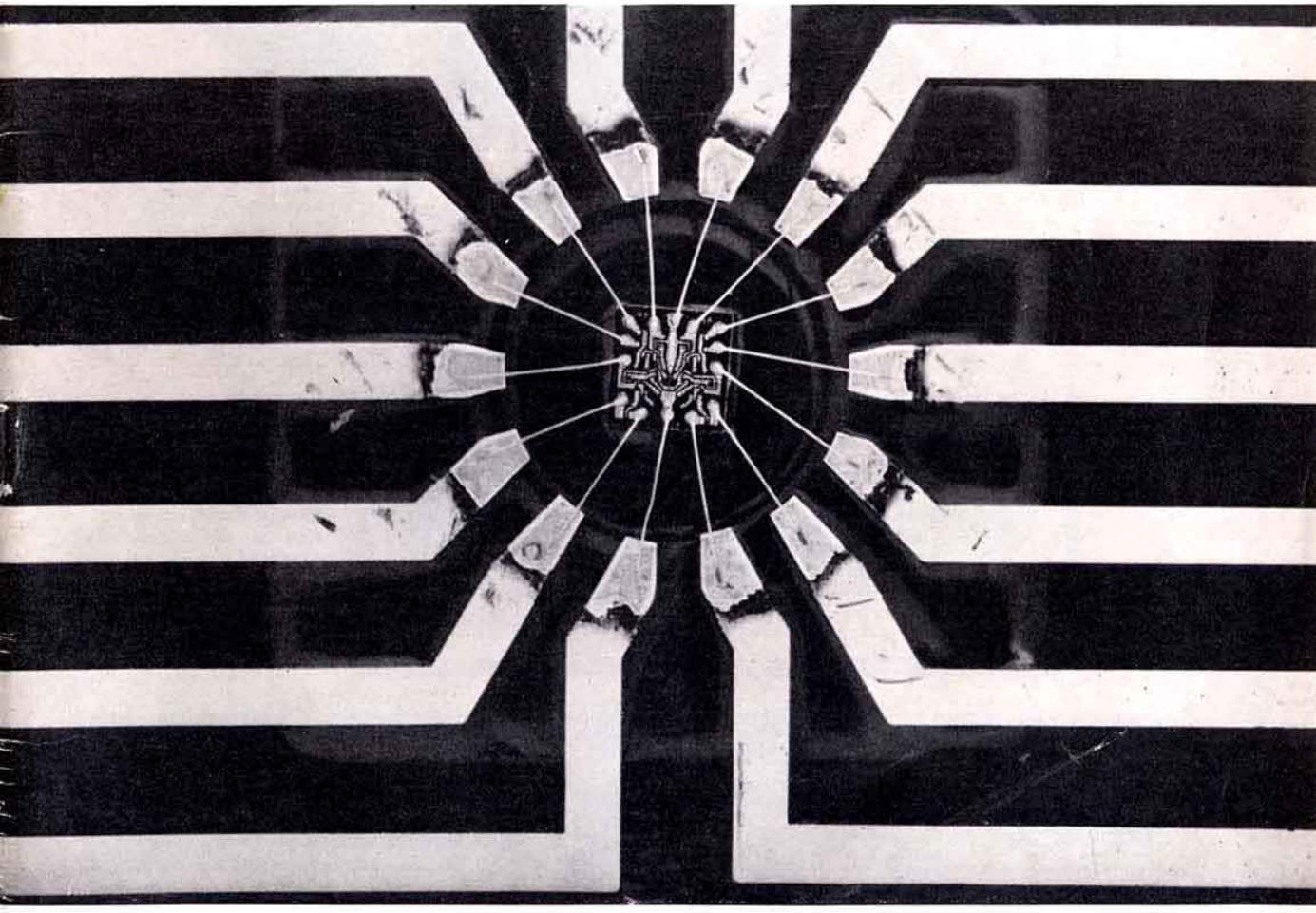
RSGB

BULLETIN

JANUARY 1967
VOL 43, No. 1

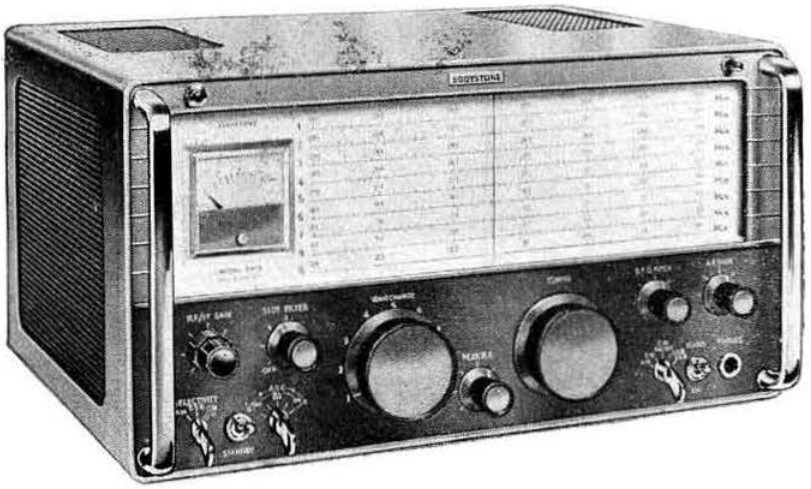


JOURNAL OF THE RADIO SOCIETY OF GREAT BRITAIN

Eddystone

HIGH STABILITY AMATEUR BANDS COMMUNICATIONS RECEIVER

EA 12
£185



The Eddystone "EA12" receiver is specially designed and built to give the extremely high performance, allied with ease of control, necessary for communications on the amateur bands under present-day conditions. With the many refinements included, this model will produce first-class results with all modes of signal.

The first oscillator is crystal controlled. The oscillator which is tuned simultaneously with the first intermediate frequency section has very high stability, as is so essential with reception of s.s.b. and c.w. signals. The correct degrees of selectivity for optimum performance are obtained in the second intermediate frequency (100 kc/s) stages.

A more than adequate degree of bandspread is provided by the superb slow-motion drive (140/1 reduction ratio) in conjunction with the wide linear scales, each of which covers 600 kc/s. A crystal calibrator and cursor adjuster permit accurate frequency resolution.

Other features to note—full coverage on six amateur bands; switched sideband selection; fine tuning control (s.s.b.); crystal filter; deep slot filter; noise limiter effective all modes; large "S" meter; two AGC time-constants; independent gain controls; stand-by sensitivity control; bright scale illumination; robust construction; modern styling and fine finish.

Comprehensive information obtainable from any Eddystone Distributor or from the Manufacturers

Eddystone Radio Limited

Eddystone Works, Alvechurch Road, Birmingham 31
Telephone Priory 2231 Cables Eddystone Birmingham Telex 33708

LTD/ED6

Volume 43 No. 1
January 1967
4/- Monthly

R S G B BULLETIN

CONTENTS

EDITOR:
John A. Rouse, G2AHL

EDITORIAL ASSISTANTS:
Trevor R. Preece, G3TRP
John J. Adey, A4663

EDITORIAL OFFICE:
RSGB Headquarters, 28 Little Russell Street, London, WC1
Telephones: HOLborn 7373
HOLborn 2444

ADVERTISEMENT MANAGER:
Mrs. P. D. Harvey, Sawell & Sons Ltd.
Ludgate Circus, London, EC4
Telephone: FLEet Street 4353

Front Cover: A vivid example of an integrated circuit dwarfed by its printed circuit connecting leads. The subject of thick film, thin film and integrated circuits introduces *Technical Topics* on page 12.
(Photo by courtesy of Elliott Automation Ltd)

The RSGB Bulletin is published on the first Wednesday in each month by the Radio Society of Great Britain as its official journal and sent to all members.
The closing date for copy for the February issue is 6 January and for the March issue 3 February.

LAFAYETTE 10-80 Metre SSB/AM/CW Amateur Receiver

75GNS.

EXTRAS
100 kc/s xtal 35/-
Speaker Mate 55/-

5 HAM BANDS PLUS WWV
3·5– 4·0 Mc/s
7·0– 7·5 Mc/s
14·0–14·5 Mc/s
21·0–21·5 Mc/s
28·0–29·7 Mc/s
WWV at 15 Mc/s

- Mechanical Filter for Exception Selectivity
- 12 Valves Dual Conversion
- Automatic Noise Limiter
- Product Detector for Selectable Upper and Lower Sideband Reception
- Complete with Crystals for 80, 40, 20, 15 and 10 Metres
- 100 kc/s Crystal Calibrator and Crystal BFO
- "S" Meter-Calibrated in "S" Units 1-9 and to +40 db

MODEL HA.350 Lafayette's newest and most advanced communications receiver. Dual conversion circuitry features an image and 1F rejection of more than 40 db. A product detector, providing selectable upper or lower sideband, solves the problems in SSB reception. Tuneable preselector circuit gives sensitivity of less than 1 microvolt for 10 db signal-to-noise ratio. Selectivity: Bandwidth of 2 kc/s at 6 db down and 6 kc/s at 60 db down using mechanical filter. Front panel 100 kc/s crystal calibrator reset control used in conjunction with the 15 Mc/s WWV station assures accurate calibration. CHECK THESE SPECIFICATIONS. Audio output: 1-watt maximum. Speaker impedance: 8; 500 ohms (speaker not supplied). Front panel controls: Preselector; Cal—On/off: Band Selector; Receive/Send; Tuning Cal Reset; Function—Off/AM/SSB1-CW/SSB2; RF gain; AF gain; ANL; Phone Jack. Valves: 6BZ6—RF amp; 6BL8—Xtal controlled 1st mixer; 6BE6—2nd mixer; 6BA6—VFO, 6BA6—1M amp.; 6BA6—1F amp; 6AL5—AVC rectifier and AM noise limiter; 6AQ8—product detector and crystal calibrator; 6AV6—1st audio amplifier; 6AQ5—audio output; 6BA6—BFO; OB2—regulator. Silicon Full Wave rectifier. Size: 15in. wide by 7¼in. high by 10in. deep. For 230v. 50/60 cps AC. Wt., 25 lb. Less Calibrator Crystal.

IMMEDIATE DELIVERY **PART EXCHANGES**

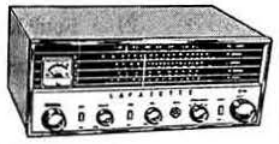
LAFAYETTE KT340 COMMUNICATION RECEIVER SEMI-KIT

Build this wonderful receiver and save pounds. Supplied semi completed, main components ready mounted, RF section already wired and aligned. Full and precise instructions supplied. Specification: 8 valves + rectifier, 4 bands covering 550 kc/s–30 Mc/s. Incorporates 1 RF and 2 IF stages, "Q" multiplier, BFO, ANL, "S" meter, bandspread, aerial trimmer etc. Operation 115/230v. AC.

Price **25 GNS.** carr. 10/-.

S.W.R. METER. Model S.W.R.3. Freq. 1 : 1 to 1 : 3. 100 μA D.C. Meter. Available 52 or 75 ohms. Bargain offer **79/6.** P & P. 2/6.

F.S.I. FIELD STRENGTH METER. Freq.: 1-250 Mc/s. 100 μA. D.C. meter. Bargain Offer **45/-.** P. & P. 2/6.



HAM-I 4 BAND COMMUNICATION RECEIVER

4 wavebands covering 535 kc/s–30 Mc/s, 5 valve superhet circuit. Incorporates S meter, BFO, BAND-SPREAD TUNING, BUILT IN 4in. SPEAKER, FERRITE AERIAL AND EXTERNAL TELESCOPIC AERIAL. Operation 220/250v. AC. Supplied brand new with handbook. **£16.16.0.** Carr. 10/-.

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50μA ..	32/6	1mA ..	22/6
100μA ..	29/6	2mA ..	22/6
200μA ..	27/6	5mA ..	22/6
300μA ..	25/-	10mA ..	22/6
50-0-50μA	29/6	20mA ..	22/6
100-0-100μA	27/6	50mA ..	22/6

100mA ..	22/6	20V DC ..	22/6
150mA ..	22/6	50V DC ..	22/6
200mA ..	22/6	100V DC ..	22/6
200mA ..	22/6	150V DC ..	22/6
300mA ..	22/6	300V DC ..	22/6
500mA ..	22/6	500V DC ..	22/6
750mA ..	22/6	15V AC ..	22/6
1-0-1mA ..	22/6	50V AC ..	22/6
1A DC ..	22/6	150V AC ..	22/6
2A DC ..	22/6	300V AC ..	22/6
5A DC ..	22/6	500V AC ..	22/6
3V DC ..	22/6	"S" Meter	
10V DC ..	22/6	1mA ..	29/6

POST EXTRA Larger sizes available—send for lists.

LAFAYETTE HA-63A COMMUNICATION RECEIVER

Outstanding value. High-class receiver covering 550 kc/s—41 Mc/s. on 4 bands. Incorporates seven valves plus rectifier. RF stage, illuminated 'S' meter, 1·5μV sensitivity. Electrical bandspread on the 80/40/20/15 and 10 metre bands. Slide rule dial, aerial trimmer. B.F.O., noise limiter. Output for phones or speaker. Operates on 115/220/240V. A.C. Supplied brand new and guaranteed, with manual. **24 Gns.** Carr. 10/-.

R209 MK. II COMMUNICATION RECEIVER

11 valve high grade communication receiver suitable for tropical use. 1-20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier drive, B.F.O. Aerial trimmer, internal speaker and 12 v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked. **£22.10/-.** Carr. 20/-.

LAFAYETTE NUVISTOR GRID DIP METER *(as illustrated)*

Compact true one hand operation. Frequency range 1·7-180 Mc/s. 230v. AC operation. Supplied complete with all coils and instructions. **£12.10.0.** Carr. 5/-.

KYORITSU GRID DIP METER

Hand held. 220/240v. AC. 360 kc/s-220 Mc/s. **£12.10.0** P & P 3/6.

TRANSISTORISED GRID DIP METER

9v. DC. 440 kc/s-280 Mc/s **£11.11.0.** P & P 3/6

Bug Keys	£4.10.0
Electronic Keys	£16.10.0
Mechanical Filters as used in HA-350 RX	£9.19.6
Lafayette De-Luxe V.F.O. 10-80 Metres	£13.19.6
Field Strength Meters 1-250 Mc/s	£3.12.6
Transistorised Field Strength Meters 2.5-55 Mc/s	£4.19.6
Coaxial Aerial Change Over Relays, 2 for	£1.19.6
H.R.O. Dials	£1.7.6
H.R.O. Coils. Full set of 9 G/C Coils	£10.10.0
1 Amp R.F. Meters	10.6

AR88D or LF. A good selection always available from **£30.**

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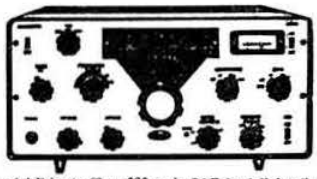
New crystal controlled triple conversion de luxe 80-10 metre band receiver. Extremely high sensitivity, selectivity and stability. Special features include 3 IF stages, crystal controlled oscillator, 4 section L/C filter, "S" meter, BFO-ANL, 100 kc/s crystal calibrator, etc. Supplied brand new and guaranteed. New Last Few! Special Price to Clear **£80** each. SAE for full details.



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200 P.I.V. 200 mA	2/6
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LAFAYETTE V.H.F. RECEIVERS

HA-55A AIRCRAFT RECEIVERS, 108-136 Mc/s. 2 R.F. Stages. Built in speaker 115/230 v A.C. Wonderful value. **£19.7.6.** Carr. 10/-.

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In the new line I can offer the Sommerkamp range comprising the FL-200-B Tx, FR-100-B Rx, FL-1000 Linear and the FT-100 transceiver, all of which are incredible value for money. Incidentally, if the temporary 10% import surcharge is removed as promised, my prices will of course, go down accordingly.

Other new stuff includes National NCX5 and the new NC2000 transceiver, Swan 350, KW2000 and the Lafayette range.

In the second hand line I can offer the following:—

RECEIVERS

Redifon R50—Magnificent beast, as steady as the rock of Gibraltar, about the same size and weight — £75 0 0

R107—One of the ugliest Rx's ever built. However I never cease to be amazed at the performance of these old clunkers. This one does perform extremely well and is AS NEW — £15 0 0

Eddystone 358—A1. — £20 0 0

HA55A Aircraft RX—In stock. These honestly are GOOD — £19 7 6

Star SR600—This one has shaken me. I thought they were dreadful, but this one is really good. As new and well worth — £75 0 0

National NC77X—Not a very good Rx but is as new and worth — £20 0 0

Eddystone 358—With ham band only coils. Excellent. — £20 0 0

HRO—Unmarked — £25 0 0

GELOSO G209—A1 hambander at a reasonable price — £40 0 0

Eddystone EC10—A1 — £38 0 0

Hallicrafter S120—Mint. Twice the number of stations above 15 Mc/s! — £18 0 0

Eddystone 740—A1 — £25 0 0

Heathkit RA1—Mint — £35 0 0

An enormous **Marconi** Double Diversity effort, complete with Marconi 1 kc/s and 2 kc/s crystal filters. A Rx in the grand manner — £35 0 0

TRANSMITTERS

KW500—Linear—Excellent. Surely must be worth 2/- a watt! — £50 0 0

Home Brew SSB TX (DAF Type)—160 to 10. Complete with 1 in. monitor 'scope built in. Separate p.s.u. Eddystone dial. The wiring is truly amazing but it works! Must be worth — £25 0 0

Home Brew CW only TX—80-10. Made of minimitter modules and pokes out the legal limit with ease. This is a good one — £25 0 0

Tokai 10 Metre Walkie-Talkies—Crystal controlled on 28·5 Mc/s. These are better than most and cheaper than most — £10 10 0

Codar AT5—And beautifully built a/c p.s.u. as new — £16 0 0

Labgear LG50—Mint. Not just one lousy sideband, this rig transmits both and a carrier as well!! — £30 0 0

Swan 350—Demonstrator — £200 0 0

Swan Full Coverage VFO. Demonstrator — £45 0 0

Special:—National N.C.190's, Brand new. (List over £97.0.0.) — £75 0 0

ODDS AND ENDS

Nombrex Transistor Sig. Gen.—Very cute. Mint — £7 0 0

70 Mc/s Baluns. Marconi—Brand new. Amongst other things they make a good putter! — 30/- post free

Kyoritsu Grid Dip Meter—New — £12 10 0

Bug Key—New. Rattle off those dits like a mad thing! — £4 10 0

QP166—In stock. (and the transistor version ordered two years ago looks like being finally delivered) — £12 12 0

Boom Mike Earphone — £4 0 0

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Hanson Transistor Checker—New — £6 0 0

Electronic Keyers—New. 30 w.p.m., while tuning over the band with your other hand! — £16 10 0

Geloso 4/102 VFO — £2 10 0

Eagle Signal Generator—Mint — £12 10 0

BC221—A good one — £20 0 0

Codar PR30X—Mint — £5 0 0

Filters—Mechanical and crystal. Meters, plugs, sockets, chokes, knobs, coils—a wide selection of bits and pieces.

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Miniature tubular trimmers ½-5 pF and 3-15 pF 1/- each or 5 for 4/-.

1000 pF feed throughs **6d.** each, **5/-** a dozen.

Small temp. compensators N1500 and N750 negative temp. coefficient 1 pF capacitors. Stop that drift. **6d.** each, **5/-** a dozen.

A s.a.e. will get you my lists of stuff ranging from the exotic to the horrible (mostly horrible!)

Trade-ins: Certainly.

H.P.: Certainly.

SERVICE DEPARTMENT

Time and again customers trade in stuff ("perfect, old boy") because it has an obscure fault which neither they nor their friends have been able to trace! In the past this has caused us much weeping, wailing and gnashing of teeth (those without teeth gnashed their gums!) but those days are over because I have at last found a colleague who has been in this business a long time and who sorts out troubles quicker than I thought possible. So if you are baffled, give me a yell and we'll let John out of his cage long enough to fix it.

73 de Bill,
VE8DP/G3UBO

RADIO SOCIETY OF GREAT BRITAIN

INCORPORATED 1926

MEMBER SOCIETY INTERNATIONAL AMATEUR RADIO UNION

PATRON — HRH THE PRINCE PHILIP DUKE OF EDINBURGH, KG

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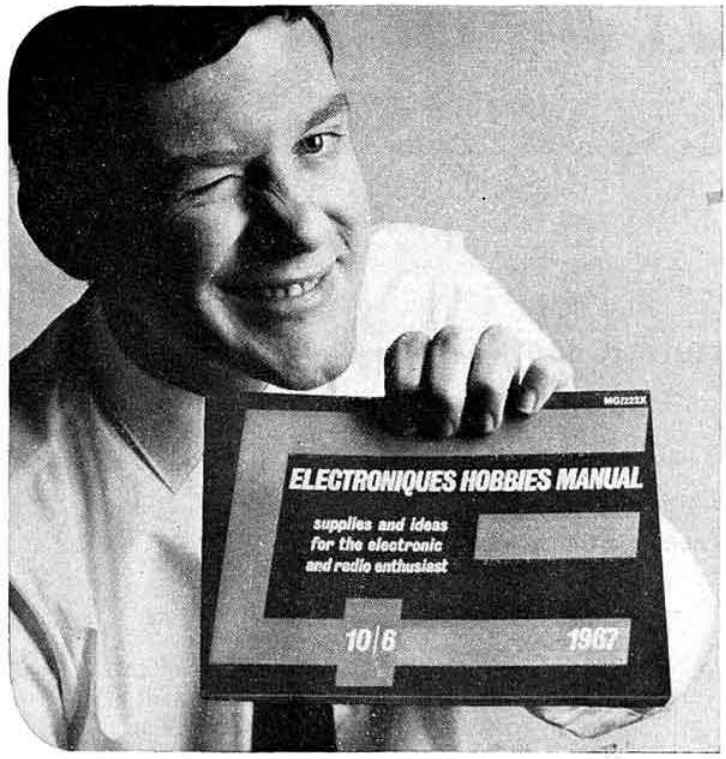


I should like a copy of the Electroniques Hobbies Manual.
Enclosed is a cheque/P.O. for 10/6.

NAME

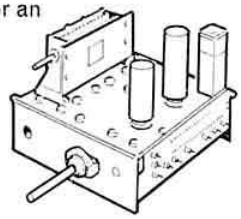
ADDRESS

R.S.I.

Two items from the Electroniques Manual...

Brilliant Valved 'QOILPAX'

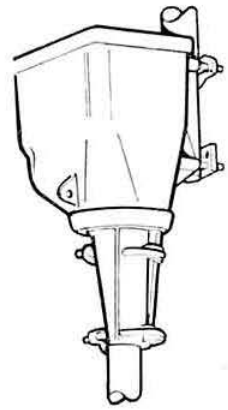
● Highly sensitive (1μV for 15dB S/N ratio when followed by a normal IF Strip) ● High-sensitivity RF stage is designed around EF 183, connected in a Miller compensating circuit, followed by an ECH81 triode heptode frequency changer, using oscillator circuits. These give optimum mixing conductance on each waveband without any pulling! Each oscillator not in use is shorted out ● General coverage and hamband models available both designed for an IF output of 1620 Kc/s ● Exceptionally low second channel interference ● Units are completely wired, tested and aligned.



Both Models: £12.12.0 each complete. p.p. 4/-.

Today's most advanced rotator aerial

● Aims within ONE DEGREE of transmitter location ● Twin synchronised motors ● No guesswork, no irritating gear clicks. Precise fine adjustment through 365° location ● Continuous Instant Direction Indication — even when motor is not in use ● Accurate repeatability — aerials position can always be pinpointed ● Turns the heaviest arrays easily under ALL weather conditions.



Price Automatic Model: £17.17.0.
Compass Model: £12.12.0 + p.p. 3/6.

Electroniques (Prop. STC Ltd.)
Edinburgh Way, Harlow, Essex.
Telephone: Harlow 26777.

High-grade components for amateur communications

electroniques

67/4MG

News from Headquarters

Mr W. A. Roberts, G2RO

The Council has accepted with much regret the resignation of Mr W. A. Roberts, G2RO, from the Society's Council. Mr Roberts was elected with effect from 1 January, 1966.

Mr B. Armstrong, G3EDD co-opted to serve on Council during 1967

The Council has co-opted Mr B. Armstrong, G3EDD, with effect from 1 January, 1967, to fill the vacancy caused by the resignation of Mr W. A. Roberts. Mr Armstrong will serve until 31 December, 1967.

Mr P. C. M. Smee

Assistant Secretary Peter Smee is leaving the Society's Headquarters staff on 12 January, 1967 to return to industry.

Although not a radio amateur, Peter has devoted himself to the Society's interests during the last three years with great enthusiasm, and we are very sorry to see him go. He takes with him every good wish for his future success.

Keyer required for Malaysia Beacon

The Malaysian Amateur Radio Transmitters Society intends to set up a 144 Mc/s beacon station and requires a keying unit such as the Keying Device No. 1 or similar. It would be appreciated if any member knowing a source of this equipment would advise G2BVN c/o Headquarters.

G2RO now leads Midland RIC

Former Council Member W. A. Roberts, G2RO, is the new Chairman of the Midlands Radio Industry Club. Mr. Roberts is Head of Administration for the BBC in the Midlands region, a position he has held since 1960. Formerly he was Regional Engineer for the Midlands Region.

The Thomas Memorial Trophy was handed by Mr R.W. Bailey, G2QB, President of the First Class Operators' Club, to the President of the RSGB, Mr R. F. Stevens, G2BVN, at the Annual Dinner of the FOC held on 29 October, 1966. It is to be awarded annually to the leading UK operator in the c.w. section of the 7 Mc/s DX Contest.

Installation of President

Mr A. D. Patterson, GI3KYP, will be installed as the thirty-third President of the Society during the course of a General Meeting and Social Evening to be held at

Kingsley Hotel,
Bloomsbury Way, London, WC1

on

Tuesday, 17 January, 1967

Commencing at 7 p.m.

Admission will be by ticket, available on request (with s.a.e.) from Headquarters. (Tickets restricted to two per member.)

Deputy Regional Representative

The following member has been appointed Deputy Regional Representative for:

SOUTH-EAST LONDON

A. J. Gould, G3JKY, 60 Merlin Grove, Beckenham, Kent.

Affiliated Societies

The following society is now affiliated to RSGB:

ST. HELENS ELECTRONICS SOCIETY, c/o B. Hardy, 198 Knowsley Road, St. Helens.

The following society was omitted from the list of Affiliated Societies published in the 1967 Edition of the *RSGB Amateur Radio Call Book*:

REIGATE AMATEUR TRANSMITTING SOCIETY

D. Thom, G3NKS, 12 Willow Road, Redhill, Surrey.

Mullard Award for 1967—Nominations Invited

In accordance with Rule 5, the Council invites nominations for consideration for the Mullard Award for 1967. Such nominations should be sent in writing to the General Manager at RSGB Headquarters to arrive not later than 28 February, 1967.

The terms and conditions governing the Mullard Award, are as follows:

(i) The Award is offered annually by Mullard Limited during the pleasure of the Directors of that Company.

(ii) The Award will take the form of a gift in kind (preferably electronic or electrical apparatus and/or books) to the value of £25, and a plaque.

(iii) The Award will be made to the member of the Radio Society of Great Britain resident in the United Kingdom who in the opinion of a Committee consisting of three representatives of Mullard Limited and three representatives of the Council of the Radio Society of Great Britain, has, through the medium of Amateur Radio during the preceding calendar year, rendered outstanding personal service to the community by his own endeavour or by his own example of fortitude and courage.

(iv) The presentation of the Award will take place during the month of April each year on a date and at a place to be decided by the Committee.

(v) In January of each year, the Radio Society of Great Britain shall, through its official journal, invite nominations for the Award. Each such nomination shall be supported by at least three Corporate Members of the Society and shall be accompanied by a brief factual account of the personal service rendered by the nominee.

More News from Headquarters on page 46

TECHNICAL TOPICS By PAT HAWKER, G3VA

The Potential of Microelectronics . Plastics (epoxy) Semiconductors . Integrated Circuits . Low-cost ICs . IC Multivibrators . Linear Circuits with ICs . IC Product Detector . V.F.O. Buffer Blocked-grid Keyer . Transistor Balanced Mixer . More on FETs . Common-gate FET Amplifier Dual-gate IGFETs . IGFET Balanced Modulator . IGFET Precautions . Useful Transistor Types

A MAJOR upheaval in equipment practice is building up more rapidly than most of us suspected, and is unquestionably going to affect our gear in the very near future. Those with their ears to the electronics ground will probably have already surmised that the opening sentence refers to the approaching era of low cost integrated circuits (ICs). Over the past few years, we have referred from time to time to the progress of microelectronic devices—thin and thick film circuits, packaged hybrids with flip-chip transistors, SICs and the like—but this had usually been accompanied by the proviso that such devices, though interesting, were still some way from entering the day-to-day practice of Amateur Radio.

Now, we believe, the position is changing, and changing fast. But, perhaps surprisingly in view of the original aims of microelectronics, their coming is not primarily going to be concerned with making our equipment much smaller—though this will be possible—but with an appeal based solidly on *price*, *convenience* in construction, and *reliability* in operation. With the aid of integrated circuits we should be able to tackle complex equipment more cheaply, more quickly and with more certainty of achieving satisfactory results. Integrated circuits—and other forms of modules—will make possible units in which literally hundreds of transistors will be accepted as normal, for instance for frequency synthesizers.

But the decisive factor will be price. This may seem surprising to these members who are aware that a lot of the current devices cost a good deal, and react at the idea of paying, say £5, £10 or even more for a unit the size of a transistor. It is true that many of the more interesting packages do, at the moment, cost considerably more than the equivalent in conventional, discrete components and semiconductors. But this position is being upset as the device manufacturers pitch into a price battle for markets, and with the growing impact of low-cost plastic (epoxy) encapsulated devices. Since the growth of epoxy units is equally bringing prices of transistors tumbling down, it is worth spending a moment on this development, before getting back again to the question of integrated circuits.

Plastics Semiconductors

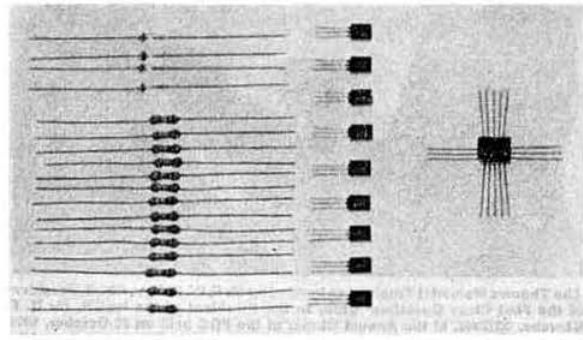
For a number of years, the majority of high grade transistors have been appearing in hermetically sealed metal cans under various " TO " designations. But the cost of such packaging represents a significant proportion of the total cost of manufacturing the devices. Recently quite a lot of semiconductors have been looking rather like little black beads, with the semiconductor pellet buried under a covering of epoxy material. This appreciably cheaper form of encapsulation has been exploited, particularly in Hong Kong, and many of the large American firms are now completing their devices there. Not only are many small-signal bipolar transistors now appearing in this guise, but a wide range of unijunction and FET devices, silicon controlled rectifiers, integrated circuits and even low-cost power transistors (for example the Bendix B5000) have been marketed.

For some months, epoxy encapsulated transistors have been offered in the UK at prices (in large quantities) of around 2s. each, and rather less in the United States. These devices tend to have some characteristics inferior to the metal units; for example, they are not so resistant to humidity and usually work over more restricted temperature ranges—but in practice many are now capable of meeting even military and industrial specifications. One snag from a radio point of view is that the considerably greater dielectric constant (of the order of five times as large), tends to reduce high frequency performance, and makes them less suitable where low internal lead capacitances are required.

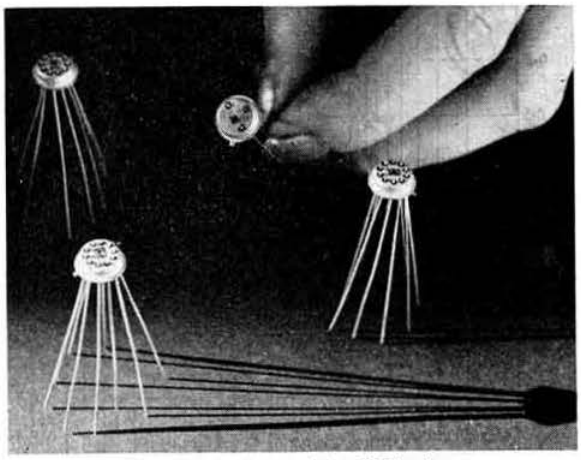
Low-cost ICs

Plastic encapsulation is one—but by no means the only—reason why integrated circuit prices are at last coming down to well below the equivalent cost of separate components. Probably a more important reason is the improvement in manufacturing yields—that is to say the number of good units one finishes up with as a percentage of the total made. Yields of ICs have been notoriously low—commonly it is said that there have been about eight or more " duds " for every good device—so that any improvement in yields can lead to dramatic reductions in price. And better yields are being obtained.

Still, it is epoxy encapsulation that is bringing on to the market some of the cheapest devices to appear so far. In front of me, as these notes are written, is a small unit, roughly the size of half a pea, from which eight leads emerge. This is a Fairchild " Micrologic " (μL) 914 " dual gate "—and it incorporates four small-signal silicon transistors and six resistors. Mike Barlow, ex-G3CVO, who sent it to me, tells me that the going price for these units in Canada is now down to $1.07 (say 8/-). And this is a unit which although intended primarily for use in computer-type digital logic



A Sony integrated circuit on the right compared with the equivalent components.



Integrated circuits mounted on TO5 headers.

circuits, nevertheless, as we will try to show, has a number of very practical applications in receivers and test gear.

As Mike Barlow puts it: " This is fantastic—just last year ICs were $4 and up, and in 1960 they were $100."

Admittedly, at the moment, and especially in small quantities, you would be hard put to find many units selling at much under £1 in the UK—but the position will almost certainly change well before the end of 1967. Indeed in " 100-up " quantities, prices of 12/- to 15/- are becoming commonplace. Only recently, we saw the prototype of a neat little Sony broadcast receiver in which the bulk of the circuit (but not the output stage) consisted of a single IC, and a number of American television makers are already putting ICs into their receivers (partly, it is said, for prestige reasons since integrated circuits and " microelectronics " are fast becoming a selling point).

So, clearly, now is the time to begin to think seriously about what ICs are, and what they have to offer.

Some Basic IC Terms

An extremely large number of introductory articles on all forms of microelectronics have appeared in recent years, and we do not intend to go very deeply into the subject or to discuss the manufacture of the various devices. But there are a few terms which must be understood in order to make any sense of what the various devices are, and how they differ from one another.

First, it should be understood that the term " microelectronics " covers not only integrated circuits but also the use of individual components, provided that the packing density is of a very high order. But we are concerned here only with complete circuit networks packaged into one unit. We can consider an integrated circuit as a group of active devices (transistors, diodes) and passive components (resistors, capacitors and inductors), and all necessary interconnections used as a building block in equipment, which will probably also have additional discrete components (and certainly will have them, at least for some time, in amateur gear).

In practice two rather different forms of IC have been developed, plus some " hybrid " forms in which these techniques are mixed together. The main groups are thin-film ICs and semiconductor ICs (SICs); there is also the thick-film devices which can be considered as a variation of thin-film units.

In thin film form, the connections, resistors and capacitors are deposited by various techniques on an insulated substrate such as ceramic or glass; the active devices (transistors) are at present usually attached separately, although active thin film devices are being developed (particularly FET devices such as MOSTs). Transistors intended for use in thin-film ICs are often referred to as *flip-chips* although many thin-film circuits use fairly conventional transistors.

The SICs fall into two main categories. In *multichip* or *chip* form, the individual components are produced on separate pieces of semiconductor material, and then assembled in a single package. On the other hand, the *monolithic* SIC is entirely fashioned out of single piece of semiconductor material, with all components, devices and interconnections (and isolation) formed within just one tiny slice of the semiconductor. This is usually done by various diffusion planar processes; and since planar techniques are easier with silicon this is usually the material involved. The only additions are the leads brought out to connect the SIC into circuit.

The IC is often referred to by the type of package in which it is enclosed; this is usually the TO5 metal can or the corresponding epoxy encapsulation; a rectangular *flat-pack*; or, to permit more leads to be brought out, the *dual in-line* form.

Thick-film units, often in flat-packs, are roughly comparable to thin-film devices but the basic unit of thickness is of the order of one-thou (0·001 in.) instead of just the few hundred angstroms of the thin film. It is some indication of the scale of dimensions in this world of microelectronics when a thousandth of an inch become " thick "!

The SIC, it should be noted, is not a " module " containing a large number of components which could be connected in different ways, but is a complete circuit having a finite number of leads brought out (up to about 22), so that there is a limited number of uses to which any particular device can be put. And since it is clearly an advantage to have these in the form of basic repetitive circuits, they have tended to be developed for logic and digital circuits, of which very large numbers may be used in computers and data processing equipment. There are now units intended specifically for linear circuits as used in radio receivers but these still tend to be expensive.

Since the circuit is pre-formed, at one time it was suggested that the coming of SICs would virtually eliminate the work of circuit designers, but in practice it is becoming clear that there is still plenty of scope for devising ways in which these units can be put together, or combined with external components to form efficient and novel circuits. And because there are serious limitations, at present, to the component values in SIC circuits, it will result in a different approach to circuits in general.

