has a working museum, though this does not seem to affect the signals I hear him putting out on 14MHz! He says that he deliberately builds old pieces into new gear as by now they seem like old friends. I wonder if we shall ever get as sentimental over an early integrated circuit as some of us do over a Taylor T20, Eimac 35T or bright-emitter LS5, or even the 807 which has been around since the mid-thirties?

1971

Too late for the New Year, but I must report a topical discovery of the research-mathematician son of Grant Dixon (G6AEC/T, G8CGK):

$$1971 = \frac{73\,(7^3 - 73)}{7 + 3}$$

We should be in for a year of "best regards"!

Simplified fet mixer

by J. GOUGH, GW3WXA*

SOME time ago it was decided to construct a solid-state, ssb transceiver for fixed/mobile use on 80m, and the G3LUB "Briefcase Portable", described in the March and April 1968 issues of *Radio Communication* seemed the most likely to offer success.

No supplier of the 3N125 fet transistor could be found, so an alternative was sought. Several dual-gate types were considered, but due to their price a single-gate 2N3819 fet was purchased. As the original mixer panel had already been constructed it was decided that as much as possible of the circuitry should be retained and the arrangement shown in Fig 1 was tried, with immediate success. C1 is a 100pF silver mica capacitor of about ⅜in of twisted insulated wire, but a fixed capacitor of 1-3pF would be an alternative. The rf choke, inductor L1, C2 and the i.f. output coupling capacitor are as used in the original design.

* Police Station, Llandovery, Carms.

Carrier re-insertion crystal

As surplus FT241A crystals were to hand, these were tried in the filter. The carrier crystal was found to be oscillating about 7kHz below its fundamental frequency, apparently due to external circuit capacity, but connecting the crystal to the emitter instead of to the collector of the transistor cured the fault.

The alternatives suggested may be of interest to anyone building the transceiver, or a similar receiver or converter.

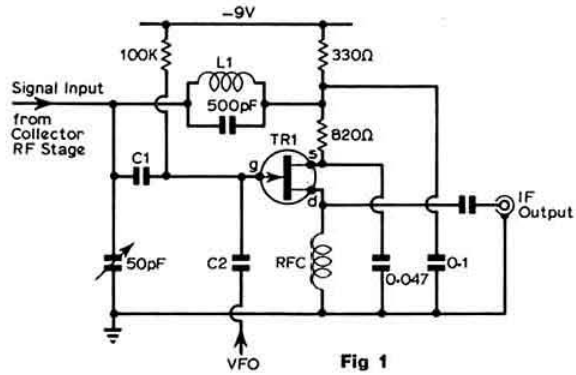


Fig 1

MICROWAVES–1,000MHz and up

by Dr D. S. EVANS, G3RPE*

A hybrid ring mixer for 23cm

Details of an attractive hybrid ring mixer have been received from G8ARM, in the design of which both G8AOL and G8AGM were involved. The main advantages of this type of mixer are its simplicity of construction, the absence of tuning adjustments, and the better match between aerial and mixer than is easily achieved by common trough-line or cavity mixers. Its efficiency is demonstrated by an impressive list of 23cm dx also supplied by G8ARM.

From the basic circuit given below it can be seen that the signal input, the local oscillator, and the two diodes are each spaced $\lambda/4$ apart, and that the two diodes receive an in-phase signal from the local oscillator, and an out-of-phase signal from the aerial. Since the local oscillator injection is almost totally cancelled at the position of the aerial port, very little oscillator power is wasted up the aerial. Similarly, almost none of the signal is lost into the multiplier chain output circuit, which results in a much improved isolation compared with a cavity. Because the ring is sufficiently broadband to accept signals at both local oscillator and signal frequencies, there is none of that infuriating loss of mixer current that seems to occur in cavities on peaking the signal circuits.

The mixer diodes used were HPA2810, although any of the 2810-2827 series should be suitable. The capacitors C1 and C2 were at first thought to be critical, but this later appeared to be due to the particular types used initially. Subsequently flat pieces of copper laminate were used, mounted with the copper uppermost and bolted to, but insulated from, the ground plane. The original model employed a local oscillator at 1,232MHz, which led to an i.f. of 64MHz, although there appears no reason why a lower i.f. could not be used.

In addition to the output circuit given by G8ARM, Fig 2, an alternative has been added, Fig 3.

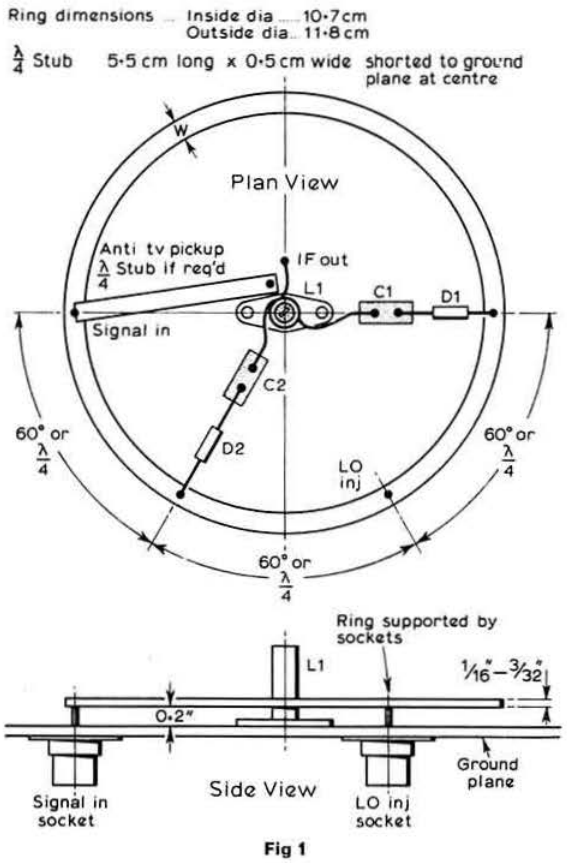


Fig 1

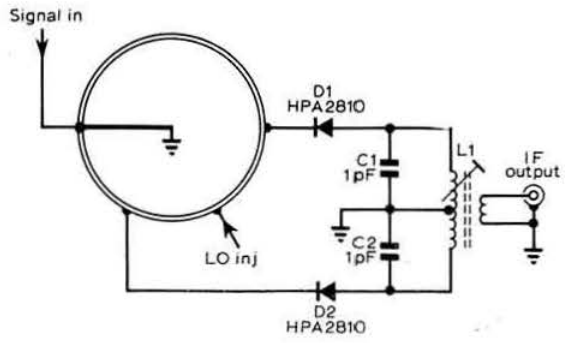


Fig 2

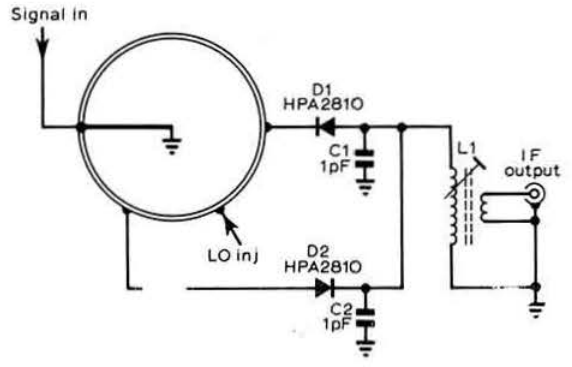


Fig 3

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

FOUR METRES AND DOWN

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

The Seventeenth on the 17th

Back in 1954 the Bristol Group of RSGB organized in that city a national convention which for panache and for the sheer profusion of things to do made it an event to remember for a lifetime. In between the formal sessions a crowd of vhf enthusiasts flocked together and organized an informal gathering to talk about their own specialized activities. From this stemmed the First International VHF/UHF Convention which took place on 14 May 1955, with DL, EI, F, PA and even ZL visitors signing in alongside a hundred or more UK callsigns. The ground-plan laid down then has served as a model for subsequent conventions that has been difficult to improve upon; that is, an afternoon tech-session followed by an evening dinner.

Other notable vhf "firsts" in 1955 were: the introduction of slot beam aerial techniques by means of an article in the then *RSGB Bulletin* by G2HCG, and whole page advertisements in "*The Bull*" by Mullard about the brand new 3/10, 3/20 and 6/40 valve range and by Pye about the ". . . new two-way radio equipment known as the Pye 'Ranger' ". Fred Lambeth's monthly column was called *Two Metres and Down*, British callsigns were into the G3J - - block, and the Class B licence was nine years away.

Now, in 1971, with the Mullard trio of valves still notable producers of rf, the Pye "Ranger" going great guns behind many a G8-plus-three callsign and J-beam aerial on "Two", and British Class A callsigns about at the end of the G3Z - - block, the big event looming up two months ahead is the Seventeenth Annual International VHF/UHF Convention. The date, by a happy coincidence of the calender, will also be the 17th, of March.

Once again Frank Green, G3GMY, in spite of increasing pressure of business interests, has agreed to be convention secretary. How much to send him for your ticket, and by when, will be announced here next time.

Spot on, or not?

Last month's parenthetical remark that the licence requires an operator to state the *actual frequency* in use and not simply the band is worth brief amplification.

It is in Paragraph 6 of the Amateur Sound Licence (A) that the requirement is stated that the station log must record ". . . the frequency (not frequency band)" in use each time the transmit switch is pressed. The point we wish to make is that it does not do to take for granted that a crystal will provide an exact multiple of its marked frequency. In some circuits, particularly overtone, there may be an error in the believed transmitted frequency amounting to some hundreds of kilohertz.

We worked a man a month or two ago who popped up in the cw end of "Two" using phone. He was horrified when he was told. He thought he was on 144·7MHz. Most of us have met cases like this from time to time, where inappropriate crystal excitation produced an inappropriate final frequency.

Apart from wild deviations like this one, smaller errors occur in vhf transmitters whose crystals do not have across them the precise value of capacitance recommended by the crystal suppliers. A crystal tried out in two separate transmitters may well produce substantially differing transmit frequencies simply because in one transmitter the Colpitts multiplier used 10 and 39pF across its grid circuit while the other had 27 and 100pF.

The safe thing to do is to take the marked crystal frequency as the starting point but to have the end product separately checked in the 2m band (or 4m, 70cm or whatever). Then the actual known transmitted frequency may be entered in the log as the licence requires.

Time on, time off

Net operation has become as much a part of the 2m scene as it is on that of the hf bands. There could be even more of it: "Two" is the ideal band for setting up multi-way contacts at high signal levels; no noise, fading or QRM, and superb audio quality.

It was the development and popularity of the net technique over the years that prompted the licensing authority to write into the licence appropriate wording to regularize its use. The licensee is permitted to engage in QSO with ". . . groups of particular amateur stations provided that communication is first established separately and singly with each station in any such group".

This requirement appears in Section 2 of the licence and should be read in conjunction with the item in Paragraph 6 ("The Log") which requires the operator to record ". . . times of establishing and ending communication with each such station". Therefore, the required procedure to follow when operating in a net is: first time round write in the log the starting time with each person spoken to; last time round, when people are dropping out, log down the finishing time with each participant. It is as easy as that.

"A little too easy" the newcomer to a 2m net may be inclined to say if his first attempt ended in some confusion because no one established the order of batting. But there is a simple answer to "who transmits when?" and it is given in the recommendations printed in "The Metre Wave Man's Code": in net operating *stick to "callbook order"*, the G2 men first, then the G3 and so on through to the G8. And if the net is wholly G8 then the G8A - - first through to the G8E.

Two eastern "Seniors" on "Seventy"

Circumstance's curious habit of offering up like events in pairs—call it coincidence, perhaps—was demonstrated a

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

few weeks ago to the VHF Certificates Manager when he received two applications for the 432MHz Senior Transmitting Award within a few posts of one another and both from the same part of the UK, East Anglia.

To receive *one* application for the 70cm Senior is rare enough: it is difficult to achieve and only seven have been issued. For two to arrive virtually at once from a region where the amateur population is not exactly thick on the ground was remarkable.

Both John Reeve, G8ATS, of Mildenhall in Suffolk, and Roger Taylor, G8BBB, of Haddenham in Cambridgeshire, decided to leapfrog the 432MHz primary award and go straight for the Senior. For G8BBB there was the additional hazard of a move of QTH made a couple of years ago which meant starting all over again from the new location to gather in the necessary nine plus 40 cards to allow the claim to be made.

Although there is not much to obstruct signals coming out of the eastern counties there is no advantage in site at either station: G8ATS is just 30ft asl. But their 70 centimetric rf is known to most users of the band. "Triple B" is one of the small number of sidebanders on "Seventy", 'ATS has 120W to a 4CX250B linear. If this seems to be beyond the capabilities of the intending newcomer to 70cm one might add that John Reeve's first two years on the band were spent with nothing more ambitious than a 3/20A tripler. It notched him six countries and over 30 counties.

Seventy southwest

Like G8BBB (above), Dave Sellars, G3PBV, has been compelled to make changes of QTH when the FMD Certificates claim was almost in sight. He operated in the early 'sixties from Wolverton in North Bucks and then from Northampton. His 144MHz certificate gained in those days has the low number of 31.

Now G3PBV operates from a 600ft site near Newton Abbot in South Devon. The excellence of take off to the east is shown by the consistent reception of the London beacon on 70cm. Curiously enough GB3GEC is there when the 2m beacon GB3VHF "... is normally lurking just below the noise level". Neither of them beams his way.

At present running lowish power on 70cm into a Two/Six and a 10-element well elevated at 45ft, G3PBV has plans to persuade on to 432 a new ssb rig built for "Two". He reports other South Devonians active on the band are G8CBZ of Brixham, and G8CKC of Uffculme about to restart from a better site.

A bit farther down the coast at Torquay is G8ABP, Mark Marment, well known in the Midlands a few years back as an active "seventy centimental" (he was the second Class B man to secure the FMD Award with Certificate No. 7; G8AAZ was the first. He too has made for the south, like 'ABP). Will old friends in the Birmingham area look for him in the south-western 2m zone, asks G8ABP. It will not be long before he resumes on 432MHz as well as "Two".

Still on a south-westerly heading ...

News from John Patrick

Handwriting on an envelope which came through the mail last month was recognizably that of ZB2BO, and indeed turned out to have come from John Patrick, not in Gib any more but now re-established as G3TWG at 5 Carpenter Road, Plymstock, Plymouth, PL9 8UA. He can be found on 144·16MHz; recalling the work he did on "Four" from The Rock his advent on this band, too, would not be unexpected, if local conditions enabled him to put Devon on the 70meg map.

In finding his way around Zone A of the 2m band he noted the larger telegraphy area at the low end, and has been wondering if the reasons for extending it to 144·15MHz are appreciated by everyone. "If you want people to observe bandplans as amended the case for doing so must be fully apparent." Which is very true, and gives us the opportunity to say again that the cw extension to 144·15 was agreed so that the UK would conform with existing Continental practice.

At the same time it was evident that the south-western zone was becoming a bit truncated in consequence. Hence its extension up to 144·5 at the time of the introduction of the simplified 2m four-zone bandplan announced in *Radio Communication* of October 1969 to come into use in January 1970.

In its first twelvemonth of life it has worked pretty well, contributing to the enjoyment of the metre-wave bands and enhancing their noted orderliness.

* * *

All the foregoing activity in the south-west may persuade operators in other parts of the country regularly to orientate aerials that way.

Diagonally across England there is another big pocket of vhf activity which tends to be overlooked when beams remain fixed along the heavily populated London to Manchester axis. So ...

Over to Norfolk

Another re-establishment in a new area: two years ago G2CDX, Arthur Porter of Cambridge, moved to Norwich. The number of stations within Norfolk he has worked since then gives a clue to the level of activity in the county: 25 Class A and 25 Class B plus half a dozen mobiles visiting the area. And then there is this comment:

"... have taken part in a number of RSGB vhf contests and usually suffer from southern counties operators not pointing their beams east of north. Please ask them to do so even when there is not an opening."

Perhaps the hint may be taken!

Welcoming G2CDX into their midst the Norfolkmen honoured him by appointing him as last year's chairman of the Norfolk Amateur Radio Club.

From B to A

Instant recognition is a characteristic of the metre-wave bands. Almost everyone to be heard regularly can be identified virtually in mid-syllable. When a strange new callsign with a familiar voice behind it pops up the listener's immediate conclusion is "Class B man just changed to Class A". And it is usually the right one.

Increasing numbers of G8 owners who have become G3 owners make for the lf end of "Two" with the intention of opening up longer distance paths than were possible when operation was restricted to telephony. Recognition from behind a key is not quite so instant, though few cw operators remain anonymous for long; the subtly differing ways in which people send the morse code help to characterize them.

Many holders of callsigns in the latter half of the G3Z-- series are not yet in the *RSGB Callbook* except under their

previous G8---callsigns. If it will help, we will print here details of new callsigns acquired and vhf/uhf bands in use.

Now pounding at the lf end of "Two" is G3ZUL, Brian Kennedy of Stourbridge, one time G8CVK. He puts out CQs most evenings on 144·12MHz "... will be glad of cw QSOs".

From G8AUE comes an amusing story of an unexpected hazard when taking the morse test. Many G8 men have never used headphones in their lives. Having to clamp them on the head when visiting the morse test centre is disconcerting, to say the least. It was to Ian Sneap: "I just could not resolve a thing with them on, so I thought the only answer was to get into practice by wearing a pudding basin for a spell!" The story had a happy ending on New Year's Day when G8AUE and G8AUF went for the test together, passed together and, promises the MPT, will be allotted G3Z--calls together, consecutive as the old ones were. But no pudding basin: just a solid slog at the code for a fortnight (wearing phones). Then, heigh ho for four metres!

Although elated at passing the test, G8AUE and G8AUF left the test centre in a somewhat thoughtful frame of mind. Reason: they had just witnessed a professional complete a test at 28wpm, reading only the mechanical clicks from the morse key.

More extra-terrestrial

Latest recruit to the "meteorites" is EI6AS. From his high-up site overlooking Dublin Bay, Albert Latham spent long hours waiting for returns off December's Geminids shower. He said it was all made very worthwhile when UR2BU pinged up as loudly as S6, and was heard several times at weaker levels.

A schedule with HA5AIR has not so far given any m-s returns. Talk-back to both of them for note-comparing is done on 14MHz.

From Ron Hamm, BRS15744, comes a report on the average hourly rate observed from the Geminids via Gdansk on 4m—and as might be expected this prolific shower turned on a higher rate than the November Leonids reported here last time. During Ron Ham's observation times of 1800 to 2300gmt the returns were: 275 on 12 December, 247 on 13 December, 280 on the 14th and 164 on the 15th.

Mini-opening

"Surely, this is a puzzle even for the experts." Thus Bill Scarr, G2WS, talking about the surprise opening on Sunday 9 January ... family cars out in thousands, anticyclone over Poland, highest temperature for the time of year since records began said Ross on Wye Observatory. And at G2WS on the Somerset coast, where the pressure did not top 1015mb, a pronounced W-to-E opening on 70cm, with GB3GEC, normally S4, hitting S9 (and it does not beam that way!) and a string of QSOs with the Home Counties on 70cm, most reports S8 or better, but nothing north of Bedfordshire except "Sutty", GB3SC, only S6. By Monday morning GB3GEC was S5, by the afternoon *out*. "An opening of such intensity and under such an atmospheric set-up is surely most odd", concludes G2WS.

Continental style

From the latest number of *IARU Region 1 News*, now in a handsome 34-page format, we note that the Belgians have a 2m bandplan. The three western provinces—broadly Flanders—have 145·0 to 145·3MHz; the two central areas, dominated by Brussels and Antwerp, have 144·2 to 144·5 MHz, and the four eastern provinces 144·6 to 144·9.

Below 144·2, telegraphy. What happens above 145·3 is not stated.

The same issue of the *News* gives a list of French certificates obtainable and general rules for REF awards. Of interest to vhf operators is DDFM Award No. A3, and DDFM Award No. A1, granted on presentation to F3JI of 20 confirmations from 20 different French *departements* worked on the same band since 30 June 1957 from the same location.

