RSGB BULLETIN

JULY 1965
VOL. 41. No. 7

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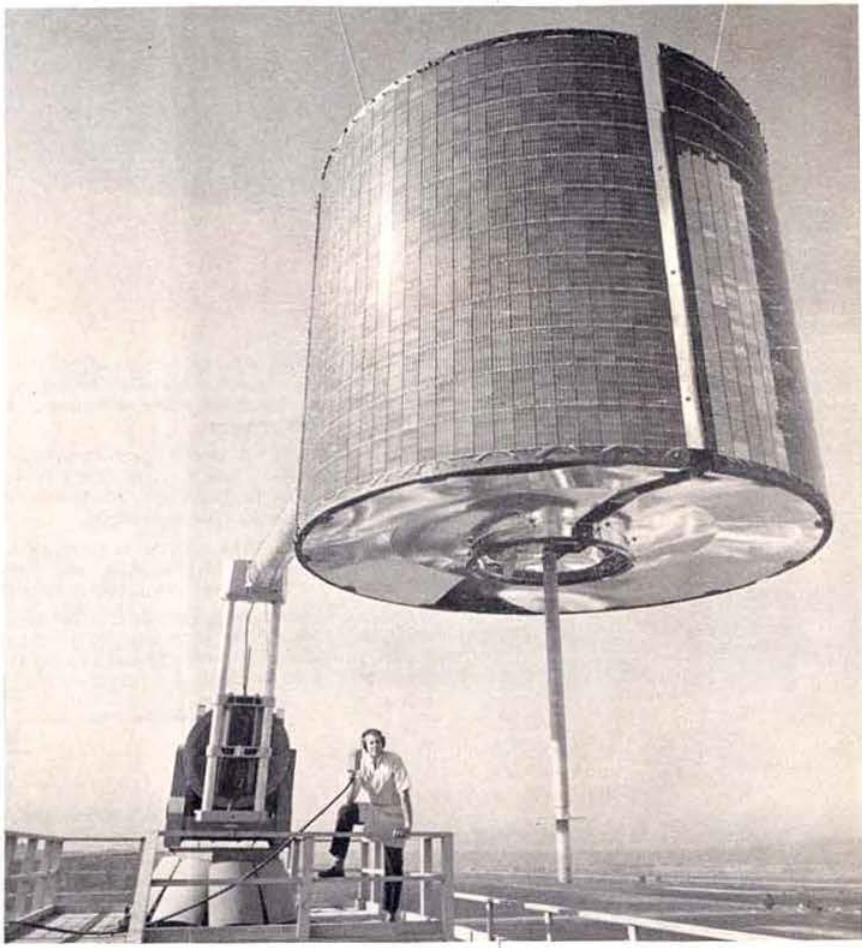

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Volume 41 No. 7

July 1965

4/- Monthly

RSGB BULLETIN

CONTENTS

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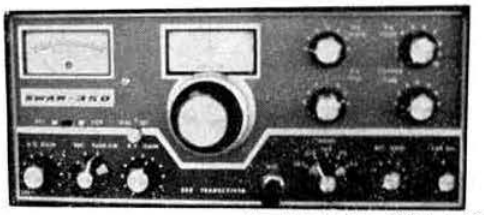

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Current Comment

discusses topics of the day

The Importance of IARU

THE International Amateur Radio Union was formed in 1925 and the second paragraph of its constitution, setting forth the objects of the Union, specifically mentions the promotion and co-ordination of two-way radio communication between the amateurs of the various countries of the world. This is the basic thought underlying the remaining objects and activities of the Union.

Since 1925 a great deal of work has been done in many countries in order to make the organization as effective as possible. The formation of the Region I Division was a vital link in the chain, and, with its many activities, is an example for the rest of the amateur world.

In addition to routine activities as a Member Society, the RSGB undertakes other tasks within the IARU framework. For example, co-operation with the German National Society, DARC, as joint co-ordinators of the Region I IQSY programmes. A Band Occupancy Check to obtain figures to support the amateur case at future frequency allocation conferences is now being undertaken by a number of volunteer operators, and here again the RSGB is co-ordinating the efforts of other European societies. At the 1963 Malmo Conference the Society was asked to undertake a review of licensing conditions throughout Region I while the Intruder Watch, an extremely valuable and competent organization, is now being emulated by other National Societies all over the world. The interests of the users of the bands above 30 Mc/s are considered by the Region I Permanent V.H.F. Committee on which the RSGB is represented.

The further development of the IARU and its ideals is a cornerstone in the preservation of the Amateur Radio movement as we know it today. Recruitment of new member societies must proceed with all endeavour, and there must be continuing liaison between the Member Societies and also between the Regions and the Headquarters Society to ensure the development of a common policy designed to safeguard the amateur cause.

How are the ideals to be put into practice? In order to facilitate essential meetings and discussions, funds must be made available. At the present time the contribution of each Member Society in Region I amounts to 50 Swiss centimes (=10d. sterling) per licensed member. Bearing in mind that the amateur frequencies have probably the *greatest investment per kilocycle* of any part of the h.f. spectrum, this seems to be a meagre basis on which to carry out vital work. This, and other matters affecting the whole future of Amateur Radio, will be considered at the next IARU Region I Conference which will take place in Yugoslavia next year. It is worth noting that the RSGB formed a Working Group some months ago to ensure adequate preparation for this meeting.

By your support of the RSGB and participation in its work, a great deal of which must necessarily be of a voluntary nature, you can maintain the Society as an effective force in the IARU and thus play an important part in the preservation of Amateur Radio.

News from Headquarters

Council Members entertain Mr. George Wallace, M.P.

On June 15, 1965, members of the Society's Council entertained Mr George Wallace, M.P., at a small dinner party at the Kingsley Hotel in London.

During the evening, Mr Wallace made it clear that his interest in Amateur Radio extends far beyond reciprocal licensing, about which he asked a question in the House of Commons on March 16.

GPO Morse Tests

Provided sufficient applications are received, the GPO will be conducting Morse tests during the week commencing September 13, 1965, at the following Head Post Offices: Birmingham, Cambridge, Derby, Leeds and Manchester. Application forms may be obtained from the Radio Services Dept., Radio Branch, GPO Headquarters Building, St. Martins-le-Grand, London E.C.1. Completed application forms, to which the entrance fee of 10s must be affixed in stamps, must be posted to the Wireless Telegraphy Section to arrive not later than August 19, 1965.

G3PL not on 80 metres

G3PL has asked us to make it clear that he is not active on 80m and does not operate single sideband.

It appears that Mr Dunn has been receiving QSL cards and other communications which should have been sent to another station with a similar call-sign.

Proposed World DXpedition

A DXpedition round the world, visiting such places as Jamaica, Antigua, San Francisco, Fiji, Samoa, etc., and ending in Kuwait, is planned for December 1 until about January 10. Good c.w. proficiency and general fitness is essential. Anyone who is interested in joining this DXpedition should write in the first instance to the Editor, RSGB BULLETIN, marking the envelope " DXpedition."

Mobile Operation

On June 25, representatives of the RSGB attended a meeting at the Ministry of Transport in London called to discuss the objections of interested organizations to the proposed regulation forbidding the driver of a vehicle to operate radio transmitting equipment whilst the vehicle is in motion. The Ministry officials took note of the very strong case made by the Society on behalf of holders of the Amateur (Sound Mobile) Licence. The Minister's decision will be made known later.

After the meeting, Ministry officials inspected a typical amateur mobile installation and expressed keen interest.

RSGB Member is re-elected Vice-President of the Society of Motor Manufacturers and Traders

The Chairman and Managing Director of the motor manufacturing company Alvis Ltd., Mr. J. J. Parkes, F.R.Ae.S., has just been re-elected as Vice-President of the Society of Motor Manufacturers and Traders. Although his work has always been connected with motoring and aviation—he was a founder of Airwork Ltd., which later became British United Airways, and has been employed by the de Havilland Aircraft Co., and the Rootes Group—he has held an active interest in amateur radio for many years. His call-sign is G8QK.

G6GR elected Chairman of Midland Section of IERE

Mr. E. L. Gardiner, B.Sc., G6GR, has been elected chairman of the Midlands Section of the Institution of Electronic and Radio Engineers. Mr. Gardiner is an ex-officio member of the Institution's General Council.

Held Over

Due to pressure on space, a number of technical and topical articles have been unavoidably held over to the August issue including *Profile* and the rules for the Region I IARU V.H.F. Contest to be held on September 4-5, 1965.

Wayne Green, W2NSD, editor of *73 Magazine* recently visited Headquarters. In this picture he is seen with G2AHL (left) at the London Single Sideband Dinner on May 29. A report on the Dinner will be published in the August issue of the *Bulletin*.
(Photo by W2NSD)

Assessing Semiconductors

Methods of Measurement and a Simple Diode and Transistor Testing Device

By R. H. MUNRO, VS6EL *

THE main purpose of this article is to describe a very simple method of testing diodes and transistors using a standard multirange testmeter.

The measuring device has the following essential features:

(i) Extreme simplicity of construction.
(ii) Rapidity of construction—the total time so spent should not exceed half an hour, including time devoted to selection of parts.
(iii) It makes use of a standard multimeter of the type used by almost every radio experimenter, and the better the meter, the better the results.
(iv) It measures forward and inverse resistances of most types of semiconductor diode, excluding silicon types.
(v) It measures I'_{co} of transistors.
(vi) It measures transistor β.
(vii) It provides a guide to the linearity of the transfer characteristics of transistors.
(viii) It possesses built-in protection against meter or transistor damage while carrying out the measuring process.
(ix) It is extremely cheap. Even the " gold-plated " variety should not cost more than 10/-, while in the majority of cases the components will come out of the junk box.

Some method of assessing semiconductors is a necessity for every amateur who is using, and trying to familiarize himself with these components. Although there is an excellent, and simple, instrument described in the *RSGB Handbook* [1], it suffers from the drawback that it ties up a good meter movement. In addition the construction of such an instrument consumes rather too much of that precious commodity, time.

As a result of talking with groups of amateurs and individuals about transistors, the writer has come to appreciate the need for something really simple which will at least provide a " good/bad " verdict. The device to be described can, if its limitations are properly understood, give a reasonable guide to the " goodness " of a transistor, but not its frequency characteristic. Consideration of the result of the test, combined with inspection, will, however, enable the average amateur to make a good guess as to whether the unmarked specimen is an a.f., r.f., or power type.

Any reader who does not know very much about transistors is strongly advised to purchase a few and practise with the testing device to be described. There are available, on the UK surplus market, a large number of transistors which can reasonably be described as " seconds." The majority of these transistors can be put to good use. They possess the advantage of being very cheap so that if one or two become extinct as a result of experimentation, no great harm will have been done to the family finances.

As an illustration of what can be done using these surplus transistors, two, described as PXA102 types, have been incorporated by the writer in the station frequency standard. This utilizes a 100 kc/s bar, one transistor functioning as an oscillator and the other as a pulse amplifier with grounded emitter, from which signals are readily detectable in the 14 Mc/s band. The interesting feature of the oscillator circuit is that it virtually reproduces the crystal maker's recommendations for use with a valve. This is a standard Colpitts configuration using no inductors.

Although the testing device has built-in protection, in order to save the unwary from wrapping the pointer of that expensive microammeter around the stop, it is essential to understand the method of use and the basic characteristics of the semiconductor under test. This may be a repetition of well known facts to quite a number of readers, and if so, they are advised to skip the next two paragraphs and go on to read about a less widely known method of computing transistor β, and the description of the testing device itself. Nevertheless, so much confusion is caused in the minds of the beginner in this sphere by being suddenly thrust into the midst of a dissertation about minority carriers and suchlike before achieving a proper understanding of how a transistor works, that it is hoped not to reproduce that error in this article. We will be concentrating on the " how," and not worrying overmuch about the " why."

Introduction to Semiconductor Theory

In a germanium semiconductor diode, the anode is formed of *p* or positive type germanium, while the cathode is composed of *n* or negative type germanium. The two are pressed against one another to form a sandwich, or *p-n* junction as it is called. In an alternative form of germanium semiconductor diode, the two elements are formed not by means of a junction, but by point contact: the modern equivalent of the old " cat's whisker " detector. The point-contact diode is formed of *n* type germanium in contact

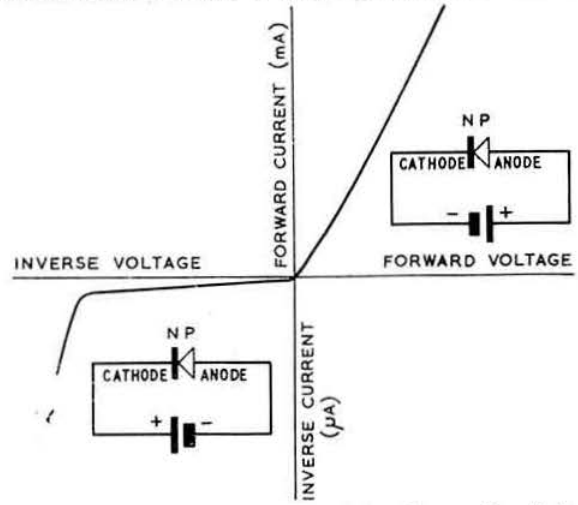

Fig. 1. Forward and inverse characteristics of germanium diode. The forward current is plotted in milliamps, while the inverse current is plotted in microamps.

* 9 Peak Mansions, 116 Peak Road, Hong Kong.

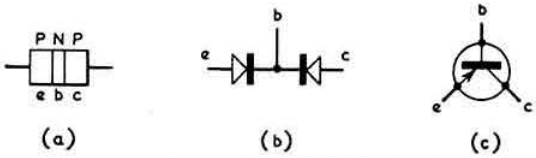

Fig. 2. The *p-n-p* transistor considered as a combination of two *p-n* diodes.

with the point of a springy tungsten wire, under which a small area of *p* type germanium is formed during the manufacturing process. Although the majority of germanium diodes in amateur use are of the point-contact type, such as the OA70, OA79, OA81 and OA85, virtually all transistors are of the junction type.

The essential operation of both junction and point-contact diodes for rectification is similar. Fig. 1 is a generalized diagram of the forward and reverse characteristics of germanium semiconductor diodes. The forward current is expressed in milliamps, while the inverse current is shown in microamps. Forward current is the comparatively large current which flows when the anode of the diode is made positive in relation to the cathode, and reverse current is the very small current which flows when the anode is made negative in relation to the cathode. The first aim of any simple test will therefore be to check the forward and reverse currents at practical voltage levels. It would of course be simple to carry out a test for forward current using the low resistance range of a multimeter. Although the majority of semiconductor diodes will safely accept a forward current in the region of 30 to 50 mA, there are a few whose maximum is much lower: as low as 5 mA. As on the low ohms range of a multimeter there may be as much as 50 mA passing through the object under test whose resistance is very low, the danger will be appreciated. Any tester ought therefore to limit the forward current to a safe figure.

In a *p-n-p* germanium transistor, the collector is composed of *p* type germanium, the base of *n* type, and the emitter of *p* type. A simple diagrammatic illustration is shown in Fig. 2(a). Some of the characteristics of a *p-n-p* transistor can be understood by considering it as a combination of two *p-n* diodes joined on the *n* sides (Fig. 2 (b)). Such an illustration must not, however, be taken any further than the description advanced here.

Referring again to Fig. 1 it will be understood that if the base of the transistor is negative relative to the emitter, current will flow between the base and the emitter. If, however, the base becomes positive in relation to the emitter, virtually no current will flow. Somewhat similarly, when the collector is negative in relation to the base, with the emitter open circuited, only a minute leakage current flows. The reader is now advised to dismiss from his mind

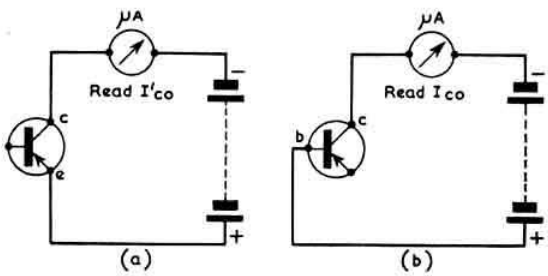

Fig. 3. The two varieties of collector leakage current, I'_{CO} and I_{CO}. (a) Collector leakage current in grounded emitter (I'_{CO}). (b) Collector leakage current in grounded base (I_{CO}).

the suggested illustration of a transistor as a combination of two diodes.

When the base is open-circuit, and the collector is made negative in relation to the emitter, a considerable leakage current flows, which in the case of an a.f. transistor such as the OC71 will be of the order of 150 μA for an applied voltage of 4·5 volts [2]. This collector leakage current with the base open-cirucit is known as I'_{ceo}, spoken of as " I dash CO." It is also known as I_{ceo} and sometimes, incorrectly, as I_c. In this article it will be referred to as I'_{ceo}. Although it has now apparently become the custom for particulars of I'_{ceo} to be omitted from the usual summaries of transistor characteristics [3], it is quite useful to be able to measure it, as will be seen later. The other important transistor leakage current is that occurring between collector and base with the emitter open-circuit, and is termed I_{co}, although it is also known as I_{cbo}: it will always be referred to as I_{co} in this article. In the case of the OC71 the I_{co} is of the order of 4 μA with an applied voltage of 4·5 volts [2]. To assist the reader to familiarize himself with these two important characteristics they are shown diagrammatically in Fig. 3.

In order to bring to life a *p-n-p* junction transistor a negative voltage is applied between the collector and emitter, the collector being maintained at a negative potential. Also, in order to keep the transistor in the continuously conducting state, the base is also maintained at a smaller negative potential in relation to the emitter by the application of a small negative bias. Any alternating current of suitable frequency when applied between the base and the emitter

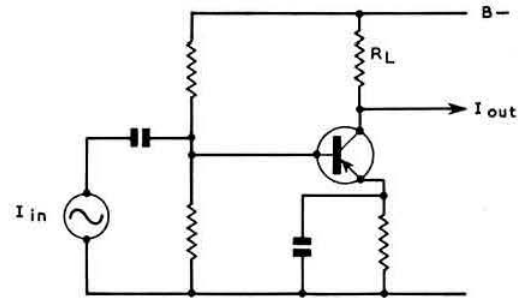

Fig. 4. Generalized circuit diagram of *p-n-p* junction transistor as a class A amplifier.

will appear in amplified form across the load in the collector circuit. Although it is not material for the purposes of the present discussion, it should nevertheless be mentioned that the transistor will be cut off for the period of time occupied by any portion of the input current which causes the base of the transistor to become positive in relation to the emitter.

It is appreciated that the configuration will be very familiar to most readers, but for the sake of completeness a generalized circuit diagram of a class A small signal a.f. amplifier is shown in Fig. 4. The ability of a transistor to amplify current is an essential feature of its " goodness." In the testing device to be described the current flowing in the collector circuit of the transistor under test, for a known applied current to the base, is measured directly. After deducting I'_{co} (the collector leakage current with no input to the base) it is possible to calculate the current amplification of the device by dividing the net output current by the input current. This current amplification factor is variously described as α' (alpha dash) or β (beta). As the measurement has been made under static, or d.c., conditions, it should more correctly be referred to as h_{FE} or α'_o (alpha dash nought), the nought in the latter term signifying zero

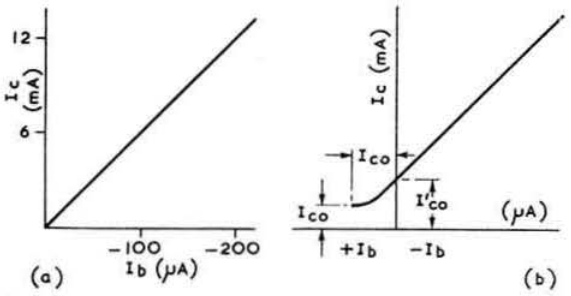

Fig. 5. Transfer characteristic of typical a.f. transistor in grounded emitter. (a) Idealized version. (b) Practical version at low base and collector currents showing reversal in sign of base current at the I_b point where the base becomes open-circuit.

frequency. Since the term β is the one with which most experimenters have the greatest acquaintance, it will be used throughout this article to denote the current amplification factor in grounded emitter mode at zero frequency.

The graph showing the transfer characteristic of a valve relates input grid voltage to output anode current, and its mutual conductance is accordingly expressed in milliamps per volt. In the case of a transistor it is also possible to draw a graph relating input base voltage to output collector current. As a transistor is a current operated device, this relationship is neither very useful, nor is it particularly linear. A much more useful graph is that which relates input base current to output collector current; this relationship is also more or less linear for a good transistor. A generalized transfer characteristic, showing this relationship, is plotted in Fig. 5(a). This graph represents an idealized version of the transfer characteristic.

A more practical version showing the relationship for low values of base current in the cut-off region of the transistor is shown in Fig. 5(b). It will be evident from this graph that the base current reverses in sign at the point where the base becomes open-circuit. At this point the only current flowing in the transistor is I'_{co}. A transistor is considered to be cut off when there is no current flowing in the emitter, and at this point the only current flowing in the transistor will therefore be I_{co}. In order to produce cut-off from the position where $I_b = 0$, the base current will have decreased from zero to I_{co}. Accordingly, the increase in collector current from I_{co} to I'_{co} will have been caused by an increase in base current of I_{co}. Expressed mathematically, this becomes

$$\beta = \frac{I'_{co} - I_{co}}{I_{co}}$$

If the reader is in any doubt about the explanation, he should refer to the graph which it is hoped will make the basis of the method of computation perfectly clear. It should be emphasized that there is a considerable difference of scale between the x and y axes of the graph in Fig. 5(b), which accounts for the apparent doubling in size of I_{co} along the x axis. The actual figure for β will be somewhat larger than that computed by this method owing to the curvature of the lower end of the transfer characteristic.

Testing Semiconductors

The method of estimating transistor β explained in the preceding paragraph has been adopted by the manufacturers of some Japanese multimeters who provide an additional current scale for use on the resistance ranges which enables measurements to be carried out on semiconductors.

In a typical case, on the $\times 1000$ resistance range, current is read from zero to 85μA; on the $\times 100$ range, to 850 μA; and on the $\times 1$ range, to 85mA. Accordingly, using the resistance ranges of such multimeters it is possible to read off directly, and swiftly, both I'_{co} and I_{co} and hence arrive at a value for β. In the case of the writer's own instrument (Sanwa, type 305-Z TR), an additional useful feature is the provision of another extra scale which shows the voltage applied to the object under test (up to 3V) which is producing the particular current indication. This provision enables a rough plot of diode characteristics to be made merely by switching meter ranges. The writer has no knowledge of whether this idea has been adopted by manufacturers of multimeters other than the Japanese.

Although the leakage method of assessing β is indeed practical and useful, besides possessing the merit of swiftness, it does suffer from two important drawbacks. It presupposes that the experimenter possesses a sensitive microammeter, and it begs one of the questions in which we are interested: namely, is the transfer characteristic linear? The first disadvantage will prevent those who do not possess a good microammeter from getting a result in the case of a good transistor, because the I_{co} will be so low as to be unreadable on a meter having a full scale deflection of 1mA, or even 500 μA. The second argument against the method arises in the case of a bad transistor where an entirely misleading figure will be arrived at in the event of the transfer characteristic being excessively non-linear. It would be possible to use the transistor tester for the leakage method of measurement but if the user has the good fortune to possess a suitable microammeter, the method is not recommended as a first choice.

To meet the requirement of simplicity of design it would be difficult to adopt the amplifying circuit shown in Fig. 4 for measuring β. It was therefore decided to experiment with the simple unstabilized amplifying circuit shown in Fig. 6. This circuit makes use of the very low impedance between the base and the emitter which results in the potential difference between the two electrodes being only between 100 and 300mV. If, therefore, a resistance is placed in the voltage supply to the collector, a current will flow into the base which, by Ohm's Law, will be a very small amount lower than $\frac{V}{R_b}$. With a 9V battery used as the power supply, the error caused by adopting $\frac{V}{R_b}$ as the base injection current will not be more than a few per cent. This is an exceedingly easy method of injecting a known current into the transistor under test. If a suitable milliammeter is inserted into the collector circuit, and the collector current noted, the current amplification, or β, of the transistor can be calculated by simple division.

Before making the calculation it will be necessary first to deduct the milliameter reading the I'_{co} of the transistor under test. This is because β is obtained by reference to the increase in collector current caused by a specific increase in base current. It would not be correct to deduct, in a similar manner, the I_{co} of the transistor from the base current figure used as the divisor in the calculation because this is already a net figure.

It should be mentioned that the outline circuit shown in Fig. 6 has formed the basis of many simple transistor testers

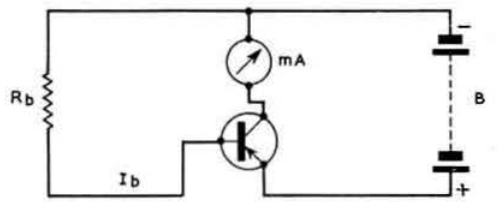

Fig. 6. Circuit of simple unstabilized transistor amplifier forming the basis of the transistor testing device.

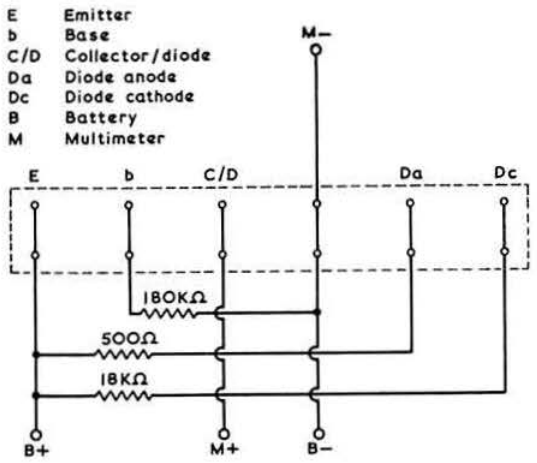

Fig. 7. The Elsiecheck Mark I. The diode/transistor tester as originally designed and constructed by VS6EL. Construction of this Mark of the tester is not recommended for reasons discussed in the text.

[1, 4, 5, 6]. An article in the Australian journal, *Radio TV and Hobbies* [6], in fact provided the spur for the writer to devise the first VS6EL transistor checker, grandiloquently christened the Elsiecheck Mark I. The circuit diagram of this device is shown in Fig. 7. As will be seen, this tester is simply constructed on a standard electrical connector with six double screw type terminals. This form of construction permitted connection to be made to the semiconductor under test without too much difficulty, but it is not an ideal method, particularly for transistors. The trouble is that the leads are of such minute cross-section that it is easy for them to slip away from under the securing screws. This problem does not arise with diodes because the lead-out wires are usually of 20 s.w.g. wire, and the screws of the connector fix them firmly in position. Should anyone construct the Mark II using the same method adopted by the writer for the Mark I, this point should be borne in mind.

The meter and battery connections are made with flexible wires of appropriate colour, terminated with crocodile clips. Since the Elsiecheck Mark I was originally constructed as a transistor tester with the diode testing provision added as an afterthought, the former will be described first. It will be seen that the transistor testing circuit is that of Fig. 6, with R_b consisting of a 180K ohm resistor. The tester was devised for use with a multimeter having current ranges of 500 μA, 3 mA and 10 mA. The battery was a standard 9V type. On the assumption that the battery p.d. is 9V during the test, the standard injection current is 50 μA. The multimeter was set to the 10 mA range, and this permitted a β reading of up to 200 at full scale deflection, each 1 mA of deflection representing a β of 20. In the case of a low β transistor, the meter was switched to the 3 mA range, thus making measurements easier. This simple circuit took no account of I'_{eo} and in the event of the transistor under test having a collector to base short, the demise of the meter movement was practically certain. This gave an additional reason for the incorporation of a diode testing provision which could also be made to double as a transistor leakage tester.

Referring again to Fig. 1, it will be recalled that the forward current of a diode is very high and the reverse current very low. It was therefore decided to use a 1·5V battery to determine the forward resistance, and a 9V battery for the reverse resistance. As it had been decided that the 3 mA range of the multimeter should be used for reading the forward current, a safety series resistor of 500 ohms was inserted to limit the current to 3 mA in the event of the diode having an internal short. This precaution is also taken when measuring inverse current. As the multimeter was to be used on the 500 μA range, a 10 per cent 18K ohm resistor was used.

Testing Diodes

With a variety of diodes and using 9V as the test voltage, the inverse current was observed to be in the range of 2 to 10 μA when using a test meter having a full scale deflection of 50 μA. It will therefore be apparent that the use of a multimeter whose lowest current range is 500 μA will not provide an accurate measurement of inverse current. Nevertheless, with a good meter movement having a large and finely divided scale, it should certainly be possible to match diodes for reverse resistance.

To test a diode, the forward current is first measured: the anode lead is inserted into the testing device at the point marked *Da*, and the cathode lead at *C/D*. The multimeter, set to its 3 mA range, is then clipped into position. Finally a 1·5V battery is connected into the circuit with crocodile clips. Even when leads are colour coded and clearly marked, the writer's experience is that mistakes are sometimes made when using crocodile clips in this manner. Therefore as a precaution, the final connection to the battery lead is first made by a quick touch to check that the meter pointer moves in the right direction without hitting the stop. This point is mentioned because both the Mark I and Mark II testers use a number of leads with crocodile clips, and it is not too difficult even for the experienced experimenter to make a mistake over connections with disastrous results.

After completing the measurement, the forward resistance of the diode can be quickly calculated from the meter reading, the known resistance in the circuit (including that of the meter if it is significant), and the battery voltage. It should be remembered that if the meter shows a current of 1·5 mA, there will only be 0·75V across the diode itself owing to the voltage drop across the limiting resistor. The resistance at this voltage may be somewhat higher than the published figure for an applied voltage of 1V.

An assessment is then made of the reverse resistance of the diode. For this purpose the cathode is connected to the terminal marked *Dc*, and the anode to *C/D*. The multimeter, on its 500 μA range, and a 9V battery are then connected to the appropriate terminals, the "touch test" procedure being used as before. The meter should show a very small deflection.

Since the reverse resistance of a good diode will normally lie within the range of 500K ohms to 5 Megohms (being somewhat dependent on applied voltage) the effect of the 18K ohms limiting resistor can be ignored. There are, nevertheless, some types of diode, of which the OA73 is an example, where the reverse resistance at this voltage may be of the order of only 100K ohms. In this case the

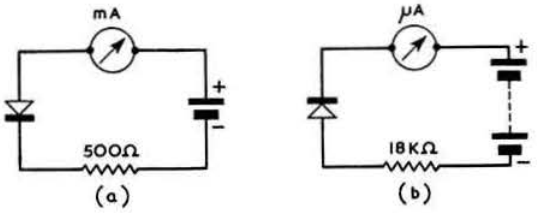

Fig. 8. Basic diode measuring circuits: (a) for measuring forward resistance, (b) for testing reverse resistance.

value of the limiting resistor will have to be taken into account.

Using the Elsiecheck Mark I, it is possible to match pairs of diodes for both forward and reverse resistance for use in such applications as balanced modulators. It would obviously be preferable, however, when measuring reverse resistance, to use a more sensitive meter than the 500 μA movement for which the testing device was designed. The experimenter who is lucky enough to possess a multimeter with a 50μA movement could put it to good use. In so doing, if it is decided not to modify the tester to provide suitable protection, measurement should initially be carried out on the 500 μA or next higher range so that the possibility of an excessively leaky or shorted diode is first eliminated. This precaution may or may not be necessary, depending on whether the multimeter has a substantial amount of series resistance built-in on the 50μA or other low range. In some cases the voltage drop across the external terminals of a multimeter on its lowest current range is 10V for full scale deflection, in which case the instrument cannot be damaged because the applied battery voltage is only 9V. If a precise resistance reading is required the total series resistance in the meter circuit has to be taken into account in the calculation.

The diode testing provision of the Mark I tester is also used on transistors before measuring β. This serves the dual

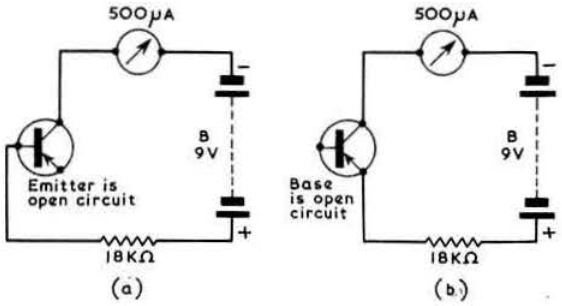

Fig. 9. Basic transistor leakage measuring circuit: (a) collector/base leakage (I_{co}), (b) collector/emitter leakage (I'_{co}).

purpose of safely eliminating the dangerous duds and at the same time measuring I'_{co} and giving an indication of I_{co}. As previously mentioned, if I'_{co} is divided by I_{co}, the figure for β so obtained should bear a reasonable relationship to that obtained from the three terminal test, after allowing for curvature of the characteristic at the cut-off point. If there is no such reasonable relationship it is probable that the transfer characteristic is not a straight line.

Measuring I'_{co} and I_{co} is absurdly simple. For I'_{co} the collector is joined to the *C/D* terminal, while the emitter is joined to the *Dc* terminal. For I_{co} the collector remains joined to the *C/D* terminal while the base is joined to the *Dc* terminal. The procedure is the same as that for measuring the reverse resistance of diodes.

Notwithstanding the added protection afforded by using the diode testing circuit for pre-testing transistors, the Mark I tester was found to suffer from a serious defect. It is therefore recommended that experimenters should not construct the Mark I as it stands, but should modify it in the manner to be described so that the defect is eliminated. The modified Mark I is called the Mark I*, which is shown in Fig. 10. The defect, and the modification necessary to eliminate it, are discussed in the following paragraphs.

One of the reasons for the choice of the rather complex circuitry shown in Fig. 4 instead of the cheap and simple one of Fig. 6 is to achieve stabilization of the working point of the transistor. I'_{co}, β, and the base-emitter voltage of a

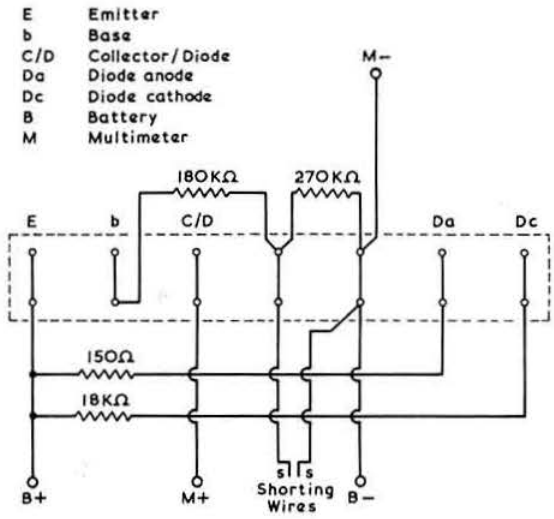

Fig. 10. The Elsiecheck Mark I*. This is an improved version of the Mark I shown in Fig. 7 and is recommended as being suitable for practical use. It minimises danger to the transistor from thermal runaway and gives readings for β.

transistor are all temperature dependent, increasing with temperature. In the simple circuit of Fig. 6, above a certain critical value of initial base current, the temperature rise caused by the initial current flow through the transistor will give rise to an increase in collector current; this increase causes a further rise in the junction temperature of the transistor which in turn causes the collector current to rise still more. Unless the collector current can be limited to a safe value, this effect, termed " thermal runaway," will continue until the transistor's collector dissipation is exceeded and the transistor is destroyed.

As a result of personal observation, where the ambient temperature is 25°C or more, the writer considers that an injection current of 50 μA may be in excess of the safe value for many a.f. or r.f. germanium transistors. As would be expected, the higher the β of the transistor, the more dangerous the situation. This is aggravated by the nature of the test. With a good transistor having a β of 100, the injection of 50 μA of base current will result in a collector current of 5 mA. Using a 9V battery the dissipation initially produced in the collector of the transistor will be 45 mW. If the maximum permitted dissipation is, typically, 50 mW, then a small increase in collector current due to thermal effect will result in the destruction of the transistor under test.

In the case of some r.f. transistors where the maximum permitted dissipation is 25 mW to 35 mW their demise is apparently certain on the application of the testing potentials. In practice, the writer has observed that the occasional application of potentials resulting in excessive dissipation (even as much as double), provided it is for a short time only, does not appear to do any harm to most transistors. However, in case anyone considers that a transistor can be ill treated in the same manner as a valve, he should be reminded that transistor manufacturers are constantly reiterating that all transistor ratings are absolute and must never be exceeded, even for a short period of time.

A Practical Tester

As a result of this defect it was decided to produce a new testing device, incorporating the same simple circuitry, which would easily overcome the thermal runaway difficulty.

The improvement consists of the addition of a 270K ohm resistor in series with the 180K ohm base current injection resistor. The total value of these two resistors limits the base injection current to 20 μA using a 9V battery.

To enable β to be assessed with 50 μA base injection current in those cases where the resulting increase in collector current will not cause the permissible dissipation to be exceeded, provision is made for shorting out the 270K ohm resistor. Reference to Fig. 10, which shows the Elsiecheck Mark I* incorporating this modification, will make this point clear. In addition to the extra resistor in the base feed circuit, two leads of solid insulated wire each 2½ in. long, with ends bared, should be screwed into position either side of this resistor.

The transistor having first been tested with 20 μA base current, a calculation should be made to determine whether the dissipation would be exceeded on the base current being increased to 50μA. Assuming that this would not occur, the " range switch " can be operated. This operation is carried out by pressing together the two bared ends of the leads to the second base series resistor, marked *S* in the circuit diagram. In case a mistake has been made and the meter starts to show an alarming increase in current, the two ends can be released, whereupon they should spring apart of their own accord. Although the purist may not approve of this method, it is the sort of arrangement which the average experimenter finds exceedingly attractive.

The other point of difference between the Mark I and the Mark I* is the substitution of a 150 ohm resistor in place of the 500 ohms in the circuit arrangement adopted for measuring diode forward resistance. The reason for this change will be discussed in connection with the description of the Mark II.

The Elsiecheck Mark II was constructed on a scrap piece of Veroboard measuring 1⅝ in. by 4⅛ in. Veroboard is a " natural " for the construction of transistor circuits as it simplifies wiring and promotes compactness. In addition it relieves one of the tedium of designing and etching one's own printed circuit board. The manufacturers are Vero Electronics Ltd., South Mill Road, Regents Park, Southampton, who will be able to advise as to sources of supply in case of difficulty.

The constructor obviously has a wide choice of methods of construction open to him, including that adopted by the writer for the Mark I, using a seven- and not a six-terminal connector as suggested for the Mark I*.

The circuit diagram of the Mark II is shown in Fig. 11, while for those who intend to use Veroboard the design is shown in Fig. 12. The tester is designed for use with a multimeter having 1 mA and 10 mA ranges. The construction is obvious from the diagrams and photographs. The use of miniature resistors is strongly recommended although it will be seen that the writer has not followed his own advice. In order to obtain the correct values for the base feed resistors it was necessary to have two in parallel, and the only suitable ones available were of a large size physically. It is suggested that if stock types are used they should be of 5 per cent tolerance and the high stability variety.

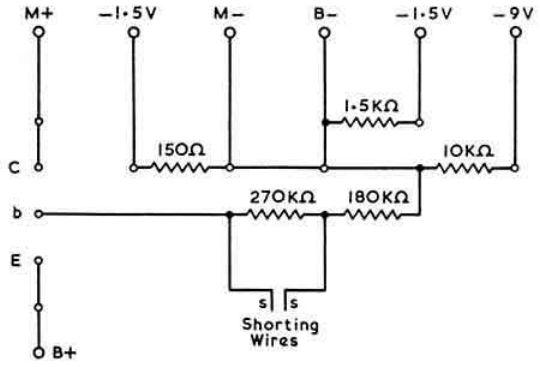

Fig. 11. The Elsiecheck Mark II. The circuitry is essentially the same as the Mark I* but is somewhat simpler and of improved construction.

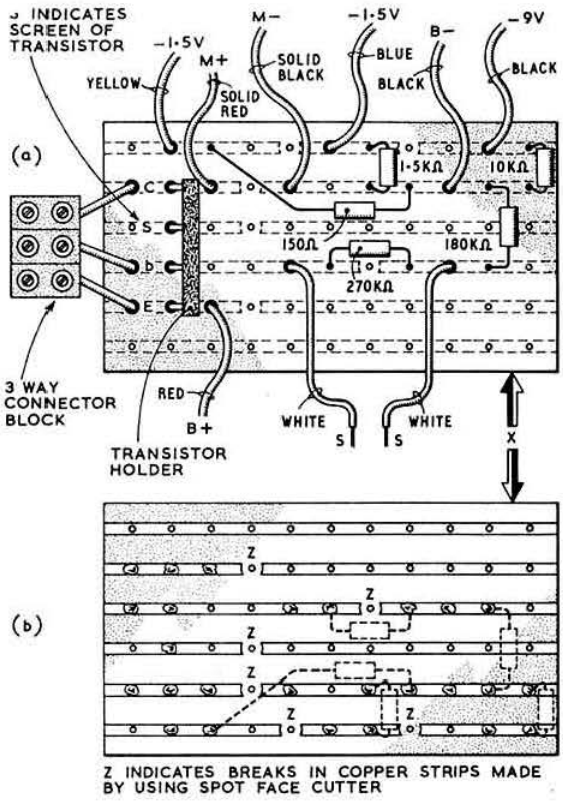

Fig. 12. Construction of the Elsiecheck Mark II on Veroboard. (a) Top side showing placement of components and pins. (b) Reverse side showing breaks in copper strips effected by using a spot face cutter. The arrows indicate the plane through which the board has been turned.

To facilitate the insertion of semiconductors into the testing device a transistor holder is used. This results in far more reliable connections than with the screw type connector, although for good measure the writer has also incorporated one of these connectors in his own instrument. The screw type connector is simpler to use when testing diodes but, as already emphasized, it is not very suitable for transistors.

