Radio Quarterly

No. 2 SEPTEMBER 1953 VOL. I

IN THIS ISSUE

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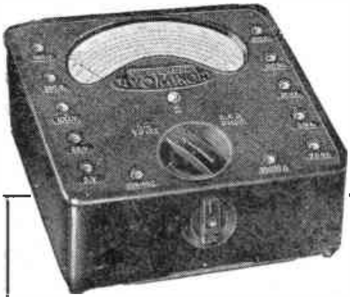

D.C. VOLTAGE	A.C. VOLTAGE
0—75 millivolts	0—5 volts
0—5 volts	0—25 ,,
0—25 ,,	0—100 ,,
0—100 ,,	0—250 ,,
0—250 ,,	0—500 ,,
0—500 ,,	

D.C. CURRENT	RESISTANCE
0—2.5 milliamps	0—20,000 ohms
0—5 ,,	0—100,000 ,,
0—25 ,,	0—500,000 ,,
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0—500 ,,	0—5 ,,
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- 0-120 ,,
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PRINCIPAL CONTRIBUTORS

L. H. THOMAS, M.B.E., G6QB
R. H. GREENLAND, B.Sc.
W. N. STEVENS, G3AKA
J. N. WALKER, G5JU
W. E. THOMPSON
F G. RAYER
G. P. WATTS
A. J. DEVON

EDITOR

AUSTIN FORSYTH, O.B.E., G6FO

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AUTHORS' MSS.

Contributions for RADIO QUARTERLY *are invited and should be addressed to The Editor. Articles must be typed double-spaced on quarto or foolscap sheets, on one side of the paper only, with wide margins. Diagrams and photographs should be separate and clearly identified with the article. Payment at good rates is offered for all material used and it is a condition of acceptance that copyright passes to Short Wave Magazine, Ltd., on publication.*

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FOREWORD

At the first offering RADIO QUARTERLY met with a most favourable response and many readers have been good enough to express themselves as finding in it something which was evidently intended for their particular requirements.

This time we are pleased to offer an issue which once more carries material of lasting value to the operator, the experimenter and the constructor. The general listener will also find much to interest him, and altogether we hope that RADIO QUARTERLY will again find favour in the field of radio for which we aim to cater.

Of particular importance in this issue are the articles on Aerial Design and the practical guidance for those who will be taking the next Radio Amateurs' Examination. On the constructional side, there are some particularly useful designs, together with much information on how to improve reception.

A glance through the contents shows that a wide range of interest has been covered, and that up-to-date reference matter is also included for the benefit of the DX operator—nor have we forgotten to give proper attention to the important subject of The QSL!

As always, we shall be very glad to have readers' views and opinions and we look forward to being able to incorporate in future issues such suggestions as may be practicable.

Austin Forsyth, G6FO

AERIAL SYSTEMS FOR THE AMATEUR

Practical Notes on Standard Designs

No matter how good a receiver (or transmitter) may be, it can only give of its best and produce real results if it is provided with an aerial designed for the coverage intended. For good reception it is in every way desirable that the aerial be of such dimensions, in the physical sense, that it can be resonated in the required band — that is, be made tunable to the signals it is desired to receive. This is a very different conception from the notion, too commonly held, that for receiving any sort of random length of wire tacked up somewhere and anyhow will do if the set is a "14-valve super-duper." What is true for reception also holds good for transmission, if possible with greater emphasis, since a transmitting aerial which is mismatched, or badly out of resonance at the required frequency, will inevitably produce a very poor result, and may cause many other troubles as well. This article gives the beginner to amateur aerial design, whether a receiving enthusiast or a transmitting operator, all the essential information for selecting an aerial system to meet his requirements.

IN all forms of short-wave work, whether reception or transmission, the aerial system is of great importance. Newcomers to the short-wave side of radio often tend to imagine that the old hand's concern with his aerials is excessive, but they very soon discover that this is not so.

For the transmitter, the difference between a good and a bad aerial can easily assume such proportions that it is at least equivalent to the difference between 10 and 150 watts of input. For the receiver, the best available aerial may make a difference between an easily readable signal of S6 or 7, and one that is below the noise level and therefore quite inaudible.

We have progressed far beyond the days when "a piece of wire, the longer the better," was considered to be an efficient aerial, either for receiving or transmitting. In fact, the design of an aerial system to do a particular job, on a particular wavelength, is now one of the most straightforward operations one can imagine, and it can be performed straight out of a text-book, with an absolute guarantee that *if the conditions laid down are adhered to,* the results will be precisely as stated.

The factor that makes aerials both fascinating and difficult for us amateurs is this: That an aerial to receive signals from a certain direction, on a certain wavelength, however efficient it may be, is practically useless to us. What we all want (but shall never get, of course!) is an aerial to receive signals from *all* directions on *all* wavelengths with more than average efficiency!

Designing for All Bands

Fortunately the bands in which we are interested are all harmonically related. This means that an aerial designed for any particular band will also perform on all the harmonics of that band—though

A group of cards from some of the small islands of the vast Pacific Ocean : Koror in the Palau Islands ; Midway Island ; Palmyra Island ; Roguron in the Marshalls ; and in the centre Rarotonga (Cook Is.) and Niue.

regarded as the proof without the production of which an amateur could not claim the various certificates issued for working various parts of the world. A QSL from an amateur station in each of the continents of Europe, Asia, Africa, N. America, S. America and Oceania enabled one to claim the WAC, or "Worked All Continents" Certificate, whereas, for the "Worked the British Empire" Certificate (WBE) evidence had to be produced of having effected two-way communication with at least one British Empire amateur located in each of the five recognised continents, N. and S. America counting as one.

As the number of amateur stations increased, it soon became necessary to produce quite a number of cards to obtain some of the more coveted certificates. The British Empire Radio Transmission Award (BERTA) is issued to those who can claim contact with stations in fifty or more different call-areas situated throughout the British Empire, and for the DXCC (DX Century Club) an amateur must furnish proof of working 100 different countries.

There are still several remote territories in the world from which Amateur Radio transmissions have rarely if ever taken place, and expeditions are organised from time to time by interested amateurs to put some of these places "on the air," if only for a week-end! QSL's from these solitary outposts are much sought after because they are so elusive and difficult to work, for as soon as such a station is heard on the air, hundreds of amateurs throughout the world are standing by, waiting for a contact; and even if conditions are good, quite often his signals are lost in the interference produced by those who cannot take their place in the queue, but must persist in continually calling him in an endeavour to work him at any cost.

Although one may make a contact with quite a rare piece of DX over the

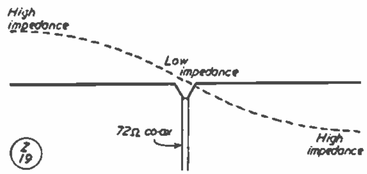


Fig. 1. Illustrating impedance effects on a half-wave dipole, and the principle of matching.

not in the same manner as on the original band itself.

To be more specific, a half-wave aerial for the 7 mc band will perform as full-wave on 14 mc, three-half-waves on 21 mc, and two full-waves on 28 mc. On all these bands it will give an equally good performance, but its optimum will come in *different directions* on each band.

Since all short-wave aerials are, in a way, related to the dipole, we must first study that fundamental type and become acquainted with its characteristics. Since study of all these types is rather more easy if we take them from the *transmitting* point of view, we will now do that, remembering that everything said about the feeding of power into the aerial, and its radiation therefrom, is equally true in the reverse direction, when it is used for receiving. But it seems much more realistic to imagine power going up the feeders, travelling along the aerial and eventually radiating outwards through the ether, than to try to visualise the signal from a transmitting station eventually reaching our piece of wire and distributing itself so as to deliver the maximum signal down the feeders to the receiver.

Never forget, however, that all remarks that apply to aerials for transmission are precisely applicable to the same systems for reception.

The Dipole as a Radiator

The dipole is a half-wave aerial fed at the centre ; and " half-wave " does not imply precisely one physical half-wave, but rather an electrical half-wave, which is slightly shorter. The exact length can conveniently be worked out from the *frequency* by using the expression

$$\text{Length (feet)} = \frac{468}{\text{f (Mc.)}}$$

This holds good for a normal aerial of wire, supported by insulators. For metal tubing, unsupported at the ends, the length is somewhat greater, and the figure becomes 492 instead of 468. This difference of 5 per cent. is the allowance for the phenomenon known as *end effect.*

Impedance Changes

Since this article is but a simple introduction to the fundamentals, we are avoiding everything likely to cloud the main issue. One such point is the confusing habit of talking about " voltage " and " current " in connection with aerials. We describe a centre-fed half-wave as " current-fed," and an end-fed half-wave as " voltage-fed " ; but as, obviously, we cannot feed either *current* or *voltage* to any aerial in a nice, self-contained tidy package, we are taking a different line of approach.

We call a centre-fed aerial " current-fed " because the impedance at the centre is *low ;* thus power is fed into it at low

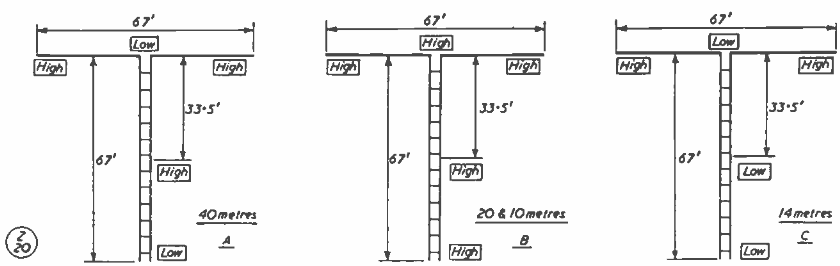


Fig. 2. A 67-foot wire, commonly used because it is one of the useful resonant lengths and within the space available at many amateur locations, with various modes of operation, as explained and discussed in the text.

search very late in the day or in the very early hours. Radio Demerara, using the call-letters ZFY, is the short wave transmitter of the British Guiana United Broadcasting Company Limited, operating from the capital, Georgetown, on a frequency of 5981 kc with a power of 2 kW. Our latest card from them gives the schedule: Weekdays, 1015-1645, 1945-0145; Sundays, 1045-1645, 1945-0145. 0130 can be suggested as a good time for British listeners; "Saturday Night Jamboree" is a good favourite at 0105 on that day.

In Venezuela, YVLK, Caracas, 4970 kc, can be recommended with an English newscast at 2345. YVMO, Radio Occidental, Barquisimeto, on 4990 kc, is another good one, but with Spanish announcements only; a sponsored "Coca-Cola" programme can be heard around 2320. YVMF, Maracaibo, 4801 kc, is another reliable Venezuelan at 0130. In Ecuador, Guayaquil, 6400 kc, is sometimes audible on Wednesdays before 0430 when it closes down. We have also noted Radio difusora del Ecuador, Guayaquil, with rumbas and similar Latin-American music at 0325 on a frequency of 4655 kc.

In Peru, OAX6E on 6339 kc can be "Radio Continental, Arequippa, Peru." Another Peruvian heard after midnight is OAX1A, Radio Delcar, Chiclayo; the daily schedule is 1600-0430, and the address for reception reports: Radio Delcar, Saenz Pena. No. 109 (Casilla No. 9), Chiclayo. Paraguay has three stations which can be heard here. ZPA5, Radio Encarnacion, 11950 kc, is sometimes audible as early as 2145; ZPA3, Radio Teleco, Asuncion, on 11850 kc, gives a Spanish News at 2200; and ZPA1, Radio Nacional, Asuncion, 6275 kc, audible at 0030, has the schedule: 1500-1700, 2230-0230.

Radio Sociedad Nacional de Mineria (National Mining Society), Santiago de Chile, operates CE622 on 6220 kc and CE1195 on 11955 kc; listen around 2200 and later. The address for reports is: Casilla 2626, Santiago de Chile, South America. Your verification card will contain the following: "Radio Sociedad Nacional de Mineria saluda cordialmente a Ud. y tiene el placer de confirmarle que su nota de recepción sobre nuestras emisiones en onda corta está correcta. Esperamos que continúe escuchando nuestras transmissiones y tenga la amabilidad de enviarnos periodiódicamente información sobre las caracteristicas de recepción." Being translated, this reads: "The National Mining Society cordially greets you and has pleasure in sending you an acknowledgment of your correct report on reception of our short wave programmes. We thank you very much and hope that you will continue to listen to our broadcasts, and please be so kind as to send us, periodically, your valuable reception reports."

In Brazil, Radiodifusora de Amazonas, Manaos, 4805 kc, is an exciting station to log, for Manaos is a tropical port on the River Amazon, eight hundred miles from its mouth. At 0230 a single gong note precedes the final announcement in Portuguese, and the Brazilian National Anthem. In Colombia, HJEF, Radiodifusora de Occidente, Cali, on 4768 kc, with a power of 3 kilowatts has recently been received at fair strength.

Special Calibration Transmissions

Many readers will recall that for some years the United States Department of Commerce and National Bureau of Standards has in its Central Radio Propagation Laboratory at Washington conducted technical radio broadcast services over Station WWV operating on a total of eight frequecies, viz: 2.5 mc (0.7 kW), 5 mc 8 kW), 10 mc (9 kW), 15 mc (9 kW), 20 mc 8.5 kW) and 25 mc (10.1 kW) simultaneously, night and day. At the same time, WWVH on the island of Maui in the Territory of Hawaii has operated similar signals on 5, 10 and 15 mc, each frequency here using a power of 2 kW.

In July, 1952, the Bureau inaugurated a new series of short wave radio disturbance forecast broadcasts over WWV. These forecasts are transmitted in Morse twice each hour, at 19½ and 49½ minutes past the hour. One of the letters 'N,' 'U' and 'W' is given, according as radio propagation conditions are Normal, Unsettled or Disturbed respectively, and the letter is followed by a digit which is the forecast of expected quality of transmitting conditions on the scale of 1 (impossible) to 9 (excellent). Two standard audio frequencies, 440 cycles per second and

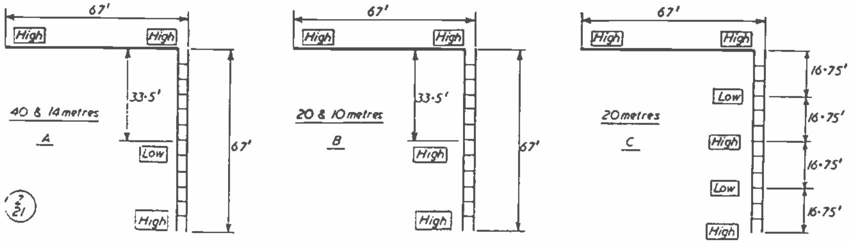


Fig. 3. This should be studied in relation to the system shown in Fig. 2. Here, the feeder arrangement is known as the " Zepp," and is widely used where it is more convenient to connect to one end of the " roof " rather than to the middle.

voltage and relatively high current. An end-fed aerial is called " voltage-fed " because the impedance at the ends is *high;* thus it is fed with a fairly low current at a high voltage.

The fact that the impedance offered by any aerial varies along its length in this manner is just another way of saying that the wire has standing waves on it ; and these standing waves " repeat themselves " every half wavelength along the wire.

Thus a dipole has a high impedance at the ends (it must, obviously, for where is there for any high currents to flow to from that point?) and a low impedance at the centre. (Fig. 1). This latter figure varies according to the height of the aerial above ground, but for normal operating heights of a half-wave or more, it may be taken as roughly 73 ohms. This figure is known as the *radiation resistance* of the aerial.

So if we feed our dipole at the centre, the ubiquitous 72-ohm co-ax gives a very nice match and is, in fact, nearly always used for this purpose.

Power may be fed up a 72-ohm line into the centre of a dipole (or, conversely, collected *from* the centre of a dipole by a 72-ohm line) with very little loss. And the radiation (or, of course, reception) will be at a maximum in the two directions at right-angles to the plane of the wire. A North-South dipole will transmit and receive most efficiently in East and West directions.

Note, now, that all these conditions hold good only so long as the dipole operates at its resonant frequency—the one for which it was cut to length. In practice, of course, we can operate a dipole on a *band* rather than a spot-frequency ; hence, when we put up a wire 33 ft. 6 in. long and call it a " Twenty-metre dipole," we mean a dipole for the twenty-metre band.

This will *not* operate satisfactorily on other bands ; the method of feed makes it essentially a single-band affair. We can, however, make it a multi-band aerial by using resonant, or tuned feeders instead of the co-ax line. A 72-ohm co-ax feeder for a dipole matches into the centre, as we have seen, and provided that is is also confronted with 72-ohm impedance at the bottom end (by the transmitter coupling coil or the receiver input) it will be a " flat " line with no standing waves on it. You can imagine it as an RF pipe.

Open-Wire Lines

Tuned, or resonant, feeder, or open-wire lines, call them what you will, are *not* flat. They carry a standing wave on them. This means that the impedance at the bottom varies according to the length of the feeder (unlike the 72-ohm matched line, the bottom of which still looks like 72 ohms however long it is). An open-wire line consists of two conductors held fairly rigidly to a certain definite spacing by means of insulating spacers. A convenient type of line, with a characteristic impedance of 600 ohms, consists of two conductors of No. 18 gauge copper, spaced at about 3½ in. by polythene spacers about every 18 in. along the line.