Rather more difficult is the DPF (Diplome des Provinces Francaises). You have to work 12 different French provinces and there are only 17, down as far as Corsica—on 144/432. Applications to F3ZU.

The awards are available to licensed amateurs anywhere.

Another "lift" from the *News:* in West Germany there are 14,000 amateur stations, 6,800 active on "Two", 670 on 70cm and 44 on the 1,296MHz band.

Finally, some news about a Finnish beacon. The beacon station OH2NUA, operating on 145·929MHz, does not transmit except when a starting pulse has been received from equipment which registers auroral reflections. The monitor receiver is extremely sensitive and the beacon is enabled to commence working well before useful auroral conditions are established. The power of the beacon station is 5W to an omnidirectional aerial. The actuating receiver works in the 100MHz band listening to a transmitter situated in Pori (QRA: KV49g). These both have high-gain directional aerials pointed to the north.

Beacon news

From Dick Harrison, domiciled in the Low Countries as PA9LY, comes information about a new beacon which has been commissioned by the Belgians. Its callsign is ON5PJ and it is putting out 1W of rf on 145·5MHz from a quarter wave ground plane aerial 16m off the ground, at a site 267m asl. The QRA Locator is CK55C and the hours of operation 2030 to 2130 European time.

Although low powered, ON5PJ appears to be well sited, and given a bit of a lift on "Two" might be audible in the south-easterly parts of the UK.

BEACON STATIONS

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

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

Photographed at an altitude of about 7,000ft during their expedition to Andorra last summer are G8CKT (left) and G8DXO (right) with an swl helper in the middle. All are members of the Oatlands Scout Group from Weybridge in Surrey. Using the call C31DD from a 9,000ft site they made a large number of contacts on "Two" into France and Spain, and were heard RS55 by G8ATK back home. No actual UK contacts that time, but next time, which will be later this summer, the expedition will be mounted again, maybe with 70cm available as well as "Two"

Beacon keeper G3DME, on whose 40ft lattice tower the new 4-el beacon beam is sited, pays special tribute to the help given by G3UYO and by strong-arm man David Cassford for the sheer hard work they put in to help give GB3SX its new found amplitude.

* * *

"Take a look on 70·699 and see how you find the Sussex beacon," remarked G3OHH (himself quite a beacon at his eyrie on Mow Cop) during a contact with nearby G3HVI. The latter did, and was surprised to note the enormously increased strength of GB3SX from Crowborough 170 miles to the south-east compared with the marginal signal it had been putting out before. And it was even detectable off the back of the G3HVI beam. The gainier aerial system which had been put in at GB3SX to replace the ground plane was proving its worth.

This it has continued to do over the last six weeks, providing to the large 4m contingent in the Channel 2 television areas of the north and north-west almost 200 miles away a weak but valuable dx signal, irrespective of conditions.

"Wrong sound"—again

"Fitting a crystal microphone in place of the dynamic one in an ex-business radio rig is not by any means always the answer to poor sounding quality on 'Two'," remarks G8BTU, John Dowson of Wigston, after reading last month's comment here on this subject. Being in vhf telecoms himself and with some useful professional experience to draw on, he makes the point that dynamic microphone modulators, if properly set up, are capable of giving audio quality comparable with—or even better than—that provided by crystal inputs.

He goes on to voice the warning that crystal microphone input can end up by proving an unacceptable sounding transmission with excessive top and unpleasant accentuation of sibilants. Audio systems *must* be tailored to roll off sharply at about 2·8kHz, whether they use crystal or moving coil inputs, if dire local splatter with consequent unpopularity with 2m neighbours is to be avoided.

Why, then, the squawky sound of many ex-commercial rigs pressed into service on "Two"? One symptom which need not detain us because it is obvious, even if its cure is not always simple, is rf getting into the front end of modulator units. Rather more insidious is the overall maladjustment that comes from attempting to re-tune a transmitter from its old commercial frequency many megs away to a new one in the 2m band. Seriously reduced drive and decrement modulation ensue, with painfully self-evident aural results. It is no use blaming the transmitter: it was not designed to be pulled that much.

Which brings us around to the thought ventured more than once in this column: that the best thing to do with a "surplus" transmitter is to pull it apart and rebuild it as an amateur one which you know is to your own design and not to someone else's.

"You can say that again in respect of the receiver section, too," says G8BTU. The bits cannibalized from ex-commercial receiver strips come in useful for building a good converter to feed the home station receiver in the traditional, and for the amateur the most effective, way.

Contest news

By custom January is the month of that pair of "dx winkling" contests on "Two", meaning those for ssb and telegraphy, the former concentrating furious activity into three hours on the usual Monday night, the latter more leisurely spread across several hours of a Sunday, with time to spare to carve the joint, and a civilized start at 10am (last year it began at 7am—and still nearly 100 people were on).

The rapid scoring of the January sideband event and the tendency to run out of stations towards the end added force to the argument that three hours is more than enough for this contest. At its height the calling frequency became a "band" as people spread out a few kilohertz either side of 145·41MHz.

The cw event took place after this piece went to the printers, but it will be interesting to examine the final results of both contests to compare the two in terms of dx winkled out, and particularly in the light of correspondents' recent comments on this page about the drop-out characteristics of ssb and telegraphy at extreme range. After last year's events the tables showed under "Best QSO km" marginally greater distances for the ssb mode than for cw, though power levels by the ssb contestants were overall rather higher.

During January, too, the first two 432MHz Cumulatives—the "meet all your old friends contest"—came as a welcome follow-on to the highly successful "private venture" organized by G8AWS and G8APZ. Half a dozen Home Counties regulars were missing from the first play-off: it happened to be the night of the Presidential Installation and of the Mid-Herts Society's annual dinner. No matter: it is always possible to catch up in the following Cumulatives, for only three out of the five submitted logs count for the final table. Even so, operators who *do* enter the lot do a service to their fellow seventy centimetrics by turning in a log for each: it might be *your* log that provides the VHF Contests Committee with just that vital bit of cross-checking which helps them fit the whole contest jigsaw together.

Here and There

"Quite a few locals are using nbfm, eg G3YRH, G8ANQ, G8BAG, G8BWH, G8CJP and G8CZY. We all seem to get out OK; and with discriminators, what a difference! It's a pleasure to listen to clear copy with a.m. effectively limited out. What is tvi?"—G8ANQ, Bishop Auckland.

* * *

"Active from new QTH 780ft asl in Halifax with G3NEO, G8CUE and G8CUI from 1130pm most evenings, 433·35"—G8BCL, still in Halifax but at an even better site than before.

* * *

"Data on my vfo published in *Radio Communication* for January has received considerable comment on 2m in the London area in the last few days. One of the comments has been that there is a resistor missing from the circuit diagram; a 270Ω between the cathode of the zener diode and the plus 10V rail"—G3YKB, London W5. Intending vfo constructors please add it to last month's circuit!

* * *

Members have asked how they should record on their own QSLs that they hold a Four Metres and Down Certificate. Like this, perhaps: "RSGB FMD 70cm Award No. 98"—or whatever the number on the certificate is.

* * *

Tim Thornton, A7120, of Wargrave in Berkshire, dug out an interesting plum from the 7MHz melee: that GC3HHZ, the only licensed amateur on Alderney, hopes soon to be on "Two". With a fine take-off to the north he should soon be in demand on the mainland.

* * *

In May or June GM8AGU and GM3JFG will "expedite" into the rarer counties of Scotland to put some really high portable power on "Two" from remote sites, operational from 8pm to midnight and 7-8.30am daily, all day Sundays. An sae to Paul Widger, GM8AGU, 87 Findhorn Bay Caravan Site, Forres, Morayshire, will bring details nearer the time.

* * *

Permanent residence in Sweden for G8DOS. The reciprocal callsign will be notified soon. In readiness is a 2m sideband rig. And the 10-element atop a 15-storey block of flats will be pointed UK-wards. Address for correspondence: J. W. Attlee, Strandgatten 50, 216-12, Malmo.

Back from Sweden after two years there is G5DF, Reading, now reactivated on "Two", looking around the cw end most nights.

* * *

"Both G8AII and I are feverishly building doublers which we hope will give some rf on 2,304MHz!"—G2WS.

VHF Personalities—No 18

G8BYV (John Tye, of Dereham, Norfolk)

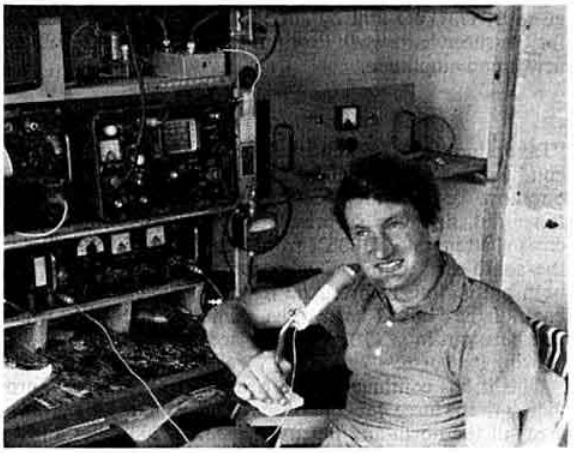
"If something is required, build it yourself if you can." How this philosophy has been translated into practice by G8BYV is demonstrated to anybody who visits the John Tye QTH. His bungalow is quite literally "a home construction": John started it in 1954 so that Joan and he could move into it upon their marriage in November 1955. So is the tower recently built by him from second-hand steel to replace an earlier timber structure he put up when vhf listening began to command an interest. The 4ft dish for 1,296MHz, like the rest of the aerials, is yet another home construction. Rotation to the central mast is imparted via an old car steering box and a second-hand electric motor to give 1rpm, another practical fit-up by 'BYV.

A visit to G8BYV discloses many other examples of make-it-yourself practicality: the garage doors open automatically when the "Mini" approaches, throughout the bungalow there are loudspeaker enclosures capable of receiving output from amateur bands or entertainment radio . . . "If you want it, make it".

By the same token as much as possible of the transmitting station is locally built. "It's a miser's dream," says G8BYV diffidently. Others would have other ideas: that the ability to fabricate your own equipment and breathe into it Promethean life is one of the prime satisfactions of amateur radio. Although on heavy construction jobs like his bungalow and his tower G8BYV starts with an advantage by the fact that he is a practising carpenter he is self-taught where radio is concerned. And as with many others in like condition he had to make three attempts at the RAE before passing in May 1968. He made his debut on 2m on 20 September that year.

His interest in radio goes back nearly 30 years before. As a lad of 14 back in 1940 he found his way round circuits by helping with the local servicing of the-generally-battery broadcast receivers of those days. When after the war ex-Service receivers began to trickle through he acquired an R107 and then an R1155N to give him the 160m facility.

After the move to the bungalow a latent interest in vhf was fanned when a VHF NFD session with the Mid-Norfolk VHF/UHF Group demonstrated to BRS27622 (as he was before G8BYV came along) what the metre wavelengths were capable of. After that, down came the 4m and 2m dipoles from the tower and up went 8-over-8s for "Two" and 70cm. A programme of improvement throughout the station was put in hand. By the time the callsign was obtained the



G8PD "2N4" transmitter had been built but with a transistor modulator, and the G8AKM varactor tripler was ready to go on 432MHz.

Later, when the RSGB *Handbook* 3/20 tripler 3/20 pa design was built for 70cm the varactor was released for 23cm. Soon, signals on "23" were being pushed as far west as G8BAV in Derby and to PA0WFO across the nearby North Sea. As for the G8BYV signal on 70cm and 2m, its potency while not enhanced by a site only 160ft asl is helped by the absence of serious obstructions over the broad lands of Norfolk. Countries worked on 70cm total nine. And that is as good a yardstick as any with which to assess a station's performance.

G8BYV is blessed with a wife who is thoroughly sympathetic towards amateur radio (she once bought him an R216 for Christmas). Susan (13) and Paul (12) receive their indoctrination through the communal speaker system throughout the house. But although G8BYV has gone far on a predominantly "do-it-yourself" basis—"with much valuable advice from the locals and especially G3XPT"—there are moments when he feels he would like to stretch the possibilities still further: "I wish I could pass the morse test. I feel a G8plus3 is a boy's licence, and I would like G4BYV."

THE MONTH ON THE AIR

A monthly feature by John Allaway, G3FKM*

TUNING around the bands these days reveals a very serious deterioration in the standard of operating by many stations, including some in the UK. The misdeeds are not by any means restricted to the newcomers, who may be forgiven if they develop bad habits from listening to some of their more senior colleagues on the lf bands. The cw section of 80m seems to produce many perfect examples of how not to operate—two-letter Gs have been heard calling "CQ DX" on the frequencies of dx stations they have called, who have not answered them, or even starting up local contacts. One of the most rewarding bad habits is the technique of "out-calling" the opposition—the idea seemingly being to prevent anyone else hearing a reply from the station being called.

Some debate is possible over the correctness of staying on a frequency where a dx station has answered a CQ call. Although the station first on may feel that it is "his" spot, it is surely much more courteous to move away and allow others the chance to call —after all, in the case of 80m the European Band Plan allows 100kHz within which to move. It may be remembered in passing that the IARU has suggested that the sectors 3,500 to 3,510kHz and 3,790 to 3,800-kHz be reserved for intercontinental contacts.

Top Band news

G3SED reports a most successful start to December with a record 55 dx contacts during the first 10 days. The highlight was a QSO with PJ2CC at 0310 on the 2nd—this being the first G/PJ contact. PJ2CC uses either 1,803 or 1,827kHz. The tests on the Japan/Europe path have so far not met with any success, possibly due to the fact that the JA's frequency (between 1,907·5 and 1,912·5kHz) is usually occupied by local UK phone contacts. The avoidance of this section of the band between 2030 and 2200 on 6 and 20 February would be very greatly appreciated. GM3LHV has received a listener report from Vladivostock, having been heard in QSO with GM3IAA on 3 April last year. GM3IAA reports working 9Y4NN on 24 December at 0100 but otherwise has not found conditions in the north to be very good, although he did hear W1HGT, K1PBW, W4QCW and W8AH during the Transatlantic Test on 27 December.

A letter from G3JGR says that he has been informed by 4S7GV that permission to operate on 160m has now been granted to amateurs in Ceylon and that 4S7s are on each day between 0030 and 0130 looking for UK contacts. G3TKN has been heard by 4S7DA (at 0045 on 27 December) at RST 559, and G3VRW and G3OLI were audible slightly earlier and a little louder on the 30th. 4S7DA is running 65W into a strapped G5RV aerial and he says that they have QRM from a broadcast station on 1,825 so that 1,820kHz would be a good frequency to use. Anyone wishing to make a sked should write to: Denver Wijesuriya, 4S7DA, AMQ C85 B, Royal Ceylon Air Force, Katunayake, Ceylon.

VK6NK reports contacts with G3s IGW, LYW, OLI, and RPB, and with GM3YCB, DL9KRA and EI9J, and hearing many more European stations. His frequency is usually 1,803kHz and he looks for callers between 1,828 and 1,835kHz. Cliff will be on the band from 2045 onwards—the opening lasts as little as five minutes so *please* restrict contacts to reports only. Please reduce calling "cycles" to two minutes, not three.

News from overseas

Bob, 5Z4LW, reports that Sid, ST2SA, and Moty, SU1MA, are starting an Arabian Net on 14,200kHz at 0500 daily. They have written letters to stations throughout the Arab world and asked them to join in, so this should be quite a gathering in due course. With reference to activity in Kenya, it seems that 5Z4KL will be in Scotland when this reaches readers and that 5Z4LW will be about the only dxer left. 5Z4MO is not interested in dx, 5Z4MG does not QSL, 5Z4MD is not very active and does not chase dx, and Robbie, 5Z4ERR, only comes on the air when there is a "new one" around! The new RSEA clubhouse is completed and was due to be opened by a minister of the Kenyan Government at the end of January. It contains a club transceiver with tower and beam aerial so maybe 5Z4RS will be around the bands by now.

Roy Swain, ZL1AAT, is now living at Te Kuiti, New Zealand, following his year of duty on the Kermadec Is during which he made over 26,000 contacts and worked 248 countries. Roy's new address will be found in *QTH Corner*. Another former UK licensee, G3TJD, has changed his callsign from ZL1BJZ to ZL1SV.

Mention of a pirate HS1ABC in December *MOTA* has produced a letter from G8NY who not only worked a station with that callsign and received his QSL card but speaks to him frequently. His QSL was sent via Box 2008 in Bangkok and HS1ABC's full QTH is: John Doherty, 49 Soi Antavimol, Rajapramap Rd, Bangkok, Thailand.

Louis Varney, G5RV, is on the air from Port Moresby with his VK9LV callsign. He is using a Yaesu FT200 transceiver and G5RV aerial (naturally!) and has already had over 500 contacts in six weeks' operation, mostly on cw.

In a letter to your scribe, Reg Beck, VE7IG, says that he has been visiting AP2AD but was unable to get on the air as only Pakistan nationals may operate from that country. He made about 250 contacts from Kabul on 13 December as YA1REG and asks that QSLs for this call as well as those for VS5RG, VU2REG and his 1970 CQ WW Contest activity from 9N1MM should be sent via VE7BWG—letters sent to VE7IG's *Call Book* address will not reach him as he left there several months ago and they will be destroyed by the Canadian PO. Reg hopes to be very active from New Delhi until mid-March and will be on 7MHz cw every evening for W and European contacts and also on 3,895kHz ssb when the band is open. During the daylight hours he will concentrate on 28MHz to assist 5BDXCC chasers. QSL cards for

* 10 Knightlow Road, Birmingham B17 8QB.

JH1CXQ, besides being an enthusiastic aqualung diver, puts a very fine signal on 21MHz cw

the CR9AK "guest" operation should be sent via Pinto's regular CT1 QSL manager, and cards for any future activities should be sent to VE7BWG unless instructions to the contrary are given.

Fred Sawyer, ex-5Z4KO/ZS6AGS and now G3SLN, will be in the UK for 18 months and may be contacted at the address in *QTH Corner*.

Rufus, W1QCO, who was born in Bolton, is anxious to have QSOs with amateurs in that town. He frequents 14,250 kHz almost daily at 1145 with his four-element beam pointed to the UK and would very much appreciate calls.

DX news

A sudden outburst of activity from Canton Is (KB6) in the form of K3QOS/KB6, K6AZD/KB6 and KH6AZB/KB6 occurred in late December. The first mentioned will probably have returned to Maryland by now but KH6AZB/KB6 is expected to remain on the island until 1972. All have been reported on 14MHz.

West Coast DX Bulletin reports that QSLing for the recent African trip by DJ1QP and DJ6QT has now begun. Cards will be sent first to those making a contribution (two IRCs in addition to those required for postage) and later on to all applicants. Their TZ2AB licence is permanent and a future visit may be arranged, as may a trip to Annobon Is if and when permission can be obtained.

The latest list of stations for whom INDXA acts as QSL manager includes AP2KS (E. Pakistan operation), KP6AL, ST2SA, TY7ATF, VE8CB, XT2AA, ZB2AY and ZD8AY. The organization now has over 800 members and is growing rapidly.

The HC8AA operation during the CQ Contest resulted in over 3,000 QSOs. HC8WW is now on the air from Floreana Is with a Swan Cygnet transceiver and beam aerial. The station on cw using the callsign HC8FN is a pirate.

Additions to the list of stations for whom *DOTM* acts as QSL manager include 4T4LM (special callsign used by OA4LM), VP9GR (after 17/9/70), W4MMO/KP4 (from 5/10/67 to 27/4/69) and VK6CIF.

The US Hydrographic Office is said to have never heard of Nordhay Is and to know of no islands between Clipperton and Cocos Is. This seems to increase doubts about the validity of "1Z4NG".

3Y3CC, thought to be located on Bouvet Is, is now said to be in Queen Maud Land, Antarctica. 8J1RL has been reported active from the Japanese base in Antarctica.

Previous information giving W3HNK as QSL manager for UA9VH/JT appears to be incorrect. However, Joe frequently contacts UA9VB who *is* the person responsible and can sometimes help with overdue cards.