For instance, a high value resistor or large capacitance capacitor takes up far more of the basic silicon slice area than does a transistor; so that it may be preferable to use a whole string of transistors just to get rid of the need for a single resistor or capacitor (it has been said, for example, that it is worth using five transistors to eliminate a single 47 K ohm resistor, and capacitors impose an even heavier penalty in slice area).

In current monolithic silicon SICs there is a limit of roughly 20 K ohms to resistor values and 200 pF to capacitors, but many units are designed for lower values than these. A considerably wider range of values is possible with thin film and multichip devices, but even here there are constraints which must be observed. The amateur will not normally be concerned with designing the IC but with devising means of using the lower cost, and possibly surplus or sub-standard units which must surely become available in large numbers.

At present there is no fully developed way of producing an inductor within an SIC, and this means that any inductors have to be added in the external circuit, if they cannot be eliminated by ingenious circuit design. There is for example the possibility of *active filters* using capacitors to provide

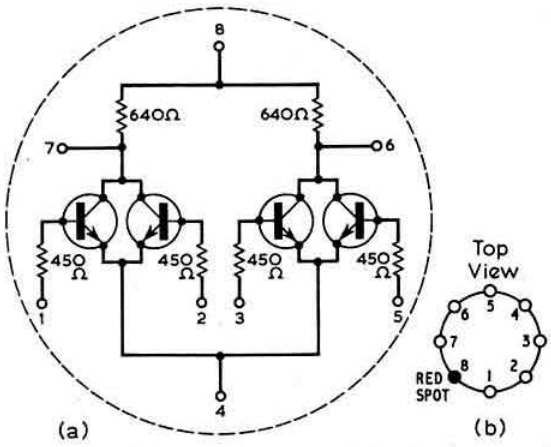


Fig. 1. All the transistors and components shown within the dotted circle are contained within the μL 914 " dual gate " integrated circuit—a relatively simple example of IC practice. Right: key to leads.

inductance but a more practical system is to eliminate inter-stage inductive coupling with various forms of d.c.-coupled amplifiers The use of d.c.-coupled amplifiers in i.f. strips has already been used in a number of radio and television designs.

For the amateur, we imagine it will often be a matter of starting with, say, one or two ICs in a piece of equipment, most of which will continue to be based on individual components and semiconductors, with ICs gradually taking over more and more of the total circuit.

Fairchild 914

Perhaps the best way of getting to grips with what ICs are beginning to offer is to consider the epoxy Fairchild dual-gate unit investigated by Mike Barlow. This is one of the low-cost series now being offered in the United States and Canada by this firm. A long article on this range appeared in *Electronics World* (March, 1966). Fig. 1 shows that within this particular device there are four general purpose 2N708-type transistors and a number of resistors. The *Electronics World* article describes various logic applications, and some of these might find use in electronic keyers, etc; but it is in the multivibrator and linear applications that the main amateur interest is likely to be concentrated. The 914, for instance, can form the basis of almost all the conventional multivibrators—and one obvious use would be as a signal injector for servicing of the type described in *TTftRA* (page 91); it can also be used to form a Schmitt trigger, etc.

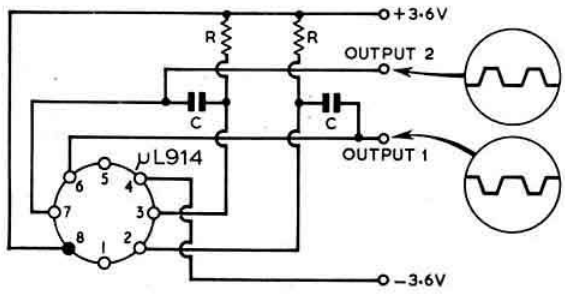


Fig. 2. An astable oscillator or square-wave generator based on the μL 914 unit.

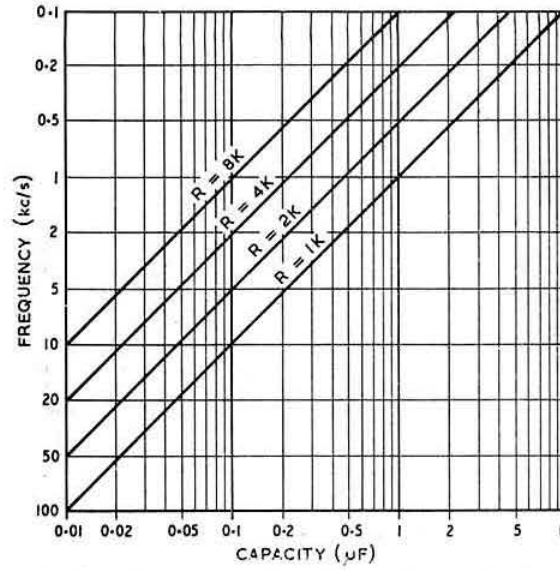


Fig. 3. Generator frequency for circuit of Fig. 2 for different values of R.

Fig. 2 shows one form of astable multivibrator using the 914 with two external resistors and two capacitors; the approximate generator frequency for various component values is shown in Fig. 3, taken from the *Electronics World* article. This basic circuit has direct application at r.f.: Mike Barlow has already tried this circuit with two 1 K ohm resistors, a single 470 pF capacitor and a 2 Mc/s crystal in place of the second capacitor: with a 1 volt supply from an almost exhausted Penlite cell he is able to hear harmonics up to 30 Mc/s on his Eddystone 640, as a compact little crystal calibrator.

Multivibrators constitute square-wave (digital) operation, but many of these digital ICs make useful linear devices. A basic form, in the case of the 914, is the differential amplifier (a type of amplifier which has a number of problems with discrete components since it requires balanced transistors). Figs. 4 and 5 show some ways in which the IC can be connected up in wideband and selective amplifiers. Although " linear " at low inputs there is usually a built-in hard-limiting action above some specified level, a characteristic

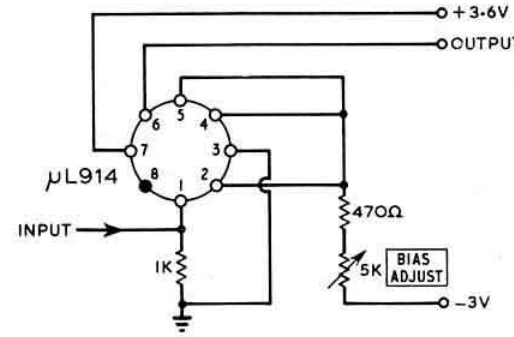


Fig. 4. Use of a 914 element as a linear amplifier (d.c. to 7 Mc/s), limiter or square-wave generator. It is linear for inputs up to 150mV, has a 26db gain, and the input and output impedances are 1 K ohm.

making such arrangements attractive for f.m. i.f. strips, though rather less so for a.m.

Another application, which Mike Barlow has already tried, is the use of a 914 as a product detector in the 640 receiver: Fig. 6, though he mentions that he could with a little more audio gain, possibly from a second IC.

It may be argued that it is still rather early to think of using ICs at the higher UK prices, but there seems no reason why the individual should not be able to obtain a few units from the States, or alternatively find a source of rejects, etc. Already the American journals are coming out with many designs incorporating ICs—Mike Barlow mentions that VE2ML is using a μL914 and a μL900 to form a small square wave generator to a design in *Popular Electronics* (November, 1966), and obtaining enough output from the 900 with a 3 volt supply to drive an 8 ohm loudspeaker. The important thing to note is that computer-type devices can be pressed into service in many other fields.

Make no mistake, there is going to be a lot to interest the amateur in the world of microelectronics and ICs—and before very long.

Since writing these notes, we have discovered that this range of Fairchild epoxy ICs is available in the UK from S.S.L. (Components) Ltd., 15 St. Mary's Road, Ealing, London, W5. The μL 914, for example, currently costs 15s. in quantities of up to 24.

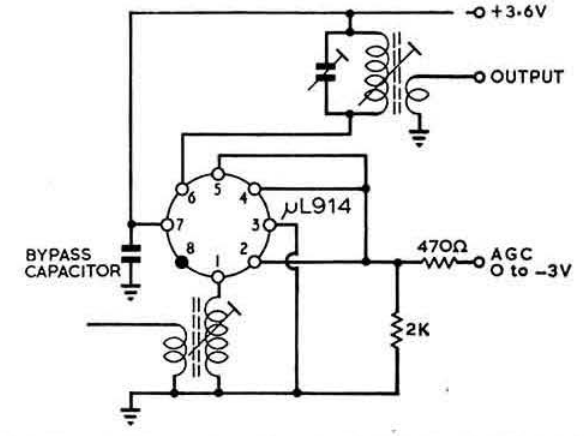


Fig. 5. Use of the 914 as an r.f. amplifier or f.m. limiter up to about 20 Mc/s, with about 30db gain. Input impedance is about 3 K ohms, and the reflected load impedance is 1 K ohm. It acts as a limiter with inputs above about 200 mV.

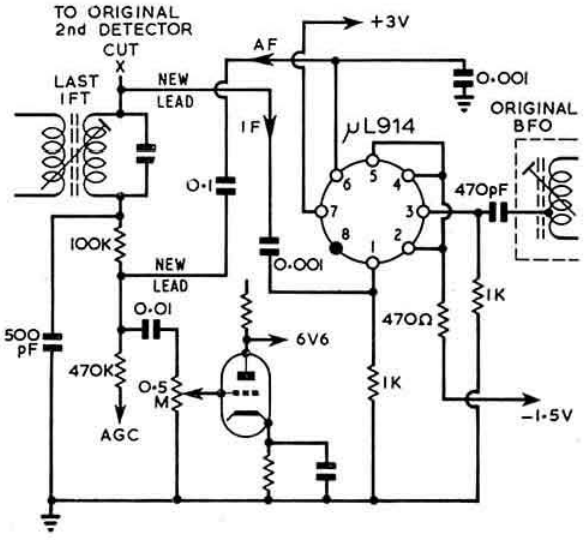


Fig. 6. Mike Barlow (ex-G3CVO) uses a μL 914 in this circuit as a product detector for his Eddystone 640.

Class A Buffer

With so much emphasis this time on semiconductor devices, we have had to fall back on W1DF and *QST* for a couple of valve circuits.

In the November *TT*, we gave details of the basic v.f.o. favoured by W1DF for his heterodyne unit (*QST*, September and October, 1966) and mentioned that he set considerable store on incorporating a really good buffer stage. Fig. 7 shows his design, using the pentode section of the same 6U8A as is used for the v.f.o.

Among the points he makes are that a good buffer should have very low voltage amplification to reduce Miller effect, and this is achieved by using only a 1 K ohm resistor as the load. The valve should also operate close to its normal class A operating point without being driven into grid current. Grid current can be detected by a voltage drop appearing across the buffer grid resistor when checked with a d.c. valve voltmeter.

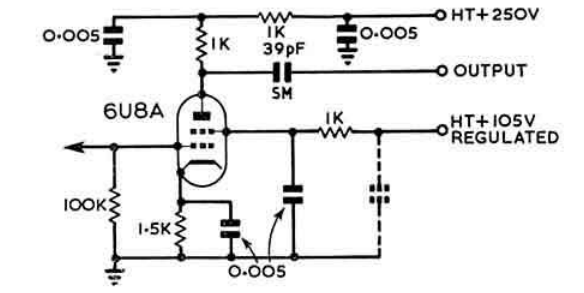


Fig. 7. A low gain buffer amplifier used with the oscillator described in *Technical Topics*, November 1966, Fig. 2.

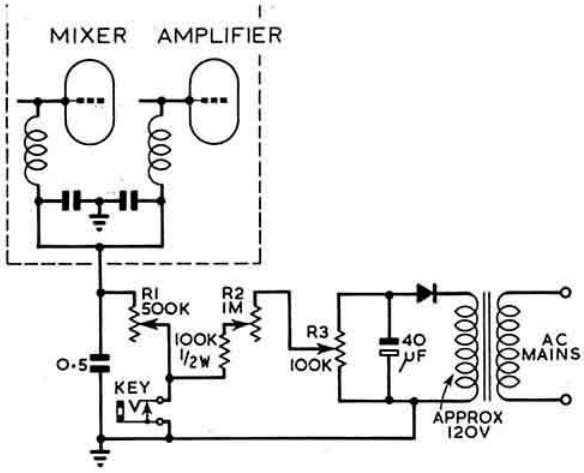


Fig. 8. A low-level blocked keyer. R1 governs "make" time constant, R2 sets the "break" constant, and R3 sets the bias. A subsequent driven stage could be simultaneously keyed by bringing a bias lead to the key connection/R1 slider.

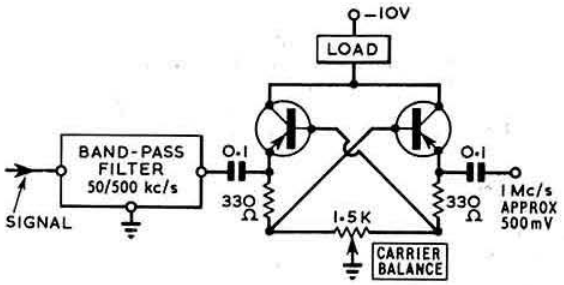


Fig. 9. The use of cross-coupled transistors to form a balanced mixer without special transformers. The load impedance is about 600 ohms.

Low-level Blocked-Grid Keying

W1DF has also been running some articles on the elimination of key clicks, and the circuit of Fig. 8 comes from *QST* (November, 1966): this is fairly conventional but the inclusion of the make and break shaping controls is rather unusual. This is for the low-level keying of early transmitter stages and it must always be remembered that any subsequent class C stages tend to re-introduce clicks, though this can often be avoided by making the keying " softer " than would otherwise be used.

Transistor Balanced Mixer

A rather novel balanced mixer using two-cross coupled transistors (somewhat akin to the valve circuit given in the November *TT*) was a recent contribution by L. E. Geisler to the *Electronics* " Designer's Casebook " feature (17 October, 1966); see Fig. 9. It is claimed that this offers advantages over the popular diode quads, in that no special transformer is required, and that there is some gain instead of being inherently lossy.

The two transistors (2N1303 in the original) have collectors in parallel, with bases and emitters cross-connected. A positive going input signal switches on one transistor, while the other remains off; a negative going input switches on the other transistor but again produces a positive-going output pulse (the circuit thus seems to have possibilities for frequency doubling).

When correctly balanced, the output comprises upper and lower sidebands (that is, heterodynes) of the two input signals and even order harmonics of the input and carrier signals; but no fundamental components (so that like the November circuit it seems to be a double balanced mixer). The circuit functions best when driven from low impedance sources. About a 600 mV oscillator signal should be used for a 60 mV carrier signal. To prevent external mixing, the input circuits and the crystal oscillator should be well shielded.

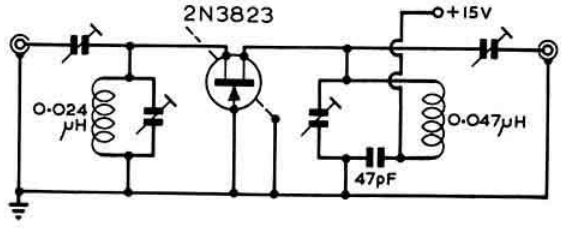


Fig. 10. A common-gate 200 Mc/s FET preamplifier with a gain of about 10db and a 2·8db noise factor. This has a gain of about 3db less than the corresponding common source amplifier but does not require neutralization. Trimmers are 0·5-8pF.

Field Effect Transistors

Information and circuits for FETs continue to appear almost in profusion. One useful arrangement which has not been given before is the basic common gate amplifier of Fig. 10 taken from a paper presented at " Wescon 66." The common gate circuit has slightly lower gain, the same cross-modulation advantages of the common-source amplifier but with the elimination of neutralization, and with the additional advantage that the signal input voltage is lower (because of the lower source impedance). There are few constructional problems, but it should be noted that the gain and noise factor of the stage are greatly affected by *any* feedback from the drain to the source, so that it is most important to use as much shielding as possible between the source and drain circuits. For v.h.f. it is also desirable to solder the gate lead to the interstage shield as close to the FET as possible and the Siliconix engineer suggests that in some cases the shield may even be soldered to the case of the FET.

This circuit has good wideband performance so that it can give good performance over the entire f.m. broadcast band, for example, without input tuning.

The opportunity to see the compact Davco DR30 receiver at the RSGB Exhibition—its miniature size came as a shock even though we already knew the dimensions—also gave us the chance to discuss some points with K4BXO. One matter which we had not gathered from the literature is that the two KMC type K1504 devices in the front end are IGFETs and not junction FETs, and he considers that the insulated gate is an advantage.

Another point that should be cleared up on FET amplifiers is that although these are high impedance devices, this does not mean that the source impedance is always very high. At 100 Mc/s the optimum input impedance for a common-source junction FET such as the 2N3823 is about 1000 ohms, and in common-gate about 300 ohms (incidentally, this means that the signal voltage which can be applied to a common-gate amplifier before cross-modulation becomes objectionable is about nine times that for a common-source amplifier, although the aerial step-up gain has to be made up elsewhere).

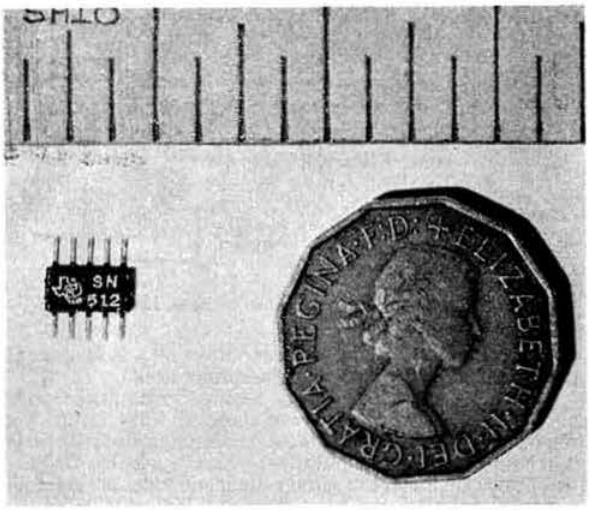
An interesting review of experiences with FETs is given by I1BBE in *IARU Region 1 Bulletin* (October, 1966) following tests with Texas Instruments junction-FETs 2N3819, 2N3822, 2N3823 and the TIS34. He reports that 2N3823 is the best; 2N3819 the least expensive; and the best compromise between price and noise factor is attained by using the TIS34. He considers the best r.f. amplifier circuits are the neutrode for h.f., cascode for v.h.f. and common-gate for u.h.f. For mixers he favours the signal going to gate and the oscillator signal (about 5 milliwatts) to source.

An IGFET v.f.o. is described by W2YM in the December *QST* and we hope to discuss this circuit next time.

Dual-Gate (Tetrode) IGFETs

Another promising development is the appearance of dual-gate or tetrode FETs, specifically intended for the front-ends of h.f. and v.h.f. communications receivers. At the moment these are expensive, but they may not always remain so, and one of the new units (the RCA TA2644) is priced in the States at just under £3 (expected to be in full production later this year). RCA have a higher performance unit, the TA7010, but this is £12-plus. Another is the TRW PT220—sold in the UK by MCP Electronics—but this one also is probably quite a high-cost device.

RCA claim that their devices offer " a major advance in communications receiver design " (see *Electronics Weekly*, 9 November). They are *n*-channel, depletion-type, silicon IGFETs featuring extremely low gate leakage currents, feedback capacitance of the order of 0·01 pF, typically some 10,000 micromhos transconductance at 7mA drain current,



This Texas Instruments IC contains the equivalent of 19 components.

and with the highly desirable square law characteristics (see *TT*, September, 1966). This signal is applied to the first gate and the gain controlled by the second gate, which can be connected to an a.g.c. line. The devices are also claimed to provide good product detectors. An experimental TRW receiver for v.h.f./f.m. broadcasts has been described using tetrode FETs for almost all stages.

Another experimental FET unit described recently was a class B audio amplifier giving some 1 watt output with special FET units, but the article concluded that low-voltage FET power amplifiers are impracticable due to poor circuit efficiency and difficult bias problems. It was pointed out, however, (*IEEE Transactions on Broadcast and Television Receivers*, July 1966) that when high-voltage FETs become available power amplifiers will become practicable, though bipolar transistors will continue to be unchallenged in direct coupled amplifiers.

IGFET Balanced Modulator

Ron Gouldstone, G3TAG, sends along a circuit (originally from SGS-Fairchild Application Report No 169) on a new balanced modulator/product detector based on the BFX78 MOST/IGFET; the report includes performance figures for 455 kc/s and 10 Mc/s. Fig. 11 gives the circuit for a 455 kc/s design. When used as a product detector the i.f. signal is fed into the output socket and the a.f. taken from the audio

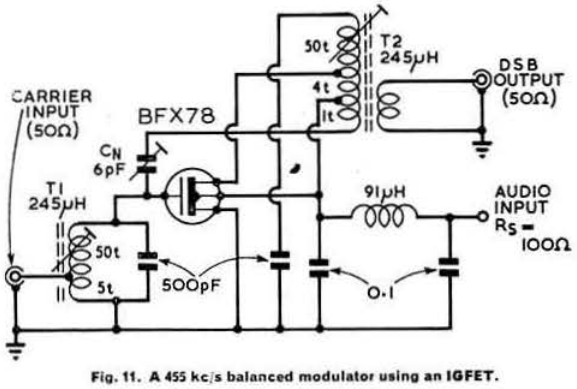


Fig. 11. A 455 kc/s balanced modulator using an IGFET.

input socket. Claimed carrier rejection using a BFX78 is up to 90db below useful signal.

G3TAG reports that he has tried a lash-up version of this circuit using an inferior MOST device: a 10-turn link wound on an old i.f.t. was used for T1, and T2 built up on an old ferrite ring core requiring only 12 turns to give the necessary inductance, with taps at the first and second turns. No screening was used on either coil. R.f. was fed to T1 and both coils adjusted for maximum r.f. output, the neutralizing capacitor then adjusted for minimum carrier; audio was then fed in and an output of about 100 mV p.e.v. obtained. Measurements showed a carrier rejection of 65db with what G3TAG calls " this crude bird's nest " and he feels that a little screening would probably bring this down to about 90db and he adds: " without a doubt this is the best balanced modulator I have tried; carrier insertion is easy, just add a d.c. supply to the audio input; the simplest to build, easiest to set up, and most stable yet? "

This seems yet another example of what one writer on IGFETs stressed recently: " these devices make possible simple and often superior circuits and merit consideration in virtually all applications which presently use transistors or valves."

IGFET Precautions

In previous articles we have pointed out the special handling procedure necessary with IGFETs, but it seems worth listing various points made in a special leaflet on the subject by MCP Electronics:

Shorting wire should be kept wrapped around leads of devices whenever possible, and always during storage. When this shorting wire is to be removed, hold the leads between finger and thumb of one hand.

Never allow a gate lead to float since there is then no bleed path for electrons. Sufficient static charges can build up to cause permanent breakdown of the gate oxide.

Always use a soldering iron with an earthed tip.

Beware of voltage transients in the test or power supply equipment (short duration voltage transients even when only present on the source or drain can damage these devices).

Do not attempt to measure gate leakage current (the extremely high impedance of the gate would make this operation hazardous with conventional techniques).

The firm also points out that because of input impedances of the order of 10^{15} ohms extreme care should be taken to avoid voltages in excess of the maximum rated breakdown voltage from being accidentally applied to the gate-to-source of gate-to-drain leads. MCP say " do not connect, touch or handle improperly grounded power supplies or equipment, as excess voltages or static charges may cause permanent damage to the gate oxide."

As we previously pointed out, these precautions apply mainly up to the time when the device is safely in the circuit with its bleed resistors.

Short-Listed Semiconductors

Unquestionably a major problem with transistors is to sort out from the mass of types now available, a few low-cost devices of particular interest to members. One list of American types was given by W7URZ in QST (October, 1966) covering many different categories. The types he listed were: 2N404, 2N706, 2N3640, 2N3646, 2N2102, 2N3053, 2N3478, 2N3819 (FET), 2N1970 and RCA numbers 40264, 40313, 40251 and 40250.

Ian Black, G8API, has prepared his own selection from those available in the UK of particular interest for u.h.f. and v.h.f. transmitting applications, following the appearance of low-price silicon *n-p-n* types. He writes: " I think that a series well worth mentioning are the RCA 40235 to 40237

(Continued on page 20)

Using R.F. Ammeters

By F. G. RAYER, Assoc. Brit.I.R.E., G3OGR *

AT one time a radio frequency ammeter was commonly included in a transmitter aerial circuit to indicate aerial current. These meters are less widely used today, but nevertheless they can be very useful, and four advantages which occur to the writer are as follows:

(i) When typical readings are established, the meter immediately shows whether the transmitter is providing its usual output.

(ii) If the aerial following the meter is unchanged, maximum meter current always agrees with maximum radiated power.

(iii) If p.a. operating conditions are wrong, maximum loaded p.a. current may not correspond to maximum r.f. output and the r.f. meter shows this.

(iv) Losses or increased efficiency in a replacement aerial coupler will be shown by the change in aerial current. In addition, the r.f. meter is inexpensive, is readily added, and may be left permanently in circuit.

Some limitations of r.f. meters should, however, be listed:

(v) Current readings are changed by modifications to the aerial system.

(vi) The meter alone will not prove the absence of standing waves.

(vii) The meter is of little use in a circuit where normal adjustments change the circuit impedance.

(viii) Readings are cramped towards zero, and more than one meter may be needed.

Despite these disadvantages, the r.f. meter may be felt worthwhile, especially in view of (i), (ii), and (iii).

Positioning the Meter

With end-fed aerials, the meter is placed in the aerial lead itself. If the aerial is operated directly from the usual pi-output the meter is included as in Fig. 1.

If a Z-match or aerial tuner is employed, the meter is

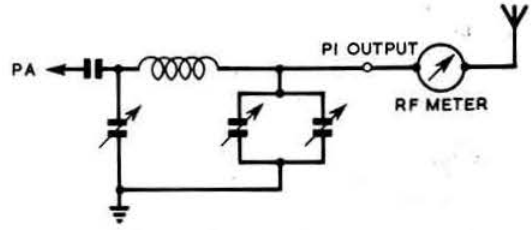


Fig. 1. R.f. meter showing end fed aerial current.

placed after the tuner, as in Fig. 2. The meter must not be inserted between transmitter and tuner, as the maximum meter reading then depends on the lowest impedance at which adjustments allow this part of the circuit to operate, and this may not result in maximum power to the aerial.

The meter shows current (I) only, and power applied to the aerial may be taken as $I^2 \times Z$. As any change to the aerial system will almost certainly modify its impedance Z, the aerial system must remain completely unaltered while making transmitter or tuner tests in which the r.f. output is compared by noting the r.f. meter readings. Provided the aerial system is not changed, maximum reading on the r.f. meter agrees

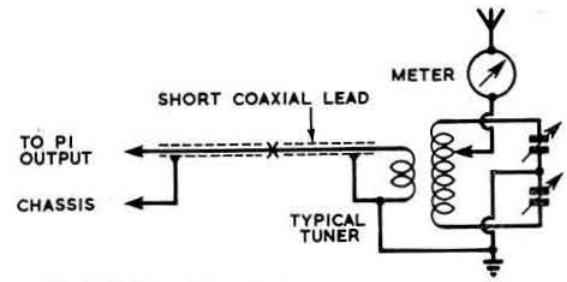


Fig. 2. Position of r.f. meter when using an aerial tuner.

with maximum radiated power, as shown by a field strength meter situated away from the transmitter aerial.

A standing wave indicator is often included at the point "X" in Fig. 2, and shows the standing wave ratio. The tuner or Z-match is adjusted for minimum reflected power, as shown by the s.w.r. indicator, which is usually designed for 72 or 52 ohms. If the aerial system and tuner are suitable, minimum reflected power on the s.w.r. indicator will agree with maximum r.f. current through the ammeter, and so with maximum radiated power. But in certain conditions, when working into feeders having high reactance, minimum reflected power, as shown by the s.w.r. indicator, may not agree with maximum aerial current. If this is the case, adjusting for minimum reflected power will not give best radiated signal strength, and it will probably be necessary to use a different L to C ratio in the aerial tuner, or modify the coupling, or tune out the link reactance with a series capacitor. The latter can be a single or twin 500pF broadcast receiver tuning capacitor for the lower bands, but less capacity will be needed for the higher h.f. bands.

With a twin feeder from tuner to aerial, it is desirable to include one meter in each wire. An initial check could, however, be made with the meter inserted in each wire in turn, and it may then be left permanently in one lead. Unnecessary feeder unbalance, or high stray capacity from meter to earth, should be avoided.

Meter Reading

The meter reads function I in the formula $I^2Z = W$. If the meter is included in a circuit where standing waves are absent, the current anticipated can be estimated from:

$$I = \sqrt{\frac{\text{r.f. power}}{\text{line impedance}}}$$

As a rough guide, the r.f. power may conveniently be taken as 75 per cent of the p.a. anode input, for a class C p.a. to be anode and screen modulated.

For example, if the p.a. input is 100W, the estimated r.f. would be about 75W maximum. Assuming a 52 ohm twin feeder to a dipole, the current expected would be:

$$\sqrt{\frac{75}{52}} = 1{\cdot}2\text{A}.$$

If the line impedance is high, the current is much lower. Assuming 75W output and a 600 ohm flat line, the current expected is:

$$\sqrt{\frac{75}{600}} = \text{approx. } 0{\cdot}35\text{A}.$$

An approximate calculation of this kind allows a suitable meter to be chosen. It will be noted that a doubling of current, as shown by the meter, corresponds to a fourfold increase in power.

When the meter is placed in a flat line, the current will be the same at any point along the line, except for losses, so that reasonable changes in line length will have no practical effect on readings (Fig. 3).

If the meter is placed in a line on which standing waves

* "Reddings," Longdon Heath, Upton-on-Severn, Worcs.

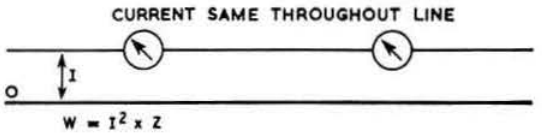


Fig. 3. Current in a "flat" line.

exist, the readings will depend on the proximity, or otherwise, of the meter to a current node (minimum current). This circumstance exists with any line which is not flat and also with tuned feeders.

The change in current expected from the presence of standing waves on the line or feeder can be found approximately by extracting the square root of the standing wave ratio, and using this figure to give the ratio of the power in the line with standing waves, compared to the power in a flat line. E.g., $\sqrt{\text{s.w.r.}}$ = ratio. This gives approximate maximum and minimum figures, corresponding to meter positions where current is a maximum, or voltage is a maximum (current a minimum) on the line. For example, the current in the flat 600 ohm line was approximately 0·35A. If this line were working with a 4 : 1 s.w.r., the current expected would be 0·35 × 2 = 0·7A at a current antinode, and 0·35/2 = 0·17A at a current node. This is shown in Fig. 4.

When the s.w.r. is extremely high, as with tuned lines, the difference in current between the high current and low

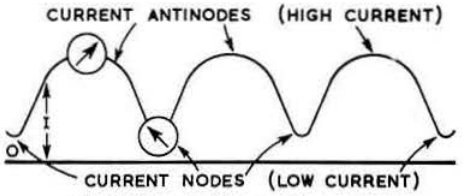


Fig. 4. Current with standing waves.

current points becomes very large. But even in these circumstances, maximum r.f. current will always agree with maximum radiated power, provided the line or aerial is not modified.

Band-changing

The r.f current can be expected to change considerably with a change in band. For example, an end-fed aerial might be a ¼-wave on 80m and thus low impedance. It would be a ½-wave on 40m, but high impedance. So a high current reading would be obtained on 80m, and a low reading on 40m.

It is clear that a meter included in the aerial, or in a tuned feeder, may show great changes in current when moving from one band to another. The low current indication on some bands does not arise from low transmitter efficiency on these frequencies.

When changing frequency in a given band, some change in aerial or tuned feeder current arises, as the position of the current node is modified. This effect is small, for small changes in frequency.

A note of the approximate current at about the middle of each band can be made, and used as a future reference to show that all is working with accustomed efficiency. Transmitter, or coupling and tuning adjustments, are made to obtain the highest r.f. meter reading, with a given p.a. input.

P.A. Efficiency

Any increase in efficiency in a *Z*-match or aerial tuner will be shown by an increased aerial current, with a given p.a. input. An increase in p.a. efficiency will also be shown by the increased r.f. meter reading.

Sometimes maximum p.a. input may not coincide with maximum r.f. output from the stage. This is likely if there is insufficient or excessive grid drive, or if other working conditions are unsuitable. In such cases, grid drive, bias (or grid resistor), etc., can be changed, while observing grid, screen grid and anode currents, to find the optimum values for maximum r.f. output, with given p.a. anode input. Working conditions are naturally adjusted in such a way as to avoid exceeding the control grid dissipation or other ratings.

The r.f. output of the p.a. can be measured with fair accuracy by adding the r.f. meter and load in Fig. 5. This is easily done with a Top Band or low power transmitter, but a

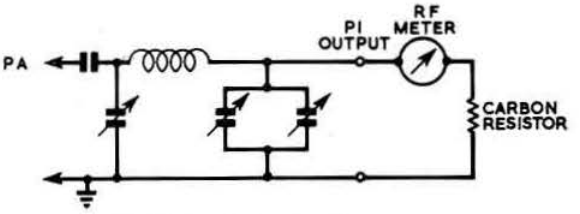


Fig. 5. Non-inductive load for output tests.

suitable non-inductive load becomes expensive with higher power. Heavy duty 50 ohm and 75 ohm non-inductive carbon resistors of 90W rating can occasionally be obtained for this purpose, but for low power, 2W carbon resistors may be used in parallel. Two 220 ohm 2W and two 180 ohm 2W resistors in parallel will provide a load very near 50 ohms, which is easily able to take the output of a 10W transmitter. (Four 200 ohm resistors could be used if available.)

Watts output = I^2R. For example, if 0·4A flows through 50 ohms, then 0·4 × 0·4 × 50 = 8W. The p.a. efficiency as a percentage is:

$$\frac{\text{output}}{\text{input}} \times \frac{100}{1}$$

Assuming 12W input, the efficiency is:

$$\frac{8}{12} \times \frac{100}{1} = 66 \text{ per cent.}$$

For maximum accuracy, the r.f. meter should give about half to two-thirds of full scale reading, and the load resistor value should be measured.

For efficiency tests without using an aerial, a domestic lamp can generally be employed. Its resistance varies with brilliance, but it is suitable for observing output on the meter while adjusting grid drive, etc. This allows maximum power to be obtained, though the actual power is not known. A lamp of 15W to 100W or 150W is chosen, to suit the expected output.

Mounting

It is wise to mount the meter on an insulated panel, or at least away from metal, to avoid excess stray capacity to earth, especially on the h.f. bands. It may be conveniently included on the aerial tuner panel, directly in the aerial lead, when an end fed wire is used. The r.f. meter will generally be employed on the bands between 1·8 Mc/s and 28 Mc/s.

Normally, 0-350mA, 0-1A and 0-2A meters will be most suitable, the 350mA type applying for relatively low power in low impedance circuits, or fairly high power in high impedance circuits. That is, about 6W r.f. into 50 ohms, 9W into 75 ohms, or 72W into 600 ohms. The 2A meter would be suitable for 200W into 50 ohms, which is ample for any purpose. However, the lowest scale marking on the 2A meter may be 0·3A, or even 0·4A or 0·5A, so two meters may

be needed. The 2A meter is of little use for currents under about 0·5A.

If the r.f. meter is included at the point X in Fig. 1, and the pi-network and aerial tuner are adjusted so that the circuit has no standing waves and is working at 75 ohms or other known impedance, the meter reading will be the same as for similar conditions in Fig. 5. The reading for a given r.f. power will also be the same for all bands.

Modulation and R.F. Power

If a 100W carrier is 100 per cent modulated by a sine wave, 25W will be present in each sideband and the r.f. meter will show a corresponding increase in current. The increased aerial current with 100 per cent sine wave modulation is 22·6 per cent; for 90 per cent sine wave modulation, the increase is 18·5 per cent. If modulation is by audio of other than sine waveform, the increase in aerial current will be different. Less increase is also to be expected when a modest common power supply provides p.a. and modulator h.t. and the voltage drops with modulator demands, so that p.a. anode current is then seen to decrease slightly.

With speech modulation, the average power in the sidebands is much less than with sine wave modulation, and the r.f. meter cannot respond to rapid fluctuations. As a result, only an occasional slight upwards movement of the meter pointer will be seen, with near 100 per cent voice modulation.

In the case of carrier-control systems, the meter reading will rise considerably with voice modulation, and remain raised with sine wave or continuous audio tone modulation.

Comparisons

Tests were made with an s.w.r. indicator, remote field strength meter, and r.f. aerial current meter, using the circuit in Fig. 1, with the s.w.r. indicator included in a short piece of co-axial lead at point *X*. Results agreed closely with the details given. Maximum aerial current always agreed with maximum radiated signal strength (the aerial remaining unchanged as explained). With a suitable aerial coupler, tuning up for minimum reflected power on the s.w.r. indicator resulted in maximum aerial current, and thus maximum radiated signal. But it was also easy to tune the pi-network and aerial tuner in such a way that maximum aerial current (and maximum radiated signal) occurred with the s.w.r. indicator showing high reflected power. This is to be expected, in view of the ease with which a pi-network can effectively feed a circuit with a wide range of impedances etc. It is thus apparent that the circuit in Fig. 1 may be tuned for maximum radiated power without the aid of an s.w.r. indicator. But the s.w.r. indicator also allows correct tuning in normal circumstances.