Should one chance to have an aerial with an impedance of 600 ohms, such a line could be used in untuned fashion and would not carry a standing-wave. In practice, however, it is usually attached either to the centre of a dipole, which looks like 72 ohms, or to the *end* of an aerial (one wire being connected to the aerial and the other left free). where the impedance may look like a *few thousand* ohms. In either of these cases there will be a standing-wave on the feeder.

This is only another way of saying that the impedance of the feeder varies at all points along its length. Therefore, no matter what length it may be, it will be possible to match a tuned circuit into it at the "home" end. If the feeder impedance is very high, then a parallel tuned circuit will be required; if it is low, a series-tuned arrangement. These are commonplace circumstances for transmitters, but for receiving use it means that an aerial coupling unit of some sort is indispensable, serving as a transformer between the receiver input and the feeders.

Fortunately, it is possible to choose the length of a pair of resonant feeders so that one *knows* what the impedance will look like at the end remote from the aerial. Just as a half-wave aerial carries a complete half-cycle of a standing-wave on its length and therefore presents a high impedance at the ends, and a low impedance at the centre, so will a feeder exhibit the same characteristics. At each half-wavelength along the feeder the same set of circumstances will hold good; if it is connected to the aerial at a low-impedance point, we shall again have low impedance. The diagram (Fig. 2) will explain, and we have taken, for this example, a 67-ft. aerial fed at the centre with 600-ohm line.

Although the diagram shows only the circumstances prevailing with feeders of either 67 ft. or 33 ft. 6 in., note that 44ft. (or thereabouts) is a very convenient length to use, as it is neither at the lowest nor the highest impedance points and looks rather similar on several wave-bands.

The important point to note, really, is that when our 67-ft. aerial is a dipole (on 40 metres) the centre impedance is low; but that on the other bands this does not hold good. On 20 metres each half of it is a complete dipole, the centre impedance then being *high*, as the feeders are really attached to the

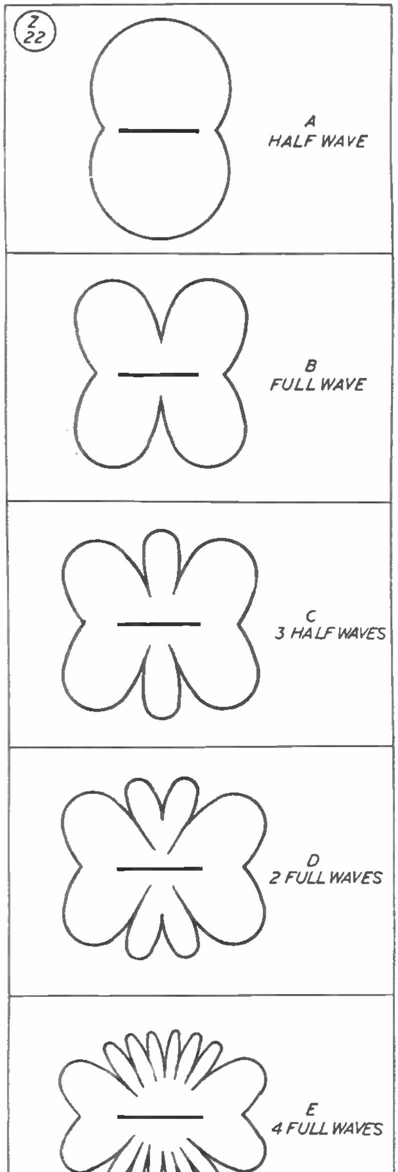


Fig. 4. Polar diagrams, or representations of the way in which energy is radiated from different types of aerials, giving rise to directional effects, as explained in the article.

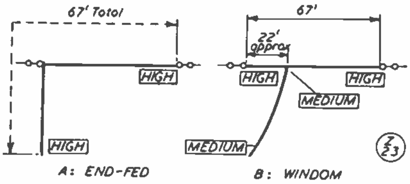


Fig. 5. Single-wire arrangements showing the distribution of impedance in two well-known types. In (A), the 67-foot wire as a whole is the aerial, and there is no feeder connection in the accepted sense; in (B), the feeder line is supposed not to radiate (or pick up) but nearly always does!

ends of two separate dipoles. On 10 metres each half consists of two dipoles attached to each other, end-on, and the impedance at the same point is still high (though not quite so high as before). On the 14-metre (21 mc) band the top consists of *three* dipoles in a row, and the feeders are attached to the centre of the middle one—so the impedance is again low.

The next diagram (Fig. 3) shows the same aerial, but with the feeders attached at the end, in what we call the Zepp. system (so named because a somewhat similar type of aerial was used during World War I by the Zeppelins!) Note, now, that the impedance at the top of the feeders is *always* high, on whichever band the aerial is used. So the condition at the bottom of the feeders is different, on certain bands, from that which was in force when the feeders were attached to the centre. Fig. 3 (c) gives some idea of what length of feeder to choose for meeting various conditions at the bottom end.

Directional Effects

We have already stated that the best directions for transmission and reception from a dipole are at right-angles to the plane of the wire. This does not mean that a sharp beam is available! Far from it—a very broad "doughnut" pattern is obtained. *See* Fig. 4 (a).

When we string two dipoles end to end, two things can happen. If they are fed at the centre point, as in Fig. 2 (b), then the polar diagram becomes sharper, in the same direction as that for one dipole. This is because the two are "in phase," each one trying to radiate, independently, as it would if it were the only dipole there.

When we feed them at one end, the two dipoles are out of phase, and their fields oppose each other instead of assisting each other. The lobes from each are then "bent outwards," rather in the manner of two magnets opposing each other and exerting a force of repulsion instead of attraction, and we have four lobes instead of two. Actually, the lobes are inclined at 54 degrees to the wire, but we can consider them as being almost diagonal.

So, whereas our North-South dipole works best to East and West, our North-South full-wave aerial (*two dipoles out of phase*) works best to North-East, South-East, South-West and North-West.

Make it twice as long (either by using twice as much wire or by going down to half the wavelength!) and the main lobes will now be inclined at 36 degrees to the plane of the wire—not enormously different from the full-wave and still classifiable as "best on the diagonals."

The longer you make the wire—that is, the greater number of dipoles strung end to end that you use—the more nearly will the main lobes come round towards the end of the wire, until a "very long wire" can be considered as being most efficient *off its ends.*

Minor Lobes

Note, at this point, that it is only a dipole which has merely two lobes; the full-wave has four, the 1½-wavelength aerial has six, and the two-wavelength aerial has eight. But from the very start of the splitting-up process it is the "diagonal" lobes which are the main ones. As each extra dipole is added to the length of the wire, two more lobes crop up, but these are now "minor" lobes, located around the broadside position.

They are important, however, in that a *very* long wire is by no means only useful along its length; the minor lobes are by now so multifarious that the wire gives virtually all-round cover, but not with the same efficiency in all directions.

At the same time, it is fair to state that situations do arise in which a long wire, by virtue of its minor lobes, gives much better reception almost at right-angles to the plane of the wire than, say, a full-wave aerial, which has a

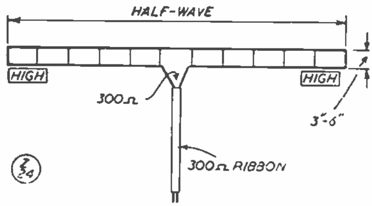


Fig. 6. The Folded Dipole mode of operation, using Telcon 300-ohm ribbon feeder, which is light, strong and very low-loss, and therefore ideally suited to these applications.

couple of minima in those directions. Reference to the small diagrams will show this plainly: compare Fig. 4 (b) with Fig. 4 (e).

Feeders

An important point often overlooked by the beginner is that if an aerial is *properly fed,* it doesn't matter how or where it is fed. A full-wave aerial, for instance, can be fed in the centre, at the end, or at a quarter-way point. A much longer wire can be fed at almost any point along its length. Provided that the feeders are properly matched at both ends, or, of course, properly tuned if they are resonant open lines, then the efficiency and general performance of the top will remain the same under all conditions. The one exception to this is the case of the full-wave aerial. As already mentioned, when this is fed in the centre it behaves as two dipoles *in phase,* and not as a full-wave, which is really two dipoles *out of phase.*

A very nice directional system for one band can be made by putting up two dipoles end to end (or, better still, with a certain amount of lateral spacing between them), feeding them both with co-ax of the same length, and arranging a reversing switch in one of the co-ax leads. The two then can be connected to the receiver or transmitter, either in the in-phase or out-of-phase condition. If the whole system runs North and South, the in-phase state will give good coverage East and West (better than that of a single dipole) and the out-of-phase state will give the full-wave pattern—which gives minima East and West but maxima at the four diagonals. Thus the system will give really excellent coverage in all directions except dead North and South.

Receiving Advantages

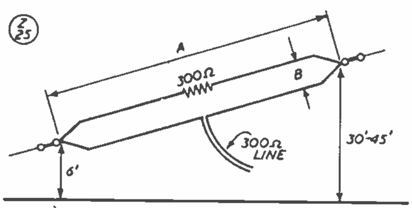
A simple switchable arrangement like this gives quite spectacular discrimination against unwanted signals on the receiver. For instance, with the dipoles in phase you may find a signal from due West (say the West Indies) at S8, with another one from the North-West (say California) at S3. Switching to the out-of-phase state may easily *reverse* these signal strengths!

The directional qualities of a simple system like this cannot, of course, be compared with those of a proper beam, but this article only purports to deal with simple arrangements. Vee-beams and Rhombics need a tremendous amount of space, and Rotary Beams of the Yagi type need (to make a good job of them) a tower, a mechanical rotating arrangement and a considerable amount of know-how for the original adjustment.

Other Methods of Feed

A compromise often has to be made between a text-book aerial and one that is the best than can be erected in the circumstances. If, for instance, it is desired to put a 67-ft. wire into a 50-ft. garden, a frequently-used arrangement is to include the down-lead in the total length and to string up a total of 67-ft., the home end being brought right down to the aerial coupling unit. This wire can then be "voltage-fed"; or, in the words which we prefer, it presents a high impedance at the end.

Its polar diagram will now be somewhat distorted, as part of the wire is in



		80 40 & 20mtrs	40 20 & 10 mtrs
LENGTH	A	94 ft	46 ft 6 ins
SPACING	B	3 ft	1 ft 5 ins

Fig. 7. A recently developed amateur aerial design, suitable for both transmission and reception. It is a multi-band system, and therefore is becoming popular, particularly as space requirements are reasonable. This system is known as the "T2FD."

a sloping or even vertical plane, but that does not mean that its general coverage will necessarily be any worse. For the transmitter this presents certain undesirable qualities, since the actual end of the radiating system is now right inside the house; excessive RF will possibly be let loose inside the shack; and, certainly, the problems of interference with BC and TV will be made more acute. For reception, though, these snags do not arise, and the end-fed aerial is probably the most common of all. It only becomes hopelessly inadequate when "any old length of wire" is strung up and expected to work with its home end just connected straight to the receiver.

From what has gone before, the reader will now realise that such an arrangement will present the receiver with a very high impedance on some frequencies and a very low one on others. Coupling will be too tight in some places and too loose in others, and it may well be that on the very band you are most interested in, efficiency will be lowest of all. So *never* put your trust in a random length of wire. Put up a half-wave, full-wave, three-half-waves or whatever you have space for, taking the lowest frequency-band you are most interested in as the starting point.

As a concrete example, a 67-ft. end-fed wire will be efficient on 40, 20, 14 and 10 metres; but on 80 metres it is a quarter-wave and will want a different form of coupling. If you want to have a similar form of feed for all bands, including 80 metres, then your "magic length" is 132 or 134 feet.

Consider, too, which is the best direction for erecting a wire of this kind, bearing in mind that its maximum efficiency will work round more and more to the direction of the wire itself as the electrical length becomes longer (in other words, as you go down to shorter wave-bands).

As an example, you may have a garden running North-South. Then a 67-ft. wire will be a dipole for Forty, and will give you good reception from the States, Central America and many areas of Asia. On Twenty it will be good for North and South America, Australia, New Zealand, South Africa and most of the interesting parts of the world. But on Ten the accent will be

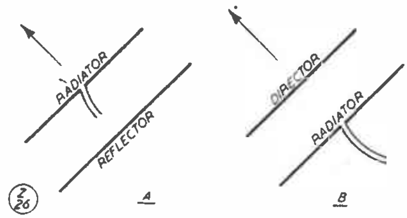


Fig. 8. Reflector and director systems, to give high gain in a particular direction. The principles are explained in the text.

getting more round to the North-South directions, and if you want, say, Central America on Ten you would be better served by a simple dipole than by this 67-footer.

The Windom

Another form of feed, not strongly recommended nowadays, is the Windom (also known as the off-centre single-wire feeder). This aerial has to be strung up in the clear to the correct length, and the feeder is then attached at a point roughly one-third of the way along the wire. When the correct point for the feeder is found, there will be very little standing-wave on it and it will present an impedance of something between 300 and 600 ohms at the bottom end—suitable for clipping on to the aerial tuning unit at a point possibly one-third of the way up the coil.

With a Windom a good earth is essential, because the aerial and its feeder have a "mirror image" in the ground beneath, and the single-wire feeder represents only *half* of the feeder, the other half being the imaginary wire running down to the "image" aerial below—the earth lead. This system is notoriously bad, from the transmitting point of view, for TVI. Nevertheless, it has its good points, one of which is that the feeder itself often *does* carry a standing-wave, *does* radiate (although it shouldn't!) and thus fills in the gaps in the polar diagram of the horizontal top. A Windom correctly adjusted would be no different from the same aerial fed in any other way, but the state of "correct adjustment" is almost impossible to obtain. It could only conceivably be achieved with an aerial suspended over open, well-conducting ground, with no obstructions such as trees, houses and the like within a short distance of it.

Really, its only advantage nowadays is that one sometimes encounters a situation, from the site point of view, in which it is very convenient to attach a single feeder, not to the end of the aerial, but to a point somewhere along its length. For reception it is well worth trying ; for transmission its value is doubtful unless one is situated well away from all television receivers!

The Folded Dipole

By erecting a dipole with two conductors instead of one, and breaking only one of them for the feed line, we gain a certain advantage in that the impedance at the centre becomes something like 300 ohms instead of 72 ohms. This folded dipole (Fig. 6) also has a flatter response curve than the single-conductor dipole and is therefore more suitable for covering an entire frequency-band. The 300-ohm property makes it ideal for the use of flat 300-ohm ribbon for a feeder ; and the latter matches nicely into the aerial terminals of many types of communications receiver. (Flat 300-ohm ribbon is a standard commercial product made by Telcon, and is widely used for short-wave aerial construction.)

Again, one has only a single-band aerial, and a folded dipole for Forty could not be expected to perform terribly well on Twenty or Ten—certainly not with the 300-ohm feeder.

By *tilting* a folded dipole, however, and by "terminating" it with a resistor of the correct value, we may arrive at an interesting multi-band aerial. The "terminated tilted folded dipole" has been dignified with the abbreviated name of "T2FD," and is the subject of much experiment among its particular fanciers. It seems to be an ideal system for those with limited garden space.

Suitable dimensions are shown in Fig. 7 and the accompanying table, from which it will be seen that the bands 80, 40 and 20 metres can be covered with a total length of 94 feet or the bands 40, 20 and 10 with half that length. There appears to be no advantage in raising both ends of this type of aerial, which means that only one supporting point is need, and one of the properties claimed for it is that it is practically omni-directional, on all the bands on which it is worked.

Pure theorists are somewhat sceptical about the whole thing, which probably means that they have not yet formulated any sort of theory as to how, or why, it works. But it is in use by quite a large number of amateurs, all of whom seem to be very keen on this rather intriguing type of aerial system.

Beam Aerials

This article has only claimed to deal with fundamentals, and the practical side of the more elementary types of aerial. Detailed analysis of beam systems is right outside its scope, and it is sufficient merely to mention one or two general types.

First, the "Vee-Beam." We have seen that a long wire, when made longer and longer, will exhibit lobes that come more and more round to the actual direction of the wire. If another similar wire be erected, in such a direction that one of its main lobes corresponds with one of those of the original wire (this is achieved by inclining one wire to the other at *twice* the main lobe angle) then these lobes will reinforce each other, and the lobes outside the system will cancel out. The main lobe will be down the centre of the acute angle of the "Vee," the two wires of which can be fed at the apex by tuned feeders in the normal manner. High directivity and gain are possible, but only, of course, in one main direction and on one band. And by "one *main* direction" we imply one bearing and its reciprocal, although the radiation off the back of the Vee may be considerably down on that from the front, on account of the physical imperfection of such a system, including the DC resistance of the wire.

The "Rhombic," or "Diamond," may be regarded as two Vee-beams placed end to end, the second one closing up the angle opened by the first. The gain and the directivity are even higher than those of a single Vee, and may be increased still further by terminating the Rhombic at the far end by means of a resistor. This makes it a uni-directional affair — it really does radiate in *one* direction only—and the gain increases accordingly.