VP8LN is currently operating from Halley Bay, Antarctica, but will soon be moving to South Georgia. 3B8DA had his equipment damaged during his return trip from St Brandon to Mauritius but he hopes to repair it in time for a visit to Rodrigues Is after the cyclone season finishes.

Peruvian stations may be heard using the OB prefix instead of their normal OA, this is to celebrate the 150th Anniversary of Peruvian Independence. Likewise, Greek stations have been authorized to use SZ0 during the whole of 1971 to denote 150 years since the liberation of Greece.

VK6HD says that JD1YAA, KS6DH and ZL4OL/A are all willing to QSY to 40m or 80m on request—the last has already been worked on 80m from the UK.

3B8BZ was 3B9BZ from Rodriguez Is in late December and seemed to prefer the region of 14,223kHz between 1300 and 1400. This operation is rumoured to be likely to continue for some months.

The prefix block 3DA to 3DM has been allocated to Swaziland and the block 3EA to 3FZ to Panama.

GW3AX is now acting as QSL manager for European contacts made by KL7DTH/KG6 on 80m. Listeners should quote the report *given* by the KG6 to the station being worked. Lee works for RCA on Guam, has a 68ft vertical aerial, and favours 3,850kHz ssb or 3,798kHz cw.

Canadian "banned" list

The *DX'ers Magazine No. 192* reproduces a letter from the Canadian Department of Communications headed "Notice to licensees of Canadian amateur stations". Among other things, the letter goes on to say that according to notifications which have been received from the General Secretariat, ITU, Geneva, the following administrations have forbidden radio communication between their amateur stations and those in other countries: Cambodia, Laos, Viet-Nam, Burundi, Cyprus, Gabon, Greece, Indonesia, Iraq, Jordan, Libya, Pakistan, South Yemen, Syria, and Turkey. Readers will no doubt be rather surprised by the presence of some names in this growing list.

Dxpeditions

Laccadive Is. There are strong rumours that a group of Indian amateurs (including VU2s CK, DK, KN and RK) will be visiting Laccadive around 14 February and using the calls VU2US and/or VU2USN. Operation on cw and ssb on several bands is anticipated. Other sources mention a desire by K6LON to go there in June, as well as to the Nicobar Is, but it seems that permission is presently being restricted to Indian nationals.

Clipperton Is. There is still no definite information on any expedition to this location but a number of "FO8s" alleging that they were on the island have been heard and all are undoubtedly pirates. A group of real FO8 amateurs are said to be attempting to plan an expedition and according to *West Coast DX Bulletin* a W5 says that he has a licence and will go in mid-February.

Tokelau Is. A second attempt by the team of Canadian amateurs which abandoned a visit to the islands earlier is possibly to be made in February. It is also rumoured that ZL2AFZ and KH6GLU are interested in going both to Tokelau and to Minerva Reef (1M4).

(As *MOTA* went to press information was received that VU5KV might be on from the Laccadive Is for 14 days starting 19 January. If this is correct it will be only of historical interest by now, but in the event of delays the expedition may still be active. Frequencies mentioned include 7,005, 14,195, 21,290 and 28,550kHz. QSL to VU2KV, PO Box 3031, New Delhi, India, with five IRCs.)

German callsign allocations

According to the *IARU Region 1 News* callsigns using the DA, DB, DC and DF prefixes are now being issued in Germany. They will be issued as follows:

DA1AA–DA2ZZ Foreign military licensees with Class A and B licences

DA4AA–DA4ZZ Foreign military licensees with Class C licences

DB1AA–DB9ZZ German amateurs with Class C licences

DC1AA–DC6ZZ German amateurs with Class C licences

DC7AA–DC7ZZ German amateurs (in W. Berlin) with Class C licences

DC8AA–DC9ZZ German amateurs with Class C licences

DC0AA–DC0EZ German amateurs with Class C licences

DC0FA–DC0JZ Foreign civilians with Class C licences

DC0KA–DC0ZZ German amateurs with Class C licences

DF1AA–DF9ZZ German amateurs with Class A and B licences

DJ1AA–DJ9ZZ German amateurs with Class A and B licences

DJ0AA–DJ0ZZ Foreign civilians with Class A and B licences

DK1AA–DK9ZZ German amateurs with Class A and B licences

DK0AA–DK0ZZ Club stations with Class B licences

DL0AA–DL0ZZ Club stations wtth Class B licences

DL1AA–DL9ZZ German amateurs (DL7 = Berlin) with Class A and B licences.

Contests

The WAB (Worked all Britain) Contests

HF Phone (14, 21 and 28MHz) 14 March 1971

HF CW 28 March 1971

LF Phone (1·8, 3·5 and 7MHz) 4 April 1971

LF CW 11 April 1971

In all cases the times are 0900 to 2100. Stations may be worked on each band and QSOs count five points. Multiplier for UK stations is number of different WAB areas worked plus DXCC countries. All British Isles counts as one country for this competition. VE, VK and W call areas also count as multipliers. Overseas entrants use WAB areas only as multiplier (note: an area which covers more than one county can be counted as one area per county). UK stations give RS(T) plus QSO serial number (starting from 001), WAB area number, county, and book number if a WAB record book holder. Overseas stations give the same less their county. Logs should be sent to reach WAB Contest Manager Norman Booth, G2DSF, 49 Baggrave St, Leicester, *not later than 50 days after the contest*. They should contain a signed statement that licence conditions and band planning were observed and give time, station worked, number sent, number received, WAB area, county and points claimed. A certificate of merit will be sent to the top scorer in each country (different UK countries count for this purpose). Listeners may enter and should not log CQ calls but only actual contacts.

John Wilson, K3NPV, and Gene Zimmerman, K1ANV, at one of the operating positions at W3AU. During a major contest they can work five bands at once and the station is often single-operated during the smaller events

The 1971 IARC Propagation Research Competition

0001 20 February to 2400 28 February (CW/RTTY)

0001 3 April to 2400 11 April (Phone)

Object is to work as many CPR (= ITU) zones and prefixes as possible. QSOs between fixed stations in different zones count one point, between a fixed and a mobile station in the same zone one point, in different zones four points, mobile to fixed in same zone two points, different zones four points, and mobile to mobile QSOs in any zone count four points. A station may be worked repeatedly for credit and QSOs lasting more than six minutes count one QSO per each six minutes or fraction thereof; in this case each period should be shown as a separate QSO in the log. The multiplier is one for each zone and each new prefix worked on each band and mode (zones only count once). Use official IARC log sheets or facsimiles with 40 QSOs per page and indicate each new zone and prefix as worked. Separate sheets should be used for each band and mode.

Listener participation is invited. Logs should be sent to: L. M. Rundlett, 2001 Eye Street, NW Washington, DC, 20006, USA.

Awards

The WAB Award

New WAB record books are being printed and will be available on 1 March, price 63p, $2, or 20 IRCs from G3ABG, John Morris, School House, 24 Walhouse St, Cannock, WS11 3DY, Staffs. Note that all services in preparing and issuing these books and awards are provided free of charge and profits go to the Radio Amateur Invalid and Bedfast Club.

The Algarve Award

Algarve Gang, c/o Paulo Vieira, Aptdo 93, Faro, Algarve, Portugal.

Requires QSOs with two Algarve stations—CT1s BN, HB (1960), HL, JR, LN, LQ, MU, NW, OD, PZ, TO, UY, XU, WQ, and ZD count.

The Worked Iberia Certificate (WIBC)

Requires four EA (not 6, 8 or 9), four CT1, one ZB2, one PX (or C31), QSOs. Non-European applicants need one of each only.

The Worked Iberian Prefixes Award

One station in each prefix area CT1, EAs 1, 2, 3, 4, 5 and 7, ZB2, PX1 or C31. In the case of all three awards a log copy plus a signed statement that it is correct should be sent to the address above. The fee for each certificate is three IRCs (five IRCs for delivery by air mail outside Europe).

The Okinawa Award

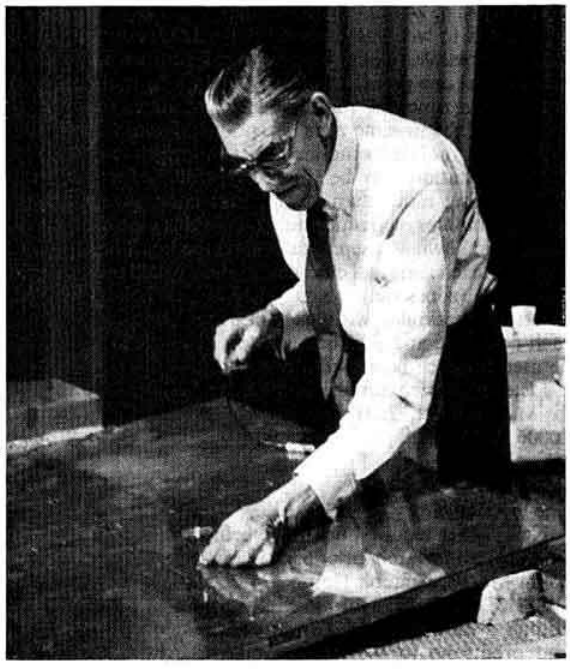
QSL and Awards Manager, OARC, PO Box 465, APO, San Francisco, Cal 96331, USA.

KR6/KR8 applicants require 25; BV, CR9, DU, HL/HM, JA/KA, VS6 and W/K 10; rest of the world five QSLs from Okinawa. Send log extract (certified by recognized society or two amateurs) plus 10 IRCs to address above. The fee of 10 IRCs is a new requirement since June 1970.

The ZL-71 Award

ZL2GX, NZARTS Awards Manager, 152 Lytton Rd, Gisborne, New Zealand.

For contacting 50 ZL stations during 1971. Send a certified list of contacts and three IRCs to ZL2GX.



The G6CJ "Aerial Circus" in action with Dud Charman manipulating his micro-mini aerials. With these bits of shaped wire he is able to illustrate exactly what happens to the rf when, for instance, reflectors and directors are added to a single dipole. Dud has now given his famous show in every corner of the UK, as well as twice abroad

QTH Corner

A2CAW	Private Bag 31, Francistown, Botswana.
ON5DO/AP	via ON5KL.
CE7DW	via HB9AKH, Luftisbuchweg 2,5600 Lenzburg, Ag, Switzerland.
CT2BB	via WA3NRV, T. L. Nickle, RFD 2-Box 283, Camden, Del, 19934, USA.
FY7AB	via WA4WTG, R. Kaplan, 445 NW 202nd Terrace, Miami, Fla, USA.
FY7AE	BP 107, Kourou, French Guyana.
KC6WS	Bill Sedore, Box 185, Yap,W. Caroline Is, 96943.
KW6AA	via WB6YCT, C. J. Ansoms, 10543 Danube St, Granada Hills, Calif, USA.
TU2CX	via W4VPD, Enos Schera Jr, 8254 SW 37th St, Miami, Fla, USA.
VK9AC	PO Box 5122, Boroko, Papua Territory.
VK9FH	via W0KHI, 4515 Sedum Lane, Minneapolis, Minn, 55435, USA.
VK9LV	Louis Varney, PO Box 900, Port Moresby, Papua, TPNG.
VK9RH	via K5QWH, Don Maddox, 838 S Montclair, Dallas, Texas, 75208, USA
VK9XX	via W2CTN (see 7Q7AA).
VP2DAJ	(see VP2MRK).
VP2EE	(1970 CQ Contest QSOs) D. L. Zeph,1320 N Delaware St, Indianapolis, Ind, USA.
VP2MRK	VE3EWY, R. C. Kenny, 2 Delbert Drive, Scarborough, Ont, Canada.
VR4CG	PO Box 310, Honiara, British Solomon Is.
VR4EN	PO Box 332, Honiara, British Solomon Is.
VR5RY	via VK1RY, F. Ryan, PO Box 43, Canberra 2600, ACT, Australia.
ex-VU2DIA	B. S. Hegde, A-29, Amar Colony, Lajpatmagar 4, New Delhi, India.
YA1REG	via VE7BWG, V. Larson, 488 East 4th St, North Vancouver, BC, Canada.
ZL1AAT	R. Swain, 37 Te Kuiti Rd, Te Kuiti, New Zealand.
ZL1SV	Nigel Hardy, 17 Tawa Crescent, Manurewa, Auckland, New Zealand.
3B8DA	Alex Mootoo, 39 Brown Sequard Av, Vacoas, Mauritius.
3B9BZ	Box 467, Port Louis, Mauritius.
ex-5Z4KO	F. Sawyer, 3 Addison Drive, Middleton, Manchester.
7Q7AA	via W2CTN, 159 Ketcham Avenue, Amityville, NY, 11701, USA.

RSGB QSL Bureau, G2MI, Bromley, Kent, BR27 NH.

Band reports

The new year began with particularly interesting conditions on the 1·8 and 3·5MHz bands and much real dx was worked in the face of European interference—mostly accidental on the former band but deliberate on the latter. Some comment has been received concerning loud signals on 160m—one German station was being received considerably louder than DHJ during one dx opening!

Many thanks to all who supplied information for this part of *MOTA*, with special thanks to the following: G2CDT, G2HKU, GW3AX, G5JL, G6JH, G8VG, G3AAE, G3GVV, G3KMI, G3LPS, G3OLI, G3SED, G3UKH, G3WPO, G3YMP, G3YWX, G3ZOQ, BRS2098, BRS17567, BRS 19682, BRS25429, BRS30231, A6148, A6248, A6658, and A7437. Stations listed in italics were on cw, the others on ssb.

1·8MHz. 0000 *KV4FZ*. **0100** K3MBF (S8). **0300** *PJ2CC*. **0500** *VP2VL*. **0600** *W0NFL*. **0800** *W5RTQ*. **2100** *VK6NK*.

3·5MHz. 0000 ON5DO/AP2. **0600** *XE0CE*, *YN1CW*. **0700** FO8BS, *JW7UH*, OA4LM. **0800** FG7XT, HR2AFK, PJ7JC, W1–W0, ZLs, ZM4OL/A. **1000** VE1IE (until 1030). **1200** *TF7GJ*. **1500** VS6DO. **1700** YB0AAO, ZLs, ZM4OL/A. **1900** UH8AE, VS6DO. **2000** JT1AJ, KL7DTH/KG6, MP4TDT, ZD3K, ZSs, 4X4DX, 9K2AL, **2100** TA2BK/1, TR8DG, UA1KAE/1, ZB2A, 3V8AB. **2200** DU1FH, FP8AP, G6ZY/CN/M, UA0ADO, ZC4s IK, JW, EL0K/5A1 (QSL to DL8UI). **2300** OX3WX, VEs, VOs. (Stations worked in Scandinavia around 1500–1600 include KL7HEF, KW6AA, KX6AE, KH6s AQ, RS, and W6/W7s.)

7 MHz. 0500 *TI2AP*, *YV7GN*, **0600** *8R1J*. **0700** HC2GG/1, *K6OS* **0800** TG9HL, *ZB2AV*. **0900** *JR1ABS*. **1100** *JA3AA*, JW7UH, *XW8BP*. **1500** *W6MSM* etc(on LP). **1700** *VU2BEO*. **1800** *JA4DBQ/MM* (S. China Sea), *MP4TDT*. **1900** *JA*s, *KX6BQ*, *VK*s. **2100** *VK5KO*, *4X4YM*.

14MHz. 0600 VR2CC. **0700** HL9UA, KL7HAC, ST2SA, YK1AA. **0800** 5T5AD, 9G1GG. **1300** *PJ2VD*. **1400** VK6HD.

Alan Cake, 9H1BL, is active on 80-10m ssb/cw and listens on 4m. He is returning to the UK about September this year

1500 M1KVC (on a.m.), *ZB2AV*, 5X5FS. **1600** ZK1CD. **1800** A2CAH, *KH6IF*, ZL3GS. **1900** KG4CS, VP2GAR, 5H3MV, *5R8AP*. **2100** ZD7SD, 8R1U.

21MHz. 0900 *FR7ZW*, *HL9VC*. **1000** *XW8DK*, 5N2AAU. **1100** DU1FH, KR6JU, M1AP, VP2LX, *VS6AM*, YB0AAG, TA1SK/P/4X4, 9K2AL, 9N1MM. **1200** DX1DX, EA9EA, *FP8CW*, VK9YR. **1300** JW8MI. **1400** *FL8BG*, ZB2CB. **1500** *XE1WWE*, *9U5AC*. **1600** *KL7HDM/VE8*, W6s and W7s.

28MHz. 0800 7X2OM. **0900** YA1REG. **1000** *XW8BP*. **1100** AX6CT, *JW8MI*. **1200** FY7AB, VK5MP, 9G1BF. **1300** ET3USA (Ron, F5QQ op.—aerial 8000ft asl, QSL to VE3IG), ST2SA, TU2CX. **1400** CE7DW. **1700** CT3AS.

Gratitude is expressed to all correspondents and especially to the following for items reproduced from their publications: The **Ex-G Radio Club Bulletin** (*W3HQO*), **DX'press** (*PA0TO*), **DX News Sheet** (*Geoff Watts*), **Intercom** (*Euradio*), **QUAX** (*G3DME*), the **DX'ers Magazine** (*W4BPD*), **NARS Newsletter** (*5N2AAF*), **Long Skip** (*VE3DID*), and the **West Coast DX Bulletin** (*WA6AUD*). Please send all items for **March** issue **to reach G3FKM no later than 8 February,** for **April** issue by **15 March,** and for **May** issue by **12 April.**

Final 1970 Countries Table

	1·8 MHz	3·5 MHz	7 MHz	14 MHz	21 MHz	28 MHz	Total
G3VBL	—	—	**31**	**104**	**138**	**71**	**344**
G3JVJ	4	75	45	48	37	29	238
G8VG	4	23	30	37	78	56	228
G3ZOQ	—	9	42	45	32	46	174
G3SWX	—	17	18	48	29	59	171
G3VPS	11	13	15	54	29	36	158
A6265	**5**	**102**	**103**	**234**	**185**	**167**	**796**
BRS25429	3	129	105	156	169	142	705
A6248	9	60	72	168	151	118	584
A7006	18	32	28	183	183	138	582
ORS31427	—	23	40	221	138	134	556
A7054	11	121	43	139	163	67	544
A6904	10	36	47	149	145	95	483
BRS27880	6	59	52	142	122	85	466
A5489	—	76	21	95	83	123	398
A6278	4	53	47	112	90	43	349
A6553	6	33	38	71	110	79	337
A6992	—	—	2	203	57	60	322
A6148	5	84	19	49	46	68	271
BRS30694	6	24	29	70	61	44	234
A6023	5	38	39	78	37	19	216
A6098	4	24	19	49	47	48	191
A7065	1	10	7	52	35	23	128
A6242	2	19	7	38	26	29	121

Congratulations to the winners and also to others who put in outstanding performances.

Propagation Predictions

Solar activity was relatively high during the past 13 months compared to 1968 and 1969. For this reason propagation conditions will vary little from those given for February 1970. The days slowly lengthen so that towards the end of the month the 14, 21 and 28MHz bands will remain open longer than during the preceding two months.

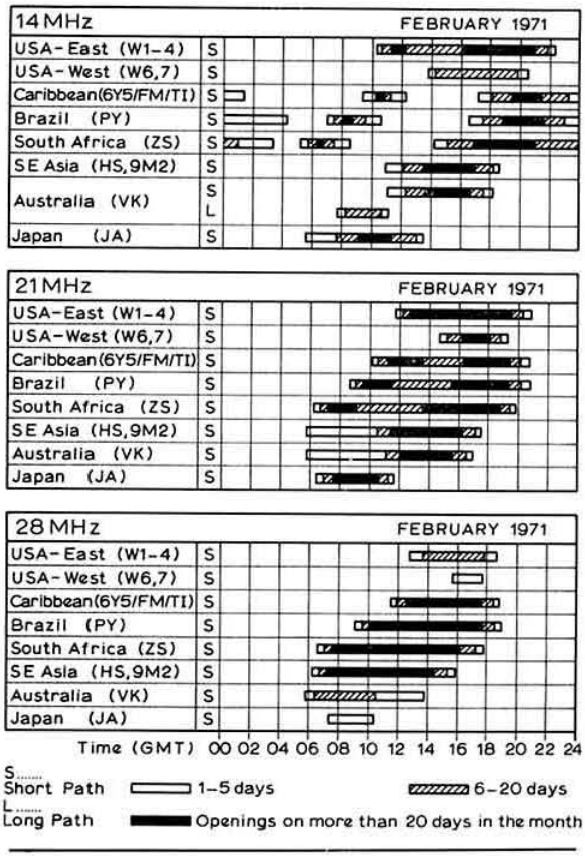
Solar activity is still decreasing and this will lead to a worsening of conditions on **28MHz**. On this band traffic with Central and South America, Africa and South-East Asia only will be possible.