For exacting commercial applications thermo-couple meters have a *frequency relative reading* correction factor. This is normally only a few per cent for currents up to 2A and frequencies up to 30 Mc/s so can be disregarded in the applications dealt with here.

Technical Topics

(Continued from page 17)

and 40238 to 40240 (f_T 1200 and 900 Mc/s respectively at about 10s. 6d. and 9s.). Likewise the STC BSY26 to 29 range, which I think could well be of use in multiplier chains of v.h.f. rigs, with prices anything from 5s. upwards. Bi-Pak Semiconductors Ltd, are offering (*Practical Electronics*) BUY11 at 15s., and Curson's (Canterbury) the AFY19 at 10s. Texas Instruments 2N2369 seems to be retailing at about 25s. Mullard BFY50 to 52 range have typical f_T around 100 Mc/s, maximum collector currents around 1 amp, power dissipation of 800 mW and retail around 8s. to 10s. The BC109 could do with more attention since although designed for a.f. it has typical f_T of 95 Mc/s, and its main claim to fame is its average current gain of 450 to 500."

G8API also draws attention to the valve type EH90, originally designed for use in locked-oscillator f.m. discriminators in dual-standard television receivers. He points out that it has many characteristics similar to the 6BN6 (EN91) but has the advantage of being a hard " valve."

Feedback

Something went wrong with the F8AJ EF183 r.f. amplifier in *TT* (November, 1966, Fig. 1). Although we took care that our circuit was identical with the original in *QST*, we should have spotted that it shows the 10 pF capacitor (C) short-circuited through the band-change switch. G2UJ believes the connection between the wire leading to the first switch rotor, and the 75 pF tuning capacitor should not be there, and it seems pretty certain he is right. This raises the problem of how the input circuit matches to the 75 ohm coax, since on the face of it, just putting a 10 pF to the grid circuit would represent a mismatch and just damp down the grid coil. We have a recollection, however, that one of the American war time receivers used a similar circuit successfully, and that the matching depends upon using the circuit magnification of what is virtually a series-tuned circuit, though our memory may be completely at fault.

John Haydon, G3BLP, is not at all happy about the circuit generally, and feels that the *TT* remarks only added to the misconceptions on the subject of amplifier stability. It was intended to take this matter a little further this time, but we have overrun our space already, so it will have to wait.

The New Electronics

A new series on modern state electronic devices called " The New Electronics " starts on Sunday, 8 January on BBC-1. Integrated circuits, Gunn oscillators, silicon-controlled rectifiers and field effect transistors are some of the newest devices in a technology which was almost unknown 10 years ago.

Power systems, microwave systems, and optical devices are extending the uses of semiconductors into fields where thermionic valves have always been needed in the past.

These 10 programmes which are intended for electrical engineers, radio amateurs, teachers in schools and colleges, undergraduates and sixth forms explain how the devices are made, how they work and some of their uses.

QRV

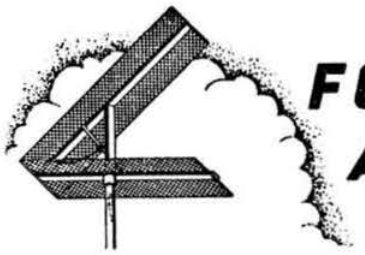
A new issue of *QRV*—the Journal of Royal Air Force Amateur Radio Society—provides a wealth of technical and topical information from many old timers, including Wing Commander " Slab " Connerton (now in Kuwait), Jack Etherington, G5UG and Vic Newport, G3CHW. The register of members lists more than 260 names including those of four Past Presidents of the RSGB.

REF QSL Bureau

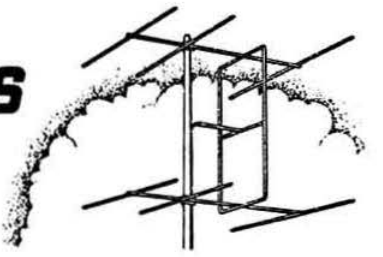
As from 1 January, 1967, the address of the REF QSL Bureau was changed to Post Box 70, Paris 12.

Mullard Film Meetings

Mullard film meetings are planned to take place on the following dates during January, 1967: 10th, Ipswich (Great White Horse Hotel); 11th, Colchester (Red Lion Hotel); 17th, Brighton (College of Technology); 24th, Sheffield (Montgomery Hall); 25th, Doncaster (Earl of Doncaster Arms Hotel); 31st, Hastings (Queens Hotel). All meetings will commence at 7.45 p.m. and the programme will include a talk entitled " Transistors and Television " preceded by the film *Electrons in Harness*. RSGB members are invited to attend these meetings but in order to assist the organizers a postcard should be sent in advance to Mr. Ian Nicholson, Films and Lectures Organisation, Mullard House, Torrington Place, London, WC1.



FOUR METRES AND DOWN



By JACK HUM, G5UM*

TO give the first " Four Metres and Down " in 1967 a flying start it is fitting to say a word or two about the Society's official v.h.f. performance table, which, of course, is the list of members who have won the " Four Metres and Down " certificate. As this list has not appeared for many months it is reproduced on the next page, brought right up to date. And to whet your appetite we reproduce also the certificate itself in inglorious monochrome!

An operator who is reasonably active on 4m, 2m and 70cm can win himself a certificate for each band. If he goes portable on each, he can win a further three sheepskins, for after all, his call-sign will change, *e.g.*, from G3VHF to G3VHF/P (just see who holds this call!).

Then he can get *another* three certificates by working the requisite number of counties and countries mobile (try that on 70cm!). And if he decides to set up station at a fixed alternative address he can make a bid for yet another chain of three " Four Metres and Down " certificates, using /A after his call.

All of which tends to sound rather theoretical, for most of us will feel that endeavour earns its own reward by the achievement of perhaps a couple of certificates for the bands one works most, with a /P thrown in for good measure.

Now none of this can come to pass unless the required QSL cards are safely gathered to prove that contact has been made with three countries and 20 counties on 70 Mc/s and 432 Mc/s, and six countries and 30 counties for 145 Mc/s, which is not an easy matter, and the more difficult still if the Two Metre Senior is aimed at, with its requirement of 15 countries and 60 counties verified.

Why is it difficult? Largely because the generality of v.h.f. operators have moved on from the stage when QSLs seemed important, so that the act of exchanging cards becomes the exception rather than the rule.

This makes it hard on those members who are within a card or two of the required total. It denies them the privilege of seeing their call-signs appear in what is the premier performance table in British v.h.f. Amateur Radio, not to mention the pleasure of seeing the certificate adorning the radio room wall.

Common courtesy calls for an acknowledgment to be made of every QSL received. It is not unknown for operators who do not collect to return cards endorsed with a note saying so, a practice which at least informs the recipient that he should try elsewhere if he seeks a card from a particular county or country.

Next time the " Four Metres and Down " performance table appears in print it will contain, no doubt, many more call-signs. They may well be there thanks to *your* card!

Now for "Twenty Three"

Everyone who studied the quite remarkable results achieved in the September and October 1296 Mc/s contests, as published in " Contest News " last month, will feel it is about time 23cm enjoyed some recognition in the way of an operating award.

The requirement here is to work three countries and 20 counties, thereby making this award at once one of the most difficult to achieve and most challenging to try for. And once again—back to QSLs—the need to make sure that contacts are verified so that claims may be put in is supremely important.

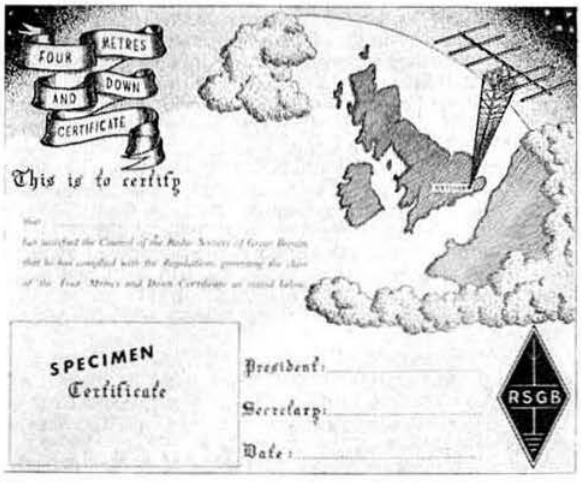
If the Editor doesn't object, we think we will suggest that the call-sign of the first winner of the 23cm " Four Metres and Down " certificate shall have extra bold type in a panel all to itself. It will deserve it.

What seems pretty evident is that aspirants to this award will be making for the high spots when weather permits in order to raise their totals of countries and counties, and this in turn is going to require the design of some lightweight and economically powered equipment. On this subject see " Of Varactors " below; but before we get there just another word about QSLs, and this time in not so happy a context . . .

QSLs—The Darker Side

As is inferred above, the QSL card has its uses. It also has its misuses, and one such, going beyond misuse to positive abuse, has come to our notice.

A newcomer to 2m in Kent was very pleased when a QSL came through the Bureau for a contact he had made with a



Who will be the first winner of the 23cm "Four Metres and Down" certificate?

* 27 Ingasby Lane, Houghton-in-the-Hill, Leicester. Please send reports for the February issue to arrive by 8 January and for the March issue by 6 February.

PA station. He was even more pleased when a listener report was received from a member in Malta saying that he had overheard the QSO.

Our Kentish friend was understandably sceptical. For one thing his beam direction, right for PA, was wrong for Malta. For another, the power input was very modest. And yet and yet . . . sporadic *E* has been known to do very peculiar things. After all, nobody believed the first YU-to-G contact on 2m to be true when it happened all those years ago, yet it was. A request to Malta for more information elicited the answer that the whole thing was a frame-up. The man in Malta didn't even possess any v.h.f. gear.

The Kent member has taken the blow stoically, but he *does* make the point that blank QSLs should never be used as visiting cards or in any way that can offer temptation to someone else to fill them in.

Of the mentality of the person who somehow acquired a Malta QSL in the present case and used it for a legpull . . . yes, *you* say it.

Enough of that, and back, as promised, to the much more savoury subject of varactors . . .

Of Varactors

A dozen years ago those of us who sought to commence operation on the 432 Mc/s band in the least expensive way possible would no doubt have used an 832A tripler—yes, modulated anode and screen and not sounding at all bad at that.

Then came the " miracle valves " that permitted unheard of levels of output at modest orders of drive, the QQV03-20 and QQV06-40. These, coupled with better aerials, did more than anything else to invigorate 70cm up to the time, almost three years ago now, that the G8-plus-threes arrived on the scene and really turned it into an active band.

With the impetus of V.H.F. NFD applied at much the same time the incentive to build 70cm equipment that would remain viable under portable conditions was strong. There was just one major snag: it was so jolly thirsty!

And now, once again, along comes a seemingly miracle device that affords plenty of r.f. out for very little in, the Varactor. Quite apart from what has been contributed by its users to " Four Metres and Down," the device significantly appears three times in the list of participants in the Second 432 Mc/s Contest, 1966 (see page 837 last month). One may forecast with confidence that it will figure increasingly in future u.h.f. contest tables.

What ought to be placed on record is that the device has not " sprung, fully armed " upon the scene, but that it has been the subject of much painstaking, sometimes frustrating and often rewarding experimental work at a nucleus of Home Counties stations, and at probably a number of others beyond, though little has emerged in print from what has been done. (An article by G8AKM will appear in an early issue of the BULLETIN.—Editor.)

Last month's claim by G3OUL to be the first north western station to put a Varactor tripler into commission on 432 Mc/s has evoked a friendly challenge from G8ANY a bit further up the Lancashire coast who writes: " As far as I know, I was the first station in the north west to use a Varactor as a tripler to 70cm. My log tells me I first made contact with G8AFJ at about 14.45 GMT on 16 July, followed by operation in the North West V.H.F. Contest on 17 July."

Dave's tripler is a BAY66 driven by a 144 Mc/s unit with three EL91 and a QQV03/10. He estimates he realizes 4/5 watts out for about 6 watts of r.f. in. When operated from Barr Beacon near Birmingham it worked GW8ACG/P on a number of occasions.

Even video has passed through the G8ANY Varactor, the picture modulation from a Vidicon camera being applied to the QQV03-10 driver's screen.

Four Metres and Down Certificates

The following is an up-to-date list of those who have qualified for these certificates. A leaflet giving details of the conditions of issue may be obtained from Headquarters on request.

70 Mc/s Transmitting Section

1 G3EHY	11 G3NDF	21 GI3HXV
2 G3PJK	12 G3IMV	22 G5UM
3 G2AIH	13 GI3HXV/P	23 G3OJE
4 G3OHH	14 G3SKR	24 G3SEK
5 G3KEU/P	15 G3OUF	25 G3RWM/P
6 G3NUE	16 G3BNL	26 G3FDW
7 G3IUD	17 G3PMJ	27 G3PPG
8 G6NB	18 G3PHG	28 G3FIJ
9 G8PD/A	19 GC3OBM	29 G3GGL
10 G5FK	20 G3TLA/P	30 G3RDQ

70 Mc/s Senior Transmitting Section

1 G3SKR

70 Mc/s Receiving Section

1 BRS15744

144 Mc/s Transmitting Section

1 G3HBW	30 G3EJO	58 G2PL
2 G3BLP	31 G3PBV	59 G3FZL
3 G3MTI	32 G3FDG	60 G3SAR
4 G5YV	33 G3OSA	61 G3NUE
5 G3BNL	34 G3JLA	62 PA0EZ
6 G3MCS	35 GC2FZC	63 G3AHB
7 G3LAR	36 G3BOC	64 G3PTM
8 G3CO	37 G3MTI/M	65 G3LAS
9 G3BA	38 G3OJY (New	66 G3RMJ
10 GW3MFY	QTH)	67 G2CDX
11 G3DFL	39 G3JWQ	68 G3ORL
12 G3NAQ	40 G3NOH	69 G2DHV/P
13 G3NNG	41 G3PSL	70 G3FIJ
14 G3OJY	42 G3LBA	71 G3CXM
15 G3KPT	43 G3FUR	72 G3HRH/P
16 G3JYP	44 G2BJY	73 G3BDS
17 G3KMT	45 G3MRA	74 G3FNM
18 G3OHD	46 G3AGN	75 G3IMV
19 G3BBR/A	47 G3MDH/P	76 G2BQ
20 G3HRH	48 G3GMY	77 G3KHA
21 GM3EGW	49 G3GGK	78 G3OHC
22 GI3OFT	50 G3MDH	79 G3SHZ
23 G3OBD/P	51 G3NLR	80 G3PKT
24 G2HIF	52 GM3LDU	81 G3UFA
25 G3JDN	53 G3CKQ	82 G3RST
26 G8VZ	54 G5HZ	83 G5NU
27 G2AXI	55 G3NNK	84 G2BHN
28 G3JYT	56 G6GN	85 G3OZP
29 G5UM	57 G5ZT	86 GW3KYT

144 Mc/s Senior Transmitting Section

1 G3CCH	5 G3CO	9 G3HRH
2 G3FAN	6 G3BA	10 G8GP
3 G5MA	7 G6NB	11 G3LAS
4 G3BLP	8 G3EDD	12 G3IMV

144 Mc/s Receiving Section

1 BRS22550	4 BRS15744	7 A3470
2 BRS22322	5 NL687	8 A4048
3 BRS15822	6 BRS20108	

144 Mc/s Senior Receiving Section

1 BRS15744

432 Mc/s Transmitting Section

1 G3NNG	6 G8AAZ	11 GW8ACG
2 G3KPT	7 G8ABP	12 GW8ACG/P
3 G3LHA	8 G3AHB	13 G8AHQ
4 G3BNL	9 G5UM	14 G8HEJ
5 G3MCS	10 G8ACQ	15 G8HGG

All applicants for these awards are reminded that a duplicated check-list together with a copy of the rules, is available upon request from Society Headquarters. Use of this list makes the recording of a claim and the subsequent checking easier and reduces the chance of a delay resulting from an inaccurate claim.

UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

PERMIT FOR ALIEN AMATEUR RADIO LICENSEE TO OPERATE IN THE UNITED STATES, Its Possessions and the Commonwealth of Puerto Rico

CHARLES JOHN BEANLAND
17 BEACON HUNT DRIVE
WEST ACTON, MASS. 01720

Effective date of this Permit: NOV 4 1966
This Permit Expires: NOV 4 1967

The above-named alien is hereby authorized to operate the following described amateur radio station in the United States, its possessions, and the Commonwealth of Puerto Rico:

Licensee or Serial Number	Licensing Country	Call Sign	Expiration date
NONE	ENGLAND	G 3 B V U	NONE

Operation under this permit must be in accordance with (1) Current International radio regulations, (2) the terms and conditions of the bilateral agreement for reciprocal amateur radio operation between the alien's Government and the Government of the United States, (3) Subparts A through E and G of Part 97 (Amateur Radio Service) of the Rules of the Federal Communications Commission, (4) the terms and conditions of the license issued to the alien by his government, and (5) the special conditions listed below.

This permit may be summarily modified, suspended or cancelled by the Commission without advance notice.

SPECIAL CONDITIONS:

FEDERAL COMMUNICATIONS COMMISSION

Ben F. Waple
Secretary

The piece of paper that means reciprocity. When John Beanland made a flying visit to England from the States he called on his friend and one time near neighbour Maurice Pyle, G2BLA, of Welwyn in Hertfordshire, and left him a photostat of his American licence. John's original British call of G3BVU must certainly cause a bit of a stir when it appears in New England on v.h.f., even with the W1 suffix.

Plan for "Four"?

It is worth placing on record that the " Four Metre Band-plan Questionnaire " which could be obtained at the RSGB stand at the RSGB Radio Communications Exhibition was filled in and returned by no less than 120 members. From the comments made, which are being analysed by the Society's V.H.F. Committee, it would appear that the majority tend to favour a c.w. segment at the bottom end of the 70·1–70·7 Mc/s spectrum, although it is only fair to add that the more elaborate plan sponsored by G3OUF received much support.

BAND PLAN

for

FOUR METRES

A band plan for 4m, based on the zonal plan published on page 804 of the December 1965 RSGB BULLETIN, is being considered by the V.H.F. Committee. Members who have views on this subject are invited to write to Headquarters for a

QUESTIONNAIRE

If *you* would like to have a copy of the 4m questionnaire send a stamped addressed envelope to Headquarters and a note asking for one, and it will be with you in the course of a post or two. Comments from operators in areas remote from the Home Counties are particularly requested.

Beacon Stations

It is perhaps natural to take the Society's beacons for granted as something always there whenever a signal is wanted either as a converter-liner-upper or as a marker to conditions (but don't let this stop you from putting out a CQ on a dead band).

The service areas of the newer beacons, although predictable, have their surprises. It is to be expected, for instance, that GB3GI in Northern Ireland and GB3GW in South Wales should reach 50 miles or so. *But how much farther?* If you are beyond 50 mile radius from either please report how you are receiving them.

Tech Corner

From G6LX:

I do not go along with the spate of criticisms that have arisen concerning operation on v.h.f. sideband. It is true that a number of commercial s.s.b. transmitters (and some home-built ones, too) have inherent spurious emissions, usually at a low level, and these show up when the offending transmitter is used to drive a v.h.f. mixer. The position can be made worse by the generation of further spurious emissions by mixing of the oscillators in the s.s.b. generator with the oscillator in the v.h.f. mixer unit and other unwanted outputs from the s.s.b. generator and v.h.f. mixer. I have even had trouble due to a mix from the receiving converter oscillator and one of the oscillators in the s.s.b. generator.

Some commercial transmitters are worse on one band than on the others. I find 14 Mc/s is fairly clean with most of the s.s.b rigs that use l.f. filters (400–500 kc/s); 21 Mc/s is also usually good but most are in trouble on 28 Mc/s. Those s.s.b. exciters that use h.f. filters are often easier to clean up than the l.f. types.

My 500 kc/s mechanical filter exciter had six spurious responses on 144 Mc/s when I started (using 28 Mc/s as the drive frequency). Changing to 14 Mc/s drive reduced the responses to two, one of them 60db down, the other only 10–15db down. A simple series trap cured the high level one, but I have been completely unable to cure the low level one without losing all my s.s.b. drive.

My 9 Mc/s crystal filter exciter exhibited only one small spurious response using the 28 Mc/s output to mix with the 4m and 2m converters, and as it is more than 100 db down I do not feel it causes trouble.

Having the facility of v.f.o. and VOX on 2m and 4m and the ability to QSY even a few kc/s really pays off. On 4m the s.s.b. exciter is used as a driver for both s.s.b. and a.m., the QQV03-20A being switchable as a class AB1 linear for sideband or as a class C modulated amplifier for A3. On 2m the a.m. facility is useful for talking to mobiles that have no b.f.o. on their receivers to permit sideband injection.

In the present context may I comment on two contributions to the December " Tech Corner "? May I say that I fully agree with G3LLJ about using low power injection for v.h.f. transmitter mixers? I originally used 20 watts of s.s.b. drive through a suitable attenuator and filter. Changing to low power drive direct from the driver stage of my s.s.b. exciter reduced the spurious levels quite a lot.

Secondly, referring to the comments from G3JGO, I

V.H.F./U.H.F. BEACON STATIONS

Call-sign	Location	Nominal Frequency	Emission	Aerial Direction
GB3ANG*	Craigowl Hill, Dundee	145·985 Mc/s	A1	S
GB3CTC	Redruth, Cornwall	144·10 Mc/s	A1	North-East
GB3GEC*	Hammersmith, London	431·5 Mc/s	F1	
GB3GI	Strabane, N.I.	145·990 Mc/s	A1	
GB3LER	Lerwick	145·995 Mc/s	A1	S
GB3LER	Lerwick	70·305 Mc/s	A1	N/S
GB3LER	Lerwick	29·005 Mc/s	A1	N/S
GB3VHF	Wrotham, Kent	144·50 Mc/s	F1	North-West

*Not operational

RSGB V.H.F. BEACON STATION GB3VHF

The frequency of the Society's v.h.f. beacon transmitter at Wrotham, Kent, when measured by the BBC Frequency Checking Station, was as follows (nominal frequency 144·50 Mc/s):

Date	Time	Error
9 November	11.02 GMT	228 c/s low
16 November	10.30 GMT	300 c/s low
23 November	11.15 GMT	300 c/s high
30 November	12.00 GMT	100 c/s low

have used the TR1997 as the basis for a 2m mixer for sideband. I can confirm that it makes quite a good basic unit, although the old SCR522 is easier to convert, using the first 832 as the mixer and the second one as the p.a. The earlier valves with modified circuit values provide the injection to the mixer. In the TR1997 I used the QV04-7 as the mixer and the TT15 as the p.a.—but I still prefer a balanced configuration for a v.h.f. mixer!

From G8ANY*:

Further to the comments about modulation quality using Varactor triplers at 70cm, a simple arrangement at G8ANY was to modulate the QQV03-10 driver stage at 144 Mc/s with a 12AX7-6V6 line-up using the transformer from a 19 Set v.h.f. unit as the modulation transformer. Local stations who reported this as acceptable found the modulation difficult to read using higher power Varactors. Users of Varactors may very well find that the tuning of the idler circuit (288 Mc/s) seems to have quite an effect on the modulation quality. As a point of interest I was 17 years old when I built the Varactor unit. The design was by G3KPT, to whom all credit.

* (Morse test passed and G3 licence applied for!)

From G8AGG:

A 70cm to 23cm Varactor tripler has just been completed at G8AGG, and is producing 2-3 watts of r.f. at 1296 Mc/s using a half-wave cavity on the output. However, one feels that the efficiency is not very good when one is putting about 10 watts in at 70cm.

I have tried a number of different types of Varactor in this tripler, the lower-capacitance varieties showing up best. Conclusions are:

(a) that the BAY96 power diode is not really suitable for tripling from 70cm to 23cm;

(b) a more suitable Varactor would be the lower power BAY66, which has a much lower junction capacitance. It is also relatively cheap!

(c) the Varactor is certainly the answer to 23cm portable operation, although I still have reservations about using a.m. (ideal for c.w., though!).

Skeds Wanted

By G8ANY, Blackpool: with EI, GI or Yorkshire stations on 432 Mc/s. Write Dave Woodhall, 67 Belvere Avenue, Blackpool.

By F5NS, three miles from the Normandy coast: requests skeds on 2m, a.m. or c.w. (He receives GB3VHF almost every day, off the *side* of its beam.) Write Dominique Lecluse, 11 rue de l'Eglise, Douvres la Delivrande, pres de Caen, Normandie.

Here and There

What, you *didn't* get a diary for Christmas after all? See if your local Boots or W. H. Smith's have got any left over after the Yuletide rush, for there's a most important date to put in: Saturday, 13 May, 1967, the date of the International V.H.F. Convention at Whitton, Middlesex.

* * *

More dates . . . those intriguing new Cumulative Activity Contests announced last month on page 839. These, catering for 2m and 70cm, do not clash with any of the established v.h.f./u.h.f. contest dates for the present year. Polish your brasses and decoke your mikes in readiness!

* * *

Another activity contest: DARC invite 2m and 70cm operators to work one another *every evening* 9-16 January, inclusive, plus the afternoons of the Saturday and Sunday, one point per kilometre. You may work the same station each night if you get the chance. Usual rising serial number.

" For the final score you have to select any three weekdays *and* Saturday *or* Sunday," says V.H.F. Manager DL1LS. Logs to DL9GS, 4521 Oldendorf, West Germany, by 31 January. Full details on GB2RS.

* * *

" I have no strong views about the G8-plus-threes on 2m without Morse: this could well be a good thing. What I do not understand is this business of slow Morse transmissions for them. If they *really* want to learn the code a simple converter (single valve would do) working into the i.f. strips of their 432 Mc/s receivers will enable them to get the excellent RSGB slow Morse transmissions on 160 metres "—G6LX.

* * *

If during the coming mobile season you hear PA9DHV don't be suspicious: it'll be old friend George Haylock, G2DHV, who can now officially add this call to his DJ0AA, ON8IR and others already held and activated for fixed and mobile working on 2m during his Continental forays.

* * *

Final-final: our friend Grundisthorpe has just remarked that conditions are never bad on v.h.f., either normal or above normal. " And as they're normal for most of the time will more people put out CQ calls on 2m during Monday Activity Nights when I'm listening?"

Ninth Scout World Jamboree-on-the-Air

Over 200 stations in Great Britain took part last year in the ninth Jamboree on the Air held during the weekend of 22-23 October. In addition to the various /A and /P calls 40 GB special activity licences were issued. This year's event will be held over 5-6 August to coincide with the Diamond Jubilee of Scouting and the 12th World Jamboree, Farragut State Park, Idaho, USA.

RSGB LONDON LECTURE MEETING

V.H.F. MOBILE RADIO

BY BRIAN ARMSTRONG, G3EDD,
OF PYE TELECOMMUNICATIONS LTD.

WEDNESDAY, 22 FEBRUARY, 1967

INSTITUTION OF ELECTRICAL ENGINEERS
Savoy Place, Victoria Embankment,
London, WC2.

BUFFET TEA	LECTURE
6 p.m.	6.30 p.m.

TICKETS ARE AVAILABLE FROM HEADQUARTERS ON REQUEST

Amateur Bands Receiver

By L. WILLIAMS, BRS25769*

THE writer has long been interested in Amateur Radio, but until two or three years ago was prevented from active participation. When the time became available it was quickly decided that a first essential was a suitable receiver.

Home construction was necessitated by financial considerations, apart from the satisfaction to be derived. Although a newcomer to telecommunication techniques, the writer is no stranger to the uses of thermionic valves. A very much more advanced design than the usual beginner's receiver was therefore decided upon.

Design Criteria

After some discussion with friends who are active amateurs, the following list of the desirable functions of an amateur bands receiver was drawn up:

(i) Each band, 160-10m, bandspread over the largest practicable portion of the tuning scale.
(ii) A low tuning rate with good frequency stability and dial setting accuracy.
(iii) High sensitivity combined with a good signal-to-noise ratio.
(iv) Good selectivity, preferably with variable bandwidth.
(v) Freedom from spurious responses.
(vi) Upper or lower sideband selection.
(vii) A good a.g.c. characteristic with fast attack and fast or slow release.
(viii) An effective noise limiter.
(ix) A tunable rejection notch filter.
(x) An accurately calibrated "S" meter.

To which were added as personal preferences:

(xi) As far as possible only readily available commercial components to be used. The valve types used should be recommended by the maker as suitable for new equipment. Spares should thus be available for a long time to come.
(xii) A minimum of different valve types to be used so that a comprehensive set of spares can be maintained with minimum demands on finance and storage space.
(xiii) A symmetrical panel layout.

Having decided upon the desirable features of the receiver, the circuitry to obtain the required performance was considered.

Modern practice favours double conversion receivers having crystal controlled first conversion oscillators and tunable first i.f. sections. This arrangement must certainly provide the best obtainable frequency stability, and if properly designed is probably the best possible arrangement for a high performance amateur band receiver.

Apart from the difficulty of construction of this type there are also, in the writer's opinion, several disadvantages. Not everyone, of course, will agree that these are disadvantages at all. They are:

(*a*) Separate unganged r.f. tuning is difficult to avoid.
(*b*) The receiver must have a constant tuning range. This means either a very large number of bands (and a large number of crystals) or the popular compromise of 500 kc/s bands. This results in the 160m band occupying only 40 per cent of the scale length, the 80m band 60 per cent and the 40m band 20 per cent.
(*c*) Whatever compromises are made a considerable number of crystals are required. These are not all available surplus and must either be purchased new at considerable expense or etched from surplus crystals requiring considerable time and equipment.

The alternative is a tunable first conversion oscillator ganged to the r.f. tuning and bandspread so that each band covers say 90 per cent of the scale. With proper attention to circuit design and temperature compensation it is possible to make tunable oscillators that approach crystal stability (c.f. the performance claimed for the best transmitter v.f.o.s). The resultant frequency stability will not, of course, be as high as in receivers with crystal conversion oscillators but should be sufficient for all but the most fastidious operator, and in return certain advantages are to be gained.

To obtain the required high selectivity three arrangements are possible:

(i) A low second i.f., usually 85 or 100 kc/s.
(ii) Crystal lattice filter.
(iii) Mechanical filter.

The first was rejected because of the relatively poor skirt selectivity associated with this arrangement. The second requires two or three half lattice sections, say six crystals and three i.f. transformers. It requires considerable time and equipment to set up properly, and if new crystals are used the cost is greater than the low priced mechanical filters now available. On the other hand, if surplus crystals are available, the necessary equipment is to hand and time is available, a very satisfactory filter can be constructed at a modest cost. On balance, a low cost mechanical filter was decided upon, as it has the additional advantages of no adjustment or setting up required, and is very compact.

The mechanical filter chosen has a nominal passband centre frequency of 455 kc/s. This would result in insufficient image rejection unless at least three tuned circuits (two r.f. stages) were used prior to the first converter. This is not a good arrangement as it would require meticulous screening and decoupling to avoid instability. The classical solution is, of course, double conversion.

The foregoing consideration has fixed the basic form of the receiver as a bandspread double conversion design with a mechanical filter at the second i.f. The actual circuit details are next considered.

R. F. STAGES

R.F. Stage and First Converter

A signal-to-noise ratio of 15db at 1mV is by no means an unattainable goal when the bandwidth is restricted to 2·5 kc/s by a filter of good shape factor. To obtain this figure, an r.f. stage before the first mixer is essential. Since multigrid mixer valves are by nature rather noisy devices 30db

* 19 Burcote Road, Pype Hayes, Birmingham 24.

TABLE 1

First Conversion Oscillator

Band Mc/s	Oscillator Mc/s	Second Harmonic	Third Harmonic	Fourth Harmonic
1·8– 2·0	3·42– 3·62	6·84– 7·24	10·26–10·86	13·68–14·48
3·5– 4·0	5·12– 5·62	10·24–11·24	15·36–16·86	
7·0– 7·3	8·62– 8·92	17·24–17·84		
14·0–14·4	15·62–16·02			
21·0–21·5	22·62–23·12			
28 –30	29·62–31·62			

of pre-mixer gain is required to raise the signal well above the mixer noise. The extra tuned circuit also increases the rejection of images and other unwanted signals. For this purpose high L/C ratios are required in the tuned circuits.

The local oscillator for the converter must be highly stable and this requires careful design. After considerable thought it was decided to purchase a fully developed commercial coil pack which was specially designed for the job, the Electroniques type QP.166.

This has optimum bandspread on each band, a frame grid r.f. stage, and temperature compensated coils. The i.f. is 1·62 Mc/s. This unit is the most expensive component part of the receiver, but since it is also the most important and the most difficult to construct the expense is justified. The coil pack is supplied complete with valves and aligned. Although the cost is quite high it is not greatly in excess of the total cost of coils, tuning gang, switch, valves and other components purchased separately.

As no design work is required on this section the only consideration remaining is to calculate the local oscillator frequencies and harmonics for later use in determining possible spurious responses resulting from their beating with the second conversion oscillator.

Second Conversion

A second i.f. of 455 kc/s was chosen because of the availability of a suitable mechanical filter. The ratio of first to second i.f. frequencies of 3·5 : 1 should result in excellent image rejections with only two tuned circuits (one i.f.t.) at the first i.f.

Sideband selection is obtained at this point by switching the second conversion oscillator frequency to first i.f. plus second i.f. for upper sideband and first i.f. minus second i.f. for lower sideband. The carrier frequency is located at the low frequency side of the mechanical filter passband so that all signals are converted to upper sideband at this point. Thus only one fixed frequency oscillator is required for carrier insertion with s.s.b. signals. The approximate oscillator frequencies are shown in Table 2.

The only harmonics falling in any amateur band are u.s.b. 14th at 29,050 kc/s and l.s.b. 25th at 29,125 kc/s.

The location of the carrier frequency with respect to the filter passband is a matter of personal preference, 200 c/s below the 6db down point being a reasonable position. When the carrier frequency has been determined it is used to calculate the actual conversion oscillator frequencies which may vary slightly from the values in Table 2 which assumes 455 kc/s.

Only two spurious responses of sixth order or less is very satisfactory.

TABLE 2

Second Conversion Oscillator

Harmonic	Upper Sideband kc/s	Lower Sideband kc/s
Fundamental	2075*	1165*
2nd	4150	2330
3rd	6225	3495
4th	8300	4660
5th	10375	5825

** The exact frequencies for the second conversion oscillator will depend on the mechanical filter used.*

TABLE 3

Spurious Responses

Band Mc/s	First Oscillator Harmonic	Second Oscillator Harmonic	Order	Response at Mc/s on scale
1·8– 2·0	3rd	5th	8th	1·990
3·5– 4·0	Fundamental	5th	6th	3·750
7·0– 7·3	Fundamental	4th	5th	7·135
14·0–14·4	—	—	—	non below
21·0–21·5	—	—	—	8th
28·0–30·0	—	—	—	

Second Converter Circuit

A type ECH81 was chosen for this duty in line with the policy of a minimum of different types, this valve being used in the QP.166 unit. As only two fixed and precisely known oscillator frequencies are required the oscillator can be crystal controlled with advantage.

The mixer (Fig. 1) is operated under the manufacturer's preferred conditions with a series screen resistor to give a

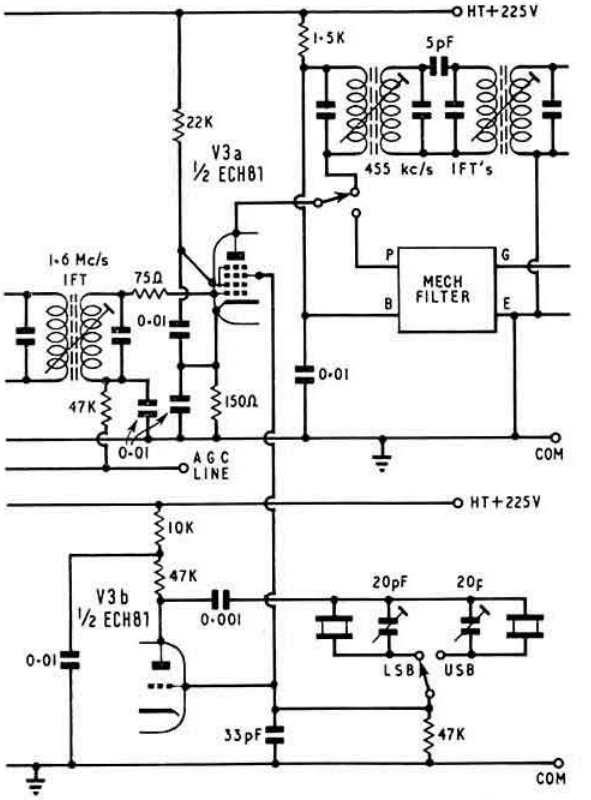


Fig. 1. The second converter circuit, showing the method of sideband selection and alternative i.f. filters.

long grid base for a.g.c. control with minimum cross-modulation. As the oscillator is crystal controlled, a.g.c. can be applied without danger of frequency shift.