Parasitic arrays are very extensively used for beam aerials. They consist of a dipole to which further "elements" have been added, but without any physical connection or any means of feeding power to them. A radiating dipole will naturally induce currents in another conductor which is coupled to it, and this property is used for many different types of "parasitic" arrays. When the extra conductor is slightly longer than a dipole, if spaced at the correct distance from it, it will serve as a reflector; that part of the dipole's radiated field which would normally have passed through the direction of this reflector will now be added to its field in the other direction. In other words, we have a "forward gain."

Another conductor, this time *shorter* than the dipole, may be placed at a carefeully chosen spacing in front of the dipole to serve as a "director" and to increase the forward gain still further. Eventually we can arrive at a multi-element beam with a main lobe which is very sharp indeed and shows considerable gain over the maximum attainable with a dipole.

The presence of these other conductors reduces the centre impedance of a dipole considerably, so that the usual 72-ohm match is no longer possible. Various matching devices are therefore used to enable a satisfactory transference of power to be made. All these variables add up to the fact that a multi-element beam is somewhat difficult to adjust to its maximum efficiency; and one that has not been properly adjusted will usually give misleading and very disappointing results.

Other types of beam use driven (as opposed to parasitic) elements; some "collinear" (in the same plane as the dipole) and some "broadside" (as in the case already described). And when we break into the sphere of VHF and UHF there are innumerable types of directional array—some of them only just in the initial stages of development. Before long it will be almost impossible to publish a comprehensive treatise on aerials within a smaller compass than that of an encyclopædia.

Possibly, however, this short introduction to the simplest types will be of some help towards an understanding of the fundamental considerations, and it is hoped that it may lead to a more detailed survey of some of the more useful types.

VERSATILE CRYSTAL RECEIVER UNIT

Simple Design with Many Applications

In these days, the utility of the humble crystal-detector type of receiver is too often overlooked. With the modern germanium crystal and the low-loss components now available, very good results can be obtained — cheaply, easily, and with no power supply requirement. More than that, the crystal detector unit has several important practical applications in addition to its function as a local-station receiver.

THE small instrument illustrated herewith is primarily a crystal receiver using modern components, *but* it also has other useful applications—including absorption wavemeter of a sensitive type, 'phone monitor and key-click detector. Some hints on the various uses are given after the construction, which is simple enough, has been explained.

Construction

Take a small metal box, fit a coil-holder at one end, a telephone jack at the other; mount a variable condenser on the major side with a suitable dial on its spindle; add a germanium crystal, a fixed condenser, an insulator and one or two odd bits—and very nearly you have the list of parts and the construction all tied up!

The coil-holder is centrally mounted at one end of an Eddystone diecast box measuring 4½in. by 3½in. by 2in. and the telephone jack, which need not be insulated from chassis, in an equivalent position on the opposite wall. The variable condenser—a low-loss modern type—is situated reasonably close to the coil-holder. A hole is made in one side to allow the top portion of the small aerial insulator to pass through. The unit is ready for wiring.

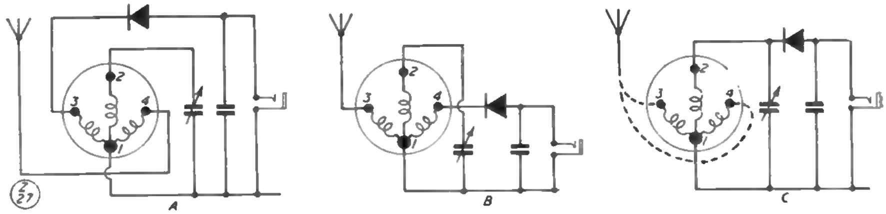
Wiring

The thick pin (No. 1) of the coil-holder is earthed to the large tag fitted beneath the bush on the variable condenser. The insulated spring on the jack —the one which makes contact with the tip of the telephone plug—is connected to one side of a .002 μF condenser (a .001 μF will do almost as well), the other wire from which is earthed to the box. The wire from the jack continues on to the crystal rectifier and thence to the coil-holder. It makes no difference which way round the rectifier is connected.

It is at this point some comment is necessary. The actual connections to the coil-holder depend on the aerial which is to be used. If this is long, the aerial terminal is connected to pin 4 and the free end of the crystal to pin 3, as shown in circuit "A." If, however, the aerial is on the short side, it is taken to pin 3 and the crystal then goes to pin 4, as in circuit "B." In some cases, better results will be obtained if the crystal is taken direct to the "hot" end of the tuned circuit, as in "C." Whatever aerial is used, it is desirable to test out all three methods of making the connections, to ascertain which gives the best all-round results. It does not take long to change over the wires.

Use as Crystal Receiver

First of all, it must be emphasised that the energy for operating the telephones comes entirely from the aerial, and it follows that the more efficient the aerial, the better the results. It is also important to connect a fairly good earth to the terminal fitted to the box near the aerial terminal, and this applies particularly on medium and long wave-



As explained in the text, results will vary according to which of the connections shown here is made. It is recommended that each be tried in turn to ascertain which works best with the particular aerial in use.

List of Parts

1 Diecast Metal Box Cat. No. 650	Eddystone
1 Coil-holder Cat. No. 707	..
Coils to choice Cat. No. 706	..
1 Variable Condenser Cat. No. 586 (140 $\mu\mu$F)	..
1 Dial Cat. No. 595 or similar	..
1 Insulator Cat No. 1019	..
1 Germanium Rectifier Type GEX33	G.E.C.
1 Telephone Jack	
1 Fixed Condenser .001 or .002 μF, Moulded Mica	
1 Single insulated tag strip.	

lengths. Therefore, make the aerial as long and as high as possible, within reasonable limits, when good signals will be received from a number of stations.

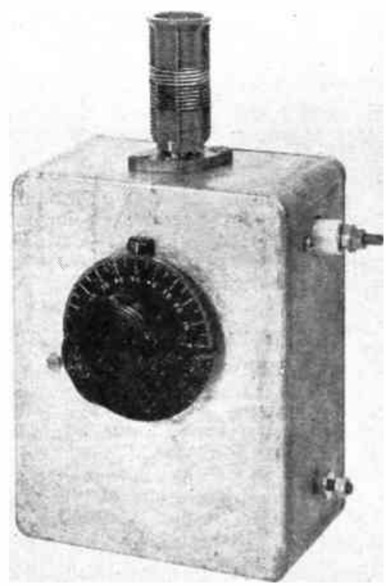
The receiver uses plug-in coils and, to begin with, some of the higher wavelength coils should be tried out. Medium wave BBC stations—and, after dark, some of the stronger Continentals (the writer has received Radio Luxembourg in daylight)—will be heard with the 706/P coil. The local station—Midland Region—comes in at full telephone strength at 65 degrees on the dial, whilst the Light Programme on the long wave from Droitwich is well received at 60 degrees on the BR coil.

As a matter of interest, stations have been received with each of the seven coils available. Admittedly, the writer has a good aerial, 135 feet long and about 30 feet high, but signals have also been received during trials on a much shorter aerial, and it is really surprising how well the small unit functions.

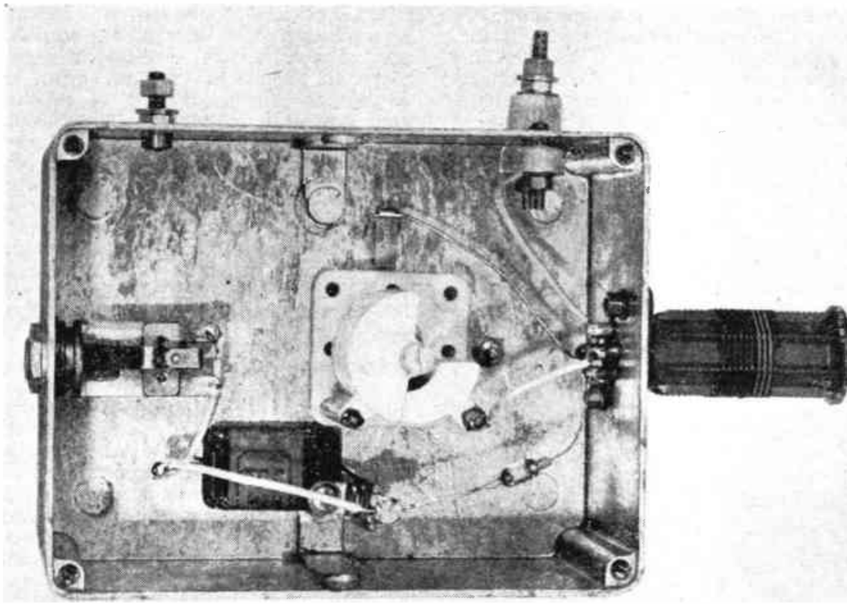
As is to be expected, little will be heard on the LB coil, which covers from 10 to 20 metres—or, in frequency (and it is better to work in terms of frequency), from 30 mc to 15 mc. The stations heard have consisted mainly of the powerful long-range telegraphy stations, audible as key clicks, and telephony stations have been very weak.

On the next coil, the 706/Y (the Y stands for Yellow, the coil being marked with a yellow spot), some telephony stations have been received, chiefly at the low frequency end. On the R coil, quite a few Continental broadcast stations have been logged. The white coil brings in local amateurs working on the 160-metre band at good strength.

One point about the receiver is the excellent quality of the signals received from the stronger BBC stations and, in



General appearance of the useful little receiver-monitor discussed in the article.



Interior construction of the Crystal Unit, showing layout and wiring — what could be simpler !

actual fact, one of the main uses for the unit is as a feeder into a quality amplifier, with most satisfactory results.

Absorption Wavemeter

If a low reading milliammeter (preferably reading to one milliampere maximum, but one reading up to 5 mA will serve, with reduced sensitivity) is plugged into the jack, the instrument becomes a sensitive and useful absorption wavemeter. Radiation from the oscillating circuit under test can be picked up by using a rod or stiff wire attached to the aerial terminal, or the coil can be brought near and inductively coupled to the tuned circuit. Rotation of the variable condenser will result in a reading on the meter, providing the frequency is within the range of the coil which has been plugged in. The sensitivity is such that the needle of the meter will swing up when the oscillator is running at quite low power, as, for example, in a superhet receiver.

Calibration may present some difficulty, but the figures in the table will help as a guide. Definite points can be found by taking an insulated lead from the aerial terminal of the instrument and wrapping it around the aerial going to a receiver, which can be tuned to the required frequencies. The crystal will then act as a loosely-coupled wave-

Coil Table

CATALOGUE NUMBER	SPOT COLOUR	APPROXIMATE FREQUENCY COVERAGE
706/LB	blue	30 — 15 mc
706/Y	yellow	16 — 6.7 mc
706/R	red	7.5 — 3.1 mc
706/W	white	3.3 — 1.3 mc
706/P	pink	1400 — 720 kc
706/G	green	750 — 300 kc
706/BR	brown	370 — 150 kc

Note: The last four types have adjustable dust-iron cores and the frequency coverage can be varied to some extent.

trap, and there will be a diminution in the strength of a received signal as the crystal unit is tuned through its frequency. When the dial readings corresponding to a number of easily identifiable stations have been recorded, a graph can be drawn giving dial reading *versus* frequency for the particular coil in use.

Uses with a Transmitter

The crystal unit has several applications to amateur transmitting work, in addition to that as an absorption wavemeter. One is as a telephone monitor, and it is only necessary to plug in telephones, and adjust the degree of pick-up by fitting a suitable length of aerial lead, to raise the signal to a comfortable level, after tuning it in as usual. No precise information can be given on the actual length of pick-up wire, as this will vary considerably under different circumstances.

In the same way, CW transmissions can be monitored—not fully, but by listening to the clicks as the key makes and breaks the carrier, with results similar to those obtained with a telegraph sounder. If the clicks are audible well to each side of the proper tuning point, it means they are excessive and steps should be taken to improve matters!

Returning to telephony, if the meter is again plugged in, the unit will indicate to some degree whether or not modulation is correct. A reading of about half-scale should be arranged, again by adjustment of the amount of pick-up and *not* by de-tuning. The needle should remain perfectly steady during transmission—if it flickers at all, the indication is that all is not well with the adjustment or operation of the transmitter. The trouble may be one of several — over-modulation, distortion, lack of drive, insufficient emission in a valve, or general mal-adjustment, and the subject is outside the scope of this article.

One final application: When the unit is placed at a distance from the transmitting aerial it will enable adjustments to be made to the transmitter, to aerial coupling, to the phasing of elements, length, etc., so that radiation is at a maximum for the power employed. Co-operation will, of course, be needed, and the useful distance which can be covered will depend mainly on the length of aerial attached to the unit which, in this instance, is used with the meter.

All in all, considering how simple the unit is to construct and bearing in mind that no power supplies of any sort are required, it is well to have this little instrument handy.

"SO YOU WANT MY QSL?"

SWL Reports from the Transmitter's Point of View

Most short wave listeners (SWL's), and especially those who are without a great deal of experience, want to know how to be reasonably sure of getting cards from transmitting amateurs. The pressure of QSL'ing and the number of SWL reports circulated having become so great, it is now a very real problem — because in sheer self-defence many transmitters have had to make it a general rule to refuse QSL's to listeners ; the cost of cards and postage is prohibitive. At the same time the really useful SWL report will nearly always get a QSL, and this article is intended to show what is of value and interest from the transmitting operator's angle.

AT least eighty per cent. of the short-wave listening fraternity seem to be interested in QSL cards—and why not? Any keen SWL with the right ideas can amass a very interesting collection of verifications, while, at the same time, he is actually *helping* those to whom he sends them.

But note that qualifying phrase—"*with the right ideas.*" With all due respect to the SWL's, we should like to say, on behalf of the transmitting amateurs, that very few SWL's *are* possessed of those requirements.

Ask any transmitter how many SWL reports really mean anything to him, and you will receive the same answer all round—an extremely low percentage. The writer of this article has only received one report of any real value during the past *five years*!

When to QSL

It takes a little time for the fledgling SWL to realise that the first cards he sends out ("Ur sigs received RST 559 on 7 mc, Pse QSL") mean precisely nothing to the recipient, and that amateurs, as a body, are not sitting waiting to reply direct, by return of post, to every card that falls on their door-mats.

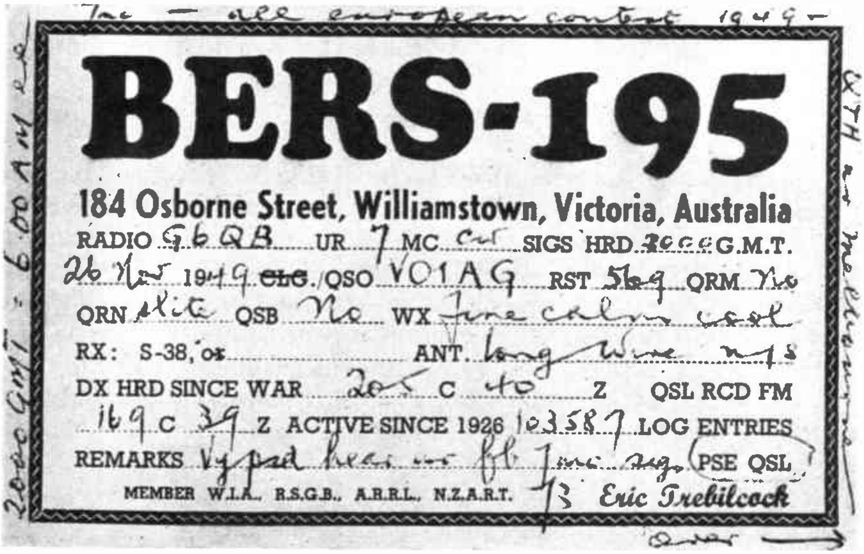
Enlightenment comes quite soon, but there is still a lack of understanding about when a QSL may be interesting enough, or useful enough, to induce the man you have heard to send a card back as a token of thanks.

Briefly, the qualifications for a useful SWL Report are these: (1) It should refer to a transmission on which he was not getting through to the SWL's country ; or (2) it should refer to a transmission which was outstandingly good compared with others from his own locality ; or (3) it should detail reception on an unusual wave-band ; or (4) it should be a painstaking "period report," covering signals over some days or weeks, and comparing them with others from the same part of the world.

Let us be more explicit and consider these cases separately. *Case* (1) might apply to, say, a VQ4 or a ZS or even a W who was either calling G stations, or calling "CQ G," but was not getting any replies, although his signals were good. An SWL report from England would at least tell him that it was only his luck that was bad on that occasion, and that his signals were doing their stuff.

Case (2) might apply to any distant amateur whose signals were head and shoulders above all the others from his

B


BERS-195

184 Osborne Street, Williamstown, Victoria, Australia

RADIO G6QB UR 7 MC SIGS HRD 2000 G.M.T.

26 Nov 1949 /QSO VO1AG RST 569 QRM Nil

QRN Nil QSB No WX fine calm cool

RX: S-38, ANT. long wire

DX HRD SINCE WAR 205 C 40 Z QSL RCD FM

169 C 39 Z ACTIVE SINCE 1926 103587 LOG ENTRIES

REMARKS PSE QSL

MEMBER W.I.A., R.S.G.B., A.R.R.L., N.Z.A.R.T. 73 Eric Trebilcock

country. Quite likely he was trying out a new aerial system, or something of the sort, and a note from an SWL telling him that he was S8-9, while all the other chaps in his part of the world were only S5 or S6, would give him some encouraging information.