On **21MHz** the decrease in solar activity will not be so noticeable as on 28MHz and contacts with all continents should be possible. The possibility of dxing on the indirect path will lessen with the effect of the forthcoming springtime conditions.

Towards the end of the month **14MHz** will remain open almost till midnight. DX traffic in the second half of the night will only be possible under exceptional conditions. In the forthcoming ARRL DX Contest conditions will be best for stations in Southern Europe.

On **7** and **3·5MHz** conditions will differ little from those of last month. Contacts with the USA on 7MHz will probably be possible from shortly before midnight till one or two hours after sunrise. On 3·5MHz conditions will be most favourable from about four to five hours before sunrise until dawn.

The provisional sunspot number from the Swiss Federal Observatory for December 1970 was 76·6. Solar activity was evenly distributed throughout the month and only on two days did the daily number exceed 100. The predicted smoothed sunspot numbers for April, May and June are 79, 77 and 75 respectively.



SOCIETY AFFAIRS

A brief report of the Council meeting held at Society HQ on 3 December 1970.

Present: *Mr B. D. A. Armstrong (Executive Vice-President, in the Chair), Dr E. J. Allaway, Messrs R. J. Hughes, A. F. Hunter, E. G. Ingram, L. E. Newnham, J. R. Petty, C. H. Parsons, W. A. Scarr, R. F. Stevens, G. M. C. Stone, J. W. Swinnerton, F. C. Ward, E. W. Yeomanson (members of Council), D. A. Findlay, general manager, A. W. Hutchinson, editor, J. O. Brown.*

Apologies for absence were received from Dr J. A. Saxton and Messrs A. C. Morris and G. R. Jessop.

Use of uhf bands
Mr Stone reported that he was present at the IERE Annual General Meeting when a paper on mobile radio was read by Mr Brinkley, of International Telephone & Telegraph Co Ltd. In this he had suggested the possible use of certain parts of the band 420–512MHz for business radio. After his address Mr Brinkley had paid tribute to amateur radio but emphasized the great pressure from users for the allocation of more frequency space. Mr Stone was of the opinion that at this stage no further action need be taken but that the matter should be kept under close review.

Membership and affiliation
It was resolved:
(i) to elect 220 corporate members and 52 associates;
(ii) to grant corporate membership to 15 associates;
(iii) to waive the subscriptions of 6 members on the grounds of blindness or other disability;
(iv) to grant life membership to one member;
(v) to grant affiliation to the Golden Valley Contest Club.

Second Zone G Conference, 19 September 1970
Mr Hunter commented on the minutes of the Second Zone G Conference and answered queries raised by Council members. He also presented a financial statement for the Scottish Mobile Rally 1970 organized by the Mid-Lanark Group.

Class B licences
Considerable discussion took place on the terms of the Class B licence and it was agreed that the Society's policy must be to support the MPT in its intention to maintain the original terms of the licence.

Honoraria
Council approved the award of honoraria to 19 members in recognition of their services for Certificates & Awards, Slow Morse and QSL Bureau.

Minutes of committee meetings
Council approved the minutes of the MPT Liaison & TVI Committee (30.10.70), Scientific Studies Committee (2.11.70), HF Contests Committee (4.11.70), VHF Contests Committee (4.11.70), Membership & Representation Committee (6.11.70), Technical Committee (10.11.70), Education Committee (14.11.70) and Finance & Staff Committee (23.11.70).

Council election
The chairman announced the results of the Council ballot for 1971. (Note: The voting was subsequently announced at the Annual General Meeting and published in the January issue).

Publicity—new licensees
Mr Petty commented that the practice of sending publicity material to new licensees had ceased. It was agreed to arrange for this procedure to be restarted.

Space Conference 1971
Mr Stevens reported that certain documents had been received in connection with the Space Conference.

Retiring members of Council
Mr Stone proposed a vote of thanks to Messrs Swinnerton and Hunter for their services to Council during their terms of office.

OBITUARIES

Mrs E. M. Butcher
Affectionately known by Essex and Kent (Medway) amateurs as "Mother Butch", Mrs E. M. Butcher died on 9 December 1970. A staunch supporter of RSGB events, she was an honorary member of MARTS (Medway).

Mr J. F. Davison, BRS24687
Mr J. F. Davison, of Arbroath, died on 16th November 1970.

Mr C. P. Ford, GD3TCH
Mr C. P. Ford died as the result of a helicopter accident on 20 November 1970 while serving with the RAF at Leconfield, Yorkshire.

Mr J. Swinburn, G3XES (ex VS1ES/DL2XP)
Jim Swinburn died at his home in Sherborne, Dorset, on 29 November 1970. He was well known on 80m at home and overseas.

Contests calendar

1971
6–7 February—ARRL DX Contest (phone)
7 February—70MHz Fixed Station Contest (Rules in January issue)
10 February—432MHz Cumulative Contest (Rules in January issue)
13–14 February—1st 1·8MHz (Rules in January issue)
20–21 February—ARRL DX Contest (cw)
23 February—432MHz Cumulative Contest (Rules in January issue)
27–28 February—REF Contest (phone)
6–7 March—ARRL DX Contest (phone)
6–7 March—144/432MHz Fixed Station Contest (Rules in this issue)
13–14 March—BERU
14 March—WAB HF Phone Contest
20–21 March—ARRL DX Contest (cw)
21 March—1,296MHz Fixed Station Contest (Rules in this issue)
27–28 March—WPX SSB Contest
28 March—WAB HF CW Contest
3–4 April—70MHz Open Contest (Rules in this issue)
3–4 April—70MHz Listeners Contest (Rules in this issue)
4 April—LP 80m
4 April—WAB LF Phone Contest
11 April—WAB LF CW Contest
21–23 May—YL ISSB QSO Party
5–6 June—NFD (Rules in this issue)
20 June—WAB VHF Phone Contest
3–4 July—Summer 1·8MHz
10–11 July—HP FD
12 September—80m FD
9–10 October—21/28MHz
23–24 October—7MHz (cw)
6–7 November—7MHz (phone)
13–14 November—2nd 1·8MHz

CONTEST NEWS

1970 VHF/UHF Listeners' Championship

There was a great temptation to reprint the 1969 report on this event because of the similarity of the results. Entries were again down, 38 logs from 11 operators compared with 38 from 12 last year. Only three of the 1969 entrants came back for more! Colin Baker kept a firm grip on the Hanson Trophy with a convincing win over Terry Cooper, who was leader in 1968. Ron Thomas, BRS15822, lost third place to newcomer David Evans of Buckley, Flintshire, who reports hearing stations as far away as Dover but "couldn't quite make it across the Channel!" The best dx was achieved by Martin Goodrun, A4798, who heard SM7AED working LX1SI via Aurora during the March "Open". He also logged GI5ALP in this way and these two stations accounted for more than half of his score!

70MHz appears to have been largely neglected, and only two entrants scored on the band (See Rule 4). As for 432MHz, BRS28005 comments "Barometer low. Also activity. It seems that the amateurs are giving the band away."

During 1971 there will be listeners' contests linked to the open contests on each band, and to VHF NFD. The championship will be re-introduced in 1972.

Posn	BRS or A	Band	Logs	Points	Converter	QTH ft asl	Aerial
1	A5032	144	5	2,544	ECC84/12AT7	280	6 el
		432	2	645	BF180/2N3478		18 el
2	BRS28005	70	2	0	AF114/AF114	200	3 wl
		144	4	2,093	AFZ12/AFZ12		8 el
		432	2	465	JXK		6/6 slot
3	A6804	144	3	1,081	Emsac nuvistor	525	4 el
4	BRS15822	70	1	142	AF186	—	3 el
		144	4	583	GM378/AF1Z2/JXK		8 el
		432	1	135	JXK pre-amp/Garex		14 el PB
5	A6111	144	3	362	—	740	—
6	BRS31172	144	2	206	Nuvistor	5	4 el
7	A5957	144	2	134	HBW mosfet	200	Dipole
8	A4798	144	1	120	Withers 6CW4	—	5 el
9	BRS30386	70	3	59	R216	—	Dipole
10	A5498	144	1	51	Homebrew	—	Dipole
11	BRS29592	144	1	30	770R Mk II	50	Halo

Second 1·8MHz Contest 1970

There were 52 entries for the Second 1·8MHz Contest last year and this was a slight drop on the 1969 figure of 57. Conditions were generally pretty good, but QSB seems to have hindered a lot of the middle-distance contacts. The level of activity was fairly good and the appearance of many European stations added some interest to the event. DL/DJ and OK/OL stations were present in some number and ZB2A was laying down a good signal over most of the UK.

The leading station was G3CXX, operated by W. T. Pawson, GW3XST, with a checked score of 831 points from 148 contacts which included 21 OK/OL stations, EI9ONE and DL1CF. The strong signal from G3CXX, which helped ensure success, came from an end-fed half-wave at 160ft above ground level, fed by a KW2000A running at 10W input.

Second place was taken by the 1969 winner, Mike Whitaker, G3IGW, who made 139 contacts worth 761 points. Mike's log included 12 OK/OL stations, EI9J, EI9ONE, DL1CF and ZB2A, and the gear was his usual homebrew rig, an EA12, and a semi-vertical half-wave.

Brian Jones, GW3WRE, operated /A from Nash Point Lighthouse to take third place with a score of 718 points from 132 QSOs. His equipment consisted of a DX100, an HQ170 and a half-wave.

Close behind in fourth place came Chris Burbanks, G3SJJ, who made 705 points using another DX100, a KW77, and a half-wave at 60ft.

In the first leg of the contest for the Maitland Trophy, GM3FXM/A leads from GM3UKG and GM3UMW/A by a considerable margin.

Quite a number of homebrew transistorized transmitters were in use. A quick scan through the logs produced the following breakdown of equipment used: commercial transmitters, 9; receivers, 35; transceivers, 14; homebuilt transmitters, 28; receivers, 2. Aerials, naturally, play an important part in the overall efficiency of a station, and it is interesting to note that the number of "high" aerials in use during this contest shows an increase over previous figures. Among the first 10, one aerial was at 30ft, and the rest were between 50 and 170ft high.

Comments from competitors—"Enjoyed the contest very much—plenty of EU stations to work"—G3CXX. "I only came for the cw! A far cry from the gentlemanly QSOs of the UHFs!"—G3NNG. "Many of the GM stations were strong and steady"—G6BQ."Would like to see one of the winter 160m contests made an all-night affair like they used to be"—G3OLB."Once again a great contest and five hours is just long enough"—G3GMK. "Would like to see a multiplier given to us 'outcasts' "—GI3VYZ. "Rain static was a problem . . . all but S9 signals were blotted out"—G3VLX. "Only one station had the courtesy to send at my sending speed"—G2FNK. "Ice formed . . . and a sprint up and down the track kept the circulation going"—G3BUF/P. "Ridiculous scoring system"—G2DC.

In the main, the entrants found the contest enjoyable and the rules satisfactory.

Subject to Council approval, the Victor Desmond Trophy will be presented to GW3XST as operator of G3CXX, and certificates of merit will be sent to G3IGW and GW3WRE.

Posn	Callsign	County	Score	Posn	Callsign	County	Score
1	G3CXX	LE	831	27	G3JLE	OX	408
2	G3IGW	YS	761	28	G3RQI	BE	406
3	GW3WRE/A	GN	718	29	GI3VGZ	AM	401
4	G3SJJ	NM	705	30	G3XOQ	SY	396
5	GM3FXM/A	FE	696	31	G3KOR	LE	366
6	G3VMO	EX	650	32	G3GMK	HE	363
7	G3YUK/A	HF	648	33	GM3WOJ	WG	330
8	G3VMW	YS	643	34	GI3VYZ	LY	326
9	G3YMH/A	CE	609	35	G3ZRE	LE	324
10	G3NNG/A	BE	597	36	GM3MGL/A	SX	312
11	G3WDF	WK	581	37	G3XFG	KT	302
12	G3JEQ	SY	564	38	G3YPG	SY	300
13	G6BQ	KT	561	39	G3FJE/A	BD	288
14	GM3UKG	BF	550	40	GW3ZQG	GN	266
15	G3XDY/A	OX	510	41	G3UQW	KT	260
16	G3SJE	MX	494	42	G3LCH	LD	240
17	G3TR	SY	489	43	G3VLX	KT	228
	G3SKC	MX	489	44	G3IGU	YS	198
19	G3SJX	SY	483	45	GM3YOR	FE	196
20	G3TIR	SX	471	46	G2FNK	MX	190
21	G3OLB	GR	465	47	G3ZOI/A	NM	184
22	GM3UMW/A	DU	457	48	G3BUF/P	DY	174
23	G3PWY	HD	447	49	G3LHN	MX	153
24	G3SIA	SY	444	50	G2HDR	GR	146
25	G3ILO	GR	442	51	G5DZ	HE	138
26	G2DC	HE	432	52	G3ZMF	SY	126

Check logs from G3XRH and G3ZQM are acknowledged with thanks.

BARTG 1970 VHF RTTY Contest results

70MHz band. No logs received for this band.

144MHz band.

Fixed Stations

Callsign	Points	QSOs	Countries	Farthest contact (km)
DJ8BT	840	9	3	380
PA0IJ	765	12	3	275
PA0IF	714	9	3	340
PA0OSI	438	6	2	260
DL8CX	432	2	2	275
G3UVZ	225	10	1	205
PA0NKD	211	7	1	80
PA0HLA	208	3	1	105
G8AEL	208	4	1	85
G3YKB	204	4	1	42
G8COT	203	3	1	27
G3TDM	202	2	1	45
EI5BH	201	1	1	18
HB9RG	201	1	1	25

Portable Stations

I1GMF/P	223	5	1	207
I1VAK/P	223	5	1	206

432MHz band

Fixed Stations

HB9P	201	2	1	35
HB9RG	201	2	1	35

The contest manager also acknowledges with thanks the very concise check log received from G6CW.

The following stations were active during the contest and were able to give scoring contacts with competing stations

144MHz band: EI4AL, G3DY, G3AJS, G3IIR, G3LNN, G3OIW, G3OVZ, G3PZH, G3TWX/A, G3VZV, G8AGM, G8ATQ, G8BBB, G8CKF, G8CUO, G8DQB, I1FP, I1AGD, I1BUL, I1CLC, ON5FY, PA0AWH, PA0CRX, PA0DLC, PA0GKO, PA0PIM, PA0SMC, PA0THT, DL3GK and DL0OG.

432MHz band: HB9AMX.

Band conditions in general were very poor but there was a considerable increase of activity in comparison to last year, the first year the contest was held. Fifty stations active this time compared with 16 last year. Two notable "Firsts": the 432MHz entries from HB9, and the Italian portable effort.

March 1971 144/432MHz Fixed Station Contest

From 1800gmt 6 March to 1600gmt 7 March.

All entries and checklogs must be sent to the adjudicator addressed to: VHF Contests Committee, c/o G3VPK, 'Maple Leaf', Great Braxted, Witham, Essex .CM8 3EJ.

The following General Rules, as published in the January issue of *Radio Communication*, will apply: 1, 2, 3, 4a, 5a, 6a, 7a, 9, 10a, 11-24. General Rule 8 will not apply.

There will be two sections:

Section A Single-operator fixed stations

Section B Club stations, other multi-operator fixed stations and temporary stations, other than portable.

Separate logs and cover sheets must be entered for the two bands.

Rules for National Field Day 1971

1. The General Rules for RSGB HF Contests, published in the January 1971 issue of *Radio Communication*. will apply.

The provisions of General Rule 4b are amended by NFD Rule 7 below. General Rule 8 is amended by NFD Rule 14 below.

2. Applications—Each group intending to compete must send in a properly completed application form to the RSGB HF Contests Committee, c/o R. G. B. Vaughan, G3FRV, 5 Filbert Crescent, Gossops Green, Crawley, Sussex, not later than 30 April 1971. Application forms are obtainable from RSGB headquarters; entries made other than on those forms will *not* be accepted.

The information required on the application form includes the following:

i Callsigns of stations, together with the bands to be used.

ii Full name and address of the RSGB member responsible for each entry.

iii Exact site location six figure National or Irish grid reference. In addition, entrants are required to give full site access information to enable a site to be located by station inspectors, who may not be familiar with the district. Incorrect or inadequate information may be grounds for disqualification.

3. When. From 1700gmt Saturday 5 June to 1700gmt Sunday 6 June 1971.

4. Eligible entrants. All clubs, affiliated societies and RSGB groups within the prefix zones G, GC, GD, GI, GM and GW. NFD is a multi-operator contest as provided in General Rule 5b.

5. Contacts. A1 (cw) only in the 1·8, 3·5, 7·0, 14·0, 21·0, 28·0MHz bands.

6. Sections

(*a*) *Double station*—Each competing group must operate two portable stations; the one using the lowest frequency shall be called the "A" station and the other the "B" station.

Each "A" station may operate on a maximum of three of the above bands; and up to three of the remaining bands may be allocated to the "B" station.

The "A" and "B" station need not be operated from the same site, provided that they are located within the same RSGB region.

(*b*) *Single station*—Each competing group must operate one portable station on not more than three of the above frequency bands.

7. Apparatus. No apparatus, and this includes aerials, aerial fittings and station tents, may be erected on the site prior to 1200 gmt on Saturday 5 June 1971. This does not apply to a tent used only for storage purposes.

8. Tents. Stations must be operated from tents.

9. Aerials. These are subject to the following restrictions:

(*a*) No part of any aerial shall be higher than 45ft above the ground.

(*b*) Except for vertical radiators (which may be of any construction) all aerials must be constructed from wire of a size not greater than 14swg cross-sectional area.

10. Equipment. At any one station this must not exceed three transmitters and one receiver. Reserve equipment may be kept available, but not connected.

11. Power input. The total dc input power to the valve or valves, or other devices, energizing the aerial, or to any previous stage of the transmitter, shall not exceed 10W.

The valve or valves energizing the aerial shall have a total maximum rated anode dissipation not exceeding 13·5W.

Where semiconductor devices are used, the total maximum rated dissipation (at an ambient temperature of 25°C) of the device or devices energizing the aerial shall not exceed 20W for the purpose of this rule. Manufacturers' published ratings only will be accepted for this purpose.

12. Scoring. Points will be scored on the following basis:

(*a*) Fixed stations in the British Isles ..... 1 point
(*b*) Fixed stations in the rest of Europe, including Eire 2 points
(*c*) Fixed stations outside Europe ..... 3 points
(*d*) Fixed stations in the British Commonwealth ..... 6 points
(*e*) Portable and mobile stations in the British Isles .. 3 points
(*f*) Portable and mobile stations in the rest of Europe, including Eire ..... 4 points
(*g*) Portable and mobile stations outside Europe ..... 6 points
(*h*) Portable and mobile stations in the British Commonwealth ..... 12 points

13. Group contacts. Points must not be claimed for contacts made by a competition station with members of its own group, whether fixed, mobile or portable.

14. Entries. These are to be in accordance with General Rule 8, with the following exceptions and additions:

(i) The normal cover sheet will *not* be used. Special cover and summary sheets are provided for this contest, and these will be sent to the person submitting the application (see Rule 2).

(ii) Points claimed must be separately totalled for each band.

(iii) Entries should be sent to the RSGB HF Contests Committee at the address given in Rule 2. **ENTRIES SENT TO RSGB HEADQUARTERS WILL NOT BE ACCEPTED.**

15. Trophies

(*a*) National Field Day Trophy to the group obtaining the highest combined score.

(*b*) Gravesend Trophy to the group obtaining the second highest combined score.