The valve has a cathode common to both sections, and so a Pierce oscillator configuration was used. The oscillator h.t. decoupling resistor was chosen to obtain 200μA grid current in the 47 K ohms grid leak. Different crystals may require some variation to obtain this grid current which is the optimum. The two trimmers in parallel with the crystals are for precise frequency adjustment.

The converter is followed immediately by the mechanical filter so that strong signals on adjacent frequencies may be removed before they are further amplified to a level where overloading of the i.f. amplifier may result in a variety of troubles.

For use on crowded bands under difficult conditions the minimum bandwidth consistent with intelligible speech is considered to be optimum. The absolute minimum value is considered to be 2·1 kc/s. The mechanical filter selected, a Kokusai MF455-10K, has a 6db bandwidth of 2·6 kc/s for the specimen supplied.

For use with a.m. transmissions under good conditions a wider bandwidth is desirable; 6 kc/s was selected. To obtain this, two high-Q i.f. transformers (Electroniques de-luxe series 1) were used with capacity top coupling. These are switched in as an alternative to the mechanical filter and should have a similar insertion loss. A second mechanical filter would be a better but expensive solution.

Second Converter Construction

The converter was arranged with the mixer and oscillator in separate screened compartments. The oscillator harmonics are thus confined.

The second i.f. filters are arranged to straddle the mixer screen with input and output terminals switched by separate switch wafers on opposite sides of the screen. The switch contacts are arranged to short circuit the input and output terminals of which ever filter is not in use, to minimise leakage. The 75 ohm resistor in series with the control grid of the mixer is a convenience for alignment; its function is explained under that heading.

Second I.F. Amplifier

For efficient operation of an envelope detector an input of at least 1 volt and preferably a little more is required. With an input of 1μV at the aerial terminal this requires an overall gain, aerial to detector, of at least 120db and preferably 130db. The estimated gain, aerial to second mixer output, is 60db. The i.f. amplifier must thus provide 70db, or 90db taking into account a 20db loss in the input filter. This is easily obtained in two stages (V4 and V5) of 45db each (a voltage gain of 178).

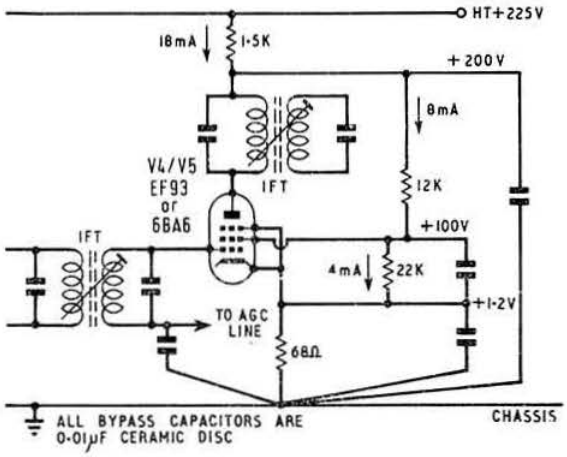


Fig. 2. An i.f. amplifier stage with typical values of current and voltage under zero a.g.c. condition. All bypass capacitors are 0.01μF disc ceramic.

So that bandwidth may be determined only by the input filters, standard i.f. transformers are used throughout the amplifier. High Q transformers might distort the near ideal frequency response of the mechanical filter.

Assuming:
i.f. transformer $f_0 = 450$ kc/s; $Q_p = Q_s = 60$;
Critically coupled; C = 100 pF; L = 1mH.
We have:

$$\text{Gain} = A = \frac{g_m \times Q \times \omega L}{2}$$

$$\text{or } g_m = \frac{2A}{Q\omega L} \text{ (amps/volt)}$$

$$\therefore = g_m \frac{2 \times 178 \times 1000}{60 \times 450 \times 2\pi} \text{ (mA/volt)}$$

$$\therefore g_m = 2{\cdot}1 \text{ mA/V}$$

To allow a margin, type EF93 or 6BA6 with $g_m = 4$ mA/V was chosen for V4 and V5. Consulting manufacturer's data and making a compromise giving the required effective g_m combined with a good a.g.c. characteristic and working at about two-thirds rated dissipation we have:

$V_a = 200$ V
$V_{g2} = 100$ V
$I_a = 10$ mA
$I_{g2} = 4$ mA
$V_{g1} = -1{\cdot}2$ V

The circuit shown (Fig. 2) approximates these conditions using preferred value components.

A.G.C. System

Consideration of all possible a.g.c. systems resulted in the system with the best performance potential being chosen. This is amplified, delayed, compensated and gated a.g.c. Although this sounds very formidable the circuitry is in fact quite simple and straightforward and uses only one more valve than the simplest and most elementary a.g.c. system. The amplification is obtained at the second i.f. by means of a separate branch of the i.f. amplifier, V12, Fig. 3. This amplifier operates under constant grid bias conditions so that it always provides maximum gain irrespective of the signal amplitude. The input signal to this a.g.c. amplifier stage is taken from the grid of the last i.f. amplifier. The last i.f. amplifier may thus be controlled by means of an a.g.c. bias potential which is totally independent of this stage's own gain.

It is, of course, this dependence of the a.g.c. potential on the controlled stage's gain which produces the usual rising a.g.c. characteristic. Any increase in input to a simple a.g.c. system results in an increase in a.g.c. bias which reduces the gain. The output must, however, increase in order to provide the extra bias. Having a gain controlled stage available outside this loop breaks this vicious circle. If the a.g.c. amplifier has sufficient gain it is even possible to make the receiver output fall for an increasing input.

In practice only a fraction of the total a.g.c. bias is applied to the final i.f. stage. This fraction is selected to produce a fall in gain in this stage which will compensate the inevitable rise in output from the previous stages. As a byproduct, the reduced a.g.c. bias on the last i.f. amplifier stage also improves its large signal handling capabilities.

The a.g.c. rectifier, V13a, is quite conventional, its delay bias being obtained from a potential divider fed from the h.t. line. This delay bias should be as large as possible to allow small signals to receive maximum amplification in the early stages of the receiver and thus get the best signal-to-noise ratio. On the other hand too large a delay bias may

result in overloading and cross-modulation. A delay of 14V was chosen corresponding approximately to 1μV at the aerial terminal.

Manual gain control is provided by a variable negative bias connected in series with the rectifier load. This bias also acts on the diode anode via the i.f.t. and effectively raises the delay bias by an amount equal to the manually selected bias. A.g.c. is thus still effective for increasing signal strengths.

To stop a.g.c. action the delay bias is raised to a value which will prevent conduction of the diode at any signal level which the preceding amplifier may deliver. For very strong signals this may be 200V peak. Fortunately the heater-cathode rating of type EB91 is 330V and it is therefore biased off by opening the delay potentiometer so that its cathode reaches full h.t. potential.

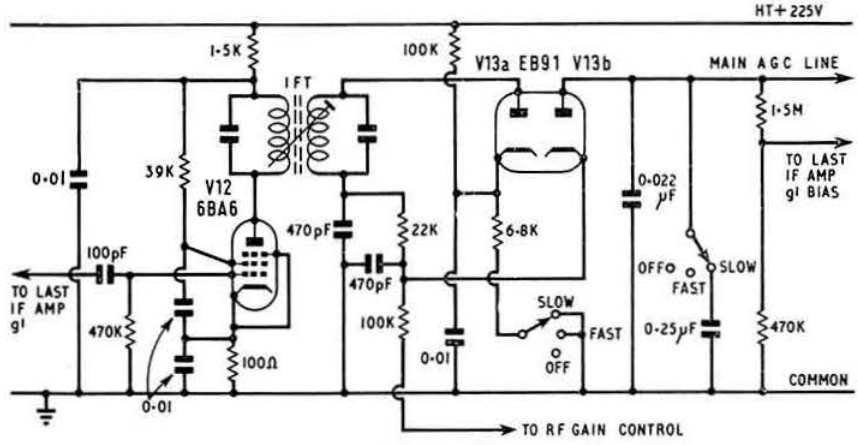


Fig. 3. The a.g.c. section comprising an amplifier, rectifier, gate and variable decay time constant circuitry.

The fast-attack, slow-release action is obtained by means of the gate diode, V13b. The time delay capacitor is charged quickly through the low forward resistance of the diode. When the rectifier output falls below the potential on this capacitor, it is prevented from discharging through the rectifier load resistor by this diode and must discharge through the high shunt resistor giving a slow release action. The discharge resistor forms a potential divider to give the required fraction of a.g.c. control to the last i.f. stage. It is this potentiometer arrangement which prevents the manual gain control bias being connected in series with the discharge resistor in the usual manner. Such an arrangement would result in the last stage receiving the entire amount of any manual control bias instead of the fraction intended.

For simplicity in switching, the release time constant is varied by changing the capacitor rather than the discharge resistor. In accordance with the object of a minimum of different valve types the same type which is used as i.f. amplifier is also used for the a.g.c. amplifier.

A.G.C. Application

Five stages have variable μ characteristics: r.f., first converter, second converter, and both i.f. amplifier stages.

The first converter must operate under constant bias conditions to avoid the danger of its oscillator being frequency shifted due to the change in inter-electrode capacitance resulting from the change in space charge distribution with bias variations. This leaves four stages available for control.

There is some question as to the application of a.g.c. bias to the r.f. stage. The case against is that by using a "straight" valve with a more linear transfer characteristic over the working range cross-modulation is avoided in an area where inevitably low selectivity makes strong unwanted signals available to produce beats. The case for, apart from a better characteristic resulting from more controlled stages, is the limitation of amplification of strong signals so that they never reach a level where overloading of the following stage results. Comparison of the two systems in actual listening tests, also involving partial a.g.c. on the r.f. stage, resulted in full a.g.c. being adopted.

About 25 per cent a.g.c. bias on the final i.f. stage produces a characteristic which rises by only 3db for an increase in input of 80db above a 1 μV datum.

Two time constants of approximately 0·5 and 0·05 second are provided for the a.g.c. release. The attack time constant is less than 0·005 second for the last i.f. stage and much faster for the other stages.

Owing to the use of thermionic diodes there is always a small negative potential on the a.g.c. line even in the absence of any signal. This is due to some of the space charge reaching the anodes and leaking away through the high circuit resistance. This in effect provides additional fixed bias which reduces the maximum gain and anode current in the controlled stages. Tests showed that the sensitivity was still adequate (owing to the 2 : 1 factor of safety used in selecting the i.f. amplifier valves). As any reduction in anode dissipation is a good thing if no adverse effects are to result, no action was taken to eliminate this potential. A resistor in series with the r.f. gain control provides an equal potential when a.g.c. off is selected.

For standby operation a negative potential is injected in series with the r.f. gain control to cut off all the controlled stages.

The Demodulators

Two types of demodulator are required: an envelope detector for a.m. transmissions and a heterodyne detector for c.w. and s.s.b. transmissions.

The envelope detector (V6a, Fig. 4) is quite conventional and is arranged to be always in circuit so that the loading on the final i.f.t. is constant whichever detector is in use.

For the heterodyne detector a mixer type was chosen in preference to a balanced modulator type using semiconductor diodes. Semiconductor diode balanced modulators usually need to operate at low impedance, and to provide this they must be operated via some form of step-down transformer resulting in some of the i.f. gain being lost and the production of a low audio output voltage. For proper operation of an envelope detector, on the other hand, an input of several volts is required, resulting in a comparatively high audio voltage. As it is desirable that the signal from each detector should be of a similar amplitude an output attenuator for the envelope detector would be required, again wasting i.f. gain.

In the system adopted the i.f. output is maintained at about 3V r.m.s. by a.g.c. action, which is sufficient for reasonable efficiency and linearity to be obtained from the envelope detector. For a 30 per cent modulated carrier this detector will have a gain (r.f. in to audio out) of about 0·3.

A 3 volt signal is much too high to apply to the control grid of a mixer valve. A 2000 pF capacitor is therefore connected in series with the existing i.f.t. secondary tuning

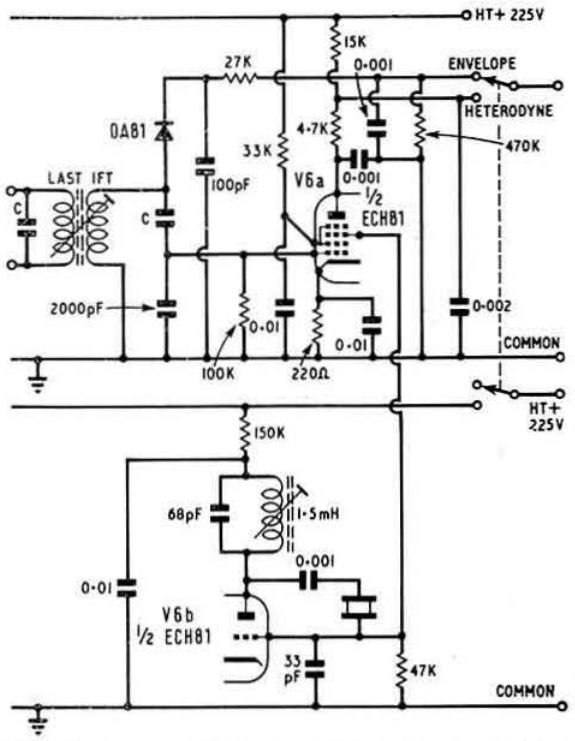


Fig. 4. The envelope and heterodyne (product) detectors which have been arranged to produce an audio output at similar levels, whichever mode is selected.

capacitor of 60 pF in the writer's case. A capacity potential divider of 30 : 1 ratio is thus formed providing a 100 mV signal for the mixer.

The valve used, another ECH81, has a conversion conductance of about 0·7 mA/volt as operated. With an anode load of 15 K ohms this gives an overall gain of $\frac{0{\cdot}7 \times 15}{30}$ which is again approximately 0·3. Thus both detectors give outputs of about 1 volt of audio.

For proper operation of the mixer an oscillator grid current of 200μA in a 47 K ohms grid leak is required. This is obtained from the triode section, operated in a Pierce circuit. A tuned anode circuit was required to obtain oscillation with the writer's crystal. The grid current was set by selecting the h.t. decoupling resistor.

AUDIO SECTION

Output Stage

An output of about 2W from V9 should be adequate. A high power sensitivity is preferred to give maximum flexibility in the choice of audio pre-amplifier arrangements. Any surplus gain can be absorbed by negative feedback with advantage.

Output valves in the required power range tend to have low sensitivity, therefore a larger valve (type EL84) was chosen. Its working conditions were then determined, making full use of the reduced dissipation possible when maximum power is not required.

EL84 Reduced Ratings

$V_a = V_{g2}$ = 225V
I_a = 25mA
I_{g2} = 3 mA
R_k = 270 ohms bypassed
P_{out} = 2·2W at 10 per cent D total
R_{load} = 10K ohms
V_{in} = 300 mV r.m.s. for P_{out} = 50 mW
For $V_a = V_{g2}$ = 250V

Similar conditions exist with R_k = 330 ohms.

The 250V conditions were chosen to enable the output stage to be fed from the first section of the h.t. filter thus rendering separate decoupling of the audio voltage amplifier unnecessary.

Output Transformer Ratio (3 ohm load)

$$= \sqrt{\frac{10{,}000}{3}} = 57{\cdot}5 : 1$$

A 58 : 1 component is available.

Provision for headphone operation is required.

If a load of suitable value (3·3 ohms) is substituted for the speaker, the voltage developed across this load should be of the right order to operate a pair of headphones directly. As the power requirements are low, most of the output will be dissipated in the load and quite a wide range of headphone impedances could be accommodated by adjusting the output voltage with the a.f. gain control.

A closed circuit jack is arranged to automatically substitute a 3·3 ohms resistor when the speaker is disconnected.

Maximum output = $\sqrt{P \times R_{load}} = \sqrt{3{\cdot}3 \times 2} = 2{\cdot}5V$

Audio Voltage Amplifier

A compromise between large r.f. voltages at the detectors for a high performance at the diode envelope detector, and lower r.f. voltages to minimise distortion in the final i.f. amplifier and allow proper operation of the product detector results in an estimated maximum audio signal of 1V r.m.s.

Maximum power level at the speaker terminals demands a potential of 2·5V r.m.s. The estimated overall voltage gain of the power amplifier is approximately unity (control grid to output transformer section), and so a voltage gain of about 3 is required which could be obtained for a low μ triode. However, a high μ type (ECC83) is used for V8a because it is also suitable for the Q multiplier and hence an additional valve type is avoided.

The surplus gain is absorbed by feedback.

ECC83 Voltage Amplifier

H.t. voltage = 225V
Anode load = 220 K ohms
R_k = 3·3 K ohms
Gain 60

The circuitry of the basic receiver is now complete, and all the remaining circuitry is concerned with non-essential but very useful refinements. Since the basic circuitry has already involved a considerable number of panel controls any further additions should have the greatest possible simplicity consistent with adequate performance.

ANCILLARY CIRCUITS

Noise Limiter

As the receiver is intended to operate with signals having no carrier to provide a reference level, self-following limiters are not possible.

For simplicity, a peak clipper with adjustable bias was

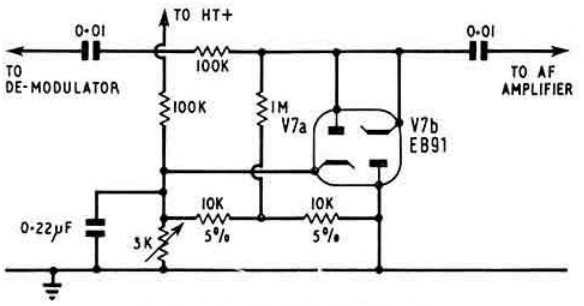


Fig. 5. A single shunt peak clipper.

selected (Fig. 5). When the i.f. bandwidth is reduced to a minimum by a near ideal filter, some of the input noise is already removed, and a simple limiter will not, in most cases, produce any dramatic improvement. However, in the case of impulse noise such as ignition interference it may well make the difference between readability and an unintelligible jumble of noise. It is therefore worthy of inclusion.

Q Multiplier

As selectivity and b.f.o. functions are performed by the mechanical filter and heterodyne demodulator, the only requirement from the *Q* multiplier is a tunable rejection notch.

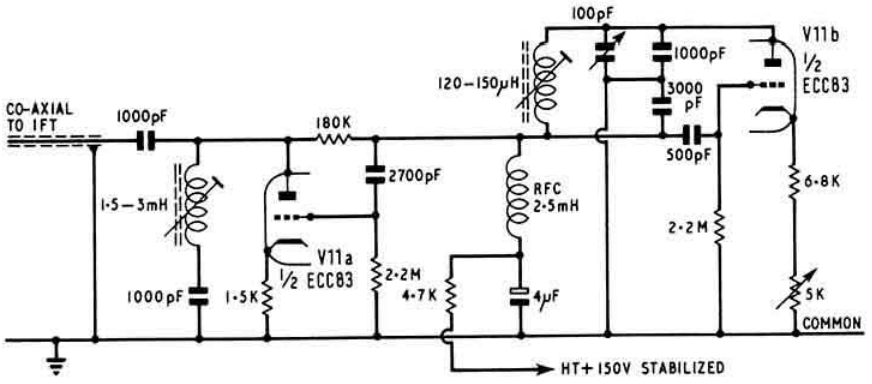


Fig. 6. The standard G2BVN Q multiplier arranged to provide a tunable rejection notch only.

The standard G2BVN circuit, Fig. 6, is used, arranged for reject only. Initially, switching was arranged to disconnect the *Q* multiplier from the i.f.t. when not required. When the *Q* multiplier is connected, the i.f. gain falls by about 6db owing to the shunt load on the i.f.t. This has no adverse effect, as the a.g.c. easily copes with this, and in fact the signal-noise-ratio is slightly improved at 1μV. But owing to the fact that the a.g.c. delay is not now overcome at this level the switch was eliminated and the notch is tuned off the i.f. passband when not required. With optimum adjustment a notch less than 200 c/s wide and over 30db deep was obtained.

S-Meter

A voltage suitable for the operation of an S-meter (Fig. 7) is available at the cathode of any of the gain controlled stages. The r.f. stage was chosen because it was located nearest the S-meter position on the panel. The meter used is a 0-1 mA f.s.d. but any meter of similar or higher sensitivity could be used.

The calibration and setting up is accomplished as follows:

(i) With zero input to the aerial terminals the meter is set to zero by means of the potentiometer.

(ii) With a signal generator delivering maximum output (see below) into the aerial terminals the series resistor for the meter is selected so that the pointer just reaches full scale.

The meter is now calibrated as required by reference to known inputs from a signal generator. Suggested calibrations are:

Voltage at Aerial Termina!	*S No.*
1 microvolt	1
2 microvolts	2
4 microvolts	3
8 microvolts	4
16 microvolts	5
32 microvolts	6
64 microvolts	7
128 microvolts	8
256 microvolts	9
2560 microvolts	9 + 20db

Crystal Calibrator

This is a useful facility which takes the usual form of a 100 kc/s crystal oscillator (V10) providing an output rich in harmonics. When the crystal is purchased new the manufacturer's recommendations should be observed. For maximum accuracy the fine frequency adjustment should be made by comparison with the BBC Light Programme on 200 kc/s. A high resistance voltmeter on a broadcast receiver a.g.c. line will indicate beats between the second harmonic of the crystal and the Light Programme carrier down to as low a frequency difference as may be desired.

The crystal calibrator will be found to be a valuable aid to receiver adjustment and will at the same time enable the receiver to function as a frequency meter.

Possible Additions

There is an unused section of an ECC83 valve in the audio section which could be used in a selective audio filter for c.w. use to provide an effective bandwidth as narrow as 100 c/s, as a gate valve to mute the audio amplifier in the absence of a signal below any selected level for inter-station silencing, or as a cathode follower for any signal required to be externally monitored.

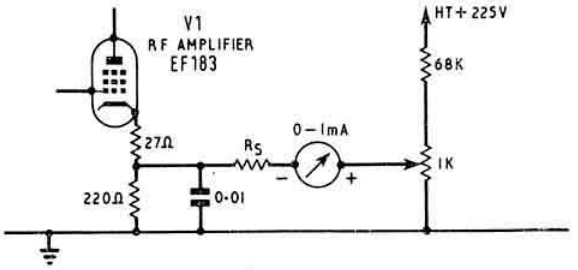


Fig. 7. A simple but very satisfactory method of obtaining a signal strength reading.

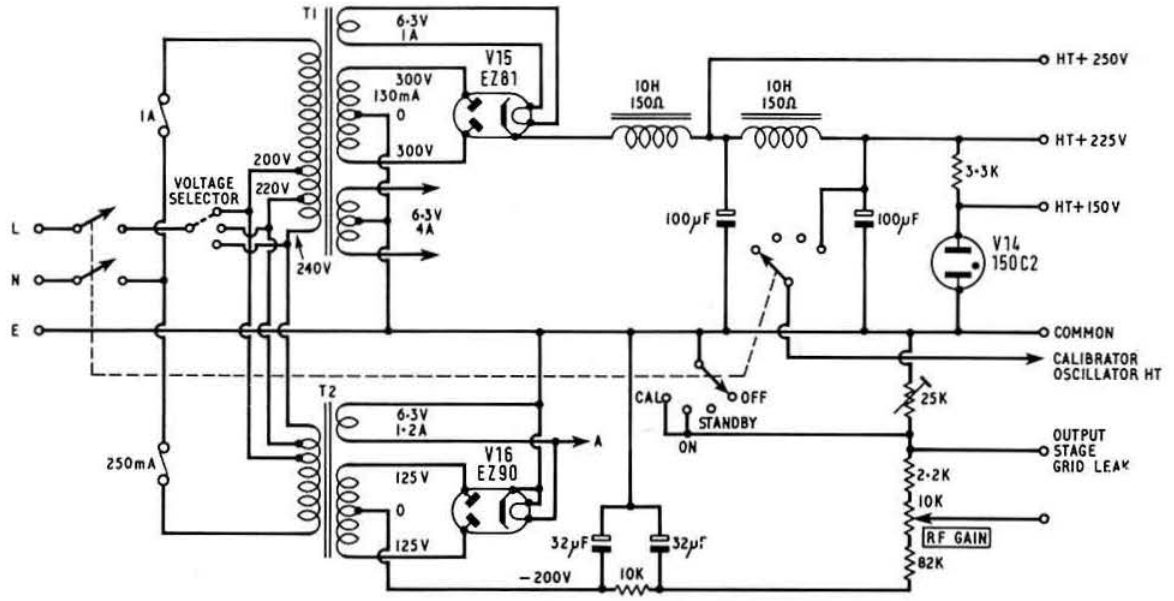


Fig. 8. Power supplies for the receiver. The bias transformer is a Radiospares midget mains transformer.

POWER SUPPLIES

The circuitry so far described requires h.t. at 225V and about 100 mA, a stabilized supply of 150V at a few mA, a total of about 5A at 6·3V for heaters, and also a negative supply for bias. For the main supplies, shown in Fig. 8, a transformer providing 300-0-300V at 130mA plus 6·3V at 4A and 6·3V at 1A, which was intended for a Mullard 510 amplifier, was used. A type EZ81 was used for the rectifier followed by a choke input filter to obtain good regulation (With four a.g.c. stages h.t. consumption varies considerably with signal strength). The type EZ81 is a very slow heating valve so that by the time it is ready to supply current there should be sufficient load to prevent peak rectification. (On standby, oscillators, some of the low consumption stages, and the stabiliser tube still draw current.) However, for safety, 450V wkg capacitors are used in the h.t. filter. The 150V oscillator supply is stabilized by a simple gas regulator.

A separate transformer having 125-0-125V and 6·3V windings is used for the negative bias supply and some valve heaters. Although rather more expensive, a separate transformer has the advantage of producing less surplus voltage to be dropped with consequent heating, and requires lower voltage smoothing capacitors. As the bias system draws very little current a satisfactory degree of smoothing is obtained with capacitors of modest size.

The operational switch consists of a double pole mains switch ganged to a 3 pole 4 way switch wafer. This applies cut-off bias to r.f., i.f. and audio output stages in the STANDBY position and h.t. to the calibration oscillator in the CALIBRATE position.

STANDBY sensitivity is adjustable by means of a preset resistor. Note that to go from STANDBY to RECEIVE it is only necessary to short out this preset resistor so that any remote switching can be very simple. One disadvantage of this system is that there is a delay equal to the a.g.c. release time when the receiver is switched from STANDBY to RECEIVE. This is negligible in the a.g.c. FAST position.

It will also be noted that the S-meter will go over to full scale when STANDBY is selected owing to the r.f. stage being cut off. This does no harm whatsoever.

The complete circuit of the receiver is shown in Fig. 9 on pages 32 and 33.

CONSTRUCTION

The Cabinet

As the writer has only limited metal working facilities a cabinet was purchased. This was one of a standard range by H. L. Smith & Co. Ltd.; type W, 19 in. × 10 in. × 8½ in.

As supplied, the bottom is assembled with flanges outside. The bottom was reversed so that the flanges were inside giving an extra ½ in. depth.

Panel Layout

The layout of panel controls (see Fig. 10), is partly determined by the dial drive (Eddystone 898) and the QP.166 unit. Where possible, the controls are located to give a minimum lead length. Unfortunately this is not always possible without an unpleasing asymmetrical layout. A compromise is effected by locating the *Q* multiplier away from the i.f. section. This has no disadvantages as the *Q* multiplier circuit used is often added externally to a receiver.

The panel controls are (1) main tuning; (2) bandswitch; (3) sideband selector; (4) band width selector; (5) a.g.c. switch; (6) a.f. gain; (7) r.f. gain; (8) noise limiter; (9) demodulator selector; (10) *Q* multiplier notch depth; (11) *Q* multiplier tuning; (12) Operational switch.

Chassis Construction

The chassis is made to fit the cabinet in width, is 2 in. less than the cabinet in length to clear the flanges, and is 3 in. deep. It is made from 18 s.w.g. aluminium. Frames bent from ½ in. × ½ in. × ⅛ in. extruded aluminium angle added to each end stiffen the whole structure and serve to join the corners. They are also a great convenience in enabling

(continued on page 34)

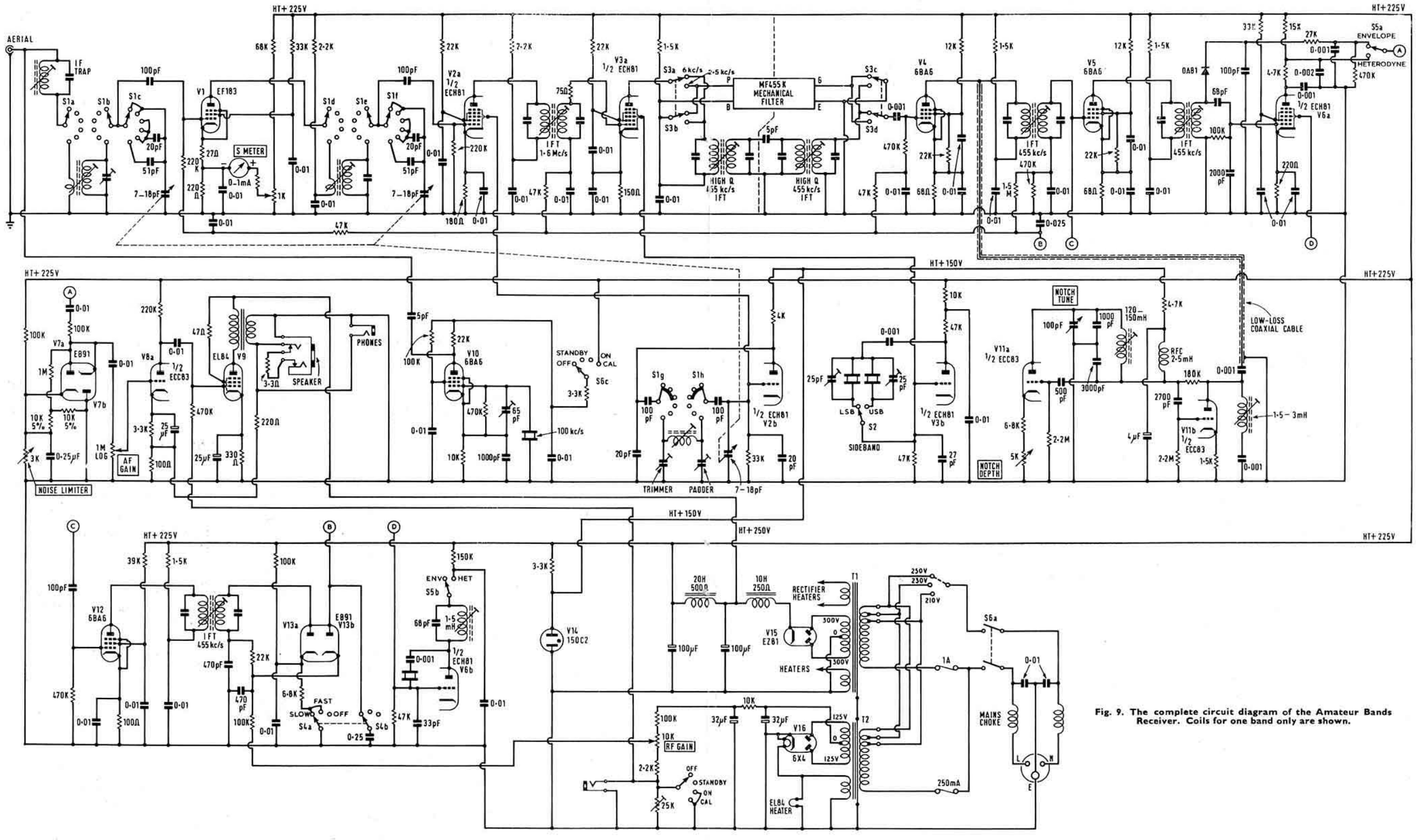


Fig. 9. The complete circuit diagram of the Amateur Bands Receiver. Coils for one band only are shown.

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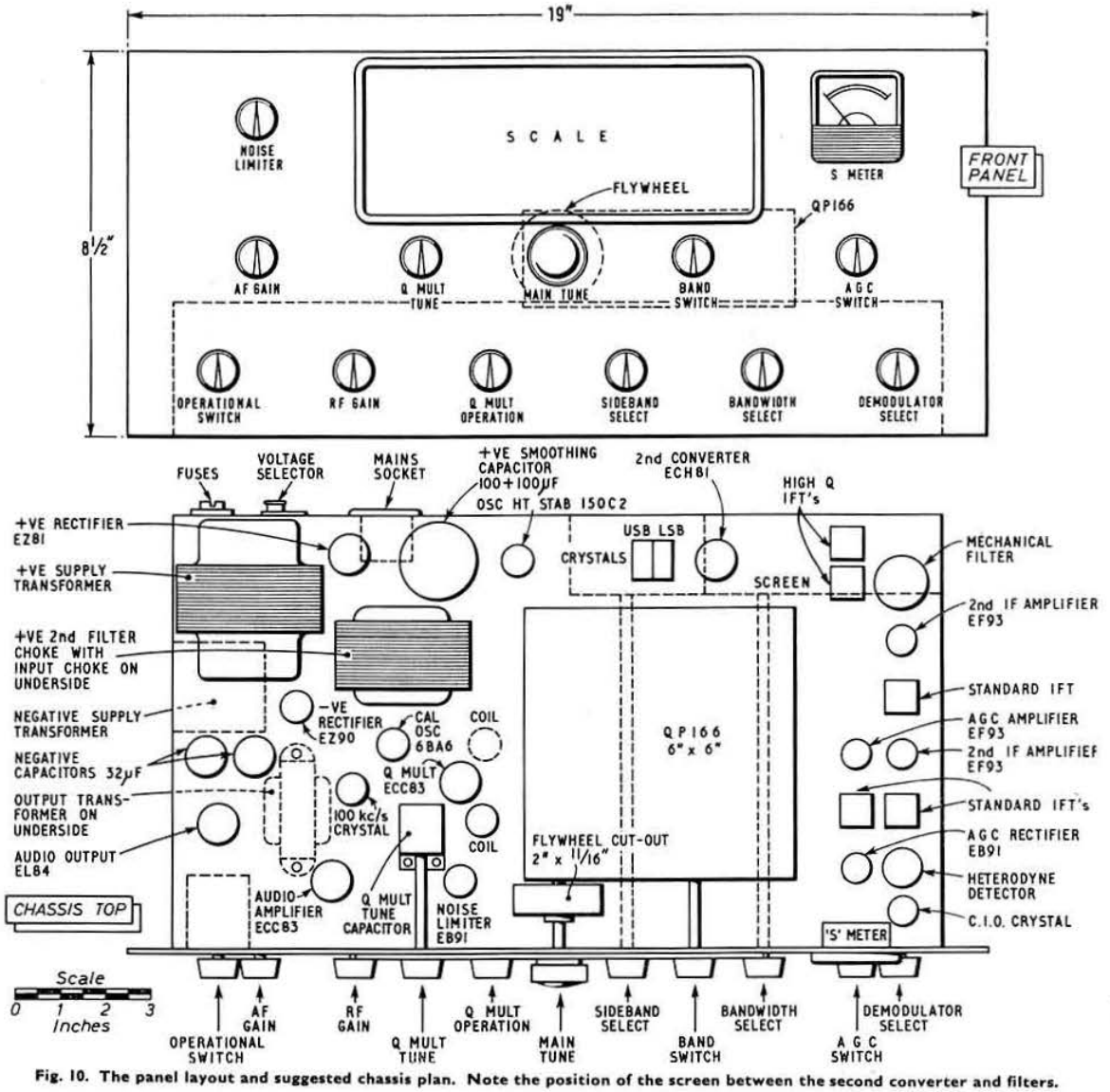


Fig. 10. The panel layout and suggested chassis plan. Note the position of the screen between the second converter and filters.

the chassis to stand inverted, on its back, or on either end.

Two rack handles are added to the front panel for ease of handling and also to make it possible to stand the complete receiver on its front panel.

The cross screens are also made from 18 s.w.g. aluminium and are screwed to the chassis through ¼ in. flanges, thus adding considerably to the chassis stiffness. The cross screens are ⅜ in. less deep than the chassis to clear the bottom flange on the cabinet. No components must project beyond these screens.

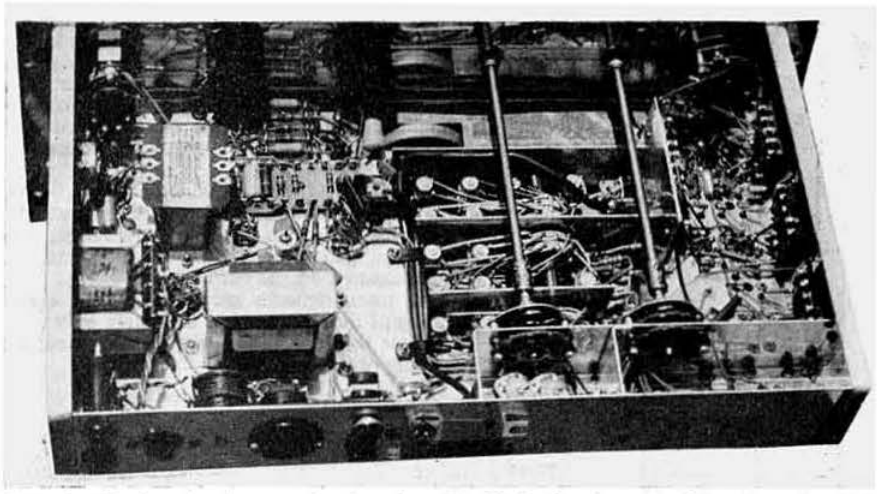
The tuner sits in a 6 in. × 6 in. hole cut in the chassis and is raised so that it lines up with the dial drive (top of tuner chassis 2 in. above main chassis). It is fixed with 6 in. lengths of ½ in. × ½ in. angle which also add considerable stiffness.