Case (3) would apply to, say, ZL's or VK's heard on 80 metres at some unusual time, when they would not normally be looked for; or W's or VE's on the Top Band; or even a distant signal breaking through on Ten when the band was apparently dead.

Finally, *Case* (4)—the period report—might cover a series of transmissions from a distant station who had been noted as being on the band at 2300 every night, working Europe. If you hear him once, that's hardly of interest—lots of other people in Europe are also hearing him. But if you hear him every night for three weeks, at varying strengths, your report may well be of value. On three or four of those nights he may have been unable to get through—if your report shows much weaker signals than usual, he will know that conditions were to blame. Or, perhaps, he altered something at his end which caused an increase or a decrease in his signals, and your report will enlighten him on its effect.

In any of these cases there will be more than a sporting chance that the chap at the other end will find your report worth one of his own cards, and he will be pleased to send one.

If you are really a King Pin among the SWL's, you will have another excellent chance of acquiring a few rarities—the difficult way! That is by being the first person to hear a new country come on the air. Our DX Hero, ZK3AA, in the remote and uninhabited 'Mjumbo Territory, puts his car radio on the 20-metre band and transmits with an input of 3 watts to a whip aerial made of bamboo. Not a soul comes back, and, so far as he knows, nobody even hears him. But the intrepid SWL, I. Gottim (Much Scraping) *does* hear him, and sends a report. ZK3AA cannot fail to be delighted, and will almost certainly QSL.

The QSL cards illustrating this article are a selection from those received by a British amateur transmitter from short-wave listeners abroad.

Note this, though. Unless his signals were the weakest of the weak (meaning that I. Gottim's receiver was a really super affair), ZK3AA will receive, not one card, but several scores of them. Also, his calls will have been answered by all and sundry, and a frantic battle for QSO's will have been going on whenever he has come on the air. So, alas!—I. Gottim's card will be one of several hundreds, and his chance of a reply will be slender indeed.

When Not to QSL

The importance of the above cannot be over-stated. Once ZK3AA becomes a much-sought-after DX man, he has only to show his nose to be inundated with calls, possibly from all over the world at once. If he *knows* that he has only got to send one "tweet" on the frequency to start the mob rioting, of what possible interest can it be to him to know that you, a solitary SWL, *also* heard him? If he is human, he will glance at your card, mutter "So what?" and add it to the rapidly rising pile of unwanted literature.

Coming out of the realms of rare DX to the less exotic ZS, or VQ4, or PY, or KH6—if you hear him working G's, or even other Europeans, he *knows* what sort of signals he is putting over here, long before your card arrives. Unless he is the very good-natured sort who answers all cards, you will be a lucky man if you hear anything more from him.

That VQ4 who puts very strong telephony into this country practically every evening—do you think *he* will be thrilled to know that you received him? He would be more surprised to hear from someone who *didn't*. But the *other* VQ4 in the same town, who struggles away night after night and rarely gets any replies—why not listen to *him* and send him a worthwhile report? To him it really would mean something. At the same time, don't write to him and say "VQ4ZZ is S9 here every night; I've only heard you once, and then you were S2." Be a little more tactful than that!

Send your reports, where possible, to the weaker stations rather than the stronger ones. They will certainly appreciate them more. Likewise, look out for unusual *times*. A GM station on the Top Band will be more interested to know that he was heard in London, say, at 11 a.m. than at 11 p.m. At the latter time he was probably working someone down there, anyway; but at the former time he may have been calling someone 20 miles away without

195, Crown Street, Barcaster, Wessex,
ENGLAND.

RADIO .... Your CW/Phone signals heard on
.... 1953 at .... GMT. Clg./Wkg ....
on .... Mc. Signals R .... S .... T ....
Phone quality .... Other remarks ....
Conditions were .... Other stations heard at
time ....
QRM .... QRN .... QSB .... Wx ....
Receiver .... Aerial ....
PSE QSL via 73 .... Opr.
BCM/QSL, London, W.C.1.

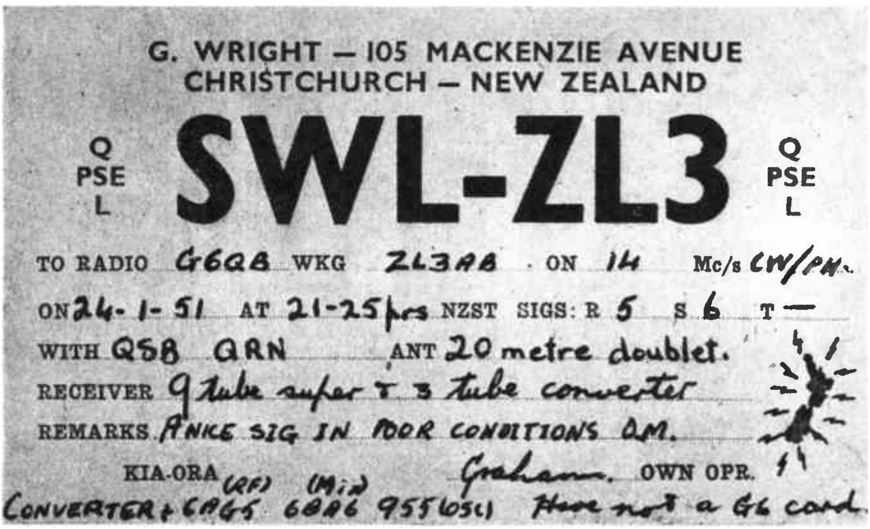
Fig 1 Specimen layout for an SWL report card.

the least idea that his signals were getting 400 miles.

In general, don't report to G stations or Europeans unless they are on the Top Band or, otherwise, unless they are known to be using extremely low power. If you chance to hear one, even on 20 metres, saying that he is using 2 watts only—then he'll probably welcome your card wherever it comes from.

What to Report

The minimum of information required on a useful report is something like this: Date; time; call-sign; strength and tone (on CW) or modulation (on phone); frequency; station being called or worked; conditions at the time; and general remarks such as (*a*) Strength of other signals from the same country or


G. WRIGHT — 105 MACKENZIE AVENUE
CHRISTCHURCH — NEW ZEALAND
Q PSE L **SWL-ZL3** Q PSE L
TO RADIO G6QB WKG ZL3AB ON 14 Mc/s CW/PH.
ON 24-1-51 AT 21-25 hrs NZST SIGS: R 5 S 6 T —
WITH QSB QRN ANT 20 metre doublet.
RECEIVER 9 tube super + 3 tube converter
REMARKS A NICE SIG IN POOR CONDITIONS O.M.
KIA-ORA (RF) (Mix) Graham. OWN OPR.
CONVERTER: 6AG5 6BA6 955 (osc) Have not a G6 card

(*b*) Difficulty in reception due to QRM, QRN or poor conditions.

Fig. 1 shows a specimen layout of a card on which this information and much more can be inscribed with very little trouble. If you like to have it overprinted "SWL Report," or the name of your town, so much the better; but if not, it doesn't really lose any value. The accompanying illustrations show some of the types of SWL cards that are in circulation to-day; some with illustrations and some without.

Strangely enough, the information that really is of very little interest to the man at the other end is the type of receiver and the aerial system used! One would imagine that these details might mean quite a lot, but long experience has shown that the important factor is the one which can *not* be shown on the QSL card—the operator's ability! A good operator, with a single-valver and a "piece of wire," can knock spots off a poor one with an HRO and a big aerial.

And when one fills up large spaces on a card with such details as "9-tube home-made superhet and 3-tube converter using EF91, EF91 and 6BA6, with 100 volts HT from full-wave metal rectifier" . . . . well, it simply is not worth anything and it just makes a card look "cluttery." Some SWL reports carry so much detail in this way that it is impossible to pick out the actual report without scanning the things closely.

Stick to essentials and present in bold letters and figures the thing that matters—the report itself.

Reply Coupons

There can be no fixed rule about whether to use the International Reply Coupons or not. In general, it is preferable to carry out all transactions through the QSL Bureaux, and in that case IRC's are unnecessary. But when a report goes to a rare DX station who has either just started up, or is of a temporary nature, then IRC's for return postage will probably be accepted gratefully.

Don't forget that it is far less trouble for the other man to fill out a card for you and put it in his next bunch to the QSL Bureau than it is to send one direct. So print, on your card, the address of your own QSL Bureau, and leave no doubt that a card sent by this means will reach you safely. That will increase your chances by at least 100%.

SOME SWL ACHIEVEMENTS

During The Years 1946-1952

This is a most interesting summary of the successes achieved by our leading SWL stations during the six years or so up until last winter. While the DX going is very much harder now, it is the time to get experience and to prepare the equipment against the expected improvement in DX operating conditions by about 1956. This refers of course to the really exciting long-distance possibilities. In the meantime, there is plenty of useful and interesting work to be done at the shorter ranges, on all the amateur bands.

At present we are passing through a spell of very poor short-wave conditions. This is common knowledge, familiar even to those who have never heard of the eleven-year cycle or of the effects of sunspots and magnetic storms on the propagation of radio waves.

The undoubted fact, the truth of which may be checked any day, is that one can listen on all the short-wave bands for long periods without hearing any signals from outside Europe. One might carry this further and say that anyone who wants to listen to DX of any kind must, in general, be a late finisher or an early starter. The best DX hours seem to be roughly 2200-0600, and we are carried right back to the early years of radio as a hobby, for in those days it was an aphorism that long-distance stations were only heard at peculiar times!

This state of affairs has undoubtedly damped the ardour of many would-be short-wave enthuiasts, not to mention that of most of the acknowledged experts in the art. So, unfortunately, many enthusiastic record-breakers of the last few years are now forced to rest on their laurels until the ionosphere starts being kind to us again—probably in two or three years' time.

If we cannot switch on the receiver at almost any time of day or night and hear our exotic DX friends rolling in, we can at least induce a little nostalgia by recalling what might be happening if we put the calendar back five years or so, and the purpose of this article is to summarise some of the doings of our star SWL stations of a few years back.

Needless to say, much of the information is collated from the columns of the SHORT WAVE LISTENER, which first appeared in November, 1946. At that time (although we did not realise it) we were climbing up the peak of the *most favourable period for over 100 years* for short-wave reception. The sunspot peak of 1947 proved to be the highest recorded since 1779, and it has been well established that short-wave propagation conditions follow the so-called " sunspot numbers " quite closely.

The stage was set, then, in the winter of 1946, for some fantastic results over the next three years or so, and the SWL's made the best of the circumstances and had a grand *fiesta* of their own.

Winter, 1946-7

The 20- and 40-metre bands were just getting going, since many countries had only had the use of 10 metres until the autumn of 1946. With the opening of *Twenty* we found most of the SWL's, old and new, flocking into this band, and their lists of Calls Heard for a single month include as many as 100 countries.

On *Ten* there were long lists under such familiar names as R. A. Hawley (Goostrey), F. A. Herridge (now G3IDG) of London, S.W.12. D. W. Bruce (London, S.E.9), D. L. McLean (Yeovil), J. M. Graham (Glasgow) and A. Frost Thornton Heath). The surprising feature of these lists to us, to-day, is that they contained literally *scores* of W6's and 7's; the other DX most prominent on *Ten* was of such a calibre as KH6, PK1, HH, OX, XZ and, of course, VK and ZL. A 10-metre list was not the mere collection of a few PY's, LU's and ZS's that it would be to-day, for it really did roam the world.

All through 1947 we find listeners recording such DX as KG6, KC6 (Canton Island), J9 (then Okinawa), all parts of China including C3 (Formosa) and C9 (Manchuria), to say nothing of the C8 in Zone 23, along with AC3, AC4, VK9, PK6 and 7, and all the nice stuff from the Pacific and Far East that one could possibly imagine. And these loggings were just as frequent on *Ten* as on *Twenty*.

In June, 1947, the SHORT WAVE LISTENER started publishing a "Zones Heard" Roll—the first of the achievement tables — and this was promptly headed by T. Burton (Birmingham) with a score of 40 Zones, 180 Countries! Runner-up was N. A. Phelps (London, N.10) with 40 and 146. These, of course, were post-war scores.

By October of the same year we had a very flourishing "Zones Heard" table, divided into "Phone Only" and "Phone and CW." The Phone Only section was headed by A. J. Slater (Southwick) — now G3FXB and a keen DX-chaser — with a score of 36 Zones, 135 Countries. Two months later his position was usurped by R. A. Hawley with 37 and 133, the Phone and CW list being headed by N. A. Phelps (40 and 181) and O. A. Good of Oswestry (40 and 170).

Winter, 1947-8

Winter, 1947, was probably the turning point for conditions. After a wonderful year on all bands, it seemed (quite rightly) that things could improve no further. To stir up the competitive spirit among the keener listeners, a table was introduced which showed Zones and Countries heard *during 1948*, and by March this was headed by L. Collis (Banstead) with 39 and 131 for Phone and CW, and 35 and 101 for Phone Only. That gives a measure of the active state of the bands, for those figures represented listening only up to early February. A month later these had been pushed by D. W. Bruce (now G3IGZ) up to 40 and 144 in the general category, and 37 and 115 for Phone Only!

By June, 1948, the leader had been passed once more, and names coming up were M. H. Preston (London, S.W.12), M. E. Bazley (Birmingham) and E. J. Logan (Hertford). The latter specialised in phone and headed the headed the Phone Only column with 39 and 124—and remember that these figures only represent listening between January 1 and May 1, 1948!

This 1948 Marathon looked liked leading up to a photo-finish and actually did end in a dead-heat. At the head of the Phone and CW list were N. A. Phelps and M. H. Preston, both with a score of 40 Zones, 204 Countries; and E. J. Logan was at the head of the Phone column with 39 and 154.

Those figures give a measure of the conditions on the bands in 1948.

Four-Band Work

In 1949 the SHORT WAVE LISTENER introduced the first Four-Band DX Table, in which listeners tabulated their countries heard on 10, 20, 40 and 80 metres. The column which decided the order of precedence was changed each month, to give specialists on each band their own chance to shine. In March it was the turn of *Ten*, A. Bannister (Manchester) leading with 119 countries on that band. The April issue gave the *Twenty-metre* enthusiasts a chance, and at their head was M. E. Bazley with 200 countries for that band alone.

In May it was the turn of the *Forty-metre* band, and a new star was in the ascendant. J. L. Hall (Croydon) headed this band with a score of 121 countries and a very handsome lead, the next one to him being W. J. C. Pinnell (Sidcup) with 75. (The same J. L. Hall was also the star in the *Eighty-metre* firmament.)

Throughout the same year another set of achievement tables had been running, listing the Zones and Countries heard during each individual month. It is this table that shows us best how the conditions varied from time to time.

In March, 1949, for instance, M. E. Bazley logged 40 and 151 on Phone and CW, and D. W. Bruce turned in a score of 35 and 125 on Phone Only. In June the conditions were obviously a little more difficult, but the same pair headed the lists again with scores of 40 and 110, and 35 and 98. But by September we find even higher scores for the Phone section, led by D. S. Kendall (Potters Bar) with 37 and 130 during the month.

Listening during 1950

By 1950 the slight downward trend was already noticeable, but it certainly did not deter the keen SWL's, who were always ready and willing to enter for any kind of contest. So in that year the SHORT WAVE LISTENER ran a Four-Band DX Table for countries heard in 1950 only. At the end of the first month we find R. S. Stott (Upminster) with a score of 113 countries on *Twenty* and 84 on *Ten*. By the end of March these figures were up to 161 and 112; at the end of June they were 170 and 126. The same listener stayed at the top of the ladder all through the year and turned in a final score of 132 on *Ten*, 187 on *Twenty*, 106 on *Forty*, and 45 on *Eighty*.

By the time we enter upon 1951 we find that the Zones Heard listing for the post-war years shows some amazingly high figures. The Phone and CW category was headed by A. H. Edgar (now G3IOE) of Newcastle with 40 Zones and 223 Countries, closely followed by R. S. Stott with 40 and 222. At the head of the Phone section was E. J. Logan (Hertford) with the score of 40 and 201 — the only listener to achieve all 40 Zones on phone.

But the rise was very slow, and the year ended with a top score by D. W. Bruce, with 40 and 230; E. J. Logan still reigned supreme in the phone category with 40 and 205. A newcomer who put a strong challenge was N. C. Smith (Petts Wood) with 40 and 228 in the general category.

Receivers Used

Success or failure in competitive listening of this kind appears to have been due more to the operator's ability that to the use of any unusual gear or aerials. For example, E. J. Logan, the undoubted Phone Champion, used a BC-342 with an RF Unit Type 32 converter for ten metres. N. C. Smith's receiver was an S.750. Others with consistently high scores were I. S. Davies (London, N.13) with a B.36, K. Parvin (Thornton Heath) with an S.504, S. Smith (Kenilworth) with a CR100 and R. W. Pennells (Lamberhurst) with a home-built 1-V-2.

Several O-V-O's and O-V-1's were doing credit to themselves very consistently, while, at the same time, other listeners were turning in much smaller lists of Calls Heard in spite of assistance from AR77's, AR88's, HRO's and all the best types of receiver. Truly it was *operating ability* that counted, and this became more and more obvious as the conditions really fell off.