(*c*) The Scottish NFD Trophy to the Scottish Group scoring the highest number of points.

(*d*) The Frank Hoosen Memorial Trophy to the group with the highest score on the 14MHz band.

(*e*) The Bristol Trophy to the group having the highest score in the single station section.

(*f*) Commemorative certificates to the groups having the highest scores on the 1·8, 3·5, 7·0, 21 and 28MHz bands.

16. Check logs. While overseas stations are not eligible to enter NFD, check logs are very welcome. A certificate will be awarded to the overseas station whose check log shows that he contributed the most points to competitors.

17. Inspections. All stations are subject to inspection by nominated representatives of the HF Contests Committee.

These representatives will make every endeavour to interfere as little as possible with the stations' operations, and to assist in this, entrants should make it easy for the inspector to see the final stage(s) of the transmitters.

March 1971 1,296MHz Fixed Station Contest

From 0900gmt to 1500gmt on 21 March.
All entries and checklogs must be sent to the adjudicator addressed to: VHF Contests Committee, c/o G3SEK, 89 Arthur Road, Wimbledon, London SW19.

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

April 1971 70MHz Open Contest

From 1700gmt 3 April to 1500gmt 4 April.
All entries and checklogs must be sent to the adjudicator addressed to: VHF Contests Committee, c/o G3EDD, 39 Angle End, Great Wilbraham, Cambridge.

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

April 1971 70MHz Listeners' Contest

1700gmt 3 April to 1500gmt 4 April

1. The contest is open to all non-licensed fully-paid-up members of the RSGB. Only the entrant may operate his station, fixed or portable.
2. Logs must show in columns:
   1. Date/time (gmt),
   2. Callsign of station heard,
   3. Report on his signals (including any defects such as over-modulation).
   4. Report and serial number sent by station heard,
   5. Callsign of station being worked,
   6. QTH and QRA locator given by station heard,
   7. Points claimed.

A given callsign may only appear once in column 2.
CW or test calls will not count for points and should not be logged.
In addition, the following General Rules as published in the January issue of *Radio Communication* will apply, the station heard being considered as a contact: 1, 2, 3, 4b, 5a, 6a, 9a, 12a, 14, 18, 19, 22, 24.

IARU Region 1 UHF/SHF Contest—Correction

432MHz Fixed Station results published in January issue. In posn 6 read G8DIU, not G8DIV.

Looking ahead

26 March—RSGB Dinner Club, Kingsley Hotel, London WC1
17 April—VHF Convention, Whitton.

RAEN Group of the Month

by P. Balestrini, G3BPT, (Chairman, RAEN Committee)

The Liverpool and South-West Lancashire Group

Group controller: W. Fitzgerald, G3DCA, 24 Yew Tree Close, Liverpool 12.

Group frequencies: 144·7MHz, 70·38MHz, 70·52MHz.

This month we again turn our searchlight north-westwards to another young group, born in 1969 and with a total membership of 19, of which four are SWLs, by 1970.

Regular message handling and map reading exercises are held, together with a weekly practice net on 70·38MHz. The controller is to be congratulated on a very well produced monthly newsletter which does much to keep the group members in touch, particularly as they are dispersed over a wide area.

The group under its enthusiastic leadership looks forward to increasing membership and activities during the coming year.

Thank you, Bill Fitzgerald!

RADIO AMATEURS' EMERGENCY NETWORK

by S. W. LAW, G3PAZ*

ALTHOUGH we were taught that it is better to give than to receive, the modern psychiatrist tends to the opposite view in that the recipient feels under an obligation tending to an unconscious feeling of resentment against the giver. This profound thought is triggered off by the news that certain Raynet groups have asked our main user service to provide lectures on *their* communications procedure. Since the lecturer is bound to be an expert in his field, what better chance to point out what kind of service Raynet (and the relevant group in particular) has to offer in the area concerned?

We feel that this method of getting a good liaison has a great deal to recommend it and may often be more successful than the more usual approach. Needless to say, the question of reciprocity should be kept well in mind, so be prepared to lay on an invitation to an exercise demonstration at a mutually agreed date and time.

Press coverage

It is with great pleasure that we note that the press is now showing an awareness of the part that Raynet can play in the speedy relief of the victims of civil disaster. (See last months' issue). We have been privileged to receive what must surely be the first "Press" of 1971 from G3HPR, area controller of the eastern section of the Norfolk Group, date-lined 1 Jan 1971. Comprising some 11 column-inches of text plus headings and a 3-column-width photograph of G3HPR and equipment, the Raynet image is admirably depicted to the public. Incidentally, we are sure that G3HPR will not object to our congratulations on his continued activity at the mature age of 74!

Dilemma?

This column has been taken to task for having fore-knowledge of a certain "surprise exercise" (published after the event) on the grounds that only the organizers were supposed to be aware of the preparations. We can only blame the keen ears of our professional friends of the BBC, who put out the item on Radio 4 as part of the morning news for the part of the country concerned. Unfortunately Raynet did not get a mention among the voluntary services said to be taking part, therefore none of the blame can be laid at our door. No doubt we shall never know how the leak occurred!

RAEN Committee

At its meeting on 12 December last, there was some spirited discussion on the problems arising from registration from the point of view of the controllers. It was ratified that original registrations must come through the hon registrations secretary in order that the RSGB insurance shall apply. Controllers should make annual returns of group membership. Correspondence from overseas continues to form an interesting topic, and it was noted that to date the list comprises S. Africa, Mauritius, Germany, Norway, Italy, Sweden and the very interesting communications from Australia and New Zealand.

Some amusement was evident at a press report quoted in the December 1970 edition of the New Zealand *Break-In* wherein questions were asked as to the efficiency of the communications system under adverse conditions when radio amateurs had to carry official traffic. A translation was read from the Swedish organ *QTC* of an article on our RAEN written by SM7COS. Some group manuals were passed round for comment. It was announced that the next SE Controllers Meeting at RSGB HQ will take place on Sunday 7 February 1971. The committee was in session for nearly 6 hours.

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. Tel Botley 4462**

*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 event:
9 May, 1971 Belle Vue Convention.

Merseyside Luncheon Club—First Monday each month, 12.30 for 12.45pm, HMS *Landfall*. Please advise G3VQT or G2AMV beforehand if you wish to attend.

Ainsdale (ARC)—3, 17 February and 3 March, 8pm, "The Morris Dancers", Scarisbrick.

Allerton (Liverpool) Scout ARS North West Region—Thursdays, 8pm, 1st Allerton Group headquarters, Aigburth Vale, Liverpool 17. All Scouts interested in amateur radio are welcome.

Blackburn (East Lancs ARC)—First Thursday each month, 7.30pm, Edinburgh House, Shearbank Road, Blackburn. Further details from G4JS.

Blackpool (B & FARS)—Mondays, 8pm, Pontins Holiday Camp, Squires Gate. Morse tuition at 7.30pm.

Bolton (B & DARS)—Please note new meeting place. Clarence Hotel, 176 Bradshawgate, Bolton. Meetings will in future be held on alternate Wednesdays, 10, 24 February. (Note, not Tuesdays as before).

Bury (B & RRS)—The start of a new year has brought about a slight re-shuffle on the committee with G3RSM cracking the "mobile whip" over an eight-man crew. G3VVQ still loves his job as secretary but likes it better now that G3ZQS has taken on the job as programme secretary. Heavy infiltration on the vhf scene has taken place, with G8DHT accompanied by G8CXX joining the crew. G3ZPL and two SWLs bring up the rear guard with G3SVI, "cap in hand", collecting the yearly subscription. At the time of writing it is not possible to give February's programme but it is hoped that this information will be made available via the RSGB News Bulletin. Meetings take place once a month on the second Tuesday at 8pm, in the George Hotel, Market Street, Bury. Next meeting 9 February. Secretary, A. Cooper, G3VVQ, 411 Holcombe Road, Greenmount, Bury.

Carlisle (C & DARS)—Mondays, 7.30pm, Currock House, Lediard Avenue, Currock. Secretary, A. Harper, 23 Roman Way, Carlisle.

Cheshire (Mid-Cheshire ARC)—Wednesdays, 7pm, Technical Activities Centre, Winsford Verdin Grammar School, Grange Lane, Winsford, All meetings begin with a morse class, the main feature is at 8pm.

Chester (C & DARS)—Tuesdays, except the first Tuesday in the month which is net night, 8pm, YMCA, Chester.

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

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

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

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

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

Liverpool (NLRC)—12, 26 February, 12 March, 8pm, Labour Party HQ, 13 Crosby Road South, Liverpool 22. Secretary, M. Graham, G3XMG, 14 Albert Road, Waterloo, Liverpool 22.

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

Manchester (SMRC)—5 February (Tape/slide lecture "A history of radio"), 12 February ("Experiments with transistor pa stages", by W. L. Seddon, G3VIW, and D. C. Holland, G3WFT), 19 February ("13cm", by H. W. Rees, BSc, G3HWR), 26 February ("Df receivers", by M. Barnsley, G3HZM). The vhf section of the club (G3UHF) meets Mondays at 8pm, at the club shack, "Greeba", Shady Lane, Manchester 23. Visitors are welcome on both Mondays and Fridays. Main club meetings at Conservative Association Divisional Office, 449 Palantine Road, Northenden, Manchester 22, at 8pm.

Preston (PARS)—4, 18 February, 4 March, 7.30pm, "Windsor Castle", (private room), St Paul's Square. Secretary, G. Windsor, 26 St Gregory's Road, Preston.

Salford (Dial House Radio Society)—A society of GPO Engineers. Wednesdays, 6pm, 8th floor (river end), Dial House, Chapel Street, Salford 3. Further details from secretary at the same address.

Stockport (SRS)—Second and fourth Wednesdays, 8pm, The Blossoms Hotel, Buxton Road, Stockport. Further details from the secretary G8BCG.

Thornton Cleveleys (TCARS)—First and third Wednesdays each month, 8pm, St John Ambulance Brigade Hall, Fleetwood Road North, Thornton, Blackpool. Secretary, G3YWH. ASR, G3ZBO.

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

Westmorland—Fridays, 7.30pm, 24 Park Road, Milnthorpe. All visitors are welcome. Secretary, J. Forrester, 44 New Street, Carnforth.

Windscale—Cumberland (WAR & ES)—Fridays, 7pm, c/o Falcon Club, Falcon Field, Egremont. Further details from N. Ramsden, G3RHE.

Wirral (WARS)—First and third Wednesdays in the month, 7.45pm, Scout's HQ, Harding House, Park Road West, Claughton, Birkenhead. Secretary, A. Fisher, G3WSD, 34 Glenmore Road, Oxton, Birkenhead.

Wirral (Wirral DX Association)—Last Thursday each month at members' homes. Secretary, J. Share, G3OKA.

REGION 2 — RR K. Sketheway, BRS20185

Bradford (BRS)—16 February (Film evening), 2 March ("Bci and tvi", by L. W. Burkitt), 7.30pm, 10 Southbrook Terrace, Great Horton Road, Bradford 7. Morse practice prior to meeting by arrangement.

Durham (DCARS)—11 February" (Fluorescent lighting and control circuits", by Arthur Dowdell), 7pm, Room 146, Durham University's Elvet Riverside Arts Block, New Elvet, Durham City.

Fulford (York) (FARS)—Tuesdays, 7.30pm, Scout HQ, 31 George Street, York. *G5KC*.

Halifax (NHARS)—10 February (W1BB Mk2 lecture), 24 February (Morse practice and ragchew), 7.45pm, Peat Pitts Inn, Ogden, Nr Halifax.

Hull (H & DARS)—5 February (The coming year), 12 February (Construction night), 19 February (Junk sale), 26 February ("Basic meters", by G3SSA and G8EAH), 7.45pm, 592 Hessle Road, Hull. *M. Longson*.

Leeds (LUUARS)—Meetings on alternate Thursdays, 7.30pm. Informal lunchtime meetings and station operation most weekdays

from 1 to 2pm, Room 460, Dept of Electrical & Electronic Engineering. Morse and RAE classes in progress. Secretary R. Sterry, G8DVS, University House, The University, Leeds, LS2 9JT. *G8DVS.*
North Riding (NRARG)—Group meets on alternate Tuesdays and Thursdays fortnightly in the back room of the Ship Inn, Falsgrave, Scarborough. Further details from the secretary Jeff Jones G3VLM, Bingley Private Hotel, Albermarle Crescent. *G3VLM.*
Scarborough (SARS)—Thursdays, 7.30pm. c/o RAF Association, Fulbeck House, 2 Westover Road, Scarborough.
South Shields (SS & DARC)—Meetings on Fridays, 8pm, Trinity House Social Centre, Laygate, South Shields.
Spen Valley (SVARS)—4 February (Satellite communication), 11 February ("Solid state modules", by P. Crapper, G3MXG), 18 February ("Stereo reception and transmission" by L. F. L. Allen, G3CJD), 7.30pm, The Grammar School, High Street, Heckmondwike.
Sunderland (SARS)—Meetings on the first and third Tuesdays in the month, 7pm, Sunderland Polytechnic. *G3XID.*

REGION 3 — RR R. W. Fisher, G3PWJ

Birmingham (MARS)—February meeting cancelled owing to the Boat and Leisure Life Exhibition at Bingley Hall, Broad Street, Birmingham. *G8BHE.*
Bromsgrove (B & DARC)—12 February (Film "Midland Red Tours"), xyls and yls welcome at this meeting. 7.30pm, J. Dufrane, 44 Hazelton Road, Bromsgrove.
Cannock (CCARS)—Meetings on the first Thursday in each month, but a natter nite every Thursday. 8pm, Bridgtown Social Club, Walsall Road, Bridgtown.
Coventry (CARS)—5 February (Nite on the air), 12 February (Junk sale), 19 February (Nite on the air), 26 February ("Vhf transmitters", by G3RMV), 8pm, City of Coventry Scout HQ, 121 St Nicholas Street, Radford.
Dudley (DARC)—2 February, 16 February (Junk sale), 8pm, Central Library, St James' Road, Club station: The Windmill, Vale Street, Ruiton, Dudley. *G3PWJ.*
Hereford (HARS)—Every Friday. 5 February (AGM), Civil Defence HQ, Goal Street, Hereford.
Lichfield (LARS)—First Monday and third Tuesday of each month, the Swan Hotel, Lichfield. *G8CNB.*
Nuneaton (NARC)—First Friday in each month, Caldecote Grange The club has now re-formed. For further details contact D. Smith, 2 Niton Road, Nuneaton.
Redditch (RARC)—11 February (Annual dinner), Montville Hotel, Mount Pleasant, Redditch. The club has now changed its name from East Worcs ARC to Redditch ARC. *G3EVT.*
Rugby (R & DAR & EC)—First Tuesday in the month, 10 Drury Lane, Rugby. *G3YQC.*
Shrewsbury (SARS)—Every Thursday, 7.30pm, Harlescott Youth Centre, 218 Sundorne Road, Shrewsbury. G3UDA.
Stoke-on-Trent (NSARS)—Every Monday,7.30pm, Harold Clowes Community Association Centre, Bentilee.
(S-o-TARS)—Every Thursday, 7.30pm, 2a Race Course Road, Oakhill, Stoke.
Solihull (SARS)—16 February (W1BB tape and slide lecture), 7.30pm, Manor House, High Street, Solihull. 2 March (Informal), Malt Shovel, Solihull. *G8BYM.*
Stourbridge (STARS)—2 February (Annual constructors' competition). 2 March (AGM). Details of venue from G3ZUL. *G8CVK.*
Sutton Coldfield (SCRS)—11 February (Visit to MEB control centre), 25 February (Natter nite), Clubhouse, Sutton Town Football, Club, Coles Lane. *G8CZM.*
Telford (WARS)—Every Wednesday evening, 8pm, Ketley Bank Youth Club, Main Road, Ketley Bank, Telford, Salop. *G3UKV.*
Worcester (W & DARC)—20 February ("Df", by T. Russell, G3JFH), 7.30pm, Crown Hotel, Broad Street, Worcester. *G8ASO.*

REGION 4 — RR T. Darn, G3FGY

Derby (DADARS)—10 February (Demonstration of power measurement), 13 February (Diamond Jubilee Dinner, 7pm, Derbyshire Yeoman, Ashbourne Road, Derby), 17 February (Informal discussion on aerials), 24 February (Film show), 26 February (Vhf/uhf night. "Propagation", by G6FK,) 3 March (Surplus sale). 7.30pm, 114 Green Lane, Derby. Meetings are also held on Monday evenings to arrange projects for the Diamond Jubilee Exhibition. *G3FGY.*
Derby (NHCAARG)—At the AGM last November the following officials were elected: hon chairman Les Jackson, G3OZ; hon secretary Peter Neil, G3WFU; hon treasurer, G3ZOW.
Heanor (SEDARS)—2 February (AGM), 9 February (Talk by Mr A. E. Richards), 16 February (Forum—questions and answers), 23 February (The "genetracer" tester). 7.30pm, South East Derbyshire College of Further Education, Ilkeston Road, Heanor, Derbyshire *T. W. Clarke.*
Mansfield (MARS)—Meets on the first Friday of each month at the "New Inn", Westgate, Mansfield. Visitors are always welcome.
Lincoln (LSWC)—Tuesdays. Lectures, demonstrations and morse classes commence at 7.30pm, at No 2 Guardroom, Sabraon Barracks, Burton Road, Lincoln. Visitors are always welcome.
Grimsby (GARS)—4 February (Night df hunt), 18 February (Tape lecture), 4 March (Project night).
Melton Mowbray (MMARS)—19 February ("Colour television", by B. Reeves). meetings 7.30pm, held at St John Ambulance Hall, Ashfordby Hill, Melton Mowbray. Top band net held on Sundays at 11am and Thursday at 8pm. Frequency 1,900kHz. *R. Winter.*

REGION 5 — RR S. J. Granfield, G5BQ

Bedford (B & DARC)—4 February ("Aerial tuner construction", by G3UQR), 11 February (Making magic with transistors—G3CWV), 18 February ("Meteorological electonics", by a visiting lecturer), 25 February (KW Atlanta demonstration by G3XNG), club meets on Thursday at The Dolphin, Broadway, Bedford.
Cambridge (C & DARC)—Fridays, 7.30pm. 5 February (Film), 12 February (Informal), 19 February ("70cm" by G3CKU), 26 February (Informal). Meetings at club headquarters, Corporation Yard, Victoria Road, Cambridge.
Luton (George Kent ARS)—The society held a meeting on 21 December on "How to obtain an amateur radio licence". Unfortunately only one unlicensed member turned up, but he went away suitably impressed—the seeds of amateur radio had been sown.
March (M & DRAS)—Club meets on Tuesday evenings at club headquarters, Old Police Station, March Isle of Ely.
Shefford (S & DARS)—Thursdays, 7.45pm. 4 February (NFD logging and operating procedure), G2DPQ), 11 February ("Probing the mysterious layers", by G3TDW), 18 February ("RAE revision, simple circuits", by G3VMI), 25 February (Club quiz and surplus sale). Club meets at the Church Hall, Ampthill Road, Shefford, Bedfordshire.

REGION 6 — RR L.W. Lewis, G8ML

Cheltenham (RSGB Group)—First Thursday in the month, 8pm, "Royal Crescent", Clarence Street, Cheltenham (same venue, new name).
Gloucester (GRS)—Second and fourth Thursdays in each month RAFA Club, 6 Spa Road, Gloucester.
South Bucks VHF Club—2 March (Talk on test equipment), 8pm, Bassetsbury Manor, High Wycombe.