Chassis Layout

As far as possible, the components with high heat dissipation are located at either end of the chassis as far away as possible from the first converter which is located in the centre. The power supplies and audio amplifier are located at one end and the i.f. amplifier at the other. The layout (see Fig. 10), was arrived at by the classical process of laying the components out on a sheet of squared paper. No doubt the same process could be used to adapt the layout for other components.

Ventilation

The object of ventilation is to obtain an adequate flow of convected air round the high dissipation components without the resulting heated air currents affecting the



The underside view of the amateur-band receiver. The i.f. circuitry is to the right, the coil-pack is right-centre, and the audio and power components are on the left. The transformer bolted to the chassis side supplies the negative rail, in the foreground is the second h.t. filter choke, and behind this is the audio output transformer.

oscillator compartment. Cold air is admitted through a row of $\frac{3}{4}$ in. holes in the bottom of the cabinet on each side of the chassis. The air passes round the high dissipation components at each end of the chassis and is exhausted through a large hole in the top of the cabinet which is covered by an overlapping plate on spacer blocks. This is, of course, not included in the standard cabinet as supplied.

BUILDING THE RECEIVER

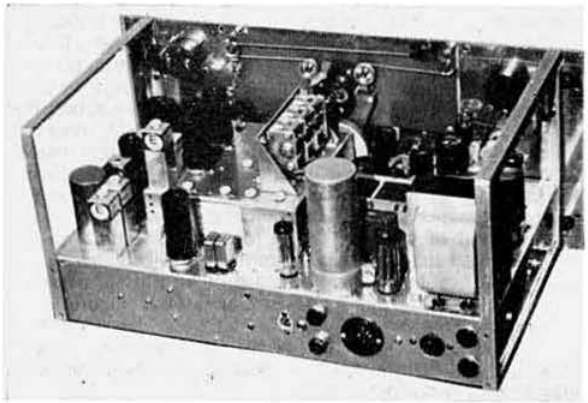
Although the complete receiver with all facilities was planned in its entirety so that the final result would be a properly integrated design, the writer's receiver was built section by section.

The metal work was first prepared as completely as possible with holes to mount all the required components. In the case of i.f.t.s and the tuning unit the dimensions were obtained from the maker's drawings.

The circuits were then added one by one; the power supply first so that each section could be tested as it was built followed by the i.f. amplifier incorporating the mechanical filter so that the converter crystal frequencies could be specified. Although the writer measured his i.f. response to satisfy his own curiosity this is quite unnecessary. A calibration certificate supplied with the mechanical filter gives all the required information.

The tuner unit and second converter were next added. At this point the receiver became operational with a pair of high resistance phones on the envelope detector. The writer's receiver was in fact used intermittently for about six months before it was complete in every planned detail.

This procedure has two advantages: If each section is tested as it is built the number of built-in faults in the complete receiver are minimised and, more important in the writer's case, the necessary expenditure was spread over a correspondingly long period of time.



A photo taken from above the chassis. The components can be identified by reference to Fig. 10.

Alignment

As the front end is supplied pre-aligned, only the i.f. circuits need be adjusted. An inexpensive signal generator will suffice for this. The carrier insertion crystal and the mechanical filter 6db points provide stable reference frequencies. With the mechanical filter in circuit the heterodyne detector is selected and the signal generator tuned until an audio note of about 1·2 kc/s is heard (signal generator unmodulated). This should place the signal generator frequency at the centre of the i.f. passband. An a.c. voltmeter across the speaker terminals is useful as an output indicator. No other apparatus is required. Those readers having more elaborate apparatus will no doubt know how to apply it to good effect.

Final Alignment Procedure

(i) Set the signal generator to the mechanical filter centre frequency and align all 455 kc/s i.f.t.s for maximum signal at the detectors. Inject a signal across the 75 ohm resistor at the control grid of the second converter. Remove the oscillator crystals, disconnect the *Q* multiplier and switch the a.g.c. off.

(ii) Re-connect the *Q* multiplier and then adjust the core of the shunt coil to obtain maximum signal at the detectors with the signal generator as in (i).

(iii) Set the core of the *Q* multiplier main coil so that the signal generator signal is rejected with the *Q* multiplier tuning capacitor at half capacitance.

(iv) Replace the second conversion oscillator crystals, tune the *Q* multiplier notch off the i.f. passband and transfer the signal generator to the aerial terminal and set it to any frequency within the range of the front-end. Tune in the signal on the main tuning control and peak the 1·6 Mc/s i.f.t.s for maximum signal at the detectors.

(v) Switch to the heterodyne detector and tune to zero beat using the main tuning control (signal unmodulated). Switch to upper and lower sidebands alternately and adjust the crystal trimmers until the signal is zero beat on each crystal.

Calibration

This is best accomplished using a crystal calibrator. On some bands commercial stations provide suitable reference

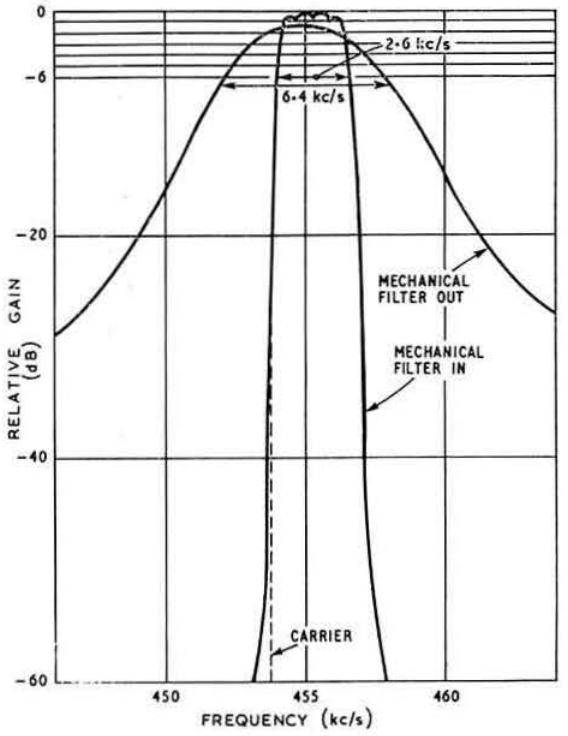


Fig. 11. The measured i.f. amplifier response in the 2·5 kc/s and 6 kc/s selectivity positions.

frequencies to identify which 100 kc/s harmonic is tuned in. The scale is generally sufficiently linear to enable the logging scale to be used to interpolate between the 100 kc/s markers.

PERFORMANCE MEASUREMENTS

To satisfy the curiosity of any reader who may wish to know how the response curves were obtained, and hence what reliance may be placed upon them, the following information is given.

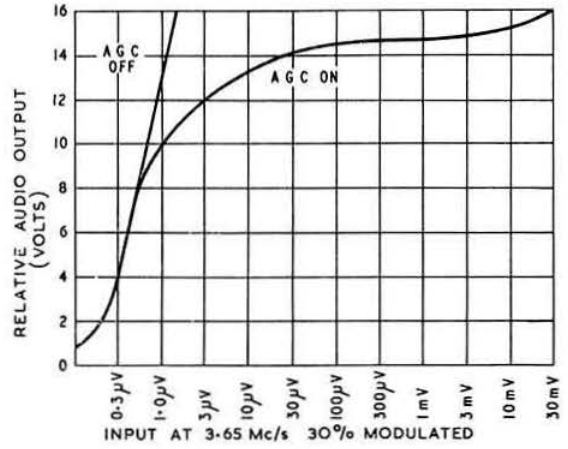


Fig. 12. The remarkably flat a.g.c. characteristic resulting from the use of a separate amplifier.

The frequency response, Fig. 11, was measured using a BC221, the i.f. output being measured on a wideband measuring oscilloscope taking a 0db reference of 50V pk-to-pk output, obtained by suitably attenuating the input from the BC221. The maximum sensitivity of the oscilloscope of 100 mV/cm enabled a 60db range to be measured with reasonable accuracy. (Oscilloscope borrowed from another anonymous source).

The a.g.c. curve, Fig. 12, was obtained using an AVO signal generator with additional 20db and 40db attenuator pads to give better accuracy in the microvolt range. The output of the signal generator and attenuation ratio of attenuators was measured on the oscilloscope.

None of these measurements are necessary to ensure correct functioning of the receiver, but they were only made to satisfy the writer that something like the expected performance was being obtained.

GBR Rugby Re-Opened

The Post Office V.L.F. transmitter at Rugby Radio Station, whose historic call-sign GBR has for 40 years provided a vital link with British ships all over the world, was re-opened on 30 November, 1966, following extensive modernization and reconstruction. Originally designed and built in the early 1920s by engineers of the Wireless Section of the Post Office Engineering Department, the station made history as the world's most powerful transmitter using thermionic valves.

When regular transmission began on 1 January, 1926, it broadcast messages in Morse on a frequency of 16 kc/s (i.e. a wavelength of 18,750m), as well as the Greenwich Time Signal at specific times of the day.

The transmitter had an adventurous history. Its aerial system was extensively damaged in the severe winters of 1940 and 1947 which put it out of action for several weeks on each occasion. In 1943 the transmitter itself was accidentally destroyed by fire, and was rebuilt in six months with only minor changes from its original design.

Recently it was decided to increase the radiated power and operating capability of the transmitter, decisions which involved complete re-design of the valve amplifiers and the modulating equipment, as well as extensive modification of the main aerial tuning circuit. The old transmitter ceased to operate at the end of 1965, after 40 years' notable service. The most striking changes are in the main amplifier stages, where three amplifier panels (each of 18 water-cooled valves), have been replaced by three vapour-cooled amplifier valves which can be used singly or in combination and in the modulator which can generate precision frequency-shift signals as well as c.w. signals at speeds up to 72 bauds. A new control centre has been installed which will also serve the other two low-frequency transmitters in the building.

The new transmitter is now being used for Navy Department traffic and Time Signal emissions. Output power is 450-500 kW and the power radiated from the aerial exceeds 60 kW at 16 kc/s. Both power and signalling speed have been approximately doubled. The transmitter, rated the most powerful and effective unit in Western Europe, was the first in the world to have its carrier frequency stabilized to the accuracy of a primary frequency standard and this has been progressively improved over the last 15 years—the present limit of variation being less than five parts in 10^{10}. It is expected that this can be improved still further, to one part in 10^{10} or better, with the aid of an atomic frequency standard (a rubidium gas cell) in place of the existing quartz resonator. This development will enhance the value of the 16 kc/s emission, already extensively used by scientific investigators throughout the world, as an international standard of frequency and time.

Prior to WW2 GBR was visited on several occasions by groups of RSGB members. G6CL

THE MONTH ON THE AIR

By JOHN ALLAWAY G3FKM

AN apparently very useful suggestion is made by W6ZY in the *DX'er's Magazine* concerning DXpeditions. He suggests that all DXpeditions use standard frequencies, e.g. 14,025,14,045 and 14,065 kc/s, likewise on other bands. It is also suggested by Gus, W4BPD, who has had a great deal of experience in these matters, that frequencies between 14,100 and 14,110, 14,150 and 14,160, and 14,195 to 14,199 kc/s be used by s.s.b. stations in the same category. The only difficulty envisaged by your scribe would arise when two different expeditions accidentally occupy the same frequency, unknown to each other! Another aid to efficient operation would be if the s.s.b. DX station would announce *when* he is listening *above* 14,200 for the USA and *below* that frequency for other callers. This would mean that the r.f. being wasted by the people calling in the wrong place need never be put out on the air, with consequent reduction of interference to other band occupiers. The directional call or call to a specific station should always be respected, but unfortunately one often hears a " QRZ W only " followed by a QSO with a G3!

A fairly large number of comments have been received about the remark concerning the QSLing habits of VE4OX on behalf of the stations for whom he acts as QSL manager. Without exception these have condemned his attitude to cards received via the bureaux and it is sincerely hoped that he will realize that not all amateurs have sufficient spare cash to spend on direct QSLing.

All readers are wished a very happy New Year, and may the increase in sunspot numbers result in more and better DX!

Top Band News

W1BB, king-pin of 160m DX activity, reports that although he was unable to obtain permission to operate /MM while crossing the Pacific en route for Japan he was able to put in some time listening. However, his aerial system had to be put up and taken down again each evening before and after use, so he was unable to listen during the vital sunset period. Stew heard W6HRG in QSO with VE7AKI while some 1600 miles west of W6, and when 3200 miles out heard KL7FRY and W0VXO. No Japanese stations were audible at all, and it seems that the low end of the band was completely blotted out in that area by some commercial phone splatter. No fresh DX possibilities in the Pacific area have been uncovered so far—KH6IJ is not on Top Band at present. Stew wishes to convey his very best wishes to " all the 160 boys " and says he is missing the Transatlantic tests.

According to a number of reports received, Bob Snyder has been in evidence once more in the shape of 9V1LP and also as W0GTA/8F4, and a number of QSOs between Bob and UK stations have taken place. ZD8J on Ascension Island has been heard on the band, but no QSOs have been reported to your scribe so far. As mentioned elsewhere ZD9BE may appear on the band at any time and should be a rather sought-after station.

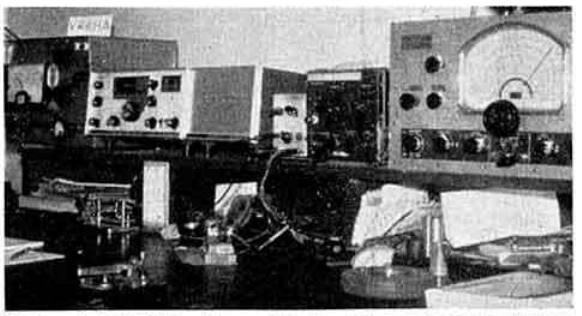
No reports on this season's first **Transatlantic DX Tests** have yet been received, and participants are requested to drop a line to G3FKM describing their results during these events. Readers are reminded that **15 January** will be an ordinary test morning and that **8 January** will be a W/VE " First Timer's " day. Full details of times and frequencies for this series of tests is given on page 661 of October BULLETIN. The weekend of 28/29 January is, of course, the time of the *CQ* WW 160 DX Competition.

According to VO1FB conditions on 160 were excellent to Europe during the weekend of the *CQ* WW Contest (26-27 November). The band was open to Europe for at least 18 hours during this period and was completely static free. Out of 93 stations worked, 63 were in Europe, and OE1KU gave Joe a new country on the band. Apart from that weekend it seems that conditions in Newfoundland have been unreliable with occasional good openings of shorter duration than those of November, 1965.

G3RQZ is at present on the M/V *Parthia* on the London-New York trip. He listens on Top Band occasionally and heard the following stations while in the vicinity of Newfoundland on 21/22 October: G3GVA (579), G3FGT (5o9), G3LIQ (579), G3RXH (579), G3SGC (549), G3SRA (469), G3TVO (449), G3UUR (349), G3VAV/A (569) and G8HX (459). Pete finds that many UK stations are audible until he reaches about 40° West, after which they thin out somewhat. The best time is from about one hour before sunset until two hours after (local time) before he starts to hear the W QRM.

QRP News

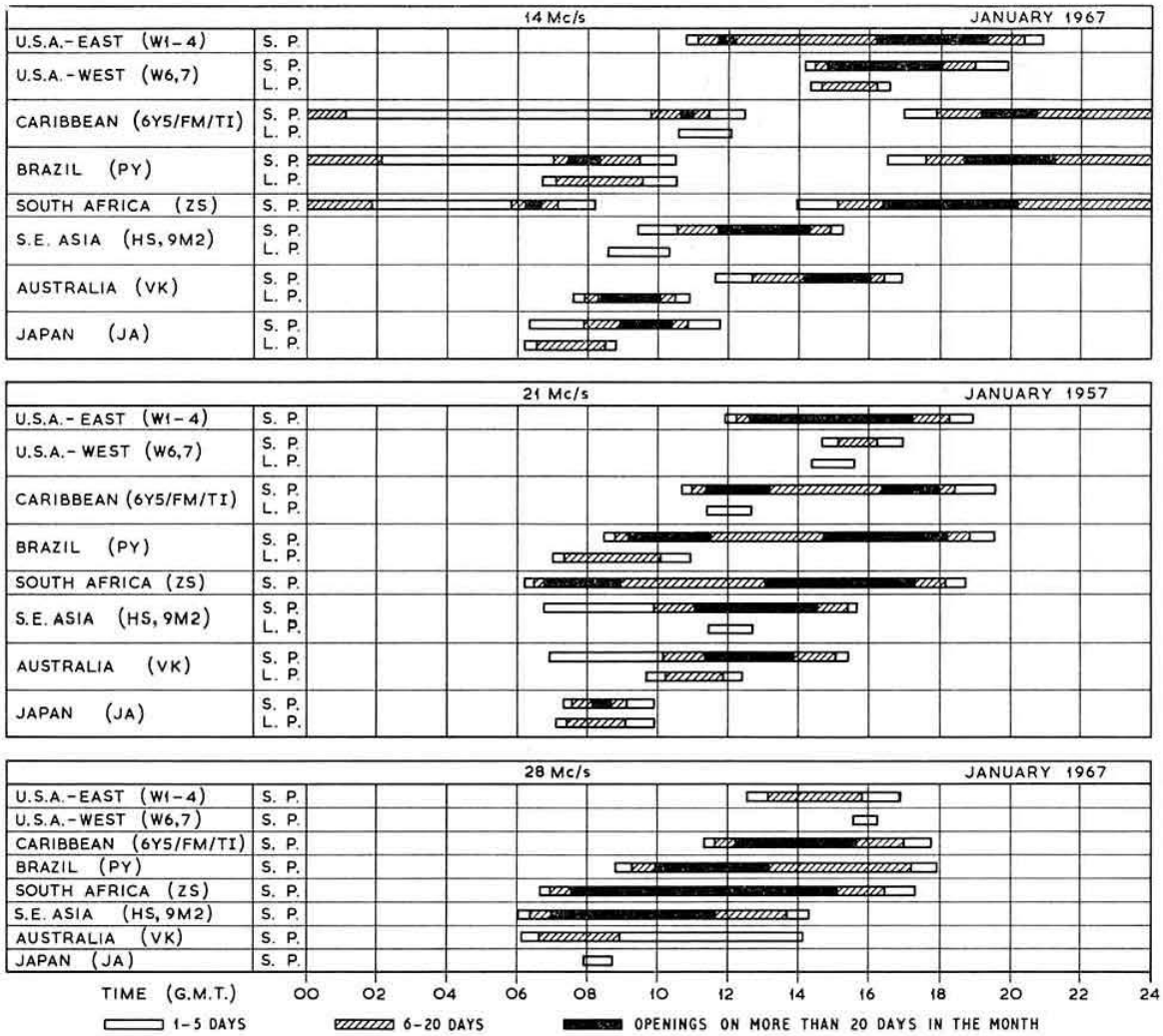
9V1NX has been on the air in Singapore since August. No doubt assisted by the rareness of his call-sign he has already worked more than 15 countries, with 10 watts, including G, GM, DL, OH, W, OK and SM. He says that he has a poor site propagation wise and his dipole lies in a dip surrounded by coconut and rubber trees! All contacts are on c.w. and



The layout at VK8HA, Darwin, one of the few stations on the air from Northern Australia

* 10 Knightlow Road, Birmingham 17. Please send all reports to arrive by **11 January** for the **February** issue, **8 February** for the **March** issue, and **15 March** for the **April** issue.

Propagation Predictions



In January, propagation conditions will differ little from those of the preceding month. Towards the end of the month the h.f. bands should remain open longer in the evenings. Otherwise the forecasts for the last month should be sufficiently accurate on all bands.

The provisional sunspot number for November, 1966 was 55·7 with solar activity distributed fairly evenly throughout the month.

The predicted smoothed sunspot numbers for March, April and May are 67, 69 and 72 respectively.

The Swiss Broadcasting service transmits the relative sunspot numbers for the previous month at 08.05 GMT on 48·66m (6165 kc/s). Dates in 1967 are: 7 January, 4 February, 4 March, 8 April and 6 May. This is an English language broadcast from station HER3.

the ragchewing type is preferred to the rubber stamp form.

G3MLN has managed over 700 QSOs in two years with about 9 watts on all bands except 10 and 15m. His transmitter is crystal controlled and feeds a Joystick at ground level. This set-up has worked 17 countries so far. On low power 15m a.m. G3MBL has contacted XE2SO and EP2RT recently, his aerial being a two element beam, home constructed. Running slightly higher power (on s.s.b.) G3RRD has so far worked 96 countries this year, and this total includes KX6, KH6, KL7, ZL, JA, and many VKs. He feels that this should encourage the lower power wire aerial enthusiasts, his aerial being an inverted V for 20m. With 25 watts to a vertical G3URX reports QSOs with TA1AV, TA2AC, and all W districts except 5 and 7.

News from Overseas

HC5NW has supplied news about four Ecuadorians who are at present sailing on a Balsa wood raft in the South Pacific. They left Ecuador on 23 October, and hope to reach Australia in seven or eight months. On 16 November they were reported to be at 01° 12′ S, 89° 06′ W. They have a transmitter on board and use the call-sign HC9EP. HC5NW has a daily sked with them at 01.00 on 14,150 kc/s s.s.b. QSL cards should be sent via the Guayaquil Radio Club, PO Box 5757, Guayaquil, Ecuador.

In a most interesting letter, Alan, ZD9BE, describes his other duties besides wireless operator on Tristan da Cunha. He is also Superintendent of Posts and Telegraphs, Postmaster, Customs *and* Immigration Officer! He has been out there

since October, 1965, and began activities on 20m with an 813 to a vertical aerial, his first QSO being with K7KBN. The following February he added a modulator, but the big step forward came when his Swan 120 arrived from W2GHK and Alan found himself on s.s.b. The location of the radio station is very favourable, being only some 40 yards from the sea. It is hoped that some 160m operation will take place during the winter. Another plan afoot is a two or three day expedition to Nightingale Island, which is most likely to take place early in 1967. This island is uninhabited by humans and has never before had a radio station on it (*IOTA* hunters please note). Alan sends his very best wishes to all readers of the BULLETIN, and wishes to thank the UK stations for their very good operating manners in the shocking pile-ups which he encounters occasionally.

An interesting letter from VO1FB describes how his visit (together with VO1IB) to St. Pierre in September coincided with the most brilliant auroral display since the last sunspot maximum. The result was a very much reduced number of QSOs for FP8BD. However, it is hoped to repeat the visit next spring. VO1IB has been issued with the call FP9DC.

W3HNK wishes to offer his services as QSL Manager for W/VE contacts to any DX operator who would care to advantage of such an arrangement. Anyone wishing to take take up this kind offer should write to him—Joseph Arcure Jr, 126 Henderson Avenue, Norwood, Pa., USA, 19074. Joe already acts in this capacity for ex-5A5TR, ex-5A5TX, YV5CEY, PA0COE, 4X4UH, 4X4RD, GW3DZJ, and ZE4JS.

Dr Terence Langdon, G3MHV/W6, is still active from California, enjoying himself working all the exotic Pacific areas on 14 Mc/s s.s.b. with no great difficulty! He also has a visitor's licence for Mexico, and has operated there using his XE0MHV call. QSLs for contacts with XE0MHV should be sent to the address in *QTH Corner*.

DXpeditions

The ill fated Royal Signals Expedition to **Kuria Muria** is now said to be set for a second attempt to reach VS9H about 3 January. It is hoped to remain there until the 17th. One frequency quoted is 14,198 kc/s for s.s.b. operation.

Don Miller, W9WNV, caused quite a stir during the *CQ* WW DX Contest (c.w.) by appearing with the call-sign 1G5A. He was supposed to be on the **Banc du Geyser,** situated about half way between the Comoro and Glorieuse Island groups. No information is yet available about the possible DXCC status of this location, but no doubt QSL cards will be submitted for consideration to ARRL shortly. At the time of writing Don was in Mombasa, awaiting transport back to VQ9. No doubt by the time this is being read he will have made some positive move, possibly in the direction of the Laccadive Islands. QSL cards for all W9WNV's DXpedition contacts should be sent *via* W4ECI.

A Polar expedition, endeavouring to retrace Admiral Peary's 1909 route, will begin in March, and hopes to reach the North Pole by 6 April. They will have three KWM-2 transceivers with them, but no definite information about their call-sign, or whether they intend to come on the amateur bands has been received so far.

Further rumours concerning a possible s.s.b. expedition to **Rio de Oro** and **Ifni** suggest that this will take place early in January, and that one week and four days will be the time spent in the two places respectively. January, 1967?

DXCC News

Although no official announcement of the addition of **Farquhar Is.** to the ARRL Countries List has yet been forthcoming, it was intimated in a letter written by W1WPO last January that Farquhar would qualify for separate status under the new political set up in the Indian Ocean Territory.

Explanation of the mystery of the disappearance of **Ebon Atoll** and **Cormoran Reef** from the listing is given in December *QST*. It would appear that some maps show that these territories belong to Ecuador and Costa Rica respectively. On the strength of this fact licences were issued by the Ecuadorian and Costa Rican Consuls in Los Angeles who at first said that they had confirmed the facts with their own capital cities. It was later demonstrated that the maps were inaccurate and that the two Consular authorities had not in fact been in contact with their home administrations. It was therefore decided that the two island groups could only be looked upon as part of the UN Trust Territory.

Contests

The 33rd **ARRL International DX Competition** will be held on the weekends of 4-5 February and 4-5 March (phone section), and 18-19 February and 18-19 March (c.w. section) from 00.01 Saturday to 24.00 Sunday in each case. Non-US/Canadian participants should contact as many W/VE stations as possible. Contest exchanges consist of RST plus input power, and W/VE stations will give RST plus state or province. Repeat contacts on additional bands are permitted. Each complete contact counts 3 points, incomplete ones 2 points. For scoring purposes the total of QSO points is multiplied by the total number of states and provinces worked on each band. Logs must contain dates, times in GMT, bands, exchanges and points, and should be sent to ARRL no later than 22 April. Free contest forms and summary sheets are available from ARRL International DX Competition, 225 Main Street, Newington, Connecticut, USA, 06111.

The *CQ* **WW 160 DX Competition** starts at 00.00 on 28 January and finishes at 12.00 on 29 January. Exchanges consist of RST plus a three figure progressive contact number starting at 001. W/VE/VO stations will also give their state or province. Contacts with other stations in one's own country count 2 points, with other countries 5 points, and with W/VE/VO 10 points. Multiplier consists of number of states, provinces, and countries worked. Entrants claiming more than 3 per cent of duplicate QSOs will be disqualified.

QTH Corner

ET3WH	Now via K7CAD, 6080 SW Burma Road, Lake Oswegpo, Oregon, USA
HV3SJ	Box 9048, Rome, Italy.
KC4VOS	(Stn. at Vostock, Antarctica) via K0YKJ, Stephen Barnes, RFD 2 Box 244-A, Boulder, Colorado, USA.
LUs ZA, ZB, ZC, ZE, ZF, ZH, ZI, ZL, ZM, ZO, ZP, ZQ, ZR, ZS, ZT—via Sub de Pral Aldo Veneria, Estado Mayor General Naval Comms. Ministerio do Marina, Canzallo 55, Buenos Aires.	
LUs ZD, ZJ, ZU, ZV, ZW, ZX—Sub. de Mayor Carlos E. Cejos, Red. Sirme-Sec Comms, Comando en Veje Ejercitio, Cabildo 65, Buenos Aires.	
TU2BD	BP 172, Abidjan, Ivory Coast.
VP2MK	W8EWS, 9500 E. Atherton Road, Davison, Mich., USA, 48423.
W1WQC/VP5	(Stn. on Sth. Caicos Is.) via W1WQC, PO Box 368, Coventry, Conn.
VP6PJ	via WB2UKP, 50 James Street, Shrewsbury, NJ.
VS9AJC	via G3TTJ, J. G. Barber, Officer's Mess, Clare Barracks, Ripon, Yorks.
XE0MHV	via G3MHV, 20 Upper Marsh Road, Warminster, Wilts.
W4TRP/XW8	via W4 QSL bureau.
ZD8BUD	via K4DEN, 6246 SW Tenth Terrace, Miami, Fla., USA.
ZS2MI	via ZS4OI, 9 1st Avenue, Parys, OFS, South Africa.
4L7A	(Stn. in UF6) Box 88, Moscow, USSR.
5G1A	via W4ECI.
5U7AC	via W9RKP, 6285 Bass Drive, New Berlin, Wisc.
5U7AK	Rev. D. Kepple, Protestant Mission, Tera, Niger Rep.
7Q7EC	via W5GIQ, Ewing Canaday, RFD 2-Box 117, Perkins, Oklahoma.
QSL Manager	
W4ECI	3101 Fourth Ave, South, Birmingham 5, Alabama, USA.

* * *

RSGB QSL Bureau: G2MI, Bromley, Kent.

Entries should be sent to: CQ 160 Contest, 14 Vanderventer Ave., Port Washington, LI, NY, USA, 11050 no later than 28 February. Log sheets and entry forms may also be obtained from this address in exchange for a large s.a.e. and IRCs.

The **Virginia QSO Party** starts at 18.00 on 7 January and finishes at 02.00 9 January. Separate logs for phone or c.w. are required as each category is separate. Exchanges to consist of QSO number, report, and country, and Virginia stations will give their county. Each QSO counts one point and the total QSO points multiplied by the number of Virginia counties worked. Frequencies to watch include 3560, 7060, 14,060, 14,240, 14,340, 21,060, 21,310, 21,410, and 28,060 kc/s. Logs should reach the Roanoke Valley ARC, Box 2002, Roanoke, Virginia, USA 24018 by 15 February.

The **First International EL DX Competition** will be held between 00.00 15 January and 24.00 16 January. This will cover all modes and bands, contest exchanges being the usual report plus serial number of QSO, starting from 001. Contacts with EL stations are worth 3 points, with other participants 1 point. Multipliers consist of total number of EL prefixes worked on each band, and entries may be single or multi-band, single or multi-operator. Certificates to highest scorer (if with more than 300 points) in each country. Logs should be signed and mailed to: Liberian RAA, PO Box 1477, Monrovia, Liberia, before 28 February.

The 1967 **French Contest (REF)** is scheduled for: *C.w.* 28 January, 14.00 to 29 January, 21.00. *Phone* 25 February, 14.00 to 26 February, 21.00. Usual five or six figure exchanges to be made, in addition French, Swiss, and Belgian stations will give their department, canton, or province. These serve as multipliers, as does 9Q5, the sum of the total number worked on each band being used for this purpose. Each QSO counts 3 points. Summary sheets should be sent with logs to: REF, BP 42-01, Paris RP, France. This is an excellent way to obtain credits for French awards (DDFM, DPF, DUF, etc.), as entrants may refer to contest QSOs in lieu of QSL cards. In the 1966 event **G3EYN** was top UK station with 28,470 points, G2WQ had 4692, G2GM 4692, and G3IRM 2520 points. In the phone section **G3TOK** was the only British entrant with 720 points.

Preliminary results of the ***CQ* 1966 S.S.B. Contest** are to hand. They show that **G3NMH** was European leader on 28 Mc/s with 4522 points, that **G8FC** was world second in the multi-operator section with 749,324 points, and that **G3NLY** was second European on 7 Mc/s with 22,601 points. G scores available are as follows:

	points		points
G3UML (All band)	**265,374**	**G5AAB** (14 Mc/s)	**30,996**
G2AJB "	9,150	G3VAO "	26,132
G3MWZ "	2,520	**G3PEU** (21 Mc/s)	**48,506**
G3NLY (7 Mc/s)	**22,601**	**G3NMH** (28 Mc/s)	**4,522**

Congratulations are due to all who took part. Certificate winners are in heavy type.

The **Arkansas QSO Party** takes place between 18.00 7 January and 02.00 9 January. Stations may be worked once on each band on each mode, and each station contacted counts as 5 points. Usual QSO exchange. Multiplier of number of Arkansas counties worked. Logs to be sent to WA5GVG, 508 N. Robinson, Harrison, Ark, 72601 by 30 January. Frequencies to be watched 3525, 7025, 14,025, 14,225, 14,325, 21,025, 21,110, 21,225, 21,425, 28,025, 28,560 and 28,650 kc/s.

The **Saskatchewan QSO Party** runs from 00.01 8 January to 00.01 9 January. Phone and c.w. are separate contests in this event. QSOs count 3 points, and total is multiplied by the number of different Sask. QTHs contacted. Logs should be sent to Regina ARA, 2117 McPherson Av., Regina, Sask., Canada before 31 January. Frequencies to look for 3C5-VE5

1966 Countries Table

	1·8 Mc/s	3·5 Mc/s	7 Mc/s	14 Mc/s	21 Mc/s	28 Mc/s	Total
G3UML	4	41	68	183	107	110	513
G3NMH	—	—	71	195	132	88	486
G8JM	5	2	14	235	117	38	411
GM3SVK	12	11	65	116	120	36	360
G3IAR	7	41	61	92	83	51	335
G3HS	15	40	58	110	70	35	328
G3SSO	9	15	20	94	108	59	305
G8VG	5	29	31	95	78	57	295
5N2AAF	9	14	23	137	68	29	280
G3KSH	8	27	59	69	60	25	248
G3LHJ	7	23	23	97	48	33	231
G3IGW	19	43	46	58	55	1	222
GM3KLA	3	38	45	44	70	15	215
9J2BC	1	1	5	56	51	45	159
9V1LP	6	14	26	49	46	27	148
G3MWZ	7	17	24	59	23	14	144
9V1LK	—	—	10	63	46	19	138
G3PQF	—	24	58	18	6	21	127
G3JVJ	16	23	30	20	9	—	98
G3WZ	2	4	27	26	2	—	61
A4038	11	19	29	249	144	98	550
BRS26222	5	40	44	215	122	73	499
BRS25429	8	57	81	146	124	79	495
A4568	5	40	42	205	127	49	468
A4609	18	37	74	121	139	73	462
A4886	6	29	42	193	116	39	425
G8	2	17	47	161	138	56	422
BRS25605	9	44	56	126	96	43	374
A4489	21	59	76	157	25	1	339
A3942	14	45	78	129	58	1	325
A4048	9	39	52	118	72	26	316
A5105	2	20	28	138	91	35	314
A4431	6	25	40	104	108	30	313
A4552	2	25	12	127	84	30	280
A4182	5	21	25	129	43	28	251
A3699	7	24	27	76	63	16	213
A4370	4	30	10	137	39	1	212
A4311	—	15	13	115	37	23	203
A4955	9	22	33	51	60	22	197
A5025	11	17	30	50	22	14	144

This month's table is in order of total band/countries and was erroneously stated in last month's *MOTA* to be going to be the last for 1966. Readers will have no doubt realized that this was incorrect. The final table will be in the February issue, and the first of the 1967 tables in the March issue.

When free from his many official duties on Tristan da Cunha, ZD9BE takes time out to provide many with their contact with this remote spot.

are 3560, 7050, 14,075, 14,250, 21,050, 21,300, 28,050 and 28,550 kc/s.

The **Louisiana QSO Party** is scheduled to cover the period 18.00 28 January to 22.00 29 January. The same station can be worked and counted on each band and mode, and one point is given per QSO. Multiplier is the number of counties worked. Logs to Lafayette ARC, 612 Harding St., Lafayette, La., USA 70501, by 28 February. For contest QSOs watch 3600, 14,100, 14,300, 21,100, 21,400, 28,100 and 28,700 kc/s.

The **Amateur Radio Club of Newfoundland** is organizing a contest to commemorate Canada's Centennial Year. This will commence at 00.01, 1 March, and finish at 23.59, 31 March. The object is to work as many VO1/VO2/3B1/3B2 stations as possible. One point for each QSO, each mode, each band, i.e. 20m—3 points maximum each VO station—1 c.w. 1 phone, 1 RTTY. List of contacts to VO1AT, ARCN, PO Box 266, Gander, Newfoundland, Canada. The first prize will be a *white mounted seal*! Certificates to other winners. The next contest along these lines will be in 2067. . . .

ZD9BE's shack on Tristan da Cunha. The photograph shows the rugged terrain of the island.

Awards

The Royal City Radio Association of New Westminster, BC, is sponsoring an award—the **Canadian Centennial Certificate**—to commemorate Canada's Centennial year. This will be available to anyone who submits proof of contacts with 100 Canadian stations during 1967. Contacts may be made on any band and on any mode. A copy of the log information certified by another amateur should be sent to: Royal City ARA, VE7FY, 7386 East Grandview Douglas Highway, New Westminster, BC, Canada. There is no charge for this certificate.

A brief resumé of the French awards mentioned in connection with the REF contest. The DPF is awarded for contacting all 17 French provinces (all phone or all c.w.), since January, 1951. The DDFM for European amateurs is obtained by contacting at least 50 of the 90 different departments on 40m and 80m only: 30 on one band and 20 on the other. Higher classes DDFM-2 and DDFM-3 are also issued. Full information on the DPF may be obtained from F3ZU, Ave. Gallieni 21, Viroflay, S-et-O, France, and on the DDFM from F3JI, rue Pierre de Blois 11, L-et-C, France.