The DX in 1952

In 1952, the first of the really lean years, scoring was noticeably slower, and a Marathon Contest decided on the basis of Zones and Countries heard (all bands) showed leading scores of 38 and 143 (by N. C. Smith), and 34 and 110 (by H. Warburton) at the end of March. No rapid scoring of 40 Zones in the first month this time! By May the leaders were N. C. Smith (39 and 171) and, in the Phone section, J. P. Warren of Croydon (36 and 128). And by the end of the year the leader had just reached 39 and 200, with A. W. Tideswell (Stoke-on-Trent) heading the phone section with his score of 37 and 144.

The respective feats of logging 200 countries (Phone and CW) and 144 countries (Phone) in a year like 1952 reflect the highest credit on the listeners concerned, but give no indication of the greatly increased difficulty attending their efforts.

A score of 40 and 220 could have been reached in 1947 with hardly any undue effort or painful concentration, but 39 and 200 in 1952 represented a certain amount of lost sleep and a lot of hard work at all sorts of hours.

What of the Future?

The experts have proved to their own satisfaction that conditions will continue at their present low level until, at the earliest, the end of 1954; after which they may improve quite rapidly and will probably reach the next peak in three years or less.

The new generation of short-wave listeners — those who have joined the ranks since, say, 1949, and have never known what *really* good conditions are — will be in for the surprise of their lives. After struggling for years to hear their first VR4, or KX6, or whatever it is, they will find them coming through when they least expect them, loudly enough to be mistaken for mere W2's! Further, the bad conditions have forced all of us to improve our receivers, our aerials and our general listening technique, which will all place us in a stronger position than ever when the conditions do finally turn the corner again.

For the present, then, we say — "Here's to 1956 . . . may it mark the start of another record-breaking spell."

TEST METER FOR THE CONSTRUCTOR

Building a Multi-Range Instrument

Here we describe the basic principles of voltage, current and resistance measurement, showing how they can be applied to the home-construction of a very useful multi-range meter. Two basic designs are discussed in detail, and the treatment is such that the reader can easily work out for himself alternative ranges for any projected piece of equipment. Apart from the theoretical aspects, this article gives much useful information on practical considerations such as values and the choice of components. It also shows how easy it is to become possessed of an instrument that will prove its worth over and over again on the bench.

A MULTI-RANGE test instrument is a prerequisite for anyone contemplating the construction of radio equipment. A short wave receiver, for instance, should not be attempted unless some method of measuring voltage, resistance and current is available, otherwise it will be impossible to make those final adjustments which make all the difference between a highly efficient and an indifferent piece of equipment. Apart from getting the receiver in working order, faults must invariably occur from time to time due to component breakdown and whilst the writer is willing to concede that there are numerous dodges which can be used for "trouble-shooting" without test instruments (and uses them himself on occasions) there are frequent cases when a multi-meter is indispensable.

Most enthusiasts, however, are perfectly aware of the usefulness of a multi-meter and recognise that it is a necessity where a great deal of constructional work is done. Amongst those who do not possess such an instrument the omission is often put down to cost, because commercial test meters are often very expensive. But why not build your own? The objection to this in many cases is the idea that such an instrument would be beyond the abilities of the comparatively inexperienced, calling for laboratory precision in construction.

It may surprise a good few meter-less enthusiasts to know that a simple test instrument can be constructed not only cheaply but comparatively simply. A basic test meter can actually be easier to construct than many receivers! It is not uncommon for a constructor to build a receiver from a published design of known efficiency only to find on completion all manner of snags—instability, poor sensitivity, lack of "punch" and all the rest. In a test meter these things just don't happen.

Providing that the values of the components are correct, that all solder joints are sound, that certain points concerning the components (noted in this article) are watched, the instrument cannot fail to work. And there are not many items of equipment you can say that for!

Another misconception is that one has to be a mathematical genius to work out the values of the shunts, multipliers and so forth. But there are no complex computations, and providing you can add, subtract, multiply and divide there need be no qualms. *Don't* be scared of a few simple Ohm's Law calculations, however new you may be to the game.

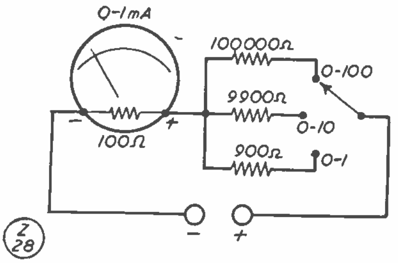


Fig. 1. Basic multi-range DC voltmeter.

In any case, the notes in this article should clarify the situation for any type of meter required.

Although it deals with a specific test instrument built by the author some years ago, which has given excellent service, the treatment will be such that the reader can design his own instrument by piecing together the various sections described in order to obtain the selection of ranges to suit his own particular requirements.

The Movement

The basis of the whole unit is, of course, the moving coil meter which, by the switching in of series or parallel resistors, provides readings of voltage and current respectively. It is common practice to favour a movement with a 1 mA Full Scale Deflection which will have a circuit resistance of 1.000 ohms per volt. Meters of lower sensitivity can be used but the accuracy when used as a voltmeter falls off due to the relatively heavy current drawn through the meter. Reasonable accuracy can be obtained with a 5 mA FSD movement but for more precise voltage readings one would have to measure the total circuit resistance and current and then work it out by Ohm's Law. For current and resistance measurements, however, there is no objection to the meter with a 5 mA deflection. A more sensitive movement (say of 500 or even 100 microamperes) is even better than a 1 mA pattern but these are usually more expensive and for general radio test work the extra expense is hardly worth while.

In the model used by the author a 500 μA microammeter is employed, but these are not easy to come by as surplus, although an identical instrument has recently been offered at 25s. as "new surplus." This is quite a good buy so far as value-for-money is concerned. However, many will wish to cut the cost even lower at the slight reduction of sensitivity and accuracy and, additionally, meters having a 1 mA scale are somewhat easier to obtain. There are some good 1 mA movements on the surplus market and also, if you are willing to scour the shops, various movements of other values, which can be readily adapted.

Bearing these factors in mind, the instrument to be described is based on a 1 mA meter, the component values having been adjusted accordingly. When selecting a meter, note the calibration of the existing scale. Remember that readings will have to be taken off it not only on the basic range but at multiples and divisions. Therefore, choose one with clear marking, preferably with five main divisions each sub-divided into ten smaller divisions. Naturally, the larger the dial the better; but also the higher the cost. The type of meter which has a scale length of about 2½ inches is satisfactory — anything much smaller tends to make reading-off rather trying. And make sure that the resistance of the meter is marked on the scale plate.

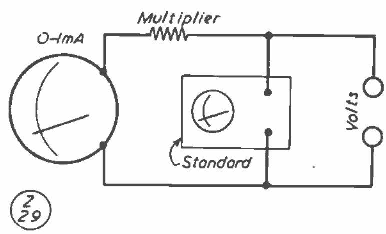


Fig. 2. How to check voltage multiplying resistors using a standard instrument.

DC Voltage Ranges

To measure voltage, the meter must be in parallel with the circuit being tested. In practice, a resistance is placed in series with the meter so that with full voltage applied the current is restricted to the FSD of the movement. As an example, if the movement is 1 mA FSD and a series resistance of

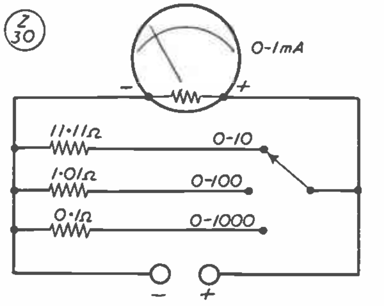


Fig. 3. Basic multi-range DC milliammeter.

1,000 ohms is inserted we can work out by Ohm's Law (V=I×R) that 1 volt will deflect the meter exactly full scale — in other words 1 mA will flow. Under these conditions we would have a 0-1 Volt DC range, the application of lower test voltage deflecting the meter correspondingly less due to the lower current flowing through the resistance.

For higher voltage ranges it is necessary only to switch in higher series resistances. In the example quoted, a 10,000 ohms resistance would provide a 0-10 V range; a 100,000 ohms resistance would give a 0-100 V range, and so on. The basic principle of the multi-range voltmeter is shown in Fig. 1. The necessary value of the series resistor for any given voltage range can be calculated from:—

$$R + Rm = \frac{V \times 1000}{I}$$

where R = resistance of series resistor; Rm = resistance of meter; V = required full scale voltage; I = Full Scale Deflection of the movement.

A glance at Fig. 1 will show clearly that the resistance of the meter is part of the series circuit and this has to be taken into account when calculating the value of the series resistances. If Rm is 100 ohms, then the 0-1 V series resistor would be 900 and not 1,000 ohms (R − Rm, or 1,000 − 100). However, on all but the low voltage ranges the resistance of the meter can be ignored. On the 0-10 V range, for instance, ignoring the meter resistance will result in an error of only 1%. So on ranges above 50 volts or so, one may simply calculate the series resistances from:

$$R = \frac{V \times 1000}{I}$$

As to the practical side, here are some notes on components for the voltage ranges. Low-tolerance resistors for use as the series multipliers are, naturally, best fitted for the job in hand, but these can be expensive and in any case it should always be borne in mind that there is little point in using resistances of greater accuracy than the movement itself! It is often considered, in instruments of the type being discussed, that 5% tolerance (gold band—or dot) resistors are satisfactory.

If the constructor does not feel that the expense of precision wire-wound resistors is justified, standard 5% tolerance carbon resistors will be suitable. But, even so, there may be difficulty in obtaining some of the odd values required. This can be overcome — even with ordinary 20% tolerance components—in one of two ways:

First, if the resistor is too high in value, the effective resistance can be lowered by paralleling another resistor across it. A useful pointer is that a shunt resistor ten times the value of the original component will drop the effective resistance by 10%; thus a 1,000 and 10,000 ohm resistor in parallel will give 900 ohms. For other combinations the standard formulæ can be used.

Where the resistor is too low in value,

Copper Wire Data

Gauge	*Length per Ohm*	*Ohm per Yard*	*Safe Current*
40 swg	27.15 inches	1.326	70 mA
36 swg	68.04 inches	0.529	150 mA
32 swg	137.52 inches	0.262	400 mA
30 swg	181.08 inches	0.199	500 mA
26 swg	381.6 inches	0.094	1 Amp
22 swg	921.6 inches	0.039	2.5 Amps.
18 swg	2714.4 inches	0.01327	7 Amps

Eureka Wire Data

Gauge	*Length per Ohm*	*Ohms per Yard*	*Ohms per Pound*
40 swg	0.98 inches	37.18	177,744
36 swg	2.4 inches	14.84	28,308
32 swg	4.9 inches	7.25	6,950
30 swg	6.5 inches	5.57	4,000
26 swg	13.7 inches	2.64	900
22 swg	33 inches	1.10	153.6
18 swg	97 inches	0.37	17.8

Fig. 4. Some useful wire tables and data for the constructor.

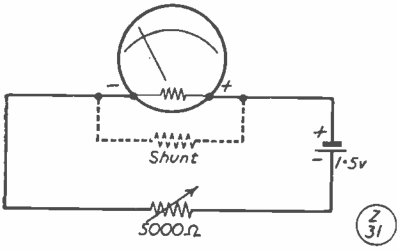


Fig. 5. Set-up for adjusting current-range shunts.

if it is a carbon type its resistance can be *increased* by carefully filing "flats" on its body. It is thus a good policy to obtain, if possible, resistors slightly below the required value as they can then be accurately "pruned up" in value. Remember that any resistor which has been filed should afterwards be given a dab of paint over the affected portion as a precaution against dampness.

Another point is that odd values can often be found in the junk box. Suppose a resistance of 900 ohms is wanted. Quite likely a wide tolerance 1,000 ohm resistor can be found which is low enough for the purpose. Where precision resistors are not used, the series multipliers should preferably be checked on an instrument of known accuracy—either at your local radio dealers (if they are of the courteous type) or by a local enthusiast if you belong to a club. On the other hand, low value resistors can be carefully filed to the correct value if voltages of *known value* are available for application to the circuit. You can, of course, take the series resistors at "face value" but it is more satisfactory, in the absence of precision components, to check them on a friend's meter in the manner shown in Fig. 2.

To sum up: Precision wire-wound or 5% tolerance (the latter can be found as surplus) resistors can be used without need for adjustment. Components with 10 or 20% tolerances can be used but should be checked and adjusted if maximum accuracy is expected.

If 500 or 1,000 volt ranges are provided the series resistance should be made up of a series of several resistors in order to avoid the possibility of flashover which can break down insulation and damage the movement. Thus where the series resistance is 1 megohm, four 250,000 ohm or two 250,000 and one 500,000 ohm resistors could be wired in series. Since the voltage drop across any given resistor is lower the risk of arcing is reduced.

Although half, or even quarter, watt types can be used, it is advisable to use one watt resistors except on the very high values.

DC Milliamp Ranges

The movement itself can be used to measure DC without any external components but it is restricted to the FSD of the instrument. To increase the range of the meter for measuring current it is convenient to place a parallel resistance or shunt across the movement, this shunt resistance by-passing the surplus current. A basic multi-range milliameter is shown in Fig. 3 ; by switching in suitable shunts, higher currents can be measured. On test, the current flowing through the circuit is divided between the meter and the shunt — the meter taking up to 1 mA in the example given. The current not flowing through the meter passes through the shunt ;

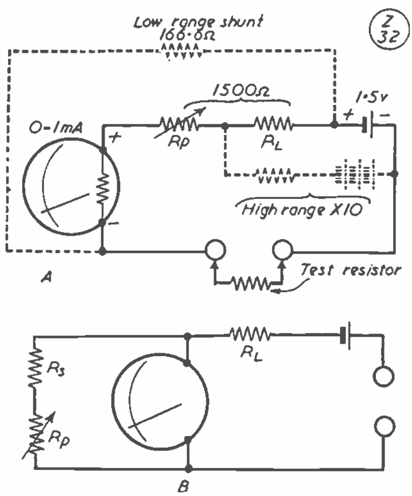


Fig. 6. (A) Basic ohmmeter, showing in dotted outline methods used to read higher and lower resistances than those provided for within the basic range of the instrument. (B) The shunt-type zero adjuster, which gives more accurate setting, as explained in the text.

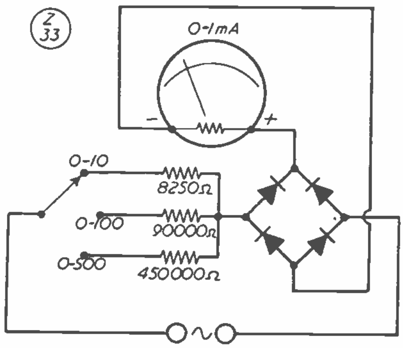


Fig. 7. The basic AC voltmeter.

thus with 5 mA applied to the test terminals, 1 mA flows through the meter and 4 mA through the shunt. It follows that each shunt must have a *lower* resistance than the meter in order to provide an "easier path" for the surplus current.

The heavier the current to be measured the lower must be the shunt resistance, which can be worked out from the formula:—

$$Rs = \frac{Rm}{N-1}$$

where Rs = resistance of shunt; Rm = resistance of meter; N = the number of times the FSD is to be extended.

As an example (using the 1 mA meter of 100 ohms internal resistance) the shunt for the 0-10 mA range — needing a "ten times" scale — has a resistance of

$$\frac{100}{10-1} = \frac{100}{9} = 11{\cdot}11 \text{ ohms}$$

Since the values of shunt resistances are very small (some will be less than an ohm) it is unlikely that components of the correct value will be available. But this need not deter the constructor as they can be easily made-up in various ways.

Ordinary enamelled or silk covered copper wire is often used for meter shunts. It has a low resistance, is easy to use and costs little. For heavy currents (up to 5 amps) 18 SWG is satisfactory and for ranges up to 500 mA, 30 SWG is suitable. These two gauges of copper wire have resistances of 53 and 5.03 yards-per-ohm respectively. From this it will be realised that due to the lengths required, copper wire is not so convenient for the higher resistance shunts.

Where copper wire shunts are used it is advisable to wind them on paxolin strips, reversing the direction of the winding at intervals to minimise magnetic effects. Probably a better scheme is to wind the resistances astatically on bobbins and so avoid the danger of magnetic fields affecting the movement and causing errors. The best way of doing this is to fold the required length of wire in two, starting the winding with the centre (fold) and working the two halves together so that both free ends will appear on the outside of the bobbin.

Unfortunately, copper wire has another disadvantage. It has an appreciable temperature co-efficient of resistance (approximately 0.004) so that changes in temperature affect its resistance considerably. A given length of such wire will, in fact, increase its resistance by 0.004 per ohm per rise of one degree at 20 deg C. An increase of temperature of some two degrees

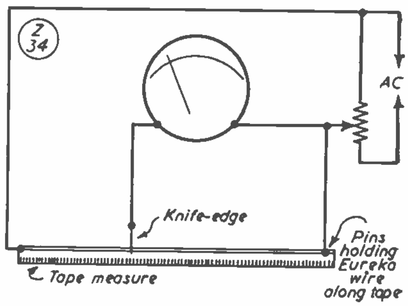


Fig. 8. Set-up used to calibrate the low AC voltage range.

centigrade will affect the accuracy by nearly one per cent. And this does not take into account any heating which may be due to the current flow through the wire.