REGION 7 — RR P.A. Thorogood, G4KD

New members in Region 7 for January—34. This makes a total of 477 in 12 months. Can we improve this; how many non-members have you ?
Acton, Brentford & Chiswick (ABCRC)—16 February ("Transceiver modifications for top band", by G3CCD), 7.30pm, Chiswick Trades & 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 Monday and last Thursday of month. 8, 25 February (Still open), 8 March (Construction night—bring your equipment even if you brought it before—let newcomers see it. £5 offered for best G3SAZ valve tester; also two other prizes. 7.30pm, St Martins Court, Kingston Crescent, Ashford, Middlesex.
Barker (B & DREC)—Tuesdays and Thursdays, 7.30pm, Gascoigne Recreation Centre, Gascoigne School, Morley Road, Barking
Bexleyheath (NKRS)—Second and fourth Thursdays. 11 February ("Modern trends in ssb", by G3RFB), 25 February (To be arranged), 7.30pm, Congregational Church Hall, Chapel Road, Bexleyheath. The Christmas net proved very popular, 16 members exchanged greetings, some dug their way into shacks.
Cheshunt (CDRC)—First Friday of month, 7.30pm, Methodist Church Hall, opp Theobalds Station, Cheshunt.
Chingford (RSGB Group)—Fridays. Telephone 01-524 0308.
Chingford (SRC)—Fridays, 7.30pm, Friday Hill House, Simmons Lane, Chingford E4.

Croydon (SRCC)—Third Tuesday in the month, 7.30pm, Swan & Sugarloaf, South Croydon.
Crystal Palace (CP & DRC)—20 February (AGM). Club construction contest will take place after the meeting. Have a go and win the Ann Cup. 8pm, Emmanuel Church Hall, Barry Road, London SE22.
Dorking (DR & DRS)—Second and fourth Tuesdays. 9 February (Discussion on ssb), 23 February (Review and construction of gear for VHF NFD). 8pm, "Wheatshaft".
Ealing (E & DARS)—Tuesdays, 7.30pm, Northfields Community Centre, Northcroft Road, W13. The hon. secretary, A. P. Teale, G3SET, has moved to 11 Burns Avenue, Mount Pleasant, Southall, Middlesex. Tel 01-574 5307.
East London—21 February ("Amateur and colour tv", by V. Brown, G6ABV/T), 2.30 for 3pm, Wanstead House, The Green, Wanstead, E11. (200 yards from Wanstead Station, Central Line). At the AGM on 20 December the following officers were elected: chairman, R. A. Ledgerton, G2ABC; hon secretary, A. W. Rix, G3RYF; hon treasurer, C. Lumley.

The 5 ACKAR RSGB East London Trophy, donated by E. Dawson-Ostermeyer Esq, is given to encourage amateur construction and any article connected in some way with radio may be entered—a single instrument to a whole station, but no article may be entered more than once. Points will be given for beauty, uility, adaption, craftsmanship, invention, efficiency, research, and any other detectable quality.

Any member of the RSGB residing permanently, or for a reasonable time temporarily, in the East London District of Region 7 is eligible to enter the contest. All contestants must submit a full description of their entry, prepared by themselves or a friend—a lecture at a monthly meeting will be accepted as such, and entries must be viewed by the judges. Closing date for entries is November.

Edgware & Hendon (E & DRS)—Second and fourth Mondays, 8pm, St George's Hall, 51 Flower Lane, Mill Hill, NW7.
Farnham, Bucks (Burnham Beeches RC)—Fortnightly on Mondays, 7.30pm, Farnham Common, Village Hall, Victoria Road.
Gravesend (GRS)—Every Thursday, 8pm, Northfleet Recreation Centre, Springfield Road, Northfleet, Gravesend.
Guildford (G & DRS)—Second and fourth Fridays. 12 February (General discussion on coming events), 26 February (This is *your* night), Guildford Engineering Society, Stoke Park. Average attendance for 1970 was 19. G2YL's lecture attracted 30 members, junk sales 25. Tel Guildford 62325 for further details.
Hampton Court (TVARTS)—First Wednesday in the month, 7.30pm, The Three Pigeons, Portsmouth Road, Surbiton.
Harlow (DRS)—Tuesdays (General; Fridays (Junior), 7.30pm, Mark Hall Barn, First Avenue.
Harrow (RSH)—Every Friday, 8pm, Harrow County School for Boys, Sheepcote Road, Harrow.
Havering (H & DARC)—Fortnightly, 8pm, British Legion House, Western Road, Romford.
Hemel Hempstead (HH & DARS)—First and third Fridays, 7.30pm, "Addmult" Sports Club, Hemel Hempstead.
Holloway (GRS)—Mondays (RAE), 7pm; Wednesdays (Morse), 7.30pm; Fridays (Club), 7.30pm, Archway School Annexe, Whittington School, Highgate Hill.
Ilford—Every Thursday, 8pm, 50 Mortlake Road, (off Ilford Lane), Ilford.
Kingston (K & DARS)—Second Wednesday in the month. 10 February ("Grid dip oscillators", by A. Cockle, G3IEE), 10 March (Junk sale, lots of goodies under the hammer), 8pm, Penguin Lounge, 37 Brighton Road, Surbiton.
London (UHF Group)—First Thursday in the month, 7.30pm. Club now meets at 32 Russell Chambers, Bury Place, adjoining Bloomsbury Square, WC1.
Loughton—Fortnightly on Fridays, Loughton Hall, Rectory Lane (nr Debden Station).
New Cross—Wednesdays and Fridays, 8pm, 225 New Cross Road, SE14.
Paddington (P & DARS)—Thursdays, 7.30pm, Beauchamp Lodge, 2 Warwick Crescent, W2.
Purley (P & DRS)—First and third Fridays, 8pm, Railwaymen's Hall, side entrance, 58 Whytecliffe Road, Purley.
Reigate (RATS)—First Wednesday, 7.45pm, George and Dragon, Cromwell Road, Redhill.
Romford (R & DARS)—Tuesdays, 8.15pm, RAFTA House, 18 Carlton Road.
Scouts (ARS)—Third Thursday in the month, 7.30pm, Baden Powell House, Queensgate, South Kensington, SW7.
Sidcup (CVRS)—4 February ("Port communications and radar", by P. Balestrini, G3BPT), 18 February (Natter night), 4 March (Rtty), All Saints Church Hall, Bercta Road, New Eltham.
Southgate (SRC)—Second Thursday in the month, 7.30pm, Civil Defence Hut, Bowes Road, N11.
St Albans (Verulam ARC)—17 February ("More ICs and practical circuits", by W. Joyce, G3WLM), Town Hall, St Peter's Street, St Albans. Attendances last year ranged between 30 and 50 members, the most successful year yet of 12 meetings in 1970. News sheet has a circulation of 100. The smooth running of the club is due to regular monthly committee meetings.
Sutton & Cheam (SCRS)—Third Tuesday in the month. 16 February (Films or tapes), 8pm, The Harrow Inn, High Street, Cheam.
Welwyn (Mid-Herts ARS)—Second Thursday in the month. 11 February ("Linear integrated circuits for the amateur", by G8BGM Visitors are most welcome), 8pm, Welwyn Civic Centre, Welwyn. At the last meeting two of the films shown were "Cabling the GPO tower" and "Age-old insulant (mineral insulation for cables)".
Wimbledon (W & DRS)—Second and last Fridays, 8pm, St John Hall, 124 Kingston Road, South Wimbledon, SW19.
Wembley (GECARS)—Thursdays, 7pm, Sports Club, St Augustin Avenue, North Wembley. (This club is open to non-GEC employees by invitation. Telephone Dain Evans, G3RPE, at 904 1262 for details).

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

Thanet (TRS)—5 February (Constructional evening), 12 February (Mobile rally talk), 19 February (AGM), 26 February (RAEN talk).
Crawley (CARC)—24 February ("Vhf techniques", by D. Atter, G3GRO), 8pm, Trinity Congregational Church Hall, Ifield, Crawley. Further details of meetings from hon secretary, G. Bowden, G3YJR.
Canterbury (EKRS)—18 February ("2m oscillators, preferred circuits", by I. Cline, G3EMU), 25 March ("Test equipment in the shack", by R. Langston, G3MDT).
Worthing (W & DARC)—Meetings held every Tuesday. 9 February (Contructional contest). 8pm, "Rose Wilmot" Youth Centre, Littlehampton Road, Worthing.
Maidstone (MYMCAARS)—Meetings held every Friday at "Y" Sports Centre, Melrose Close, Loose, Maidstone.
Mid-Sussex (M-SARS)—All meetings and club station at Marle Place, Leylands Road, Burgess Hill.
Eastbourne (SARS)—Meetings held first Monday in the month at Victoria Hotel, Latimer Road, Eastbourne.

REGION 9 — RR J. Thorn, G3PQE

Bristol, City & County (BARC)—Tuesdays and Thursdays. 4 February (Business meeting), 10 February (Skittles—v Bath Radio Group at the Wingrove, Keynsham), 16 February (Visit to Distillers (Yeast) Ltd), 25 February ("Vhf lecture", by G3PTO), 7 March (Bristol 160m contest, phone section. Details from G3SWH). Club meets at Club HQ, G3TAD, 41 Ducie Road, Barton Hill, Bristol 5. *G3RKH.*

(RSGB Group)—22 February (AGM brought forward from December, followed by a talk by W. Scarr, G2WS on "Uhf"), 7.30pm, Becket Hall St Thomas Street, Bristol 1. 25 January saw a good attendance to meet the RSGB Council member from London who gave an insight into the functions of the RSGB. *G3ULJ.*

(Shirehampton)—Every Friday, Twyford House. Change of secretary from G3YIQ to Eddie Davis, G3SXY. A RAE course is running under the tutorship of Maurice Wilkins.

(University)—Every Saturday afternoon, Dept of Physics, Royal Fort, Tyndall Park Road, Bristol 8. *G8ADP.*
Cornwall (CRAC)—Meetings at SWEB Social Club, Pool, Camborne. *G3UCQ.*

(Falmouth)—G3OJN.

(Newquay)—G3THT.
Exeter (EARS)—2 February, 2 March (Talks). Meetings at the Community Centre, 17 St Davids Hill, Exeter. *G3TXG.*
North Devon (NDARC)—10 February ("Aerials" talk), 24 February (Ragchew), 7pm, RAE chat. "Grinnis" High Wall, Sticklepath, Barnstaple. *G4CG.*
Plymouth (PRC)—2 February (Colour slide show by J. Peters, G3YDU), 16 February (Open meeting), 2 March (to be discussed), Virginia House, Bretonside, Plymouth. *G3SPI.*
Saltash (S & DARC)—5 February (Your chance to acquire some junk), 19 February ("Audio evening" some aspects of af equipment), 7.30pm, Burraton Toc H, Warraton Road, Saltash. *G3X WA.*
South Dorset (SDRS)—Meetings at Technical College on the first Friday in month. *G3EAT.*
Taunton (T & DARC)—Fridays. 5 February (Film "The junction transistor in radio rxs), 5 March (Film). Every Friday club meets at

club HQ (the old SEVO Conference Room), The Barracks, The Mount, Taunton. *G8CWD.*
Torbay (TARS)—Every Tuesday and Friday, and Saturday 27 February (Junk sale). Saturday 13 March (Annual dinner). Quiz results at the December meeting showed a win for Exeter. Club meets at Club HQ, rear of 94 Belgrave Road. *G3NQD.*
Weston-super-Mare (WSMRS)—5 February (Lecture "A mini-quad", construction and erection, by G. Twist, G3LWH), 5 March (Lecture "Facsimile", by K. Otway, G8AGT), 7.30pm. Small Lecture Theatre, Ground Floor, New Technical College. The AGM was held in January, and the committee continues with a change of treasurer and two additions. It was agreed to hold a Regional Meeting here in September. *G3GNS.*
Yeovil (YARS)—Wednesdays, The Park Lodge. *G3NOF.*

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

Blackwood (ARC)—Fridays, 7pm, Blanche Cottage, off High Street, Blackwood. Mon.
Barry College of Further Education (ARS)—Thursdays, 7pm, Barry College of Further Education, Colcot Road, Barry, Glam. *GW3VPB.*
Cardiff (RSGB Group)—Mondays 8 February, 7.30pm, lecture, TA Centre, Park Street, Cardiff.
East Glamorgan Raynet Group—Details of meetings and excercises from GW3ZFG. Tel Cardiff 62411.
Haverfordwest (ARS)—Tusdays, 7.30pm, new headquarters, Rosemary Lane,
Haverfordwest, Pembs. Club callsign is GW3XCT. *GW3YBB.*
Hoover (ARC)—Mondays, 7.30pm, Hoover Social Club, Hoover Works, Pentrebach Nr Merthyr, Glam. Secretary, Mr F. E. Tribe.
Port Talbot (ARC)—Second Tuesday of each month, 7.30pm, Trefelin Club & Institute, Port Talbot, Glam. *GW5VX.*
Pontypool (ARC)—Tuesdays, 7pm, Educational Settlement, Rockhill Road, Pontypool, Monmouth. *GW3JBH.*
Pembroke (ARC)—Last Friday of each month, 7.30pm, Defensible Barracks, Pembroke Dock, Pembs. *GW3LXI.*
Sully & District Short-wave Club—Tuesdays, 7pm, The Annexe, Sully Bowls & Social Club, 59 South Road, Sully, Glam. Secretary, Mr Glyn Maggs, 3 Thorley Close, Cyncoed, Cardiff.
Rhondda (ARS)—Meets at Rhondda Transport Employees Club & Institute, Rhondda, Glam. *GW3PHH.*
Swansea Telephone Area (ARS)—Tuesdays, 7.30pm, Telephone Engineering Centre, Gors Road, Swansea. Club callsign GW3ZTK. Secretary is Mr D. E. Connor, 7 Glanmon Park Road, Sketty, Swansea, Glam.
University College, Cardiff (ARS)—Details of meetings and activities from the secretary, c/o Students Union, Dumfries Place, Cardiff.
University College, Swansea (ARS)—Details of programme from the secretary, c/o Students Union, University College, Singleton Park, Swansea, Glam.

REGION 11 **RR P. H. Hudson, GW3IEQ**

Conway Valley (CVARC)—18 February ("Vhf and uhf", talk by G. Baines, G3AOS, to be held at the Parade Hotel, Llandudno). The annual dinner held on 11 December was well attended, as was the junk sale on 17 December.
Bangor (UCNWARS)—11 February (("Meteor scatter and moon echo techniques for amateurs", by J. Stace, G3CCH), 25 February (Presidential address by Dr D. W. F. James, UCNW). The annual dinner has been provisionally fixed for Friday 5 February.
Rhyl (R & DARC)—Meetings held on the second Tuesday of each month, 7.45pm, Mona Hotel, Market Street, Rhyl.

REGION 12 **RR** *post vacant*

Aberdeen (AARS)—Fridays, 7.45pm, 6 Blenheim Lane, Aberdeen. *GM3HGA.* Tel Aberdeen 33838.
Dundee (DARS)—Thursdays, 7.30pm, 3 Magdalen Place (off Roseangle), Dundee. *GM3KYI.*
Inverness (IRS)—Thursdays, 7.30pm, 4 Falcon Square (nr railway station), Inverness. *Mr Norris* (QTH as per January *Radio Communication*).
Lerwick (LRC)—Tuesdays and Thursdays, 8pm, Annsbrae House, Lerwick. *GM3XPQ.* Tel Bixter 249.
Lhanbryde (MFARS)—Wednesdays, 7.30pm, St Andrews School, Lhanbryde, by Elgin, Morayshire. *GM3UKG.* Tel Clochan 225.
Thurso (CARS)—Second Tuesday in each month, 7.30pm, Thurso Technical College. *GM3JUD.*

REGION 13 **RR V. W. Stewart, GM3OWU**

Lothians Radio Society (LRS)—11 February (NFD, past and present), 25 February ("Lasers", by GM3OWI), 7.30pm, 66 Hanover Street, Edinburgh 2.

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

Ayrshire (AARG)—14, 28 February, 7.30pm, YMCA, Howard Street, Kilmarnock.
Ayrshire (Ardeer Recreation ARC)—9, 11, 16, 18, 23, 25 February 7.30pm, Ardeer Recreation Club, Amateur Radio Section, Stevenston. Further details from J. F. McCreight, GM3DJS, 10 Auchenharvie Road, Stevenston, Ayrshire.
Falkirk & District RSGB Group—26 February, 7.30pm, Temperance Cafe, Lint Riggs, Falkirk.
Glasgow University (GURC)—12 February, (Tape lecture), 7.30pm, George Service House, University Gardens, Glasgow W2. 26 February (Visit to Mid-Lanark RSGB Group).
Greenock & District (G & DARC)—5, 12, 19, 26 February, 7.30pm, James Watt Library, Union Street, Greenock.
Mid-Lanark RSGB Group—26 February, 7.30pm, YMCA Brandon Street, Motherwell.
West Scotland (ARS)—5, 12, 19, 26 February, 7.30pm, Royal Signals HQ, 21 Jardine Street, Glasgow, W2.

REGION 16 **RR W. J. Green, G3FBA**

Pending a removal to Suffolk, Mr W. J. Green's temporary address is Wilby Cottage, West End Avenue, Brundall, Norwich, NOR 86Z. Tel Brundall 3388.

Basildon (VARS)—Thursdays, 7.30pm, The Scout Hall, Fairview Road, Vange, Basildon, Essex. *G3VOP.*
Chelmsford (CARS)—First Tuesday in each month. 7.30pm. 2 February (Film show "Atlantic crossing", etc), 2 March ("Weather Forecasting", by F. C. Jackson, Met Office). 7.30pm, Marconi College, Arbour Lane, Chelmsford. *G3KRZ.*
Clacton (CRDC)—Second and fourth Tuesdays in each month, the Martello Tower, Marine Parade, Clacton on Sea. *G3YAI.*
Colchester (CARS)—Wednesdays, 7pm, NE Essex Technical College, Colchester. *G3VAG.*
Gt Yarmouth (GYRES)—Fortnightly, 7.30pm, 98 South Market Road, Gt Yarmouth. *G3HPR.*
Ipswich (IRC)—Last Wednesday in each month, 7.45pm, Gippeswyk Hall. The February meeting will include a junk sale. *G3YWM.*
Lowestoft (LARDC)—12 February (Tape lecture), 26 February (Slide show by Mr W. Pickard). Full details from G3JMU, QTHR. Tel Lowestoft 3119 (day) or 3067 (night).
Norwich (NARC)—Mondays, 7.30pm, The Brickmakers Arms, Sprowston Road, Norwich. Secretary, G. Purcell. Tel, Drayton 459.

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

Basingstoke (BARC)—Meetings on the first and third Saturdays each month, 7pm, Chineham House, Shakespeare Road, Popley, Basingstoke, Hants. All visitors and new members are most welcome. *G3CBU.*
Bournemouth (Wessex ARGP)—Meetings on Friday 5 February and Monday 22 February, 7.30pm, Cricketers Arms, Windham Road, Bournemouth, Hants. *G8BBN.*
N. Berks (AERE Harwell, ARC)—Meetings on the third Tuesday in each month. Also informal meetings and junk sales every Friday lunchtime. 7.30pm, Social Club, AERE Harwell, Didcot, Berks. Visitors and new members not on AERE staff are always welcome. *G3NNG.*

Regular meetings are also held by the following clubs, but no programme details have been received up to the "going to press" deadline: Chippenham ARC; Fareham ARC; Farnborough ARC; Maidenhead ARC; Newbury ARC; Petersfield RNARS; Portsmouth ARC; Reading ARC; Southampton Gp; Swindon ARC.
G2HIF.

MEMBERS' ADS

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

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

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

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

No correspondence concerning this free service can be entered into.

See the current order form for further details.

FOR SALE

Hdphns, USA make with chamois earmuffs, low impedance. Mono or stereo 26/6d. Hi-fi spkr fitted 12W woofer and 2W tweeter, crossover network, 8Ω, modern cabinet £7 10s ono. G3KPO, QTHR.

Exch unused Ten-Tech PM2 trnscvr for pair Sommerkamp 28·5MHz handie-talkies. Must be perf. Also sell Katsumi EK9X electronic keyer, £4 5s. G3ZEC, c/o Post Office Radio Station, Nebo, Amwlch, Anglesey.

Mohican, £25. BC221, £25. Sig gen, 8 to 330MHz, modulated, perf £10. Psu 1000V 800mA, 500V 500mA, bias 150V, ex C43 tx. 120V input, very heavy, offers. GW3EJM, QTHR. Tel Llangrose 277.