The only feature of the Mark II which requires an explanation is the diode testing provision. Reference should be made to Fig. 11. When testing a diode the terminals *C* and *E* are used in conjunction with a 1·5V or 9V battery for reverse resistance, and a 1·5V battery for forward resistance. A 9V supply is recommended for measuring reverse resistance as this will give a greater deflection of the meter. It should be remembered that even with 9V a high back resistance diode of the OA81 variety will only pass a current of about 5 μA which is one two-hundredth of the full scale deflection of the meter on its 1 mA range, so the indication will be very small.

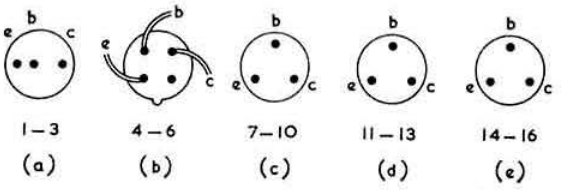

Fig. 13. Undersides of the unidentified transistors which were tested, the results of which are shown in Table II.

To test reverse resistance the cathode of the diode (usually marked with a band or spot) is connected to *E* and the anode to *C*. *B*+ is connected to a 9V battery and the terminals of the multimeter on its 1 mA range are clipped on. Finally the negative terminal of the battery is connected to the −9V terminal of the testing device and the meter deflection noted.

If the experimenter possesses a multimeter with a low current range of 50 or 100 μA, he should nevertheless first test the diode using the 1 mA or other comparable range and satisfy himself that the leakage is small. After disconnecting the 9V supply, it will then be safe to switch to the low current range when the testing voltage can be re-applied. It should not be forgotten, however, that the only protection now afforded by the device itself will be from the 10K ohm limiting resistor. In the event of a short suddenly developing in the diode under test, the meter, if it has no internal protection, will be exposed to an overload of 10 or 20 times and rapid action would then be necessary to save the movement. While this warning should be remembered, it should not deter the experimenter from making the test. The chances against the occurrence of a sudden internal short with an applied potential of only 9V are enormous.

When measuring the characteristics of a diode of the OA73 variety having a comparatively low back resistance, the 10K ohm limiting resistor would form an appreciable part of the total circuit resistance. A final test can be made by applying the 9V testing potential to the *B*− terminal of the tester. In this connection the earlier warning about the possibility of meter overload should not be forgotten.

To measure forward resistance a 1·5V battery is used as for the Mark I. The limiting resistor is reduced from 500 ohms to 150 ohms (as suggested for the Mark I*) and the multimeter is used on its 10 mA range. The advantage of a smaller limiting resistor is that for a given change in diode forward resistance there will be a bigger movement of the meter pointer, thus facilitating measurement. The improved discrimination reveals differences of a few ohms in forward resistance.

Ideally, to ensure diodes are matched for forward resistance, measurements should be made at more than one applied voltage. Such matching would be important, for example, in the selection of diodes for balanced modulator circuits. For this purpose the resistance range or ranges of the multimeter can be used. Before doing this, the experimenter should make certain that the current passing through the diode during the test will not destroy or damage it. Should there be no meter indication when using the resistance range for testing forward resistance, the multimeter leads should be reversed. In the case of the majority of such instruments used by the writer the test voltage has been observed to be of opposite polarity to the indication given by the terminals.

To carry out a measurement of forward resistance the diode is inserted into the test circuit with its anode connected to the *E* terminal and its cathode to that marked *C*. The *B*+ terminal is then connected to the positive pole of a 1·5V battery. The multimeter, on its 10 mA range, is then put into the circuit using the crocodile clips and making sure that the colours match, red to red and black to black. Finally the "touch test" is applied by first touching the yellow −1·5V terminal on the battery negative pole before clipping on the crocodile clip to take the reading.

The Elsiecheck in use

In the construction of transistorized apparatus the writer has found the Elsiecheck indispensable. An initial test for I'_{co} and I_{co} is made on every transistor used. For this test the writer uses a Sanwa multimeter on its ×1000 resistance range: the 85 μA full scale deflection of this range is particularly useful. β is then calculated. The internal test voltage of the multimeter for these tests is 3V. It is therefore quite possible for β, even with a good transistor, to be somewhat different with a higher applied potential. It is suggested that this initial leakage test should always be carried out using a 9V battery and a calculation made for β which can then be used as an independent check on the direct measuring process. The reader will nevertheless appreciate that because of the minute current involved, he will only be able to measure or estimate I_{co} for an r.f. transistor of low leakage if he possesses a sensitive microammeter.

In order to give the reader some idea of the results to be expected from the device when testing transistors, 26 surplus transistors were tested. One batch, consisting of ten transistors (costing £1), were all marked with Ediswan type letter/number identifications; the other batch of 16, also costing £1, were unmarked. Both batches were described as having been tested. Notwithstanding this warranty, one should obviously not expect too much from a transistor costing 2/-, and even less from one costing only 1/3.

The results of the tests are set out in Tables 1 and 2. The bracketing of transistors in Table 2 indicates that the transistors concerned were of similar external appearance. As already explained, since the writer tests all transistors for leakage (I_{co} and I'_{co}) on the Sanwa multimeter, the duplication of the tests using the Elsiecheck was regrettably omitted. It should be mentioned that at the time the transistors were tested the cataloguing of the results was not done with a view to publication. However, as a result of discussions about the device with a variety of people, it was felt that the results of the tests might be of general interest. Owing to personal circumstances it has not been possible to duplicate the leakage tests using the Elsiecheck. Interpretation of the results should therefore be made with due regard to the fact that the leakage tests were made using a 3V battery, whereas the β tests using the Elsiecheck were carried out with a 9V battery.

Table 1 gives the results of the tests on ten transistors with Ediswan markings. The figures in the last two columns have been extracted or calculated from information given in *Radio Valve Data* by Iliffe. The figures for β are small signal parameters and are stated to be measured with an applied potential of 5V, except for the PXC101 where the test potential was 6V. The PXA101 and PXA102 are both

TABLE I

Results of tests on surplus type transistors having Ediswan type letter/number identification

(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Serial No.	Type	I_{co} (μA)	I'_{co} (μA)	$\frac{I'_{co}}{I_{co}}$	beta (I_b = 20μA)	beta (I_b = 50μA)	Published beta	I_b for published beta (μA)
1	PXA101	0·5	3·5	7	10	10	35	29
2	PXA101	0·25	2·0	8	15	15	35	29
3	PXA102	0·3	28	90	250	—	60	17
4	PXA102	0·6	58	93	225	—	60	17
5	XB102	2·6	47	18	42	44	30	33
6	XB102	3·7	50	14	25	27	30	33
7	XB103	2·2	180	82	11	90	66	15
8	XB103	2·3	217	106	200	—	66	15
9	PXC101	3·8	185	49	20	120	66	120
10	PXB113	1·8	95	53	10	140	66	15

TABLE 2

Results of tests on surplus type transistors having no identification letters or numbers

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	Serial No.	I_{co} (μA)	I'_{co} (μA)	$\frac{I'_{co}}{I_{co}}$	beta (I_b=20μA)	beta (I_b=50μA)
(a)	1	7	210	30	24·5	80
	2	2·2	110	50	12·5	100
	3	2·0	42	21	5	50
(b)	4	7	318	45	27·5	90
	5	5·8	72	12	6	20
	6	4·5	220	49	12·5	66
(c)	7	3·5	260	74	20	160
	8	2·5	52	21	3·5	36
	9	0·5	34	68	3·5	120
	10	3	54	18	4	40
(d)	11	2·6	100	39	3	70
	12	2·2	40	18	4·5	60
	13	0·4	16	40	1·5	90
(e)	14	4·5	70	16	20	36
	15	0·2	4	20	0·5	14
	16	6	220	37	20	76

r.f. types, the cut-off frequencies in grounded base being 5 Mc/s and 8 Mc/s respectively. The remainder are a.f. types having a permissible maximum dissipation of 150 mW, except for the PXC101 which is 165 mW.

It will be seen that the figures for the two PXA101's show good correlation and although the β is low, the transfer characteristic would appear to be reasonably straight. The two PXA102's exhibit an extremely high β, both in the leakage tests and as calculated from collector current measurements using the Elsiecheck. As the collector currents were of the order of 4·5 mA to 5 mA with a base injection current of 20 μA, it was decided not to risk tests with the higher base current, whereupon the collector current would probably have risen to 12 mA or thereabouts. Although the maximum permissible dissipation of these transistors is 120 mW, it was deemed unwise to carry out a test which would have resulted in this maximum being approached. These two transistors, as already mentioned, have been incorporated in the writer's frequency standard with surprisingly good results.

The tests also show that the two XB102's were up to standard and possessed apparently linear transfer characteristics. The first XB103 (No. 7) exhibited a surprisingly small β with 20 μA base current and a probable non-linear transfer characteristic. The second XB103 showed a high figure for β. Although the calculated collector current of 10 mA using 50 μA base current would only have resulted in a dissipation of 90 mW during the test (compared with the permitted maximum of 150 mW) it was decided at the time, probably incorrectly, that it was too risky. Both the PXC101 (No. 9) and the PXB113 (No. 10) show non-linearity. However, the guess is hazarded that in the case of the PXC101 this may have something to do with the design characteristic of the transistor rather than some defect in the particular specimen tested, the transistor appearing to be specifically a large signal amplifier.

Identifying Transistor Connections

Before examining the results of the tests on the unmarked specimens it would perhaps be helpful to consider how the connections can be identified so that the transistor is placed in the test holder (and, of course, in the apparatus in which it is to be used!) the right way round. If one is unlucky enough to put the emitter in the collector socket and vice versa, while the base is correctly connected, the demise of the transistor is virtually certain and the excessive current may also ruin the movement of that expensive multimeter. The appearance of the undersides of the five groups of unmarked transistors which were tested in the Elsiecheck is shown in Fig. 13. It will be seen that three groups, those containing numbers 7-10, 11-13 and 14-16, all have similar undersides. The writer's practice is to endeavour to find the correct terminations by inspection of the transistor before carrying out any identification tests.

As is well known, many transistors have a coloured, or white, spot to identify the collector, but in this case there were no such markings. Where the terminations are in a straight line the collector is usually at one end and the emitter at the other, with the base in between. The screen, if any, is between the base and the collector: the collector is the termination which is farther away from that adjacent to it than any other termination. This served to identify the group containing numbers 1-3. Where the terminations form an isosceles triangle, when viewed with the apex at the top, the collector is on the right, the emitter is on the left, the screen (if any) is in the middle of the baseline of the triangle and the transistor base is at the apex. This served to identify the groups containing numbers 7-10, 11-13 and 14-16. The group containing numbers 4-6 was a little more puzzling: as can be seen by referring to Fig. 13(b) the underside contained outlets for four terminations but only three of these had lead-out wires. By rotating the transistor 45° to the right of the position shown in the diagram it can be seen that the three wire terminations form the isosceles triangle, while the collector is identifiable as being at the right hand corner as in the other similar groups.

Having regard to the accepted methods of configuration of the undersides of transistors it was reasonably certain that the terminations had been correctly identified. The next problem to be solved was ascertainment of the polarity-type of the different groups of transistors. The Elsiecheck is designed for the testing of *p-n-p* transistors, and although it is possible to test *n-p-n* transistors by reversing battery and meter connections, such a practice is definitely not recommended as a mistake is ultimately inevitable. Among the 60 or 70 transistors in the writer's possession there is only one *n-p-n* type. If and when the time should arrive when this type will be used in significant numbers, it was decided that another device, restricted to *n-p-n* types, would be constructed. Nevertheless, it was possible that all 16 of these unmarked transistors were *n-p-n* types so it was necessary to devise a suitable method of testing to determine polarity-type.

The simplest method of type determination is to assume *p-n-p* polarity and test the reverse resistance of the collector-base diode. This can easily be done on the Elsiecheck. On the assumption that the Mark II is used, place the collector lead of the transistor in the *C* entry of the holder and the base in the *E* entry. The emitter is left floating. The *B*+ connection is made to a 9V battery and the multimeter is clipped into circuit on its 1 mA range. Finally the negative terminal of the battery is connected to the −9V termination of the device. If the meter reading is barely perceptible then the test reveals a *p-n* junction with its high reverse resistance. If, on the other hand, there is a substantial or very high reading on the meter then the test probably reveals an *n-p* junction with its low forward resistance. In the latter event, or in any case of doubt, reverse the transistor connections and repeat the test. Before removing or replacing the transistor in the test circuit the battery voltage should always be removed. If, on repeating the test with the connections to the transistor reversed, the resistance is now very high resulting in only a small deflection of the pointer then it is certain that the junction is *n-p*, and the transistor is an *n-p-n* type.

The question that will have already been posed in the mind of the experimenter who has fully grasped the suggested testing technique concerns the degree of certainty of the identity of the transistor terminations. For example, the lead that has been identified by inspection as being the

collector may in fact be the emitter. Although by testing the forward and reverse resistances of both junctions to the base any doubt as to the polarity of the transistor is removed, there still remains the question as to whether the end that has been identified by inspection as the collector is indeed the collector and not the emitter.

It must be conceded that transistor manufacturers do make mistakes and although the writer has not yet come across a transistor where the leads have been incorrectly wired to the transistor " sandwich," he has come across a case where, in a transistor having terminations of the type shown in Fig. 13(a), the red dot was incorrectly placed at the emitter end.

Unfortunately it is not possible to eliminate every doubt but advantage can be taken of the fact that the inherent resistance of the collector-base junction is higher than that of the emitter-base junction. The reverse resistance of the collector-base junction ought therefore to be the higher of the two reverse resistances, while the forward resistance of the emitter-base junction ought to be the lower of the two forward resistances.

In carrying out tests on the emitter-base junction any manufacturer's restriction as to the maximum potential to be applied thereto should be heeded: this maximum voltage is frequently of the order of 1V and may be as low as 0·5V. It will therefore be appreciated that where there is doubt as to the identity of the collector and the emitter, the test carried out upon both junctions should be limited to the −1·5V termination of the testing device, using a battery of that voltage. If it is decided to risk exceeding the voltage limitation, steps should be taken to limit the current flowing through the base junction to a low figure. It would probably be unwise to allow this to exceed 1 mA.

Conclusion

Referring again to Table 2 the results suggest that the transistors numbered 1, 2, 4, 6, 7, 14 and 16 should all be usable in normal circuits although their transfer characteristics appear to be far from linear in the majority of cases. The remaining transistors appear to be all " good " in the context of " good/no good " terminology but apparently suffer from excessive non-linearity of the transfer characteristic. They would therefore be of more use in oscillator circuits than as amplifiers in circuits where linearity is important. Judging by appearances and results of the tests, number 1-3 and 4-6 were classified as a.f. types. Numbers 14-16 had the appearance of being r.f. types, although if this should prove to be the case, numbers 14 and 16 have excessive I_{co}. Numbers 7-10 and 11-13 were somewhat similar in appearance: in these two groups numbers 9 and 13 have the low I_{co} expected of r.f. transistors. The remainder were provisionally categorized as probable a.f. types.

These tests have underlined the need to develop a method of ascertaining whether transistors are of a.f. or r.f. type, and if the latter, a method of measuring or estimating the f_T, which is the frequency where the forward current gain is unity. Work is now proceeding on the development of a simple device which it is thought might be used as an " add-on " unit in conjunction with the Elsiecheck.

It is hoped that the description of the present device will persuade non-users to " have a go " with transistors and will have assisted the user to a better understanding of the workaday characteristics of semiconductors in general.

[1] *The Amateur Radio Handbook*, RSGB, Third Edition, pages 488-9.

[2] *Reference Manual of Transistor Circuits*, Mullard, pages 19-20.

[3] *Radio Valve Data*, Iliffe. *RCA Transistors and Semiconductor Diodes*, Radio Corporation of America (Ref. SCD 108A).

[4] *Radio Laboratory Handbook*, M. G. Scroggie, Seventh Edition, page 326.

[5] *Radio Constructor*, " A Transistor Test Board," V. T. Rolfe, Vol. 9, page 644.

[6] *Radio TV & Hobbies*, August, 1960.

The IQSY and Sporadic E

MEMBERS are again invited to participate in a section of the Society's IQSY programme by reporting reception of the experimental stations on 29·005 Mc/s and 70·305 Mc/s operating from Lerwick, Shetland, under the call-sign GB3LER.

There always exists the possibility of reception of these stations by tropospheric propagation but during the summer months it will also be possible for operators in most parts of the UK to receive either or both of these transmissions by sporadic *E* propagation. Reception of signals by this type of propagation is unpredictable and the source of the ionization of the sporadic *E* area is not definitely known. It appears that sporadic *E* occurs when small areas at a height generally between 50 and 90 miles above the surface of the earth become highly ionized and reflect signals of a much higher frequency than the rest of the *E* layer, and this effect can be observed on both the 28 and 70 Mc/s bands. Signals propagated by sporadic *E* are characterized by their unreliability and the fact that they suffer from very large changes in signal strength in short periods of time.

Observations of signals from GB3LER on the 28 and 70 Mc/s bands will provide an opportunity to examine the possibilities of correlating reception with other known factors during a period of low solar activity. Possible causes of the sporadic *E* effect are particle radiation from the sun, ultra-violet radiation or the trapping of ionized particles in the earth's magnetic field. If observations showed a link between any of these effects and sporadic *E*, then it would be possible to find a method of accurately forecasting the occurrence of this type of propagation.

The 29·005 Mc/s transmission was first received in the London area this year on May 9 and there have been numerous instances of reception by sporadic *E* since that date. In a number of cases the signal on 29 Mc/s has been S7 to S9 at midnight clock time. Similarly, the 70 Mc/s signal has been widely reported. GB3LER transmissions are radiated 24 hours a day and consist of a carrier interrupted at frequent intervals for c.w. identification. The transmissions are beamed alternately north and south by switching between the two aerial arrays at five minute intervals, i.e., during the first five minutes of every hour the signal will be beamed in a northerly direction, whilst during the second five minutes the signal will be radiated towards the south.

Log sheets for reporting these signals may be obtained by a request to the Scientific Studies Committee at RSGB Headquarters, to which all reception reports should also be sent. G2BVN

The P.T.O.

By R. C. MARSHALL, M.A., A.M.I.E.E., G3SBA*

WHILE nearly all amateurs appreciate the utility of the grid dip oscillator, the design of this particular item of equipment seems to have become standardized around the thermionic valve. To substitute transistors would seem to hold many advantages, not the least of which would be a reduction in physical size and freedom from a trailing mains lead. Unfortunately, using transistors to produce a piece of apparatus which functions like a g.d.o. is not just a question of substitution: there are many hidden difficulties, added to which is the consideration that to designate it as a g.d.o. is no longer accurate.

This article contrasts the operation of valve and transistor circuits, gives details of an unusual circuit arrangement, and suggests a new name for the class of equipment, which although transistorized, functions in the manner of a valve operated grid dip oscillator.

Operation of the G.D.O.

The grid dip oscillator is basically an instrument which will measure the resonant frequency of a circuit inductively coupled to it. The external circuit under test need not

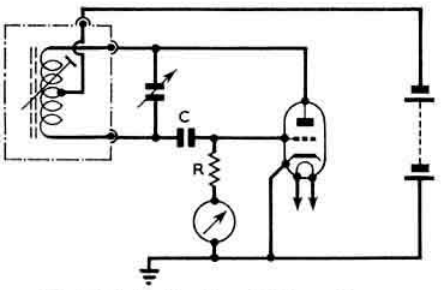

Fig. 1. The basic valve grid-dip oscillator.

necessarily be an LC arrangement, but could be a resonant aerial system such as a dipole, multi-element beam, vertical aerial or a loaded whip.

Fig. 1 shows the standard arrangement, and it will be seen that it consists of a tuned circuit—usually employing plug-in coils to achieve the desired frequency coverage—arranged in such a manner that it can be coupled to the circuit under test. At the earthy end of the grid leak R is a meter, and this monitors the grid current of the oscillator.

When the coil of the oscillator is coupled to a circuit which is resonant at the same frequency as that of the oscillator, the external circuit will absorb power from the oscillator. This effectively reduces the Q of the oscillator coil which in turn reduces the amplitude of oscillation. This shows as a drop in the grid current and will be indicated on the meter. The tighter the coupling between the g.d.o. and the external circuit, the greater will be the dip in grid current of the oscillator.

Fig. 2 illustrates the grid and anode waveforms of a class C oscillator. The flow of grid current through the grid resistor R produces a standing voltage on the grid capacitor C, so that, for most of the cycle, the valve is biased beyond cut-off, and only at positive peaks of grid voltage does anode current flow. The flow of anode current " kicks " the tuned circuit which then, due to its Q, completes the cycle.

As we have noted, the loading on the tuned circuit is such as to reduce its Q, so that the completed cycle will be of

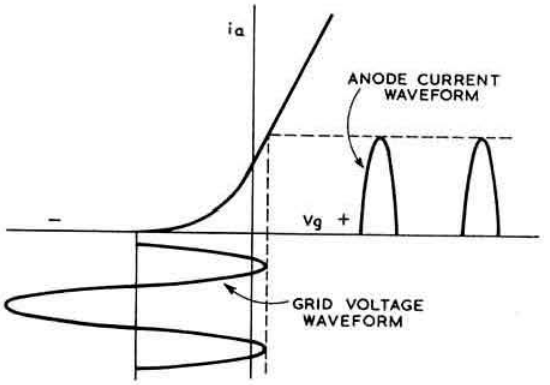

Fig. 2. The grid and anode waveforms of a class C oscillator.

smaller amplitude than that in the unloaded condition, and thus the bias current will decrease. In terms of grid voltage, however, there is a self-compensating action. The decreased bias due to the load on the tuned circuit increases the duration of the anode current pulse, and this has the effect of increasing the amplitude of oscillation so partially compensating for the original fall. Due to this stabilizing effect, the oscillation voltage level is not such a good measure of changes in Q as is the level of grid current.

Squegging

If R or C, Fig. 1, are made too large, then too much of the anode voltage swing will be present at, or fed back to, the grid, and low frequency oscillation—squegging—will take place. In turn this will mean that the r.f. output of the oscillator will be in bursts. Since the frequency of the squegging will vary in sympathy with changes in the Q of the oscillator tank circuit, it could be used as a measure of the resonance of an external circuit—rather than the normal grid current method.

The Standard Transistorized G.D.O.

The transistor oscillator must differ substantially from its valve counterpart in its bias arrangements, since, for oscillation to start, some predetermined current must flow in its base circuit. Further, to combat temperature effects, the collector current must be kept sensibly constant.

Fig. 3 illustrates a typical transistor oscillator in which the

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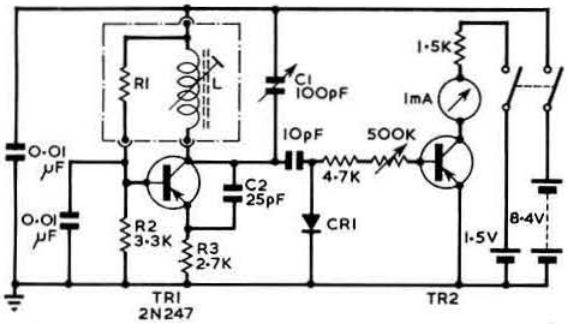


Fig. 3. A standard transistor "g.d.o." This is not as satisfactory as the circuit of Fig. 4, however.

foregoing requirements are satisfied by components R1, R2 and R3. Unfortunately these components also prevent variations in the *Q* of the tuned circuit, L, C1 from affecting the direct currents flowing in the circuit. Thus no longer is it possible to secure an indication of the "draw" from the tank circuit by an external circuit by measuring a d.c. current.

Indications of coupling, or loss of energy from the oscillator tank circuit to the external circuit, are secured in another manner. The usual arrangement is to indicate the amplitude of oscillation in the tank circuit on a meter. In Fig. 2 part of the tank circuit oscillation is rectified by CR1 and fed to a d.c. amplifier, TR2, which in turn operates the indicating meter.

The snags with this arrangement are that the circuit should only just be oscillating to obtain high sensitivity, and the best amplitude will vary from range to range, thus necessitating a sensitivity control.

The Passive Test Oscillator

The passive test oscillator, or p.t.o., bypasses these difficulties by forcing the oscillator to squegg at an audible frequency, and substituting a miniature loudspeaker or earpiece for the meter. The arrangement is shown in Fig. 4.

TR1 is an r.f. oscillator similar to that shown in Fig. 2 with the exception that the feedback point is tapped down the coil. In this arrangement, R3 is added to reduce unwanted phase shift, and to reduce the loading on the tuned circuit.

R.f. from the tank circuit of the oscillator is rectified by CR1 and fed to the base of TR2 which in turn controls the base current of the oscillator TR1. C4 and C5 delay this action so that squegging occurs at a convenient audio frequency, the tone of which is adjusted by VR1. If one of the end stops of VR1 is removed so that the wiper goes completely off the track, then this will act as a convenient on/off switch, since without any current into the base of TR1 via VR1 and R1, TR1 will cease to operate. Being a silicon transistor, its leakage current can be ignored.

In practice, a 30 ohm balanced-armature earphone is used as the loudspeaker. The tone is loud enough to be easily heard in a quiet room.

Construction

As a way of indicating resonance audibly has been found, as opposed to a visual method, this means that the unit can be operated in any position, without having to keep at least one eyeball concentrated on a meter. From this it seems but a natural step to arrange for the unit to be operated easily by one hand. The tuning condenser is therefore fitted with a knurled edge knob which projects so that it can be operated with the thumb while the rest of the hand grasps the case of the instrument.

To avoid reading and calibration errors, and also to make it easy to add extra ranges, each calibrated tuning scale has been made part of the actual plug-in coil with which it is associated. To achieve this, the coils are supported on $\frac{1}{16}$ in. thick s.r.b.p. sheet shaped as shown. To this sheet are riveted three pins from an English Octal valvebase in such a manner that they align with three sockets fitted to the $\frac{1}{8}$ in. s.r.b.p. panel of the main unit. The frequency scale

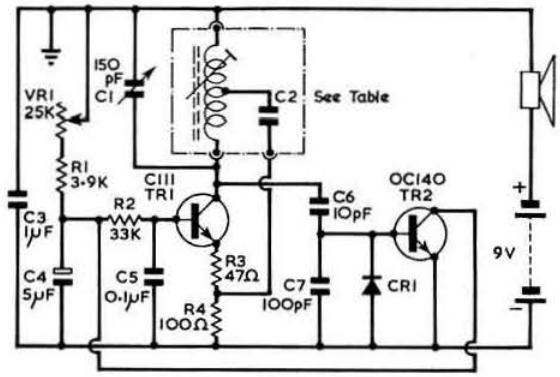


Fig. 4. The final arrangement: the passive transistor oscillator. Resonance is indicated by an audio tone, instead of visually with a meter.

is fitted to the sheet by adhesive, spacers being placed between the scale and the sheet so as to clear the fixing of the connecting pins.

Coils

Differing coil arrangements are employed on various ranges. The low frequency coils are wound on ferrite rod, the completed coil being secured to the sheet by Insuloid "P" clips. The medium frequency coils are constructed in the traditional manner, and are close-wound. In the higher ranges, air spaced coils are employed. These are constructed by winding a helix of wire through two rows of holes drilled in the mounting sheet, the winding being eventually secured with polystyrene cement.

(Continued on page 445)

TABLE I

Coil Details

Band (Mc/s)	Turns	Tap*	S.W.G.	Former	C2 (pF)
0·9—1·7	62	12	26	$\frac{3}{8}$in. × 2in. ferrite rod close wound	2,200
1·6—4·0	52	12	28	1in. diam. Paxolin tube close wound	470
3·5—8·5	21	4	23	1in. diam. Paxolin tube close wound	470
8·0—21	14	2	18	1in. diam. self supporting spaced 1·7in.	220
20—48	6	4	18	0·6 in. diam. self supporting spaced 0·7in.	22†

Notes:
* *Count turns starting from the cold or h.t. end.*
† *With an additional 100pF capacitor between the junction of R3 and R4 and TR1 collector.*

TECHNICAL TOPICS By PAT HAWKER, G3VA

Salute to Early Bird . Using other people's Satellites . W1DX Receiver
Unbalanced 7360 Mixer . New Semiconductors and Valves . 1·8/144 Mc/s Transmitter
Ground Planes, and Counterpoises . Ceramic B.F.O. . Transistor Frequency Multiplier
Rate-of-change Limiters

THE ability of a diminutive, 85-lb package of electronics called *Early Bird* to provide a non-stop broadband link across the Atlantic has caught the imagination of the public to whom radio communication developments are normally a closed book. And to the radio amateur the exercise should mean much more than just an opportunity to see long-distance " live " television programmes of somewhat variable interest.

For here is a further demonstration of the changes that are sweeping over the whole communications field. Recently, a Hughes Aircraft engineer told me that he considered the new era of 24-hour DX broadband working to be comparable with the revolution brought about by the opening-up of the short-waves for speech and telegraphy in the 'twenties—and few could quarrel with this assessment.

Many of us remain awestruck that a tiny 4160 Mc/s transmitter with an output of just 4·3 watts and the modest aerial gain of 9db can successfully transmit a baseband signal several megacycles wide over distances of 25,000 miles—and that the package can be launched and manoeuvred into the precise position determined months beforehand, and is now thought likely to remain operational, without maintenance, for 4-5 years.

For amateurs there are several significant lessons to be learned from this fantastically successful operation. First, wholehearted praise for those who devised the present equipment, or contributed to the now long line of communications satellites which began with *Score* in 1960, and for those who had sufficient belief in the whole " crazy " concept to authorize the spending of many millions of dollars and pounds (for Goonhilly). And, perhaps, a sneaking satisfaction that the very first man to suggest (in 1945) the potential value of radio relay stations in a synchronous orbit was Arthur Clarke, a British writer most widely known for his science-fiction books. Although, to the best of our knowledge, one cannot claim that Clarke was an " amateur " in our sense of the word, this at least shows that the informed outsider can still contribute imaginatively to communications engineering.

Furthermore, synchronous communications satellites (" syncsats ") have been brought to their present success largely by the efforts of a relatively few enthusiastic engineers —at least one of whom offered to sink his personal savings in this " wildcat " scheme to get action moving. Enthusiasm, it seems, can still move mountains and launch *Early Birds* and *OSCARs*—surely a satisfactory reflection for every radio amateur. And so quite soon new generations of " super-power " syncsats, including one already designed to have a 100 watt transmitter with a novel pencil-beam aerial, electronically " de-spun " to counter the stabilization spin of the satellite, may open the day when syncsat signals will be receivable on relatively simple ground equipment.

A new variation of space communication techniques which could well prove of interest to amateurs, particularly those keen on moonbounce, is currently under investigation at the Signal Research and Development Establishment in Hampshire. SRDE has for some years been developing moonbounce and has a link with the Royal Radar Research Establishment at Malvern capable of carrying some 15 simultaneous teleprinter circuits. Now, to supplement moon communication which inevitably fades out when the moon sinks below the horizon, use is being made as passive reflectors of the more than 100 main objects at present in orbit and expected to increase to some 10,000 by 1975.

SRDE suggests that while most of these space objects are sufficient only to support low-rate information channels even with their moonbounce equipment, signals reflected from the increasing number of cylindrical satellites exhibit large " glints " or " flashes " capable of sustaining high-capacity circuits. SRDE has advanced equipment including low-noise superconducting masers, 17 ft. dish aerials, and 1·5 kW transmitters on 2600 Mc/s. But one wonders if these " glints " could not be used by amateurs with much less ambitious rigs for narrow-band c.w. in much the same way as meteor trails are now used.

" The Miser's Dream "

Any article on h.f. receivers by Byron Goodman, W1DX, of *QST* staff, can be counted upon to be thought-provoking. His latest, " Some thoughts on Home Receiver Design " (*QST*, May, 1965) is no exception. This is essentially an " ideas " rather than a constructional piece, though it out-

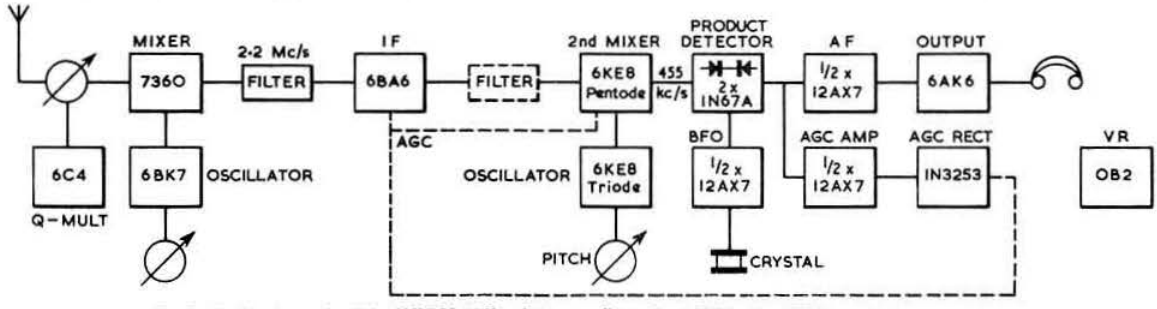


Fig. 1. Block schematic of the W1DX " Miser's Dream " receiver (QST, May 1965) containing a number of novel ideas to minimize the spending of money, time and space.

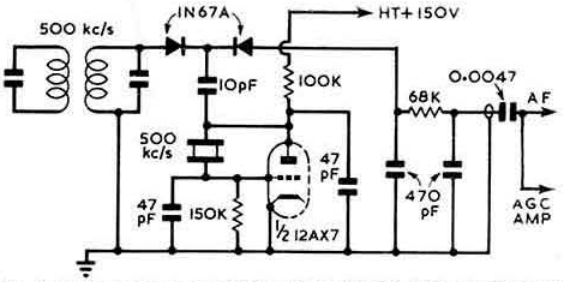


Fig. 2. Product detector and b.f.o. of the W1DX " Miser's Dream." With about 6 volts peak b.f.o. voltage, maximum signal voltage is about 0·1 volt.

lines a complete receiver (which he calls " the miser's dream ") for which a full circuit diagram is available for 25 cents (about 1s. 9d.) from the Technical Department, ARRL, 225 Main Street, Newington, Connecticut, USA. W1DX admits frankly that there are still various points which could be improved—for instance some operators would reckon plug-in coils as archaic (despite their many constructional advantages); the a.g.c. is not ideal; and a separate aerial tuner may still be needed to put image response into the category essential today.

Fig. 1 shows the block diagram of this design, from which it will be quickly noted that the set has many unconventional features. These include the use of an unbalanced 7360 beam-deflection mixer, with no r.f. stage but with an r.f. *Q*-multiplier to sharpen up the characteristics of the input circuit to reduce image response; a 2·8 kc/s wide crystal lattice filter immediately following the mixer, and with a sharper 250 c/s filter for c.w. reception in the subsequent i.f. stage. We guess that even misers in the United States are prepared to fork out their shekels for two crystal filters when pressed.

With the necessary selectivity achieved in the 2·2 Mc/s i.f. section the reader may be wondering why bother with a further conversion down to 500 kc/s. The answer lies in the resulting elimination of the old problem of b.f.o. voltages leaking back into the i.f. strip. This is avoided by changing signals down to 500 kc/s but *without* any further amplification before the product detector.

The detector (Fig. 2) is an adaptation of a little used Norgaard circuit described a number of years ago, but using (despite the increase in noise contribution) crystal diodes rather than thermionic diodes. A 6 volt crystal-controlled b.f.o. signal is injected with a signal level of around 0·1 volt. An a.g.c. amplifier valve is used in conjunction with a pair of silicon diodes and a long time constant load suitable for c.w. or s.s.b. operation, details being given in *QST*.

The front-end is of particular interest: see Fig. 3. It has an unbalanced 7360 deflection beam mixer, simpler than the original balanced mixer suggested by W2PUL (see *TT*, December, 1963), though presumably a shade more susceptible to cross-modulation than the balanced version. Also incorporated is a 6C4 r.f.-type *Q*-multiplier which uses the aerial input tuning circuit plus the aerial coupling winding as feedback coil. A 2·2 Mc/s parallel-tuned trap in the aerial is used to reduce i.f. breakthrough.

For the h.f. oscillator a high-*C* Colpitts is used with negative-temperature-coefficient capacitors to reduce drift. With low-noise mixers, such as the 7360 or triodes, it is interesting to note how the comment of " clean " signals standing out from the background inevitably turns up in the descriptions.

A constructional dodge which allows the well-known Eddystone dial to be used without having to cut the chassis is to space off the chassis from the panel.

New Semiconductors and Valves

The recent RECMF exhibition at Olympia, London provided an opportunity to see some of the latest semiconductors and valves. Mullard, for instance, have some useful looking new types both in production and in development (note that development types are re-allocated final type numbers when in production). The " TVistors " range of transistors intended primarily for television receivers look like giving us some useful u.h.f. transistors at " entertainment-device " prices. For example, the alloy-diffusion AF186 has been developed for low-noise u.h.f. tuners (470-960 Mc/s), for operation as r.f. amplifiers and as self-oscillating mixers. It is claimed that compared with contemporary valve tuners (which use the PC88-PC86 combination) these transistor tuners provide an appreciably lower noise figure; higher power gain; lower oscillation radiation level; simpler construction; and have lower power dissipation. The value of such germanium transistors for v.h.f. and u.h.f. converters needs no stressing.

In the development stage are *n-p-n* silicon planar power transistors intended for business radio mobile transmitters: the 94BLY (development type-number) can provide six watts output at 180 Mc/s or 10 watts at 80 Mc/s with a maximum gain of 6db; another addition is the BLY14 with an output of 3 watts at 180 Mc/s.

A development type (9BLY) silicon planar *n-p-n* h.f. transistor is capable of 40 watts output up to 30 Mc/s with an efficiency of 60 per cent and power gain of about 6db.

Brimar have some new silicon power diode rectifiers including the Y1910 with a p.i.v. of 1000 volts and maximum peak transient rating of 1500 volts. This maker has also

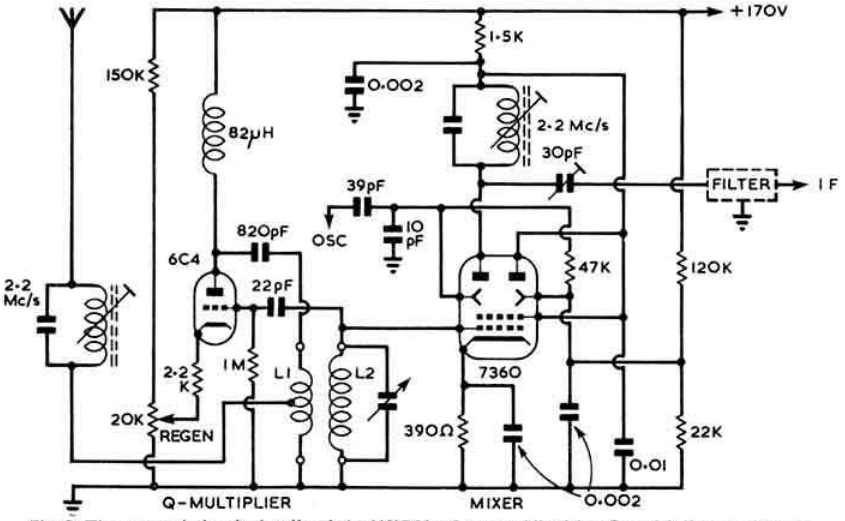


Fig. 3. The unusual circuit details of the W1DX " front-end " with a Q-multiplier to sharpen the selectivity of the single pre-mixer tuned circuit which uses plug-in coils. Oscillator voltage at mixer deflection plate is about 2 volts.

extended the lower voltage range for use with transistorized equipment, e.g., the Y1103 with 50 volt p.i.v.

A new Brimar audio output pentode, type EL506, looks promising; this is on the small Magnoval (B9D) base but has a 19 watt anode dissipation. A single class A valve can give 10 watts audio output, under high-quality conditions. And with 19 watts anode dissipation it should be suitable for use in class C r.f. stages up to around 50 watts input.

Dual-band Transmitter

At the RECMF exhibition, Thorn-AEI were handing out copies of several of their most useful Applications Laboratory investigation reports, including the third issue of No. L87 describing a dual band amateur transmitter by D. W. Furby, G3EOH. This design is one of the few which feature the logical combination of a low-power 144 Mc/s transmitter with 1·8 Mc/s in a size suitable for fixed or mobile operation. Three of the four valves are used on both bands but with band-changing without any switching of v.h.f. circuits. This is achieved by incorporating dual-frequency anode circuits not unlike the arrangement used in a.m./f.m. broadcast receivers. Fig. 4 shows the third stage which operates as a frequency doubler on v.h.f. and as buffer amplifier on 1·8 Mc/s without any switching.

The complete transmitter section comprises 6BW7-6BW7-7558-7558 operating as an 8 Mc/s crystal-oscillator-tripler/tripler/doubler/p.a. on v.h.f. and as -/Clapp v.f.o./b.a./p.a. on 1·8 Mc/s with the first 6BW7 switched out on 1·8 Mc/s. Power input is 15 watts on 144 Mc/s, reducing to 10 watts on 1·8 Mc/s. The report is published by Thorn-AEI Radio Valves & Tubes Ltd, Brimsdown, Enfield, Middlesex. (An article describing G3EOH's interesting design will be published in the BULLETIN shortly.—EDITOR.)

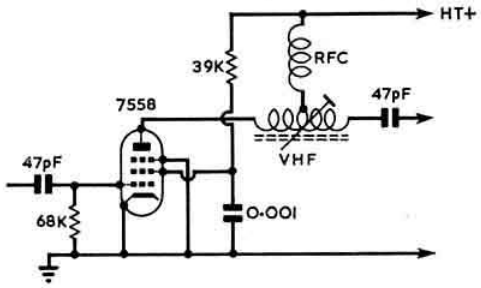


Fig. 4. One of the " dual-band " stages in the Thorn-AEI transmitter for 1·8 and 144 Mc/s. The valve acts as a doubler on v.h.f. and as an untuned buffer on 1·8 Mc/s.

Ground Planes, Radials and Counterpoises

The description (*TT*, March, 1965) of OZ5S's ground-plane has stirred John Farrar, ex-5B4JF, VS9SJF, to send along details of a modified form of ground plane, originally devised by 5B4IP (formerly G8IP) to overcome the problem of low feedpoint impedance when using horizontal radials.