Band Reports

Conditions generally have been fairly good for the time of year, a considerable volume of DX being workable on all bands from 10 to 160m. The long dark nights mean that 10, 15 and 20m have all been closed by early evening, although on at least one occasion 20m has been open to W and JA at 23.00. Long path propagation during the late afternoon hours on 20m has been much in evidence, signals from FO8 being heard at this time. The behaviour of 160m has not disappointed the enthusiasts, and it seems that even at this stage of the sunspot cycle the DX is audible and workable on the band.

Thanks are extended to the following contributors without whose help it would have been difficult to write this article: G2BOZ, G2LB, G3AAE, GW3AX, G3HCT, G3HDA, G3NMH, G3PQF, G3SML, GM3SVK, G3VJG, G3VNC, G4JZ, G4MJ, G8JM, G8VG, BRS20317, BRS25429, A3942, A4038, and A4568.

1·8 Mc/s C.W.: CO2BO (06.20), DL0ITU (21.30), VE3AGX (07.00), VO1FB (01.05), W5HWR/VP9 (02.24), K1JGD (02.04), W2OPQ (06.13), YO8BCV (18.15), ZD8J (22.35-00.30), W0GTA/8F4 (22.08), 9V1LP (23.05).

3·5 Mc/s C.W.: CO2BO (08.32), FP8CQ (01.45), KG4CX (00.06), MP4BDF (20.47), PY7AGT (22.10), UA0KFB (20.27), W7SFA, W7YGN (08.10), ZL4BO (07.56), W0GTA/8F4 (23.13).

3·5 Mc/s S.S.B.: CR5SP (20.00), CT3AV (20.00), HI8XAL (06.40), KP4COY (22.00), DL2WB/M1 (21.13), MP4MAW (22.45), MP4TBO (21.00), UW9AF (20.42), VS9AJC (21.00), VS9ALV (23.55), ZB2AM (22.04), ZC4MO (00.17), 7Q7PBD (22.00), 9X5WM (21.00).

7 Mc/s C.W.: CX2CO (06.56), EP2RV (02.05), HI8XAL (01.15), KA7AB (11.15-15.56), KG6AQA (14.21), KR6UD (16.05), MP4BDF (23.50), UA0KFG (13.32), UA0KKB (12.38), VQ9AR (00.03), W7SFA (02.25), ZD8J (00.30), 4L7A (21.15), 6Y5MJ (03.40), 6O6BW (17.00), W0GTA/8F4 (19.15).

7 Mc/s S.S.B.: JA6AK (21.00), MP4MAW (20.30), PY6WA (21.18), PZ1CF (20.30), VK4VJ (19.30), VP2AA (22.00), VP2SG (22.00), 5N2AAS (21.23), W0GTA/8F4 (23.57), 9X5MH (21.15).

14 Mc/s C.W.: FG7XJ (19.20), FP8CS (18.20), HK0AI (21.50), JT1AJ (08.50), JX5XF (04.02), LU1ZX (18.50), VK5XK/VK2 (Lord Howe Is. 14.30), VP2GLE (20.30), VQ9AA/F (14.30), VQ9AR (18.05), ZD9BE (18.35), 1G5A (05.30-18.00).

14 Mc/s S.S.B.: FB8XX (18.00), FB8YY (17.00), FB8WW (17.13), FO8's AB, BQ (16.10), FR7ZP (16.57), HZ1AT (15.30), IS1ALX/P (Maddalena Is. 16.00), KC4AAD (08.45), KC4VOS (18.10), PX1PA (10.12), VK0KM (Antarctica 17.00), VP1PV (12.35), VP2KC (Anguilla 20.07), VP2MK (12.30), VP2SYL (17.25), VP8CW (20.20), VQ9AX (17.43), VQ9AA/A (17.13), W4TRP/XW8 (12.50), YJ8BW (09.40), 5R8AU (16.55).

21 Mc/s C.W.: CO2BO (13.30), CR9AH (09.18), FL8RA (07.16), HK0AI (16.11), HM1BW (08.00), HP1AC (12.17), HZ1AB (07.53), JT1AG (09.40), KS4CC (11.48), VKs (09.00-12.00), VQ9BC (06.30), VS6FO (10.46), ZD9BE (07.40), ZL4BO (11.12), W0GTA/8F4 (06.35).

21 Mc/s S.S.B.: DU1AO (09.30), EL2AT (11.50), HR1CN (12.15), JAs (L.P. 08.00-09.00, S.P. 09.00 onwards), UA9VH (11.00), UA0BP (11.31), VP5RB (09.30), ZLs (08.40-11.15), 9M8RS (14.03).

21 Mc/s A.M.: CR3KD (14.45), FR7ZG (14.28), PJ2MJ (16.38), ST2SA (14.36), TJ8AC (15.28), YB1RI (? Indonesia 13.08).

28 Mc/s C.W.: CE6EF (13.09), CR9AH (08.35), CX2CO (10.54), HI8XAL (13.19), HK0AI (16.52), KP4BJM (13.43), OA4PF (17.24), UA9EV (10.08), YV1AJ (17.00), VKs (08.20-10.30), VS6FO (08.49), VU2FN (08.26), Ws (10.00-15.00), ZD7IP (16.08), 4L7A (12.10), 5R8CQ (10.58), W0GTA/8F4 (09.30).

28 Mc/s A.M.: UA0SDS (08.35), K6APH (16.36), XE2EEL (15.10).

28 Mc/s S.S.B.: FP8CY (14.36), KP4BCL (15.20), KV4CX

(Continued on page 44)

Technical Correspondence

Some Thoughts on Transistor Oscillators

I HAVE wondered for a long time why descriptions of high stability oscillators have almost always been valve types, when the transistor would appear to be ideal for this application. I have been intending to publish a theoretical and practical investigation of transistor oscillators, but see no prospect in the near future of carrying out the latter aspect, and so in view of the current interest in the subject I will " stick my neck out " and state my present views.

There are two causes of instability in an oscillator: variation of the active device and changes in the frequency-determining network. A successful oscillator must be able to deal with both.

G3BIK has provided some excellent advice—backed by results—for the network, but I would like to indicate how I think the amplifier can be improved.

In a nutshell, I believe that we should use feedback to make the amplifier gain independent of the transistor and then use an a.g.c. circuit to ensure that the device works essentially in class A. This is not a new idea, but one seldom sees it put into practice. If this philosophy is adopted, there is no real difference—as far as the network is concerned—between a valve and transistor oscillator design.

For a completely " down to earth " approach to amplifier design using transistors—almost a child's guide—I can thoroughly recommend " The Design of Wide-Band Transistor Feedback Amplifiers," by Cherry & Hooper, *Proc. IEE*, Feb. 1963, pp. 375-389. They show that an amplifier with an emitter resistor—unbypassed—should be fed from a low impedance and into a low impedance—i.e., as a voltage in to current out amplifier. If a current in to voltage out amplifier is required shunt feedback from collector to emitter should be used and the amplifier fed from and into high impedances. Voltage in to voltage out can be achieved by a cascade of series and shunt amplifiers, and current in to current out by shunt followed by series feedback.

If this approach is followed, completely predictable h.f. low pass amplifiers can be designed from a knowledge of transistor f_T, C_{ob}, and the order of R_B and β, nothing else need be known. They also show that the series feedback stage is the " easy " one as far as h.f. performance is concerned.

Various feedback networks can be devised for an oscillator. These networks are always drawn as reactance networks. For each type of network there is a " natural " type of amplifier which will allow the circuit to be designed as if the amplifier did not load it. For the Colpitts, Clapp, Vackar and Seiler type of oscillator, the natural amplifier is voltage in to current out, i.e., high input and output impedances. As we have some " worked examples " of this type I shall concentrate on the Vackar and the BRS25769 circuit values.

To design this type of oscillator the relevant transfer function of the network (in this case output voltage over input current) should be computed as if an ideal amplifier were being used—this will always be very easy as I shall show. The level of impedence of the network should then be chosen such that the finite input and output parameters of the amplifiers are swamped.

The amplifier should be designed such that its input and output impedances, and gain—in this case g_m—are independent of amplifier current and voltage.

The only snag with the above—if a good job is made of it—is there is nothing to limit the amplitude of oscillation, apart from cut off or saturation in the amplifier. Thus the oscillation will have a high harmonic content.

In a high stability oscillator it seems to be a good idea to keep the level of oscillation such that the amplifier is operating as a linear device—and hence its properties are completely known. This can be done by rectifying the oscillation—amplifying the resultant d.c. if necessary—and applying it as feedback to a voltage controlled attenuator in the loop. The time constant should be very long compared with the oscillation period.

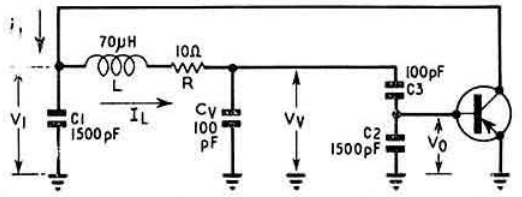
A really excellent paper by Lerner—" The Effects of Noise on the Frequency Stability of a Linear Oscillator," *Proc. Nat. Electr. Conf.*, 1951, Vol. 7, pp. 275-280, shows that the oscillator can be considered as a highly regenerative feedback amplifier whose input is noise and whose output is the oscillation.

Lerner shows that frequency stability improves as $d\phi/d\omega$ of the network increases—implying high Q—and as the ratio of the mean square value of desired oscillation to the mean square value of the open loop noise increases. Thus, although a low level of oscillation is desirable from the point of view of linearity it must not be too low because of noise problems.

Lerner's work has been extended in a recent article by Hafner, " The Effects of Noise in Oscillators," *Proc. IEEE*, Feb. 1966, pp. 179-198. I have not had a a chance to properly digest this article yet (wait until you see it!), but I think that it will be well worth the effort.

As a concrete example, let us have a look at the BRS25769 Vackar—the same methods will apply to the G3BIK Seiler.

First draw the oscillator as below. This clearly identifies amplifier and network.



The coil resistance has been taken as 10 ohms, and C_v as 100pF, to simplify the maths. This implies a Q of 88 at 2 Mc/s, although BRS25769's coil is probably much better than this.

If the amplifier is perfect:

$$\frac{V_0}{V_v} = \frac{C_2}{C_2 + C_3} \approx \frac{C3}{C2} \text{ for } C2 >> C3.$$

Also $I_L = V_v j\omega C_p$

where $C_p \approx (C_v + C3)$ for $C2 >> C3$.

$$\therefore\ V_1 = V_v + I_L(j\omega L + R) = V_v\left[1 + j\omega C_p(j\omega L + R)\right]$$

$$\therefore\ I_1 = I_L + V_1 j\omega C_1 = V_v\left[j\omega C_p + j\omega\ C_1(1 - \omega^2 L\ C_p + j\omega C_p R)\right]$$

$$\therefore \frac{i_1}{V_0} = \frac{C2}{C3}\left[(j\omega(C_p + C_1 - \omega^2\ L\ C1C_p) - \omega^2\ C1C_pR\right]$$

Thus for oscillation:

$$\omega^2 = \frac{C1 + C_p}{L\ C1\ C_p} = \frac{C1 + C3 + Cv}{L\ C1(C3 + C_v)} \approx \frac{1}{L(C3 + C_v)}$$

Required g_m is:

$$g_m = -\frac{i_1}{V_0} = \omega^2\frac{C1\ C2\ C_p\ R}{C3} = \frac{RC2\,(C1 + C3 + C_v)}{LC3}$$

Thus $g_m \approx \dfrac{RC1\ C2}{LC3}$.

As C_v, the variable capacitance, does not appear in this equation, the required g_m is independent of frequency so long as R remains constant. This it usually does—to a first order of approximation—over a moderate frequency range, as L is not varied.

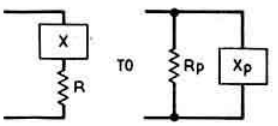
Taking the BRS25769 values:

$$g_m = \frac{10 \times 1500 \times 1500 \times 10^9}{70 \times 100 \times 10^{12}}\ \text{mA/V}$$

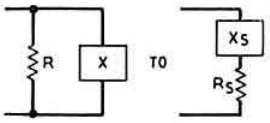
$\therefore\ g_m = 3{\cdot}2$ mA/V.

What values of input and output resistance can be tolerated before the amplifier has to be considered non ideal?

It seems to me that provided the effective Q of the network is the same as that of the coil, the condition is met. This can be quite easily calculated by employing the series to parallel transformation.

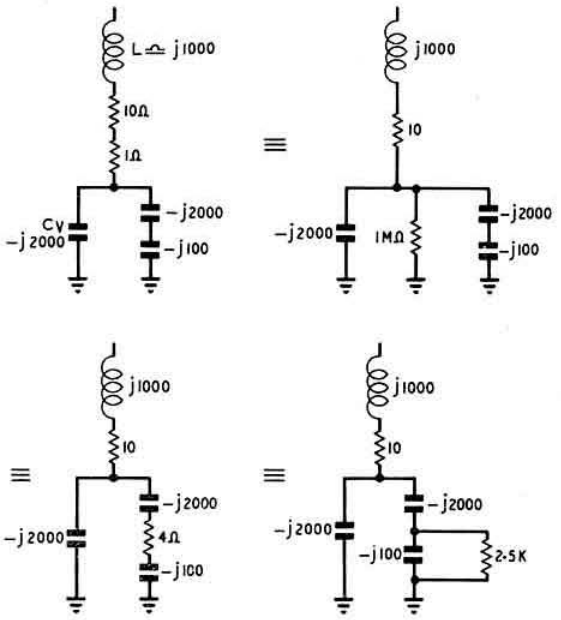


QTY	EXACT	$X^2 >> R^2$	$R^2 >> X^2$
R_p	$\frac{R^2+X^2}{R}$	$\frac{X^2}{R}$	R
X_p	$\frac{R^2+X^2}{X}$	X	$\frac{R^2}{X}$



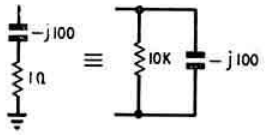
QTY	EXACT	$X^2 >> R^2$	$R^2 >> X^2$
R_s	$\frac{RX^2}{R^2+X^2}$	R	$\frac{X^2}{R}$
X_s	$\frac{R^2X}{R^2+X^2}$	$\frac{R^2}{X}$	X

Say a series resistance of 1 ohm can be considered negligible—in practice it would help to do better than this. Consider L arm.



In the above, reactance values have been rounded off to make maths easy, as only an " order " result is required.

For C1 arm:



Thus the network should be fed from at least 10 K ohms and should feed into at least 2·5 K ohms.

If this cannot be achieved by the amplifier, then C1 and C2 should be lowered and the required g_m recalculated.

For the amplifier in use:

$g_m \approx \frac{1}{r_e}$ and is $g_m = \frac{1}{r_e + R_s}$ if an unbypassed emitter resistor is used.

$r_e = \frac{26}{I_e(\text{mA})}$ ohms.

$I_c \approx \frac{6 \times 10}{32} \times \frac{1}{3{\cdot}9}$ mA = 0·43 mA.

$\therefore$ r_e = 60 ohms g_m = 16·7 mA/V.

For this non-feedback amplifier:

$R_{in} \approx R_B + \beta r_e$ = 6 K ohms for β = 100.

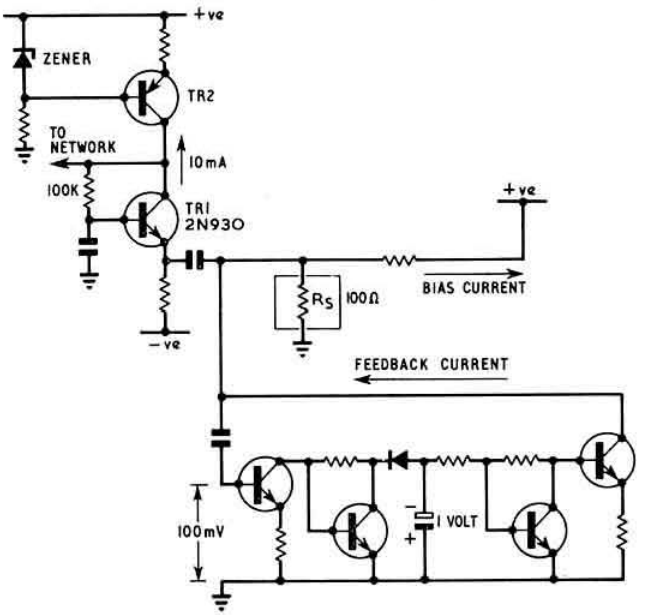
For feedback amp. $R_{in} = \beta(r_e + R_s)$.

$R_{out} \approx$ 4·7 K ohms — the value of the collector load.

Thus the amplifier has a reasonably good input resistance, too low an output resistance and much too high a g_m. Also, both g_m and R_{in} depend upon the operating current — R_{in} in a complicated manner, since β varies with current. This no doubt explains the tendency to squegg, and how this fault is cured by adjustment of the operating point (*Technical Topics*, July 1966 BULLETIN). If only one transistor is allowed, a study of the published β v I_c curve for the OC170 should indicate the optimum working point.

If several transistors can be allowed—and they are cheap enough—the above ideas can be put into practice, and a linear oscillator designed.

The following is an outline circuit to illustrate the point.



TR1, the oscillator transistor, is a high frequency silicon type. If the current is set to 10 mA, r_e = 2·6. Thus if R_s = 100, g_m = 10mA/V and is independent of the transistor.

TR2 is an " opposite polarity " transistor used to set TR1 current, and provide a high impedance load. This will allow the network to be fed from a resistance in excess of 10 K ohms, the minimum desirable value.

For linear operation, the signal current should not exceed, say, 1 mA peak. Since R_s = 100 this means that signal voltage at TR1 emitter should be 100 mV. This point is taken care of by the amplifier detector arrangement shown in outline.

R_s is a non linear resistor which can be considered linear if the current through it is only 1mA. A suitable—if not a particularly practical—arrangement would be 38 diodes in series with a forward current of 10mA through them. Each diode would have an incremental resistance of about 2·6 ohms.

The feedback amplifier is arranged to reduce the diode current as the oscillation level increases—this decreases the amplifier g_m and hence reduces the oscillation level.

Provided the detector load time constant is long, and there is enough gain in the feedback amplifier—the oscillation will stabilise to a level of 100mV if the initial d.c. conditions are calculated correctly.

Going back to TR1: a suitable V_{ce} would be 5V giving an f_T of about 200 Mc/s. This is achieved by the inclusion of the base to collector resistor. The current in this resistor will be I_c/β. Thus its value can be calculated. It will have to be experimentally

adjusted—first time—but if TR1 is a silicon transistor, it will not need further adjustment.

Obviously more suitable current or voltage variable resistors can be devised. Diodes could be used at the input of a current amplifier where their incremental resistance could be allowed to be higher, but this implies a phase reversal if a shunt/series amplifier is used instead of TR1. Another possibility is an FET used as a non-linear resistor.

One further point, which I consider important, is the question of phase shift in the oscillator amplifier. This becomes important as frequency increases, especially as it then becomes essential to use more than one transistor in the oscillator if all the design requirements are to be met.

Phase shift is bad as it implies that it will vary with transistor voltages and shifts the network off the max. $d\phi/d\omega$ part of the resonance curve. Thus the effective Q of the network is lower than it could be.

The above leads to the conclusion that the amplifier should be designed as a wideband lowpass amplifier, having an upper cut-off frequency well in excess of the highest frequency of oscillation. Where this is difficult or impossible, e.g. in v.h.f. oscillators, the amplifier should be designed as a wideband, bandpass amplifier, the bandwidth being well in excess of the desired tuning range.

That just about concludes my views on the subject. Incidentally, drawing the G3BIK Seiler in the " approved " manner shows that the two 1K ohm emitter resistors are across the oscillator output, and do not contribute any negative feedback to the oscillator loop.

One rather esoteric closing thought. Can the network be improved by active devices? Using a straight Q multiplier on the coil is useless as its stability will vary. Orchard has published an interesting account of gyrator requirements and promises further details: see " Inductorless Filters," *Electronics Letters*, June, 1966.

I wonder if this method will allow stable high Q inductors to be realised in conventional networks or if it will be possible to get very high $d\phi/d\omega$ by building stable non-minimum phase networks?

Street, Somerset. G. BIRD, AMIERE, G3KOV

Varactor Multipliers

At the RSGB Exhibition, two 70cm varactor triplers were on display and they apparently aroused considerable interest. They were basically similar, although one design incorporated an output filter while the other did not. The inclusion of a filter does assist in reducing spurious frequencies in the output but it is by no means a complete cure.

As a result of a discussion at the Radio Communications Exhibition by the undersigned, it was desirable to stress some of the pitfalls of these apparently simple devices.

A varactor multiplier is capable of both multiplication and division and can therefore produce outputs at say $2\frac{1}{2}$ or $3\frac{1}{2}$ times the drive frequency (i.e., $\times 5$ or $\times 7 \div 2$). Worse still, it can produce outputs at frequencies apparently unrelated to the drive and very close to the required output frequency. It is therefore undesirable to align a varactor tripler for maximum output power alone. Commercial users employ spectrum analysers during alignment, but the average amateur obviously does not have access to such equipment. He has, however, or should have, a crystal controlled 70cm converter which can be used during alignment to ensure that the output is on the required frequency and clear of major spurious outputs.

Fortunately, once the multiplier is properly aligned such troubles should not arise without changes in operating conditions, i.e., change of load impedance.

Alignment should, as with any other transmitter, be carried out into a dummy load. As an interim move it might be better to use varactor triplers as drivers for a conventional p.a., using the p.a. as a means of modulation and as a further filter between the tripler and the aerial, transferring the varactor multiplier as a direct output device after experience in its use.

It is worthy of note that transistors are capable of varactor action in the collector base junction both intentionally and accidentally, and these notes in some measure apply also to transistor amplifiers and multipliers.

This letter is not intended to frighten potential users of varactor multipliers; we just think that these devices are best tackled knowing some of the problems.

G. R. JESSOP, G6JP
D. L. LISNEY, G3MNO

The Month on the Air

(Continued from page 41)

(11.55), SV0WL (Crete 14.07), VK6CF (10.12), VP5RB (12.43), W7EMP (16.45), 4U1SU (09.45).

DX Briefs

During a short QSO with G3FKM, FB8XX said that the valve in his linear amplifier was giving trouble and that he thought that there would be only a little more s.s.b. operation from Kerguelen Is.

Both VP8HZ and VP8CW have had parts for quads sent out to them by G3NMH recently. VP8CW is parting with his transceiver to Dave, VP8HJ, and is acquiring an NCX-5. VP8HZ is building an SB-100, so the Falkland Islands should be very audible on s.s.b. in the not too distant future.

4L7A was the call-sign of a group of UP2 amateurs operating from Georgia (UF6) in early December. W3KVQ/2 is still QSL manager for 9N1MM, CT3AV, VU2RM, MP4BDF, VP2AR, 5R8AN, and 4S7WP. He may be reached at 2308 Branch Pike, Cinnaminson, NJ, USA 08077.

Tony, ex-VP5AR, is now in the Seychelles, and has the call-sign VQ9AR. He hopes to operate on all bands in the near future. VQ9AX has also been reported heard on s.s.b. from the same location.

UA1KAE/6 has been active on 14 Mc/s s.s.b. from the base at Vostok in Antarctica. There are also Americans at the base and the station signs with the call KC4VOS when being used by them.

Scotty, CX3BBD, is said to have mentioned the possibility of operating from South Georgia before returning home to the US from Uruguay. No details are available. It is also rumoured that a new station—VK0CR—will be on from Macquarie Is. on s.s.b. soon. VK0MI is understood to have made a good recovery from the illness which caused him to return to Australia.

EA9EJ is said to be on the air from Rio de Oro. He has been reported on 21 Mc/s a.m. and is believed to be able to copy s.s.b. stations. He is supposed to be going to be there for about a year.

All correspondents are thanked for their assistance, and special thanks are due to the following: *The L.I.DX.A Bulletin* (WA2EFN), *DX'press* (PA0FX), *The DX'er* (W6HVN), *DX News Sheet* (Geoff Watts). *The DX'ers Magazine* (W4BPD), *The West Gulf DX Bulletin* (W5IGJ), *Florida DX Report* (W4MVB) and *CQ DX* (A.R.I.). Please send all news items for the **February** issue to arrive by **11 January**, for the **March** issue by **8 February**, and for the **April** issue by **15 March**.

Always " arm-chair " copy with ZB2AJ!

IARU

Region 1 calling

INTERNATIONAL AMATEUR RADIO UNION

AT no time has the need for international co-operation in amateur radio been more vital than at the present and in this matter Region 1, comprising Europe and Africa, has set a pattern for the rest of the world. In order to provide members with news of activities in Region 1 of the IARU this column will appear periodically.

The National Societies of the following 22 countries are members of the Region 1 Division: Austria, Belgium, Finland, France, Germany, Ghana, Greece, Ireland, Italy, Luxembourg, The Netherlands, Nigeria, Norway, Poland, Portugal, Rhodesia, Spain, Sweden, Switzerland, United Kingdom, USSR and Yugoslavia. In addition, the National Societies of the following countries are members of the IARU but not yet of the Region 1 organization, although applications from several are now being processed: Algeria, Congo (9Q5), Cyprus, Czechoslovakia, Denmark, Iceland, Israel, Kenya, Lebanon, Liberia, Morocco, Syria, Uganda, Tanzania and Zambia.

Membership of the IARU has been applied for by the Faeroes Islands and Malta and their admission may be expected shortly. The total number of IARU Societies in all Regions is 72.

Societies which are members of the IARU, but not of the Region 1 Division, pay no annual contributions whilst members of the latter organization pay a sum per licensed member per year, and for 1967 this amount has been fixed at 75 Swiss centimes. The members of the Region 1 organization attend the triennial conference and at all times work closely together on matters of common interest. The administration of the Region's tasks are co-ordinated by an Executive Committee whose six members are elected by the votes of all Member Societies.

Licences in Austria

The Austrian Society, OeVSV, has provided the RSGB with full information on the method of obtaining a licence in Austria. It is not possible to reproduce this but a copy may be obtained from the writer. An important point is that application should be made at least one month in advance.

Amateur Radio in Africa

QTC, the newsletter of the Radio Society of East Africa, contains a down to earth statement on the necessity of introducing amateur radio to the nationals of the African countries. There has been extensive co-operation between RSGB and ARRL in Liberia and Nigeria, who now both have IARU Societies, with the Nigerian Amateur Radio Society also a member of Region 1. A number of classes of instruction are now running in both countries, and prominent members of the governments have shown interest in amateur radio.

Intruder Watch

Several IARU Societies now maintain Intruder Watch organizations and the monthly report of GW3PSM, the RSGB Intruder Watch Organizer, mentions that Radio Tirana, active in the exclusive amateur 7 Mc/s band for some five years has not been heard since 12 November. To offset this Radio Peking now operates on seven different frequencies in the 7 Mc/s band. Unfortunately China is not bound by the Geneva Radio Regulations, 1959.

The European Band Plan

Frequency Band	Types of Emission
3·5 — 3·6 Mc/s	C.w. only
3·6 — 3·8 Mc/s	C.w. and phone
7·0 — 7·04 Mc/s	C.w. only
7·04 — 7·1 Mc/s	C.w. and phone
14·0 — 14·1 Mc/s	C.w. only
14·090 Mc/s	RTTY
14·1 — 14·35 Mc/s	C.w. and phone
21·0 — 21·15 Mc/s	C.w. only
21·15 — 21·45 Mc/s	C.w. and phone
28·0 — 28·2 Mc/s	C.w. only
28·2 — 29·7 Mc/s	C.w. and phone

Amateur Radio Facts is a newsletter produced by Bill Orr, W6SAI, designed to focus attention on international amateur radio. The first issue contained a full report on the Opatija Conference whilst the second issue reproduces advice from A. Prose Walker, W3BMX/W4CXA, a Chairman of CCIR, urging national and international co-operation before any future Administrative Radio Conference. The issue also contains the USSR report on the Region 1 Conference. G2BVN

RSGB Amateur Radio Call Book

We were interested to receive, " for favour of review " an interesting new work by the well-known best-seller author John Clarricoats. It has the evocative title of *RSGB Amateur Radio Call Book*, and there is no denying that a number of new ideas have been incorporated into this volume. The cover is conventional enough for paperback books of this type, showing a small portion of the contents and printed in a seductive shade of green.

On the first page there is a striking proclamation that all problems can be solved by a kind of aircraft part, which is certainly a novel idea. After a brief author's foreword we are plunged straight into the story and the author wastes no time in getting to the point. Starting with the earliest aspects of the tale, every subject is explored to its root. His treatment of the facts is so methodical that it could be said to be predictable. The story pursues itself all around England, although towards the end it becomes truly international, venturing into Scotland, Wales and other unexplored regions. The vocabulary is truly rich, although after a while things do tend to become a little repetitive. Nevertheless the cast of characters is enormous, ranging from the lowest of the low to the highest of the high and higher. It is almost certain you will find someone who could almost be your neighbour. One surprising point is that the author rarely finds it necessary to repeat names and the range goes from the solid Smith, Davies and Binks to the aristocratic Compton-Burnett and the exotic Dzyzishnarck. As one proceeds the period subtly changes nearer to the present day and by the end things are right up to date. Of course a book of this type can never be right up to the minute.

One excellent new idea occurs on page 84 where a table to help pronounce difficult words is shown and further on a list of some of the secret codes in use is shown. These touches of realism always give speed to a story. There is, also, a map showing where the action is.

The only possible comparison is with the *London Telephone Directory* and this is an excellent six bobs'-worth. L. S. M.

(Stolen with glee from the December 1966 issue of *Mobile News*.)

More News from Headquarters

Better Buying Service

Arrangements have now been completed for Home Corporate Members of the Society over 21 years of age to use the facilities of the Better Buying Service. Full details are contained in the leaflet enclosed with copies of this issue of the BULLETIN sent to eligible members. It is regretted that the scheme cannot be extended to Associates or other members under 21 years of age.

All arrangements must be conducted direct with the Better Buying Service and the Society cannot enter into any correspondence.

Braaten Trophy 1966

The Council has awarded the Braaten Trophy for 1966 to Mr W. A. Roberts, G2RO, who was the leading G station in the ARRL DX Competition (C.W. Section) 1966. Mr Roberts' score was 138,701 points.

Milne Trophy 1966

The Council has awarded the Milne Trophy to Mr D. Gibson, GI3OQR, the Leading UK station, other than G, in the ARRL DX Competition (C.W. Section) 1966. Mr Gibson's score was 387,072 points.

Royal Air Force Amateur Radio Society

Mr R. F. Stevens, G2BVN, Immediate Past President, has been made an Honorary Member of RAFARS. The existing Honorary Members of the Society are: Air Marshal E. B. Addison, CB, OBE, MA; Wing Commander W. E. Dunn, OBE, G2LR; Wing Commander D. McLaren, OBE; Sir C. Ian Orr-Ewing, OBE, G5OG, and N. Davis, Esq., G6TV.

SSC Net

The Scientific Studies Committee's s.s.b. IQSY net on 80m will in future be held on Tuesday and Friday evenings at 19.15 GMT, and on Sundays at 10.30 GMT. The frequency will be 3783 kc/s. Whenever an event of particular interest to the net occurs, stations are invited to call in at 19.15 GMT any evening.

Change of Secretary

The secretaries of the following affiliated societies are now:

THE ELECTRICS SOCIETY

P. A. Holliday, G3UVZ, Ethel Villa, Stanley Road, Endon, Stoke-on-Trent, Staffs.

NORTH KENT RADIO SOCIETY

P. T. Baber, BRS22106, 64 Latham Road, Bexley Heath, Kent.

Radio Amateurs' Examination

The following college is running a RAE Course.

Queens Park. Queens Park Further Education Centre, Westfield Secondary School, Chester Road, Bedford.

Tuesdays, 7 p.m. Second term commences 10 January, 1967. Enrolment can be arranged by the secretary, L. W. Matcham, telephone Bedford 52901.

Another Pirate Fined

On 2 November, 1966, at Petersfield Magistrates Court, a Mr Hercules Robert Debeneducci of 10 Barnside Way, Liss, Hants, pleaded guilty to a charge of using wireless telegraphy transmitting apparatus without the appropriate licence, contrary to the provisions of Section 1 of the Wireless Telegraphy Act, 1949. He was fined £15 and ordered to pay £8 8s. towards the costs.

RSGB Welcome-to-London Scheme

For the past several months much thought has been given to the increasing problem of providing suitable hospitality to overseas Amateur Radio visitors to London. The Luncheon Club, although never an official activity of RSGB, filled a great need in this respect. It is to be hoped that the newly-formed Dinner Club will do as well, at least, as the Luncheon Club, which entertained 576 visitors from 93 countries in the 16 years of its existence.

Whether the Dinner Club meets quarterly or monthly, there is always a number of foreign guests, amounting to a stream in the tourist season, who seek hospitality and advice. At the moment the staff at Headquarters have to add this burden to their other problems of understaffing, too much work and hopelessly inadequate accommodation.

We discussed this situation with some members who have extended a great deal of hospitality to a wide variety of overseas visitors, making their own arrangements with the guests. It is their opinion that the majority of the foreigners who phone or call at RSGB want nothing more than a chance to meet a group of British amateurs with interest similar to their own, and sometimes to get advice on shopping, hotel accommodation, entertainments, or even medical emergencies!

It was decided therefore to set up a panel of voluntary workers, to be called the RSGB WELCOME-TO-LONDON-SCHEME. A list of telephone numbers will be published in the RSGB BULLETIN and issued to overseas publications during the tourist season. Visitors will be asked to call one of these numbers and make personal arrangements to suit himself.

This system would serve the purpose of lifting the pressure from the RSGB staff but if a visitor phones Headquarters he will be referred to the panel.

Each " case " would be handled by the members of the panel according to the particular circumstances. The usual arrangement made by members who are already experienced in this work is to assess the visitors' age, interests and background, then to arrange a simple, informal meeting, either in somebody's home or, perhaps, in a pub or restaurant. The host is involved in little more than providing a cup of tea and a place to chat, getting in touch with his local amateur friends to make up the party.

This is a pilot scheme. At first each " incident " will have to be played as it comes. With experience it is hoped that the scheme will soon run smoothly.

It will be suggested in the publicity that a letter to arrive beforehand at Headquarters would be appreciated, as this would give the panel time to assess the particular interests of the visitors and to make suitable arrangements.

We stress that there is no scheme envisaged at the moment for arranging accommodation for visitors. They will be merely referred to the Hotel Accommodation Service (Telephone WELbeck 2555), which exists in London, if they have arrived without making their own arrangements. This is as much as the panel could attempt at this stage.

Members who would like to join the panel are invited to write to Maurice Margolis, G3NMR, 95 Collinwood Gardens, Ilford, Essex.

Amateur Licences

On 30 November, 1966, the number of amateur licences in force in the United Kingdom was as follows:

Amateur (Sound) Licences A:	12,013
Amateur (Sound) Licences B:	517
Amateur (Sound Mobile) Licences A:	2,178
Amateur (Sound Mobile) Licences B:	8
Amateur (Television) Licences:	175

There were also 10,253 model control licences in force.

RSGB Amateur Radio Call Book

The following are corrections to the 1967 edition of the RSGB *Amateur Radio Call Book*.

G2CXR, E. M. Challons, 20 Windmill Balk Lane, Woodlands, Doncaster.
G2HMY, G. R. Priday, 41 Mark Road, Headington, Oxford.
G3AO, S. Levings, Broadhatch, Andrew Lane, High Lane, Stockport, Cheshire.
G3HJM, D. Outram, 1 Culross Buildings, Battlesbridge Road, London, NW1.
G3IMN, F. E. Perrisset, 23 Victoria Park, Dover, Kent.
G3KKF, J. Court, 2 Martin Dale Crescent, Martin Mill, Dover, Kent.
G3REA, C. F. Peers, 21 Abbotsbury Gardens, Eastcote, Pinner, Middlesex.
G3REI, Reigate Amateur Transmitting Society, 44 Allingham Road, South Park, Reigate, Surrey.
G3SCW, R. Hopper, Railway Station House, Tavistock, Devonshire.
G3TQT, R. H. Gwinnett, High Cote, Sutton Valence, Maidstone, Kent.
G3UNG, M. G. Rutter, Netherfield House, Seghill, Dudley, Northumberland.
GW3UMB, J. Taylor, 19 Second Avenue, Rhos-on-Sea, Colwyn Bay, Denbighshire.
G6RP, R. W. B. Parsons, 35 The Avenue, Ickenham, Uxbridge, Middlesex.
G8ATI, J. W. Wanden, 18 Harcourt Road, Bexley Heath, Kent.
G8AHJ, B. Loveday, 34 Chapel Road, Weldon, Corby, Northants.

Red Cross Transmissions

The International Red Cross Society in Geneva will be conducting test transmissions on 7200 kc/s during alternate months this year. Listener reports are particularly desired and these should be sent direct to the British Red Cross Society, 14-15 Grosvenor Crescent, London, SW1. The information required is the signal strength, time, interference from nearby stations (quoting nationality if possible), whether any fading was present, and how other stations were being received in same band during the same period. The transmissions will be at 0.600-07.00, 11.30-12.30, 15.00-16.00 and 23.00-24.00 GMT on 23, 25, 27 January, 13, 15, 17 March, 22, 24, 26 May, 17, 19, 21 July, 18, 20, 22 September, and 20, 22, 24 November.