Hallicrafter SX122 double superhet, ssb xtal cal, 0·5MHz to 32MHz, bandspread ham-bands, as new, £95. Prefer buyer coll. G3ACB, QTHR. Tel Cuffley 3695.

Texas 2N5345 fets, brand new, 8s ea or £4 10s a doz. Heat-sinks BFYS1 type, 10s a doz. 144MHz convtr, 2N5245s throughout, 24-26 MHz i.f., printed circ, £8 10s. J beam phasing harness 70cm, suitable match 4 75Ω beams, £2. 115V Venturi fan, £1 10s. G8APV, QTHR.

Pye Ranger 2007, high band, built in psu, vy gd cond with circ diagrams and conversion details for 2m, £6 + carr or exch for R1392. Wood, Teneriffe, Elm Grove, Barnham, Bognor Regis, Sussex. Tel Eastergate 2253.

Quantity of old but wkg valves, real historical interest inc 4242A, V1907, Z1712, GZ3Z etc. Also four vibrators, 6V, various selenium rectifiers and coils. Any offer accepted. G2AFB, QTHR. Tel Esher 62560.

C52 rx, faulty on 160m, otherwise fine, exc mechanical cond, manufacturers ac psu, £6 5s. GM3YYY, 94 Larkfield Road, Lenzie, by Glasgow. Tel 041-776 4833.

KW 50/75Ω swr bridge, £6. KW 1p filt channel 17, Belling Lee sockets, £4. Both mint. KW600 linear, £80. G3VMY, 3 Stanlake Park Cottages, Twyford, Nr Reading, Berks. Tel Twyford 5621 weekends.

Heathkit DX60B and HG10B vfo, both new. Going ssb must sell both for £50 or best offer. G5ARL, QTHR. Tel Eriswell 2236.

CR70A, less than 12 mnths old, full wkg gd cond, £15 ono. Archer, 51 Arlington Drive, Alvaston, Derby DE2 0AW.

S27 (27-144MHz), £18. Buyer coll. BC221 with charts, £18. Wayne Kerr vhf admittance bridge, £20. BCC69, wkg on 4m, £8. Collins mech filt, 300kHz 3kHz bw, £8. 2 3CX100AS, £5. G3LBA, QTHR. Tel Cobham 2628.

Pye Ranger lowband boot mounting, comp unmod, £5 10s. G3ZKR, QTHR. Tel Southampton 73378.

Tuneable field strength indicator, new, £3. Mullard 510 type amp and pre-amp, £7 ono. G8DHO, QTHR. Tel 977-8888 ext 128.

Codar RQ10X Q mult, mint, £6 10s. PR30 preselector, mint, £4 10s. Standard Joystick and tuning unit, £7. Russell, 2 Chatsworth Ave, Wallasey, Cheshire L44 0AJ. Tel 051-638 6306.

Rtty: two teleprinters, 7B, immac cond, £15 ea. Various other pieces of rtty machinery, buyer coll but poss deliv in London. G3YKB, QTHR.

PCR-2, gd wkg cond, 2-23MHz, medium wave band, small and compact, Cairns, Merryend, Hoghatch Lane, Follyhill, Farnham, Surrey. Tel Farnham 6852.

HRO-MX, rewired, resprayed, stabilized psu, mods inc noise limiter, 10 coils inc 20m bandspread, manual, hdphns, £24 ono. 19 yards 300Ω feeder, 7/6d. Upstone, 76 Cleevelands Avenue Cheltenham, Glos GL50 4PS.

Lafayette HA500, vgc, comp with manual, £30. Will consider delivering. G3RHD, QTHR. Tel Banbury 3285.

Morse courses 0 to 14wpm on two C90 tape cassettes, instructions inc, several available, £3 10s ea. Taylor, 37 Pickerill Road, Greasby, Upton, Cheshire. Tel 051-677 1818.

Nombrex sig gen, Mod 31, £8. Sommerkamp FR100B rx, mint cond, £10. Beckley, 32 Hillside, Totteridge Hill, High Wycombe, Bucks. Tel High Wycombe 23777.

Heathkit stereo tape amp, matching Heathkit psu, cost £40, sell or swap. Good communications rx wanted, eg GEC BRT400 series or why. Robinson, 21 Inhurst Road, Portsmouth, PO2 0QJ. Tel Portsmouth 67757.

Marconi CR150/2, good wkg cond, £20 or will consider sensible offers. Debney, 111 Penn Lea Road, Bath, Somerset. Tel 0225 23562.

SR200 with 8 pole xtal filt. AT5, mains psu, vgc. 100W 2m tx, screen mod. Offers. Buyer coll. G3UUR, QTHR. Tel Littleport (Cambs) 574.

Branded transistors: OC22, OC28, OC35, 3s ea. BC107, BC108, BC109, BCY70, BCY71, 2N3904, 2N3906, 2N3391A, BFY50, BFY51, 2N696, 2N1131, BCY31, 2CY32, 2CY34, BSY95A, ACY19, ACY20, 2S501, 2N2646, C111E, 1/6d ea. Send 1s for post or strong sae. G3LNT, QTHR. Tel 01-698 3189.

Eddystone S750 rx, £35. G2FOS, QTHR. Tel 051-677 4542.

Heathkit Mohican GC1U with UBE1 psu, both little used. Bennett, 13 Dickinson Road, Formby, Liverpool, L37 4BX. Tel Formby 73502.

Pye PTC2207 transistor Ranger, high band, a.m., 25W, QQV06-40A, pair OC35 mod, transistor psu, remote control/spkr panel, ptt mic, OK commercially, 25kHz spacing, £40 or exch for vry gd AR88D. G3XCF, 77 Weston Road, Runcorn, Cheshire. Tel Runcorn 72419.

Delay lines, lopt, fopt etc, for ww colour tv rx. G3PGN, QTHR. Tel Basildon (0268) 43274.

BC348J, silicon psu, fault on 6-9·5MHz range, otherwise fb, £12 10s. Transistor mod, 15W output, £6 10s. HC6/U xtals: 33·75, 44·3, 45·9MHz, 7s ea. Post/carr extra or buyer coll. G8BUR, 33 Brook Bridge Lane, Datchworth, Knebworth, Herts. Tel Knebworth 2229.

Murphy high-band trnscvr, un-mod, QQV03-10 final with circ, £8 carr extra. R1392 rx, 100-150MHz, un-mod with circ, £6. G8CQU, QTHR. Tel Selsey, Sussex 2092.

FT400/500 with 160m on Aux1, £185 ono. FLd2000 lin, new, only air tested, £95. Three 6JS6A valves, new boxed, £4 or 30s ea. 6HF5, 35s. KY102 semi-auto keyer, new unused, £3. G3RJS, 47 Gerald Road, Wollaston, Stourbridge, Worcs.

BC221, as new cond, correct charts, stabilized psu built in, pref buyer coll and inspect, £30 ono. G8CEL, QTHR. Tel 021-236 8901 daytime.

Codar AT5 tx, T28 rx, ac psu, 250/s dc psu and control unit, Halston /M ant, £40 the lot. Avometer, model 8 Mk2, £12 10s. G3KCT, QTHR. Tel Melbourn (Cambs) 693.

Hudson radiotelephone type AM108, comp modified for 4m, tuneable rx, exc wkg order, with one xtal £9. G3OUF, c/o S. Sims, RSGB HQ. Tel 01-837 8688.

Heathkit SB101 trnscvr with ac psu. £160. Also linear with pair of QV08-100s, 400W out on 5 bands, £50. G3RK, The Hills, Uggeshall, Beccles, Suffolk. Tel Wangford 619.

HRO rx with ½ lattice xtal filt. No psu. £7 ono, GM3WJF, 4 Teviot Road, Hawick, Rox. Tel 0450 3719.

Home-brew psu, suit HW12 or HW32, £15. Home-brew linear, 4 6HF5s, built-in ant c/o and psu, £25. 2m convtr, 24–26MHz i.f., £6. G3VQL, QTHR. Tel Shrewsbury 51733.

HW32A trnscvr, mint cond, factory aligned, matching HP23 psu and ptt mic, £65. Will exchange for TW 2m convtr with psu. G3UFQ, QTHR. Tel 021-373 6642.

National NCX5 with NCXA in mint cond. Exch for Collins 75S3 (going cw only). G3KDA, 2 Crawford Close, Bideford-on-Avon, Warks.

Trio 9R-59DE, £30 ono. Smith, 17 Anthonys Ave, Lilliput, Parkstone, Poole, Dorset. Tel Cawford Cliffs 79401.

Eddystone S meter, as new, £6 10s. G3XWV, 63 Weoley Ave, Selly Oak, Birmingham 29.

AR88LF, exc cond, £30 or would part exch for Hammarlund HQ170 (with cash adjustment), G3OSF, 6 Grange Crescent, Rubery, Rednal, Birmingham.

KW Viceroy, £65. AR88D, £25 or offers. View by arrangement. G8ASO, QTHR. Tel Worcester 23434 ext 113 (office hours).

Eddystone S640, gd cond, with hndbk, £15. G2BDL, QTHR. Tel 061-789 4121.

Ferranti potted choke, 60H, 130mA, 13kV insulation. Weighs 16lb. 30s plus post. Wanted: Barograph. G3KSU, QTHR. Tel Ryde 5551.

Lafayette HA500 with manual, vgc, £30. Might del. G3RHO, QTHR. Tel Banbury 3285.

Eddystone 840C, mint cond, £35 or exchange for EC10 plus cash if necessary. GM3XUY, 22 Swanston Gardens, Edinburgh 10. Tel 031-445 1324.

Advance E1 sig gen, £7. Pair unused 572Bs, £10. Cowl-gill motor £2 10s. 12/24V blower, 35s. Trnsfmrs: 2kV; 1½kV; 1kV; 300mA, £7 10s. 800V 300mA 6·3V, £4. 10V 10amp, £3. Drum twin coax, £2. G3BWY, QTHR. Tel 01-777 6645.

Electroniques gen coverage valved coil pack, 1·6MHz as fitted Heathkit RX1, little used, comp wkg order, £12. Manfield, Corries, Churt, Surrey. Tel Headley Down 3326.

Tavasu /M ant, mint cond, coils for 80, 20, 15m, £7. GW3TMP, QTHR.

AR88LF, fb cond with rack panel, 30W tx Geloso vfo, £40. Various PSUs, other cheap comps. Pref buyer insp and coll. G5IK, Keyhaven, Milford on Sea, Hants.

160m/Portable/M 6 valve trnscvr tuneable rx. Xtal controlled tx. 12V pos earth, only draws 2·5A, size 6in by 7·5in by 9in, uses external ls and pa tuning meter, £6 + 10s carr. G3THX, QTHR.

Theremin model Melodia by R. H. Mogg transistorized, £10 ono. Barnes-Rickers, 83 Wolversdene Road, Andover, Hants. Tel Andover 4493.

150W tx Geloso vfo 813 pa, £15 ono. Valve voltmeter, £5. Resistance/capacitance bridge, £5. 2 × 250V dc 6·3V ac PSUs, £2 ea. Large selection of valves. Sae for list. G3NJU, 3 Rostherne Road, Wilmslow, Cheshire. Tel 24665.

Minimitter MR44, much modified. New ae trim, anl, sig meter, Q mult, frame grids really work. KW trap dipole, 50ft coax, 1kW hilo pass filts, plugs, sockets, dow relay 6V. Offers. G5NG, QTHR.

Valves, surplus gear going cheap. Sae for list. Wanted: AT5. G2HKU, QTHR.

Codar CR70A, rx, also matching PR30 preselector unit, both in exc cond, £18 ono. Greenall, 20 Corbridge Crescent, Haughton, Darlington, Co Durham.

Oscilloscope, 2 mod, 10/mv/cm Y amp, vgc but slight fault in timebase, £10 with circuit. 52 SET tx less valves, £8. Hammersley, 5 Rymers Green, Formby, L37 3HT. Tel Formby 75988.

Bulletins 1950–67 complete. *SWM* 1946–67 complete. Offers. G3DVP, QTHR. Tel Leicester 813511.

TR1196B. Mains trnsfmrs 3kV at 16mA, 1kV at 25mA. Crt 1CP1. Technical Press *Basic Electronics* Vols 1–5. Mullard valve voltmeter. Offers. Pettitt, 82 Downhills Way, London, N17. Tel 01-888 8696.

Racal RA17 rx with hndbk, £155. Also modfied BC348, no psu, £5. Buyer coll. Smith, 3 Waterloo House, Addington Grove, Sydenham, SE26. Tel 01-778 3217.

KW2000 + ac psu, late model fitted new 6146B, exc cond. Also KW Vanguard Mk2 tx 160–10. GM3WOJ, QTHR.

KW2000A + psu with Q mult. Hansen swr bridge and EK9-X keyer, all fb cond, £175 ono. G3VYG, QTHR. Tel Norwich 52549.

Top band and 80m cw station, Bendix RA1, £5 without psu. Home brew tx, £5. KW Geloso type convtr, £5. Buyer insp and coll by appointment. GW3YTJ, QTHR.

B40D silicon psu, £23 10s carr pd. 4CX300A and base, offers. Grundig Party Boy vhf/mw/lw, £20. Sony TC100A cassette recorder, batt/mains, mic, nine cassettes, £35 ono. Rx/tx valves, ht/lt trnsfmrs, etc. Sae for list. Marshall, 33 Brookbridge Lane, Datchworth, Knebworth, Herts. Tel Knebworth 2229.

Vhf rx type R1132A, no psu but in gd wkg order, £5. Wanted: am/cw tx with ac psu covering 3·5-5MHz, gd wkg cond, for ATC sqn. Sae pse. Swift, 341 Walsall Road, Stone Cross, West Bromwich, Staffs.

10 unused 807s, 4s ea. 813, 14s. New 5B/254Ms, 10s ea. 5U4Gs, 6s. Pair 832As, 10s ea. Wanted: J-Beam 46 el Multibeam for 432MHz. G8BGO, 25 Church Lane, Sarratt, Rickmansworth, Herts. WD3 6HN.

Hamgear PM1 atu and preselector, £3 + pp. Locke, 97 Snoots Road, Whittlesey, Peterborough. Tel Whittlesey 3447.

Hammarlund SP600, rack mounting with pair matching spkrs, £85 ono. G2CBC, QTHR. Tel Peterborough 5080.

Jan to Dec 1968 *Radio Communication*, vgc, £1. Also Jan to Dec 1970 *Radio Communication* £1 5s. Variable voltage psu 0–300V 150V stab, + 6·3V ac as pub in *Radio Constructor* Nov 1963, £5. Pratt, 30 Lyndale Road, Eldwick, Bingley, Yorks. Tel 097-66 3699.

Drake 2B, all 10m xtals, Q mult, spkr, 100kHz bar, exc cond, £90 or cash difference on 2000A with ac psu. Offers G3OFN, QTHR.

Pye Ranger, boot mounting with control unit, spkr, etc, 12V, lowband, £10 ono. G8DOG, QTHR.

RSGB Bulletins, 233 copies from 1948 to 1968 (11 years comp), offers for the lot. Collins ART-13 autotune tx, wkg order, £12. Tektronix ac current probe P6020 and pair probes P6006, £15. G3WCT, QTHR. Tel Melbourn (Cambs) 693.

Mosley TA33jnr 3-band beam, £15. Spare trap end elements, £8. Heathkit SB101 trnscvr, factory checked recently, £130. All ono. Buyer coll or pays delivery. G3UAW, QTHR. Tel 01-890 3894.

HRO-MX rx, gd cond, psu, ls, coils, etc, £15, ono. LG50 tx, hardly used, £20 ono. Homebrew 160m tx, 807pa mod pair 6AQ5s am/cw, suit beginner, £4. G3PTQ, QTHR. Tel Cambridge 47230.

Codar T28, £10. Mullard L101 scope, £25. KW E-Z match and 75Ω swr meter £14. KW Q mult, 465kHz, £5. Carriage extra. G3TUX, QTHR. Tel 01-428 4481.

BC221, comp, £20 ono. R209, £8 ono. R209 hndbk, £1. 70cm preamp, £5. G8BVP, QTHR.

Heathkit HW17A, £55. Philips stereo tape recorder N4404, £65. Ballance, 31 Polstead Road, Oxford.

KW Viceroy Mk3A with extra half-latt filt, aco relay with interconnecting cables, £80 ono. Duvidal 50kΩ Japanese mic, £4. G3WPP QTHR.

Minimitter rx, 3 units as new, £20. *ARRL Handbook* 1969, 25s. *ARRL Handbook* 1964, 15s. *Transistor transmitter for amateurs*, 12/6d, *RCA rx tube manual*, 15s. *Transistors theory—circuitry*, £1. *FET circuitry*, £1. G3WRD, QTHR. Tel 994 6976.

Property of late G5MM: Three psus + many comp vols of *RSGB Bulletin, QST. SWM.* Offers. Buyer coll. G3UXH, 99 Bell's Lane, Hoo Street, Werburgh, Rochester, Kent.

B&W audio phase-shift network, unused, two transfmrs, 350-0-350V at 160mA + various heater windings, offers. Wanted: 2m convtr, low i.f. G3NYY, QTHR. Tel 01-579 8588 (office hours).

M&G trnscvr with matching ac psu, 100W pep, cw/ssb covers 160, 80, 20m, exc cond, £65. Lafayette HE30 gen coverage rx, as new, £20. Cash only. G3YNZ, QTHR.

HRO rx with six coils covering 160-10m, matching solid-state psu and ldspkr, £18 ono. Carr extra. GM3XUV, 217 Dryburgh Road, Wishaw, Lanarks.

Minimitter 160m/M whip, mount, 30s. 12V rotary generator, 275V 100mA, 7/6d. Carr extra. G3TCC Devonshire House, Gold Street, Stalbridge, Sturminster, Newton, Dorset.

AR88D, gd cond, hardly used, pvc wire harness and manual, hdphns, spare valves, IFs, dial-geartrain, offers to GW3VNO, QTHR. Tel 0222-78799 (after 6pm).

Sommerkamp FL1000 linear, exc cond, orig packing, £65. G3TDJ, 7 Glamorgan Road, Coombe Glen, Cheltenham, Glos. GL51 5JF. Tel Cheltenham 26530.

C52 rx, wkg but defective on 160m, £4. GM3YYY, 94 Larkfield Road, Lenzie, by Glasgow. Tel 041-776 4833.

Trio 9R-59DE, exc wkg ord + SP5D matching spkr, £37 10s. Carr extra if necessary. Cross, 64 Semley Road, Norbury, London SW16. Tel 01-679 3215 (after 6pm).

2m /P trnscvrs. Pair Cossor 102PD comp except xtals. Model 2000 o'scope 4½in tube. RA1 rx, xtal calibrator, spkr. Sell or exch for Eddystone hf rx, teleprinter terminal unit, offers. Buyer coll. G8AWE, QTHR. Tel 01-574 0418.

Fb variable bench psu, double 10-350V dc 125mA +, 2 × 6·3V 5A, switched ranges, fully stabilized/metered. Also single psu similar spec. Buyer to coll. Offers or swap for suitable ham radio gear, GDO convtrs etc. G8CWU, QTHR. Tel Coventry 411629.

HA600 Lafayette am/cw/ssb, mint cond with spkr, anti surge fused, 12 hours' use only, £35 ono. Buyer coll or arrangements made. Crowther, 12 Warren Drive, Prestatyn, Flints. Tel Prestatyn 3286.

Eddystone EC10 in vgc, £30. Also matching hdphns, £2 10s. Buyer coll. Clayton, Davy Hall, Oaklands Road, Salford, M7OPX. Tel 061-792 1709.

KW2000 with ac and dc power units, gd cond, £135 ono. Pref buyer coll. G3MCB, QTHR. Tel Shenstone 736.

Mint AT5 with matching mains psu, xtal mic and hndbk, £19. Mosley trap dipole, 20-15-10, £2. Transistor two-tone osc, £1. Unused BSR Monarch autochanger, 4 speed, comp, £2 10s. Transistor xtal marker, £1 10s. G3TYJ, QTHR.

KW2000A with ac psu and Shure mic, £140. AR88D MOS, brand new, six weeks' use. Phones, hndbk, trimming tools and set of new valves, £69. Vibroplex standard, £4. Lee, 5 The Square, Laleston, Bridgend, Glam. Tel Bridgend 55471.