For more accurate and stable readings, a material less likely to be affected by temperature changes is wanted; "Eureka" resistance wire is the answer. This is the trade name for a wire alloy (60% copper, 40% nickel) which has a temperature co-efficient of only 0.00005

— a much better proposition. Apart from this, it is of higher resistance than ordinary copper wire so that shunts can be made more compact. On average, Eureka wire has 27 times the resistance of enamelled copper wire. To enable readers to calculate the lengths required for shunts, details of useful gauges in copper and Eureka wire are given in Fig. 4.

When selecting a wire for shunt winding, it must be such that there is no question of overheating on test which would result in changing values and consequent errors. Generally 36 SWG up to 50 mA, 30 SWG to 250 mA, and 22 SWG beyond is satisfactory.

Quite often, both types of wire are used — Eureka wire for shunts between 1-10 ohms and copper wire for shunts less than one ohm. With its smaller resistance-per-inch it will be easier to use copper wire for the very low value shunts but be careful not to stretch the wire in handling as this will increase its resistance due to the lowering of the cross-sectional area.

With the wire tables and shunt formula the necessary resistances can be wound. But owing to small mathematical errors and other factors the shunts may not be of exactly the right value when actually placed in position. This can be easily remedied.

Rig up a battery and potentiometer with the meter (see Fig. 5) — they can be any convenient value but care should be taken not to damage the meter. With 1½ or 2 volts do not use a potentiometer of less than 5,000 ohms. With the potentiometer at *maximum resistance* in circuit, connect up and adjust until the meter registers *exactly* full scale deflection, *i.e.*, 1 mA. Then, without disturbing the setting of the potentiometer, connect the shunt — *very short* pieces of copper wire can be used to make the connection.

If the shunt is for the ten times (0-10 mA) range, the meter should read one-tenth the scale — 1 mA. The shunt can then be adjusted until the pointer is exactly on the correct setting. Note that the resistance of Eureka wire can be altered by the simple process of running solder along it until the right value is obtained.

When the 0-10 mA range shunt has been adjusted, leave it in position and adjust the potentiometer until full scale

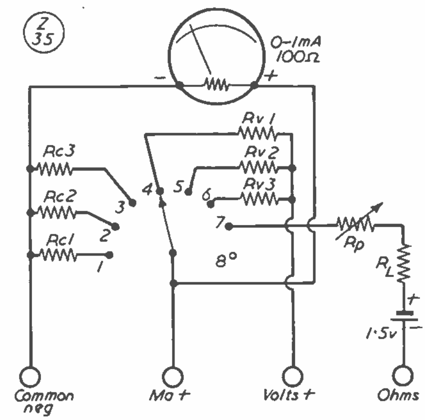


Fig. 9. Suitable Multi-Meter designed for many receiver tests. A more elaborate instrument is shown in Fig. 10.

Table of Values

Fig. 9 Values for the Circuit above.

Current Shunts

Rc1	=	11.11 ohms
Rc2	=	1.01 ohms
Rc3	=	0.1 ohms

Voltage Multipliers

Rv1	=	9,900 ohms
Rv2	=	100,000 ohms
Rv3	=	1 megohm

Ohms Range Values

Rp	=	250 ohms, wirewound
RL	=	1,200 ohms

Switch positions

1, 0-10 mA; 2, 0-100 mA; 3, 0-1000 mA; 4, 0-10 V; 5, 0-100 V; 6, 0-1,000 V; 7, Ohms range; 8, meter Off.

reading is obtained. Then connect up the 0-100 mA (or hundred-times) shunt. Since the meter already has a 0-10 mA shunt across it, it is reading full scale at 10 mA; with the 0-100 mA shunt also connected it follows that 10 mA will be indicated at one-tenth FSD. On the original meter scale (marked 0-1 mA) this will appear at 0.1 mA.

This process continues until all the shunts are adjusted. It is useful to check the shunts by comparison with a meter of known accuracy but the system described is a good substitute method. On the other hand, much trial-and-error work can be avoided if the constructor has access to an accurate resistance bridge.

Measuring Resistance

No instrument of this kind is complete without at least one resistance range. Such an ohmmeter is actually a current reading meter, the basic circuit being shown at Fig. 6 (a). The movement is placed in series with a resistance (part of which is made variable) and a small battery, the values being such that with the test prods shorted out the resistance can be adjusted to enable a full scale reading to be obtained.

If, however, instead of shorting the test probes, a test resistance is placed across them the meter will register something less than full scale due to the current flow being restricted by the extra resistance in circuit. As an example:

Using the 1 mA meter and a 1.5v. battery, a resistance of 1,500 ohms would enable a full scale reading to be obtained with the probes shorted. If, instead, a test resistor of 1,500 ohms is inserted the total circuit resistance would be 3,000 ohms and the current flowing would be 0.5 mA. In such a case the scale reading of 0.5 mA becomes synonymous with "1,500 ohms." By working out a few such simple examples the ohms range scale can be calibrated. For instance, still using Ohm's Law (I = V/R), if a 4,500 ohms test resistor is used the total circuit resistance would be 6,000 ohms and the current would be 0.25 mA so that this reading on the scale also indicates "4,500 ohms."

This system can be used quite satisfactorily for normal (medium) resistance measurements and many commercial multi-meters provide only one resistance range—giving readings up to 100,000 ohms on a 1.5v. battery. To provide readings above this, a higher external battery and higher series resistor is required. Whilst such a range is adequate for much general testing it is always useful to be able to measure higher and very low resistances. On the standard range discussed accurate readings of low resistance is not possible and it is also difficult to obtain accurate readings at the high resistance end due to the cramped calibration scale.

The system mentioned is not practicable for low resistance measurements due to the fact that the voltage drop (or change in current) is so small as to be practically indiscernible. It is possible, however, to obtain a larger voltage drop across low value resistances by passing more current through the test circuit and this is done by fitting suitable shunts in parallel with the movement and series resistor.

The application of this principle is simple. In the previous examples a 1,500 ohms series resistor, with 1.5 volts, gave us 1 mA full scale deflection. If a ÷ 10 range is wanted, this resistance must be reduced from 1,500 to 150 ohms (a shunt of 166.6 ohms); for a ÷ 100 range the resistance should be 15

Fig. 10 Circuit of the Test Meter.

Current Shunts

Rc1 = 11.11 ohms
Rc2 = 1.01 ohms
Rc3 = 1.0 ohms

Voltage multipliers

Rv1 = 900 ohms
Rv2 = 9,900 ohms
Rv3 = 100,000 ohms
Rv4 = 1 Megohm
Rv5 = 8,250 ohms
Rv6 = 90,000 ohms
Rv7 = 450,000 ohms

Ohms range resistors

Ro1 = 9,000 ohms
Ro2 = 111.1 ohms
Ro3 = 10.1 ohms
RL = 925 ohms
Rp = 300 ohms, wirewound
Rs = 200 ohms

Switch positions

(S1): 1, ohms; 2, 0-1000 mA; 3, 0-100 mA; 4, 0-10 mA; 5, 0-1 mA (normal scale, no shunt); 6, 0-1 V DC; 7, 0-10 V DC; 8, 0-100 V DC; 9, 0-1000 V DC; 10, 0-10 V AC; 11, 0-100 V AC; 12, 0-500 V AC.
(S3): 1, high ohms (x 10); 2, normal ohms range; 3, low ohms (1 - 10); 4, very low ohms (1-100).

NOTE: When making tests, S2 must be at appropriate position (AC or DC/Ohms).

Switches

S1 Twelve-way, two pole (if S1C is included, this should be twelve way, three pole).
S2 Two-pole, two-way
S3 Four-way, two-pole
Sp Meter on/off. Can be of the press-button type or standard low resistance make and break type.

Miscellaneous

M = Moving coil movement 1 mA FSD, 100 ohms internal resistance
IR = 1 mA instrument rectifier
E1 = 15 volt grid bias block
E2 = 1.5 volt cell, high current type.
C1 = 4 μF (only needed if Output Meter facilities are required).

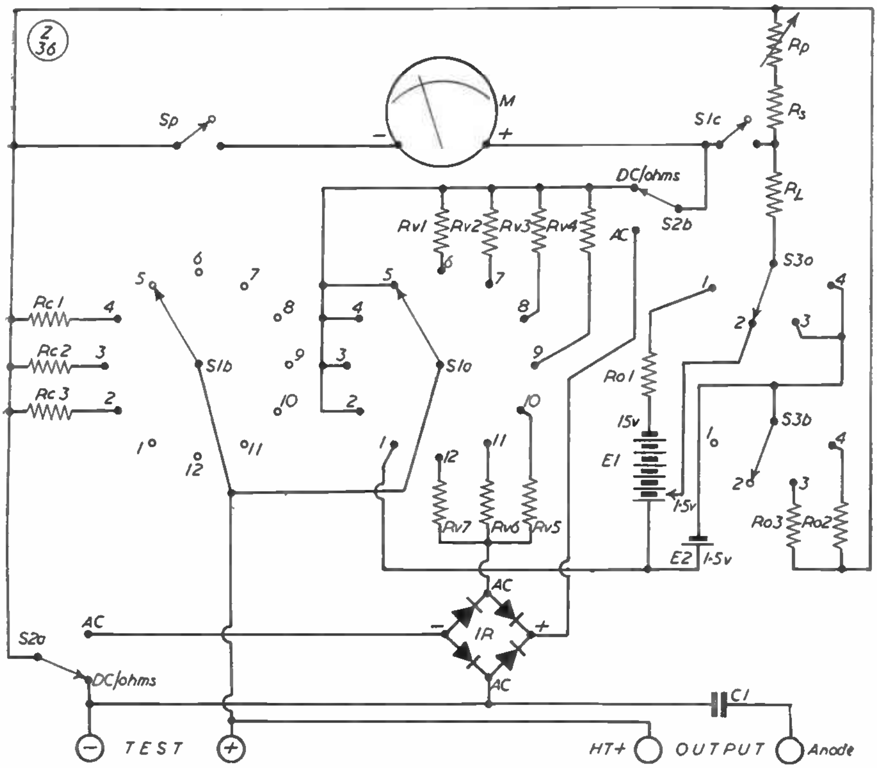


Fig. 10. Circuit covering all the possibilities discussed in the text, resulting in a very versatile instrument giving both AC and DC readings over a wide range, as well as resistance values.

ohms (a shunt of 15.15 ohms). To obtain higher resistance readings the series resistor and the voltage are increased in direct proportion; thus to obtain a " × 10 " scale both must be increased ten times — 15,000 ohms and 15v. This is about the practical limit since a " × 100 " range would need a 150v. battery; in any case the " × 10 " range gives readings as high as most constructors will require.

When making these calculations, the meter resistance must be taken into account. Note also that part of the limiting resistance must be variable; dry batteries drop in voltage through use and age and so some adjustment must be available. Also, a new battery may be slightly higher than the rated value and a little extra resistance is then available to allow for this. The total resistance of Rp and R1 is such that with Rp at full resistance FSD is obtained when the battery is new and at full voltage. When it ages, the position of the Rp slider can be adjusted to enable the correct current to flow. Since it is generally recognised that 1.2v. is the lowest a 1.5v. battery can be used with any degree of reliability the circuit resistance can be arranged so that when the battery falls to this level it is impossible to get FSD on the meter, thus providing a hint that the battery needs replacing.

The potentiometer is of low value to avoid the danger of meter damage due to excessive current flow. It will also

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be clear that the potentiometer should be adjusted each time resistance measurements are made; this by shorting the test probes and adjusting until FSD is registering. The resistance is thus called the Zero Adjuster.

Although often used in home built (and some commercial) test sets the series-type zero adjuster has one disadvantage. In the circuit of Fig. 6A, when the battery is delivering its full 1.5 volts, the total circuit resistance will be 1,500 ohms for full scale reading. With a 1,500 ohm test resistor (giving 3,000 ohms total in circuit) the meter will read half scale (0.5 mA). Now when the battery runs down less resistance is needed to obtain a similar deflection. For instance if the battery is down to 1.25 volts, half scale is obtained with a total resistance of 2,500 ohms in circuit. As the limiting resistance total must be 1,250 ohms to obtain FSD at 1.25 volts, it is obvious that half scale deflection will be obtained with a test resistance of 1,250 ohms (2,500-1,250) applied. In other words the midway point on the meter scale could be calibrated as "1,500 ohms" or "1,250 ohms" according to the condition of the battery.

Greater accuracy can be obtained by using the shunt-type zero adjuster as shown in Fig. 6B, where RL is the normal series current limiter and Rp/Rs comprise the shunt. One variable could be used in place of Rp/Rs but if the potentiometer is semi-fixed as shown smoother control of zero adjustment is possible.

The value of Rp and Rs depends on the resistance of the meter and of RL, taking into account battery voltages of between 1.5 and 1.2. For simplicity, assume RL to be 1,000 ohms; then 1.5 mA will flow without Rp and Rs in circuit. The shunt, then, must take care of the 0.5 mA excess current, and as this is half that which the meter can handle, the shunt must be twice the resistance of the meter, by Ohm's Law.

In practice, Rp is made of a value such that (in series with Rs) it will not be so high that FSD cannot be obtained when the battery is low. In all final calculations, Rm must be considered. As this is in parallel with the shunt—which will be of different value according to the condition of the battery—some compromise must be made. However, by taking the mean of the extremes (Rm in parallel with Rp at maximum and Rp at minimum) and subtracting it from the nominal 1,000 ohms of RL, substantially constant resistance ranges can be obtained.

To conclude this discussion on resistance measurement, a few notes on suitable components would not come amiss. The zero adjuster should be of the wire-wound type, preferably with the Ohms On/Off switch combined, if this is part of the system (*see* later). If low resistance ranges are used, the shunts must be capable of carrying heavy current without overheating, and so they should not be made with less than 30 SWG wire. These shunts can be made in the same manner as described for the current-range shunts.

Owing to the heavy currents flowing when the shunts are in position (this would be 150 mA in the 100 range), the battery should be of a type designed to withstand such current drain.

To check the accuracy of the resistance range shunts, it is necessary to obtain a resistor of known value which will give a reading somewhere about mid-scale on the respective ranges. In the instrument to be described later, mid-scale on the fundamental range is 1,000 ohms, so that the ÷ 10 range has a mid-scale point of 100 ohms. With the shunt in circuit, the probes are shorted and zero adjustment carried out. Then the 100 ohms test resistor is inserted—if the reading is not mid-scale the shunt must be adjusted, noting that each time the shunt is altered in value the meter *must* be re-adjusted for zero setting.

On the ÷ 100 range, if used, the central reading would be 10 ohms, and the same process is repeated, except that a 10-ohm test resistor is used. Incidentally, the test resistors (in this case 100 and 10 ohms) can be made up from 30 SWG Eureka wire and measured on the basic and ÷ 10 ranges respectively.

AC Voltage Ranges

If required, AC measurements can be made available. Here the requirements are less exacting. A low voltage range (say 0-10v.) is desirable for measuring heater voltages; a high range (say 0-500v.) is useful for checking mains voltages and rectifier input voltages; an intermediate range (say 0-100v.) will be

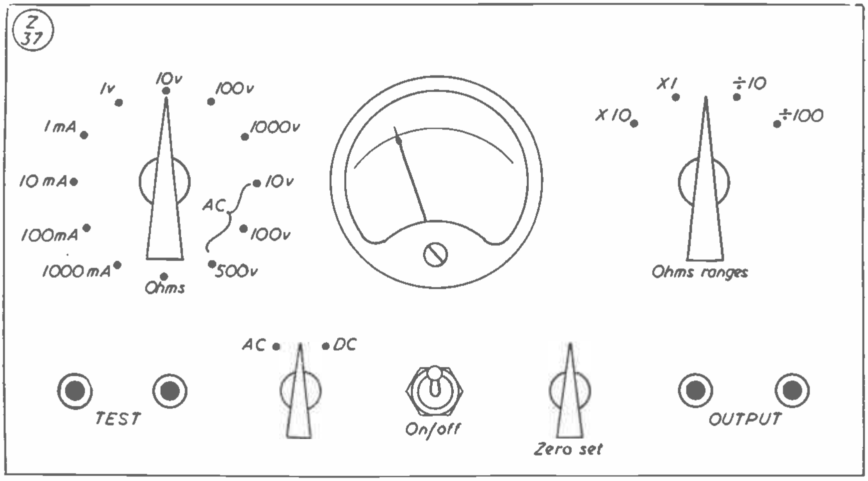


Fig. 11. Suitable panel layout for the instrument for which the full circuit is given at Fig. 10.

useful where the constructor needs accurate measurement of heater circuits in AC/DC equipment.

The measurement of current in AC circuits is seldom required, since continuity tests are all that are necessary—used in conjunction with voltage checks. This is just as well, because on the higher current ranges it is necessary to use a current transformer, shunts being quite unsuitable. Such transformers are difficult to obtain and are not an easy proposition for the home constructor.