QRM—The Cure

Two of the circuits described in last month's article by G3JGO unfortunately appeared with the wrong captions. The correct captions for the second and fourth diagrams should have read:

Fig. 2. G3FLP keying system. The values are suitable for an EF91 buffer with an h.t. of 300 volts and bias —45 volts. C1, 500 pF; C2, 0·02 μF; R1, 47 K ohms, $\frac{1}{4}$ watt; R3, R4, 10 K ohms, $\frac{1}{2}$ watt; R5, 47 K ohms, 1 watt; V, EA50.

Fig 4. An audio filter with values for a cut-of of 3 kc/s. C1, 0·001 μF, $\pm$ 10%, mica; C2, 270 pF, $\pm$ 10%; C3, 0·1 μF, 350V wkg, paper; R1, R2, 100 K ohms, $\pm$ 5%, $\frac{1}{4}$ W; R3, 470 K ohms, $\frac{1}{4}$ W; R4, 3·3 K ohms, $\frac{1}{4}$ W; R5, 56 K ohms, $\frac{1}{4}$ W.

The circuit of Fig. 4 was also in error—C1 and C2 should have been shown connected from earth to the junctions of R1-R2, and R2-R3 respectively.

Obituaries

ARTHUR LYLE BUDLONG, WIBUD

Arthur L. Budlong, W1BUD, of South Lyme, Connecticut, retired Secretary and General Manager of the American Radio Relay League and one of the world's outstanding experts in the field of international radio regulations, passed away on 13 December, 1966, at the Lawrence Memorial Hospital, New London, Connecticut, at the age of 65 years.

" Bud " joined the staff of ARRL in 1925 and was soon appointed Assistant Communications Manager. As the League grew and its staff expanded, the then ARRL Secretary—Kenneth B. Warner—chose Arthur Budlong to be his right-hand man. On the death of KBW in September, 1948, " Bud " was appointed Secretary and General Manager of the League, which post he held until his retirement due to ill health 12 years later.

Arthur Budlong was involved in every radio conference affecting amateurs since the Washington Conference of 1927. During World War 2 he was Chief of the Frequency Allocations Section of the US Coast Guards with the rank of Lieutenant Commander. He served on various committees preparing the basic plan for the 1945 general allocation of the frequency spectrum and it was this plan which largely became the post-war world allocations table adopted by the ITU Conference at Atlantic City in 1947. Arthur Budlong participated in all the other conferences which led up to the Geneva Conference of 1959.

The RSGB delegates (G6LJ and G6CL) to the Atlantic City Conference remember nostalgically the many happy occasions spent during the Conference with " Bud " and his wife Nan. At the Geneva Conference 12 years later, when Bud's health had begun to deteriorate, the IARU Region 1 delegates enjoyed the opportunity on many occasions of talking over Conference problems with Bud and John Huntoon.

To Mrs Nan Budlong we extend the sympathies of Bud's many friends in the United Kingdom. To John Huntoon and his colleagues we share their sorrow in the loss of an old friend whose whole adult life had been devoted to the cause of Amateur Radio. G6CL

M. OSLER, G3ANT

The death occurred suddenly as the result of a heart attack on 16 November, 1966, of Montague Osler, G3ANT, of Forest Town near Mansfield at the age of 65. " Monty" became interested in radio back in the mid-1920s and indeed was offered a licence in those days but for some reason did not actually take a call out. He was in fact licensed just after the war and although his main interest was phone on the DX bands he was well-known locally on 160m.

A man of quiet manner and well respected he leaves a widow and a married son to whom we extend our sympathy. F.N.F.B.

STAN HOWELL, G5FN

The sudden death of Stan Howell, G5FN, of Sale, Cheshire, on 28 October, 1966 at the early age of 59 came as a great shock to his many friends, particularly in the Medway and Cardiff areas. Active on all the h.f. bands and one of the old school of brass pounders, Stan was a member of the RSGB for 35 years, and a staunch supporter of NFD.

While resident in Gillingham, Kent, he was organist of a local church and a well-known member of the Medway Amateur Radio Transmitters Society. On moving to Sale, Cheshire, he became very active in Civil Defence. Recently he had been appointed head of a Government works associated with Chatham Dockyard.

He is mourned by his many friends, particularly G2HKU, G6CH, G4FN and G6NU.

To his widow and daughter we express our deepest sympathy.
—R.M., W.E.N.

Silent Keys

We record with sorrow the passing of the following amateurs.

C. J. Bayes, G2JS, of King's Lynn, Norfolk.
R. A. Beaumont, G3CS, of Ewell, Surrey.
J. Blake, G5BC, of Harrow, Middlesex.
L. A. Bradshaw, G4LM, of King's Lynn, Norfolk.
T. Caldicott, G5TT, of Newquay, Cornwall.
W. Coleman, G3VNE, of Tonbridge, Kent.
A. Hine, G4RA, of Wroxham, Norfolk.
Major W. A. Maddocks, G2AWF, of Heswall, Cheshire.
M. Osler, G3ANT, of Mansfield, Nottingham.
Rev. G. W. D. Spurrell, BRS5205, of Norwich, Norfolk.

LETTERS TO THE EDITOR

Neither the Editor nor the Council of the Radio Society of Great Britain can accept responsibility for views expressed by correspondents. Letters for inclusion in this feature should be concise and preferably not more than 200 words in length.

Operating Standards

With the New Year upon us, I wonder if I may be permitted to voice a personal opinion, through your columns, about a subject which is very often in my mind these days, namely that of how we conduct our over-the-air contacts.

As radio amateurs we have been contacting one another since the start of the century, and I say contacting advisedly, as generally speaking this is just about all we do, as by no stretch of the imagination could we really state that we communicate between ourselves except in the most elementary manner. If we take a good look at the content of our operating on the air, we must come to the conclusion that probably more than 90 per cent of our talk is repetitive in the extreme, and what is so sad too, that it is often inane to a degree that verges on the puerile. We are all too familiar with the long drawn out overs, the unnecessary use of phonetics when plain English will do better, the Queen Roger Mary nonsense for interference, and so on; the list of these absurdities is endless. To the casual observer who listens to the Amateur Bands it is no wonder that he classes us all as a lot of overgrown schoolboys playing games, and not very well either!

When you examine our way of operating, unless you are deluding yourself all the time, you must come to see that although by our own choice we call ourselves " communicators," we can no more communicate with one another than walk in the air. Is it asking too much that when we strike up a contact with another amateur that we dispense with all our gobbledygook and baby talk and have a simple and sensible conversation with the man on a question and answer basis just as we would do over the telephone or if we met him in the street?

Modern transmitters are fitted with facilities for BKIN; PTT; and VOX control and if any self-respecting amateur cannot make his rig with a single switch system for instantly changing over from send to receive then I despair altogether of him as even a low level technician. This is 1967 and not the hook up days of the early 20's, and I would have thought that we had advanced enough to have our rigs operate to transmit when we speak and return to receive when we are not so doing; to me this is common sense, but I doubt very much that more than 5 per cent ever converse in such a manner—even the US Citizens Band people do better!

May I end with this thought? If an amateur friend rang you up from the USA what would you do? Conduct a long one sided dissertation, padded up with inanities and telegraphese phonetics?—No, of course not, you would talk to him like a normal human being. If you can do it on the telephone you can do it on the radio telephone you have in front of you.

Let us all make a resolution this year, and for the future, to shake out the old outworn ideas and conventions of amateur radio operating and to make full use of our modern facilities to promote conversation and thus get more sensible information exchanged in a much shorter time and by so doing gain a better understanding of our fellow amateurs and the art of our hobby.

T. P. DOUGLAS, G3BA

Four Oaks, Sutton Coldfield.

(*Members' comments on Mr. Douglas' strictures will be welcome.* —EDITOR.)

Delivery Dates

The advertisement pages of the BULLETIN are filled every month with details of equipment and components, often at attractive prices. For " country " members of the RSGB, especially those living in GI, GM, GW and GD areas, these pages are our shop-windows. The shops themselves, unfortunately, may be hundreds of miles away. Members living within easy reach of Lisle Street or the Edgware Road can have no idea of the frustrations endured by those who buy through the post. Delivery dates are cheerfully—in fact, recklessly—quoted, and then not adhered to. The most frequent letter I have to write is one which begins: 'Sir, the goods which you promised to send me within 14 days are now three weeks (or four, or five) overdue. . . ."

May I, through your columns, appeal to both dealers and manufacturers to quote realistic delivery dates, and then, having done so, to keep to them. It is not a minority of firms who offend: one can be sure that most mail orders will only arrive days or weeks after the quoted date.

It is only right and proper to name the one shining exception: Radiospares have never failed to have the goods at my local dealer within three days of placing the order. If they can do it, why cannot the rest of the trade?

Need I say that I have no connection whatever with the firm mentioned, apart from being a customer?

REV. FREDERICK NESS, GD3ESV

Castletown, Isle of Man.

QSL Cards

QSL cards these days are a costly commodity, hence it is desirable to ensure that, while everyone who wants a card should sent one, those who do not, should not have one sent to them!

If this utopian situation were to become reality, we should all be able to conserve our expensive cards, the QSL Bureaux throughout the world would be saved a great deal of work and the societies a lot of money.

The cost of postage is now so great that we all consider whether it is worth it, before committing anything to the post. For example, a 22 lb. parcel sent to a sub-manager now costs 10s 6d and at a rough estimate, 40 per cent of its contents will never be collected.

May I, therefore, with some trepidation, advocate a few simple rules which we can all apply to this matter thus effecting an all round saving.

(i) Send a card only to a contact who specifically says " pse QSL "
(ii) If we want a card, then say so.
(iii) Do not QSL repeat contacts unless requested to do so.
(iv) If we do not require a card, then say so during the QSO.
(v) If a card is received, whether requested or not, then the gentlemanly thing to do is to QSL.

Personally, I cannot see any snags in this little rule 5. What do other members think?

A. O. MILNE, G2MI
RSGB QSL Manager

Contests

It is perhaps unfortunate that, in the very BULLETIN (December, 1966) which includes further correspondence condemning the present-day plethora of contests, we should find, of the 68 pages of " readable " matter (as distinct from advertisements), no less than 10 devoted to this subject.

I imagine many, like myself, on reading through what promised to be a bumper issue, were disappointed to find this much space given over to what is obviously a minority interest. Especially when one considers that only four months earlier over 20 per cent of the August issue concerned contest matters.

If this amount of information is considered reasonable and necessary then perhaps the Society will at least consider spreading it more evenly throughout the year's BULLETINS.

F. ALLAN HERRIDGE, G3IDG
(*Life Member*)

Basingstoke, Hampshire.

What a lot of drivel these anti-contest people write. It is quite obvious that they are quite out of touch with modern world-wide Amateur Radio. They continually bleat about not being able to work anyone at contest weekends other than contest stations, yet they say that the majority are penalised for the benefit of the few. What nonsense! What majority are they referring to? The fact that only a small proportion of G stations support the

major contests is quite immaterial; the bands are allotted for international use and not to any specific country.

The following figures which show the number of stations that competed and submitted logs, in major contests during 1965, show the true international picture:

ARRL 1075, CQ WW 1407, WAE 464, All Asian 559.

In view of the above figures how can anyone seriously entertain such a ridiculous suggestion as made by G5YN to effect that the bands should be restricted frequency-wise for contest operation.

G3BID shares the same views as G5YN and suggests that RSGB should set an example and limit its own contests to half the band, c.w. or phone in each contest. RSGB sponsors only two all band contests each year, NFD and BERU. Last year no fewer than 210 stations competed in NFD and I estimate that at least 600 UK amateurs were involved. Does G3BID really think that the majority of UK operators would like the bands cut frequency wise by 50 per cent for NFD and does he think likewise that BERU, our one and only world-wide contest, should be treated in the same way?

G3FI also has views on this subject and from what he says, it is fairly obvious that he is completely out of touch with modern day competitive work in this field. His statement to the effect that contests today are not a test of operating ability but one of endurance and that anyone with a good beam can make world-wide communication with comparative ease—yes this is true on the three bands 28/21/14 Mc/s, especially nowadays, when a high percentage of G stations are equipped with commercial transmitters with linears. However, there are two other bands to be considered on which DX is not all that easy and for which there are not a selection of ready made commercial aerials available. If G5FI thinks that all one has to do is to open up and slog away, and get good results, let him have a go and he will be in for a surprise.

If it were possible to get international agreement, I would suggest that a 10 kc/s segment of each band at either edge, be set aside for non-contest operators during major contests. If 1000 contest operators can work happily in 100 kc/s band then 10 kc/s should be ample for the tiny minority that prefers to waffle—RSGB could possibly put out a marker signal so that they could even find the 10 kc/s band edge without difficulty!

JACK DRUDGE COATS, G2DC

Ringwood, Hants.

Second 432 Mc/s Contest 1966

Referring to the comments on page 837 of the BULLETIN for December 1966 concerning the above contest, it is noted that several of the participants have stated that they would prefer a return to the " continuous " contest instead of having the rest break.

I wonder how many of these were " Multi-Operator " stations, where it is possible for some to sleep whilst others carry on?

It is becoming more and more obvious that the rules for this, and other contests, are very heavily loaded against the single operator home stations. Look at the results of the above contest, where you will find that out of the 12 leading stations 10 were either /P or /A, and possibly in some cases were multi-operator also.

It is with great pleasure therefore that I welcome the advent of the Cumulative Activity Contests and look forward to some interesting evenings during 1967.

G. A. JEAPES, G2XV

Great Shelford, Cambridge.

Class B Licences

I would like to suggest that the Society considers making an approach to the licensing authority with the object of obtaining permission for Class B licence holders to use Morse code on the u.h.f. bands if they so desire.

The following argument in favour of such a move comes to mind: (i) Technically there is no doubt that contacts can be made over longer distances, or under more adverse conditions, when using Morse than other commonly used modes of transmission. The B licence has a restrictive effect on the fields of endeavour open to its holders.

(ii) U.h.f. contests have increased enormously in popularity since the advent of the B licence and it seems unfair to handicap the G8-plus-three operators by denying them the use of c.w. which in turn means denying them several weak signal, long distance, high score contacts per contest. Admittedly the licensing authority is not directly concerned with the fairness of our contests, nevertheless a considerable amount of "self training in wireless telegraphy" takes place on such occasions.

(iii) It is my experience that the most difficult problem faced by people learning Morse is getting sufficient practice. The problem would be eased if Class B licence holders were allowed to use and practice Morse code on the u.h.f. bands. Once again this is another facet of the all-important " self training in wireless telegraphy " for which the licence is issued and would be an excellent way of helping Amateur Radio " freshers " to graduate to the Class A licence as quickly and painlessly as possible.

What of the case against such a proposition? Apart from an instinctive reactionary attitude I do not believe there is one. It would be most interesting to hear the views of others, both for and against, in this connection.

ALAN BAYLISS, B.Sc., G8PD

Wembley, Middlesex.

As a recently licensed G8 and having been a regular listener on 2m for the past four years I would like to endorse the points made by G8AKA (November BULLETIN).

To all those who may object to his suggestion of the extension in the Amateur (Sound) Licence B to cover 2m the answer surely lies in the amount of Morse heard on this band. The number of such signals is negligible compared with the number of phone. Another point in favour is the general level of activity; unless conditions are good or there is a contest the number of stations heard on a normal weekday are few.

By extending the licence it could do much to increase activity on both the 2m and u.h.f. bands, and also interest in Amateur Radio generally. I'm sure the thought of having to pass a Morse test initially deters many would-be amateurs.

G. SWAN, G8ASJ

Sittingbourne, Kent.

QSL Managers

I have just read Mr. Pain's letter in the December BULLETIN regarding Ed McVittie's reported statement on this subject of QSLs. Having spent two years in Canada and having met Ed and seen the efficient and conscientious manner in which he runs a bureau for VE4 and acts as QSL Manager for several DX stations I must reply on his behalf. I'm sure he won't bother even if he sees the BULLETIN.

Ed orders and pays for the cards of some of the DX stations for whom he acts. If he did not do this there would be no QSL at all. Cards in Canada are more expensive to buy. As a matter of interest it cost me $12 to have 500 existing cards overprinted with my VE call.

As far as I know there is no central VE bureau for handling outgoing cards, unlike the excellent service provided by the RSGB. I can therefore understand Ed's policy. Why should he spend his money on cards, postage and packing to individuals (or bureaux) when the QSL may not really be required?

If Mr Pain does not like this situation, I suggest he offers to take over the chores and expense involved and act as manager for a DX station. (Not a DXpedition—the majority of which are well supported financially before, during or after their travels).

Why does Mr Pain quote air mail rates for his QSLs? Sea mail is cheaper and almost as quick bearing in mind that the logs from the DX station have to reach the manager before the QSL is issued by him. Ed is most punctilious in this respect.

At least we know where we stand with Ed. He requires an s.a.e. and IRC to defray costs. I would suggest that this is not unreasonable in this day and age of rising costs.

D. A. BARRY, G3ONU

Bushey, Herts.

Subscriptions for Students

I am afraid that I had to resign from the RSGB last summer when I obtained my licence, because it would not be possible for me to pay 50s. a year on top of 40s. a year for my licence.

There has been some talk recently of a student subscription. May I suggest that those who are at school or university (i.e. paying for their education) should pay the 25s. membership fee, but those earning money should pay the 50s. fee together with its advantages—regardless of licences. If this sort of scheme were to be organized I would gladly join again as, I am sure, would many other schoolboys like myself who have obtained their tickets.

M. BALLANCE, G8AQB

Douai School,
Woolhampton, nr. Reading.

National Field Day, 3-4 June, 1967

THE complete rules for NFD 1967 are as follows (RSGB General Rules do *not* apply):

1. Duration. The contest will commence at 17.00 GMT on **Saturday, 3 June** and end at 17.00 GMT on **Sunday, 4 June, 1967.**

2. Eligible Entrants. Any group of members within the British Isles which for the purpose of the contest comprise the prefix zones G, GC, GD, GI, GM and GW may enter. The group may be a local RSGB Group, a group of RSGB members, a club or an Affiliated Society. Entrants must operate within the terms of their licences. The use of the GB prefix will not be permitted.

3. Operators. Operators of portable stations competing in the contest must each hold a current British (GPO) Amateur (Sound) Licence A or a valid GPO Amateur Radio Certificate and must be *fully paid-up* Corporate Members of the RSGB at the time of the contest.

4. Stations. Each competing group will be permitted to put two stations ("A" and "B") in operation. The station operating on the lowest frequency employed shall be designated the "A" station. Such stations must operate in not more than three of the bands 1·8, 3·5, 7, 14, 21 and 28 Mc/s; the other three frequency bands will be allocated to the "B" station, i.e., no group may operate two stations on any one frequency band. Both stations may operate from the same site or from different sites, provided that they are located within the agreed limits of the area covered by their Regional Representative. It will be permissible for two groups within a Region or adjoining Regions, each operating a single station, to amalgamate for the purpose of scoring, bands to be allocated between the two stations as detailed above.

5. Licences. Each station must be licensed to use a different call-sign.

6. Applications. Each group intending to compete must send in an Application Form (obtainable from RSGB Headquarters) properly completed to the RSGB H.F. Contests Committee, 28 Little Russell Street, London, WC1, not later than **Wednesday, 26 April, 1967.** *Entries not made on the Official Entry Form or posted late will not be accepted.*

The information required on the Official Entry Form includes the following:

Call-signs of stations, the exact location in National Grid Reference of each station, the bands to be used by these stations, the full name and address of the RSGB member responsible for each entry.

A change of site may be permitted in cases of urgency providing that full details of the new site is made known to the H.F. Contests Committee at RSGB Headquarters in time for their inspectors to be advised of such a new site prior to the day of the commencement of the Contest.

Failure to notify such a change may cause the entry to be disallowed.

7. Tents. Stations must be operated from tents.

8. Apparatus. No apparatus may be erected on the site prior to 12.00 GMT on **3 June, 1967.** This rule includes aerials and aerial fittings as well as tented accommodation for the stations. A tent to be used for storage purposes only may, however, be erected prior to 12.00 GMT.

9. Aerials. Any aerials may be used, subject to the following limitations:

(*a*) All aerials must be constructed from wire of a total cross section area not greater than 14 s.w.g. with the exception, however, that vertical radiators of any construction may be used.

The use of tubular metal elements as well as metal foil wrapping for aerials is not permitted.

(*b*) No part of the aerials shall exceed a height of 45 ft. above ground level.

10. Transmitters and Receivers. Equipment at any "A" or "B" station must not exceed three transmitters and one receiver. Reserve equipment may be kept available, but not connected.

11. Power Input. The total in d.c. input power to the valve, valves or other devices energizing the aerial, or to any previous stage of the transmitter, shall not exceed 10 watts.

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

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 20 watts for the purpose of this rule. Manufacturers' published ratings only will be accepted.

12. Power Supply. Power for any part of the station must not be derived directly from supply mains.

13. Type of Emission. The contest is restricted to the use of c.w. (A1) only.

14. Contest Exchanges. An exchange of reports must be made and acknowledged before points may be claimed. In contacts made by competing stations the report must include a rising serial number commencing with 001 and increasing by one with each successive contact, *irrespective of band*, made by the station (e.g. RST579001), etc and such serial numbers, both incoming and outgoing, together with signal reports, must be entered on the log sheets.

Only the signal report from a non-competing station need be logged. Proof of contacts may be required.

15. Contacts. Only one contact with each station, as defined by basic call-sign, may count for points on each band during the contest. Duplicate contacts must be logged without claim for points.

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

17. 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

18. Summary Sheets. An entry will be accepted as valid ONLY if the complete summary sheet has been signed by the member solely responsible for the conduct of the event within his group, however constituted.

19. Names and Call-Signs. Contacts made by an operator whose name and call-sign does not appear on the Cover Sheet(s) of the appropriate log(s) will be disallowed. Operators call-signs must be shown on the logs against all contacts made by them. *Failure to comply with this rule will result in automatic disqualification.*

20. Entries. The entry from each station shall consist of extracts of the station log on the printed log sheet, *separate sheets being submitted for each band worked, together with a cover sheet for each band, and a summary sheet.* The points claimed must be totalled for each band. Forms for these purposes will be supplied by Headquarters. Entries must be addressed to the RSGB H.F. Contests Committee, 28-30 Little Russell Street, London, WC1, postmarked not later than **19 June, 1967.** Logs must be kept, and entries submitted, in GMT.

In the event of any dispute the ruling of the Council of the RSGB shall be final.

21. Awards.

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

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

(*c*) The Frank Hoosen Memorial Trophy to the group with the highest score on the 14 Mc/s band in addition to the miniature replica and certificate awarded under (*f*).

(*d*) The Scottish NFD Trophy to the Scottish group scoring the highest number of points.

(*e*) The Bristol Trophy to the group which, having entered only one station, shall obtain the highest number of points in comparison with other groups entering on a similar basis.

(*f*) Miniatures and certificates will be awarded to the groups with the highest score on each frequency band.

(*g*) A certificate to the chief operator of the overseas station whose checking log shows that he contributed the most points to competitors.

22. Station Inspections. All stations are subject to inspection by nominated representatives of the H.F. 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.)

GUIDANCE NOTES TO ENTRANTS

In past years there have been a disappointingly large number of entries received which have had to be disallowed for some reason or another.

The following notes are written to help entrants to ensure that their entries are accepted.

1. Late Entries. Ensure that your entry is posted before the *closing date of* last date of posting, i.e., 19 June, 1967.

2. No operators call-signs on Log Sheets. Make sure that each contact has the call-sign of the operator on the log sheet. It is *not* necessary for the operator to sign each contact.

3. No summary sheet. Do ensure that there is a summary sheet with your entry.

4. Cover Sheets. Do attach a separate cover sheet for each band. Do ensure that the name of every operator (for a particular band) and his call-sign appears on the cover sheet for that band. It is not necessary for each operator to sign the cover sheet.

5. Signature of Responsible Person. Do ensure that the summary sheet is signed by the person solely responsible for the entry.

6. Separate Log Sheets for each Band. Make sure that log sheets are made out for each band.

7. Location of Station. Be certain that the exact location of each station using National Grid Reference is included on the Official Application Form of Entry.

8. Application Forms for Entry. Use the Official Form and make sure it reaches RSGB HQ not later than Wednesday, 26 April, 1967.

9. Rules. Read the rules carefully and be sure you comply in all respects, particularly Rule 11.

The H.F. Contests Committee is very anxious that NFD should be enjoyed by all entrants. They desire above all a fair contest with the best groups winning the awards.

They dislike having to disallow entries. They want to get out the results as soon as possible after the events.

Please help them in every way you can.

General Rules for RSGB Contests 1967

The following rules apply to all RSGB Contests except where modified in individual events and are to be read in conjunction with the details for each contest published in the RSGB BULLETIN. All entries will be acknowledged by Headquarters within seven days of receipt but it is the responsibility of the entrant to refer to Headquarters if an acknowledgment is not received.

Rule 1. **Entrants** must operate in accordance with the terms of their licences.

Rule 2. **Unlicensed Stations.** Contacts with unlicensed stations will not count for points.

Rule 3. **Contacts** Only one contact on each band may be claimed with a specific station, whether fixed, portable, mobile or alternative address. Mobile stations are stations installed in motor vehicles or vessels on inland waterways and so equipped that they are capable of operation in motion without any alteration. Duplicate contacts must be logged and clearly marked as duplicates without claim for points. Cross-band contacts may not be claimed. Proof of contact may be required.

Rule 4. **Entries** must be clearly written or typed ON ONE SIDE ONLY of RSGB contest log forms or on foolscap or quarto paper and must be set out in the form prescribed in the published details for the contest concerned. The **cover sheet** of an entry must be made out in the following form:

Contest..... Date..... Claimed Score.....

Section (if any)..... Call-sign.....

Name .....

Home Address .....

.....

Address of station or Portable Location.....
(*if other than home address above*)

.....

QTH as transmitted.....
National Grid Six Figure Reference, QRA Locator County Code Letters

or other co-ordinates (see contest details).....

Transmitter(s)..... Input Power.....

Receiver(s) .....

Aerial(s) .....

DECLARATION: I declare that this station was operated strictly in accordance with the rules and spirit of the contest, and I agree that the decision of the Council of the RSGB shall be final in all cases of dispute. I certify that the maximum input to the final stage of the transmitter was.....watt(s)

Date..... Signed.....

Failure to complete the cover sheet or sign the declaration may involve disqualification of the entry.

Rule 5. **Entries.** All entries become the property of the Radio Society of Great Britain. In the event of any dispute the ruling of the Council of the RSGB shall be final.

Rule 6. **Multiple Operator Entries.** Unless otherwise stated, single operator entries only will be accepted. A single operator station is one manned by an individual operator who receives no assistance from other persons during the contest periods. A multi-operator station is one which does not conform to this definition. In those contests where multiple operator entries are allowed, such entries will only be accepted provided that:

(*a*) The call-sign of the operator concerned is indicated for each contact.
(*b*) The declaration is signed by only one operator who will be regarded as the entrant.
(*c*) The names and call-signs of all operators are listed on the cover sheet.

Rule 7. **Portable stations** must operate from the same site for the duration of a contest and may not be located in a permanent building. Power must not be derived directly from public or private supply mains. No apparatus may be erected on the site prior to the day of the event.

Rule 8. The details relating to specific contests published in the RSGB BULLETIN shall be regarded together with these general rules as the rules of the contest.

Rule 9. The use of GB call-signs is not permitted.

For V.H.F./U.H.F. Contests Only

Rule 10. All entrants must be fully paid-up members of the RSGB.

Rule 11. Multi-operator entries will be accepted (see Rule 6 above), provided that:

(*a*) only one call-sign is used.
(*b*) the call-sign of the operator concerned is indicated for each contact.
(*c*) the declaration is signed by only one operator who will be regarded as the entrant.
(*d*) the names and call-signs of all operators are listed on the cover sheet.

Rule 12. Contacts via any form of repeater or reflector devices will not count for points.

CONTEST NEWS

RESULTS—REPORTS—RULES

Second 144 Mc/s Contest (Open) 1967

Check logs from listeners are invited and may be credited towards the V.H.F. Listeners' Championship. Any comments on the rules will be welcome and will be considered when the rules for the next similar contest are made.

1. **When:** 18.00 GMT on **Saturday, 4 March** to 18.00 GMT on **Sunday, 5 March.**

2. The General rules of RSGB Contests as published in the January 1967 issue of the RSGB BULLETIN will apply except as superseded by the rules of this contest.
Sections (A) Single operator fixed station;
(B) other stations.

3. **Contacts** may be made on any mode permitted in the Amateur (Sound) Licence A except A2 (m.c.w.).

4. **Scoring** will be on the basis of one point per km.

5. **Contest Exchanges:** RST or RS reports followed by the contact number and location (e.g. RST 599001, 4 north Macclesfield, Cheshire). This location must be accurately identified on the Ordnance Survey " Ten-mile " map. Alternatively, five-character QRA locators may be exchanged. It is the responsibility of the receiving operator to obtain the information necessary to calculate his distances correctly.

6. **Entries:** Logs should be tabulated in columns headed in this order: " Date/Time (GMT) "; " Call-sign of station contacted "; " My report on his signal and serial number sent "; " His report on my signal and serial number received "; " Location of stations received "; " Points claimed."

7. Entries must be post-marked not later than Monday, 20 March, 1967.

Awards: At the discretion of Council the Mitchell-Milling Trophy and certificate of Merit to the leading station in Section A. Certificate of Merit to the runner-up in Section A and leading station in section B.

Listeners' 144 Mc/s Contest 1967

The following are the details of the Listeners V.H.F. contest to be held at the same time as the 144 Mc/s Open contest. Entries for this event will be automatically credited to the V.H.F. Championship.

1. **Duration.** The contest will commence at 18.00 GMT on Saturday, 4 March and end at 18.00 GMT on Sunday, 5 March, 1967.
2. **Eligible entrants.** The contest is open to all fully paid up members of the RSGB. Only the entrant may operate his receiving station for the duration of the contest. Holders of amateur transmitting licences are eligible to take part if they do not own transmitting equipment for the 144 Mc/s band.
3. **Logs and scoring.** Entrants will be required to log stations operating in the 144-146 Mc/s band. Logs must be set out and scores calculated as described in the rules for V.H.F./U.H.F. Listeners' Championship.
4. **Awards.** At the discretion of Council Certificates of Merit will be awarded to the leader and runner-up.

The 1967 V.H.F/U.H.F. Listeners' Championship

The major alteration in the Championship rules for 1967 involves the method of scoring. With the increasing use of QRA Locator exchanges in transmitting contests the scoring has been based on this system as it was felt that it would be easier to convert geographical locations to QRA Locator rectangles than vice versa. Any map marked with latitude and longitude can be used for this purpose. A description of the QRA Locator system appeared in the March 1965 RSGB BULLETIN but basic details are given here for the benefit of new members.

The basic rectangle measures 2° of longitude by 1° of latitude. These basic rectangles are lettered Z to the west of the Greenwich Meridian 0° and A to the east. Further west each rectangle is one letter lower in the alphabet and further east one letter higher. The second letter defines the latitude commencing with A which is 40°-41°. For example ZL is bounded by 0-2° west and 51°-52° north.

Rules

1. **Eligible Entrants.** The Championship is open to all non-licensed fully paid-up Members of the RSGB. Only the entrant may operate his receiving station which must remain at one site for the duration of each contest of the Championship. Entries will be accepted from newly licensed members provided that the contestant was unlicensed at the time of his first entry in 1967 and that no transmitter is used during any period for which he submits a listener log.
2. **Duration.** The Championship will run from January to December 1967 on those dates and times when the RSGB v.h.f. and/or u.h.f. contests and tests occur.
3. **Entries.** Entrants may submit logs for any or all RSGB v.h.f. and u.h.f. contests in 1967. The scores of the best six logs from each entrant will be totalled at the end of the year. Not more than four of these six logs will be for v.h.f. (70 Mc/s or 144 Mc/s) bands. Entries must be set out on RSGB Contest Log Sheets, available from RSGB HQ or on one side only of foolscap paper and must be posted within the period allowed for the appropriate transmitting contest. Entries for the 70 Mc/s and 144 Mc/s Listener Contests will be automatically credited to the Championship.
4. **Logs.** Logs must show in columns: (*a*) Date/time GMT; (*b*) Call sign of station heard; (*c*) My report on his signals; (*d*) Report and serial number sent by station heard; (*e*) Call-sign of station being worked; (*f*) Location given by station heard; (*g*) QRA Rectangle; (*h*) Points claimed.
In the case of multi-band events, e.g. V.H.F. NFD, separate logs are required for each band and stations may be logged once on each band.
5. **Scoring.** Points are to be scored as follows:
   (*a*) For each station logged in the same two letter QRA rectangle as the entrant—4 points.
   (*b*) For each station logged in any other two letter QRA rectangle—6 points.
   (*c*) For each two letter QRA rectangle received an additional —40 points.
   (*d*) For an incomplete entry or an entry of a station not giving serial numbers, half the above points may be claimed.
   (*e*) For an entry of a telegraphy transmission double points may be claimed.
   (*f*) The whole score, including bonuses, for the 432 Mc/s band is to be multiplied by three and the whole score for any frequencies above 1215 Mc/s is to be multiplied by ten.
6. **Awards.** At the discretion of Council the Hanson Trophy will be awarded to the leader of the Championship and Certificates of Merit will be awarded to the runners-up and for particularly meritorious logs for individual events. (These awards are in addition to the awards for the Listeners' Contests.)

80 Metre Field Day 1966

The winner of the 80m Field Day held on 11 September, 1966 was L. V. Easter, G3JHF, who operated from a site at Kegworth, near Derby, and scored 136 points from 55 contacts, of which 21 were with portable stations. G3CWL and G3MWO tied for second place some 17 points behind the leader.

Both activity and entries were down on last year's contest, which is rather disappointing; it has been suggested that the clash of dates with the RSGB National Mobile Rally at Woburn was a major cause. A number of other portable stations, some with high serial numbers, appeared in the logs and one wonders why they did not send in their results.

With only one exception, each entrant was awarded fewer points than he claimed; most of the inaccuracies were because of misread call-signs and locations.

Nearly all the entrants used half-wave aerials, G3VFD's was kite-bourne; receivers varied from an AR88D to a Mohican. G3DOP, using an input of 400 mW, was the only " all transistor " station.

Check logs are gratefully acknowledged from G2DHV, G3BY, G3IDG, G3STQ and GW3UKI/P.

Call-sign	Points	Call-sign	Points
1. G3JHF/P	136	7. GW3HGL/P	90
2. G3CWL/P } G3MWO/P }	119	8. G3IGU/P	83
		9. G6GH/P	77
4. G3SIA/P	115	10. G3VFD/P	69
5. G3BIK/P	111	11. G3DOP/P	66
6. G3BZM/P	105		

CLUBROOM

A Monthly Survey of Club and Group Activities

For further information on membership or the activities of a particular club, application should be made to the person whose call-sign is indicated at the end of the item. Full addresses may be obtained from the RSGB Amateur Radio Call Book.

AEI Rugby Recreation Club announces a series of short Sunday afternoon Direction Finding Contests to be run during the winter. It is hoped that one event will be held each month, weather permitting, until RSGB qualifying events resume in the summer. These events will be used to try various ideas and experiments with contest rules and organization. Visitors will be welcome and details are available from D. E. Newham, The Toll Lodge, Watling Street, Watford (Village), Rugby. *G3BXF.*

Basildon and District ARS has given a face-lift to its newsletter, but are requiring an Editor. When an editor is press-ganged into service he will, of course, notice the omission of the society's name! *G3IJB.*

Bristol RSGB Group. At the last meeting over 50 members attended a talk given by Mr W. D. Gilmore of EMI, Wells, on "Inductive Loops and Controlled Model Cars." The use of working models made this an enjoyable evening for all. Among the 42 members and friends who attended the Annual Dinner on 3 December were Zone D Council Member Mr G. Twist, G3LWH and Region 9 Representative Mr R. E. Griffin, G5UH. *G5UH.*

Bromsgrove and District ARC looks back over another very successful year in which it took part for the first time in National Field Day. In addition, three exhibition stations were staged, and a mobile picnic was held, which, together with a series of lectures and demonstrations, completed the programme for 1966. Among the projects for the next 12 months will be equipping the newly acquired club shack. *G2CLN.*

Cambridge University WS has recently completed another successful term. The formal meetings included talks on transistorized equipment by G3SBA, V.H.F. Mobile Radio by G3EDD and ionospheric research by Dr Rishbeth of the Radio and Space Research Station. Meetings resume this month on 24 January with a talk by G3PDM on Keying and Break-in. *G3TGY.*

Chelmsford ARS entertained last year's RSGB President Roy Stevens, G2BVN, on 3 November. During the evening G2BVN presented the European V.H.F. Trophy to Peter Blair, G3LTF for his outstanding work on v.h.f. G3PMX then presided over a Junk Sale. Among bargains of note were 3 in. 200μA meters going for 15s. *G3RZP.*

Attending to the aerials at the Halifax Scout HQ station G3MVH/A for the Scout Jamboree-on-the-air last year were members of the Northern Heights ARS: Mary G3OMM, Chris G3VJV, Alan G3TQA, SWL Mike White, Barrie G3TXX and Richard G3UGF.