In Cyprus, with many flat roofs, it is much easier to have the radials horizontal than sloping downwards, so that the impedance drops to around 20-30 ohms, presenting a mis-match to coax feeder. To overcome this, 5B4IP increased the length of the vertical radiator element from 90 electrical degrees (i.e. quarter-wavelength) to 113° and so raised the impedance to about 75 ohms. This results on 14·1 Mc/s in a radiator length of 22 ft. 6 in., still quite manageable. Since the aerial is not resonant, there is a reactive element at the feedpoint and this is tuned out by the insertion of a 60 pF variable capacitor in series with the inner core of the coax and the radiator: see Fig. 5. This capacitor must be capable of withstanding the high voltages developed at this point and should therefore be similar in spacing to that in the p.a. tank circuit. It should be mounted at the base of the radiator in a

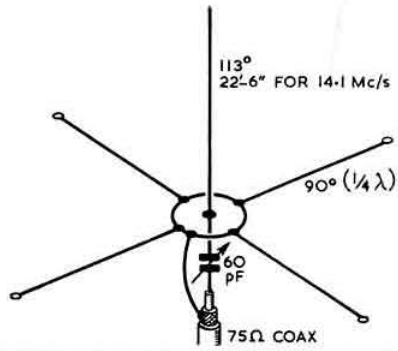


Fig. 5. Ground-plane for use with horizontal radials.

water-tight box. John Farrar states that with an s.w.r. bridge in the feeder line, unity s.w.r. can be obtained easily by adjusting the capacitor and also that the aerial works quite well on 21 Mc/s.

G5XD, on the subject of ground planes generally, mentions that after using a triband ground plane made from lighting flex taped to lashed together canes, with three sets of three radials and three radiators taped together, he came to the conclusion that the close proximity of the radiators was not good, and now uses—with better results—two separate ground planes for 14 and 21 Mc/s about five yards apart and fed in parallel with 50-ohm coax. He still finds that cane rods lashed together, with plastic covered (single) lighting flex are satisfactory. G5XD is interested in obtaining user experience of verticals not using radials—from what one reads a good deal would seem to depend upon the effectiveness of the earth system so that results in an area of poor earth conductivity may not match up with those achieved elsewhere.

In this connection, we noted some interesting comments on the effects of " earths " on mobile operation by G6GR in a recent issue of *Mobile News*, the ARMS journal. He points out that, contrary to widely held views, optimum results on 1·8 Mc/s are more likely to be obtained from low lying, relatively marshy areas than from those super hills where the rocky soil usually forms a poor capacitance earth in conjunction with the car body.

The other day it came to us with something of a shock that one seldom sees much comment or even reference to the use of " counterpoise " earth systems for Top Band Marconi aerials. At one time counterpoises (often comprising just a single 66 ft. wire suspended a few feet above earth and running roughly beneath the main aerial) were held in high regard by those without a really good earth system—and our own recollections of using them in the 'thirties are distinctly favourable. Yet it now seems ages since we have seen any general description of them in the amateur literature. Any comments?

Ceramic Oscillator

PZT ceramic (lead zirconate titanate) i.f. transformers (" transfilters ") for use in transistor receivers have been referred to several times in *TT* (e.g. April, 1961) though, apart from the Heathkit " Mohican " have not been very widely used. In *CQ* (May, 1965), W6QLV comes up with a new use for these compact units; this is as the frequency-determining circuit for a b.f.o. with provision for a convenient frequency range of about 5 kc/s. Fig. 6 shows the circuit recommended by Clevite for the TO-01 unit. It is pointed out that the small size, freedom from screening requirements or from affect by magnetic fields; and frequency tuning by means of a potentiometer are all useful features.

The 0·01 μF capacitor across the transfilter forms a

padding capacitor to put the frequency some 2 kc/s above the nominal i.f. of the unit, and the value of this capacitor can be adjusted if necessary so that the unit gives a symmetrical frequency range about the i.f. The actual frequency is adjusted by changing the forward bias of the transistor, thus changing its internal impedance, by means of R1 (no value for this component is given in the original article).

The frequency stability is not as good as with a crystal oscillator but, with a stabilised power source, is said to be adequate for s.s.b. reception. Frequency will be affected by changes in the temperature of the transistor.

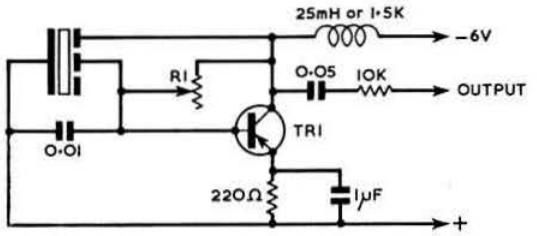


Fig. 6. Use of a ceramic " transfilter " as a variable b.f.o.

Solidstate Frequency Multiplier

An increasingly common method of obtaining r.f. power at u.h.f. and microwave frequencies is the use of parametric varactor diodes (see Microwave Associates circuit in *TT*, April, 1963). A brief note in *Electronics World* (June, 1965) draws attention to a new Canadian technique whereby a single transistor can be used to generate useful amounts of power at frequencies well above the rated alpha cut-off frequency of the transistor.

Although only a limited amount of practical information is provided, the arrangement shown in Fig. 7 is said to provide an output of some 1·25 watts at 240 Mc/s when driven by about one watt at 60 Mc/s. The transistor operates as a 60 Mc/s amplifier in a common-emitter mode with the output tap on the emitter tuned circuit adjusted for optimum coupling of the 240 Mc/s component from the transmitter to the load, with trap circuits to reduce the 60 and 180 Mc/s components.

Rate-of-Change Noise Limiters

In the May *TT* we included a circuit from an article by K5JKX of what was claimed to be a version of the " rate-of-change " noise limiter. This resulted in some interesting correspondence from John Haydon, G3BLP who feels strongly that the circuit (our Fig. 1) is really only a variation of the standard Dickert limiter and not a true " rate-of-change " limiter. He is also uneasy about some aspects of the Makino circuits, particularly our Fig. 3, though he hopes to

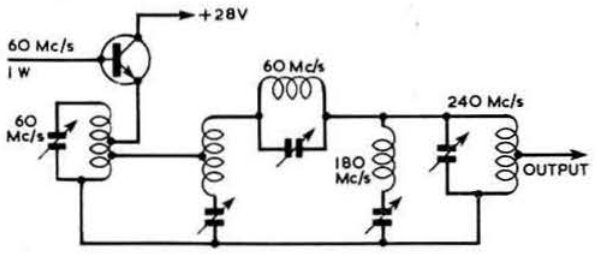


Fig. 7. Solid-state frequency multiplier claimed to be capable of providing an output of 1·2 watts at 240 Mc/s when driven by 1 watt of 60 Mc/s r.f.

carry out some experiments with the arrangement of Fig. 2 which, he thinks, may well be an improvement.

As almost immediately afterwards we got caught up in attending the Montreux television symposium—where we were glad to meet HB9AEQ (Hon. President of the International Amateur Radio Club), OZ5F and a former OK1—we have had little opportunity to dig out much more information on these types of limiters. But Fig. 8 shows the basic Pye rate-of-change limiter (British patent 605,206) as developed a decade ago for television sound channels. The following description of its operation comes from our *Television Engineers' Pocket Book*:

" This is one of the most successful noise-suppression circuits. Resistors R1 and R2 are of the order of megohms, so that a steady current of, say, 50 microamps flows through the diode. The capacitor C is a critically large value chosen so that the time constant formed with R2 is just capable of being charged and discharged by the current flowing through the diode at the highest audio frequencies it is desired to reproduce. At audio frequencies the cathode of the diode follows the anode. If, however, a negative-going interference pulse of very short duration appears, the diode will immediately cut off and the cathode circuit will commence to discharge. Before any great change has taken place, the pulse ends and the audio signal reappears at the output bearing only a small triangular ' pip ' instead of the original large noise pulse. The further smoothing is provided to smooth out this remaining pip."

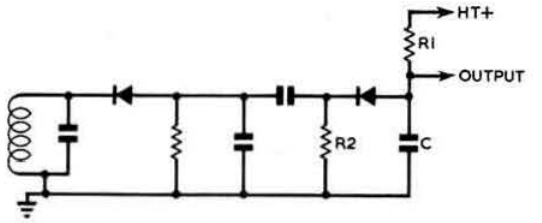


Fig. 8. Following limiter of the type used in some television receiver sound channels. Thermionic diodes can be used.

The P.T.O. (Continued from page 441)

If the coil details are changed from those given in Table 1, the position of the tap and the value of C2 may require alteration in order to secure a constant audio tone over the range covered by the coil.

Conclusion

The squegging action produces more than 100 per cent modulation with a non-sinusoidal waveform so that there is sideband spread. For example, at 14 Mc/s, this amounts to some 500 kc/s. However, indication of resonance is much sharper than this.

Calibration may present something of a problem for the standard methods used for a conventional g.d.o. cannot be employed. The best arrangement is to calibrate the instrument with tuned circuits of known resonant frequency.

It should be particularly noted that *n-p-n* transistors have been specified. *P-n-p* transistors such as the OC171 (TR1) and OC71 (TR2) may be substituted, but if this is done, it is essential to remember to reverse the polarity of the battery supply and the diode.

The p.t.o has now been in use for about a year and has proved as accurate as, and definitely more convenient than the " old " g.d.o.

Single Sideband

By G. R. B. THORNLEY, G2DAF*

MANY amateurs operating single sideband to-day are limited to operation with a bare foot exciter for two major reasons: (i) the difficulty of obtaining valves suitable for a higher power amplifier at reasonable cost, and (ii) the inherent fear of the danger of high voltages of 2,000 to 3,000 in the shack and the natural desire to restrict all power supplies to more familiar voltage levels around 700 or 800 volts. Additionally, there is the further attractive feature that a power supply of 1,000 volts or less can be safely and compactly smoothed by low cost electrolytic capacitors in a simple series-parallel arrangement.

These considerations have caused experimenters and designers of single sideband equipment to look for acceptable valve types in the low cost commercial television receiver field. The requirement for a single sideband power amplifier is a high peak current at a low anode voltage, together with an anode dissipation capability in the range 20 to 40 watts. These characteristics are available in the modern colour television line time base output valves, and because these valves are manufactured in very large numbers the cost is relatively low—about thirty shillings each for the type 6HF5.

Since these valves are designed and controlled in manufacture only for deflection amplifier service, manufacturers do not normally publish data or operating conditions for amateur single sideband service. Of very great importance is the capability of the valve to operate with an acceptably low level of third and fifth order intermodulation distortion products. To this end it is very necessary to determine the degree of linearity by a process of trial and error, careful measurement, inspection of the modulation envelope on the oscilloscope, and finally test and evaluation by on-the-air reports. A great deal of the pioneer work in this field has been undertaken by G6VX who has not only demonstrated that an r.f. amplifier using paralleled line deflection valves is capable of a low distortion signal up to the licensed maximum allowable, but has also provided a wealth of circuit information and the incentive to other sideband workers to also try them.

Line Time Base Valves as R.F. Power Amplifiers

One amateur who was encouraged by the pioneer work of G6VX to build his own deflection valve amplifier is G3NSN. This amplifier has been in regular use on the 80m band recently and has proved to be stable and have an inter-

* 5 Janice Drive, Fulwood, Preston, Lancs.

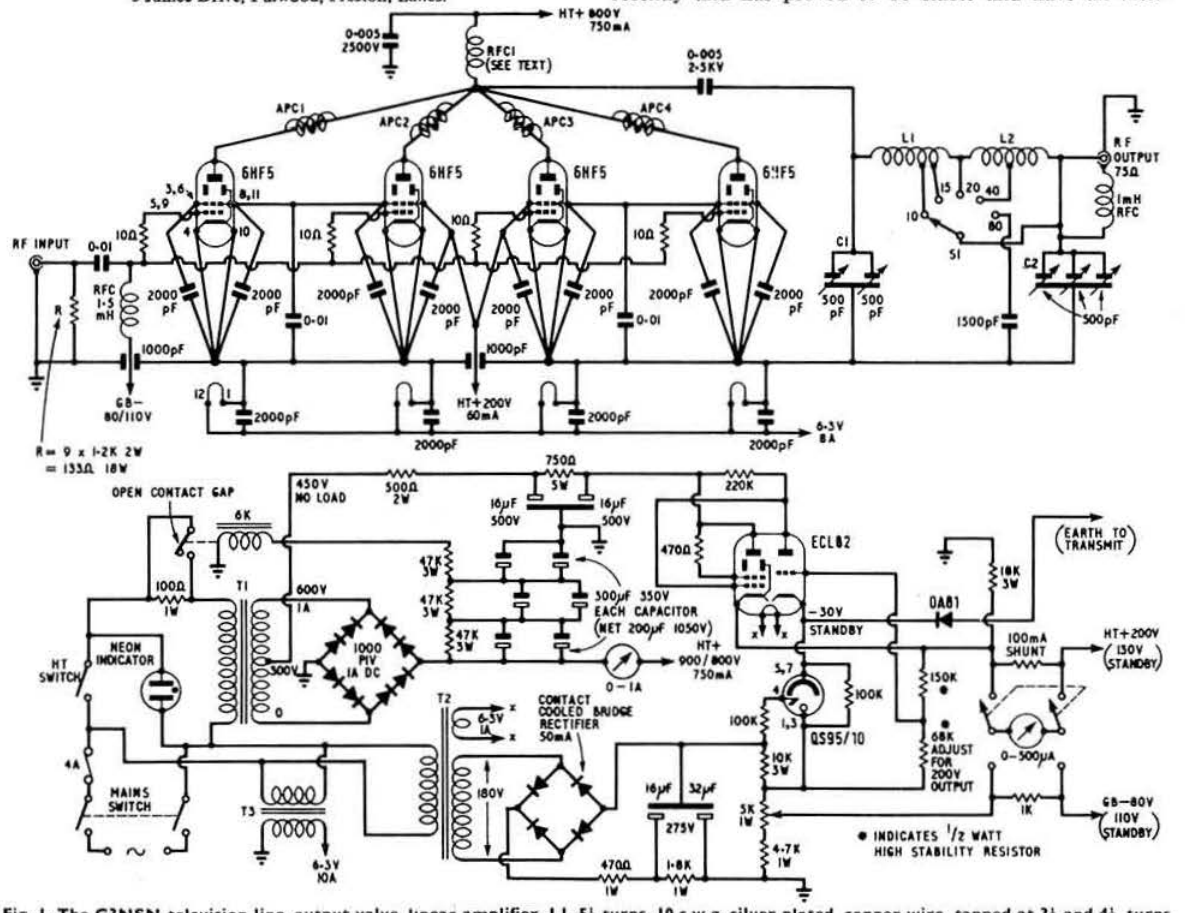


Fig. 1. The G3NSN television line output valve linear amplifier, L1, 5½ turns, 10 s.w.g. silver plated copper wire, tapped at 3½ and 4½ turns from hot end, 1 in. inside diameter, 1⅝ in. long. L2, 7½ turns, 18 s.w.g. silver plated copper wire, tapped at 3 turns from hot end, 1¼ in. diameter, 1 in. long. APC1, 2, 3 and 4, 47 ohm 2 watt resistors overwound with 4 turns of 18 s.w.g. enamelled copper wire. RFC1, 112 turns, 26 s.w.g. enam., wound on 1 in. diameter ceramic former, 3⅛ in. long.

modulation distortion level estimated to be better than 35db down.

The complete circuit including the power amplifier is shown in Fig. 1. It will be noted that four Sylvania 6HF5 horizontal deflection valves are wired in parallel and that the amplifier uses the now common passive grid input circuit. Low voltage high current valves will require a low r_l (anode load) and as four valves in parallel will require one quarter the r_l of one, the final value will necessitate very low reactance values in the output tank circuit. This means few turns on the coil and quite unconventional values for C1 and C2. Fortunately the requirements can be met using standard broadcast type variable tuning capacitors, plus an additional fixed 1,500 pF capacitor that is paralleled with C2 on the 80m band position of the pi-tank switch S1.

It is important to realise that the amplifier is not neutralized and that stability is dependent only on the damping of the grid input circuit by the passive grid resistor. A low value of 50 or 75 ohms will give improved stability but requires a greater driving power to develop the wanted peak r.f. grid swing. With the value of 133 ohms as given in the circuit, the amplifier can be driven fully with a single 6146 in the exciter—it is, however, of greater importance that stray r.f. feedback between the anode and grid sides of the amplifier be kept to a minimum. This means careful attention to the lay-out so that the input connections are kept underneath the chassis and all the components associated with the anode circuits on top—i.e. the grid input side must not be able to " see " any part of the anode output side of the p.a. valves—and thorough bypassing of both the screen grid connections on each valveholder.

The mains transformer T1 is a " special " manufactured by a local transformer winding organization to provide a secondary output of 600 volts r.m.s. centre-tapped with a maximum current rating of 1,000 mA. Both primary and secondary windings have very low resistance, and this, together with the low resistance silicon rectifiers and large effective value of smoothing capacity, produces a very heavy switch-on current surge that would blow the mains input fuse. It would be unwise to increase the fuse rating beyond 4 amps because this would defeat its protective function and the switch-on surge current is held to a normal value by the 100 ohm 1 watt resistor in series with the transformer primary. As the smoothing capacitors charge up towards their maximum value, the rising voltage increases the current through the 6,000 ohm relay winding until the contacts finally close and short out the 100 ohm current limiting resistor. The relay is adjusted to close when the h.t. output reaches approximately 600 volts by adjustment to the contact gap—this will be wider than the normal gap setting.

Operating bias for the 6HF5 control grids and the screen supply regulator valve (ECL82) is provided by T2 and the 50 mA bridge rectifier with conventional smoothing and output load circuit. The p.a. bias supply is adjusted by means of the 5 K ohm potentiometer for a total zero signal anode current of 120 mA (30 mA each valve). On " standby " the cathode of the ECL82 triode section is at negative 30 volts, the 6HF5 bias line at negative 110 volts and the screen grid supply at positive 130 volts—this reduces the standing zero signal anode current to a very low value and enables the valves to cool down on pauses between transmission periods. For " transmit " the triode cathode is shorted down to earth via the exciter " press to talk " relay and muting line, the 6HF5 grid bias is then negative 80 volts (or whatever value is necessary to maintain a total zero-signal anode current of 120 mA) and the screen supply is positive 200 volts. It is necessary to incorporate the series OA81 diode in the muting line to prevent the 100 volt negative muting voltage on the G2DAF exciter rail from reaching the ECL82 triode cathode—the diode merely acts as a one-way gate, the characteristics not being critical, and any similar type to the OA81 is therefore suitable. It is, of course, not essential to use the G3NSN regulator valve arrangement shown in the circuit diagram, and an alternative arrangement that might appeal to some constructors is the more usual screen feed via a dropper resistor and VR105/30 voltage regulator valves. As the combined maximum signal screen current for the four 6HF5 amplifier valves is 40 mA, it will be necessary to use four VR105/30s in a series parallel arrangement to give 210 volts regulated at a maximum current capability of 60 mA.

TABLE 1
Amateur Band operating conditions (max. 400 watts p.e.p.)

V_a = 800 volts	Single-tone	Two-tone
Anode current (zero sig.)	120 mA	120 mA
Anode current (maximum sig.)	750 mA	475 mA
Power input (d.c.)	600 watts	380 watts
P.E.P. input	600 watts	600 watts
I_{g2}	40 mA	24 mA
I_{g1}	0 mA	0 mA
V_{g2}	200 volts	200 volts
V_{g1} (peak drive)	92 volts	92 volts
Anode Dissipation	200 watts	180 watts
P.E.P. Output	400 watts	400 watts
Power Output (mean)	400 watts	200 watts
Anode Efficiency	66 per cent	52 per cent

For a maximum signal anode current of 750 mA at an anode voltage of 800, $I_a(peak) = I_a(d.c.) \times K$ (where K is a constant dependent on the angle of anode current flow—in this case 200 degrees giving a value for K of 3). $I_a(peak)$ therefore equals $750 \times 3 = 2250$ mA. Assuming that the dynamic anode voltage swing at its lowest point is 100 volts, from the formulae $RI = 2(V_a - V_a\ min)/I_a(peak)$ the values are $RI = 2(800-100)/2250$. This equals an RI of 622 ohms. The pi constants are then $RI = 622$ ohms; $RI(out) = 75$ ohms. The ratio $RI/RI(out) = 8{\cdot}3$ and the square root of 8·3 is approximately 2·9, the reactance ratio, $(XC1 : XC2)$. Designing for a Q of 12;

$XC1 = RI/Q = 622/12 = 52$ ohms.
$XC2 = XC1/2{\cdot}9 = 52/2{\cdot}9 = 18$ ohms.
$XL = XC1 + XC2 = 52 + 18 = 70$ ohms.

These values are a simple approximation but are quite near enough for amateur purposes. From a reactance chart the values for 80m are C1 = 900 pF total (825 μF + 75 pF stray); C2 = 2,700 pF and L = 3·3 μH. Values for the other bands scale down in the same ratio as the band wavelength as follows:

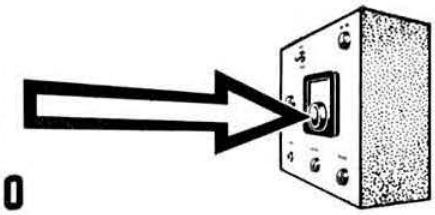
Band	C1	L	C2
80m	900 pF	3·3 μH	2,700 pF
40m	450 pF	1·6 μH	1,350 pF
20m	225 pF	0·8 μH	675 pF
15m	172 pF	0·6 μH	500 pF
10m	112 pF	0·4 μH	337 pF

Construction

Chassis layout is not critical but all leads carrying r.f. should be kept as short as possible—the amplifier should be built as if it were going to operate on five meters—with the 6HF5 valves arranged in a square and the anode r.f. choke in the centre. C1 and C2 should be above the chassis, on either side of L1-L2 and S1. The main h.t. smoothing capacitors are standard television types that are readily available with a rating of 300 μF at 350 volt working. As the cans are not isolated the six capacitors must be mounted on an insulated panel of paxolin or perspex. C2 is a standard three gang broadcast type tuning capacitor of 500 pF each section, and C1 is also a standard two gang broadcast type capacitor of 500 pF each section but of the old pre-war physically large type with not less than 25 thou. spacing between rotor and stator plates. Both the pi-tank inductances L1 and L2 are mounted in the same plane and supported by the switch S1 which should have ceramic insulation and have substantial contacts suitable for carrying several amps of r.f. (the TU5B switch is very suitable). The ceramic former from

(Continued on page 456)

PROGRESSING THROUGH AMATEUR RADIO



Part 5

By K. L. SMITH, B.Sc., G3JIX *

FROM Oersted's and Faraday's work has developed the remarkable interplay of electricity and magnetism which forms perhaps the major part of the practical uses of electrical energy, and especially the operation of radio circuits. Simple effects noticed with magnets are well known, such as the tendency for a suspended magnet to come to rest in a north-south direction. Faraday also suggested lines of force to picture the field of influence around magnets. The lines are assumed to start at the north seeking pole, and end on the south seeking pole. The similarity with the electric field is noticeable, but there is an important difference in

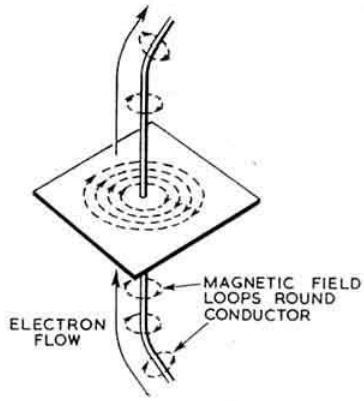


Fig. 1. " The magnetic field forms loops around the current in a wire, and is always at 90 to its direction."

the magnetic case in that no separate poles exist in the way that positive and negative charges can. A south pole will always be found near a given north pole, or else the magnetic lines join up into complete loops. If a magnet is broken up, then the separate pieces form smaller magnets, complete with north and south poles. North poles repel each other; similarly south poles. Opposite poles attract.

The interesting cases involve the magnetic fields produced by an electric current and the current set up in a circuit by a magnetic field moving near it. The field produced by a current is in the form of loops surrounding the conductor carrying it. In the case of an electron beam travelling in a vacuum, a field surrounds the beam in a similar way. If this beam passes through the field of a magnet held near, the fields interact and the resultant forces shift the beam of electrons one way or the other depending on the direction of the field of the magnet. The beam can therefore be deflected by electric attraction and repulsion, or by magnetic forces acting on it. The cathode ray tubes used in oscilloscopes usually have electric deflection by means of plates each side of the beam, whereas the tubes in television use coils to produce a magnetic field and thus deflect the beam magnetically. Magnetrons are very high frequency valves which rely on magnetic fields for their operation.

* RSGB Education Committee

The Moving Coil Meter

As an example of electromagnetic action, the meter movement is useful and straightforward. However, it is only one example from the vast number of electromagnetic devices. There are loudspeakers, transformers, some types of microphones, and indeed aerials, tuning and the very operation of radio itself. Once the fundamental laws are appreciated, all the separate devices become at once understood. As we have seen, the magnetic effects produced by a current will react with any other nearby magnetic fields, produced by the same current, another current, or by a permanent magnet. Thus for instance the giant windings around " Zeta " (the machine used for atomic research) are bound by strong shackles to prevent the conductors exploding by magnetic forces when the pulses of current, hundreds or thousands of amperes, pass through them.

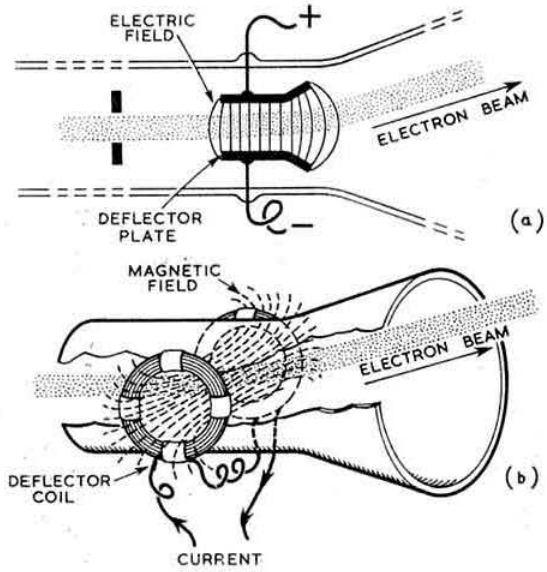


Fig. 2. (a) An electric field acts on the electron beam to deflect it towards the positive plate. (b) Again, the magnetic field is at right angles to the current flow (beam). Horizontal coils deflect the beam vertically.

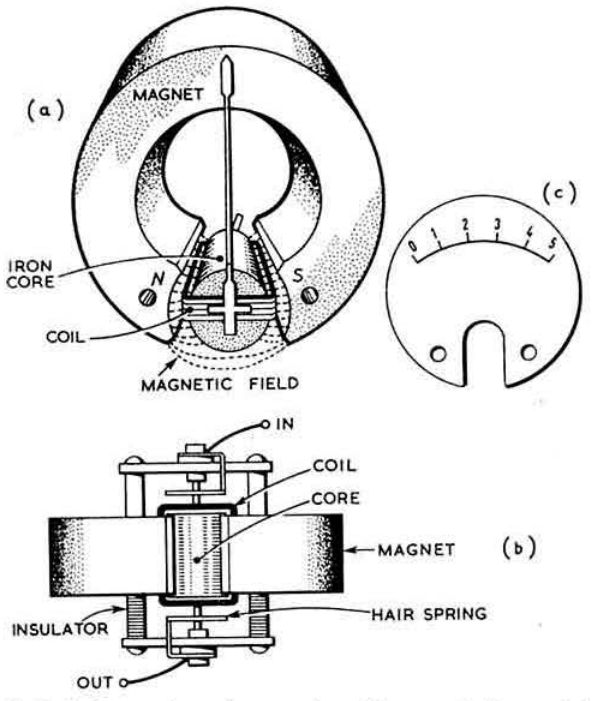


Fig. 3. (a) In a moving coil meter, the coil is suspended in a radial magnetic field, and tends to turn round when current flows. The hairsprings and pivot bearings are not shown for clarity. (b) An underneath view showing suspension and spring positions. (c) A linear scale.

When a current flows through the coil of fine wire pivoted between the poles of a magnet, as in a moving coil meter, forces act and the coil will turn round. Hair springs lead the current in and out, and also hold the coil and pointer in position. The stronger the current, the greater the turning force. The angle the coil turns against the springs is proportional to the current, so that the scale calibration is *linear*. Only d.c. will operate this type of meter, as a.c. would tend to turn the coil first one way, then the other. To measure a.c., an indirect method must be used; that is, one must first convert it to d.c. by *rectification*. We see later that the magnetic field strength produced by a coil depends on the number of turns used. Very sensitive meters, such as the one used in the test-meter design, have coils with many turns

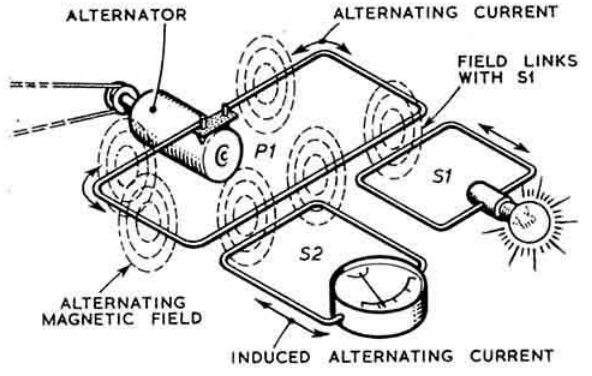


Fig. 4. In this diagrammatic transformer, P1 is the primary, and S1, S2 are the secondaries.

of very fine wire. They also have jewelled pivots. As we saw in the test-meter design, if a large current is to be measured, the majority of it must be shunted round the meter coil by using a low value parallel resistance. By using a high series resistance, a high voltage is required to drive the full scale current through the coil plus resistance, and the device now operates as a volt-meter, because I is proportional to E by Ohm's Law.

A.C. Effects

Summarising, a moving charge produces a magnetic field around it, and a moving magnetic field sets up e.m.f.'s in any nearby conductors. If the conductors form complete circuits then current will flow. This is the crux of electromagnetic theory. Notice how motion is involved in both cases; stationary charges or fields produce no effects. Imagine now a wire carrying an alternating current. Around the wire is a magnetic field varying in sympathy with the current. If other circuits are nearby, currents will be set up in them, alternating to and fro in step with the continuously changing field. This is the effect used in a.c. transformers. What is more, currents are even set up in the original conductor producing the field. The above effects are those of electromagnetic induction. The e.m.f.'s and currents set up are said to be *induced* into the circuits (the first circuit is naturally called the *primary*, the others are termed *secondaries*). When the effects involve two or more separate circuits, we talk of *mutual induction*. Similarly, the e.m.f. induced into the circuit which is producing the field in the first place, is said to result from *self-induction*. Self-induction occurs in all circuits carrying a varying current, whether there are secondaries or not. An interesting point is that the induced currents are always in a direction which opposes the change. If the current is growing, then the induced current tends to flow against it and prevent the growth. Likewise, when the current is decreasing the magnetic field is moving the other way and the induced current tends to keep the main current flowing. The property of circuits to set up self or mutual induction effects is measured in units of *inductance*, symbol L.* If the effects are prominent, then we talk of a "highly inductive" circuit. The magnitude of the e.m.f. induced into a circuit is found to be proportional to the rate of change of current. That is, e.m.f. $\propto$ rate of change of current. The idea of "rate of change" is important here. Let the symbol $\left(\frac{dI}{dt}\right)$ stand for the rate of change of $\left(\frac{dI}{dt}\right)$. Then $V \propto \left(\frac{dI}{dt}\right)$ or $V = \text{constant} \times \left(\frac{dI}{dt}\right)$. The constant of proportionality is determined by properties of the given circuit: its shape, length of conductors, and so on. In fact, it is the value of circuit inductance, L. A large V is induced by a given current change, if the circuit has a large inductance.

Therefore: $V = L\left(\frac{dI}{dt}\right)$ V – volts, L – Henries, $\left(\frac{dI}{dt}\right)$ – amperes per second.

The unit of inductance, L or M, is called the *Henry*. The equation is usually written:

$$V = -L\left(\frac{dI}{dt}\right)$$

the minus sign showing that any changes are opposed. In fact, V is often spoke of as the *back e.m.f.*

A.c. is continually changing, and therefore a continuous opposition to a.c. occurs in all circuits, extra to the ordinary resistance.

* When mutual inductance is discussed, the symbol M is used.

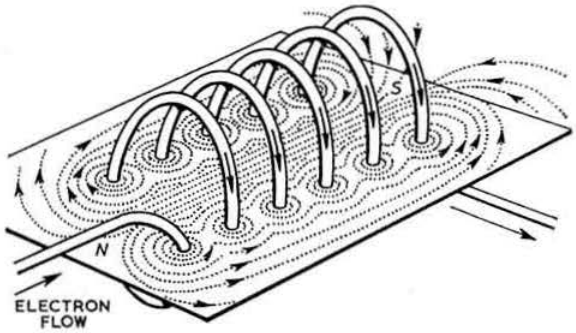


Fig. 5. Individual field loops always tend to link up, producing a magnetic field around a coil similar to that around a bar magnet, complete with N and S poles.

Artificially Increasing Inductance: Inductors

If a wire carrying current is coiled up, then the magnetic fields produced by each turn reinforce each other, and the result is a much increased magnetic effect. The effect of iron in a magnetic field is well known; it becomes magnetised and concentrates the field. If an iron core is used inside the coil, then the magnetic effect and therefore the inductance are increased even further. The number of times a specimen of iron can increase the inductance of a coil is called its *permeability*. The ultimate increase is obtained when the ferrite or iron completely fills and surrounds the coil. Examples of this are toroids, pot cores, and, of course, ordinary laminated core transformers.

Coils with or without special cores are called inductors, and together with mutual inductors (transformers) make up the third circuit component so common in radio. An examination of any radio circuit shows that resistors, condensers and inductors form the complete set up, together with the valves or transistors. Other components are simple specialised devices such as switches, relays, lamps, and so on, which are usually easy to understand. Even quartz crystals are considered as equivalent condenser-inductor-resistor combinations. So an idea of the action of the three types, especially with a.c., as well as being satisfying for its own sake explains all circuits which are likely to be encountered.

The inductance of coils is found to increase with the number of turns, the diameter of the winding, with layer winding and of course the presence of iron in the core.

Construction of Inductors

Coils are more often home-made than condensers. Coils, including commercial ones, are usually less efficient than condensers because of the inevitable resistance in the long lengths of wire used to wind them. This means that the losses in a circuit nearly always result from unwanted resistance in the inductors, so that their design for minimum loss is important. Losses in Ls or Cs is measured by a quantity known as the *power factor*.

The wire is wound on an insulating tube called the former. Most modern formers for small inductors carry a thread on the inside so that special iron cores can be screwed into them. Sometimes the core is attached to a brass screw. To adjust the cores, special " trimming tools " are used, made of plastic material to keep metal (especially steel screwdriver blades) out of the magnetic and electric fields around the components. Coils vary in size from one or two turns of thick silver-plated wire, spaced and self-supporting to many thousands of turns of fine insulated wire on a former. The inductance can be varied by tapping off at different turns, or by positioning an iron core as mentioned above. The need for different values of inductance is closely associated with tuning or electrical resistance, which is discussed later.

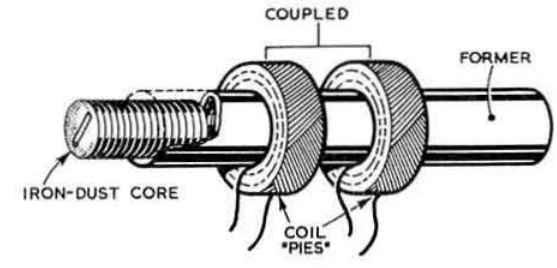


Fig. 6. The type of modern miniature machine-made coil often used for i.f. transformers.

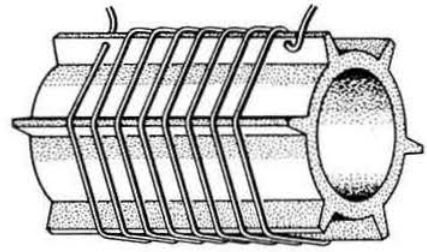


Fig. 7. Spaced turns reduce the capacity between different parts of the coil. The " ribbed " former keeps the material in contact with the wire to a minimum.

The coils of many turns are usually wound by special machines so that a pattern of winding appears in a similar way to that on some cotton bobbins. This method is called " wave-winding " and each section is called a " pie." By winding the coil like this, its self-capacity is reduced. The self-capacity is also reduced in a single layer coil by spacing the turns.

When two or more coils are wound so that the fields link up, then a transformer or mutual inductance is formed, as we have seen. The coils are said to be coupled. Close

... the drill often going through the former and the winding as well.

coupling is when the fields strongly link, and loose coupling is the term used to describe a weak interaction. Many types of transformer are used for the various jobs in a circuit, and we speak of r.f., i.f., intervalve, driver, modulation, output and power transformers, and so on, but they all work by magnetic linking of primary and secondary windings carrying a.c., which may be power from the mains, or signals. There is one special device called an auto-transformer, which appears to have only one winding, but this is tapped and in effect one section is used as the primary, and this section, together with the rest, is used as the secondary. This means that the circuits are electrically connected together.

Another very useful transformer, usually working on the auto-transformer principle, bears the commercial name " Variac," and has a variable tap enabling the supply voltage to equipment working from it to be set between zero and about 270 volts. Unfortunately these transformers are somewhat expensive.

If *solid* iron is placed into a coil carrying a.c., then currents will be induced into it because it is itself a conductor in a varying magnetic field. These are called *eddy currents* and make the core very hot. Power is being lost and this is usually undesirable. Eddy currents are put to good use, however, in such applications as heating up the parts inside a valve after the vacuum has been pumped, to " outgas " the metal, and also in purifying semi-conductor materials by the " zone-refining " technique. To reduce greatly the eddy currents in the cores of inductors and transformers for low frequencies, the iron is usually split up into thin sheets (called laminations) insulated from one another. For higher frequencies, a very fine iron dust is pressed into shape after being mixed with an insulating cement. These iron dust cores are fragile, and the slot in them easily breaks with rough usage. If a steel screwdriver is used for adjustments, the core often jams in the former, and the only hope is to drill it out, the drill often going through the former and the winding as well! Other common core materials are the ferrites or ferroxcube.

Further Effects of A.C. and Inductance

A sine wave variation of current has the greatest rate of change when the value is passing through zero. No change occurs for an instant at the peak values, because this is the point at which the current stops rising and begins to fall again. The e.m.f. across a coil is proportional to the rate of change of current, and is therefore at a maximum when the current is growing from zero. The voltage falls and reaches zero as the current rises and reaches its peak value where it is not changing. It reverses when the current starts to decrease because the magnetic field is now moving the other way. The voltage is seen to be 90° out of phase with the current, but this time it is the voltage which leads the current. If the frequency increases, then the rate of change goes up and the opposing e.m.f.'s become greater. The result is that less current flows. In other words, the opposition to a.c. offered by a coil *increases* with the frequency. For d.c. there is no change going on and no opposition is offered, apart from the resistance of the wire. When deliberate use is made of this increasing opposition the component is usually called a " choke."

We can write that the inductive reactance, $X_L \propto fL$ or $X_L = kfL$ where $k = 2\pi$, by a similar argument to the condenser case.

Therefore $X_L = 2\pi fL$

where X_L = reactance in ohms,

f = frequency in cycles per second,

and L = inductance in Henries.

Notice that the inductance is opposite in all respects to capacitance. It is likely, in circuits containing both types of component at the same time, that really interesting action takes place. . . .

Things to do

A convincing demonstration of electromagnetic induction is to connect a single dry cell across the winding of a loudspeaker transformer; a small mains transformer will also serve. By holding the ends of the wire and breaking the circuit a distinct shock is felt, although the cell is producing an e.m.f. of only 1·5 volts. When the circuit is broken, the collapsing magnetic field produces a pulse of many times this value and a " kick " is felt. If you don't fancy a shock, then the spark at the point of make and break can easily be seen as a result of the induced effect.

Roget's Jumping Spiral

A very pretty illustration of the interaction of the magnetic field produced by each turn of a coil can be set up simply by winding a helix of wire about an inch in diameter with sixty to eighty turns and suspending it by one end to hang straight down. The bottom end just touches a piece of metal and the circuit is completed through the metal piece, then to the spiral, back to the battery, and to the metal piece again. A fairly strong current is required, so an accumulator or battery charger unit is preferable to a dry battery. With the current flowing, the spiral will jump up every time the end touches the metal contact. Mercury contained in a small cup makes a much superior bottom contact, but it is not essential. This shows clearly the attraction each turn has for the next one when current is flowing. Another simple experiment to illustrate electro-magnetic induction is to connect a coil of about 20 turns of wire, 2 to 3 inches in diameter, to the aerial and earth terminals of a broadcast receiver. If a similar coil is connected to the aerial and earth leads, then by adjusting the distance and orientations of the coils relative to each other with a station tuned in, a convincing demonstration of the variation of coupling is obtained. The old " swinging coil " reaction relied on the variations of the positions of tuning and reaction coils.

Coils

A very good modern coil former is the plastic moulded type with a square flange at one end and designed to fit into a square aluminium screening can. The former is threaded inside to take standard iron dust cores, and it has a diameter of 0.3in.

There are many occasions when coils covering the amateur frequencies are useful, and the table given below gives an indication of the number of turns required on these formers to resonate (i.e., tune in to) the various bands. The tuning capacity has a maximum value of 50 pF, and to give the values of inductance quoted the cores are supposed to be partly inside the winding. In fact, once the coil is in circuit, the core is positioned to bring the l.f. band for the range in question just on to the tuning swing of the 50 pF variable condenser.

Range (Mc/s)		L (μH)	Turns	S.W.G.
L.F.	H.F.			
3·5	7·0	30	100	38
7·0	14·0	6·5	40	32
14·0	28·0	2	20	26

References

[1] J. H. Reyner, *Cathode Ray Oscillographs.* Pitman.