KW2000A and ac psu in immac cond, only used for a few hours, £160. G3XLR, 22 Walmer Close, Romford, Essex. RM7 8QJ. Tel Romford 43966.

DX100U, gd cond, £37 10s. Pye PTC112 4m tx/rx, 12V version, mod for variable rx tuning, £3 10s. Vickers, Wrekin Cottage, Great Coxwell, Faringdon, Berks. Tel Faringdon 3182 (weekends).

Brand new 4CX250Bs, pair £4 10s plus pp 2/6d. Collins mech filters, ssb at 500kHz, type F5002-5, usb and lsb available, £6 ea. All enquiries sae. G3WXO, QTHR. Tel Stony Stratford 3346.

SP600-JX-10, £120. Highly mod Ranger, £10. Hunts cr bridge, £10. Colt Woodsman match target (FAC reqd), £38. All deliv except Ranger, buyer must insp and coll. Part exch offers welcome. GW3UCJ, QTHR. Tel Briton Ferry 2376.

Yaesu Musen FTDX400/500 trnscvr, £145 + carr. G3JZI, QTHR. Tel Tean 2527.

100m 75Ω coax, £2 10s. 50m Uniradio 95 50Ω coax, £2 10s. Valves: 807, 8s.; 12AX7, 5s; 6BW6, 10s; 6BR7, 10s; EL86, 6s. Ferguson 3216 tape, £40. Wanted: Trio 9R-59D or 500SE. Stewart, 2West Road, West Drayton, Middx. Tel West Drayton 6818.

Drake R4-B, £179. MN-4 ant matching network, £41 14s. T4X tx, £166 12s. AC-4 psu, £41 14s. All inc carr. Will sell sep. Usual used price over £500. G5AGX, QTHR. Tel 01-894 6880.

Eddystone S640 gen coverage rx, 1·7-32MHz, in gd wkg order, £15. G3POQ, 78 Hawthylands Road, Hailsham, Sussex. Tel Hailsham 3876.

Electroniques GC166T transistor tuner/converter unit, brand new, comp with all data, £16 15s, post paid ono. G8DFR, 1 High Street North, West Mersea, Colchester, Essex.

AR88D less cabinet, £25. 60W 2m tx, phone only, rack mounted, £40. 4m valve convtr and psu, £4. For spares only, Cossor 1035 scope, £6. G6FK, QTHR. Tel 021-440 2681.

DX100U with new 6146s, £35 or would exch for marine band tx/rx with cash adjustment. G3XOI, QTHR. Tel Southend 557468.

14AVQ, £12 ono. SX28, product detector, needs attention on 3 ranges otherwise OK, £10. Cornishman, less a few parts, with psu, £5. G3OCS, QTHR.

KW Viceroy Mk3, extra half-lattice filt, fitted 6146Bs in final circuit and manual, mint, £90 ono. Heathkit Mohawk rx, 160-10m, am/ssb/cw, calibrated 2m band for convtr with orig assembly manual, mint, £50 ono. Buyer pays carr. GI3XCZ, 39 McClay Park, Hospital Road, Omagh, Co Tyrone, NI.

Going QRT: 2m am/fm tx, 6/40A linear, CR100, fet convtr, 100W audio amp, many other units and comps. Wanted: 28-30MHz am/ssb tx low power. Sae for list. G8CMU, QTHR. Tel Finedon 284.

AR88D, orig S meter, hndbk, realigned, £40. Xtal filts 1·4MHz usb and lsb with carrier xtal, £12. Metrix 230 wobuloscope 5-220MHz and 530-740MHz, spare circuit, manual. Offers. G3NGK, QTHR. Tel Beaconsfield 3109.

Heathkit 5in laboratory scope model 10-12U, hardly used. Also AVO7 meter recently overhauled by manufacturer, £35 the two. Buyer coll. Guest, 157 Birmingham Road, Bromsgrove, Worcs.

Joymatch tuner, type 4, one owner, 25s. BM3 mic, new boxed, £1. Carr extra. G2BCO, QTHR. Tel 061 428 8576.

Juliette NA5018A 5 band /P, as new, £30. Wanted: Eddystone EC10. Perrin, 30 Franchise Street, Kidderminster, Worcs. Tel Kidderminster 61752.

VHF Communications for Feb, May, Aug, November, 12/- the lot. Baldwinson, 33 Cherry Close, Tulse Hill Estate, SW2.

Coax aco relay, £4. Ribbon mic magnet and ribbon fixings, 10s. Both post free. Mann, 45 School Lane, Milton Cambs. Tel Cambridge 824150.

Valiant 160-10, psu, pref test on 160m, £20. BC348 large psu, £5, Buyer coll. G3WXW, QTHR.

Vox AC15 guitar amp with tremelo and spkr in cabinet, £50 ono. Fuzz tremelo box, £5, free with amp. R1155, £2. R1155N, £3 10s. Needham, 50 The Mall, Faversham, Kent. Tel Faversham 2162.

Geloso G209R ham band rx, 10-80m, needs vry slight attention, £25. Buyer insp and coll. G3ZSQ, 27 Hurst Way, Leagrave, Luton. Tel 0582 591020.

HQ170 Hammarlund hamband rx, barg, £60 or best offer. EICO753 trnscvr with psu, 80, 40, 20, 120W pep, ssb/am/cw, £60 or best offer. G3UDA, Sunny Bank, Oak Lane, Bicton Heath, Shrewsbury, Salop.

Freq counter, 8 digit readout, max freq 13MHz, auto reset and count, well made, home built, circ and spares inc. Write for details, £70 ono. G3OCB, QTHR. Tel Stithians 480.

T & R Bulletins from 1931, many separates. Also some bound vols. *SWM* late 30s, piles of old science fiction mags. Sae for details. All reasonable offers considered. Lee, G3YCC, 8 Westland Road, Kirkella, Hull. Tel 0482 658745.

HW32A, SB600 with ac psu, HM15 reflectometer + control unit for semi break-in cw, proff assembled, exc cond comp with mic. Will del reas dist, £65 ono. G3URX, 1 Kimberley Road, Cambridge. Tel Cambridge 52278.

26ft 2in dia secnl steel/aluminium mast, with 3 wall brackets and base ball bearing, £5 ono. Buyer coll. G8BWO, QTHR. Tel 021-556 1875.

DL6SW 2m and 4m fet convtrs comp with cases, xtals, 28-30MHz, £10 ea. G8DBW, 10 North Road, Gloucester. Tel 20462.

½ lattice filt/carrier xtals, FT243, 5975kHz. Set of 6 ground for 1·7kHz spacing, + adjustments. Best offer secures. Sae only. No separating. G3VKR, QTHR.

AR88D gd wkg cond, non standard cabinet, 230V input, £22. G6CT QTHR. Tel Burgess Hill 2563, evngs only.

Transfmr mains primary, secondary 18V 2A, 10s. 8Ω 2W 5in ls, 7/6d. Driver and output trnsfmr for OC81s etc, 5s pair. Variable cap 365 + 365pF with 25 + 25pF + 6 : 1 sm, 7/6d. 30pF beehive, 2s. All unused. 1692kHz tested xtals, 5s. MacDuff, 17 Larchfield Road, Bearsden, Glasgow.

Eddystone 840C rx, internal psu and spkr, 480kHz to 30MHz, bfo, exc cond, 2 new valves, £37 10s. Benwell, 61 Rutherwyke Close, Ewell, Epsom, Surrey. Tel 01-393 9361.

Two Hallicrafters S27 vhf rxs gd cond, £12 ea. Wanted: Electroniques coilpack, ham bands only and 800-0-800V 200mA transfmr. G8BJR or G3TYB, both QTHR. Tel Charing 2158.

Trio JR310 ssb rx, new last summer, little used, absolutely mint in orig packing, £60. G3EGC, QTHR. Tel Bolton 51502.

Heathkit HW100 comp with psu, £150. Elan 3-el beam on 40ft mast, comp with turning and direction indicator, £25. Heathkit valve voltmeter V7AUK, £20. Heathkit RC bridge 3CU, £12. Many other items. G6UI, QTHR.

813 at 25s Tiger 2m convtr, has slight fault, £8. Instant heat soldering iron, £2. Heater trnsfmr for pair 813, 50s. Wanted: Coax changeover relay. G3KH, 133 Station Road, Cropston, Leicester, LE7 7HH.

R1155 comp with psu pack and amplifier, £15. G8ALB, QTHR. Tel 01-527 8893.

DX-40U and VF1U, £20. C52 rx, faulty on 160m, mains/dc psu, £6 10s ono. GM3YYY, QTHR. Tel 041 776 4833.

Heathkit RA1 rx, xtal calibrator, exc cond, factory aligned September, £30. Heathkit fm tuner, £5. LG50 tx, 60W cw, 40 fone, vgc, £20. Mather, 6 York Road, Torpoint, Cornwall. Tel Torpoint 496.

Tx/rx 4m base station. Rx tunable, mains psu, 75W o/p, £20. Redifon fm tx/rx simplex/duplex hi band, mains psu, £45 ono. Vanguard tx 160-10m. Ae c/o. £32 10s. Donohue, 41 Garway,Woolton, Liverpool, L25 5LP. Tel 051-428 6851.

Several pc board 1W 4-transistor amp kits comp less spkr (3Ω) and 9V supply, £1 inc post. Bonner, 90 Aveling Park Road, E17 4NT.

Tv gear: Marconi transistorized waveform generators; RCA monitran units; Head amplifiers; Patch panels etc. Sae for details and prices. G3ION, 71 Bassett Green Close, Southampton. Tel Southampton 69706.

Hammarlund HQ170A hambands only. Rx 160-6m, fitted 24hr autotimer, slot filter etc., inc hndbk and mains trnsfmr, £75 ono. Will del 75 miles free or carr extra. G3VAB, QTHR. Tel Brighton 45172.

Heathkit GDO model GD1U, covers 430kHz to 240MHz, comp with 8 coils, gd cond, £8 10s ono. G8DNZ, QTHR. Tel 01-759 0048.

LG50, revalved, £15. Heathkit two-er, rough, £10. Collect (Tyneside). G3VAH, QTHR. Tel North Shields 72379.

CSE 2A10 tx. Topmobile rx. G whip, £35 comp. LG300 rf unit, rough, £7 10s. G3MUL, QTHR. Tel Stafford 52215.

B2 (spy) tx/rx unmodified mains or batt operation, comp with leads, coils, morse key in orig case, £15 ono. Will exch for HW30 or similar. Wright, 34 Webbs Way, Stoney Stanton, Leics. Tel Sapecote 3404.

3·5-28MHz 150W a.m. rig in 6ft Imhof rack on wheels, variac controlled ht, 0-2,000V 0·4A, mod with UM3 trans, HK257B pa + spare tube, £20. 9 HRO coil packs inc 80, 40, 20, 10m band spread and ancient HRO, £5. Cowlgill motor, £1. Buyer coll. G3YFM, Northwood, Brightwalton, Newbury, Berks. Tel Chaddleworth 418.

2m Parabeam, nearly new, £9. Heathkit RA1, factory built, as new, £20. KW Vanguard, gd cond, £20. Buyer coll. G3RQX, QTHR. Tel 0902 38131.

KW swr bridge, as new, 75Ω £7 10s. Class D wavemeter with hndbk, phones. £5. Wanted: HE30 rx or similar. G3WXT, QTHR.

Rxs: Lafayette HE30, G2DAF part built, £18 ea. Xtals: 6·081, 8·3444 (2), 8·9219 (4), 11·4125 (5), 12·1625 (7), 18·16875 (2), 18·24375 (2), 28·2375 (2), 28·3875 (2), 13·6125 (2), 8s ea. Speedboat for sale, will exch for radio gear. Bargain component shack clearance for callers. G3VUT, QTHR. Tel 01-550 9300.

HRO b/s coils, 160-10m, psu, mint, £20. Minimitter Mercury 200 tx, 80-10m, fb cw/am, £20. 75 Ω KW swr meter, new, £5. Switchable 52Ω-75Ω KW swr meter, £6. G3KGM, 52 Pinewood Avenue, Sidcup, Kent. Tel 01-300 0767.

Property of late Tom Dwyer, G2BLT: KW2000B, £200. KW E-Z match, £12. KW swr bridge, £8. Codar AT5, £18. T28 rx, £16 10s. Mains psu, £7. Please send sae for list. Curtis, 32 Tillotsom Road, Sheffield, S89UM, Yorks.

QQV03/10, gd cond, will swop for min xtal 12MHz to 12·166MHz. Also mech filt cut from Pye Vanguard. Ferroxcube type LA1, offers. Wanted: QQV03/20 base. Nock, Faenol Isaf Farm, Tywyn, Merionethshire.

HRO junior, £10. SX28A, £16. DX4OU, £13 10s. BC221, ac psu, £14. EMI scope, new 3in tube, £15. 3339 D-beam scope, faulty, £4 10s BPL sig gen, £5. UM3, £2. UMO, £1. Wanted: Ssb trnscvr. G2BUW, QTHR. Tel Romford 43122.

Station of late G3YUA: 2m linear. Two 4CX250Bs, £25. 2m 150W TX, Series Gate Mod, mic, psu, £18. Snowflake, £8. Codar AT5, psu, £18. Class D No 1, £6. Class D No 2, £10. Coax etc. G3SBF, QTHR. Tel Markfield 2585.

Pye Reporter, £3 10s. Cossor 339, £7 10s. 4CX250B valve bases, £3. Solartron scope, dc 10MHz, £15. Cambridge galvanometer, £3 10s. RCA uhf oscillator. G3XNH, QTHR. Tel East Horsley, Surrey 3982.

Copies *SWM* 1964-1970, 1s ea. Cyldon tv/vhf tuner, less valves, new cond, 25s. BSR ribbon mic, floor and desk stands, as new, £7 10s. Ono for all items. Signey, 50 Sturdee Gardens, North Jesmond, Newcastle upon Tyne, NE2 3QT. Tel Gosforth 852020.

HRO mx, psu, manual, five gen coverage coilsets, £15 or would part exch for 9R59DE, AR88, EC10, etc. G3YQB, QTHR. Tel High Wycombe 26200 extn 290.

Valves ideal for use at 23cm and usable to 4GHz. Special quality version of 2C39/ML7210, 12sec warmup, gold plated, conduction cooled. Several available, £4 ea. Sae for details. G3PKT, QTHR.

19in rack, 5ft high, opening side and back doors, on castors, fitting drawer and table, £6. G3YPS, QTHR.

HW17 modified to HW17A by Heathkit, £40. HW17-1 12V psu, £10. Olivetti teleprinter with mains psu, £10. Buyer coll or will del 50 miles. Wanted: pair air system sockets 4CX250B with chimneys. G8BDS, QTHR. Tel March 3477 evenings.

8·8GHz English Electric Klystron, ht requ 700V, 6·3V, heaters, brand new, offers. Also high power tx tuning capacitor, very large, approx 30pF capacitance, brand new, £1. Buyer coll. Etheridge, 288 Elm Park Avenue, Hornchurch, Essex. Tel Hornchurch 52088.

RA1, xtal calibrator, matching spkr QPM 16 all as new, £40. Marconi valve voltmeter wobbulascope, needs working on, £10. Pair Stanley Kelly hi-fi cabinet spkr units, £10. G3TQU, QTHR. Tel Dunstable 62592.

KW2000A and ac psu, £160 ono. Eddystone 840C, £27 ono. Buyer coll or pay delivery. Wanted: EC10 Mk1 or 2, or similar transistor rx, homebrew or why. CRO tube type 5UP1/F. G3XOD, QTHR.

70cm 24 el Skybeam Yagi by J-beam, gain 17·5dB, inc all fittings, £4, pp 10s, all in gd cond. G8AKT, QTHR. Tel Potton 462.

Unmodified Rangers, cabinet and boot mounting, 12V, low band comp with control boxes, £5 ea. You pay rail or coll. Watts, 136 Thornhill Park Road, Southampton. Tel Southampton 57202.

Creed 75 teleprinter with perf deluxe silence cover 45/50 bauds, £50. Creed 54 teleprinter, £45. 655 auto tx, £20. All mains motors. 85R printing perf, new, bargain, £25. G8BMQ, QTHR. Tel 01-653 8489.

KW 1pfs chan 1 52Ω and chan 5 75Ω, £2 ea. G3GEJ, 19 Horseman Drive, Copmanthorpe, York. YO2 3SN.

WANTED

Case for AR88D. G3YPG, QTHR. Tel Horley 3302.

Mastering Morse by Camm; *Practical Morse* by Clarricoats; *How to learn the morse code* by Gee; *Amateur newcomer's*; *Uhf* and *Noise suppression;* pre-war manuals by RADIO; *Building an amateur radio telephone transmitter* (ARRL). G3IDG, 96 George Street, Basingstoke, Hants.

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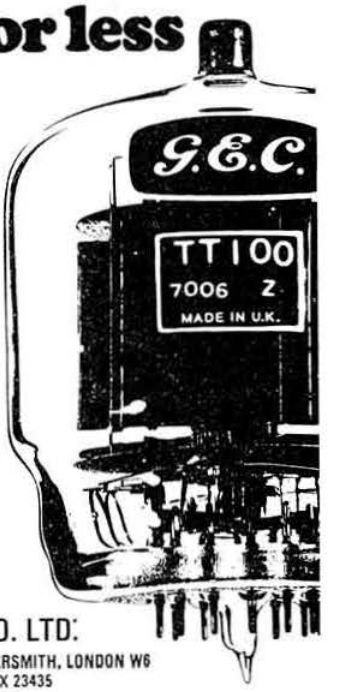

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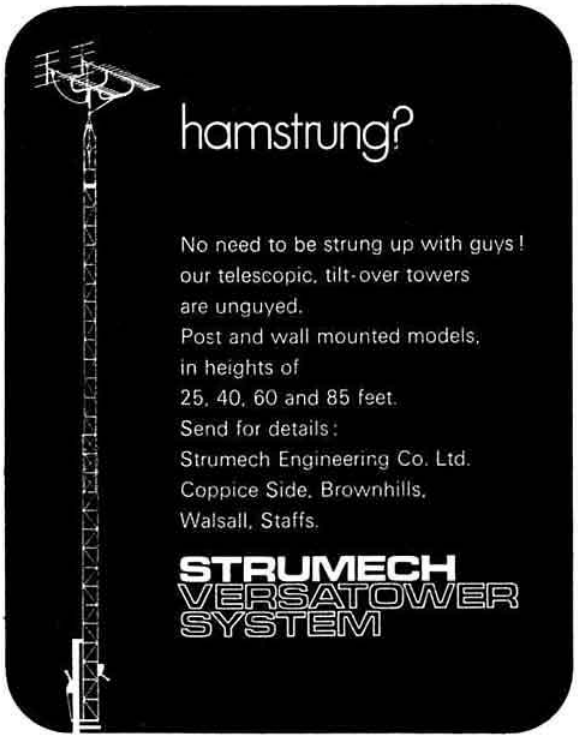

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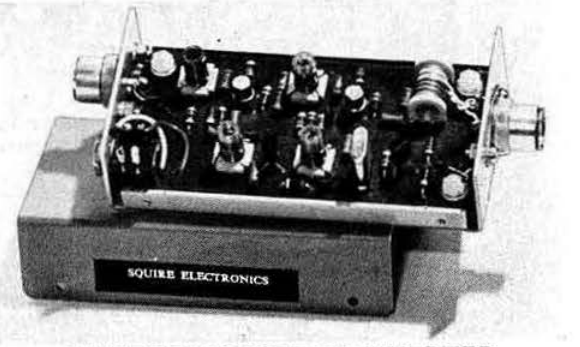

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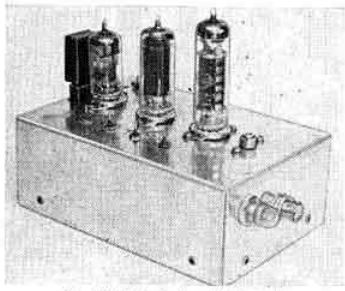

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