The AC voltmeter is essentially the same as the DC voltmeter already described, except that a small instrument rectifier is used (Fig. 7). On the higher ranges, the existing meter scale can be used, as the AC scales will be substantially linear. On the low AC voltage range, however, the scale shape will be distorted owing to the forward resistance of the rectifier, which becomes an appreciable fraction of the total meter resistance. Thus, the resistance of the rectifier varies according to the current flowing through it. This can be overcome by the use of a potential transformer to step up the test voltage to a higher value, so that it can be applied to a meter range which has adequate swamp resistance. In this way, a satisfactory scale shape and low temperature errors are obtained. The construction of a suitable transformer is, however, not for the inexperienced.

The average constructor will find it convenient to calibrate the low AC range on the existing scale plate. There are several methods of so doing, but a popular one is by tape measure! You will need a source of AC somewhere above 10 volts (such as two 6.3 volt windings on a power transformer connected in series), a heavy duty wire-wound potentiometer (of between 50-100 ohms), a length of Eureka wire, a knife edge (a razor blade is suitable) and a long tape measure. The set-up is shown in Fig. 8.

The actual resistance of the Eureka wire is of little importance, but 34 SWG (3.6 inches per ohm) is satisfactory. The knife-edge is arranged to be at point " A," so that the full length of the wire is across the meter. The tape measure should be secured beside the wire as shown, and the wire cut to a specific length of not less than five feet.

Having set up the bits and pieces, apply the AC voltage and adjust the potentiometer until the meter reads full scale (the range-switch, of course, must be set to the 0-10v. range). The rest is simple arithmetic ; if the length of wire is 5 feet (60 inches) and equals 10 volts, then 9 volts will be obtained when the knife edge is connected to 9/10ths of five feet (54 inches), 8 volts at 4-5ths (48 inches), 7 volts at 7/10ths (42 inches), and so on. Put in another way, the tape measure calibration provides an equivalent comparison of six inches per volt.

As each adjustment is made, note the relevant scale reading on the existing scale so that it can later be calibrated for the 0-10v. AC range. It will be noted that the scale become progressively more cramped as the lower voltages are applied.

Practical Instruments

It should now be possible for the reader to piece together a simple multimeter using the current, voltage and resistance circuits described. The switching of the various ranges calls for a few comments, and so two practical circuits will be described.

The actual selection of ranges can be made by switching or by plug and socket. The former is more convenient, but both systems are used commercially. Some users prefer plug and socket selection on the grounds that one is less liable to make mistakes in range selection and so reduces the risk of damaging the meter. One disadvantage with the plug and socket method is that, on the Current ranges, as soon as the plug is withdrawn from the range socket, the shunt is out of circuit and the meter will be destroyed, due to the heavy current flowing through it. This, of course, could only occur when range-changing is attempted with the test circuit connected — a practice not recommended on *any* instrument—but it does show that a moment's thoughtlessness could ruin the movement.

This also applies to simple switching systems where there will be no shunt in circuit between the make-and-break of successive switch positions. It is possible to arrange the switching so that the rotor of the switch makes contact with the following position before it disconnects with the previous position. Switches for range selection must be of the low contact resistance rotary type, this being particularly important with the Current ranges. Simple on/off switches such as those required in the second instrument to be described must also have low contact resistance. All these meter switches could be of the types specially made for the purpose, but failing this, an efficient self-cleaning type of the Yaxley pattern are usually satisfactory. Standard toggle switches are *not* recommended for the simple make-and-break positions, as any resistance in the contacts will cause erratic readings and general inaccuracy.

As a useful refinement, a press-button switch can be incorporated ; it being of the type which is pressed and rotated, it being necessary to rotate in the opposite direction to release it. One advantage is that no reading is possible until the switch is depressed—the time lag necessary to perform this operation enabling the user to re-check that the range selection is correct. Other assets of this system will be obvious. If such a switch is incorporated, it should be placed in the positions marked "Sp" in the circuit diagrams of Fig. 9 and Fig. 10.

We now come to a practical application of the preceding notes. The circuit of Fig. 9 shows a very simple DC instrument which should satisfy the needs of a great many readers whose constructional activities fall short of the more complicated pieces of equipment. Those whose main interest is building receivers and similar gear will find this test meter perfectly suitable.

Using a 0-1 mA, 100-ohm, movement, provision is made for three current and three voltage ranges, with a single ohms range. Using the formulae previously given, these ranges could be modified or added to according to personal preference. A movement with a different basic sensitivity could be used, providing the shunts and multipliers are recalculated.

The current ranges are 0-10 mA (shunt Rc1), 0-100 mA (Rc2) and 0-1000 mA (Rc3). The voltage ranges are 0-10v. (multiplier Rv1), 0-100v. (Rv2) and 0-1000 (Rv3). The ohms range uses a series-type zero adjuster which will prevent full-scale readings when the battery has dropped to 1.2 volts. With this range, resistances up to 100,000 ohms can be measured.

For range selection, an eight-way single pole rotary switch is used, and in order to simplify the switching, four sockets are required for the test probes. The negative probe is always plugged into the Common socket, whereas the

Positive probe is plugged into either the Current, Voltage or Ohms plug according to the tests to be made. Ordinary wander plugs in the meter ends of the probe leads are used for selection.

This simple instrument will more than repay the small cost of building. It will be noted that the various ranges are all exact multiples of the basic range (in tens), so that conversion is automatic —just a matter of adding noughts.

A more elaborate instrument—the one mentioned earlier—is shown in Fig. 10. This provides four DC current ranges, four DC voltage ranges, three AC voltage ranges and four resistance ranges.

Selection is by switching throughout, the main selector being S1, which is a 12-way, two-pole rotary type, and carries all ranges except those for ohms. Current shunts are assembled on one section and the voltage multipliers on the other; the functions and values for all resistors is given with the circuit diagram.

Switch S2 is to bring the rectifier into circuit for the measurement of AC voltages. Switch S3 is a four-way two-pole rotary for selection of the Ohms ranges. It should be noted that switch S1c must be closed when using the ohms ranges, but open when using the voltage and current ranges. It can be conveniently ganged to the S1 assembly or, alternatively, S1 can be a three-pole unit using the additional wafer for S1c. This switch could be separate, but ganging to S1 is recommended, as this will prevent accidentally leaving S1c set with the zero adjustment shunt in circuit when measuring voltage or current. Sp can be of the push-button type already mentioned, or may be a low resistance on/off type. The two additional test terminals marked "Output" are optional, but may be useful when using the AC voltage section for use as an output meter in lining up sets, checking frequency response, and so forth.

If, when making output tests of this kind, it is considered better to disconnect the loudspeaker, then a dummy load must be provided across the voltmeter terminals, *i.e.* across the "TEST" terminals—the probes being across the "OUTPUT" terminals. As most sets use tetrodes or pentodes as single-ended output valves, it is generally satisfactory to use a 10,000 ohm resistor for the load; if in doubt about load impedance, consult the data on the output valve being used. Under these conditions, the 100v. AC range at FSD will equal an LF output of 1 watt and the 500v. AC range will give a full-scale reading corresponding to 25 watts AF. There is little point in calibrating a "watts" scale, since for most purposes one needs only a relative reading for comparison checks.

As regards construction, this will depend on personal taste. A suggested layout is shown in Fig. 11, but it is not critical by any means. The reader now has all the necessary information to build up a useful test meter—either from the two designs shown or by working out his own multi-meter around the basic circuits to suit his own personal needs. There is no reason why every radioman should not have a test-set.

IMPROVING HF RECEPTION

Simple but Effective Aerial Tuning Unit

This article shows how it is possible to boost up signals at the front end of any receiver by means of a tuning unit designed to bring the aerial to resonance. If constructed as described, it will be found to be very much a worth while addition to the DX operator's equipment.

THE more one accumulates radio gear, the more one realises that it is the small auxiliary pieces of equipment which "make all the difference" and which one would not be without once they are built and put into service.

One such piece of equipment is the aerial tuning unit — simple enough to construct, requiring about an hour's work, yet capable of boosting up the S points considerably on the HF bands.

For maximum sensitivity in the RF stage, the aerial feeder must be matched to the receiver input circuit. By matching the feeder to the receiver, greater signal strength will be obtained, particularly on the higher frequencies.

There are several ways by which this matching can be obtained, but the most popular system is the pi-section coupler. This type of coupler will enable a wide range of aerial impedances to be matched to the receiver input and the circuit will be familiar to the transmitting amateur as the now widely-used output tuning arrangement for the PA stage. The circuit is shown in Fig. 1.

The device consists of a series inductance, tapped at appropriate points, with two parallel variable condensers, one each side of the inductance. The coupler is provided with this variable capacity adjustment because the important factor of the signal-noise ratio is dependent in large measure on the degree of aerial-receiver coupling. Another advantage of providing a variation of tuning is that the coupling can be slackened off in cases where a very strong local signal blocks the receiver or causes cross-modulation effects.

Construction

The method of construction depends on individual requirements. The model as described here was built up on a strip of aluminium measuring 7" x 5", the reason for this type of construction being that it is bolted to the main station control panel. By using smaller components (those shown were items picked out of the "spares box") the size could be reduced considerably. Also it is possible that most readers would find it more convenient to build the tuner into a small metal box, such boxes being readily obtained for a few shillings at most radio components stores. Using miniature variables, the unit could probably be accommodated in a box measuring about 6" x 4" x 2".

The coupler was built for use with a random length long-wire receiving aerial and the circuit shown can be used with this type of aerial or with an aerial using an unbalanced coaxial feeder system, the connections being clearly shown in the diagram. Where a balanced line is used, it will be necessary to include a second tapped coil, as shown in Fig. 1 (b). The switch should, of course, be of the two-pole type, and the variable condensers must be *insulated from the panel* or box by suitable washers or spacers.

Where coaxial feeders are in use it is advisable to fit normal coaxial type connectors and plugs for the input and output terminals. In any case, the tuner should, for best effect, be placed in a convenient operating position and as near to the receiver as possible.

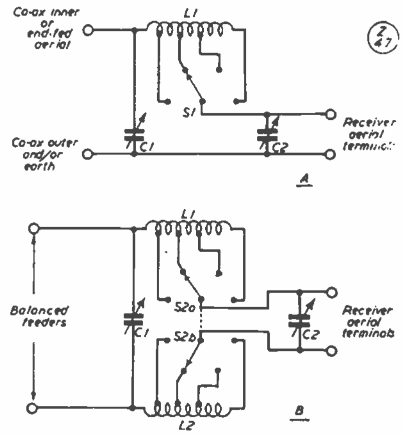
The coil is wound on any convenient former of about ½″ to ⅝″ diameter. The tappings are made in the usual way by twisting the wire double for about half an inch at the various points as the winding is wound on. It will be possible to solder these twisted ends direct to the switch tags in several cases. The gauge of wire and number of turns is not critical and, indeed, some experimenting with the tap positions may pay dividends to those prepared to undertake some cut-and-try juggling.

Operation

There is nothing complicated in using the tuner. It is adjusted for maximum signal strength by switching the coil to different positions for coarse tuning and then rotating the variable condensers for the finer adjustments. Although the tuning may be fairly sharp it should not be necessary to re-adjust the settings of the condensers except when changing bands or when re-tuning the receiver from one end of a band to the other.

Do not expect miracles from the aerial tuning unit! On the other hand it will be found to give *appreciable* extra gain on the HF bands (from, say, the 14 mc amateur band or 25 metre broadcast band) upwards. The advantage will not be fully realised on strong signals but it is definitely possible to pull hitherto unreadable weak signals out of the background noise and enable them to be copied. And, remember, that it is the weak ones which often turn out to be the DX plums.

On frequencies lower than about 9 mc, the tuner will offer no real advantage but there is no need to disconnect it from the receiver. It can be left in position irrespective of the band to which the receiver is tuned. It is advisable, however, to set the variable condensers to minimum capacity and switch the coil to the minimum number of turns in circuit. Under these conditions the residual reactances in the tuner will have negligible effect on receiver performance.



Circuits for the front-end tuner discussed in the text. An aerial coupler of this sort will nearly always give much improved results and is very desirable for serious DX work on the S/W bands.

Table of Values

Circuit of the Aerial Tuner Unit

C1, C2	=	100—160 μμF variables.
S1	=	Single pole, four way rotary switch (for unbalanced line)
S2a, b	=	Double pole, four-way rotary switch (for balanced line).
L1, L2	=	30 turns, 26 SWG enamelled copper wire, tapped at 3, 8 and 16 turns. (L2 only required for balanced feeders). Wound on ½–⅝in. dia. former.

The cost of building the unit will depend on materials already to hand. But even assuming that everything has to be bought, the total cost of components, based on average prices of suitable parts now available, should not come to more than about eight shillings. Good miniature variables are now available extremely cheaply.

Those who have tried similar aerial tuners will readily agree that for the initial outlay, a unit of this sort is one of the most valuable pieces of "extra-equipment" in the station.

SOMETHING ABOUT QSL's

The QSL is the Verification of the QSO

Everyone with an active interest in Amateur Radio knows what is meant by QSL cards — what they are, and why they have such a fascination for the keen listener and amateur station operator. This article discusses the subject in general terms, and shows why nowadays QSL cards are of such importance to those amateurs (SWL's and transmitters alike) who wish to qualify for the various achievement certificates awarded for prowess in the Amateur Radio world. New readers should note that the June issue of RADIO QUARTERLY contained a List of the QSL Bureaux of the World.

A CONTACT over the air with a fellow-amateur, although real enough at the time to the operators at both ends, leaves no evidence of the QSO once it is concluded. It is to G2UV, a British operator, that we owe the invention, many years ago, of the QSL card, which is now accepted as the tangible proof, or souvenir, of the QSO. He confirmed in writing, by means of a post-card, the date and time of each contact, together with details of his station, and asked in return for a "QSL" or written acknowledgment of the reception of his signals.

It was not long before many other operators were copying his example, and the voice of Amateur Radio quickly spread the idea to the remotest parts of the globe; and today there are few amateurs who regard a DX contact as complete until the QSL to verify it has been received.

The *Radio Amateur Call-Book*, published quarterly, gives the call-signs, names and addresses of the majority of the 100,000 amateurs throughout the world. This publication, which is readily obtainable, now renders it unnecessary for most operators to give their address over the air, and they usually request their QSL "*via* the QTH in the Call-Book."

Nowadays it is probably only the newly-licensed amateur who sends a card by post direct to everyone he works; then after a while, when he begins working DX, he may only QSL stations outside Europe. Even this can become rather expensive, and operators usually send most of their cards in batches to the QSL Bureau in their own country, where they are sorted, and either sent to their inland destinations or passed in bulk to the bureaux of the countries to which they are addressed, and where they are then dealt with. Some operators only send cards to DX contacts of the rarer kind, to new countries, and to those amateurs who particularly ask for them. The greater percentage of the world's QSL traffic flows through the various bureaux, and on his card many an operator asks for his QSL to be sent *via* the one in his own country.

Need for QSL Cards

From early days QSL cards have been

The QSL cards illustrating this article are a selection from those received by a British short-wave listener from amateur transmitting stations abroad.

air, getting a card as proof of it is another matter. Everyone who works that particular station will no doubt send a QSL (many by air mail), and in addition he will be greeted with maybe hundreds of listeners' reports, everyone asking for his card in return. Most of the rare-DX operators are, however, pretty good at sending QSL's, even though the station may very often be located in an otherwise uninhabited spot, and many weeks may elapse before the amateur returns to "civilisation", and is able to get the necessary cards printed for those who were lucky enough to work him. In such cases, it can mean several months of patient waiting before the prized card eventually arrives.

The various national societies decide by consultation whether these remote parts, mainly islands, are to be counted as a separate "country" or otherwise; and there are quite a few operators who have worked nearly 250 out of the present possible total of about 269 recognised countries.

During recent times, for Amateur Radio purposes, the world has been divided into 40 different Zones. There are few who can claim the WAZ (Worked All Zones) Certificate, due to the lack of amateur activity in the Zones that cover Tibet and certain parts of China, Mongolia and Siberia; and at the present time, owing to the restrictions imposed on amateurs in the U.S.S.R., it is no longer possible to contact all 40 Zones.

(Elsewhere in this periodical will be found an up-to-date list of Countries, listed in order of Prefix, and giving the Zone in which each is located.)

Besides the main certificates already mentioned, practically every national society now has its own particular awards; for example, WAS (Worked All States of the U.S.A.) and WABC (Worked All British Counties)—the

Prized QSL's from some of the more remote and elusive islands of the world: Swan Island, Mauritius; Tristan da Cunha; and on the right, Marion Island, the Galapagos, and a card from PK5AR when operating portable on Timor Island. All the QSL cards illustrating this article belong to a British SWL and confirm his reception in this country of amateur transmitting stations located in the places mentioned; many of these cards have a high rarity value.

Until about three years ago, it was possible to obtain QSL cards from Russian amateurs, and some examples are shown above. These cards were printed in bulk and issued to stations as required, with space left for the sender's own callsign and other details. Nearly all such cards had a propaganda flavour.

latter being issued for contacts on the 1.8 mc band only. There are also awards available to the short-wave listener, such as the "Heard the British Empire" (HBE) Certificate for those with QSL's verifying their reception of signals from at least fifty British Empire call-areas.