[2] F. J. Camm, *Wireless Coils, Chokes and Transformers.* Newnes.

A Fully Transistorized Converter for 432 Mc/s

By J. R. GAZELEY, BRS20533*

SINCE the transistorized converter for 430 Mc/s was described by the writer in the December 1962 BULLETIN, a number of experiments have been conducted with a view to improving the small signal performance of that unit, particularly in respect of the signal to noise ratio. The initial approach consisted of various pre-amplifier designs employing u.h.f. transistors currently available through normal retail channels, and whose price tag compared favourably with valves of a similar performance.

The design and construction of a pre-amplifier which could realize the full capability of the u.h.f. transistor proved to be far more difficult than had been imagined, and in many of the initial pre-amplifier units, regeneration had a hay-day. Indeed it was often found that the leads of the transistors themselves were the root cause of self-oscillation.

Probably the biggest single surprise was that a " lumped circuit "—a coil and capacitor combination—was far easier to tame than the accepted tuned line, and moreover, allowed the theoretical gain and noise figures to be achieved. While such lumped circuits are generally considered to be bad practice due to their low Q and poor frequency discrimination at frequencies in excess of 400 Mc/s, there is no doubt of their adequacy in the design to be detailed. Furthermore, they bring about a welcomed—even if accidental—simplification in construction.

The pre-amplifier section of this converter employs a GM0290 transistor. If a slightly inferior performance can be accepted, then the somewhat cheaper GM0378 can be substituted. With the GM0290, the pre-amplifier has a noise figure of the order of 5db, and a gain of some 14db with a bandwidth of at least 2 Mc/s.

While the initial purpose was to produce a pre-amplifier for the original converter, the end product turned out to be a full blown, and greatly improved, design for the whole unit, largely because the writer could not resist the temptation to seek to improve the performance of the original converter design.

The Circuit

The circuit of the pre-amplifier is shown in Fig. 1; an arrangement which is substantially duplicated for the input stage TR1 of the actual converter. Fig. 1 is an optional masthead pre-amplifier which, although a separate unit, is constructed in a similar manner to the layout shown for TR1 in Fig. 5. Power for this head-amplifier, if used, is taken via the co-axial line from the main converter and requires the provision of the components shown and noted near TR1 in Fig. 2.

Since change-over switching between RECEIVE and TRANSMIT is fairly individualistic, this is not shown. However, v.h.f. transistors are particularly sensitive to stray r.f. and every care must be taken to guard against power from the transmitter leaking across any relay system, for if it does, it will surely ruin the pre-amplifier transistor. These remarks also apply to the converter when this is used barefoot.

The circuit of the converter is shown in Fig. 2, the upper section being the r.f., mixer and i.f. amplifier stages, and the lower section the crystal controlled oscillator-multiplier chain, the output of which is fed to the mixer, TR2.

Transistor TR1 is operated as a grounded base r.f. amplifier, no input tuning being employed.† The behaviour of this stage is broadly similar to that of a grounded grid thermionic valve amplifier. The collector of TR1 is tuned to 432 Mc/s by L1/C3. It should be noted that collector is tapped down L1, and this serves to damp the transistor without the need to employ resistors for stabilization purposes, the Q being low enough to remove the need for further damping. Despite the low Q it will be found that C3 tunes quite sharply, but not to such an extent that it requires continual adjustment over the normally used frequency range on the 430 Mc/s band.

At 430 Mc/s, the coils are quite diminutive, and link coupling between r.f. and mixer stages is hardly practicable. Certainly, in a design which is to be to any degree repeatable, the critical nature of such an arrangement would be undesirable. Thus capacity coupling is employed between TR1 and TR2.

Initial examination of the circuit diagram could lead to the conclusion that despite the foregoing statement, link coupling is in fact employed since it would appear that L2 is a link winding to L1. This is not so, for L2 is in reality an r.f. choke which is placed in the field of L1 to increase the coupling co-efficient without introducing a high impedance at the i.f. frequencies between the base and emitter of TR2. The inclusion of such an impedance at the i.f. frequency is a common cause of low mixer sensitivity.

Oscillator injection at 408 Mc/s is applied to the emitter of TR2. The condenser C7, together with the inductance of the coupling loop L14 and the one inch connecting lead form a series resonant circuit at 408 Mc/s so making for efficient transfer from the oscillator chain to the mixer.

L3 and the output capacity of TR2 form a resonant circuit at the i.f. frequency of 24 Mc/s. Precise adjustment of the frequency of this circuit is effected by the core of L3. In order to damp L3 in the interests of bandwidth and stability, the coupling coil, L4, is made larger than usual, a method which has been found to be more effective than loading L3 with a resistor.

The output from the converter could in fact be taken directly from the link winding L4 since the level would be adequate for most receivers. However, employing a " built-in " i.f. amplifier has certain advantages. It allows L3 and L5 to be tuned in such a manner that a more level response is achieved over the bandwidth of prime interest, and by increasing the general level of the i.f. output, helps to reduce i.f. breakthrough on badly screened receivers by permitting them to be operated at a lower level of r.f. gain.

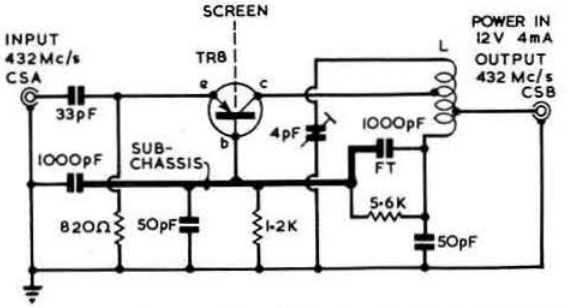


Fig. 1. A masthead pre-amplifier which was evolved during the design of the 432 Mc/s converter.

*192 Haselbury Road, Edmonton, London, N.9.

† RSGB BULLETIN, January 1963, page 330.

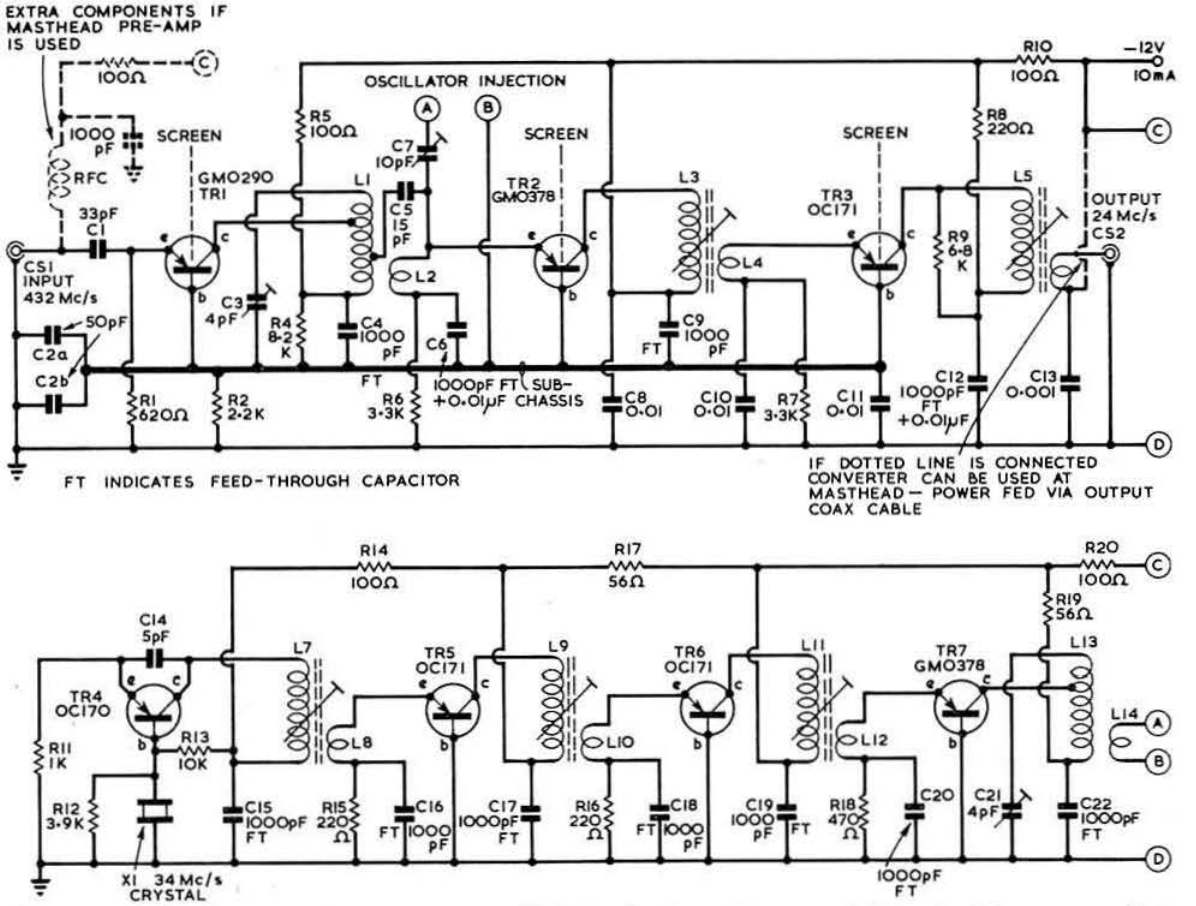


Fig. 2. The r.f., mixer and i.f. stages, unit 1 (above), and the overtone oscillator and multiplier stages, unit 2.

The i.f. amplifier, TR3, requires no particular description since it follows standard practice, although it may be worth noting that in the case of L5, recourse is made to resistor damping to assist in achieving the desired bandwidth.

Turning now to the oscillator-multiplier chain, TR4 operates in an overtone circuit using a miniature HC6/U crystal at 34 Mc/s. This circuit is perfectly satisfactory for overtone crystals of the type mentioned, but difficulty may well be experienced if FT243 crystals are substituted. If it is desired to use FT243 crystals then a more usual circuit should be employed.‡

In the overtone circuit shown, L7 and the output capacity of TR4 tune to 34 Mc/s. L7 is link coupled to TR5 by L8, the output of TR5 being tuned to 68 Mc/s, bias being obtained by base emitter rectification of the drive from L8. Supplementary bias is derived from R15 which has been chosen to encourage TR5 to give maximum output. To some extent, the value of R15 is a compromise between efficiency, output, and the danger of thermal runaway. Increasing its value will increase the efficiency of the stage, but at the expense of peak attainable output. Reducing it below the value given, while increasing the output, holds the danger of thermal runaway under high ambient temperatures.

The output of TR5 is coupled to TR6 by L10, TR6 acting as a doubler from 68 Mc/s to 136 Mc/s. This circuit is identical with that of the previous stage, the output coil, L11, being resonated by the output capacity of the transistor.

Finally, TR7 operates as a frequency tripler from 136 Mc/s to 408 Mc/s. L13 and C21 tune to the desired fre-

‡ RSGB Bulletin, January 1963, page 331.

COMPONENT DETAILS

C3, C22, 4 pF Wingrove and Rogers airspaced trimmers.
C7, 10 pF Wingrove and Rogers airspaced trimmer.
C6, C8, C10, C11, C12, Mullard miniature paper capacitors, 30V working.
CS1, CS2, Belling Lee L734/S flush mounting co-axial sockets.
Other capacitors are miniature ceramic, except for C13 which is a Radiospares 0·001 μF stand off type, and 9 1000 pF Radiospares feed-through capacitors.
Eddystone 650 die-cast box.
All resistors are Radiospares miniature ½ watt.
GM0290 (1 off) and GM0378 (2 off) transistors are manufactured by: Texas Instruments Ltd., Manton Lane, Bedford.
Xtal, Miniature 3rd overtone type HC6/U, ½ in. spacing, with holder. (Henrys Radio Ltd., Edgware Road, London W.2.)

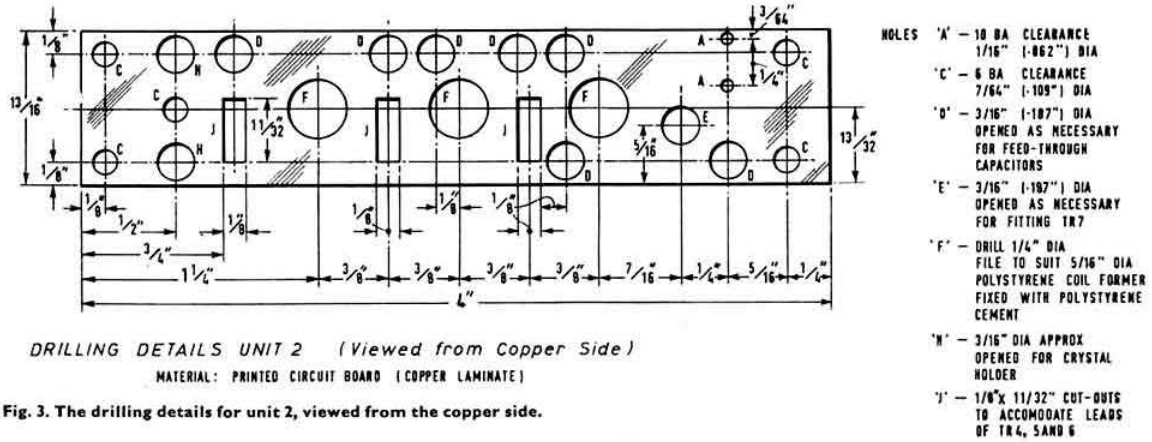


Fig. 3. The drilling details for unit 2, viewed from the copper side.

quency, the collector of TR7 being tapped down L13 in order to achieve the highest possible *Q*. The output link L14, which has been mentioned previously when dealing with the mixer TR2, is positioned in the centre of L13.

Construction

The converter takes the form of two units, one being the r.f. section, and the other the oscillator-multiplier chain, both of which are housed in an Eddystone die-cast box type 650 which provides complete screening.

The working diagrams Figs. 3-5 show in far greater detail than the most lucid description, the component parts, construction and assembly of the converter. Suffice it to say that Fig. 3 is the drilling of the copper laminate board used for the oscillator-multiplier chain, while Fig. 4 gives not only the drilling details of the copper laminate board for the r.f. section, but also the details of the screens. Fig. 5 shows how the two sub-assemblies are fitted into the die-cast box.

One detail which is not illustrated but does require mention is the mounting of the sub-assemblies on the lid of the die-cast box. Each sub-assembly is mounted on four brass pillars so that it stands away from the lid. The pillars which support the r.f. board are $\frac{3}{4}$ in. long, drilled and tapped 6BA at each end, while those which support the oscillator-multiplier board are $\frac{3}{8}$ in. long and also tapped 6BA at each end.

COIL TABLE

L1 2 turns, $\frac{1}{4}$ in. diam $\frac{1}{2}$ in. long, 18 s.w.g. tinned copper wire, with leads $\frac{1}{2}$ in. long. The collector of TR1 is connected to main body of coil at C3 end. C5 is connected to main body of coil at C4 end. Self supporting.
L2 1 turn, $\frac{1}{4}$ in. diam., 22 s.w.g. tinned copper wire, spaced $\frac{1}{4}$ in. from and connected " in phase " with L1. Self supporting.
L3 $\frac{1}{8}$ in. diam., $\frac{1}{2}$ in. long, 36 s.w.g. enamel close wound. Dust iron slug tuned.
L4 4 turns, 7/42 p.v.c. insulated (Radiospares) wound over L3.
L5 $\frac{1}{8}$ in. diam., $\frac{1}{2}$ in. long, 36 s.w.g. enamel, close wound. Dust iron slug tuned.
L6 2 turns 7/42 p.v.c. insulated (Radiospares) wound over L5.
L7 $\frac{1}{8}$ in. diam., $\frac{1}{4}$ in. long, 26 s.w.g. enamel, close wound. Dust iron slug tuned.
L8 3 turns 7/42 p.v.c. insulated (Radiospares) wound over L7.
L9 $\frac{1}{8}$ in. diam., $\frac{1}{2}$ in. long, 26 s.w.g. enamel, close wound. Tuned with Salford 200 Mc/s dust core, coded blue.
L10 $1\frac{1}{2}$ turns, 7/42 p.v.c. insulated, wound over L9.
L11 8 turns, $\frac{1}{8}$ in. diam., 22 s.w.g. tinned copper, spaced by wire diameter. Dust iron slug tuned, as L9.
L12 1 turn, 7/42 p.v.c. insulated wire, wound over L11.
L13 2 turns, $\frac{1}{4}$ in. diam., $\frac{1}{4}$ in. long, 22 s.w.g. tinned copper, with $\frac{1}{2}$ in. leads at C21 end (TR7 collector is tapped into the main body of coil), and $\frac{3}{4}$ in. long at C22 end. Self supporting.
L14 1 turn, $\frac{1}{4}$ in. diam., 22 s.w.g. tinned copper, with $\frac{3}{4}$ in. and $\frac{1}{4}$ in. leads interwound with L13 ($\frac{1}{4}$ in. spacing from coil L13).

Adjustment

Transistors do not permit errors to be made twice, and so before applying power to the converter, a most careful visual inspection should be made to ensure that no disasterous mis-connections have been built into the unit. Above all, make sure that the battery polarity is correct.

The oscillator-multiplier chain should be adjusted first. While monitoring the frequency of 34 Mc/s, either on a receiver, or by means of a sensitive wavemeter, adjust the core of L7 to the point where there is no appreciable change in frequency even though the core is adjusted slightly above and below this setting. By switching the power on and off, check that the oscillator remains on frequency. If it does not, then the oscillation is not controlled by the crystal, and further adjustment to the core of L7 is needed.

If the crystal fails to oscillate at all, either try another OC170, adjust the bias to this stage, or ease off the coupling winding L8 until the circuit is operating in a satisfactory manner.

Once the crystal oscillator is functioning, connect a voltmeter across R15, and adjust the coupling of L8 to L7 for maximum drive to TR5 consistent with reliable operation of the crystal oscillator. Not less than 0·2V should be secured.

As a final check on the crystal oscillator, and with the meter connected across R15, remove the crystal. No voltage should now be present across R15. If by chance there is, then the crystal oscillator stage is self-oscillating.

Connect the voltmeter across R16, and adjust the slug in L9 for maximum reading. Check that L9 is tuned to 68 Mc/s by means of a wavemeter.

Connect the voltmeter across R18, adjust the slug of L11 for maximum indication on the meter and check that the frequency at L11 is 136 Mc/s.

As the tuning range of the combination C21/L13 in the collector circuit of TR7 is limited, a wavemeter is not absolutely essential to check the frequency of this circuit. However, a wavemeter will, of course, serve to verify the frequency. To adjust L13, temporarily disconnect C7, and from point A on the output link of L14 connect a crystal diode and sensitive microammeter in series to earth, bypassing the meter with a small capacitor. Adjust C21 for maximum indication on the microammeter.

Alternatively, a voltmeter may be connected across R6, and with C7 set to half capacity, C21 should be adjusted for a rise in the standing reading. This rise will be quite small, but quite perceptible on the 10 V range of an Avo 7. Finally, C7 is adjusted to the position which causes a further rise in the standing voltage.

As a final check that all is well with the oscillator-multiplier

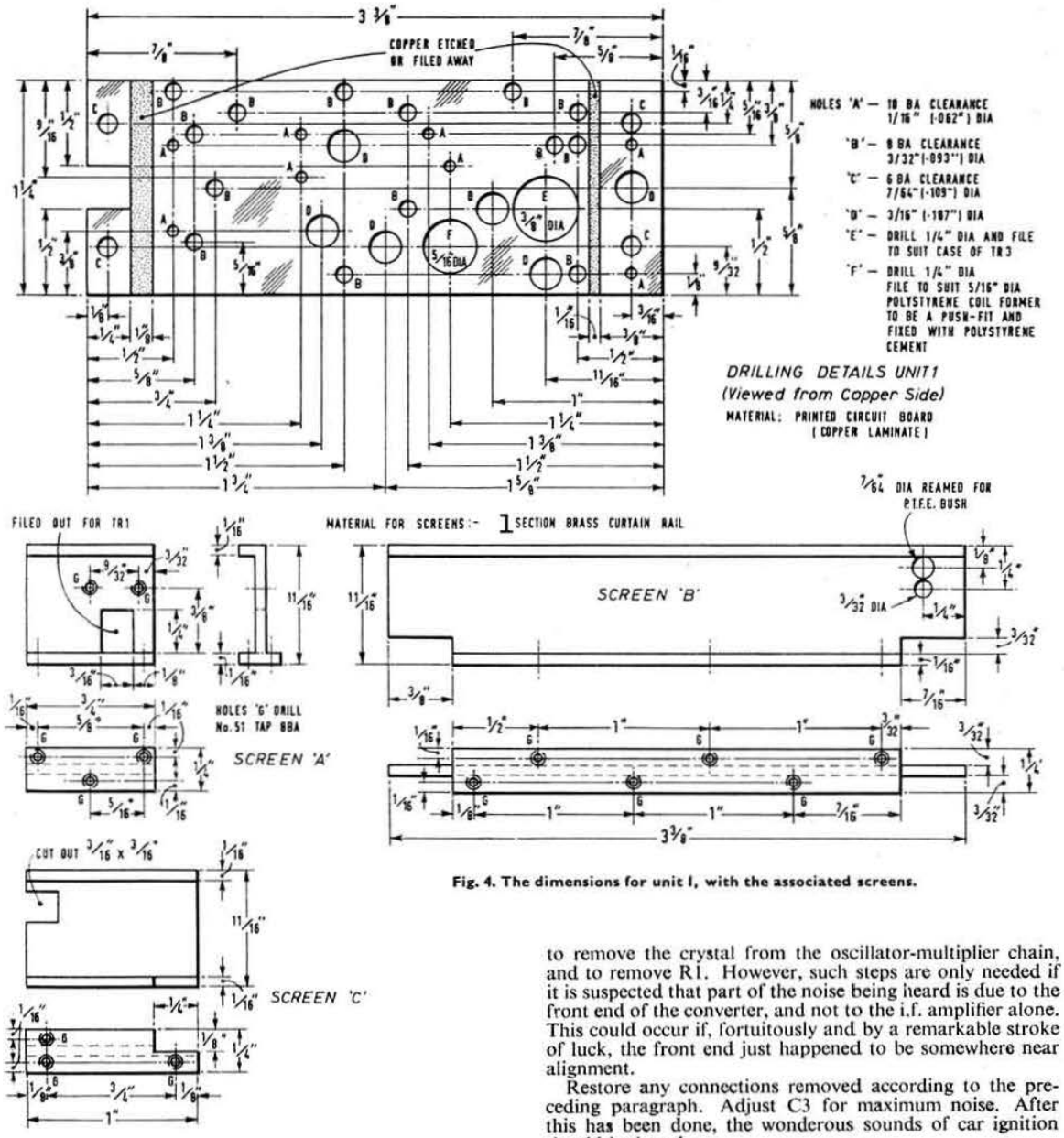


Fig. 4. The dimensions for unit I, with the associated screens.

chain, remove the crystal. All drive to the mixer TR2 should cease.

The converter may now be connected to the main receiver via a length of co-axial cable. Swing the receiver tuning between 24 Mc/s and 26 Mc/s and adjust the cores of L3 and L5 to give an even noise response over this frequency range. Attention to the values of R7 and R9 and/or the direction of the windings of L5 and L6 should overcome any regeneration causing peaks in the noise response.

In respect of the foregoing adjustment, it may be necessary to remove the crystal from the oscillator-multiplier chain, and to remove R1. However, such steps are only needed if it is suspected that part of the noise being heard is due to the front end of the converter, and not to the i.f. amplifier alone. This could occur if, fortuitously and by a remarkable stroke of luck, the front end just happened to be somewhere near alignment.

Restore any connections removed according to the preceding paragraph. Adjust C3 for maximum noise. After this has been done, the wonderous sounds of car ignition should be heard.

For the next adjustments either a local signal on the 430 Mc/s band is required, or a signal created by a g.d.o. or a signal generator. If either of the last two mentioned sources is being utilized, it is necessary to employ a harmonic, be quite sure that the correct harmonic is identified. In addition, be even more certain that you are not picking up the image frequency which in this case would be 408 Mc/s less 24 Mc/s which is 384 Mc/s.

Adjust C3, C7 and C21, and in that order, for maximum output. Final adjustments are made on weak signals in the usual manner.

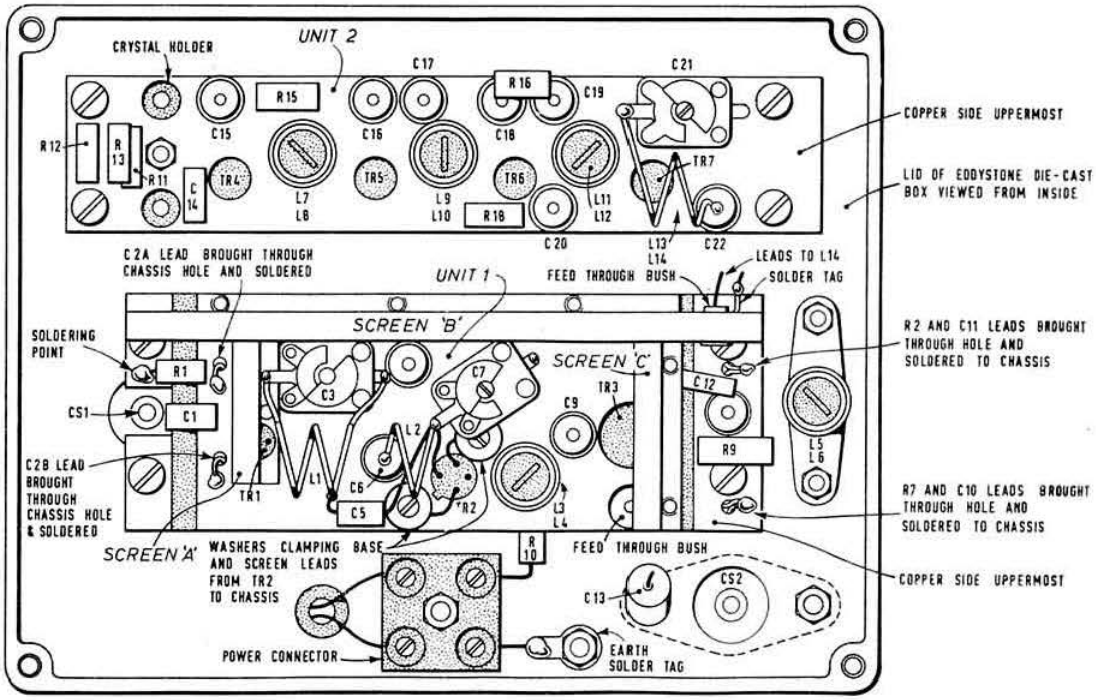


Fig. 5. Layout of the principal components in the diecast box.

Conclusion

This converter has far more gain and a substantially improved noise figure than that previously described, and its performance in respect of weak signals is rather better than a valve-operated type using an A2521.

When it was used barefoot, that is, without the masthead pre-amplifier, by G3FD/P during the 1964 420 Mc/s Open Contest from a site on Dunstable Downs, it enabled 26 stations to be worked, and GW and Continental stations to be heard.

To say that this converter has no shortcomings would not be strictly correct, but they are of such a nature as to be excused in the light of the overall performance. There is a tendency to cross modulation from very powerful stations, and also, under conditions of very high local field strength, stations in the 90 Mc/s f.m. band can beat with the 68 Mc/s multiplier stage to produce the i.f. of 24 Mc/s. Both of these faults could be cleared, the first by arranging a gain control on the r.f. amplifier, and the second by the use of a suitable trap in the input circuit. However, since the conditions which cause these effects to occur are rarities, their inclusion was not felt to be warranted.

In conclusion, the writer would particularly like to thank G3FD for his valuable assistance in field testing this device.

Single Sideband **(Continued from page 447)**

an old a.c./d.c. broadcast receiver mains dropper resistor is suitable for winding the pi r.f. choke and the winding of 112 turns of 26 s.w.g. enamelled wire may be single layer wound in any way provided that the total winding is spaced out to $3\frac{3}{8}$ in. This spacing reduces the self capacity to a value that does not produce any self resonance at the amateur bands operating frequencies.

Operation

The amplifier should be tuned for maximum r.f. output and then the loading adjusted by C2 to give the screen currents given in the table above, single tone input 40 mA, two-tone input 24 mA. Maximum r.f. output occurs at maximum screen current and not necessarily at minimum dip. (This is due to the relatively large anode to grid capacity of four valves in parallel—the effect is more pronounced at higher frequencies.)

Mobile Column

By E. ARNOLD MATTHEWS, G3FZW*

THE sixth **Thanet Mobile Rally** drew an attendance of 200 people, who arrived in 60 cars—and one helicopter! G3TKC was winched down from this vehicle to the cliff top site at Pegwell Bay in the brilliant sunshine which helped to make the rally a great success. Of those who arrived by more mundane means, 28 contacted the talk-in stations which operated on 2, 4 and 160m, the prize for the longest range contact going to G3JEQ/M on 160m. Other prizes were awarded as follows: best equipment, G3AYH/M, whose equipment is completely transistorized; attending from furthest away, GW3GIN/M; valve identification and tuned circuit tests, G6SXX/T; battery voltage contest, G3FS. Among other attractions was a display of communications equipment by F. Signals.

The **Saltash & District ARS's** first rally at Calstock deserved to be a success if only for the efficient publicity with which it was advertised. But this did not do justice to the programme, which contained more novel features than we have seen for some time. A SARDAC Cake competition was won by G3DSV, and a novel " Hunt the Hidden Ham "

The Saltash and District Amateur Radio Club's rally talk-in station GB3SAL being operated by G2DFH.
(Photo by D. Bowers, BRS26760)

contest by s.w.l. D. Jacobs. Possibly the most exciting, and certainly the most amusing item was the " Mobile's Race " for Topbanders, in which competitors had to make a dash for a line of QSL cards placed face down, find their own and return to their car and transmit their call-sign. The first call-sign to be identified by the talk-in station was the winner. This proved to be G3NXV, who was by no means first back to his car, but whose s.s.b. signal was nicely resolved in the a.m. receiver by the welter of carriers in the background! (There seems to be a moral here.)

A talk-in station GB3SAL operated on 160, 80, 4 and 2m. Prizes for the furthest contacts on each band were won by G3OIP, G3NKE (using 0·8 watt input), G3SRL and G3IGV respectively. G8AFA came from Yeovil to win the prize for the furthest distance travelled. G3JFH was awarded the prize for the best mobile installation, this contest being judged by the presidents of the Saltash, Cornish, and Plymouth societies (G3SN, G3NKE and G5ZT).

Conditions were poor for DX-TV until about 4 p.m., when several countries were received, including a good test card from OK.

* 1 Shortbutts Lane, Lichfield, Staffs.

A view of the cliff-top car park at Pegwell Bay taken during the Thanet Mobile Rally.
(Photo by R. A. Bostow)

There were also the usual displays by various equipment manufacturers, Police, CD, etc.

Publicity for the event, which was very well attended for a rally in a somewhat remote part of the country, extended until the next day, when the event featured in the BBC South-Western News.

Many mobileers going on holiday in Cornwall have been disappointed by the lack of 160m activity, local activity in the county being mainly on 80 and 4m. We would like to acknowledge the very kindly action of G2BSA (Looe) in equipping himself with a 160m transmitter for the specific purpose of giving visiting mobiles an opportunity for QSOs.

Wethersfield Mobile Rally

One of the most successful Mobile Rallies of the year was held on Whit Sunday, June 6, at RAF Wethersfield, Nr. Braintree, Essex. The hosts to the RSGB were as always the 20th Tactical Fighter Wing United States Air Force.

Col. W. Cragg, the Base Vice Commander who was introduced by E. W. Yeomanson, G3IIR, RSGB President, kindly consented to open the rally at 12.30 p.m. The Colonel must have been impressed, for he returned twice that afternoon to see how things were going (or perhaps just to see if the base was still in one piece).

The Radio Society was successful in securing for licensed American personnel on the base and any other visiting foreign amateurs the use of the amateur frequencies for the MARS transmitters. Needless to say those who were able, made full use of this facility.

The Wethersfield Rally always has the Mobile Committee fooled with regard to attendance, for the place is so big that one is inclined to feel that not too many have made the journey.

All the attractions were very well supported, and a new crowd event this year, the American base-ball match, was very well received by all the visitors. An extremely able display of model aircraft control line flying was enjoyed by the many who saw it. Fire fighting, static displays of aircraft, including tactical bombers, jet trainers, transport and communication types pleased all the small boys and all of the bigger ones too.

The strictly amateur trade exhibition was very well supported indeed and the Society is always pleased to see those stalwart members of the trade who give up free time to support these functions.

Three raffles were going on in the hangar; one for a DX 40 attracted a great deal of interest as did the main raffle and ladies raffle with its very varied assortment of prizes.

The Radio Society is most grateful to all those who lent a hand in this very successful event, particularly to the USA organizing Committee headed by Lt. R. D. Largent, to G3MVV who ran the 4m talk in station, to G3DGN for his

most interesting phone modulated gas laser demonstration, to the Civil Defence, Essex, who put on an interesting static display and to General John W. Baer, for having us all there on that most successful Whit Sunday.

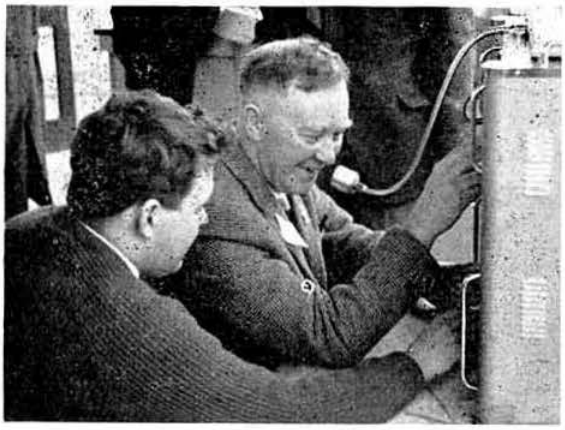
Northern Ireland Mobile Rally

The first mobile rally to be held in Ireland took place on Sunday May 30 at Nutts Corner Airport, under the auspices of the Belfast and District RSGB Group. Nutts Corner was originally the Belfast Airport, and as a result the old terminal buildings and control tower, which are still standing, were used once again.

The talk-in station on 4m established in the control tower started operation at 10.00 using a ground plane aerial at a height of approximately 80 ft. The location turned out to be excellent for 4m operation and 95 QSO's were made using the call GB3NI. Of these, 50 stations were mobiles which attended the rally both from GI and EI.

The event was well attended and out of approximately 250 people present, 100 were licensed amateurs representing G, GL, EI, VS9, VE and DJ. The prize for the longest distance travelled by road went to EI6AS.

The rally was officially declared open by Council Member



The 70 Mc/s talk-in station at the Northern Ireland Mobile Rally being operated by Frank Robb, GI6TK.
(Photo by GI3KYP)

and Chairman of the Mobile Committee, Mr Fred Parker, G3FUR, who commented on the large number of 4m mobiles which dominated the scene, and the almost complete absence of unwieldy whips and loading coils which are so conspicuous at rallies in England. The highlight of the afternoon for everyone was undoubtedly an excellent flying display by members of the Ulster Model Aircraft Club who demonstrated radio controlled model flying at its best, in somewhat windy conditions. A fine static display by 66 Signal Regiment, TA, under Capt. W. Douglas, GI3IWD and a reconnaissance by the Civil Defence under Mr J. Thompson, GI3ILV, were two other items of interest.

The driving test attracted a large number of entries and was won by Bob Semple, GI3OYG, with ozy Osborne, GI3SLI, runner up. A competition for the best all round mobile which was judged on signal strength, modulation depth, quality, safety of installation, and general neatness, was won by T. Ford, GI3TOH, RAF Ballykelly, who received the GI3KYP Perpetual Cup.

The programme ended with the distribution of prizes at 18.00 after a rather cold but enjoyable day.

Despite a cold, overcast and blustery day, the **RNARS Mobile Rally** held at HM Signal School (HMS *Mercury*) on May 30 has been voted a great success. Visitors came from far and wide; from Torquay in the west and Edinburgh in the north. Overseas visitors included two from South Africa and two from Belgium. Out of 208 cars parked on the sports ground, 74 were fitted for mobile operation, and attendance records show that 1,165 people attended the rally. The visitors were entertained to displays given by the Hampshire Constabulary dog handling unit and the local Red Cross, while later in the afternoon a display of radio controlled model boats operating on the establishment swimming pool enthralled young and old alike.

The mobile treasure hunt, over a 16 mile course, proved a popular feature of the rally, with the local Civil Defence providing communications between the rally ground and the five check points. The overall winner of this event was s.w.l. Everitt.

Musical entertainment during the afternoon was provided by the band of TS *Mercury*.

G6NZ and G2DZT had a tough job judging the mobile installations, and both remarked on the very high standard of those present. G3GMN and G3ISZ were the winners of this competition. Mrs Morgan, wife of the Commanding Officer, presented a prize for the longest distance travelled to the rally to GM3HUN from Edinburgh (an RNARS member), and for the longest distance contact with GB3RN to G3IIO/M.

Thanks are due to the Portsmouth and Fareham Amateur Radio Clubs, without whose assistance the rally could not have been staged.

The Peterborough & District Amateur Radio Society will feature a mobile treasure hunt—with clues over the air—at their first Mobile Rally to be held at Peterborough on August Bank Holiday. It is stressed that local knowledge will not be required for anyone competing in the treasure hunt, for an Ordnance Survey map will contain all the necessary information. Talk-in stations will be on 4 and 2m as well as 160m. Further details may be obtained from G3KPO.

Special Events Stations

The Malvern College Radio Society will be celebrating the school's centenary by putting an exhibition station in operation during the period July 22 to 25. All bands from 160m to 70cm will be used and the station will sign **GB3MC.** All reception reports should be sent to the QSL Manager, Malvern College Radio Society, c/o G. P. Shirville, G8ADM, 2 The College, Worcs.

Members of the Yeovil Amateur Radio Club will be operating a special station with the call-sign **GB2YC** from July 5 to 10. This will form part of the Yeovil Youth Centre exhibit at a Leisure-time Exhibition which is being staged to introduce young people to the various activities in the district. Operation will be on 10-160m, from 09.00 to 21.00 GMT. Further information may be obtained from D. L. McLean, G3NOF, 9 Cedar Grove, Yeovil, Somerset.

On Saturday, July 17, **G3MBL/A** and **G3MWF/A** will be operating stations at the Finchley Carnival, Victoria Park, London, N.3. Top Band and 2m will be used most of the time, but equipment will be available for operation on the other h.f. bands from 80 to 10m.

With the help of the Hull and District Amateur Radio Society, the D.C.L. Sports and Social Club plans to operate from Hedon, near Hull, from July 4 to 11, as an exhibition station in connection with the Distillers Co. Annual Gala Day. Operation will be on 160 to 2m on a.m., c.w. and s.s.b. under the call-sign GB3DCL. QSLs will be issued to confirm all contacts.

Uncle's Southend Do

The annual " Do " at Southend, organized by G6NU, will be held this year on Sunday, July 18. Amateurs, their families and friends are welcome to take part, and should assemble at the entrance to the pier at 12 noon.

QUA Associates

conducted by "JIX"

BONK, bonk . . . bonk! The last of the pegs for the old fourteen-foot tent is driven in.

" Hey, Dave, give us a hand with the receiver and 'phones, I fell over once." Yes, it is quite a hill up the bridle path to the edge of the wood, so Dave dashed off to give a hand of assistance to the perspiring boy with the HRO.

" Are we going to chuck the aerial up the tree, or fly a kite over it, like last year?"

" The trouble with the kite was that it stayed up over the tree, do you remember? It just wouldn't come down in that breeze."

" Yep, that's right, fun though, wasn't it."

" Here, Ron, how about getting the bangers on, and we'll have a bit of grub soon." So a few more chunks of wood went on the fire and soon the aroma of frying sausages and beans began to fill the atmosphere around the site.

Now while all the bustle of setting up camp was going on, tent erecting, grease pit digging, piles of sleeping bags, beds, mugs, spoons, socks—as well as HROs, petrol cans, p.a. valves and tangled aerial wire, all to be sorted and claimed, Ray was philosophically musing about the " new " power supply. This was going to be the real McCoy! A.c. (2000 cycles per second, just think of the saving in smoothing!) with plenty of watts at a voltage which would allow a fair old run of cable from the genny to the rig, without losing at least half. At last, the ear-splitting two stroke chatter of yesteryear would become a distant burr this time—Heck! did we forget the long power cab . . . ? No! thank goodness, there it is, stoutly binding Andrew's blankets and chattels.

" Hey Andrew—Andrew. Ah! there you are, when are you going to untie your stuff then. How did you get a knot like *that* in 7-029!? "

" Let's explore over near the fence for a site to set down the generator." Up runs Eric.

" Let's come and start it."

" Start it! We're up to our eyebrows—have you dug your bit out of the trench behind the bushes yet? "

" No, but. . . ."

" Well don't you think . . . watch out you'll! . . . Oh well, hope you'll take off your boot and clean it *before* you come into the tent tonight. That reminds me, have we collected the milk from the farm? "

Now the sun touches the horizon, and the sky takes on a salmon tint. We have had some grub now—bits of grass in it of course—but it was great. It's one thing about this season, out setting up camp, the meals are always welcome, although the washing up has not the same attractions. Yes, weary though we are, we have the power on . . . and a bit of wire up the tree. Too tired after today's bustle, but the station's all ready to go.

It's quite dark now, there's an owl afar off. Out comes the old Tilley lantern and with a few pumps on the handle a silvery glow lights up a row of youthful faces. We have set up our camp again this year, and for a moment we wonder how many of our associates in the RSGB have set off on their own adventures all over the country. Here we are at the end of the day and contented with it. Time to turn in. Our little'un, still young enough to murmur,

" There might be a big storm tonight, and we might get stranded, and we'd have to call ' Mayday ' on Top Band, and there'd be a helicopter and a rescue team, and . . . and we. . . ."

Ah! how peaceful, now for a rest, then tomorrow we can (yawn . . .) yes we . . .