Civil Service Radio Society's long awaited visit to Jodrell Bank Radio Observatory took place on 19 November, and was enjoyed by all members of the party. Visitors and prospective members are always welcome to attend any meeting. *G3IIE.*

Cornish ARC recently held a V.H.F. Group meeting and for reasons best known to those concerned only two attended the meeting the purpose of which was a visit to the GPO repeater station at Morrfields, Truro. On 29-30 October members with families paid a visit to the Goonhilly Down Satellite Tracking Station, but owing to the size of the party the group had to split. Complete contrast to the visit on 11 November. *G3OCB.*

Coventry ARS plans to start a fund raising campaign for the purchase of a modern s.s.b. transceiver. A letter from its President points out that plans are afoot to sell the existing equipment which he hopes, together with a Grand Draw, will raise sufficient finance. *G3OCB.*

Crawley ARC held its November informal meeting in the home of Alan Jones, G3SGA. An unexpectedly large attendance surprised and delighted Alan and his wife Eileen who made everyone welcome. *G3FRV.*

Cray Valley Radio Society's December newsletter *QUA* devoted a page to the subject of transistor oscillators. Elsewhere, the following wanted notice appeared: "In a certain recording company, everybody is looking for the idiot engineer who dubbed one of his tapes backwards. Over 400 copies of the record were sold before someone realised that the bagpipe music he was listening to was playing in reverse. No comment." *G3JJG.*

Culcheth Amateur Radio Society has just been formed and has elected a committee. Meetings are held every Friday at 7.30 p.m. in the Harrow Inn, Culcheth, nr. Warrington, Lancs. *G3VPX.*

Derby and District ARS. A talk on electronic organs was given on 26 October by Eric West, G3KTP. The lecture was very popular and provoked much interest.

Edgware and District RS held a successful club construction contest on 14 November when S. Marcus, A4860, won with his 160/80m transistorized transmitter. *G3RAA.*

Grafton RS will resume meetings following the Christmas recess on Friday, 13 January. We wish them luck! *G3SIL.*

University of Keele RS was host to Burslem ARS during the *Short Wave Magazine* contest. Burslem ARS has no transmitting site and was pleased to operate from Keele. *G3COY.*

Mansfield ARS continues to meet at 7.30 p.m. on the first Friday in each month at the New Inn, Westgate, Mansfield. *G8HX.*

At the last meeting of **Midland ARS** G6RKU/T presented another successful demonstration of amateur television, assisted by G8ANY. It was unfortunate that a /A licence was not issued in time for the talk. *G3SCG.*

North Kent RS devoted much of October to aerials. On 13 October H. Shelvey produced an interesting talk on this subject and on 27 October a task force was put to work preparing the club station for operation. *G3PUI.*

Northern Heights ARS operated under the Halifax Scout Association's call G3MVH/A during last year's Scout Jamboree-on-the-Air. More recently G. E. Craven gave a talk on unusual electronics followed by a lecture on aerials by G3IBN. *G3MDW.*

Plymouth RC reports a general increase in attendance at meetings and finds it gratifying that members should support the society to such a full extent during the winter months. *G3SVZ.*

Salop ARS held, on 17 November, its first "Hot Pot Supper and Natter Nite" with 30 present out of a membership of 46. Among the many guests were RSGB Region 3 Representative, R. W. Fisher, G3PWJ, and past speakers. The long awaited club station is now complete and made its inaugural transmission on 22 December. *G4LU.*

Saltash and District ARC passed through its AGM on 4 November. The treasurer reported an excellent profit from the Christmas draw and Annual Mobile Rally. *G2DFH.*

G5PP demonstrating the pro's and con's of amateur mobile radio to a recent meeting of the Radio Society of Harrow.

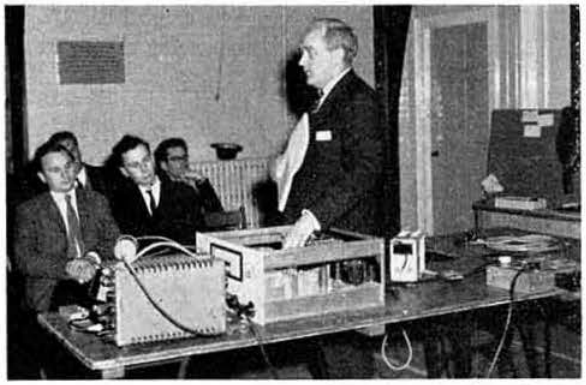
Members of the **Southgate RC** enjoyed themselves during the recent MCC Top Band Contest running 10 watts into a TT11 p.a. In the spirit of all club contests the object of the exercise was not so much to gain as many points as possible, but to have a good time. *G3TDM.*

South Dorset RS had a very interesting lecture on a c.w./s.s.b. transceiver at its December meeting, to which they were indebted to G3IWV and G3NAE. On 6 January an Extraordinary General Meeting will be held at the Guilds Hut, Litchfield Road, Lanehouse Rocks Estate, Weymouth, to consider the purchase of the new club house. *G3EAT.*

Sutton and Cheam RS has completed plans for this year's NFD. A new site has been chosen but its NFD committee is having difficulties deciding on what aerials to use. *G3HSK.*

Members of the **Torbay ARS** visited the RSGB Communications exhibition last October and spent a pleasant day, but commented on the lack of surplus gear and components on show. Perhaps as a consolation the society held a sale of surplus equipment on 26 November. *G3LHJ.*

A convincing case for " going sideband " (if one is needed!) was put to **Verulam ARS** members at its November meeting when Gerry Gibbs, G3AAZ, gave a splendid talk on the principal features of his award-winning s.s.b. transmitter. The transmitter is built within a cubical framework using several sub-chassis to achieve a modular construction and provide benefits in terms of versatility and the ability to be modified at a future date without detracting from the overall attractiveness and mechanical excellence of the design. Much practical advice was given to would-be constructors by Gerry, including how to get a minimum of 60db unwanted carrier suppression with a maximum of long-term stability. The use of a 'scope and a two-tone tester was strongly recommended by G3AAZ to all sidebanders, whether running home-brewed or commercial gear—a point that struck home to those with equipment in the latter category! Gaining popularity at meetings is a member's " flog-it " board upon which any member can pin a postcard advertising his wants or articles for sale. Recent club activities have included participation in a Top Band contest from a 16th century haunted cottage in Hertfordshire where the combination of a deep encircling moat and a very long aerial produced excellent results. Stations reporting a strange hollow sound to Verulam's note should not be surprised, it seems! *G3GJX.*



" Mechanical and electrical stability are vital considerations," stated Gerry Gibbs, G3AAZ, demonstrating his award-winning ssb transmitter at Verulam ARS.

Wakefield and District RS have started Morse classes with 10 keen members attending. On 17 January a Beginners' Night will be held for which questions are invited. An RAE Course has been arranged to start this month and anyone interested should contact G3TQV or The Principal, Mr Jowett, Wakefield Technical College, Wakefield. *G3TQV.*

Wolverhampton ARS will be meeting on 23 January for an informal meeting at 8 p.m., at Neachells Cottage, Stockwell Road, Tettenhall. *G3UBX.*

Wimbledon and District RS are still in need of contributors for its newsletter *QRK-5.* Over 90 per cent of the copy for the December issue was prepared by G3EPU and SWL Geoff Smith. However, matters are improving.

* * *

It would be of assistance to the compiler of " Clubroom " if reports could be typed double-spaced and submitted before the final deadline if at all possible. In handwritten reports, please spell unusual words in block capitals.

Deadline for the **February** issue is **6 January** and for the **March** issue **3 February.**

Can You Help?

● R. F. Hills, BRS26703, 29 Elms Road, Harrow Weald, Middlesex, who wishes to obtain a list of the connections for the 16 way plug on the panel of the Collins TCS-6 transmitter, details of the power requirements, and a circuit diagram?

● A. Hall, G3UWA, 228 Leek Road, Endon, Stoke-on-Trent, Staffordshire, who requires information on the Pye V.H.F. base stations PTC 262 and 293?

CONTESTS DIARY

14-15 January—Affiliated Societies' Contest (1·8 Mc/s) (see page 836, December 1966)
29 January —First 144 Mc/s Contest (C.W.)* (see page 835, December 1966)
4-5 February —ARRL DX Contest (Phone)
12 February —First 70 Mc/s Contest (Open)* (see page 834, December 1966)
18-19 February—First 1·8 Mc/s Contest
18-19 February—ARRL DX Contest (C.W.)

4-5 March	—Second 144 Mc/s Contest (Open)* and 144 Mc/s Listeners' Contest* (See page 52)
4-5 March	—ARRL DX Contest (Phone)
11-12 March	—BERU (see page 838, December 1966)
18-19 March	—ARRL DX Contest (C.W.)
2 April	—Low Power Contest (3·5 Mc/s)
15-16 April	—Second 70 Mc/s Contest (Open)* and 70 Mc/s Listeners' Contest*
7 May	—Third 144 Mc/s Contest (Portable)*
20-21 May	—First 1296 Mc/s Contest (Open)*
27-28 May	—First 432 Mc/s Contest (Open)*
3-4 June	—National Field Day (See page 50)
2 July	—Fourth 144 Mc/s Contest (Portable)*
8-9 July	—1·8 Mc/s Summer Contest
23 July	—Third 70 Mc/s Contest (Portable)*
2-3 September	—V.H.F. NFD/IARU Contest*
10 September	—80 Metre Field Day
7-8 October	—Second 1296 Mc/s Contest (Open)*
14-15 October	—RSGB 21-28 Mc/s Telephony Contest
14-15 October	—Second 432 Mc/s Contest (Open)*
28-29 October	—RSGB 7 Mc/s DX Contest (Phone)
11-12 November	—RSGB 7 Mc/s DX Contest (C.W.)
18-19 November	—Second Top Band Contest
3 December	—Fourth 70 Mc/s Contest (C.W.)*

* Qualifying contests for V.H.F./U.H.F. Listeners' Championship.

RSGB Publications

28 LITTLE RUSSELL STREET, LONDON, WC1

	Post Paid UK
RSGB PUBLICATIONS	
Radio Data Reference Book	14/–
Technical Topics for the Radio Amateur	10/8
Amateur Radio Call Book (1967 Edition)	6/6
Radio Amateurs' Examination Manual (Fifth Edition)	5/9
Guide to Amateur Radio (Twelfth Edition)	5/9
S.S.B. Equipment	3/–
Communications Receivers (Second Edition)	3/–
Morse Code for Radio Amateurs (Fourth Edition)	2/–
Log Book (RSGB)	7/3
ARRL PUBLICATIONS	
Antenna Book, 10th Edition	18/6
A Course in Radio Fundamentals	10/–
Hints and Kinks, Volume 7	10/–
Mobile Manual for Radio Amateurs	23/6
Radio Amateur's V.H.F. Manual	18/6
Single Sideband for the Amateur (Fourth Edition)	23/6
Understanding Amateur Radio	18/6
USA Licence Manual	5/–
CQ PUBLICATIONS	
Antenna Roundup	23/6
Antenna Roundup Vol. 2.	30/–
CQ Anthology, 1952–59	23/6
CQ Anthology, 1945–52	16/–
CQ Mobile Handbook	23/–
CQ New Sideband Handbook	24/–
RTTY Handbook	30/–
Shop and Shack Shortcuts	29/6
73 MAGAZINE PUBLICATIONS	
Care and Feeding of a Ham Club	8/–
Parametric Amplifiers	15/–
Simplified Maths for the Hamshack	4/6
Test Equipment Handbook	4/6
V.H.F. Antenna Handbook	15/–
RADIO PUBLICATIONS INC.	
Beam Antenna Handbook	28/–
Better Short-wave Reception	24/6
Cubical Quad Antennas	22/–
Electronic Construction Handbook	22/6
S-9 Signals	8/6
EDITORS & ENGINEERS	
Transistor Radio Handbook	42/6
AMERICAN MAGAZINE SUBSCRIPTIONS‡	
CQ (*Cowan*) Monthly (p.a.)	44/–
†*QST* (*ARRL*) Monthly (p.a.)	43/6
Institutions, groups, etc. (p.a.)	50/–
†*73 Magazine* Monthly (p.a.)	30/–
† *Sample Copy 2/6*	
‡ *Mailed direct from USA*	
MISCELLANEOUS PUBLICATIONS	
Basic Electronics (*Dover*)	23/6
Basic Electricity (*Dover*)	25/6
Basic Theory and Application of Transistors (*Dover*)	11/6
★Dictionary of Electronics (*Penguin*)	8/–
Foundations of Wireless (*Iliffe*)	22/3
Guide to Broadcasting Stations (Iliffe)	6/6
★How to Listen to the World (*New Edition*)	26/–
Ham's Interpreter (5th Edition)	8/6
Log Book, 150 pages, opens flat (*Martins*)	22/6
Manual of Transistor Circuits (*Mullard*)	13/6
Outline of Radio and Television (*Hawker*)	34/6
Radio Amateur Operator's Handbook (*Data*)	5/6
Radio Amateur's Vocabulary (German/English)	9/3
★Semaphore to Satellite (I.T.U.)	70/–
Short Wave Listening (*Iliffe*)	13/2
Short Wave Receivers for the Beginner (*Data*)	6/6
Transistor Radios, Circuitry and Servicing (*Mullard*)	5/9
Understanding Television (*Data*)	40/–
Wireless World Radio Valve Data	10/6
★World Radio–TV Handbook (1967)	32/–
MORSE COURSES	
G3HSC Rhythm Method of Morse Tuition	
Complete Course with three 3 speed L.P. records + books	84/–
Beginner's Course with two 3 speed L.P. records + books	60/6
Beginner's L.P. (0-15 w.p.m.) + book	50/–
Advanced L.P. (9-42 w.p.m.) + book	50/–
Three speed simulated GPO test. 7 in. d.s. E.P. record	11/6
RSGB Morse Instruction Tape (900 ft.)	35/–
RSGB Morse Practice Tape (450 ft.) (both at 3¾ i.p.s., up to 14 w.p.m.)	20/–
SHACK AIDS	
★Easibinders, round backed, gold blocked, for RSGB Bulletin	16/6
Easibinder Year Stickers (1965, 1966 or 1967)	1/6
★Admiralty Great Circle Map (In Postal Tube)	8/–
QRA Locator, Western Europe	5/6
RSGB Countries List	1/–
Panel Signs, transfers (*Data*)	
Set 3: White Wording	4/9
Set 4: Black Wording	4/9
Set 5: Dials (Clear Background)	4/9
Set 6: Dials (Black Background)	4/9
Decalet Panel Lettering Transfers (Black or White)	1/–
Blick Dry Print Lettering (Letters and Numerals, Black)	2/6
RSGB MEMBERS ONLY	
Bound copy RSGB Bulletin (Vol. 42–1966)	25/–
Car Badge (De Luxe with call-sign)* (*Postage on overseas orders 5/6 extra*)	25/–
Car Badge (RSGB Emblem with call-sign)*	18/–
Car Badge (RSGB or RAEN Emblem)	9/–
Leather Key Fobs, with RSGB Diamond attached —Black, Natural, Red, Green, Blue	7/–
RSGB Terylene Tie (Maroon or Dark Blue)	16/–
RSGB Blazer Badge (Black or Dark Navy Blue)	8/-
Stereo Block (RSGB or RAEN Emblem)	10/–
Area Representatives Badge (ARs only)	10/–
Members Headed Qto. Paper (100 sheets)	10/6
Call-sign Lapel Badge (with RSGB or RAEN Emblem, pin or stud fitting)*	8/6
Call-sign Lapel Bar*	7/–
RSGB Lapel Badge (½ in. size) stud or pin fitting	2/–
Plastic Window Sticker (RSGB or RAEN Emblem)	1/3

★ *These publications will be available at the end of the current month*

* *Delivery 6-8 weeks*

(*Stamps and Book Tokens cannot be accepted*)

Forthcoming Events

Details for inclusion in this feature should be sent to the appropriate Regional Representatives by the **first of the month** preceding publication. A.R.s and club secretaries are reminded that the information submitted must include the date, time and venue of the meeting and, whenever possible, details of the lecture or other event being arranged. Standing instructions cannot be accepted.

Ainsdale (ARS).—11, 25 January, 8 February, 8 p.m., 77 Clifton Road, Southport.
Allerton (Liverpool) (SRHS).—Thursdays, 8 p.m., 3rd Allerton Scout Group Headquarters, Church Road, Woolton, Liverpool.
Ashton under Lyne (AUL & DARS).—Fridays, 7 p.m., Rooms F52 and F53, Ashton College, Beaufort Road.
Blackburn (ELARC).—5 January, 2 February, 7.30 p.m., YMCA, Limbrick, Blackburn.
Blackpool (B & FARS).—Mondays, 8 p.m., Pontins Holiday Camp, Squires Gate. Morse tuition from 7.30 p.m.
Bury (B & RRS).—10 January (subject to be announced), 8 p.m., Old Boars' Head Hotel (private room), Crompton Street.
Chester (C & DARS).—Tuesdays, 8 p.m., YMCA. Except first Tuesday in each month.
Crewe & District.—6 February, 8 p.m., Earl of Crewe Hotel, Nantwich Road.
Eccles (E & DRC).—Tuesdays, 8 p.m., Patricroft Congregational Schools, Shakespeare Crescent, Patricroft. Every Thursday Club Top Band net 20.30 GMT.
Liverpool (L & DARS).—Tuesdays, 8 p.m., Conservative Association Rooms, Church Road, Wavertree.
(ULARS).—2, 16, 30, January, 7.30 p.m., Students' Union, 2 Bedford Street North, Liverpool 7.
Macclesfield (M & DARS).—17, 31 January, 8 p.m., The George Hotel, Jordangate.
Manchester (M & DARS).—Wednesdays, 7.30 p.m., 203 Droylsden Road, Newton Heath, Manchester 10.
(SMRC).—Fridays, 7.45 p.m., Rackhouse Community Centre, Daine Avenue, Northenden.
Morecambe.—4 January, 1 February, 125 Regent Road.
Preston (PARS).—10 January, 7.30 p.m., St Paul's School, Pole Street.
St Helens (SES).—10 January (subject to be announced), 24 January ("Moonbounce," by G2HCG), 7 February (AGM), 7.30 p.m., IVS Centre, 55 College Street.
Southport (SRS).—11 January ("Getting Mobile," by G3KXC), 25 January (AGM), 8 February ("Aligning with an Oscilloscope," by G3NKL), Wednesdays 8 p.m. and Sundays 4 p.m., The Esplanade.
Stockport.—11, 25 January, 8 February, The Blossoms Hotel, Buxton Road.
Wirral (WARS).—4 January ("FET's" by G3UMF), 18 January, 1 February, 8 p.m., Harding House, Park Road West, Claughton, Birkenhead.

REGION 2

Barnsley (B & DARC).—13 January ("Aerial Matching Experiences," by W. Williams), 21 January (Annual dinner. Tickets and details from G5KM), 27 January (Sale of surplus gear). Meetings at 7.30 p.m., King George Hotel, Peel Street.
Bradford (BRS).—31 January (Members' Colour slides), 7.30 p.m., Bradford Technical College, Great Horton Road, Bradford.
Durham (DCARS).—12 January (Junk Sale), 26 January, (Mullard Film Show), 8 p.m., Bay Horse, Gilesgate, Durham City.
Hull (H & DARS).—6 January (Workshop Organization), 13 January ("G2DAF Receiver" by G3TEU), 20 January (Workshop Organization), 27 January (AGM), 8 p.m., 592 Hessle Road, Hull.
Northern Heights.—18 January ("Measurement of Power in S.S.B. Equipment," by A. W. Walmsley, G3ADQ), 1 February (Film Show), 7.45 p.m., Sportsman's Inn, Ogden, Halifax.
Scarborough (SARS).—Thursdays, 7.30 p.m., rear of 3 Trinity Road, Scarborough.
South Shields (SS & DARC).—6 January (Colour slide show of Club events and local shacks), 8 p.m., Trinity House Social Centre, Laygate, South Shields, 21 January (Annual Dinner, details from G3KZZ).
York (YARS).—19 January (AGM), 8 p.m., 61 Micklegate, York.

REGION 3

Cannock Chase (CCARS).—First Thursday in each month. Bridgtown Social Club, Walsall Road.
Dudley (DARC).—13 January (Film—ICT Computers), 27 January (Talk by G3UMV), 8 p.m., Art Gallery, St. James Road.
Midland (MARS).—Third Tuesday each month, Midland Institute, Margaret Street.
Leamington Spa (MWARS).—9 January (AGM), 23 January ("Radio Servicing" by L. Baker), 7 Regent Grove, Leamington Spa.
Salop (SARS).—19 January (Film—Nuclear Power), 26 January ("Station Activities" by G3RRN), Old Post Office Hotel, Milk Street, Shrewsbury.
Worcester (W & DARC).—21 January (Junk Sale), 35 Perkswell Park, Droitwich Road.
Wolverhampton (W & DARC).—16 January ("Early Days of Amateur Radio" by G2YM), 8.15 p.m., The Golden Lion.

REGION 6

Cheltenham RSGB Group.—First Thursday in each month, 8 p.m., Great Western Hotel, Clarence Street, Cheltenham.

REGION 7

Acton, Brentford & Chiswick (ABCRC).—17 January (AGM), 7.30 p.m., AEU Club, 66 High Road, Chiswick.
Ashford (Middx) Echelford (ARS).—11, 25 January, 7.30 p.m., Links Hotel, Ashford.
Bexley Heath (NKRS).—12 January ("Modulation," by T. L. Herdman, G6HD), 26 January ("Safety First," by Dave Wooderson, G3HKX), 7.30 p.m., Congregational Church Hall, Chapel Road, Bexley Heath.
Chingford Group.—Alternate Fridays, 13, 27 January, contact G3EHD, SIL 5642.
(SRC).—Fridays (except first in month), Friday Hill House, Simmons Lane, Chingford, E4.
Croydon (SRCC).—17 January, 7.30 p.m., Blue Anchor, South Croydor.
Dorking (D & DRS).—10 January (Informal Meeting), 8 p.m., Wheatsheaf, 24 January (Formal Meeting), 8 p.m., Star & Garter, Dorking.
East Ham.—First and third Tuesdays, 7.30 p.m., 12 Leigh High Road, East Ham.
East London.—15 January (Lecture and Discussion), 2.30 p.m., Wanstead House, The Green, Wanstead, E11.
East Molesey (TVARTS).—First Wednesday each month, Prince of Wales, Bridge Road, East Molesey.
Edgware & Hendon (EADRS).—9 January (AGM), 23 January (Film Show), 8 p.m., John Keble Hall, Church Close, Deans Lane, Edgware.
Gravesend (GRS).—Third Wednesday each month, 7.30 p.m., RAFTA Club, Overcliffe Road.
Guildford (G & DRS).—13, 27 January, 8 p.m., Guildford Model Engineering Society, in Stoke Park.
Harlow (DRS).—Tuesdays and Thursdays, 7.30 p.m., Mark Hall Barn, First Avenue.
Harrow (RSH).—Fridays, 6, 20, 27 January (Practical, Morse and RAE), 13 January (AGM), 8 p.m., Roxeth Manor School, Eastcote Lane.
Havering (H & DARC).—11, 25 January, Romford.
High Wycombe (CARC).—26 January, 8 p.m., British Legion, St. Mary Street, High Wycombe.
Holloway (GRS).—Mondays (RAE), 7 p.m., Wednesdays (Morse), 7.30 p.m., Friday (Club), 7.30 p.m., Montem School, Hornsey Road.
Hounslow (HADRS).—9, 23 January, Canteen, Mogden Main Drainage Dept., Modgen Works, Isleworth.
Ilford.—Thursdays, 8 p.m., 579 High Road, Ilford, Essex.
Kingston.—5, 19 January, fortnightly, 8 p.m., YMCA, Eden Street, Fridays (Morse classes), 2 Sunray Avenue, Tolworth.
Leyton & Walthamstow.—10, 24 January, 7.30 p.m., Leyton Senior Institute, Essex Road, London, E10.
London U.H.F. Group.—5 January (AGM; U.H.F. Surplus!), 7.30 p.m., Bull and Mouth, Bloomsbury Way, Holborn.
Loughton.—13, 27 January—Meeting alternate Fridays, 7.30 p.m., Loughton Hall (Nr. Debden Station).
Maidenhead (M & DARC).—17 January, 7.30 p.m., Victory Hall, Cox Green, Maidenhead.
New Cross.—Wednesdays and Fridays, 8 p.m., 225 New Cross Road, SE14.
Norwood & South London (CP & DRS).—21 January ("Crystal Filters for S.S.B.", by G3FZL), CD Centre, Catford, London, SE6.
Paddington (P & DARS).—7.30 p.m., Wednesdays, Beauchamp Lodge, 2a Warwick Crescent, W2.
Purley (P & DRC).—20 January, 8 p.m., Railwaymen's Hall, Side Entrance, 58 Whytecliffe Road, Purley.
Reigate (RATS).—11 January (AGM), 7.30 p.m., George and Dragon, Cromwell Road, Redhill. 24 February (Annual Dinner and Dance), Lakers Hotel, Redhill.
Romford (R & DRS).—Tuesdays, 8.15 p.m., RAFTA House, 18 Carlton Road.
Science Museum (CSRS).—7 February (Science Museum, Star Dome (Planetarium): conducted tour and talk by H. Saunders), 7.30 p.m., Science Museum, South Kensington.
Scout (ARS).—19 January, 7.15 p.m., Baden Powell House, Queens Gate, South Kensington, SW7.
Sidcup (CVRS).—5 January, 2 February, 7.30 p.m., Congregational Church Hall, Court Road, Eltham.
Slough (SDR Group).—First Wednesday every month, 8 p.m., United Services Club, Wellington Street.
South London Mobile Club.—7 January, 8 p.m., Clapham Manor Baths, SW4.
Southgate & District.—12 January, 7.30 p.m., Parkwood Girls School (behind Wood Green Town Hall).
St. Albans (Verulam ARC).—18 January (G2YS talking about his trip to USA, with colour slides), Cavalier Hall, Watford Road, St. Albans.
Sutton & Cheam (SCRS).—20 December, 8 p.m., The Harrow Inn, High Street, Cheam.
Welwyn Garden City (Mid Herts ARS).—12 January (Bring and Buy Sale), Backhouse Room, Handside Lane, Welwyn Garden City. 20 January (Informal Dinner), 8 p.m., Roebuck, Stevenage.
Wimbledon (W & DRS).—13 January, 8 p.m., Community Centre, St. George's Road, Wimbledon, SW19.
Wembley (CECARS).—Every Thursday, 7 p.m., Sports Club, St. Augustines Avenue, N. Wembley. This club is now open to non-employees of GEC by invitation; telephone: ARNold 1262 first.

REGION 8

Crawley (CARC).—11 January (Informal, details from G3FRV), 25 January (Film Show), 8 p.m., Trinity Congregational Church Hall, Ifield.

REGION 9

Bath.—20 January, 7.30 p.m., RNR Training Centre, James Street West, Bath.
Bristol.—27 January, 7.15 p.m. New location to be announced in January circular.
(BARC).—Mondays and Thursdays, 7.30 p.m., 43 Ducie Road, Barton Hill, Bristol 5.
Burnham-on-Sea (BoSARS).—Second Tuesday in each month, 8 p.m., Crown Hotel, Oxford Street.
Camborne (CRAC).—First Thursday in each month, Staff Recreation Hall, SWEB Headquarters, Pool, near Camborne.
(CRAC V.H.F. Group).—First Thursday in each month, 7.30 p.m., The Coach and Horses, Ryder Street, Truro.
Exeter.—First Tuesday in each month, 7.30 p.m., George and Dragon Inn, Blackboy Road, Exeter.
Plymouth (PRC).—Tuesdays, 7.30 p.m., Virginia House, Bretonside, Plymouth.
Saltash (S & DARC).—Alternate Fridays, 7.30 p.m., Burraton Toc H Hall, Warraton Road, Saltash.
South Dorset (SDRS).—First Friday in each month, 7.30 p.m., Labour Rooms, West Walks, Dorchester.
Taunton.—Alternate Thursdays, 7 p.m., Lecture Theatre, Taunton Technical College.
Torquay (TARS).—28 January, 7.30 p.m., Club HQ, Belgrave Road, Torquay.

"V.H.F. MOBILE RADIO" by BRIAN ARMSTRONG, G3EDD

Wells (WARS).—Mondays from 8 p.m., EMIE (Wells) Sports and Social Club, Chamberlain Street, Wells, Somerset.
Weston-super-Mare.—6 January, 7.30 p.m., Main Engineering New Block, Weston Technical College.
Yeovil (YARC).—Wednesdays, 7.30 p.m., Park Lodge, The Park, Yeovil.

REGION 10

Blackwood.—6, 13, 20, 27 January (include informal classes for RAE candidates), 7.30 p.m., Blanche Cottage, off High Street, Blackwood, Mon.
Cardiff.—9 January, 7.30 p.m. ("Demonstration of Alignment of CR150/4 Receiver, Using a Wobbulator" by D. M. Thomas, GW3RWX), TA Centre, Park Street, Cardiff.

REGION 11

Llandudno (CVARC).—19 January ("Semiconductors in Amateur Radio" by J. T. Lawrence, GW3JGA), 7.30 p.m., Cross Keys, Madoc Street, Llandudno.

REGION 13

Edinburgh (LRS).—12 January ("Modern Test Equipment," by D. Stewart), 26 January ("RTTY," by J. Buchanan and B. Flynn), 7.30 p.m., YMCA, South St. Andrew Street, Edinburgh.

REGION 14

Ayrshire RSGB Group.—First and Third Wednesdays of the month, 7.30 p.m., Park Hotel, Monkton.
Auchenharvie & District.—Tuesdays and Thursdays, 7.30 p.m., Auchenharvie Community Centre, Stevenston.
North Ayrshire (ARC).—First Sunday of the month, 7.30 p.m., Ardrossan ATC, The Academy, Ardrossan.
Glasgow RSGB Group.—Second and Fourth Fridays of the month, 7.30 p.m., Christian Institute, Bothwell Street, Glasgow.
Glasgow University (GURC).—Second Wednesday of the month, 7.30 p.m., Engineering North Building, University of Glasgow, Glasgow.
Greenock & District (G & DARC).—Alternate Fridays, 7.30 p.m., Arts' Guild, Campbell Street, Greenock.
Motherwell RSGB Group.—Third Friday of the month, 7.30 p.m., Carfin Hall, Motherwell Road, New Stevenston, by Motherwell.

REGION 15

Belfast and District RSGB Group.—Third Friday in each month, 8 p.m., War Memorial Building, Waring Street, Belfast.

REGION 16

Basildon (BDARS).—Details from G3IJB.
Chelmsford (CARS).—7 February (Radio Question Time), 7.30 p.m., Marconi College, Arbour Lane, Chelmsford.
Great Yarmouth (GYRC).—Fridays, 7.30 p.m., The Manager's Office, The Old Power Station, Swanstons Road, Great Yarmouth.
Ipswich (IRC).—25 January ("Transistors," by G3MUT) 7.30 p.m., Red Cross HQ, Gippeswyk Hall, Ipswich.
Norwich (NARC).—Mondays, 7.30 p.m., Old Lakenham Hall, Mansfield Lane, Norwich. Details from G3TLC.

GB2GG

April 1, 1967 will be an important day in the history of Amateur Radio when the originator of GB3BUS, Robert Barton, G3PQH, and Clive Collins, both of Marlow, Bucks, put into operation a plan first devised five years ago.

The first trip made by GB3BUS was to Woburn Abbey, and the sight of the Harrier, one of the few remaining genuine English Road Coaches, owned and run by James Hewat, was enough to create an idea which is now to become a reality in the shape of Mobile Radio Station GB2GG.

The Harrier, well known by visitors to the Abbey, was built in 1866 and now, 100 years later, it will be transporting a different type of passenger, all amateur radio enthusiasts, at least one of whom will be a licensed amateur. Dressed in period costume and having radio equipment as their luggage, they will travel in fine style from Woburn Abbey to The Five Bells, O'Stanbridge, hoping on the run to contact other radio amateurs not only in Great Britain but also overseas.

So make a note in your diary and a date with your radio for this occasion and a unique QSO.

Receipts

Receipts for subscriptions paid by cheque, bankers' order or postal order are not now issued unless specially requested.

GB2RS SCHEDULE

RSGB News Bulletins are transmitted on Sundays in accordance with the following schedule:

Frequency	Time	Location of Station
3600 kc/s	9.30 a.m.	South East England
	10 a.m.	Severn Area
	10.15 a.m.	Belfast
	10.30 a.m.	North Midlands
	11 a.m.	North West England
	11.30 a.m.	South West Scotland
	12 noon	North East Scotland
145·10 Mc/s	9.30 a.m.	Beaming north from London
	10.00 a.m.	Beaming west from London
145·8 Mc/s	10.15 a.m.	Beaming south from Belfast
145·30 Mc/s	10.30 a.m.	Beaming north west from Sutton Coldfield
	11.00 a.m.	Beaming south west from Sutton Coldfield
145·50 Mc/s	11.30 a.m.	Beaming north from Leeds
	12 noon	Beaming east from Leeds

News items for inclusion in the bulletins should reach Headquarters not later than first post on the Thursday preceding transmission. Reports from affiliated societies and from non-affiliated societies in process of formation will be welcome.

Region 1 Lecture

MERSEYSIDE

Aerial Power Tactics

Mr Peter Jones, G2JT, will deliver a lecture entitled "Aerial Power Tactics" in Liverpool on 25 January, 1967. Tickets are available free of charge from B. O'Brien, G2AMV, 1 Waterpark Road, Prenton, Birkenhead.

Please apply early as a large attendance is anticipated.

RSGB DINNER CLUB

NEW YEAR DINNER

Saturday 7 January 1967

7 for 7.30 p.m.

Kingsley Hotel
Bloomsbury Way
London, WC1.

Applications for tickets, price 30/- each, should be accompanied by a remittance payable to RSGB, and sent to Headquarters.

LOOKING AHEAD

17 January.—Presidential Installation and Social Evening.
22 February.—RSGB Lecture at IEE, London.
13 May.—RSGB Annual V.H.F. Convention.
18 June.—ARMS Mobile Rally.
9 July.—South Shields Mobile Rally.

LONDON LECTURE MEETING 22 FEBRUARY 1967

THE RSGB INTERNATIONAL RADIO ENGINEERING AND COMMUNICATIONS EXHIBITION

1967

will be held at the

NEW HORTICULTURAL HALL

VINCENT SQUARE
LONDON
SW1

27—30 SEPTEMBER

Applications for stand space should be addressed to the Society's Exhibition Organizer:

P. A. THOROGOOD, G4KD, 35 GIBBS GREEN, EDGWARE, MIDDLESEX.

RECENT ADDITIONS TO THE RSGB PUBLICATIONS DEPT.

Outline of Radio and Television (Hawker)	34/6
Radio Amateur Operator's Handbook (New Edition) (*Data*)	5/6
Radio Amateurs' Vocabulary (German – English)	9/3
From Semaphore to Satellite (ITU)*	70/-
Hints and Kinks (ARRL) Vol. 7	10/-

* Reviewed on page 232 of the April *Bulletin*

Dover Series	
Basic Electricity	25/6
Basic Electronics	23/6
Basic Theory and Application of Transistors	11/6
CQ Publications	
Antenna Roundup Vol. 2.	30/-
Iliffe Books	
Guide to Broadcasting Stations (New Edition)	6/6
Radio Valve Data (New Edition)	10/6
Short Wave Listening	13/2
Admiralty Great Circle Map Folded	6/9
Rolled	8/-

All prices are post paid in the UK

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SITUATIONS WANTED

EXPORT SERVICES available to manufacturers, world-wide coverage and know-how.—G3UOX, 1 Daver Court, Mount Avenue, London, W.5.

SITUATIONS VACANT

UNIVERSITY OF LEICESTER

A Technical Assistant is required for the maintenance and construction of electronic equipment, including test instruments and spectrometers, in the Research Laboratories. Salary according to age, experience and qualifications to a maximum of £1,180 p.a.
Applications giving the names of two referees should be sent to the Senior Experimental Officer, Department of Chemistry, from whom further particulars can be obtained.

ASSISTANT TELECOMMUNICATIONS ENGINEER

Required by the EAST AFRICAN POSTS AND TELECOMMUNICATIONS ADMINISTRATION on contract for one tour of 24 months in the first instance. Commencing salary £1994 in scale rising to £2262 including allowances. Terminal gratuity 25% of salary drawn. Generous overseas installation grant. Free passages. Liberal leave on full salary. Accommodation provided at low rental. Education allowances.

Candidates should be aged between 28 and 45 years and possess relevant City and Guilds Certificates (or equivalent) and have a thorough knowledge plus sound experience of the installation and maintenance of HF and VHF radio equipment. A knowledge of carrier and telegraph equipment would be an advantage.

Apply to CROWN AGENTS, M. Dept., 4, Millbank, London S.W.1, for application form and further particulars, stating name, age, brief details of qualifications and experience and quoting reference M2T/62721/RC.

project/development engineers

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