Now for the next letter in the series.

B is for:

Bias

In order to operate a circuit in radio and electronics, energy must be supplied. This usually takes the form of d.c. power, whether the circuits use valves or transistors. The power packs not only supply the energy, but also supply it at the appropriate potential and current. Thus 6 volts would hardly operate valves, while 200 volts would make short work of most transistors! Choosing the correct voltage and current levels for a device or circuit is called setting the *bias*. In valves, the h.t. supply must bias the anodes positively. The grid, though, is usually negative.

* Any resemblance to persons living is quite deliberate!

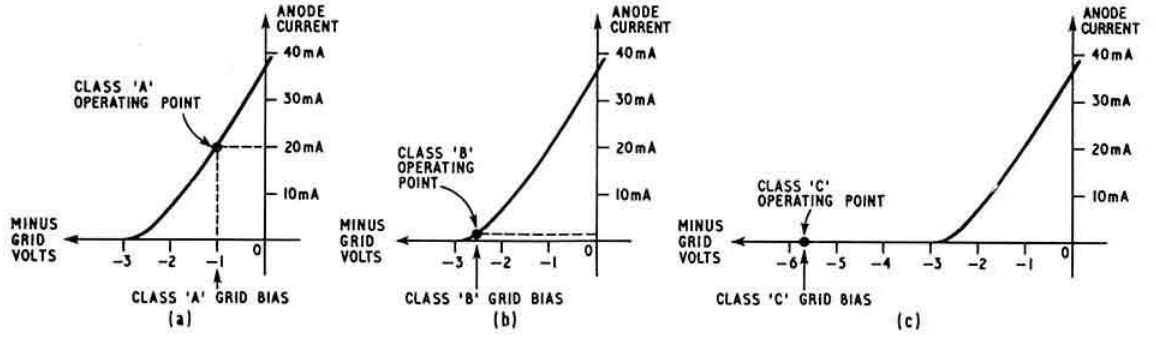


Fig. 1. As a valve grid is made more negative the anode current gets less and less. Class A bias places the operating point on the centre of the " straight " portion (a). Class B bias is just about at the cut-off point (b), and class C bias is well beyond the cut-off point (c).

In pentodes, the screen grid also has a positive bias. All these potentials are relative to the electron emitting electrode or cathode. Transistors have bias supplies, the polarity of which changes according to whether *p-n-p* or *n-p-n* types are being used. *P-n-p* types require a negative bias on the collector. The base bias is no longer a *voltage*, as in the case of valves, but is thought of in terms of a bias *current*. This base bias is usually obtained from the same supply as the collector. The correct choice of bias values set the valves and transistors to the appropriate *operating point* for the job in hand. There can be more than one operating condition, even for the same type of valve or transistor. Thus we find class A, B or C grid bias. Whereabouts the operating point is set in any given case, is seen clearly by " plotting " it on the *characteristic curves* of the valve or transistor being used. Graphs are always useful pictures, and characteristic curves are no exception, for they enable us to design the circuits, and pick component and bias values. The figures found in valve manuals are really an average. These are the values most commonly used, although as we have seen, the curves shoe the whole range of values, and not just one point.

Battery

Battery means a group of similar objects working together, though formerly only in connection with a battery of guns

Fig. 2. The long and short strokes of the symbol for a cell are supposed to have been handed down from fairly ancient times. They are meant to stand for the two electrodes (copper or carbon, and zinc) that were dipped into a pot of dilute acid in the first cells made.

(from to batter, beat or strike blows). We use the term to describe a group of cells connected up to supply an appropriate voltage. Many people use *battery* to describe a *single* cell now, although as you can see, strictly the meaning is only correct as in a " battery *of cells*." Ah well, words change.

Base

This is one of the electrodes in a transistor. The name *base* was derived from the construction of the now obsolete *point contact* transistor. The base really was a base, upon

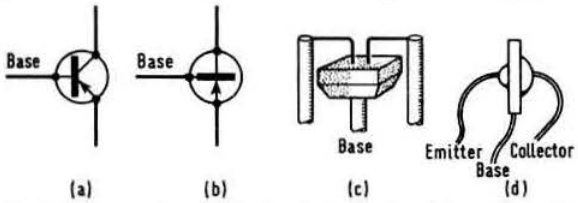


Fig. 3 (a) shows a diagram of a transistor developed from the early point contact type; (b) shows a symbol used by some authors which is much nearer the modern junction type layout; (c) illustrates the construction of the obsolete point contact type; (d) shows the sandwich construction of one type of junction transistor.

which two " cats-whiskers " (wire electrodes) were placed. Nowadays the transistors available are *junction* types, with the base sandwiched between the emitter and collector materials.

News and Views this Month

Paul, A4035, writes an interesting letter yet again, and includes a club news-sheet. Best 73 to all your school club members from us all.

Alan, A4335, has written me two letters on the QSL topic (he has some strong feelings about this, obviously!). I was not able to make very many suggestions on this problem.

A letter from **Hugh Church, A4260,** mentioned a prize won in connection with a receiver he made. Congratulations Hugh.

John Wardle, A3321, writes to " QUA . . . " for the first time. John uses a PCR2 receiver with a modified television converter for 2m. Any advice on how to get rid of breakthrough into the PCR would be welcomed by John.

A welcome is offered to **David Duff, A4627,** as a new member of our Society. Dave uses a 124 ft. dipole and a " Mohican " receiver, and he says that he is very keen on the " post card " circuits we have had featured in " QUA . . . " (we have put them aside for a while, but if you are interested in them, a line to the Roding Boys' Soc. would be in very good order for developments are forging ahead there). David, who lives in Silloth, Cumberland, would be pleased to know if there are any other "A" members nearby who are keen to take the RAE soon, or who would like to contact him.

Robert Mannion, A4032, writes a short note, including a 2·2 Megohm resistor—" to help you to resist the occasional pun in the BULL " (I think that one ought to be for the Editor!).

I had a letter from **BRS15104,** expressing interest in a possible club in Sevenoaks. If you are interested, how about a line to J. C. Williams, 90 Cramptons Road, Sevenoaks, Kent.

Al Wang, A3539, drops a line to compliment our column. He has passed the RAE, so a new call should soon be heard on the bands. Al uses an HRO receiver, together with an Eddystone S670, so he has quite a good start to back up his ticket when it arrives.

I have heard from **A4335,** and **A3699** again, from opposite ends of the country. Both of them are engaged in training for the same job. Alan, A4335, complains about the QSL card system and its poor turnover for listeners. Gillies, A3699, has heard 201 countries, with 62 confirmed with QSLs.

Two letters have arrived from Youth Centres. One is from **G3NOF,** and is in fact, from the Yeovil Amateur Radio Club. This club is in a Youth Centre and has many links with young people there. This is good news, and I can see a thriving Junior Radio group developing there, going ahead with camps and youth radio projects. Any lads in Yeovil? How about getting in touch with G3NOF? The other letter concerns a station set up within a Youth Centre for the young members there. It is at South Reach County Youth Centre, which is affiliated to the National Association of Boys' Clubs and to the NAYC. The leader is **Derek Fisher, G3LKO,** and he says that interest is a little low at the moment. Once again, there must be a number of boys and " A " members within visiting distance of this club station. Contact G3LKO.

Broadcast Programmes

Just as I thought, I'm afraid that there has been no mention of any interest from any department in the BBC, either programme production or engineering department, to our suggestion of a small series on Amateur Radio for young people. I know that anything of a scientific or serious hobby nature is right out of fashion in the " Pop entertainment " field, especially when one considers the views of the professionals generally, when it comes to the work of amateurs. All I can suggest is a combined effort from you in writing to the Independent Television Network saying that a technical series would be of benefit to thousands of scientifically minded young people in this country. They might just conceivably be more flexible than the BBC.

Anyway, 73 to you all, and we are all standing by to hear the good news about this year's RAE. Best of luck.

* * *

Reports for this feature should be sent direct to Ken Smith, G3JIX, 82 Granville Road, Walthamstow, London, E.17.

RTTY

By J. A. McELVENNEY, G3LLV *

THE weekend of March 20/21 saw the first annual BARTG RTTY DX Contest; a full list of winners appeared in the Group's May newsletter. It only remains for the writer to congratulate all concerned for a fine contest, and in particular, G2HIO for organizing it and FG7XT for winning it. An estimated 200 stations took part, nine of which worked all continents. The runners up were KP4AXM and K8MYF.

Adjusting Shift Values

The values of shift used in RTTY have been standardized at 850 and 170 c/s. Incorrect shift may or may not be of importance during any given QSO. If the receiving station uses the linear discriminator type of terminal unit, normal copy will be obtained from shifts ranging between 150 to 1000 c/s. However, should a more modern two-tone circuit be used, then the shift must be within 100 c/s of the standard for consistent copy. It should be pointed out that optimum signal to noise ratio will only result if the correct shift value is employed for the terminal unit in use.

Like the writer, most RTTY'ers employ a simple diode

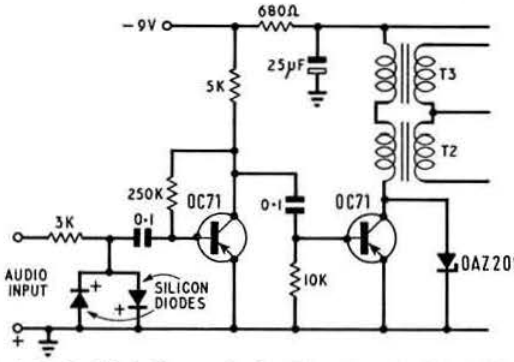


Fig. 1. Basic shift indicator circuit. The values for T2 and T3 are discussed in the text.

f.s.k. circuit in which the shift is adjusted by small alterations to the forward bias. This "partial conduction" circuit is a doubtful method of obtaining and maintaining correct shift values, for it depends for its action on small variations of forward resistance to alter the L/C ratio of the v.f.o. Small variations in ambient temperature, supply voltage and diode characteristics result in changes of shift.

In some recent experiments with simple transistorized terminal units, the writer decided to use his simple two-tone discriminator to set the shift of the v.f.o. This proved successful, so a separate circuit was bread-boarded. Fig. 1 shows the first attempt. The circuit consists of a simple "Round-Travis" discriminator in which the diode current is monitored by a centre-zero microammeter. Audio is fed to the tuned circuits from a line to a 50 ohm transformer. The potentiometer is a balancing control, the use of which will be explained later. T2 and 3 are American 88 mH surplus telephone loading toroids, with 20 turns of 28 s.w.g. wire wound over them as primaries. These are resonated, with the associated capacitors, to 2125 and 2975 c/s respectively. The capacitors should be of the polyester type.

Practically every component in this circuit has some

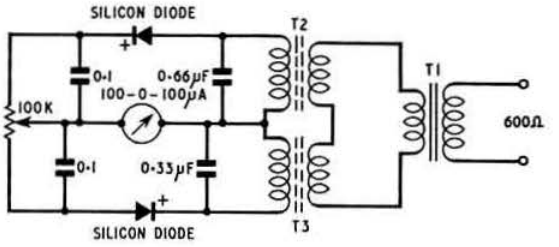


Fig. 2. Shift indicator limiter and driver.

latitude in its value. T1 may be ommited if a low impedance source of audio is available. T2 and 3 can be any surplus high *Q* inductors of about 50 to 100 mH. The values of the tuning capacitors must be adjusted accordingly.

Setting up requires an accurate source of audio at 2125 and 2975 c/s. Audio is fed in at 2125 c/s and T2 peaked on the meter by adding or subtracting capacity. A fine adjustment may be obtained by removing turns from the coil. The same process is carried out with T3 at 2975 c/s.

The circuit is now ready for use. Connect the input to the output of the station receiver. Tune in a beat note from the v.f.o. with the teleprinter on mark and adjust the receiver for a peak in negative direction on the meter. This will be 2975 c/s. Change to space and adjust the shift so as to obtain a peak in the positive direction. With some shift circuits this operation may be reversed. Finally, adjust the balancing potentiometer to obtain equal swing in either direction.

Limiter Amplifier

Fig. 1 has two drawbacks. Firstly, the readings on the meter vary with the setting of the receiver gain control and secondly, it may only be used to set one value of shift. The difficulty arises in that 850 c/s is obtained by using the two peaks but any smaller value must be determined by interpolation between these two. As the audio drive is not a constant, the exact setting on the meter will vary each time it is used.

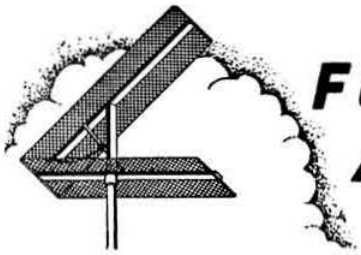
To overcome these difficulties, the limiter stages of the previously mentioned terminal unit were pressed into service. Fig. 2 shows the circuit. It consists of a simple parallel diode limiter feeding a two stage audio driver. The output is limited to around 4 volts by the use of a Zener diode. Audio may be obtained from any stage that has sufficient output to make the circuit limit.

Adjustment is as for Fig. 1. Meter readings should stay constant for large changes in input voltage. The circuit may now be calibrated for any value of shift. For shifts less than 850 c/s, the receiver tuning is adjusted to obtain a predetermined meter level on mark and to a further predetermined level on space. Due to the nature of the driving circuit, variation in battery voltages will have only a small effect on meter readings.

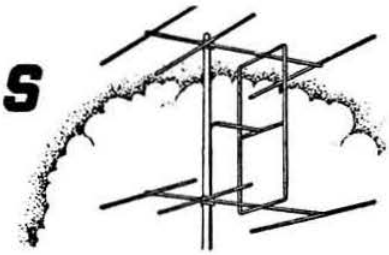
Any method of setting shift values must rely on an external standard. The purpose of the circuits shown is to enable test gear to be used for other purposes and not to be continuously tied up monitoring shift. It is obvious that the standard 2125 and 2975 c/s tones need not be employed. Any two frequencies may be used that are known to be separated by 850 c/s. It must be emphasized that both circuits were only bread-boarded and that no real attempt was made to optimize the circuit for maximum performance. Suffice to say that they work quite well. The primaries of T2 and 3 are very likely a poor match to the driving transistor and the number of turns could be adjusted for a more equal output on mark and space. The microammeter used was

(*Continued on page 466*

* Honorary Secretary, British Amateur Radio Teleprinter Group, 15 Havelock Square, Broomhill, Sheffield 10.



FOUR METRES AND DOWN



By F. G. LAMBETH, G2AIW*

IT is very pleasing to note the increasing number of G8+3s who are appearing in this column; they must be giving a very welcome fillip to the u.h.f. scene. These amateurs all appear to be very keen, and are obviously a principal cause of the uplifting of activity on 70cm recently, as well as conditions. For instance, **G8AOU/A** (Malvern) worked G3HAZ/P at 20 miles distance at RS 58 though with only about 250 milliwatts from a DET24 tripler without h.t., during the First 432 Mc/s Contest on May 29-30. Conditions were quite good for both G3NNG/P and G3FP were RS57 on the Saturday night with a 19 element Yagi at *10 ft.* Incidentally, G8AOU/A would appreciate skeds from the home QTH (nr. Peterborough) at the beginning of August when he hopes to be running 6 watts!

G8AAN (York) is also looking for skeds on 70cm on Tuesdays, Fridays and Saturdays. He transmits on a.m. or c.w. for 10 minutes prior to the half hour and listens for the first 20 minutes of each half hour period between 20.00 and 22.00 GMT. The frequency is 433·64 Mc/s, with input powers of 15/25 watts and 120/150 watts.

G3OCB (Truro) found the contest weather rather better, and a station signing G3OCB/P was set up at the usual site using a 6-over-6 J Beam and a 32 element Colinear aerial, a QQV02-6 transmitter and a transistor converter preceded by a GM0290 pre-amp. The Colinear array proved superior and G5ZT/P (nr. Okehampton) and G8AGU (South Moulton) were worked at excellent strengths. Some time was lost at the start, but G3MPS was heard at S9+ on the converter and 6-over-6. The converter was feeding into a transistor mobile receiver. Other signals heard were G6GN and G3OBD/P who was peaking at about S6 from the back of his beam while firing eastwards. Improved aerials and 25 watts are modifications envisaged. More news about this is promised so that operators may continue to be induced to beam towards Cornwall.

G3BJD (Seascale) reports on what is believed to be the first 70cm activity from Cumberland, which took place on Sunday, May 30.

The equipment comprised the following apparatus: *Transmitter*: 12AT7 oscillator, tripling to 24 Mc/s; E180F tripler from 24 to 72 Mc/s; E180F doubler to 144 Mc/s; EC88 g.g. tripler to 430 Mc/s; EC88 g.g. amp; DET24 g.g. amp in $\frac{1}{4}\lambda$ cavity, with an anode current of 60 mA at 300V —the output at 433·91 Mc/s is 9 watts measured. *Aerial:* an 8-over-8 slot on a 20 ft. pole at 1000 ft. a.s.l. 6 miles north of Millom. The equipment had not been tested on the air, and the contest seemed an appropriate opportunity to make the effort. G3RHE, G3FDW and G3BJD erected the aerial. Only seven stations were contacted: G8AGC, G8AFJ, G8AHQ, GW8ACG, GW8AAP/P, G3KMS and G2OI. G3LEE got away and it is believed that G3HAZ (Worcester) was heard. Several weak carriers were heard and if they had been c.w. doubtless many contacts would have ensued. Why don't they use it?

G3LQR reports an opening to PA land on June 2.

G3AHB (Slough) is now active with 35 watts input to a QQV03-20A into a 10 element Skybeam at 35 ft. An AF139 pre-amp into EC88s in g.g. cascode gives a bonus of 2 S points on *all* signals, not just the weak ones. This was the first 70cm contest he has entered for some 15 years, and a sudden opening to the west proved very interesting, with G6GN, G3MPS, and GW3ATM/A worked. He has a county score of 16, and succeeded in contacting some 40 stations in only 4 weeks on the band. However, screening is much more severe than on 2m.

G3LHA (Coventry) found conditions during the First 70cm contest (May 29/30) excellent on Saturday night, but only average on Sunday. Similarly, activity was very high on Saturday, but only mediocre on the Sunday. G3LHA worked 53 stations in 19 counties during 10 hours operating, the majority being worked on the Saturday. Much DX was heard but not worked on Saturday: G3ILD (Durham), G8AAY/P (Dorset), GW8AGT/P (nr. Pontypool), PA0GER and G3TND/P (Dorset) were all called without success. The majority of the portables were putting out very good phone signals, but the modulation quality of a few left much to be desired. The best DX worked was G3OBD/P (nr. Shaftesbury, 106 miles), G8ACI (Petersfield, 105 miles) and G3LQR (Colchester, 109 miles) with many S.E. and London stations in the 90 mile range. An idea that some portables were using poor receiving equipment seemed to be confirmed by the fact that whilst some of them were putting out good signals all day Sunday, they could not be raised. Hats off to G8AAH/P (Ivinghoe Beacon) who was putting out a wonderful signal throughout the contest—and working many stations, too! G3LHA found the Sunday 23cm event "a bit of a curse" for the 70cm men, for when many strange carriers appeared on 70, the band practically collapsed! He suggests different dates in the future, or an earlier close down for 70cm (say 13.00 GMT), leaving the period 13.00 to 19.00 exclusively for 23cm. People could still be portable with 70cm gear for cross-band work. Comments are invited.

G3NNG/P (Uffington Castle) had 74 QSOs in the contest—a record number for this party although the start was 30 minutes late!

GW8AIB (Caersws, Montg.) is extremely interested in 70cm but heard very few amateur stations. He operates from various places including two spots 1500 ft. a.s.l. in Montgomeryshire, and would welcome skeds, from the Midlands area especially, on July 11 and 18. The telephone number is Caersws 288.

G3NBQ found conditions fair to poor in the contest, Saturday night being fair and the remaining time poor. Activity was very good. Considering conditions, it seems amazing that many signals which were then S8 or better are rarely heard normally in the Midlands. Examples are

* 21 Bridge Way, Whitton, Twickenham, Middlesex. Please send all reports for the August issue by July 9 and for the September issue by August 6.

Charlie Newton, G2FKZ, ponders over a tricky point during his talk on Radio Aurora at the Scottish V.H.F. Convention on May 8.

A few members of Dunfermline V.H.F. Group. Back row, left to right, GM3IQL, GM3CIG, GM3HYX; front row, GM3EGU, GM3AEY, GM3EGW and s.w.l. Bob Braid. A report on this convention was published last month on page 398.

Andy Lawrence, the Secretary of Dunfermline Radio Society, receiving the Jock Kyle Award from V.H.F. Manager, Ray Hills, G3HRH, on behalf of the Dunfermline V.H.F. Group.

G3FP (8), G2HDJ (9), G2ANS (9), G3IRA (8), G3LTF (8/9) and G2RD (8). They were all heard consistently at the stated strengths or greater during the whole of the contest including Sunday afternoon, when conditions were at rock bottom. Out of a total of 44 QSOs four were over 100 miles and 19 over 50 miles.

G3JGJ (Moretonhampstead) had a QSO during May with G8ACI (Fareham). G8AGS (Torquay) was heard on the 13th and G8AFH/P (Nr. Dorchester) was worked at S9 both ways. G5ZT/P (Okehampton) was worked RS 59 both ways. G8ADP (Dawlish) was heard on the 30th. G3JGJ is now looking for 70cm stations every evening, including Sundays, beaming east at 10.30/11.00 GMT and 19.00/20.00 GMT. He also operates at other times if conditions are good, and skeds are welcomed.

G3XC (Indian Queens) says that three Cornish stations (G3XC, G2BHW, and G3OCB) operated G3OCB/P during the Saturday evening, and more testing of gear took place than stations worked!

Moonbounce on 432 Mc/s

There will be opportunities for Moonbounce QSOs on July 24, when KP4BPZ (Puerto Rico) using the 1000 ft. hemispherical reflector of the Cornell University Ionospheric Laboratory at Arecibo, Puerto Rico, will be calling CQ on 432.000 Mc/s from 11.10 GMT. The duration of the test will be just under 3 hours. After initial c.w. contacts KP4BPZ will shift to lower sideband s.s.b. and attempt two way voice communication via the moon. It is anticipated that 100 watts output on s.s.b. and an aerial gain of 15db should permit voice work.

70cm Record Smashed in USA

During a major opening between April 12 and 14, many states were worked on 70cm over distances never before achieved, and this activity culminated in a record breaking QSO, over a 1000 miles path, between W5LUU (San Antonio, Texas) and WA4KFW (Margate, Florida). Congratulations to them, and also to all the other stations, in Texas, Georgia, Florida, Mississippi and Alabama, who also worked over long distances during this period.

Four Metres

The immense increase in activity on the 4 metre band is reflected in the phenomenal number of new stations worked by **G3TXB** of Neasden in his first four weeks on the air—a total of 150. Although a large proportion of these were notched during the very popular 70 Mc/s Contest in May, many accrued from run-of-the-mill operating sessions. In furnishing this information G5UM adds that Sunday morning still produces heaviest occupancy of " Four ", at least in the south-east. He expresses the view that more mid-evening activity would not be a bad thing in order to increase the possibility of contacts at times when the band seems all too dead. It is appreciated that this often means tackling and beating the TVI problem, but this is not difficult in many areas by judicious choice of crystal frequency. Although this may mean buying a crystal to special order, this is not really such an expensive step.

The Second 70 Mc/s Contest (Open) on May 15-16 seemed satisfactory, at least in the Midlands, according to **G2BJY**, Walsall. Although activity was high, however, the conditions were generally poor. The maximum workable distance appeared to be about 120 miles, the exception being G3JHM/A (Sussex) and G3FDW/P (Cumberland). These two stations put out consistently good signals at all times. EI2W was heard at good strength on Sunday May 16 during the morning, but many frantic calls failed to raise him—he always went back to someone else. The only other station heard at any distance to the north was G3RIK/P (nr. Rochdale) and activity from that direction seemed somewhat lacking—or was it conditions? Another good signal, apart from the regulars, was G3IAG (nr. Ely) and the best mobile was G5JO/P on the Clee Hills (S 8/9). Some very clean c.w. was copied from G3OJE/P (nr. Aylesbury), G3IMV (Bletchley), G3OUF (nr. Harrow), G3OWA (nr. Caterham) and G3NJF/P (Claxby, Lincs.). G2BJY made 37 contacts in

eight hours operating time, nine of which were over 100 miles away and two over 150. Several new counties were worked to bring his total up to 34. Thirty-one of these have been added since last September.

When QRP at 8 watts, TVI is no problem for G2BJY, but the normal power of 30 watts causes much trouble. He wonders whether others might find a simple power reduction and the use of c.w. a solution to the TVI question.

GW3RUF/P operated from Snowdon on 4m and 2m as expected. The best DX was G3JHM/A (Worthing) on sked. A total of 60 QSOs were made on 4m before moving to the contest site. Another portable effort was the 70 Mc/s Open Contest, which provided 106 contacts. Requests for c.w. received a good response, especially from G3RCV (Sidcup) who was patient enough to use the receiver-transmitter change-over mechanism to send c.w.! Forty-nine stations were over 100 miles distant, the best DX being GC3OBM (Guernsey), G3JYP (Appleby), G3JQI (Norwich), G3FDW/P (Millom), and G3LQR (Colchester), all over 170 miles away. This addition to the contest calendar is reckoned very worthwhile, and the operating was excellent, says G3KXA (who reports this news). He also points out that the Scottish stations enter these v.h.f. contests without even a chance of being runners-up, and suggests some bonus for them to give them a chance. It would raise their morale and stimulate v.h.f. participation from over the Border.

G3LQR (Dedham, Sussex) detected what appears to have been a Sporadic *E* opening on May 28. Noticing interference on BBC Channel 4, he checked 10m and found G and GI stations in QSO. Thinking that this condition might reach 4m or 2m, 4m was checked and GI stations were found on the band. The first one heard was GI3FFF, followed by GI3CDF who was worked RS 5-8/9 with a ground plane aerial at the Irish end. After this, conditions deteriorated quickly, but GI3TJM was worked with signals RS 5-6/7 both ways.

G3JMB (Margate) has had a fair number of QSOs and is now using a temporary 2 element beam 16 ft. high. Although only seven contacts were completed in the contest due mainly to lack of time, the following were heard: GW3RUF/P (R4S6), G3ENY/P (57), G3PIA/P (58), G3SKR (58), G3RTF (57), G2DQ (58), G3PPG (56), G3RMN (57) and G3MEH (46). G2JF, G5MR, G3IMU (101 miles), G3MHW (87 miles), G3JHM/A (86 miles) and G3BAC/P were worked. Since the contest, which certainly proved there can be activity on the band, Norfolk has been added to the county list by G3JQI. Quite a few stations in the Medway area have also been worked.

G3OUF managed several hours of operating during the contest on May 15/16. Contacts providing new counties were with GW3RUF/P (Monmouth), G3PPG (Worcester), G3FDW/P (Cumberland) and G3NJF/P (Lincoln). Other contacts over 100 miles were with G2BJY, G3ENY/P, GC3OBM, G3BNL, GW3AHD/P.

On May 28 there was a surprise Sporadic *E* opening to GI and GM. The best conditions were from about 17.30-18.00 GMT, when several contacts with stations in the S.E. were made. G2CDN/M near Paddington station worked GI3TJM, G3SKR worked GI3TJM and GI3PKY/M and G3HYG worked GM2UU. G3OUF heard several GI stations after 18.00 GMT but none were identified because of the deep and rapid QSB. There should be several opportunities during the summer for this type of opening which is indicated by the many f.m. and other broadcast stations to be heard in the band. The TV bands are also a good indication.

G3OCB (Truro) found better weather for the contest, but results were poor with fewer stations worked than last year, although a site 20 miles further east and 3000 ft. high was in use.

The **G5FK** 70 Mc/s frequency standard tests were carried out recently without a hitch, and proved to be a valuable service. A similar series on 144 Mc/s will be conducted after the summer. Full details will be announced later.

G3XC (Indian Queens) had fair weather for the contest, and 26 stations were worked by the Cornish lads (signing G2BHW/P). " But where oh where are the well-equipped stations as are found on 2m? " G3SHK, G3PPG, and G3PIA/P were all consistent at around 200 miles distance, but why only these few? Conditions were satisfactory.

Two Metres

Since our last notes on 2m propagation, there has been very little to stir up activity except for the periods May 11 and 12, June 2, 3, 4 and 5, when signals in the normal tropo mode were extremely strong up to about 200 miles. During this latter period DL1AC in Bremen at 380 miles was audible in the south of the United Kingdom, via extended tropo, as were the stations DJ9DL in locator DL76A and DJ9UX in locator DL66G at a range of approximately 270 miles. As usual these good conditions coincided with high pressure systems, one being equatorial and the other polar.

Towards the end of May, sporadic *E* signals made their annual appearance at frequencies up to 70 Mc/s, but so far there has been no indication that they reached 145 Mc/s.

It should be remembered that the months of May and June are the most likely times for sporadic *E*, and it is therefore desirable to keep a look out for this phenomenon from 28 Mc/s upwards.

New stations heard recently on 2m in the south of England are G3NBP (Cambridge), G3GGO (London), G3JKO/P (Ditchling Beacon) on leave from West Africa, G3RPJ/A (Warwickshire), G3LAZ (Thornton Heath), G3MYX (Folkestone), G3UFA (Digswell), G3GQ/A on holiday near Spilsbury, Lincs., G3LQV (Maidstone) and G3NAO (Dewsbury).

G3TOZ (Peasmarsh) reports hearing a new German beacon station signing DL0SG on a frequency of 144·010 Mc/s, beam heading north.

ON4LF (Brussels) reports working G2JF at approximately 150 miles with an input of 2mW on the evening of June 10 when extremely good propagation prevailed in an east/west direction. ON4LF was using two transistors, type AS102 and type AS118. The battery voltage was six, and with an 8-over-8 aerial system his signals at G2JF were Q5, S5/6. This contact must rank as unique, and it is wondered if there are other known occasions when such long distances have been covered at v.h.f./u.h.f. with such infinitesimal power inputs.

Reporting on GW3RUF/P (Snowdon), **G3KXA** thought that the third 144 Mc/s Contest (Portable) on May 2 was very good, although the main receiver packed up during the first few minutes. They did as well as last year but could not contact a Cornish station this time. The weather was calm against last year's gales, but they had snow during the night's " exile." However, band conditions seem to matter little at 3560 ft. a.s.l. because although they heard grumbles about conditions they noticed no lack of DX signals. Ten stations QSOd were over 200 miles away, the best being GM3FYB/P (St. Andrews, 235 miles), G3SJO (Colchester, 230 miles) and G3GWB/P (I.O.W., 210 miles).

From the VERON *V.H.F. Bulletin* we learn of a QSO on 144·735 Mc/s between 7X2SMA (Algiers) and F9BG (Toulon) on May 16. On May 10 and 16 there were also several QSOs between F9NL (Pyrenees) and other Northern French stations, with GB3VHF and G6XM heard. We are not sure whether perhaps a contact with G6XM actually took place.

G3EMU (Canterbury) thinks that conditions are gradually warming up and says that signals even on average days are a couple of S points up. One or two continentals can be worked on most days. The best day lately was June 2 when over 20 PAs were worked. PA0ZR/M using only 4 watts to a halo in the Hague was S8 and PA0RDS with a 12AT7

in the final was S9+! This occasion gave a chance to many of the PAs who have only a dipole or indoor aerial. Some new contacts on May 30 were with G6FI, G3TGE, and G3TEK. G3EMU reports that PA0CML is in hospital, but he could not be separated from his transmitter and has a few watts and a dipole by his bed. If a weak signal is heard instead of the usual S9 one, he would appreciate a call. PA0ACG (Abcouda) is louder than ever with a 20 element Yagi on an 85 ft. tower. In order to get the best height in a notoriously low-lying country actions like that of PA0AKA (who climbed the slag heap at a disused coal mine) are more the rule than the exception.

G3OCB (Truro) found both weather and propagation conditions equally bad during the 2m contest, and very few QSOs were made. The usual stations are on most evenings, but very few have been worked outside Cornwall lately. QSOs have been made with G3RMB, G3KHA and G3BA, however. Mobile QSOs have been achieved, using a dipole above the car, with G2JF and G6XD (Teignmouth) as well as with more local stations. Now that planning permission has been received for building a small mast, it is hoped to have the beam up to 50 ft. soon, which should improve results to the north and S.E.

G3JGJ (Moretonhampstead) heard G3OCB/M between 12.30 and 12.35 GMT on May 14 and called several times without reply. This happened again on May 24 with the same result. GC2FZC is worked most evenings at 18.30 GMT with GC3OBM occasionally and G5ZT also most evenings at 17.30 GMT.

G3XC (Indian Queens) has little news, except that G3IGV/P reports hearing an SM station on May 28 at 20.00 GMT. No other details are available, but no G-DX was audible at the time. G3FIH (Bath) has been heard lately, and recently G3BA (on c.w.) appeared on what seemed to be a dead band. G6GN (Bristol) is easily workable under most conditions and G2BAT (Salisbury) seems to be able to produce a useful signal almost any time.

Twenty-three Centimetres

G3LQR has a "near QSO" with PA0DBQ during an opening on June 2.

G3SIC (Worcester), although not yet active on the band, has a converter working, and a tripler under construction. The converter is a 12AT7 35·5 Mc/s 3rd overtone oscillator, EF91 tripler to 106·666 Mc/s, E180F doubler to 213·333 Mc/s, A2521 tripler to 640 Mc/s and a GEX66 diode doubler to 1280 Mc/s. The remainder consists of a simple hi-Q break and mixer trough line with a 1N23 mixer diode. The i.f. amplifier is an E88CC cascode. The aerials are a 4 ft. dish and a small corner reflector. The main problem at present is to find a local station to test the gear with—it is hoped that G3MTI (Malvern) will be active soon. The tripler is a squared-off version of the *Amateur Radio Handbook* design with a 3CX100A5. A start has also been made on the G3HBW transistor converter. G3SIC hopes to be ready for 23cm tests and V.H.F. NFD.

G3KEF (Coventry) found the 1296 Mc/s Contest on May 30 very welcome and had QSOs with G3GWG, G3BNL, G2CIW, G3NBQ and G3OXD/A , and also two crossband contacts (G3NNG and G3KFD, with G3KEF receiving on 23cm). He was surprised that London area stations did not appear to be looking for 23cm contacts. The 23cm site was Honey Hill, 8 miles east of Rugby in Northants. G3NBQ was 22 miles away during the contest and was audible on 23cm with no aerial on the converter. G3KEF recently built a 16 element stack for the band; its performance is about 3db down on a corner reflector. **G3NBQ** feels that the good activity on the Sunday afternoon was entirely due to the 23cm contest, and thinks the tests are now outdated by the contest experiences. His best QSO was a crossband one with G3FP (98 miles) and confirms that G3KEF was the best signal at 22 miles. G3KEF's aerial on the converter was a ball-point pen, and G3NBQ's a small screwdriver! Regular QSOs are now being achieved with G3BNL (33 miles) and G3GWL (47 miles). G3LHA, G8AEX and G8ABD are now building for the band, but tests with G3MCS and G2FNW have been negative so far. We are promised further news as soon as a 4 ft. dish is in operation.

G3HWR (Hampstead) has had success with his "anglicized" version of the K6AXN converter feeding an AR88 at 16 Mc/s. The aerial is a 2 ft. 3 in. paraboloid (indoors) and there have been crossband QSOs with G2RD and G3FP at very encouraging strengths. The transmitter will be a 2C39 tripler to the G3FP design, which is expected to be ready for the 23cm tests. The frequency will be about 1297 Mc/s.

G3RPE (Hemel Hempstead), who is also involved in this activity, has a similar converter and an 18 in. dish with a 2C39 to follow. He has had crossband contacts with G2RD, G3FP and G3GDR. All this activity has inspired G5FK to start work on 23cm. The aerial is an 18 in. dish identical to G3RPE's, the receiver will be another K6AXN and the transmitter a 2C39 tripler. They were all on for the 23cm contest using G3HWR's converter and G3MLS's aerial, an 18 in. dish. A BSC 16 varactor was borrowed and a tripler was rapidly put together. With an output of 30 mW, there was one QSO with G3FP, but they unaccountably failed to work G2RD at the same distance.

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

Call-sign	Location	Nominal Frequency	Emission	Aerial Direction
GB3CTC	Redruth, Cornwall	144·10 Mc/s	A1	North-East
GB3VHF	Wrotham, Kent	144·50 Mc/s	A1	North-West
GB3LER	Lerwick	145·995 Mc/s	A1	N/S
GB3LER	Lerwick	70·305 Mc/s	A1	N/S
GB3LER	Lerwick	29·005 Mc/s	A1	N/S

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
May 25	16.20 GMT	290 c/s low
June 1	14.45 GMT	700 c/s low
June 15	10.05 GMT	680 c/s low
June 24	12.35 GMT	90 c/s low

News and Views

GM3RUF/P will be on safari for 10 days from August 26 to some of the rarer counties on 2m; operation will be from 06.00 to 08.30 GMT and 18.00 to 23.00 GMT daily. The operators will be G3KXA and G3UAW. Please arrange skeds with G3BA who will be their "anchor man and beacon" and will pass on all news from day to day.

G6AU is staying at Haytor, Dartmoor, until about July 17 and will be active mobile and portable on 4m with a B44 Mk III. It would be appreciated if other stations can keep a look out for him. Likely frequencies are 70·26 and 70·425 Mc/s.

G3BHT (Formby, Lancs.) will be active on 2 and 4m from various parts of Ireland during the two weeks between July 21 and August 4. He will be travelling with **G3SKT** and operating EI2AX/P on 70·205 and 145·295 Mc/s. A special site is being chosen for the 4m Contest on July 25. They will also be available on 3760 kc/s with a KW2000 for arranging skeds.

G3SIC and **G3STW** will be operating on 2m in Wales from July 24 to August 7. The frequency will be 144·328 Mc/s.

G3EMU reminds us of the beacon station DL0AR which is on 144·0 Mc/s with 500 watts primarily for aurora checking.

GB2GC will be re-established in Alderney, Channel Islands, from August 17 to September 7 with gear for all bands from

4m to 23 cm. Although several skeds have been arranged, there is still time for many more, and skeds would be welcomed. The information required by the group are the times available for skeds and the transmitting frequency. The group will provide the exact sked time and other details when replying. Skeds should be addressed to G3SHZ (QTHR). The GB2GC transmitting frequencies will be 70·405 Mc/s, 144·15 Mc/s, 432·15 Mc/s and 1296·45 Mc/s.

Will any 2m station within a 20 miles radius of Bletchley interested in a local activity night please contact **G3TGE** (address as call book). If sufficient interest is shown operation on 145·1 Mc/s is contemplated, this frequency covering Zones 5 and 6. A meeting will be held at a fairly central Hostelry in the area to discuss the time, day etc.

GB3MC (Malvern College Centenary Exhibition station) will be out portable on July 25 on 4m from the top of the Worcestershire Beacon, 1395 ft. a.s.l. Operation will count as Herefordshire and G3SGR will probably be the operator. (From G8AOU/A).

G3OCB (Nr. Truro) is looking for skeds on 4m and 2m during V.H.F. NFD and will be glad to hear from interested stations.

The **Coventry V.H.F. Group** Meeting of May 19 was well attended; the main attraction was an excellent talk on parametric amplifiers by G3CCA.

Meteor Scatter

G3OUF (Ealing) has arranged some special m.s. tests with **G3PLX** (Liverpool) for the Perseids shower in August. If any stations are interested perhaps they could approach one of these stations.

DL3FM, quoting from *Radio* (USSR) reports that on October 29 last SM7BAE worked UR2KAC on 432 Mc/s, the distance being 820 km.

On 2m, **UA1DZ** (Leningrad) worked UA6AJ (Armavir) at 1910 km, and F8DO (2300 km). UO5BDG (Kishinev), in common with other UO5 stations, is anxiously looking for m.s. contacts, whilst UP2ON has worked HB9RG, PA0OKM, ON4TQ, G5YV and F8DO by m.s. recently.

CT1CO (Lisbon) is preparing his equipment for the Perseids; he has a 500 watt p.a. and a 10 element Yagi, with which he has been able to contact EA4AO (Madrid). EA4AO is described as Iberian 2m Champion, and I am sure we all agree with this. CT1CO thinks that British stations are more likely to QSO the Oporto area, but using tropo. CT1IK is a likely station there that could be contacted by c.w. The other stations are usually on phone. We are promised more details about Oporto stations after CT1CO pays a visit to that city shortly.

Auroral Activity

From Geoff Stone, G3FZL, comes details collected by the Scientific Studies Committee of the first significant auroral opening of the IQSY which occurred on Wednesday afternoon, June 16. BRS26076 (N. Berwick), received signals from GB3VHF at 16.45 GMT and also from GB3LER on 10m, 4m (where the aerial is beaming south continuously) and on 2m. GM3GUI (Froickheim Angus) first noted auroral signals on 60 Mc/s at 12.30 but was unable to check the 144 Mc/s band until 15.25 when he heard GB3LER, DL0AR and GB3VHF. At 16.14 he heard LA1VHF on 145.15 Mc/s and at 16.58 OZ2GW. Both DL0AR and GB3VHF were still audible at 18.10. G3ENY, who runs an automatic receiver, received auroral signals from GB3LER on 70·308 Mc/s from 15.00 to 17.15. After that he continued to receive meteor pings from GB3LER. GM3LTP of Lerwick, Shetland reports that the magnetometer at the Observatory was active from 13.00 to 18.00. There was, however, no further magnetic activity during the night as has happened before. Very weak auroral signals were observed by GM3SFH from 15.20 to 15.25 on GB3LER. The Scientific Studies Committee would appreciate any further reports on this opening.

RTTY (Continued from page 461)

stripped from a surplus unit. A less sensitive one might be used if a limiter using a pair of higher gain/output transistors were built.

45·5 *v* 50 Bauds

Every AGM of the BARTG produces the same old chestnut, whether or not we should use 45·5 bauds for all amateur RTTY communications.

American amateurs may use only 45·5 bauds. Since the working of W stations is the " bread and butter " DX of most RTTY'ers on the h.f. bands, practically everyone uses the slower speed. On the l.f. bands contacts with Europe are nearly all on 45·5 bauds because of the reluctance of these amateurs to use two speeds.

There is little doubt that we will soon be the only country employing 50 bauds for regular RTTY communication. A dual standard is nothing more than one more inconvenience—a luxury we can do without. Using 50 bauds, we will end up talking to ourselves and you know what happens to people who do this. The choice is yours, 45·5 or 50. I have made mine. CU on 45·5 de G3LLV.

RSGB QSL Bureau—New Postage Rates

Members sending envelopes to the RSGB QSL Bureau Sub-Managers are asked to make certain that stamps are affixed according to the new postage rates. The minimum letter rate is 4d. for 2 oz, instead of 3d. for only 1 oz. The separate 1 oz. to 2 oz. rate, previously 4½d., has been abolished, and is now, of course, included in the 4d. charge. Every additional 2 oz. costs 2d.

Grafton Top Band Contest 1965

The top scores in the Grafton Annual Top Band Contest, which was held on April 3 (C.W. Section) and April 10 (Phone Section), are as follows:

Members' Section		Open Section	
Call-sign	Score	Call-sign	Score
G3SIL	96	G3HS	121
G3ONS	57	G3ERN	93
G3RPB	56	G3TIR	80

Awards for the highest c.w. scores are gained by G3RPB with 58 points, and G3HS with 58 points, and for the highest phone scores by G3SIL with 52 points and G3SWC with 67 points.

THE MONTH ON THE AIR

A CHRONICLE OF EVENTS ON THE HF AMATEUR BANDS

By M. E. BAZLEY, G3HDA*

THE shortwave listener of today is tomorrow's newly licensed amateur and in all probability he will be aged about eighteen years and possibly still a student with very little money to spare on his hobby. It is therefore surprising that all the reports received from s.w.l.'s are mainly for s.s.b., and in fact the writer, who operates mainly on c.w., receives s.w.l. reports frequently for his s.s.b. transmissions but very rarely one for c.w. operation. For someone on a limited budget and who wishes to work DX the cheapest and easiest form of transmitter to build is for c.w. only, and 25 watts correctly matched into an inverted Vee or ground plane will be effective in contacting distant stations. S.s.b. may be the modern mode and c.w. considered by some to be out of date, but without doubt c.w. offers the best value for money. Listeners would therefore be advised to pay a little more attention to the code (which has to be mastered in any case for a class A licence) and in particular those who collect QSLs would probably find that their average return would increase if they sent out more c.w. reports.

While on the subject of reports the writer was recently asked whether the band reports which appear in *MOTA* each month are of any value. Two main reasons can be given in their defence, firstly they provide a useful guide to what has been worked and heard on the h.f. bands from the United Kingdom. Secondly, and the most important, if they are used in conjunction with the propagation predictions they provide a useful source of information for the operator to determine when is the best time to contact different areas of the world on each of the h.f. bands.

News from Overseas

W2CQA, who operated from Granada recently with the call **VP2GTA,** writes that he had over 1300 contacts during his stay of four weeks on the Island. Ed used a Collins " S " line into a Mosley TA33 on 20m and 15m, and dipoles for the l.f. bands. Ed goes on to say " that transmission and reception were absolutely fantastic, I have operated from many sections of the world both North and South of the equator, but never have I heard such signals as I heard in Granada. In approximately 20 days that the beam was up, 106 countries were worked, and for the first time in my life I was able to enjoy numerous contacts on both 40m and 80m with many European stations and contacts extending as far as Russia and Afghanistan."

From Bob Tanner, **5Z4AA,** comes news of a four band contact on May 31 with **G3PCI.** Over a period of 19 minutes the following contacts were made: 17.25, 15m, R5 S9; 17.33, 10m, R5 S6; 17.40, 20m, R5 S9; 17.44, 40m, R5 S7. This is a fine achievement by stations who are prepared to use to the full the openings that occur on the h.f. bands.

G3GPE, who was one of the operators on the Kamaran Island and Kuria Maria DXpeditions will arrive in Sarawak during July for a stay of twelve months. At the moment, Ken does not know what his 9M8 call will be but when it is issued he will be active with 15 watts on crystal frequencies of 7040 and 14,080 kc/s.

Bob Milton, **9M4LX** who has put so many Asian countries on the map during the past two years will be returning to the UK in July. Anybody needing a QSL from one of his many calls should address his request to G3EOV, via the RSGB QSL Bureau. Bob has QSLd all his contacts 100 per cent, but is still receiving requests for QSLs referring to QSOs over a year old. The following stations are listed by Bob as being active on s.s.b. from the Malaysian area: 9M2AA, DQ, FR, LO, LS, SR, TC. 9M4JY, LP, MB, ME, MF, MO, MP, MT. 9M6AA, AC, BM, JH. 9M8EE, KZ, RS and VS5MH.

Mike Matthews, G3JFF, is off on his travels again and from June 12 he will be operating from Gibraltar with the call **ZB2AM.** The QTH appears in *QTH Corner*.

5N2AAF will be in Thailand as an s.w.l. from July 1 until December 1. Mike does not intend taking any transmitting gear with him but he will have an Eddystone EC10 receiver and promises to send reports of activity heard. All QSL chores will be cleared before leaving Zaria, but unfortunately as he is not taking his 5N2 logs with him any QSLs that arrive after leaving will have to wait until his return in December. It should be noted that all applications for the 5N2 award should now go to the Nigerian Amateur Radio Society, Box 2873, Lagos, and not to 5N2AAF at the Zaria QTH.

G3JPQ, who is ex **9M4LU,** is going to Bahrain Island for one year from July and during that time may be contacted c/o 23 Eldorado Road, Cheltenham. Mike is hoping to operate mainly on 40m c.w., on which band he was an outstanding signal in the UK from Singapore.

WO1 J. E. Grigsby operating the Gurkha Signals Club Station 9M2SR in Seremban, Malaya.

* Please send all reports and news items to RSGB Headquarters to arrive not later than **July 15** for the **August** issue and **August 12** for the **September** issue.

RSGB member VE3FQC will be operating from W4-land for the next two years under the reciprocal licensing facilities. Plans include plenty of mobile operation on the h.f. bands.

Pat Dunbar, **VR1S,** writes from Funafuti Island (seven miles long and a half mile wide at its broadest point) in the Ellice group. Pat uses an NCX3 with a home made power unit giving about 90 watts input. Dipoles are used for 20, 40 and 80m, together with an untuned quad for 20m rotated by " The Armstrong Method." VR1S has been on the Island since November 1963 but only operating semi-seriously for the past two months and expects to continue the activity until he leaves in February 1966. Pat promises to QSL 100 per cent and hopes that stations who have sent Air Mail QSLs with two IRCs will understand if they get their replies by surface mail. He only gets 7d. for an IRC and the Air Mail rate to the UK is 3/7d. Two hundred cards have already been mailed to the bureau (the entire stock) and further QSLs are on order. Cards are on their way via the RSGB for G2BOZ, 2LB, 2RO, 3AAE, 3HCT, 3LDR, 3RFE, 3SEY, 4CP, 6XL, GW6YQ and GM3ITN.

VS9ADF will be extremely active for two months from June 24 on 40m and 20m c.w. Douglas, who has worked 50 countries to date from Aden, will be trying to obtain his DXCC before leaving. QSLs may be sent via the RSGB or to the address given in QTH corner.

Martin Haasen, **OY7ML,** who was listed last month as having DL6EQ as his QSL manager has written to say that since January, 1965 he has been dealing with his own QSLs which can be sent to Bogota 4, Torshavn, Faeroe Islands or via the OY QSL Bureau. There are now 31 licensed amateurs on the Faeroe Islands but as many of them are radio operators in the Merchant Service only about 16 are regularly active.

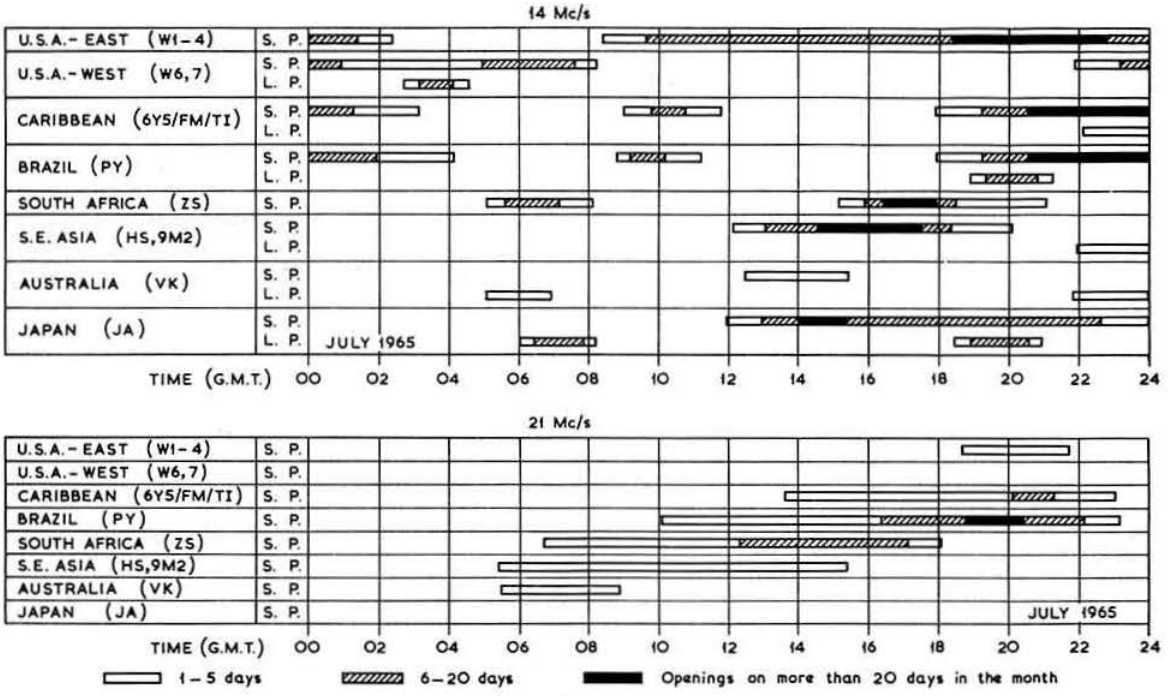
Mac, **MP4BEK,** who is now QRT from Bahrain Island and back in the UK is hoping to get a " G " licence in the near future. Anyone who has not received an MP4BEK QSL may reach Mac at the address given in QTH corner.

Stations who wish to contact **VR6TC** in Pitcairn Island may obtain skeds through the help of W5OLG. One of the reasons why Tom Christian is not as active as DX stations would like is due to the high cost of diesel fuel oil to run his electric generator. Consequently, Tom is reluctant to use the generator too much in day-light hours and at present operates rarely more than once a week. Tom, like all the others on the Island, must earn a living and a lot of his spare time is taken up fishing and gardening which are musts if he is to survive, besides having to be a Jack-of-all-trades for the commercial radio station. Those who are fortunate in making a contact with Tom may QSL via W4TAJ.

DXpedition News

The annual DXpedition to the Aland Islands will be made from July 18 until July 27. OH2BH, BQ, BS and SB will operate 24 hours a day using the call **OH2AM/OH0** on the following frequencies: s.s.b.: 3790, 7070, 14125, 14240 and

PROPAGATION PREDICTIONS



Conditions during July will be similar to those prevailing during the previous month. Operators referring to the accompanying forecast charts will certainly have frequently noticed that the most favourable times for traffic with certain DX zones do not always produce contacts with stations in those zones. This is particularly the case when the favourable times for propagation do not coincide with the main periods of activity for the stations in the areas concerned. Thus the best opportunities for contacts exist when the times given in the forecast charts coincide with the main periods of activity of the amateurs in the desired DX zone. This applies especially to those areas with relatively few amateurs.

It is hoped to publish in the near future a table showing main activity periods in DX locations in terms of GMT.

The provisional sunspot number for May 1965 was 26·4 with the period of greatest activity lying between the 15th and the 25th of the month. The predicted smoothed monthly sunspot numbers for September, October and November are 24, 26 and 29 respectively.

KH6FBJ, Clay, using his KWM2 during his recent Johnston Island trip.

21350 kc/s; c.w.: 3505, 7005, 14040 and 21040 kc/s. All QSLs will be handled by W2CTN.

Readers are reminded that those who require direct replies from Hammarlund DXpedition stations are requested to send self addressed (not stamped) envelopes to Box 7388, GPO, New York 10001, USA. All other QSL cards will be forwarded via the respective bureaux.

The recent DXpedition by CE0XA from San Felix Island has been confirmed as a new DXCC country addition and all QSLs will be accepted for credit after August 1, 1965.

It is rumoured that ZD8HL will be active from Tristan Da Cunha Island in the near future before making an extensive DXpedition tour of all VP2 Islands.

Apologies to **W4BPD,** Gus Browning for sending him to Britain instead of Bhutan (*vide* June DX Briefs). Gus has now completed his tour of the AC prefixes and at the time this was being written he was on his way to Calcutta. Activity is planned from **9N1MM** during the end of June and early July with operation from East and West Pakistan afterwards if the necessary visas can be obtained. As Gus, from past experience, can change his itinerary at a moment's notice, watch should be kept on his preferred frequencies of 14035, 65, 110 and 140 kc/s.

Monaco will be activated by **ON4FO/3A0, ON4QJ/3A0** on c.w. and **ON5DO/3A0** on s.s.b. from July 9 until July 11. W2CTN will handle the QSLs for ON4QJ while cards for the other two stations must be sent to their home calls in Belgium. The new prefix 3A0 is being issued to foreign amateurs visiting Monaco.

VP2SRC, who operated from one of the smaller islands in the St. Vincent group for three days during May was asking all stations contacted for one dollar to be sent towards the cost of a special QSL card. No one has yet been able to tell the writer how an ordinary QSL may be obtained at not such an exhorbitant fee!

Awards

The Malmoe Short Wave Club offers four certificates for working each of the capital cities of Asia, Africa, Europe and the Americas. There are three classes to each award which require 15, 20 or 30 capitals to be worked. Send applications, GCR list, and 10 IRCs to SM7DQK, Box 74, Skurup, Sweden AMOB/M.

In connection with the Hammarlund DXpedition of the month, details of an all-continent award will be issued in the near future. Applicants will have had to have worked Hammarlund stations on each of the six continents. Further details will be given when they come to hand.

The Radio Society of Ceylon offers a certificate for working ten of their number. Though there are over 25 4S7 stations listed in the current call book it is believed there are now only nine active, so this award will take some doing!

The United States County Hunters award is sponsored by the Certificates Hunters Club and requires GCR proof of contacts with different US states, call districts, ITU zones and US counties. There are eleven classes of this award and the basic requirements are to work 300 US counties, 30 US states, seven call areas and two of the three ITU American zones. The top award calls for proof of contact with all 3077 US counties in 50 states, 10 call areas and the three ITU zones. The charge for the initial certificate, which measures 17 in. × 22 in., and pictures all the US counties, costs 10 IRCs, after which stickers are available for the higher classes and return postage is all that is required. Address all applications to CHC Secretary, **K6BX,** Box 385, Bonita, California, USA. A trophy will be awarded to DX stations who manage to prove contact with 2400 US counties.

Contest News

To commemorate the 100th anniversary of the ITU the Amateur Radio Club of Colombia is sponsoring a contest which runs from midnight on July 16 to midnight on July 18. Briefly, all bands and modes may be used with an ascending serial number to be exchanged with the report. European stations have to contact as many HK stations as possible and their score is calculated by multiplying the number of contacts by the sum of the different HK call areas worked on each band. Logs must be postmarked not later than October 20 1965 and sent to July Contest, LCRA, Box 504, Bogota, Colombia. Further details and log sheets may be obtained by sending a s.a.e. to G3HDA.

The 11th European **WAE DX Contest** will be run as follows: c.w.: 00.00, August 14 until 24.00, August 15; phone: 00.00, September 11 until 24.00, September 12. Rules are similar to those used in previous years and complete information may be obtained by sending an s.a.e. to G3HDA. In connection with the 10th WAE contest **G2DC** and **G3MWZ** were certificate winners in the c.w. section while **GD2HFD/A, GM3JDR** and **GW3NWV** won certificates in the phone section.

The 1964 ***CQ* C.W. Contest** attracted 1305 entries from over 100 countries but none were received from Scotland or Wales. W1WY of *CQ Magazine* hopes that they will have

Tom Christian, VR6TC, and YL Betty on Pitcairn Island (see page 468).

QTH Corner

CT2AM	Box 3, Santa Maria Airport, Azores Island.
CX8AAW	Box 286, Montevideo, Uruguay.
FY7YL	Box 267, Cayenne, French Guiana.
HP1CC	Box 168, Panama City.
HK0QA	Via K9ECE, 5115 Delaware Ave., Fort Wayne, Indiana.
HL9TQ	APO San Francisco, 96358 California.
HS1HS	Box 2008, Bangkok, Thailand.
KM6DJ	US Naval Security Group, Navy 3080—BO—FPO, San Francisco, California.
KJ6BZ	APO, San Francisco, 96305 California.
KZ5LC	Via W2CTN.
Ex MP4BEK	24 Woodlands Road, Charing Cross, Glasgow C.3
OY	QSL Bureau, Box 184, Torshavn, Faeroe Islands.
OD5	QSL Bureau, Box 1217, Beirut, Lebanon.
TL8SW	Box 302, Bangui, Central African Republic.
VP5LV	Box 4187, Patrick AFB, California.
VR4CR	Box 49, Honiara, British Solomon Islands.
VR6TC	Via W4TAJ, Box 3301, Johnson City, Tennessee.
VS9ADF	Sgt. D. Higgins, Royal Signals, Attd. 2nd Coldstream Guards, BFPO 90.
W2CTN	159 Ketcham Ave., Amityville, NY.
XW8BA	U.S. Embassy, APO, San Francisco, 96352 Calif.
YV5BIG/7	Via K3SLP, RFD 2, Village-By-The-Brook, East Stroudsburg, Penn. 18301, USA.
ZB2AN	C.R.S. M. J. Matthews, CPO Mess, HMS *Rooke*, Gibraltar.
W2ZIA/ZK1	363 Ludington Street, Buffalo 6, NY.
ZD8PI	279 Hoole Lane, Chester.
5N2AAC	Via G3PCY, 79 Manchester Road, Accrington, Lancs.
5T5AD	Box 100, Nourakchott, Rep. of Mauretania.
5U7AG	Box 201, Nianey, Niger Republic.
5W1AG	Via K6EXO, 5849 Moorcroft Ave., Canoga Park, California.
6Y5XG	Via G8VG, 121 Laburnam Ave., Dartford, Kent.
7G1A	Box 477, Conakry, Rep. of Guinea.
HZ3TYQ/8Z4	Via W1RAN.
9K2AM	Box 326, Kuwait.
9M2SR	17 Gurkha Signal Regt., c/o GPO Seremban, Malaya.

more entries from the United Kingdom in 1965 and states that they do give an attractive certificate to winners of all band and single band sections. Our congratulations to **G3HCT** for being European leader on 15m.

CQ C.W. Contest

All Band—Single Operator

PY4OD	..	796,740	9M4LX	..	494,910
UB5CI	..	766,108	W4YHD	..	481,052
W3GRF	..	578,993	UB5FJ	..	462,142

Continental Leaders

Single Band

21 Mc/s

ZS6IW	..	405,460	**G3HCT**	..	**35,773**
K1NOL	..	44,544	VK4EL	..	16,297
UA9VB	..	38,142	PY5EG	..	16,254

14 Mc/s

CX2CO	..	435,732	JA1BWA	..	164,300
9J2VB	..	303,420	KH6EPW	..	161,667
W4KFC	..	266,631	DJ2BW	..	153,036

7 Mc/s

5A1TW	..	227,814	IT1TAI	..	115,346
4X4FA	..	174,505	PY4AP	..	81,673
W6AM	..	161,991	VK3ADB	..	15,600

3·5 Mc/s

4X4DH	..	55,440	VE3AU	..	13,908
M1ZG	..	34,750	VK3XB	..	1,443

1·8 Mc/s

OK1ZC	..	3,060	VE2UQ	..	2,626

England

G2DC	.. ..	**A**	**148,176**	**343**	**54**	**142**
G8FC	.. ..	„	127,565	414	50	105
G3FTQ	.. ..	„	33,853	235	28	69
G3DXY	.. ..	„	29,944	284	21	55
G2AJB	.. ..	„	23,556	154	27	51
G3HZL	.. ..	„	23,115	140	40	75
G3MWZ	.. ..	„	12,408	114	22	44
G3NVK	.. ..	„	8,448	80	23	43
G3HCT	.. ..	**21**	**35,773**	**175**	**26**	**57**
G3FKM	.. ..	**14**	**110,635**	**372**	**32**	**77**
G3PJW	.. ..	„	20,475	280	14	31
G8DI	.. ..	„	5,472	99	9	29
G3RJB	.. ..	„	1,536	55	6	24
G3HDA	.. ..	**7**	**43,368**	**357**	**23**	**63**
G3DDY	.. ..	„	29,944	284	21	55
G3ESF	.. ..	„	20,436	329	13	39
G3GGS	.. ..	„	13,395	173	16	41
G3OLN	.. ..	„	3,480	60	13	27
G3RAU	.. ..	„	**1,660**	**71**	**4**	**16**
G5MP	.. ..	„	312	28	2	10

Channel Islands

GC4LI	.. ..	**A**	**28,938**	**180**	**28**	**50**

Northern Ireland

GI3GAL	.. ..	**A**	**23,166**	**156**	**28**	**53**

England (Multi-Op)

G3SBI	.. ..	**A**	**74,462**	**359**	**35**	**82**

(G3SBI, G3RIK)

Number groups after call letters denote the following: Band (A-all), Final Score, Number of QSO's, Zones and Countries. Certificate winners are listed in ***bold face***.

Commonwealth Call Areas Table

	1·8	3·5	7	14	21	28 Mc/s	Total
G3KSH	—	26	24	75	26	—	151
5N2AAF	—	6	14	65	43	16	144
G3DYY	—	9	31	55	19	7	121
G8JM	4	—	—	70	15	1	90
VO1FB	11	15	13	31	8	1	79
G3AAE	—	—	7	40	22	—	69
G3LHJ	3	3	5	29	26	2	68
A2111	3	24	28	86	62	16	219
A4038	3	8	6	67	32	14	130
A2498	2	8	10	74	29	7	130
A4552	—	2	—	44	58	8	112
A2340	6	13	22	51	18	1	111
A4048	5	13	5	58	17	2	100
A4311	1	10	1	60	17	3	92
A3699	5	11	10	39	24	2	91
A4431	3	8	4	41	34	1	91
A3902	4	14	2	41	22	6	89
A3942	4	14	24	37	7	—	86
A4201	4	9	4	53	13	3	86
A4391	4	6	2	30	19	4	65
A3766	1	8	2	35	13	1	60

Band Activities

The past month maintained excellent conditions on the h.f. bands, but the writer would appreciate further reports of activity on 80m and 40m as it is known that some of the regulars on these bands are quietly enjoying DX contacts most evenings. 20m has lived up to expectations with **ZL3VB** putting useful signals into the UK on c.w. and s.s.b. during Ian's limited stay on Chatham Island. **CR8BH** came and went, but to the disappointment of many was not active over weekend periods at times which suited Europe. **5W1AG** showed up for three days' DXpeditionary s.s.b. activity

from Western Samoa. Many UK stations would not have been able to make QSOs if not for the fine efforts of VE8RG who managed to break through the wall of W QRM to let the operators know that they also had nearly all Europe calling them. Twenty metres has been staying open 24 hours on some days with signals from Asia, Far East and Australia coming through after 01.00. Fifteen provided many fine openings particularly to Africa and South America with the occasional opening to Asia, Far East and Oceania. Ten still provides interest for those who are prepared to be patient, and this month we have reports of stations heard/worked on five continents and in 61 countries. **9M4LP** writes that on May 23 he had four contacts with Europe on this band and **GI3IVJ** was one of the European stations making the grade. Signal strengths were better than those on 15m or 20m at the time.

Once again contributors are thanked for their interest and this month's offerings are compiled from reports sent in by G2BOZ, G2RO, G3AAE, G3APZ, G3FKM, G3HCT, G3KSH, G3OAD, GM3RKO, G3SML, G4MJ, G8JM, A2111, A3699, A3902, A3942, A4038, A4048, A4311, A4328, A4431, A4474, A4489, A4533, A4552, A4574, A4641.

1·8 Mc/s C.W.: DJ3KR (21.30), DL8AM (23.50), HB9TT (01.20), OL1AAM (21.30), OL5ADA (20.50), OL6AAE (23.23), OL7ABI (00.21), W1BB/1 (01.00), 4U1ITU (21.45) 4U2ITU (20.10), 4U3ITU (21.30), 4U6ITU (01.00), and NS1A heard giving his QTH as the North Sea! (obviously someone who has not the capabilities to get a legitimate call sign of his own).

3·5 Mc/s C.W.: UH8DC (21.15).

3·5 Mc/s S.S.B.: HZ1AT (23.35), 4U3ITU (22.50), 9J2WR (22.10).

7 Mc/s C.W.: CR4AB (23.00), LU8ADV (23.20), OY2J (22.52), TA2FA (21.20), VP6BW (23.10), ZL3VB (Chatham Island 07.30), 4U1ITU (00.20), HZ3TYQ/8Z4 (23.20).

7 Mc/s S.S.B.: OX3MN (20.15), TF2WJF (21.10), TG9RH (00.00), VK6ZK (21.20), VP1LB (00.10), VP2SK (22.00), VP2SM (23.10), VP6KL (21.20), ZS1XX (21.55), ZS1ZH (21.05), ZS5GU (20.50), 4U5ITU (20.10), 5A2RT (20.55), 9J2WR (21.30).

14 Mc/s A.M.: CR4BC (21.01), CT2AM (20.27), EA8DV (08.56), EL1H (17.32), EP2BU (22.18), EP3RO (09.30), OA8NX (22.00), PZ1BI (21.02), YV6CG (20.39), ZB2AJ (11.25), 5A4TS (20.41), 7X2BB (10.11), 9K2AG (20.55).

14 Mc/s C.W.: AC1H, 2H, 3H, 4H, 6H, 7H, 8H (13.00-16.29), CO2BB (23.10), CP5EZ (19.00), CR4AE (08.26), CR8BH (08.45), CR9AH (21.10), CT3AQ (23.25), DU1OR (17.40), EL2AD (14.30), FG7XC (22.20), FK8AH (08.00), FM7WH (22.15), FO8BI (07.55), FU8AG (08.15), HM1BB (09.12), HM3CG (08.15), JT1AG (12.10), JT1AJ (14.40), JY7TY (20.12), KM6CE (06.55), KM6DJ (07.18), KZ5TD (00.01), OA6W (00.58), OD5LX (13.45), PJ2CJ (22.55), PZ1BH (01.00), TL8SW (20.10), TI2WD/8 (21.10), TU2AN (21.03), UA0YR (Zone 23, 11.00), VK4TE (Willis Island 05.45-10.50), VP2AV (22.05), VP3AC (21.00), VP3YG (17.00), VP4LF (07.35), VR1S (08.55), VR4CR (07.35), VR6TC (06.00-07.00), VS6FC (16.25), YS1RFE (23.38), ZA1GK (13.40), ZD7IP (19.35), W5MGU/ZK1 (07.10), ZL3VB (05.00-09.00), ZL4JF (Campbell Island 07.22), 5T5AD (20.50), 5W1AZ (07.08), HZ3TYQ/8Z5 (16.34), 7G1A (16.33), 9E3USA (18.00), 9L1TL (11.55), 9M8RS (14.45).

14 Mc/s S.S.B.: AC1H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H, 0H (14.40-17.51), CE1DD (20.40), CP5AD (20.59), CP8AB (22.30), CR4AJ (17.45), CR8BH (15.50), CR9AI (14.35), EP3AM (20.39), FO8AA, 8BI, 8BJ (06.53-07.23), WA0IFW/FO8 (07.19), HB0LL (15.24), HC8FN (06.35), HK0QA (22.30), HL9TQ (15.40), HS1HS (15.59), HV1CN (19.27), KB6EPQ (07.25), W5CQK/KH6 (Kure Island 06.15), W9FKL/KJ6 (07.34), KJ6BZ (08.02), KS6BQ (07.13), KW6EJ (08.56), KX6BU (08.50), PJ2MI (16.33), TJ1AC (18.01), UA0YP (Zone 23, 14.20), VK0GW (07.24), VP2KL (20.25), VP2LS (23.45), VP2SM (21.05), VP3JR (19.28), VP5LV (Grand Turk Island 02.40), VS6AJ (15.43), XW8AY (16.06), YA3TNC (15.40), W2ZIA/ZK1 (05.45), ZL3VB (05.00-08.00), ZL4JF (06.33), ZP7BM (22.25), 4S7IW (14.40), 4U1SU (16.20), 4W1Y (15.40), 5H3JR (19.10), 5W1AG (07.40-08.30), 7G1L (17.24), 7X6FT (19.10), HZ1AT/8Z4 (08.05), 9E3USA (Special Prefix for Ethiopia 18.45), 9K2AN (19.20), 9M8KZ (14.15), 9X5CE (17.30).

21 Mc/s A.M.: CE4FH (21.10), CR4AD, AO, AS, (20.00-21.00), CX1PI (20.40), CX2CN (19.35), EA6AM (17.51), FG7XW (21.50), HC1EL (21.55), KP4CS (21.40), KZ5BT (23.15), MP4BEN (12.20), OA4PH (22.20), OA6P (15.15), PJ3AW (22.55), PZ1BE (20.34), PZ1BK (19.40), SV0WO (Crete 19.30), TN8BK (11.20), TU2AN (16.30), TU2AP (17.45), VK6QL (07.55), VP2GW (22.15), VP2LA (21.40), VP4LE (22.10), VP4RS (21.25), XE1CP (22.45), XE1DW (20.58), ZP5EC (21.10), ZS9G (11.00), 5X5AJ (18.05), 6Y5EM (21.40), 9GI's (16.00-20.00), 9L1WN (16.38), 9J2's (17.00-19.30), 9K2AD (17.10), 9Q5's (16.00-20.00), 9U5IB (19.05), 9X5AV (17.33), 9X5MW (18.30).

21 Mc/s C.W.: CR4AE (20.00), JA2DSH (13.20), JA6AA (09.55), PJ2CZ (20.00), TL8SW (13.30), VR6TC (22.00), VS9AMD (12.00), WA6SBO (22.00), ZD7IP (18.10).

21 Mc/s S.S.B.: CE3QB (19.55), CR6DA (17.43), CX3VX (19.08), HB0ZT (20.35), HI7XRB (18.26), KV4CX (20.28), KZ5AC (23.07), LU5DBS (18.18), LX1DO (18.05), SV0WF (Rhodes 19.11), TI2JH (22.58), TL8SW (17.40), VP3AA (21.04), XE1C (23.05), YV4MV (20.36), ZD7GP (18.29), ZD8LT, JL, TV (18.10-21.15), 5H3JR (18.18), 6O6BW (19.35), 7Q7PM (17.41), 9J2JN (09.15), 9L1MJ (18.17), 9X5HP (17.28).

28 Mc/s S.S.B.: CT1, DL, EA, EI, F, G, GI, GM, HB, I, LA, OE, OK, OZ, PA, SM, UA, UB5 and YU (08.00-20.00), EL2U (19.45), LU1DAB (20.00), LU3BAC (20.05), SV1AE (15.15), VS9ARO (14.21), W4BJ (19.43), ZE1JE (13.55), 3A2CP (12.45), 5A5TH (17.10), 5H3JJ (14.55), 5X5IU (13.00), 5Z4AA (17.59), 7Q7GS (16.00), 9J2FK (14.15).

28 Mc/s C.W.: HK5CR (22.25), ZB2A (15.00), ZC4CZ/P (09.45), ZC4GB/P (08.35), 5H3JJ (11.10), 7Q7PM (10.40) 9H1AA/P (09.40), 9J2DT (12.40).

28 Mc/s A.M.: CT1, EA, EI, F, G, GC, GM, GW, HA, HB, I, IS, LA, OE, OK, OZ, PA, SM, SP, UA1, UA2, UB, UC, UO, UP, UQ, UR, YO, YU (07.00-21.00), CE3BQ, 3DI., 3HE, 3MY, 3VW (18.00-20.05), CR4AD (17.15), CR6ACB (14.05), CR6HF (15.58), CR6JM (11.14), CR7AA (17.02), CR7FZ (17.08), CT3AN (19.00), CX1AAM, 2CN, 2DT, 3FT, 4CS (17.00-21.00), EA9AF (19.30), HB0ML (15.40), LU's Galore (17.25-21.00), PY3BNJ (19.15), PY5DI (18.30), TN8AD (18.05), UD6NFK (15.25), UL7APG (19.25), ZE's (10.00-17.30), ZC4GT (12.30), ZC4MO (14.25), ZS2OM, 2OW, 6AMO, 6AWH (11.00-16.00), ZS9G (13.30), 5H3JJ (15.55), 5N2AAF (15.40), 5N2KOB (13.40), 7X2BB (17.15), 7X2EW (13.00), 9G1FR (18.25), 9G1FS (16.30), 9J2BC, DT, FJ, GJ, W. WR (10.00-18.30), 9Q5AI (16.05).

DX Briefs

WA5HZY and WA5CGT will be active from Honduras between June 21 and August 22 with the call **HR1HZY**. QSLs via WA5CNP.

GC2HFD/A will be operating on 14,125 kc/s between July 24 and August 14 from Alderney Island and listening for calls 5 kc/s up or down or 200 kc/s up for Ws. All QSLs via G2HFD at his home address.

PY7AFN is reported to be still active on a.m. from Fernando De Noronha Island between 17.00 and 18.30 on 14,247 kc/s.

Mike Matthews, **ZB2AM** reports that the only stations

(Continued on page 477)

CONTEST NEWS

RESULTS — REPORTS — RULES

First 1·8 Mc/s Contest 1965

The first single operator Top Band contest of 1965 was held on March 20/21. This is still one of the most popular contests, although the number of entries this year is down to 77 compared with 84 in 1964 and 93 in 1963.

The leading station is G8FC, the well-known club station of the RAF Amateur Radio Society at Locking in Somerset, operated by Sgt. R. Handley, G3GJQ, with a total of 684 points from 144 contacts. As club stations operated under the club call-sign are ineligible for the Somerset Trophy, the winner is again D. J. Andrews, G3MXJ, who also won the trophy in 1963 and was placed fourth last year. His 673 points gave him a lead of 14 points over I. T. Cashmore, G3BMY, who was third in 1964. J. A. Bratby, G3GVA, with 636 points improved his position from thirteenth last year to third this time, but with a margin of only one point over D. G. Alexander, G3KLH.

This year's winner of the Maitland trophy is Tom Heslop, GM3KMR. Although not scoring as heavily as W. G. Cecil, GM3KHH, in this contest, his efforts in the second contest of 1964 were enough to give him a 155 point lead.

Certificates of merit will be awarded to I. T. Cashmore, G3BMY, J. A. Bratby, G3GVA, and to M. Harrison, BRS24733 for his check log.

Conditions

Conditions would seem to have been good and several stations contacted VO1FB, although very few continental stations appear in the logs, OK1AII being the only one giving any appreciable number of QSOs. Although some people thought activity was a little lower than in previous years, the number of contacts made by the leading stations is well up to normal. The rate at which QSOs are made is probably higher in this contest than in any other RSGB event. The first eight stations all achieved over 60 contacts in the first two hours. To maintain such a high rate of scoring most QSOs must result from brief CQ and QRZ calls and a case in point is the check log of G6BQ, which shows that out of a total of 144 stations worked, only eight were called by him in the first place.

Comments

With only nine stations including any comments with their entries it is difficult to assess how the contest went except that most people had no complaints! BRS24733 dislikes the practice of some stations who sign with the call-sign of the station they are working and not their own. Whether stations should do this is open to question, but it is being increasingly used, particularly by DXpedition stations, in an attempt to reduce confusion. For example, if G2ZZZ has several replies to a CQ, the station replied to frequently loses the first part of the next over in the QRM. If now G2ZZZ $\overline{BK}$ is sent at the end of this over no-one knows to whom G2ZZZ has replied. If, however, he sends G4AAA $\overline{BK}$ then obviously G4AAA is the other station concerned in this contact. For the information of G3IOR and any others, general rule 6 does preclude a single operator station from having a logger to help out.

Comments from logs

" The final result could once again be a close finish. A tribute to the present scoring system "—G3BMY; " Condi-

RESULTS

Position	Call-sign	County	Contacts	Points
*	G8FC	ST	144	684
1	G3MXJ	KT	158	673
2	G3BMY	SE	137	659
3	G3GVA	WK	132	636
4	G3KLH	BE	139	635
5	G3JEQ	SY	146	614
6	G3IGW	YS	134	603
7	G3SED	HE	124	560
8	G3BFP	SY	132	554
9	G3OSW	ND	111	551
10	G3HVX	HD	111	540
11	G3FM	SY	128	531
12	G3SWH	GR	113	523
13	G3JVJ	SX	114	514
14	G3LHJ	DN	101	488
15	G3ITH	SD	100	484
16	G8AB/A	EX	112	483
17	G3PYI	GR	100	476
18	GM3KHH	BF	94	465
19	GI3NZZ	DW	93	463
20	G3GGS	LE	96	450
21	G3SYS	SX	97	431
22	GW3PMR	CV	87	428
*	G3PIA	BE	94	425
23	G3IOR	NK	88	424
24	GM3KMR	MN	87	423
25	G3JSK	SD	88	422
26	GM2HCZ	DF	81	403
27	G3KAX	SY	93	388
28	GW3TJE	MH	79	381
29	G3CBW	HF	85	375
30	G3LDT	CH	82	368
31	G3TIR	SX	82	365
32	G3TAM	LD	83	353
33	G3RTU	LE	79	347
34	G3RZI	WR	70	338
35	G3GZB	EX	78	326
36	G3KPU	NM	66	318
37	GW3CW	DB	67	316
38	G3RFN	LE	65	291
39	G3OJE	LD	73	289
40	G3TIK	HF	68	288
41	G3MCX	SY	68	276
42	G3CWW	LD	70	274
43	G3NQT	EX	66	267
44	G3JKY	KT	68	266
45	G3EMO	LE	58	264
46	G3RFT	LE	59	262
47	G3NEU	NR	53	254
	G3HIW	EX	62	254
49	G3LPT	SF	53	250
50	GW3MTL	MH	53	249
51	G3GJX	HF	58	248
52	G3SVW	LE	54	246
53	G8JM	LD	60	222
54	GI3OTV	DW	45	221
55	G3SVL	EX	60	220
	G2QT	KT	50	220
57	G3TQD	WR	48	218
	G3PDU	LE	48	218
59	G3JWB	LD	51	195
60	G3RDU	DN	37	178
61	G3OMU	HE	40	175
62	G3LZZ	YS	40	173
*	G3PRC	DN	34	169
63	G3TAA	LD	47	163
64	G3SGF	LD	44	152
	G3SCH	DN	33	152
66	GW3RXO	GN	34	148
67	G3PHW	SF	30	144
68	G3CBU	HE	32	138
69	G3KGU	EX	38	136
70	G3OGP	EX	36	130
71	G2BLA	HF	27	125
72	G3TUM	EX	25	85
73	G3DGN	EX	20	69
74	G6OO	LN	9	41

* Club station.

Maitland Trophy

Position	Call-sign	Score Nov. '64	Score Mar. '65	Total points
1	GM3KMR	543	423	966
2	GM3KHH	346	465	811
3	GM2HCZ	341	403	744
4	GM3AVA	731	—	731
5	GM3KLA	405	—	405

tions varied from superb to awful "—G3IGW; "Going seemed hard this time"—G3MCX; "Operating standard very good"—G3CBU; "Enjoyable contest"—comment from nearly all letters; "Again, my strongest objection to these rules"—G3MXJ; "Under these rules it is no longer worth the time to write out an entry"—G6BQ.

Check logs

The following stations are thanked for sending in useful check logs: BRS24733, G3SVK, G4VF, G6BQ, GM3ORX and OK1AII.

High Wycombe D/F Qualifying Event

The High Wycombe Qualifying Event took place on May 9 in perfect weather conditions after the heavy rain of the previous few days. All 16 competing parties received strong signals from both the transmitters at the starting point, a few miles west of High Wycombe.

On the second transmission, however, although signals from station B remained strong, many competitors failed to hear station A which, it soon transpired, was very close to the start. It was, in fact, located in a thicket on Cadmore End Common, about 550 yards from and in sight of the starting point; the signal strength had been carefully adjusted to be less than that from station B which was 12½ miles away on top of one of many overgrown mounds in a disused brickfield. Four competitors succeeded in locating both stations and all found station A first. E. L. Mollart was again ahead of the field to find his second station and win the event in two hours; detailed results are given below.

Over fifty tired but happy participants sat down to tea at Marlow through the generosity of Mr. Berger who placed his restaurant at their disposal; thanks are due to him and to the many helpful ladies who prepared and served an excellent tea. At the conclusion, the High Wycombe Challenge Trophy was presented to Mr. E. Mollart by Mr. D. A. Findlay of the RSGB Contests Committee, who was a welcome visitor. Thanks were expressed to the organizer, Mr. G. T. Peck, his helpers and to G8VZ and G3KJK who operated the transmitters.

Position	Name	Group	Station A	Station B
1	E. L. Mollart, BRS10977	Oxford	1429	1520
2	B. J. Mahony	Rugby	1434	1533
3	M. P. Hawkins	Oxford	1444	1555
4	A. Bristow	Oxford	1441	1616
5	R. Pearce-Boby, G3JLE	Oxford	1528	—
6	B. J. Mudge, G3MDD	Oxford	1530	—
7	J. J. Grant, BRS635	Rugby	1532	—
8	J. Laurence	Salisbury	1533	—
9	O. W. Harding	Rugby	1551	—
10	I. Butson	Oxford	—	1528
11	E. W. Bristow	Oxford	—	1534
12	W. North	Chilterns	—	1613
13	T. Gage	Oxford	—	1628
14	I. Jackson	Rugby	—	—
15	A. C. Newman, G2FIX	Salisbury	—	—
16	P. Simmons, G3IZC	Loughborough	—	—

Rugby D/F Qualifying Event

The weather was dull, dry and windy on April 25 for the first qualifying event in this year's RSGB Direction Finding Contest. It was run by the Radio Section of the AEI Recreation Club; Mr. D. T. Price G3LYU, the organizer and starter was assisted by Mr. C. Earl, G3OXV, who provided a 4m link. The signals, which began at the new time of 13.20 BST, came from directions approximately 90° apart, their strengths being about equal. The field was thus fairly well divided between the A and B stations throughout the contest.

Station A, operated by Mr. B. J. Mahoney, G3NDM, was well hidden in a copse beside a disused airfield near Deddington and was accessible from a footpath, clearly marked on the map but rather overgrown.

Station B was operated by Mr. R. T. Craxton, G3IKL, and was located by a disused railway line near Halse. The telegraph poles had been stripped only of the wires, leaving ready-made supports for an inconspicuous aerial. Once this was noticed, the competitors' troubles were only beginning, because following of the obvious course of the wire led to a wet and muddy culvert under the railway embankment inside which a dark shape with a pair of wellingtons could just be seen. A fifteen yard crawl on hands and knees revealed a dummy of straw in an old pair of trousers and a tidy knot at the end of the wire. Some competitors' expressions were captured on cine film as they re-emerged; this should be worth seeing! The transmitter was, in fact, situated at the other end of the wire in dry grass some eighteen inches high, and affording only the minimum of cover.

Mr. D. A. Findlay, representing the RSGB Contests Committee, once again made a welcome appearance.

Rugby D/F Event

Position	Name	Times of Arrival (BST) Station A	Station B
1	R. J. Pearce-Boby	14.50	15.30½
2	E. L. Mollart	16.14	15.34
3	S. W. Smith	14.33	16.15
4	A. Hitchcock	14.53	16.27
5	E. W. Bristow	16.30	15.12
6	J. R. Mondaint	16.32	15.12½
7	P. Simmons	—	15.30
8	W. J. North	—	15.30?
9	T. C. Gage	—	15.35½
10	M. D. Fowler	15.45	—
11	I. R. Botson	—	15.52
12	A. Bristow	15.54	—
13	M. P. Hawkins	14.25	—
14	J. J. Grant	16.10	—

D/F Qualifying Event

The following are details of the **Slade Qualifying Event. Sunday, August 1, 1965.**

Organizer: M. D. Fowler, G3GKZ, 8 Gleneagles Drive, Great Barr, Birmingham, 22A.

Map: Ordnance Survey, sheet 130, "Kidderminster."

Assembly: 13.00 BST for first transmission at 13.00 BST.

Location: Clee Hill, NGR 612766, approach by track through Whatsill, leaving A4117 at Foxwood.

Frequencies and Call-Signs: To be announced at the start.

Entries and Tea: Intending competitors should notify the organizer by July 24, stating the number in their party requiring tea.

CONTESTS DIARY

July 17-18	- 1296 Mc/s Tests (see page 192, March, 1965).
July 18	- Oxford D/F Qualifying Event (see page 402, June, 1965).
July 25	- Third 70 Mc/s Contest (Portable).
August 1	- Slade D/F Qualifying Event.
August 14-15	- WAE Contest (C.W.).
September 4-5	— Region 1 IARU V.H.F. Contest.
September 4-5	— V.H.F. National Field Day.
September 11-12	— WAE Contest (Phone).
September 12	— 80m Field Day.
September 19	— D/F National Final, Derby.
September 25-26	— 21/28 Mc/s Telephony/Receiving Contest.
October 2-3	— WADM Contest (C.W.)
October 9-10	— Raynet Rally.
October 16-17	— 7 Mc/s DX Contest (Phone).
October 23-24	— CQ World Wide Contest (Phone).
November 6-7	— 7 Mc/s DX Contest (C.W.).
November 13-14	— Second 432 Mc/s Contest.
November 20-21	— Second 1·8 Mc/s Contest.
November 28-29	— CQ World Wide Contest (C.W.).
December 5	— Fourth 70 Mc/s Contest (C.W.).

Rules for the RSGB 7 Mc/s DX Contest 1965

Radio Amateurs throughout the world are invited to take part in the fourth RSGB 7 Mc/s DX Contest to be held on October 16-17 and November 6-7, 1965.

The rules for the 1965 Contest have been changed to give a greater opportunity to the DX stations and the attention of all entrants is particularly drawn to rule 8.

Rules

1. **Duration:** Each section of the contest will take place between 18.00 GMT on the Saturday and 18.00 GMT on the Sunday as follows:

Phone: October 16-17, 1965. **C.W.:** November 6-7, 1965.

2. **Eligible Entrants:** The contest is open to licensed amateurs in all parts of the world who must operate in accordance with the terms of their licences.

3. **Contacts:** Contacts must be made in that portion of the **7 Mc/s band** for which the entrant is licensed. Contacts with unlicensed stations will not count for points. Proof of contact may be required. Only one contact may be made with a specific station, whether fixed, portable, mobile or alternative address in each section. Duplicate contacts must be logged and clearly marked as duplicate without claim for points.

4. **Contest Exchanges:** An exchange of RST (or RS) reports followed by a three figure serial number starting with 001 for the first contact and increasing by one for each successive contact and for each separate tion (for example, 58002, etc.) must be made before points can be claimed.

5. Entries may be made as (i) Single Operator, (ii) Multiple Operator.

6. **Entries:** Entries (*a*) should be clearly typed or written on one side only of foolscap or International A4 size paper; (*b*) must be ruled in columns headed (in this order): (i) Date/Time (GMT); (ii) Call-sign of station worked; (iii) I sent him; (iv) He sent me; (v) Bonus points; (vi) Total points claimed; (*c*) must be addressed to the **Contests Committee, Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1, England,** the name of the contest being clearly shown on the top left hand corner of the envelope which must be **postmarked not later than November 22, 1965.** Log sheets are available from RSGB Headquarters.

SAMPLE COVER SHEET

RSGB 7 Mc/s DX Contest 1965 **Claimed Score** .....

Section ..... **Call-sign** .....

Name .....

Address .....

Transmitter ..... Aerial(s) .....

Receiver ..... Call-signs of operators .....

.....

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 ..... watts.

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

Failure to provide and sign the declaration may involve disqualification of the entry.

7. **Scoring:** British Isles stations may not work each other for points. Overseas stations may only claim points for contacts with British Isles stations (G, GB, GC, GD, GI, GM and GW).

Each completed contact between a British Isles station and a station in any one of the six Continental areas will score as follows:

Contacts between British Isles and Continent of Europe	5 points
Contacts between British Isles and Continent of North America	15 points
Contacts between British Isles and Continents of South America, Africa and Asia	25 points
Contacts between British Isles and Continent of Oceania	50 points

The closing date for posting entries is November 22, 1965

Bonus Points:

British Isles Stations: A bonus of 20 points may be claimed for the first contact with each new country. For the purposes of scoring, the **RSGB Countries List** will apply with the exception that VE, VK, W/K, ZL and ZS call areas will each count as separate countries.

Overseas Stations: A bonus of 50 points may be claimed for the first contact with each British Isles country-numeral prefix, i.e. G2, G3, G4, G5, G6, G8, GB, GC2, GC3, GC4, GC5, GC6, GC8, GD2, GD3, GD4, GD5, GD6, GD8, GI2, GI3, GI4, GI5, GI6, GI8, GM2, GM3, GM4, GM5, GM6, GM8, GW2, GW3, GW4, GW5, GW6, GW8.

8. **Awards:** Provided that the log contains 20 or more valid contacts, certificates of merit will be awarded to the overall leaders and runners-up in each section and to the leading station in each of the other five British Isles countries. Certificates will also be awarded to the leading station in each overseas country. VE, VK, W/K, ZL and ZS call areas counting separately as in Rule 7. If the leading entrant in any country is a multi-operator station, a certificate will also be awarded to the leading single operator station.

Listeners' Section

1. **Duration:** Each section of the contest will take place between 18.00 GMT on the Saturday and 18.00 GMT on the Sunday as follows:

Phone: October 16-17, 1965. **C.W.:** November 6-7, 1965.

2. **Eligible Entrants:** The contest is open to short-wave listeners throughout the world. All entrants agree to be bound by these rules. Only the entrant may operate his receiving station for the duration of the event. Holders of amateur transmitting licences are not eligible to take part.

3. **Entries:** Entries (*a*) should be clearly typed or written on one side only of foolscap or International A4 size paper; (*b*) must be ruled in columns headed (in this order) (i) Date/Time GMT; (ii) Call-sign of station heard; (iii) Report and serial number sent by station heard; (iv) Call sign of station being worked; (v) Bonus points; (vi) Total points claimed; (*c*) must be addressed to **The Contests Committee, Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1, England.** The name of the Contest must be clearly shown on the top left hand corner of the envelope, which must be postmarked not later than November 22, 1965. Log sheets are available from RSGB Headquarters. All entries must contain the following declaration:

I declare that this receiving 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 do not hold an amateur transmitting licence.

Date ..... *Signature* .....

4. **Scoring:** British Isles entrants may only log **overseas stations working UK stations in the Contest.** Overseas entrants may only log **British Isles stations in contact with overseas stations in the contest.** A station whether fixed, portable, mobile or alternative address may be logged once only for the purpose of scoring. *CQ or test calls will not count for points.*

For British Isles entrants, each completed log entry of a contact between a British Isles station and a station in the following continents will score as indicated:

Continent of Europe	5 points
Continent of North America	15 points
Continents of South America, Africa and Asia	25 points
Continent of Oceania	50 points

For overseas entrants, each completed log entry of a contact between a British Isles station and any other station in the contest will score as indicated:

Where the listener is in continent of Europe	5 points
Continent of North America	15 points
Continents of South America, Africa and Asia	25 points
Continent of Oceania	50 points

Bonus Points:

British Isles Entrants: A bonus of 20 points may be claimed for the first station logged in each new country. For the purpose of

(*Continued on page 477*)

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.

Bulletin under fire

DEAR SIR,—Having been concerned indirectly with the production of the BULL for a good many years, I am naturally very reluctant to criticize the publication.

However, the trends which have become so noticeable in recent months will have so concerned many members that comment cannot be longer withheld. So self-evident are the facts that a mere comparison between the April 1965 BULLETIN and that of a year previous will I think serve my purpose. The two issues had exactly the same number of pages but the contents showed vast differences. Here are some of them in terms of pages:

	April 1964	*April 1965*
Construction of amateur station equipment	18½	2½
Technical notes	4	1½
Elementary physics for beginners	Nil	6
Construction of ancillary equipment	½	2¼
Supposedly humorous articles	Nil	1

Members will draw their own inferences from these figures and I will confine myself to a few comments.

The core of the Society membership is the body of licensed amateurs. The BULLETIN's first service is to provide them with the necessary technical advice to enable them to keep their equipment up-to-date. A great deal is being developed and constructed but it is not being reported in the BULLETIN. If members will not realize their obligation to make their experiments known, they should be given greater incentive by one means or another.

Everyone is sympathetic to the young enthusiast and anxious to help him gradually to equip himself to obtain a licence. But this does not justify the use of BULLETIN space to reproduce the kind of elementary physics which is readily learnt from students' text-books or the numerous booklets which are on the market. Do we really want to teach our young members to make Leyden jars in 1965? I do hope, Sir, that you will do your utmost to discover whether these comments of mine are shared by other members.

Yours faithfully,
W. A. SCARR, G2WS
Past President

Coventry.

(Members' comments on G2WS's views will be most welcome.
—EDITOR)

Offshore Pirates

DEAR SIR,—As if the pirate commercial radio stations off the coasts of these islands are not providing sufficient annoyance, we now have a new form of pirate Amateur Radio station.

On the evening of May 28, 1965, at midnight, a station with a staggering signal signing NS1A " . . . QTH North Sea, so might as well use this call as any other . . . " made his appearance on Top Band. Among the hundreds calling him was GFH, who told him to QRT. The said NS1A replied, pointing out that as he was outside the territorial limits, he was also outside the jurisdiction of the Post Office, and, in attempting to prove his point, continued with a CQ. GFH also called CQ, and pointed out to all stations on the frequency that NS1A was unlicensed.

Undeterred, the wolf-pack continued to call relentlessly!

Now surely the licence points out its own limitations, both from where, and with whom, contacts may be made, and it is in the interest of all individuals to both recognize and appreciate these conditions. Surely it is not worthwhile risking the loss of one's hobby to add a further unusual prefix to one's list, especially when the true allocation of the initial letters are flaunted.

The General Post Office sets down conditions for Amateur Radio stations that are for the benefit of all concerned against the practices of the unscrupulous individual. It is up to us to support and uphold these regulations, the only alternative being chaos. If the pirates had no audience, then their operation would be in vain. Let us try to put this into practice!

Yours faithfully,
PATRICK J. A. GOWEN, G3IOR

Norwich, Norfolk.

Evolution of Single Sideband

DEAR SIR,—With reference to the write up of the RAOTA Reunion in the June issue, it is stated that " Sir Albert Mumford in quipping mood claims to have experimented with the s.s.b. method of transmission in 1927."

This statement, whilst correcting an impression amongst some amateurs that s.s.b. is a recent American invention, could have been extended to include a little more interesting detail about the mode.

The first inception of " Side Band Telephony " goes back to 1915, the patent for suppressing the central carrier frequency and selecting one of the sideband modulated frequencies, etc. being taken out by J. R. Carson in that year (British Patent).

Carson's circuitry was later modified by R. V. L. Hartley, this again being covered by British Patent. A different method was used by H. S. Osborn (US Patent).

Transatlantic tests were successfully carried out between New Southgate and Rocky Point in 1923, and this fact is on record in the official archives. In both Carson's and Osborn's methods, nothing was radiated while the microphone was not being spoken into, and current requirements, then as now, were related to actual transmission. Sidebands were selectable, and the superior " Talk Power " or p.e.p. of the system was fully realized, the only disadvantage being that there was some difficulty in applying s.s.b. to the shorter wavelengths. However, as we well know, the problem was overcome in time.

It seems hard to believe when listening to the expertise on the 80m band these days that single sideband is celebrating its Golden Jubilee.

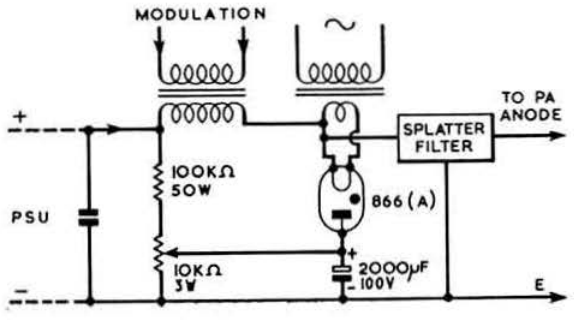
Yours faithfully,
E. G. KENDALL, G3APA

Overmodulation

DEAR SIR,—The letter by old-timer G6YP in the January,1965, issue on the dangers of overmodulation brings out the fact so often forgotten, that whereas undistorted positive peaks cause little trouble and may even be beneficial, negative modulation peaks which interrupt the carrier are the main cause of " splatter " and " spread."

May I add a plea for the more general use of that very simple device which virtually eliminates this problem: the high-level negative peak-clipper, or diode clamp? All that is involved is a diode connected inversely across the h.t. line *after* the modulation transformer secondary, having its cathode towards the positive rail, and anode to earth through a small bias source, equal to about 5 per cent of the h.t. voltage in use. This diode, which can be of the same type as the main h.t. rectifiers, will not conduct whilst the cathode is positive, but as soon as the voltage swings downwards on negative modulation peaks to reach the bias level, i.e., some 95 per cent below the unmodulated mean h.t., the diode conducts and shorts out further power from the modulator which would tend to reduce the line voltage to (or below) zero. Thus the carrier can never be reduced below about 95 per cent of its normal unmodulated level.

The accompanying diagram shows the simple circuit which has been in permanent use at G6GR for about 30 years, during which time there has never been a report of overmodulation or splatter. The h.t. pack is adjustable up to 2 kV, so that an 866 mercury-vapour rectifier is used to withstand the high voltage peaks sometimes experienced. This must be fed with heater



current from a very well insulated transformer, as the primary-to-secondary insulation must withstand the sum of the h.t. voltage plus the positive modulation peaks, which is perhaps the only snag in the high-level clipping arrangement. Transformers with 5 kV insulation specially designed for the 866 (A) often appear on the ex-government market. As the valve only needs 2·5 volts, however, the writer made a transformer by the simple trick of winding a few turns of e.h.t. ignition cable over the existing bobbin of a disused heater transformer, the original secondary being neglected. The 866 is automatically biased from a potentiometer across the h.t. line, and adjusted to give the best clipping performance when checking the modulated carrier envelope on an oscilloscope. A very large electrolytic capacitor must be used across the bias resistor, however, for during over-modulation it will have to maintain a sufficient bias level during quite large peaks of current through the diode. This bias system has the advantage that it is very nearly self-adjusting over a wide range of h.t. voltages, to which the pack may be set up by means of the Variac transformer feeding the h.t. transformer primary.

A mercury-vapour rectifier is the most suitable device for this type of circuit, because it has a very low impedance when conducting, and the voltage drop is negligible in relation to most h.t. voltages. An additional advantage is that when an excess negative peak occurs, the rectifier gives a blue flash, so that if it is mounted where it can be seen (perhaps through an escutcheon in the panel) it provides an excellent overmodulation indicator! Keen experimenters could add a relay in series with the anode circuit, which would close when the clipper diode passes current, to operate a warning pilot-lamp or any other favoured gadget! For lower voltage power units, the old type 83 rectifier gives good results. However, now that high-voltage silicon diodes are becoming available at reasonable prices, it should not be difficult to make up an even more effective solid-state clipper circuit, which would eliminate the need for the special heater transformer. It would, however, be advisable to use diodes rated at four or more times the h.t. line voltage and passing a peak current of at least 1 amp to give reasonable security against breakdown.

Yours faithfully,

Wolverhampton, Staffs. ERNEST GARDINER, G6GR

ZE Beam Raiser

DEAR SIR,—I have read with interest Mr Poulter's modifications to the ZE beam raiser on page 199 of the March issue of the BULLETIN.

Both suggestions have their merits. However, may I point out the disadvantages.

The safety pawl is an excellent idea if it can be made of rust-free material, guaranteed to operate after prolonged exposure to weather. In this system simplicity was thought to be the essence of safety.

The triangular key and key-way was discarded because of expansion of the hoisting cable (considerable out here). This will leave the carriage with free movement in the wind and will result in wear to the mast, plus annoying squeaks. More important, the turning moment of the beam will cause the carriage to ride downwards on the key thereby increasing weight on the hoisting cable and attachments. Increasing the tension of the cable to obviate this could cause trouble at the low end of the temperature scale.

With apologies to Mr. Poulter.

Yours faithfully,

T. G. M. BAILLIE, ZE4JS

Salisbury, Rhodesia

QRA Locator System

DEAR SIR,—Although Mr R. A. Bastow, G3BAC, is loud in his condemnation of the QRA Locator system* his objections would appear, upon examination, to be based upon uninformed prejudice rather than on a practical knowledge of the factors involved.

G3BAC is correct in saying that the international system of latitude and longitude has proved quite adequate for *location* by land, sea and air. However, in these applications it is used in conjunction with properly constructed charts of suitable scale and projection. As G3HRH stated in his article in the March BULLETIN, a map of suitable scale would be expensive, large, and possibly not available in all countries. An additional objection to the use of latitude and longitude in this context must surely lie in the fact that a position requires at least 10 characters for identification, e.g., 5149N 0011W, whereas the QRA Locator system group for the same position involves only 5 characters, e.g. ZL 20 G.

So much for *location*. It is in the measurement of *distance* that the major pitfalls arise. With some map projections, scale is sufficiently constant to permit the accurate measurement of distance within the coverage involved. However, many of the maps which are generally available employ projections on which scale is far from constant. Possibly the most convincing illustration of this is the case of the widely used Mercator's Projection, on which the scale expansion is proportional to secant latitude. If one is conversant with the use of this projection, it is simple enough to allow for the constantly changing scale. However, if one were to use a constant scale—as most non-professional users do—it would be found, for example, that on a map having a basic scale of 1 : 3,000,000 at 15° North, a chart length of 1 in. is equivalent to a distance of 29 miles at Paris, 25 miles at Newcastle and 21 miles in the Shetlands. These are basic errors due to chart construction, and one would expect to find even greater discrepancies due to inaccurate plotting and measurement on smaller scale maps.

The QRA Locator system would appear to overcome these difficulties in a sensible and practical manner, and I feel that G3HRH is to be congratulated on his admirable explanation of the system. The advantages which he lists are all perfectly valid, and need not be repeated here. Every new system is inevitably ridiculed by detractors who cannot or will not take the trouble to study it objectively and who are content to dismiss the entire matter with a sneer and an airy wave of the hand.

If G3BAC learned all about latitude and longitude at school, then he is extremely fortunate. He should be in a position to understand the problem better than most, and should certainly have very little difficulty in mastering the QRA Locator system if he will devote a little study to G3HRH's informed and valuable article.

Yours faithfully,

G. C. MOORE, G3MCY

RAF Benson, Oxon.

* RSGB BULLETIN, May 1965, p. 327.

Class D Amplification

DEAR SIR,—In " Technical Topics " in the March issue, G3VA made one or two incorrect statements.

The name class D was indeed proposed by Mr P. J. Baxandall, but not with reference to pulse width modulation (p.w.m.) audio amplifiers. He was referring to high efficiency sine wave oscillators and amplifiers.

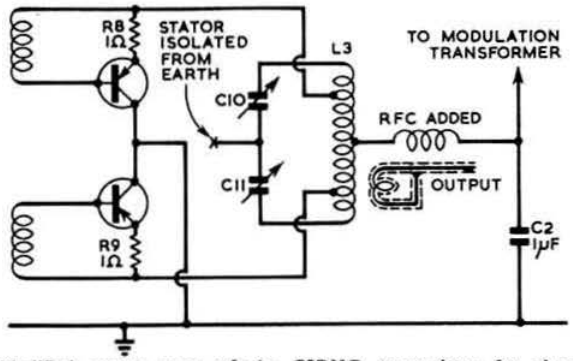
The application of this mode of operation was first applied to transistor audio amplifiers by K. C. Johnson some five years ago, and I was fortunate enough to be associated with him during and subsequent to this early development work.

There is a very real danger that class D and p.w.m. will get a bad reputation if steps are not taken to prevent this. Very exaggerated claims are sometimes made for it by over-zealous advertisers, particularly with regard to distortion. This is especially true when the p.w.m. is achieved by operating the switches at a time corresponding to the intersection of a saw-tooth or triangular waveform and the modulating waveform, and then amplifying the resulting pulse train. This method of p.w.m. is sometimes called open loop operation.

By using a system of positive feedback to produce the switching action and negative feedback to define the switching time a big improvement is possible. This system is sometimes called closed loop operation. A circuit by Messrs Turnbull and Townsend appeared in the April *Wireless World* and I think that we shall be hearing more in the near future about this type of circuit. Much work remains to be done before a " standard " circuit will emerge, so I would like to make a plea that no one be put off if one of the published designs fails to live up to one's hopes.

In the same edition is published a design for a Top Band transmitter using AUY10s in the p.a. This p.a. would greatly benefit from the application of Mr Baxandall's class D operation, and the modifications to the circuit are shown in the accompanying circuit diagram, Fig. 1. The isolation of the p.a. tank circuit from earth allows the AUY10s to bottom, and the whole tank circuit then has a voltage with respect to earth at the second harmonic of the resonant frequency. This necessitates the use of a screened link using coaxial cables.

It is important that the drive should have a 50 : 50 mark space



Modified output stage of the G3DXO transmitter for class D operation.

ratio, and 180° conduction angle unless appropriate precautions are taken.

With AUY10 transistors running at 400mA and bottoming to 1 volt, and using a 25 volt h.t. rail, the power dissipation in each transistor is 200mW, and the efficiency is 96 per cent at 10 watts input. This figure does not, of course, include any tuned circuit or switching losses.

I hope that this letter will stir up some interest in this mode of operation, particularly when it is considered that it is not restricted to use with transistors.

Yours faithfully,

Bramhall, Cheshire. I. D. MACARTHUR, G3NUQ

P.S. If high level modulation is to be used, as in G3DXO's original circuit, the h.t. voltage should not exceed 15 volts and if class D is used, the h.t. voltage should not exceed 9·5 volts, otherwise the maximum voltage rating of the transistors will be exceeded.

Zig-Zag Aerial

DEAR SIR,—Last year a report was brought to the writer's attention by a colleague, concerning the endfire zig-zag aerial on which design details were given in the May, 1964, BULLETIN.* The report showed that it was possible to give mechanical support to the aerial by a metallic rod or wire in the manner shown in Figs. 1 (*a*)-(*d*), although the method shown in Figs. 1 (*a*) and (*b*) was found to decrease the bandwidth compared to the unsupported zig-zag. In the other two cases the bandwidth remained the same but the design frequency was lowered by

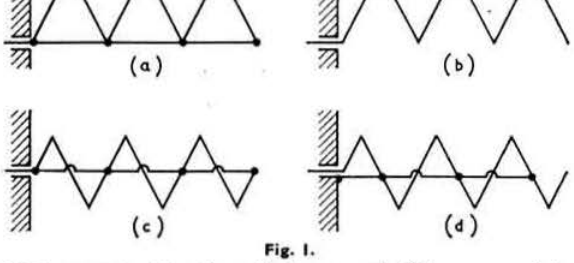


Fig. 1.

10-20 per cent. Also, the radiation moved off the array axis by approximately 15°. This may, perhaps, be due to the unsymmetrical placing of the support wire affecting the surface wave propagated along the structure, and could possibly be counteracted by a similar support placed on the other side of the aerial. These experiments were done in the microwave region where the ratio diameter/wavelength of the support wire was roughly $\lambda 30$, so the effect might be more noticeable than at v.h.f., say, where the ratio used would be approximately an order of magnitude smaller. It would seem probable that these methods of support could be used also for the double zig-zag.

* "The Zigzag Aerial," R. A. K. Said, Final Year Project Report No. 36, Elect. Eng. Dept., Univ. of Birmingham, April, 1964.

The zig-zag aerial may also act in the backfire direction (radiating towards the feedpoint) when designed as a logarithmic-periodic aerial for wideband operation. The ground plane can be eliminated by use of the backfire radiation property and at the same time the 4m, 2m and 70cm bands can be easily covered with one aerial. The writer hopes to describe some of the results to be found in the literature on these aerials in a later article.

Yours faithfully,

Quebec 4, P.Que, Canada C. R. FRY, M.SC., GRAD.I.E.E. (ex-G3NDI, VE2ARO)

More Talk

DEAR SIR,—Further to the letter from Mr Biddell, G3GNM, it would appear that many amateurs are unaware that call-signs need now only be given every fifteen minutes; or at the beginning and end of the QSO.

Writing as an early exponent of break-in working, since 1954 on a.m. and more recently on s.s.b., I am constantly amazed by the many operators who not only find it necessary to give call-signs every time they cough, but also seem to delight in the process. Listening to these protracted type QSO's, I am reluctantly drawn to the conclusion that these characters find it necessary to augment the endless waffle with a plethora of superfluous call-signs in order to maintain the transmission for the longest possible time.

When it is considered that no-one in his right senses would, if in company, monopolize a conversation for up to fifteen minutes, why therefore do it on the air? Not only is it bad manners, it is bad operating.

The only practical solution is the one I use, that is, if an over exceeds three minutes, I am simply not there when the transmission is eventually passed to me. On mobile QSOs I consider one minute overs desirable.

Yours faithfully,

Edgware, Middx. B. S. SUTHERLAND, G3IES

(It is surprising how many amateurs are unaware that it is necessary to transmit the call-sign at least every 15 minutes—see Paragraph 9(2) of the Amateur (Sound) Licence.—EDITOR)

RSGB 7 Mc/s DX Contest 1965 (Continued on page 474)

scoring the **RSGB Countries list** will apply, with the exception that VE, VK, W/K, ZL and ZS call areas will each count as separate countries.

Overseas Entrants: A bonus of 50 points may be claimed for the first station logged in each British Isles country—numeral prefix, i.e. G2, G3, GM4, etc., as listed in Rule 7 for the Transmitting Contest.

5. **Awards:** At the discretion of the Council, certificates will be awarded to the British Isles leading entrant and runner-up and to the leading entrant in each overseas country.

The Month on the Air (Continued from page 471)

active from Gibraltar besides himself are **ZB2A** and **ZB2AJ**.

VQ1GDW is now back in the United Kingdom and using his old call of G3NUF.

VK4TE (Willis Island) closed down on June 10 and left for home in South Australia. Willis Island changes its three man staff every June and it is not yet known whether a licensed amateur is included in the new party (Tks VK4SS).

YJ8BG is a new station on the New Hebrides who prefers 15m a.m. (Tks VK4SS).

* * *

Correspondents are thanked for their co-operation and acknowledgement is made to the *West Gulf DX Club Bulletin* (W5IGJ), the *LIDXA Bulletin*, (W2FGD/W2MES), *DX'press* (PA0FX) and *The DX'er* (N. Californian DX Club). Please send all items to RSGB Headquarters to arrive not later than **July 15** for the **August** issue and **August 12** for the **September** issue.

REGION 1 ORM

ON Saturday, May 15, the Blackpool Top Band regulars were disturbed by the arrival in convoy of G3ERB/M and G2AMV/M. Nevertheless they were made very welcome and a highlight of the arrival was a very successful multi-way contact from Blackpool promenade with EI6AS.

The vanguard of the official party arrived at the Imperial Hotel to find G5ND and his helpers busy fitting out a caravan in the hotel car park as a talk in station. The next to arrive from London by train, right on schedule, was John Rouse, G2AHL, General Manager and Secretary of the RSGB. There followed a most pleasant social evening which included a dinner party attended by G2AHL, Mr and Mrs G5ND, Mr and Mrs G3ERB and the G2AMVs.

By then the Blackpool air was beginning to work wonders and it needed great tact to restrain the General Manager from visiting a Ten Pin Bowling Alley at midnight.

His wish was, however, granted next morning with a visit to the Bowling Alley immediately after breakfast. On returning to the Imperial the party found the talk-in station busy working the mobiles arriving from all over the region. G3OCX handled the cars coming from the North with G3TNN (Ruth) bringing in those from the South. Once in Blackpool the hotel station G3UCA/A got them to the hotel. With beflagged whip aerials in the fashion the hotel car park seemed full of the Bengal Lancers.

Members, wives and families at lunch totalled 113 and the Regional Representative welcomed all those present, including the official party. Fred Parker, G3FUR, replied appropriately.

The business meeting in the afternoon began by all Region 1 local representatives introducing themselves. G2AMV then spoke about Regional matters—expressing his appreciation for the satisfactory attendance. The opportunity was also taken of thanking all those present, especially the local representatives, for their support which helped so much in the administration of the Region for which he was proud to be the representative.

The talk-in station at the Region 1 ORM on May 15, 1965.
(Photo by G3ERB)

The members of the HQ Party, G3ERB, G3FUR and G2AHL all spoke on matters in which they were concerned. A large number of questions then came from the members. Many controversial subjects were discussed including an apprenticeship period on c.w., mobile operating and postal delays. Nevertheless the meeting proceeded in a most orderly manner—obviously to the satisfaction of all present.

A vote of thanks was passed to the official party for their attendance.

Tea was followed by a draw and tape lecture on whip aerials by G3FIF.

Thanks are due to G5ND and his helpers for an excellent weekend.

G2AMV

Symposium for Radio Amateurs

An event which is attracting widespread interest among would-be and experienced amateurs is the symposium which is to take place at the Residential Youth Centre at Ollerton, Notts., in the heart of Robin Hood country, on September 11 and 12. It is being organized by the Newark and District Amateur Radio Society.

The primary function of the week-end is to introduce the hobby of amateur radio to youth leaders and others. Parallel to the course of lectures for those without previous experience in the hobby there will run another course of lectures of a more specialized technical nature for those who already have a knowledge of the art. There will be no hard and fast division so that a mixed programme can be chosen. An amateur transmitting station, manned by younger members of the Newark clubs, will be in operation for most of the time and Sunday afternoon will be devoted to the more social aspects of Amateur Radio. This will comprise a " hamfest " at which visitors will be welcomed from far and near. Events during the afternoon will include competitions, work with radio controlled model aircraft and junk sales.

On Saturday, the opening lecture in the introductory course will be given by Mr E. W. Yeomanson, President of the RSGB, to be followed by lectures on the History of Amateur Radio, Radio for the Disabled, World Wide Amateur Radio, and How to Introduce Amateur Radio to Young People by Mr L. E. Newnham, an RSGB Council member, Mr Eric Box, a blind amateur from Lincoln and Mr K. L. Smith.

The course for established amateurs will include lectures on the International Aspects of Amateur Radio, The Role of Measurement, Radio Astronomy at Jodrell Bank, and the Radio Amateur Emergency Network, by Mr G. M. C. Stone, Immediate Past President of RSGB, Mr K. L. Smith and Mr R. G. Lascelles with a talk by Mr E. W. Yeomanson.

Talks on the introduction of Amateur Radio to schools will be given during the introductory course on Sunday by Mr R. Wallwork, Science Master at Newark Magnus Grammar School and Mr S. Denner, Science Master at Newark Parish C of E Secondary School. Each of these schools operate transmitting stations.

The fee for the full residential course is £2 2s. The fee for non-residents, but including all meals, is £1 1s. A registration fee of 5s. (2s. 6d. for those under 18) for admission to any part of the symposium, but not meals, is included in these prices. A site is available for caravans. Full details can be obtained from Mr S. Denner, 68 Hawton Road, Newark, Notts. (Telephone: Newark 3757.)

Subscription Rates

effective July 1, 1965

Home Corporate Members	£2 10s. p.a.
Overseas Corporate Members	£2 10s. p.a. ($7.00 US)
Associate Members	£1 5s. p.a.

Society Affairs

A Brief Report on the May, 1965 meeting of the Council

A MEETING of the Council was held on May 3, 1965, and was attended by Messrs. E. W. Yeomanson (President), N. Caws, J. C. Foster, J. C. Graham, R. C. Hills, E. G. Ingram, R. H. James, A. O. Milne, L. E. Newnham, F. K. Parker, A. D. Patterson, J. Fraser Shepherd, R. F. Stevens, G. M. C. Stone, J. W. Swinnerton, L. Varney, (Members of the Council), John A. Rouse (General Manager and Secretary) and P. C. M. Smee (Minuting Secretary).

Apologies for absence were submitted on behalf of Mr. H. A. Bartlett and Mr. L. N. Goldsbrough.

Amateur Radio Mobile Society/Red Cross Pageant

It was agreed to pass on to the Essex Group of RAEN an invitation to arrange a demonstration at the ARMS/Red Cross Pageant on June 26.

Membership

The Council approved 120 applications for membership (86 Corporate and 34 Associate). In addition, nine applications for transfer from Associate to Corporate grade were accepted.

Affiliation

The Council granted affiliation to:

Auchenharvie and District Amateur Radio Club.
Howard House (Brunswick) Boys' Club.

Staffing at Headquarters

The Council gave detailed attention to a report on the staffing of Headquarters prepared by the General Manager. The report indicated that additional staff was urgently required in both the editorial and administrative sections of Headquarters to deal with the greatly increased work due, in particular, to larger issues of the BULLETIN and a higher membership.

Late Delivery of the Bulletin

Further consideration was given to a complaint from a member regarding late delivery of the RSGB BULLETIN. Inquiries showed the delays do not occur at the despatch office which issues a certificate of posting each month. Members of the Council commented on the serious delays occurring in the delivery of all classes of mail. Nevertheless, all complaints of late delivery received at Headquarters are referred to the despatch office for investigation.

Motor Vehicle (Construction and Use) Regulations

The Council received a report on urgent action taken to protect members' interests in view of the proposal by the Minister of Transport to amend regulations to forbid the driver of a motor vehicle to speak into any radio transmitting equipment whilst in motion. (A statement on this subject was published on page 366 of the June issue of the BULLETIN. —EDITOR.)

"Daily Mail" Schoolboys and Girls Exhibition, December 27, 1965 to January 8, 1966

It was agreed to accept an invitation to participate in the 1965-66 Exhibition. The Council considered that the Exhibition offered an excellent opportunity to publicise Amateur Radio and the Society amongst young people. It is expected that the attendance will be not less than 250,000.

Resignation of Intruder Watch Organizer

The Council received with great regret the resignation of Mr. R. H. Farr, G8IJ, from the office of Honorary Organizer of the RSGB Intruder Watch. He would remain a watch-keeper.

It was agreed that the President should write to Mr. Farr expressing the Society's appreciation of all his hard work for the Watch, the importance of which to the whole Amateur Radio movement cannot be over-estimated. Without the devoted work of all concerned, the number of intruders in the exclusive amateur bands would be even greater.

Mr. Ingram offered to assume responsibility for the organization of the Intruder Watch.

International Amateur Radio Club

It was reported that Mr. John Gayer, HB9AEQ, Honorary President of IARC, had accepted an invitation to meet members of the Council at Society Headquarters on May 31, 1965.

Reports of Committees

The Council received reports on the meetings of the following Committees:

Mobile (25.3.65 and 14.4.65), Education (27.3.65), Finance and Staff (5.4.65), H.F. Contests (8.4.65), and the IARU Working Group (12.4.65).

* * *

The meeting ended at 11 p.m.

Science Fair in Cambridge

The British Association for the Advancement of Science is this year holding its annual meeting in Cambridge. Forty-four schools will be exhibiting at least 100 examples of science projects which have been in progress since last October, and several of these will be concerned with electronics. The fair will be situated in Homerton College, Cambridge, and will be open during the following periods: September 2, 2.45 p.m. to 8 p.m., September 3, 10 a.m. to 4.30 p.m., September 4, 10 a.m. to 12.30 p.m., and September 6, 10 a.m. to 4.30 p.m.

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.

Brussels Occasion

By John Clarricoats, O.B.E., G6CL*

IT has become a tradition for the Belgian National Amateur Radio Society (UBA) to invite leading figures in European Amateur Radio to attend their Annual Assembly in Brussels. It was appropriate, in every way, that the 1965 Assembly should coincide with that weekend in May when radio amateurs the world over were commemorating the centenary of the International Telecommuncation Union (May 17). Nineteen-sixty-five is also International Cooperation Year, due to reach its climax in October, when the 20th Anniversary of United Nations is commemorated during People-to-People Week. The IARU, the ITU and the ICY were certainly linked together in Brussels during the period May 15-17, when the President (Albert Deschodt, ON4AK), the General Counsellor and Immediate Past President (René Vanmuysen, ON4VY) and other members of the Council of UBA acted as hosts to the President of RSGB (Eric Yeomanson, G3IIR), the Immediate Past President (Geoff Stone, G3FZL), the Honorary Treasurer and Past President (Norman Caws, G3BVG), the President of USKA (Robert Thomann, HB9GA), the President of VERON (Wyn Dalmijn, PA0DD), the first Vice-President of DARC (Herbert Picolin, DL3NE), the Secretary-Editor of IARU Region I Division (John Clarricoats, OBE, G6CL), the Treasurer of Region I Division (Dr Jacques Simonnet, F9DW—representing REF), Mrs Ruth Yeomanson (wife of the RSGB President), Miss Ceri Taylor, G3SGN, and W. J. P. " Bill " Hayes, G3CJQ, of the BBC Foreign Service, who acted as interpreter and guide.

Visit to ON4UB

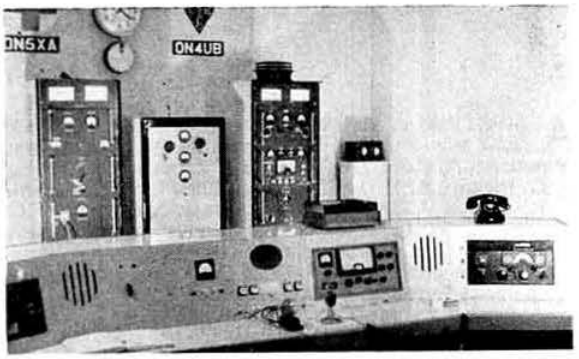
During the early evening of May 15 the foreign delegates were given the opportunity of visiting the National Station of UBA (ON4UB), which is located in the Headquarters building of the Belgian Red Cross on the outskirts of Brussels. In the same room is the transmitter used by the Red Cross Amateur Radio Emergency Service. A massive semi-circular consul enables both stations to be operated simultaneously by teams of operators.

While the visit was in progress some members of the British party were able to talk back home, in fact the RSGB President succeeded in contacting his Council colleague, Roy Stevens, G2BVN, who was operating on 3·5 Mc/s as GB4ITU. Geoff Stone's efforts to break into the " Lerwick net " were less successful but by that time a pleasant cocktail party was beginning to get under way. Among the hosts at the Ham Shack were the President of UBA (ON4AK), the Past President and General Counsellor (ON4VY), and the Shack Manager E. Lemper (ON4YD) all with their ladies; in fact it was the ladies who were chiefly responsible for the party arrangements.

Dinner—Grand Style

Following the visit to ON4UB the party were entertained to dinner in grand style by the President and Members of the UBA Council at Les Ailes Centre Restaurant. At the end of a very convivial evening, during which topics of many kinds were discussed, G6CL on behalf of the guests thanked their hosts for an evening long to be remembered. Replying, ON4AK spoke of the honour which had been paid to UBA by the presence of so many distinguished visitors from other countries. With typical Swiss gallantry and to complete a delightful evening USKA President, Bob Thomann, presented freshly picked roses to the ladies—a charming and much appreciated gesture.

* Secretary, IARU Region I Division. Official Historian to the Society.



The National Station of the UBA, ON4UB, which operates as ON5XA when engaged on Belgian Red Cross duties. The three transmitters are each capable of operating at an input power of 300 watts, a.m. telephony and telegraphy. News Bulletins are transmitted from ON4UB on Sundays from 10.30 to 11.30 local time on frequencies of 3645 kc/s and 145.350 Mc/s.

UBA Luncheon and General Assembly

Contrary to the practice in some other countries, UBA believe in starting off *their* General Assembly with pre-lunch cocktails and by a banquet of much substance. Cocktail-time provided the opportunity for " ragchews " and in the pleasant hour before lunch friendships were re-established after breaks of many years. One such reunion was with John Douglas, G/GM/GW2CAS (who for some years was RSGB Regional Representative for North-east Scotland) and Mrs Douglas. John Douglas is now in Antwerp where he operates under an ON5 call. Pre-lunch time arrivals included Wyn Dalmijn, PA0DD from Arnhem, and Jacques Simonnet, F9DW from Longwy.

Chief guest at the luncheon and General Assembly was Mr L. Ros, Inspector-General of the Belgian Post Office. In his speech to the assembled company Mr Ros recommended that amateurs should continue to develop the scientific aspects of their hobby as well as their experimental work. He referred to the great help which Belgian amateurs give to the Red Cross.

Welcoming the guests from other countries the President of UBA spoke of the international character of the occasion and the usefulness of the personal contacts which were taking place. The Secretary of IARU Region I Division (G6CL) conveyed greetings from the members of the Executive Committee and recalled an earlier international gathering in Brussels during August, 1935 when the hosts on that occasion were the President (Paul de Neck, ON4UU) and Council of the pre-war Belgian National Society, then known as Reseau Belge. (Only one other person present that day (ON4HX) claimed to have been present with G6CL on that earlier occasion.) The secretary of IARU Region I spoke briefly about Regional Conferences and expressed the hope that the Conference to follow the one to be held in Yugoslavia during 1966 would be held in Brussels either in 1968 or 1969.

In extending good wishes to UBA from RSGB the President (G3IIR) referred to the part played by UBA in the struggle to obtain reciprocal licensing arrangements. He also referred to the pleasure which he and his colleagues had experienced in visiting the UBA National Station. Mr Yeomanson recalled the visit of a party of UBA members to London in August, 1964, led by René Vanmuysen, ON4VY, who had had the distinction of being the first Belgian amateur to operate, officially, a British amateur station.

Other speakers included the Treasurer of IARU Region I Division (F9DW), the President of VERON (PA0DD), the President of USKA (HB9GX), the first Vice-President of

(*Continued on page 481*)

NEWS . . .

Collated by John Clarricoats, O.B.E., G6CL

FCC Proposals for Incentive Licensing. The United States Federal Communications Commission has issued a Notice of Proposed Rule Making to upgrade the licence structure in the Amateur Radio Service. One major effect of the proposals, if adopted, would be the creation of a new higher class of licence—Amateur First Class—applicants for which will be required to pass a 16 words per minute code test and a written examination. Holders of this class of licence or the Amateur Extra Class will be entitled to utilize certain frequency segments exclusively. For monitoring purposes all new amateur stations will be systematically assigned a distinctive call-sign to denote the licensee's class of operator licence.

ITU Council. The 20th Session of the Administrative Council of the International Telecommunication Union, held in Geneva from April 12 to May 18, 1965, was chaired by Mr Clyde J. Griffiths of Australia. Mr Rudolf Rutschi of the Swiss Confederation was Vice-Chairman. On May 17 the Council participated as guests of the French Government in a ceremony in Paris, that being the exact date one hundred years earlier on which the original ITU Convention was signed. The UK was represented at the 20th Sessions of the Administrative Council by Mr C. E. Lovell of the Post Office, assisted by Mr H. C. Greenwood.

Hush! An electronic detector has been designed by the Texas Instrument Co. of Dallas, that warns of trespassers and intruders by monitoring elastic waves broadcast through the earth by footsteps. It is so sensitive that it can locate a man creeping through undergrowth even though he is not making any audible noise. The device operates on a seismic principle somewhat like the sharp-eared American Indian scouts of long ago who pressed an ear to the ground to listen to far-off raiders.

Trust the Ladies for finding some delightful names for awards. YL International SSB'ers Ltd. offer the King Neptune Award (KNA), the Belt of Orion Award (BOOA) and the Venus Trophy for various DX achievements using s.s.b. Mayree Tallman, K4ICA, 428 S.W. 28th Road, Miami 36, Florida, who edits *SSB'ers Voice*, will provide any interested s.s.b. enthusiast with all the information he or she may need to claim these awards. Incidentally, the Venus Trophy is reserved for those who work 500 sidebanders who are YLs and just to make it easy 250 of the contacts must be on c.w.!

Congratulations to PZK who this year are celebrating the 35th anniversary of the formation of a National Amateur Radio Society in Poland. The present Society, Polski Zwiazek Krotkofalowcow, sprang from the Lwowski Klub Krotkalowcow which became a member of the IARU on August 15, 1930. As the application from the Lwow Club was published in IARU Calendar No. 3 (dated December 31, 1929), there has been a National Society in Poland for at least 36 years. Incidentally, SSA (Sweden), USKA (Switzerland) and WSI (forerunner of IRTS—Ireland) also became Members of IARU on August 15, 1930. At that date IARU comprised 18 Member Societies.

Reciprocal Licensing. Bolivia became the third country to sign a reciprocal operating agreement with the US. Previous agreements had been signed with Costa Rica and the Dominican Republic. The separate treaty between the US and Canada remains in force. Negotiations are continuing between the US and some 20 other administrations.

Transistor Ignition. Controversy is developing in the US between those who advocate transistorized ignition systems and those who adhere to conventional systems. Breaker points in the usual system make and break thousands of times a minute. As the current-flow through the points is around five amps, the points soon wear out. The transistorized system allows the points to carry a very small current, adding thousands of hours to their useful life. Len Buckwater in *Popular Electronics* for June discusses the pros and cons of the old and new systems.

Television Society. More than 500 members and guests were present at the annual dinner of The Television Society when the Baird Scholarship prize was presented to B. J. Vieri for his work on band-width compression. The Society's silver medals went to Bernard Braden for his work *before* the camera and to Rex Ferkis for his work *behind* the camera. Mr F. N. Sutherland, C.B.E., President of the Society, was in the chair.

IEE Appleton Lecture. The Institution of Electrical Engineers is to inaugurate an annual Appleton Lecture to commemorate the life and work of Sir Edward Appleton, the eminent physicist who died recently. Sir Edward was an honorary member of the Institution and was awarded the Faraday Medal in 1946.

All on a Record. A television show, complete with sound track, can now be played from a gramophone record by means of a new electronic device housed under the turntable. Up to 400 still pictures and 40 minutes of sound can be played from a single record. The new system, developed by Westinghouse Electric Corporation and known as Phonovid, is expected to be used for audio-visual instruction and sales promotion.

Rare Scottish Counties Again!

From July 3-17, the call GM3SIG will be heard on all bands from 160 to 10m. Operation on 160 will be during the late evening, on c.w. only; on the other bands, both c.w. and s.s.b. will be used. QTHs will be Angus and Kincardine.

It is also hoped that GM3SIG will again be operating on 2m, in the correct segment allocated by the Band Plan. Both c.w. and a.m. will be used. Whilst the station will be manned most evenings, it is proposed to work /P on Sunday, July 11 from 12.00 to 17.00 GMT on Cairn o'Mounth, 1500 ft. a.s.l.

GM3SIG is the call-sign of the Radio Club of 92nd Signal Regiment AER. This Club is affiliated both to the RSGB and to the Royal Signals Amateur Radio Society; amongst its members are no less than a dozen licensed amateurs.

Further details about the Club and 92nd Signal Regiment can be obtained by sending a postcard to G2CAV, G3GVV, or G8PG.

Brussels Occasion (Continued from page 480)

DARC (DL3NE). The remainder of the meeting was devoted to receiving reports from the General Secretary (ON4DQ), the Treasurer (L. P. Dierckxsens) and the General Counsellor (ON4VY). V.H.F. Manager (ON4TQ) and the Traffic Manager (ON4UN) then took over the platform and for the best part of an hour, amid a rising hubbub of noise, finally succeeded in presenting a number of trophies and certificates to contest winners.

Item 7 of the agenda read:

" Interruption. Distribution des bulletins de vote en présence de deux témoins choises dans l'Assemblée. Dernier dépôt des candidatures aux fonctions d'administrateurs."

Judging the time to be ripe and taking care not to become involved in the election of the new UBA Council, those visitors who had stayed through to this point in the proceedings began to fade away after expressing their individual thanks to those of UBA who had contributed to a memorable Brussels Occasion.

Thank you UBA for your generous hospitality.

CLUBROOM

A Monthly Survey of Group and Club Activities

For information on membership or activities of a particular club, please apply to the person whose call is indicated at the end of the item. Full addresses may be obtained from a Call Book.

The AERE Amateur Radio Club in its current issue of *QAV* is concerned with last minute arrangements for NFD, which they have aptly christened National Fiasco Day—born, so it seems, from some experiences due to an army of gremlins which invaded their last year's efforts. However, with one operator who copies zero beat stuff, another who likes the fast c.w. under the QRM, and yet another with an aptitude for left footed Swahili, the club hopes to rise above a previous fourth position for single entry stations. (*G2HIF*).

The BBC Ariel Radio Group is running a long duration contest, from June 1 to December 31, with the object of promoting QSOs amongst staff amateurs and Ariel Radio Clubs, with prizes for leading individual and regional club scores.

British Amateur Television Club's publication ,*CQ-TV*, issue 55, describes a great deal of transistorized equipment including a video amplifier, line scan, frame scan and a video pre-amplifier suitable for use directly after the vidicon target. Also included is a review of a video tape recorder operating at a tape speed of 12·5 ft./sec., which, with 10,000 ft. of triple play tape gives a running time of 13½ mins. Costing less than £100, and with a response to 2 Mc/s, the picture quality is quite good. We wonder whether this is the start of a breakthrough.

Bromsgrove ARC is holding its next meeting on July 8 at 8 p.m., and on August 1 a Mobile Picnic at Dodrill Common on the B4091, at which visitors will be welcome. (*G2CLN*).

Bury and Rossendale RS levels some pretty hot criticism at sponsored all-commercial stations taking part in NFD, and indeed, are not too happy about semi-commercial outfits, which, in their opinion, are out of keeping with the original spirit of NFD. Particularly they feel that petrol driven generator sets are merely a way round the " no mains " clause. For their effort, they rely entirely on storage batteries. The July meeting will take place on the 13th at the Old Boars Head and is a " Noggin and Natter Night." (*G3BRS*).

Cambridge and District ARC produces an excellently written and presented magazine under the title of *Cambeam*, on the inside cover of which is a map showing the location of the club's premises. In addition a forward planned programme is included giving details of some 17 future meetings, so that if members do become out of touch for a week or two, they can easily pick up the threads again. (*G2CDX*).

Mr. H. W. E. Willis, G6OU, has just passed his eightieth birthday, and it is probably quite true that he is one of the oldest members of the clubs in the country. He is seen here presenting the " Willis " cup to this year's winner of the trophy at a meeting of the Basingstoke Amateur Radio Club.

Clifton ARS has been hard at it manufacturing a lightweight beam for use during NFD. Recently they held a Day and a Night D/F event and have two more day events yet to run off. (*G3OGE*).

Cornish RAC are feeling more than somewhat hot under the collar at your humble conductor for having quoted an extract from their publication *Cornish Link* concerning v.h.f. activity in Cornwall in the May issue of *Clubroom*. It seems that we took an item intended as editorial humour as gospel. To that trojan G3XC who has done so much to stimulate v.h.f. activity in the Duchy, our unqualified apology. The Chairman's Notes in the June issue of *CL* give some very sound advice on home-brew. (*G3OCB*).

Cray Valley RC are holding meetings on July 18 and August 1, the latter being a Mullard Film Show. Those who are interested in stations-worked diplomas will be interested in the CVRS Diploma. For details write to G3MCA.

Crawley ARC are holding their Annual Mobile Meeting on the Hog's Back at Guildford on Wednesday July 21. Nothing is being organized but all will be welcome for a rag-chew. Having disposed of NFD, attention is being concentrated on the v.h.f. event when the club will again be 16km N. of Bognor Regis. (*G3FRV*).

Crystal Palace and District RC have a member—G3OOU—who has decided to end the frustrating errors, both accidental and incidental, in normal frequency measuring. Surrounded by 200 transistors he is busily popping them into a circuit which will measure to 1 c/s accuracy. Drifters, and others—Beware! (*G3FZL*).

Derby and District ARS have a current paid-up membership nearing 170 which should give some idea of the very real strength of this society. Attention is now being turned to their Mobile Rally to be held on Sunday, August 15, at Ryknеld School, Derby, with most of the regular attractions already arranged. (*G2CVV*).

Dudley ARC report that membership is still on the increase. On June 26, they had a station operational at the Quinton Garden Fete under the call G3RXK/A on bands 160-10m s.s.b. Meetings are held on alternate Friday evenings at the Art Gallery, Dudley, commencing at 8 p.m. (*G3PWJ*).

East Worcs ARG seem to have mislaid the club rig and are involved in a full scale search to locate it. Meetings will continue during the summer months, and it is hoped that come September there will be enough entrants to arrange an RAE course at the Redditch College of Further Education. (*G3HZG*).

Echelford ARS operated an exhibition station at the BP Research Centre, Sunbury, on May 29, and despite cold weather, it went over well with the onlookers. Their monthly Newsletter runs to six double sided foolscap sheets. Meetings take place on the last Wednesday in each month. (*G3DXA*).

Harlow and District RS are now installed at their new headquarters " Mark Hall Barn," and on Tuesday, July 13 are holding a Junk Sale. (*G3TLJ*).

Hereford ARS put on an exhibition station at the Ross-on-Wye Hobbies Exhibition sponsored by the Ross Rotary Club. To their credit a considerable amount of the equipment was home-brew, in addition to which they mounted a large display of QSL cards from all over the world, and this attracted a lot of attention. A particularly nice touch was the special QSL cards on the back of which were printed the names and call-signs of the operators, plus the SWL's who rendered staunch support. (*G3ESY*).

Harrow RS are mounting an exhibition to the Channel Isles later in the year, and one of the pieces of equipment going on the journey will be the 70/23cm transmitter by G3HBW which won a prize in the society's constructional contest. The society will be putting on a display and station at the Grafton Fair, an event which is held annually at the Harrow County Grammar School

and enjoys considerable popularity. Membership stands near the 100 mark, with several saying silent prayers on the outcome of the RAE. (*G3TUX*).

The Irish RTS current journal extols the benefits to be gained from operating out of doors in the summer months, pointing out, and rightly, that such ventures can be fun for the whole family making an excellent compromise between the desire of the XYL to " get out " and away from the chains of the kitchen sink, while at the same time satisfying the yen of the OM also to " get out." (*EI9U*).

Liverpool and District ARC will be mounting an exhibition station during the Liverpool Show on July 15-17 under the call-sign GB2LS. The club has a more or less permanent place in this show in which they have participated over the past five years. Modes of transmission will be c.w./a.m./s.s.b., and they will, in due course, QSL 100 per cent all contacts. (*G3PDC*).

Norfolk ARC have a very full programme arranged for the future with something for everyone on the schedule. New members and visitors are always welcome. (*G3TLC*).

Magnus RS recently carried out a D/F expedition using bicycles as the means of transportation, and despite all the attempts of Mother Nature to damp enthusiasm, the event proved very successful. (*G3PAW*).

Malta ARS is progressing from strength to strength with a total of 16 members. On April 17 new call-signs in the series 9H1 were issued to the 30 current licensees. Four new applications are expected to be made shortly. (*9H1W*).

Medway ARS were blessed with excellent weather for their Mobile Rally, which was well attended. The current *Newsletter* contains the design of a single transistor Top Band converter for use with a standard car radio, and this really shows how simple things can be made. (*G2FJA*).

Mid-Warks ARS have at last found permanent HQ centrally situated and, surprisingly, provided with ample car parking spaces. A working party has been hard at it fitting out the large meeting room, and arranging workshop facilities, and, we believe, just made it in time for the official opening by the Mayor of Leamington. From the description supplied, there can be little doubt but that the society received the unqualified support of the Borough.

The Midland ARS mobile rally at Trentham was a resounding success, but they are left with a problem. Have you ticket 1399, for if you do, an unclaimed prize in the shape of a co-axial relay is looking for a home. The *Newsletter* under review contains a useful article by G3GPL on the deceptively simple art of soldering. Of especial interest is the use of a BY100 silicon diode to act as a half-power device so that the iron may be on " stand-by " for long periods without the usual degeneration of the bit. (*G3AVE*).

Newark SWC now has its own call-sign, G3UEB. In a very enterprising manner, G3TWV has made a cine film of a typical club night, while G3TWX struggled with the accompanying sounds on tape. The club has decided to produce its own magazine—a copy of which we hope will be sent to RSGB Headquarters. Meetings are on Mondays and Thursdays at the Hall, Guildhall St., Newark when visitors and new members will be welcome. (*G3TWV*)

North Wales University College ARC have recently secured the call-sign GW3UCB for their club station which they hope to have on the air soon. Recently they had a demonstration of microphones and microphone techniques which included some excellent live stereo recordings.

Northern Heights ARS ran a demonstration station at the Warley Gala, and for good measure, had a /M station in the procession. On July 7 they will be having a display of members gear, while on July 21 a good old fashioned, but ever popular, rag-chew. (*G3MDW*).

North Kent RS had a large sized panic over their entry into NFD, but despite the marching feet of a miriad gremlins, were on the ball when zero hour arrived. In the June issue of the *Newsletter*, G2FNT's XYL, with an obvious ally in the Editor's XYL, takes a not too serious—we hope—stab at Amateur Radio in a well written snippit which could be titled the " Damsel's Delusions." (*G3PUI*).

Plymouth RC were very pleased to note that the attendance at the AGM was a record. On June 8 they had a visit from G3SXW who had to have the club's arrangements for NFD brainwashed out of him before he departed. Thus, as they say, their highly confidential plans to keep them at the bottom of the list, were secured. Well this certainly is a new approach! (*G3SVZ*).

Radio Amateur Invalid and Bedfast Club's current issue of *Radial* contains the conclusion of Paris Venture, mentioned in *Clubroom* previously. We have followed David's descriptions with keen interest and feel that he is to be congratulated on his finely drawn word pictures. Congratulations are also in order to two newly licensed members G3TIO and G3UCN. G3SSV (Preston, Lancs. area) is looking for contact with a licensed school master who might be able to help organize some accommodation for Czech students for a few nights in the summer. Any offers would be most welcome. Contact G3SSV direct. (*G3LWY*).

Reading ARC are devoting their July meeting to an open discussion on the relative merits of A.M. *vs* S.S.B. No charge for admission will be made to those who walk like ducks as well as talk like them! On a more serious note, maximum effort is being mounted for the club's participation in the Silver Jubilee Reading Show in which they hope to have both a.m. and s.s.b. stations. (*G3TOQ*).

Reigate ATS went 12 strong to the Thanet Mobile Rally. Also in May the club paid a visit to the ITA transmitting station at Croydon which all found most interesting. At the meeting to be held on July 17, there will be a talk on Transistors for Transmitters and this should prove to be of exceptional value. (*G3UEQ*).

Roding Boys Society report a pretty busy month with plenty of activity. They were particularly pleased to have a visit from the Welwyn branch of the RBS, and to learn that all was going well with them. (*G3TAJ*).

Saltash and District ARC continue to enjoy the hell and high water experiences of the invincible G9BO whose Technical Know-not-how have won him a special place for dispensing gen to the unsuspecting. On July 11 they hope to support the Torbay ARS Mobile Rally, on July 25 the Cornish RAC Rally at Newquay, and on July 30 they are going " up river " to Weir Head. G3TIV/A gets a special mention as he will be near Redruth for 9 months " while he is building a new reservoir " ! (*G2DFH*).

Scunthorpe ARC now hold meetings on every Tuesday evening commencing at 7.30 p.m. New members and visiting amateurs are assured of a hearty welcome. (*G3MSB*).

Sheffield ARC will be hearing from 7Q7LA on his experiences in Malawi in a talk scheduled for July 30. In addition to normal Amateur Radio interests, the club has a flourishing hi-fi group which holds its own separate meetings. While split interest clubs are not always successful, in this case it works out very well indeed. We wonder how much " cross conversion " takes place. (*G8AET*).

South Birmingham RS will be putting on an exhibition station at the Barnt Green Flower Show. On Thursday, July 15, Bob, G3NXV will be giving a demonstration and talk on his KW2000 transceiver. In August, the society will be mounting yet another exhibition station, this time at the Marston Green Flower Show on the 21st. (*G3TQO*).

South London Mobile Club are, like most clubs, anxious to increase their already strong membership. On July 17 there will be a talk by G4KD on the RSGB. July 31 is the date provisionally fixed for the weekend camp, while on August 14, G3OLM will give the second part of his talk on s.s.b. (*G3SLM*).

South Dorset RS have settled the forward arrangements for the society's set-up at the Weymouth Model Engineering Exhibition between August 3 and 7. The July meeting will be out in the open at Hardy's Monument.

Southgate and Finchley Group's Mobile Treasure Hunt attracted so many entries that it literally shook them rigid, especially bearing in mind the dismal weather. Indeed, some idea of the success can be gleaned from the fact that a repeat is to be held in September. The July meeting will take place on the 8. (*G3TXA*).

Surrey Radio Contact Club will be meeting on July 13, when G3TR will be giving a lecture on Aeronautical Radio. As Air Traffic Controller at Gatwick, John should know what he is talking about, and, to boot, he is an excellent speaker. (*G3KGA*).

Wimbledon and District RS meet on the second Friday in each month and are keen to increase their membership. On July 9, that trojan of the QSL system, G2MI, will be going to the society's meeting. (*G3RZN*).

Yeovil ARC recently held a joint meeting with the South Dorset RS, and enjoyed the experience. Club members have been supporting various Mobile Rallies, some at quite long distances.

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. Regional Representatives are requested to set out the copy, preferably typed double spaced, in the style used below. Standing instructions cannot be accepted.

REGION 1

Ainsdale (ARS).—July 7, 21, August 4, 8 p.m., 77 Clifton Road, Southport.
Blackburn.—Fridays, 8 p.m., West View Hotel, Revidge Road.
Blackpool (B & FARS).—Mondays, 8 p.m., Pontins Holiday Camp, Squires Gate. Morse tuition from 7.30 p.m.
Bury (B & RRS).—July 13 (Discussion Night), 8 p.m., Old Boars Head (private room), Crompton Street.
Chester.—Tuesdays, 8 p.m., YMCA, except first Tuesday in each month.
Crewe & District.—July 5, August 2, 8 p.m., Earl of Crewe Hotel, Nantwich Road.
Eccles (E & DAC).—Tuesdays, 8 p.m., Patricroft Congregational Schools, Shakespeare Crescent, Patricroft, Eccles. Every Thursday, Club Top Band net at 20.30 hours.
Liverpool (L & DARS).—Tuesdays, 8 p.m., Conservative Association Rooms, Church Road, Wavertree.
Macclesfield.—July 20, August 3, The George Hotel, Jordongate.
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.—July 7, August 4, 125 Regent Road.
Preston.—July 13, 27 (all meetings start with a Morse practice at 7.30 p.m.), St. Paul's School, Pole Street.
Southport (SRS).—Wednesdays, 8.30 p.m., Sea Cadets Camp, The Esplanade.
Stockport.—July 14, 28, The Blossoms Hotel, Buxton Road, Stockport.
Wirral.—July 7, 21, August 4, 7.45 p.m., Harding House, Park Road West, Claughton, Birkenhead.

REGION 2

Bradford.—July 20 (Display of members' gear), 7.30 p.m., 66 Little Horton Lane.
Catterick.—Tuesdays and Thursdays, 7.30 p.m., Clubroom, Vimy Road.
Northern Heights.—July 7 (Display of members' gear), July 21 (Ragchew) 7.30 p.m., Sportsman Inn, Ogden.
Scarborough.—Thursdays, 7.30 p.m., rear of 3 Trinity Road.
Spen Valley.—July 8 (AGM), 7.30 p.m., Heckmondwike Grammar School.

REGION 3

Birmingham (Slade).—July 9, 23, 7.30 p.m., The Church House, High Street, Erdington.
(South).—July 15, 7.30 p.m., ("CW2000 Transceiver," by Bob Jennings, G3NXV), Friends Meeting House, Moseley Road.
Cannock (CCARS).—August 5, 7.30 p.m., The George Inn, Walsall Road, Cannock.
Coventry (CARS).—Mondays, 8 p.m., Westfield House, Radford Road, Coventry.
Dudley (DARC).—Fridays, 8 p.m., Art Gallery, Dudley.
Redditch (EWARG).—July 8, 8 p.m. ("WIBB Tape Lecture and Slides"), Redditch Old People's Centre, Park Road, Redditch.

LOOKING AHEAD

September 18.—N.W. V.H.F. Convention.
October 10.—Manchester Amateur Radio Convention, Belle Vue.
October 16-17.—Eighth Jamboree-on-the-Air.
October 27-30.—RSGB International Radio Exhibition.
December 17.—RSGB Annual General Meeting.

Details of Mobile Rallies are given on page 485

Salop (ARS).—July 8, 7.30 p.m., Morris Hall, Bellstone, Shrewsbury.
Stratford-upon-Avon (S-u-AARS).—Fridays, 7.30 p.m., Masons Arms, Sanctus Road, Stratford-upon-Avon.
Wolverhampton (WARS).—Mondays, 8 p.m., Neachells Cottage, Stockwell Road, Tettenhall.

REGION 4

Derby (D & DARS).—July 7 (Surplus Sale), July 14 ("Colour Television," Part II, by R. E. F. Street), July 21 (D/F Practice Run—Social Evening), July 28 ("My visit to the USSR," by D. Stanners, G3HEJ), August 4 (Surplus Sale), 7.30 p.m., Room 4, 119 Green Lane, Derby.
Loughborough (LARC).—July 9 (Mobile night out), July 16 (Components Sale), July 23 (Night on the air), July 30 (S.W.L. Night), 7.30 p.m., Club Room, Bleach Yard, Wards End, Loughborough.
Mansfield (ARS).—Fridays, 7.30 p.m., The New Inn, Westgate, Mansfield.
Nottingham (ARCN).—Tuesdays, Thursdays, Room 3, Sherwood Community Centre, Woodthorpe House, Mansfield Road, Nottingham.
Newark (Magnus GS).—Tuesdays, 3.50 p.m., Junior Physics Lab, Magnus Grammar School, Newark.
Peterborough (P & DARS).—Fridays, 8 p.m., the old Windmill Clubhouse, London Road, Peterborough.
Worksop (NNARS).—Tuesdays (RAE Class), Thursdays (Lecture), 7.30 p.m., Club Room, 13 Gateford Road, Worksop, Notts.

REGION 5

Bedford (B & DARC).—Second Tuesday, and fourth Thursday in each month, Harpur Secondary Modern School, Horne Lane, Bedford.
Luton (L & DARS).—Tuesdays, 8 p.m., ATC Headquarters, Crescent Road, Luton, Beds.
Royston (R & DARC).—Wednesdays, 8 p.m., Manor House Social Club, Melbourne Street, Royston, Herts.
Shefford (S & DARS).—Thursdays, 7.45 p.m. (Morse classes 7.45-8 p.m.), Church Hall, High Street.

REGION 6

Cheltenham.—First Thursday in each month, 8 p.m., Great Western Hotel, Clarence Street, Cheltenham.

REGION 7

Acton, Brentford & Chiswick (ABCRC).—July 20 (NFD Questionnaire), 7.30 p.m., at AEU Club, 66 High Road, Chiswick.
Ashford (Middx.) Echelford ARS.—July 14, 28, 7.30 p.m., Links Hotel, Ashford.
Bexley Heath (NKRS).—July 8, 22, 7.30 p.m., Congregational Hall, Chapel Road, Bexley Heath.
Barnet (BRC).—June 20, 8 p.m., Red Lion Hotel, Barnet.
Chingford (Group).—July 16, contact the Secretary, Loughton 2397.
(SRC).—Fridays (except first), 8 p.m., Friday Hill House, Simmons Lane.
Croydon (SRCC).—July 13, 7.30 p.m., Blacksmiths Arms, South End.
Dorking (D & DRS).—July 13, 8 p.m., Wheatsheaf, Dorking.
East Ham.—Tuesdays fortnightly, 7.30 p.m., 12 Leigh High Road, East Ham.
East Molesey (TVARTS).—First Wednesday each month, Prince of Wales, Bridge Road, East Molesey.
Edgware & Hendon (EADRS).—July 12, 26, 8 p.m., John Keble Hall, Church Close, Deans Lane, Edgware.
Enfield.—July 15, 8 p.m., George Spicer School, Southbury Road.
Gravesend (GRS).—July 21, 7.30 p.m., RAFTA Club, 17 Overcliffe.
Guildford (G & DRS).—July 9, 23, 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).—July 9, (Practical Night), July 16 (Brains Trust), July 30 (Junk Sale), 8 p.m., Roxeth Manor County School, Eastcote Lane, Harrow.
Holloway (GRS).—Mondays and Wednesdays, 7 p.m., (RAE and Morse), Fridays, 7.30 p.m. (Club), Montem School, N.7.
Hounslow (HADRS).—July 12, 26, Canteen, Mogden Main Drainage Department, Mogden Works, Isleworth.
Ilford.—Thursdays, 8 p.m., 579 High Road, Ilford (Nr. Seven Kings Station).
Kingston.—July 8 (Surplus Gear Sale), 8 p.m., YMCA, Eden Street. Fridays (Morse classes), 2 Sunray Avenue, Tolworth.
Leyton & Walthamstow.—July 20, 7.30 p.m., Leyton Senior Institute, Essex Road, London, E.10.
London Members' Luncheon Club.—12.30 p.m., third Friday every month. See separate advertisement.
Loughton.—First Thursday in each month, 7.30 p.m., Loughton Hall (Near Debden Station).
New Cross (CARS).—Wednesdays and Fridays, 8 p.m., 225 New Cross Road, London, S.E.14.
Norwood & South London (CP & DRS).—July 17, CD Training Centre, Catford, London, S.E.6.
Paddington (P & DARS).—Wednesdays, 7.30 p.m., Beauchamp Lodge, 2a Warwick Crescent, W.2.
Purley (P & DRC).—July 16, 8 p.m., Railwaymen's Hall (Side Entrance), Whytecliffe Road.
Reigate (RATS).—July 17, 7.30 p.m., George & Dragon, Cromwell Road, Redhill.
Romford (R & DRS).—Tuesdays, 8.15 p.m., RAFTA House, 18 Carlton Road.
Scout ARS.—July 15, 7.15 p.m., Baden Powell House, Queens Gate, South Kensington.
Science Museum (CSRS).—July 8, 23, 6.30 p.m., Science Museum, South Kensington.
Slough (SARS).—First Wednesday in each month, 8 p.m., United Services Club, Wellington Street.
Southgate & District.—July 8, 7.30 p.m., Atlasta Lodge, Tottenhall Road, Palmers Green, N.13.
St. Albans (Verulam ARC).—July 21 ("BCI & TVI," by Mr. Turner of GPO), 8 p.m., Marconi Service Works.
Sutton & Cheam (SCRS).—July 20, 8 p.m., The Harrow Inn, High Street, Cheam.
Uxbridge.—July 5, 19, 8 p.m., St. Andrews Scout Hut.
Welwyn Garden City.—July 8, (Annual Sausage Night), Club Cottage, Burnham Green, Nr. Welwyn.
Wimbledon (W & DRS).—8 p.m., Community Centre, St. Georges Road, Wimbledon, S.W.19.

REGION 8

Crawley (CARC).—July 14 (Informal, for details contact G3FRV). July 21 (Annual Mobile Meeting), 8 p.m., Hog's Back, Guildford.

REGION 9

Bristol.—July 23, 7.15 p.m., Small Physics Theatre, Royal Fort, Bristol University, Woodland Road, Bristol 8.
Burnham-on-Sea (B-o-SARS).—Second Tuesday in each month, 8 p.m., Crown Hotel, Oxford Street, Burnham-on-Sea.
Camborne (CRAC).—First Thursday in each month, Staff Recreation Hall, SWEB Headquarters, Pool, near Camborne.
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 (SADARC).—Alternate Fridays, 7.30 p.m., Burraton Toc H Hall, Warraton Road, Saltash.

LONDON MEMBERS' LUNCHEON CLUB

will meet at the White Hall Hotel, Bloomsbury Square, London, W.C.1 **at 12.30 p.m. on Fridays, July 16, and August 20, 1965.**

Telephone table reservations to HOL 7373 prior to day of luncheon. Visiting amateurs especially welcome.

South Dorset (SDRS).—First Friday in each month, 7.30 p.m., Labour Rooms, West Walks, Dorchester.

Torquay (TARS).—Last Saturday in each month, Club HQ, Belgrave Road, Torquay.

Weston-super-Mare.—First Friday in each month, 7.15 p.m., Victoria Hotel, Weston-super-Mare.

Yeovil (YARC).—Wednesdays, 7.30 p.m., Park Lodge, The Park, Yeovil.

REGION 10

Cardiff.—July 12, 7.30 p.m., TA Centre, Park Street, Cardiff.

Port Talbot (PTRC).—July 27, 7.30 p.m., Trefelin Workmen's Club, 8-10 Jersey Street, Port Talbot.

REGION 11

Bangor (UCNWARS).—No meeting during the summer. Meetings will resume on October 14.

Llandudno (CVARC).—July 8 (Visit to ITA Station at Moel-y-Parc). Details from B. Clarke, GW3HQL, 103 Tan-y-Bryn Road, Colwyn Bay.

Prestatyn (FRS).—July 28 (Film Show), 8 p.m., Railway Hotel, Prestatyn.

REGION 14

Glasgow.—First and Third Wednesdays in each month, Christian Institute, 70 Bothwell Street, Glasgow, C.2.

REGION 16

Basildon (BDARS).—July 22 (Visit to Marine Communications Centre, Lathol Road). Details from G3IJB.

Chelmsford (CARS).—No meeting in August.

Great Yarmouth (GYRC).—Fridays, 7.30 p.m., the Manager's Office, the Old Power Station, South Quay, Swanston's Road, Great Yarmouth. Details from G3HPR.

Ipswich (IRC).—July 28, 7.30 p.m., Civic College, Ipswich.

Norwich (NARC).—July 12 (Treasure Hunt). Meetings on Mondays, 7.30 p.m., the Club Centre, 140 Oak Street, Norwich. Details from G3TLC.

Southend (SDARS).—July 16, 30 (Lecture by G3KXQ), the Executive's Canteen, E. K. Cole Ltd., Priory Crescent, Southend-on-Sea. Details from G3NPF.

MOBILE RALLIES 1965

July 11.....North-Eastern Mobile Rally, South Shields

See page 384, June, 1965

Organized by the South Shields and District Amateur Radio Club

July 11..... Tenth Anniversary Mobile Rally, Oxford

See page 387, June, 1965

Organized in conjunction with the RSGB by the Oxford and District Amateur Radio Society

July 11.....Torbay Mobile Rally

Junior Leaders Regiment, Royal Signals, Denbury Camp, Newton Abbot, South Devon

This rally will take place regardless of the weather: plenty of indoor entertainment will be provided. Refreshments will be available. A heated swimming pool is nearby.

G3NJA/A	...	1·880 Mc/s	talk-in stations
G3PYZ	...	3·660 Mc/s	
G3LMG/A	...	70·25 Mc/s	
G3LMG/A	...	144·13 Mc/s	

Organized by the Torbay Amateur Radio Society

July 25.....Cornish Mobile Rally

Pentire Headland, Newquay

The usual raffles and competitions will be run; there will also be several sideshows.

GB3CRC	...	1.985/144.02 Mc/s	talk-in stations
G2BHW	...	70.375 Mc/s	

Organized by the Cornish Radio Amateur Club

August 15.....Derby Mobile Rally

Ryknеld Schools, Derby

Organized by the Derby and District Radio Society

August 30.....Peterborough Mobile Rally

River-side Park, adjacent to swimming pool, Peterborough

G3DQW	...	1.980 Mc/s	talk-in stations
G3EEL	...	1.920/144.47 Mc/s	
G3RED	...	70.26 Mc/s	
G3KWY	...	145.35 Mc/s	

Organized by the Peterborough and District Amateur Radio Society

September 12.....RSGB National Mobile Rally

Woburn Abbey, Bedfordshire

Organized by the RSGB Mobile Committee

September 12.....UBA International Mobile Rally

See page 385, June, 1965

Organized by the Brabant-Sud and Brabant-Sud Est Section of UBA

September 26.....Harlow Mobile Rally

Magdalen Laver Village Hall, Magdalen Laver, near Harlow

Organized by the Harlow and District Radio Society

Writing to Headquarters?

When writing to Headquarters please use separate sheets of paper for:

Changes of Address (return a wrapper from the *Bulletin* if possible)
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Queries
Bulletin Items

When paying your subscription please return the reminder card sent to you by Headquarters or quote the date on which your subscription falls due.

Whenever you write to Headquarters please write your name in block letters and quote your call-sign, BRS or A number.

Can You Help?

● D. Byrne, G3KPO, Jersey House, Eye, Peterborough, Northants., who requires information on the DST100 receiver and the Valve Voltmeter No. 2?

● Giacomo Minella, Via Zamenhof, 11—Como, Italy, who is trying to obtain the circuit of the British m.f./h.f. transmitter type 963A (serial No. 619)?

● M. Goodman, A4529, 28 Ridgeway Crescent, Newport, Mon., who wishes to purchase or borrow the manual for the CR100/2 receiver?

● M. C. Osment, A4300, 223 Rivermill, Harlow, Essex, who requires data on the Marconi CR150/4 receiver, and would like to hear from anyone who has used this version of the CR150?

● A. G. Edwards, G3MBL, 244 Ballards Lane, North Finchley, London N.12, who wishes to purchase or borrow the following American books: *Radio Service Manual*, Vol. 14, by John F. Rider; *Communications Manual*, Vols. 1 and 2, 42/322, by Howard W. Sams; and the service manual for the Scott Philharmonic 30 tube receiver model AA-128?

RSGB PUBLICATIONS

The Amateur Radio Handbook (Third Edition)	36/6
Radio Data Reference Book	14/–
Amateur Radio Circuits Book	8/6
Service Valve Equivalents (Fifth Edition)	3/6
S.S.B. Equipment	3/–
Communication Receivers (Second Edition)	3/–
The Morse Code for Radio Amateurs (Third Edition)	2/–

ARRL PUBLICATIONS

Antenna Book, 10th Edition	18/6
A Course in Radio Fundamentals	10/–
Hints and Kinks, Volume 6	10/–
Mobile Manual for Radio Amateurs	23/6
Radio Amateur's Handbook (*1965 Ed.*)	42/6
Buckram Bound	50/–
Radio Amateur's V.H.F. Manual	18/6
Single Sideband for the Amateur (Fourth Edition)	23/6
Understanding Amateur Radio	18/6

CQ PUBLICATIONS

Antenna Roundup	23/6
CQ Anthology, 1952-59	23/6
CQ Anthology 1945-52	16/–
CQ Mobile Handbook	23/–
CQ New Sideband Handbook	24/–
Diode Source Book	13/–
Electronic Circuits Handbook	22/9
RTTY Handbook	30/–
Shop and Shack Shortcuts	29/6
Surplus Schematics	19/–
Television Interference	14/–

73 MAGAZINE PUBLICATIONS

Care and Feeding of a Ham Club	8/–
Index to Surplus	12/–
Simplified Math for the Hamshack	4/6

EDITORS AND ENGINEERS PUBLICATIONS

Radio Handbook (16th Edition)	78/–
Transistor Radio Handbook	42/–

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/–

BRITISH PUBLICATIONS

Guide to Broadcasting Stations (*Iliffe*)	5/6
Log Book (*Webbs*)	6/3
Log Book, hardbound (*Martins*)	18/9
Manual of Transistor Circuits (*Mullard*)	13/6
Radio Amateur Operator's Handbook (*Data*)	5/6
Short Wave Radio and the Ionosphere (*Iliffe*)	12/–
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 (*Iliffe*)	8/6

MISCELLANEOUS

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
Single, Advanced (9-42) or Beginners (0-15 w.p.m.) + books	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/–
Easibinders, round backed, gold blocked, for RSGB Bulletin	16/6
Call-sign Lapel Bar*	5/6

SHACK AIDS

British Isles Two Metre Band Plan	6d
QRA Locator, Western Europe	5/6
RSGB Countries List	1/–
Panel Signs, transfers (*Data*)	
Set 1: Receivers, Amplifiers	3/9
Set 2: Test Equipment	3/9
Set 3: White Wording	4/9
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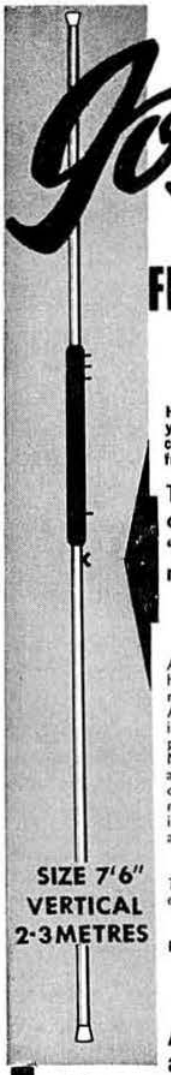

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DEPARTMENT OF ELECTRICAL ENGINEERING

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I, the undersigned, agree that in the event of my election to Membership of the Radio Society of Great Britain, I will be governed by the Memorandum and Articles of Association of the Society and the rules and regulations thereof as they now are or as they may hereafter be altered; and that I will advance the objects of the Society as far as may be in my power; providing that whenever I shall signify in writing to the Society addressed to the Secretary that I am desirous of withdrawing from the Society I shall at the end of one year thereafter after the payment of any arrears which may be due by me at that period be free from my undertaking to contribute to the assets of the Society in accordance with Clause 8 of the Memorandum of Association of the Society.

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