The writer of this brief article is not a licensed amateur, but has been a regular short-wave listener since 1938—even at that, quite a lot of exciting new DX has been unavoidably missed during the past year or so, due to pressure of business! Although QSL's are not *always* forthcoming in return for listeners' reports, as a result of careful listeneng, discriminating reports, and mastering the Morse Code, cards have been received to date from a dozen short of 200 different countries, situated in 37 Zones.

Many interesting individual designs, in brilliant colour, have been developed since the days of the original QSL's, and a selection of cards from the writer's collection is shown in the panels.

LIST OF COUNTRIES BY PREFIX AND ZONE

This we believe to be the most accurate and up-to-date Country/Zone Prefix List yet published. So far as possible, any prefix previously used since the War by a particular country is included, to enable easy checking of Zones and Countries heard, worked or confirmed. The places named in this List also represent the total of 272 Possible Countries in the Amateur Radio world. If you hold cards for 150 countries in 38 zones you have done very well.

Prefix	Country	Zone
AC3	SIKKIM	22
AC4	TIBET	23
AG2	TRIESTE	15
AP	PAKISTAN	21, 22
AR1	*(see YK)*	
AR8	*(see OD)*	
C	CHINA	23, 24
C3	FORMOSA	24
C9	MANCHURIA	24
CE	CHILE	12
CEØ	EASTER ISLAND	12
CM/CO	CUBA	8
CN2	TANGIER	33
CN8	FRENCH MOROCCO	33
CO	*(see CM)*	
CP	BOLIVIA	10
CR4	CAPE VERDE ISLANDS	35
CR5	PORTUGUESE GUINEA	35
CR5	ST. THOMAS AND PRINCE ISLANDS	35
CR6	ANGOLA	36
CR7	MOZAMBIQUE	37
CR8	GOA (Portuguese India)	22
CR9	MACAO	24
CR10	PORTUGUESE TIMOR	28
CS2, 3	*(see CT2)*	
CT1	PORTUGAL	14
CT2	AZORES ISLANDS	14
CT3	MADEIRA ISLANDS	33
CX	URUGUAY	13
CZ	*(see 3A)*	
D	*(see DJ)*	
DJ/DL	GERMANY	14
DU	PHILIPPINE ISLANDS	27
EA	SPAIN	14
EA6	BALEARIC ISLANDS	14
EA8	CANARY ISLANDS	33
EA9	SPANISH MOROCCO	33
EA9	IFNI	33
EA9	RIO DE ORO	33
EAØ	SPANISH GUINEA	36
EI	EIRE (Irish Free State)	14
EK	*(see CN2)*	
EL	LIBERIA	35
EP/EQ	IRAN (Persia)	21
ET	ETHIOPIA	37
F	FRANCE	14
FA	ALGERIA	33
FB	MADAGASCAR	39
FB	KERGUELEN ISLANDS	39
FB	NEW AMSTERDAM AND ST. PAUL ISLANDS	39
FC	CORSICA	15
FD	FRENCH TOGOLAND	35
FE	FRENCH CAMEROONS	36
FF	FRENCH WEST AFRICA	35
FG	GUADELOUPE	8
FI	FRENCH INDO-CHINA	26
FK	NEW CALEDONIA	32
FKS	*(see OE)*	
FL	FRENCH SOMALILAND	37
FM	MARTINIQUE	8
FN	FRENCH INDIA	22
FO	FRENCH OCEANIA	32
FP	ST. PIERRE AND MIQUELON ISLANDS	5
FQ	FRENCH EQUATORIAL AFRICA	36
FR	REUNION ISLAND	39
FT	*(see 3V)*	
FU	NEW HEBRIDES	32
FW	WALLIS ISLAND	32
FY	FRENCH GUIANA and ININI	9
G	ENGLAND	14

LIST OF COUNTRIES BY PREFIX AND ZONE

Prefix	Country	Zone
GC	CHANNEL ISLANDS	14
GD	ISLE OF MAN	14
GI	NORTHERN IRELAND	14
GM	SCOTLAND	14
GW	WALES	14
HA	HUNGARY	15
HB	SWITZERLAND	14
HC	ECUADOR	10
HC8	GALAPAGOS ISLANDS	10
HE	LIECHTENSTEIN	14
HH	HAITI	8
HI	DOMINICAN REPUBLIC	8
HK	COLOMBIAN REPUBLIC	9
HL	KOREA (Chosen)	25
HP	PANAMA REPUBLIC	7
HR	HONDURAS	7
HS	SIAM (Thailand)	26
HV	VATICAN CITY	15
HZ	SAUDI ARABIA (Hedjaz and Nejd)	21
I	ITALY	15
I5	ITALIAN SOMALILAND	37
I6	ERITREA	37
IS	SARDINIA	15
IT	SICILY	15
I/Trieste	(*see AG2*)	
J	(*see JA*)	
J8	(*see JAØ*)	
J9	(*see KR6*)	
JA	JAPAN	25
JAØ	BONIN (Iwo Jima) and VOLCANO ISLANDS	27
JY	TRANSJORDAN	20
K	(*see W*)	
KA	(*see JA — until recently KA was prefix for Philippine Islands*).	
KAØ	(*see JAØ*)	
KB6	BAKER, CANTON, ENDERBURY, HOWLAND and AMERICAN PHOENIX ISLANDS	31
KC4	LITTLE AMERICA (Antarctica)	13
KC6	CAROLINE ISLANDS	27
KC6	PALAU ISLANDS	27
KG4	GUANTANAMO BAY	8
KG6	MARIANA ISLANDS (Guam) KG6S Saipan Island KG6T Tinian Island	27
KG6I	(*see JAØ*)	
KH6	HAWAIIAN ISLANDS	31
KJ6	JOHNSTON ISLAND	31
KL7	ALASKA	1
KM6	MIDWAY ISLANDS	31
KN	(*see W*)	
KP4	PUERTO RICO	8
KP6	JARVIS AND PALMYRA ISLANDS	31
KR6	RYUKYU ISLANDS (Okinawa)	25
KS4	SWAN ISLAND	7
KS6	AMERICAN SAMOA	32
KT1	(*see CN2*)	
KV4	U.S. VIRGIN ISLANDS	8
KW6	WAKE ISLAND	31
KX6	MARSHALL ISLANDS	31
KZ5	PANAMA CANAL ZONE	7
LA/LB	NORWAY	14
LA/LB	JAN MAYEN ISLAND	40
LA/LB	SVALBARD (Spitzbergen)	40
LI	(*see 5A*)	
LU	ARGENTINA	13
LX	LUXEMBOURG	14
LZ	BULGARIA	20
M1	SAN MARINO	15
MB9	(*see OE*)	
MC1, 2	(*see 5A*)	
MD1, 2	(*see 5A*)	
MD3	(*see I6*)	
MD4	(*see I5*)	
MD5	(*see SU*)	
MD6	(*see YI*)	
MD7	(*see ZC4*)	
MD9	(*see 4W*)	
MF2	(*see AG2*)	
MI3	(*see I6*)	
MP4	(*see MP4B, etc — . until recently MP4 was the prefix for all*)	
MP4B	BAHREIN ISLAND	21
MP4H	TRUCIAL OMAN	21
MP4K	KUWAIT	21
MP4Q	QATAR	21
MS4	(*see I5*)	
MT1, 2	(*see 5A*)	
NE1	NEPAL	22
NY4	(*see KG4*)	
OA	PERU	10
OD	LEBANON	20
OE	AUSTRIA	15
OH	FINLAND and LAPLAND	15
OK	CZECHOSLOVAKIA	15
ON	BELGIUM	14
OQ5	BELGIAN CONGO	36
OQØ	RUANDA-URUNDI	36
OX	GREENLAND	40
OY	FAEROE ISLANDS	14
OZ	DENMARK	14
PA/PI	NETHERLANDS (Holland)	14
PJ	DUTCH WEST INDIES	9
PK1, 2, 3	JAVA	28
PK4	SUMATRA	28
PK5	DUTCH BORNEO	28
PK6	CELEBES and MOLUCCA ISLANDS	28
PK6, 7	DUTCH NEW GUINEA	28

LIST OF COUNTRIES BY PREFIX AND ZONE

Prefix	Country	Zone
PX	*(see 7B)*	
PY	BRAZIL	11
PZ	DUTCH GUIANA (Surinam)	9
SL/SM	SWEDEN	14
SP	POLAND	15
ST	ANGLO-EGYPTIAN SUDAN	34
SU	EGYPT	34
SV	GREECE	20
SV	CRETE	20
SV5	DODECANESE ISLANDS	20
TA	TURKEY	20
TF	ICELAND	40
TG	GUATEMALA	7
TI	COSTA RICA	7
TI9	COCOS ISLAND	7
TR	*(see 5A)*	
TT	TANNU TUVA *(see UAØ)*	
UA1	FRIDTJOF NANSEN LAND (Franz Josef Land)	40
UA1, 2, 3, 4, 6	EUROPEAN RUSSIAN SOCIALIST FEDERATED SOVIET REPUBLIC	15, 16, 17
UA9,Ø	ASIATIC RUSSIAN SOCIALIST FEDERATED SOVIET REPUBLIC	16, 17, 18, 19, 25
UAØ	TANNU TUVA REPUBLIC	23
UB5	UKRAINE	16
UC2	WHITE RUSSIAN SOVIET SOCIALIST REPUBLIC	16
UD6	AZERBAIJAN	21
UF6	GEORGIA	21
UG6	ARMENIA	21
UH8	TURKOMAN	17
UI8	UZBEK	17
UJ8	TADZHIK	17
UL7	KAZAKH	17
UM8	KIRGHIZ	17
UN1	KARELO-FINISH REPUBLIC	16
UO5	MOLDAVIA	16
UP2	LITHUANIA	15
UQ2	LATVIA	15
UR2	ESTONIA	15
VE	CANADA (including VO Newfoundland and VO6 Labrador)	1, 2, 3, 4, 5
VK	AUSTRALIA (including VK7 Tasmania)	29, 30
VK1	HEARD ISLAND	39
VK1	MACQUARIE ISLAND	30
VK9	PAPUA TERRITORY	28
VK9	TERRITORY OF NEW GUINEA (including Bismark and Admiralty Islands)	28
VK9	NORFOLK ISLAND	32
VO	*(see VE)*	
VO6	*(see VE)*	

Prefix	Country	Zone
VP1	BRITISH HONDURAS	7
VP2	LEEWARD ISLANDS (including Antigua, Barbuda, British Virgin Islands, Montserrat, St. Kitts-Nevis, Anguilla)	8
VP2	WINDWARD ISLANDS (including Dominica, Grenada, the Grenadines, St. Lucia, St. Vincent)	8
VP3	BRITISH GUIANA	9
VP4	TRINIDAD AND TOBAGO	9
VP5	JAMAICA	8
VP5	CAYMAN ISLANDS	8
VP5	TURKS AND CAICOS ISLANDS	8
VP6	BARBADOS	8
VP7	BAHAMA ISLANDS	8
VP8	FALKLAND ISLANDS	13
VP8	SOUTH GEORGIA	13
VP8	SOUTH ORKNEY ISLANDS	13
VP8	SOUTH SANDWICH ISLANDS	13
VP8	SOUTH SHETLAND ISLANDS	13
VP8	GRAHAM LAND (Antarctica)	13
VP9	BERMUDA ISLANDS	5
VQ1	ZANZIBAR AND PEMBA	37
VQ2	NORTHERN RHODESIA	36
VQ3	TANGANYIKA	37
VQ4	KENYA	37
VQ5	UGANDA	37
VQ6	BRITISH SOMALILAND	37
VQ8	MAURITIUS	39
VQ8	CHAGOS ISLANDS	39
VQ9	SEYCHELLES	39
VR1	GILBERT AND ELLICE ISLANDS AND OCEAN ISLAND	31
VR1	BRITISH PHOENIX ISLANDS	31
VR2	FIJI ISLANDS	32
VR3	FANNING ISLAND (including Christmas and Washington Islands)	31
VR4	SOLOMON ISLANDS	28
VR5	TONGA (Friendly) ISLANDS	32
VR6	PITCAIRN ISLAND	32
VS1	SINGAPORE	28
VS2, 3	MALAYA	28
VS4	SARAWAK *(until recently VS4 was prefix for British North Borneo)*	28
VS5	BRUNEI	28
VS6	HONG KONG	24
VS7	*(see 4S)*	
VS9	ADEN (including Kamaran and Perim Islands) AND SOCOTRA ISLAND	37

LIST OF COUNTRIES BY PREFIX AND ZONE

Prefix	Country	Zone
VS9	MALDIVE ISLANDS	22
VS9	SULTANATE OF OMAN	21
VS9	TRUCIAL OMAN *(see MP4)*	
VT1	*(see MP4K)*	
VU	INDIA	22
VU4	LACCADIVE ISLANDS	22
VU5	ANDAMAN AND NICOBAR ISLANDS	26
VU7	BAHREIN *(see MP4B)*	
VU7	NEPAL *(see NE1)*	
W	U.S.A.	3, 4, 5
WG6	*(see KG6)*	
WH6	*(see KH6)*	
WL7	*(see KL7)*	
WN	*(see W)*	
WP4	*(see KP4)*	
XE/XF	MEXICO	6
XZ	BURMA	26
YA	AFGHANISTAN	21
YI	IRAQ	21
YJ	*(see FU)*	
YK	SYRIA	20
YN	NICARAGUA	7
YO	ROUMANIA	20
YR	*(see YO)*	
YS	SALVADOR	7
YT	*(see YU)*	
YU	YUGOSLAVIA	15
YV	VENEZUELA	9
ZA	ALBANIA	15
ZB1	MALTA	15
ZB2	GIBRALTAR	14
ZC1	*(see JY)*	
ZC2	COCOS (Keeling) ISLANDS	29
ZC3	CHRISTMAS ISLAND *(off Java)*	29
ZC4	CYPRUS	20
ZC5	BRITISH NORTH BORNEO (including Labuan)	28
ZC6	PALESTINE	20
ZC8	*(see ZC6)*	
ZD1	SIERRA LEONE	35
ZD2	NIGERIA AND BRITISH CAMEROONS	35

Prefix	Country	Zone
ZD3	GAMBIA	35
ZD4	GOLD COAST (including Ashanti and British Togoland)	35
ZD6	NYASALAND	37
ZD7	ST. HELENA ISLAND	36
ZD8	ASCENSION ISLAND	36
ZD9	TRISTAN DA CUNHA and GOUGH ISLAND	38
ZE	SOUTHERN RHODESIA	38
ZK1	COOK ISLANDS (including Raratonga)	32
ZK2	NIUE	32
ZL	NEW ZEALAND	32
ZM	WESTERN SAMOA	32
ZP	PARAGUAY	11
ZS1, 2, 4, 5, 6	UNION OF SOUTH AFRICA	38
ZS2	MARION ISLAND	38
ZS3	SOUTH-WEST AFRICA	38
ZS7	SWAZILAND	38
ZS8	BASUTOLAND	38
ZS9	BECHUANALAND	38
3A	MONACO	14
3V	TUNISIA	33
4S	CEYLON	22
4W	YEMEN	21
4X	ISRAEL	20
5A	TRIPOLITANIA AND CYRENAICA (Libya)	34
7B	ANDORRA	14
9S	SAARLAND	14

Countries with no regular assigned prefixes :

Country	Zone
ALDABRA ISLANDS	39
BHUTAN	22
CLIPPERTON ISLAND	7
COMORO ISLANDS	39
MONGOLIAN REPUBLIC	23
TOKELAU (Union) ISLANDS	31
WRANGEL ISLAND	19

Pse QSL

AMATEURS THROUGHOUT THE WORLD ASK FOR SWL REPORTS

Elsewhere in this issue we give a good deal of practical information about QSL cards and the process of acquiring them. In these three pages are the callsign/ addresses of some 130 amateurs, in all parts of the world, who have informed us that they would be glad to have SWL reports in accordance with the details requested. Useful and correct reports will be confirmed by QSL card, either direct or through our Bureau. Make out a clear, concise and accurate report and send it to the address given, mentioning " Pse QSL " in this issue. Alternatively, use the QSL Bureau address for the country concerned — see pp. 91-94, June issue RADIO QUARTERLY. As it is intended to retain " Pse QSL " in future issues, please make your report as comprehensive as possible. Another list, of about 100 or more stations different from those given here, will appear in the December RADIO QUARTERLY

AP2R 583728 *Cpl. Handley R., R.P.A.F. Drigh Road, Karachi* 8, *Pakistan.* 14200 kc phone, 1230-1430 and 1530-2100 GMT : 14050-14090 kc CW, at 0330-0930, 1230-1430 and 1530-2100 GMT. Details of speech quality, and period reports of comparative signal strength with other Asian stations.

CN8FN *Lt. Teddy Helderman, 735th AC and W Sqdn. Det.* 1, *APO* 117, *c/o Postmaster, New York City, U.S.A.* 1.7, 3.5, 7, 14, 21 and 28 mc phone and CW. 0600-2359 GMT.

CN8GU *M/Sgt. R. H. Michael, P.O. Box* 166, *Casablanca, French Morocco.* Reports on speech quality and modulation percentage of 14 mc phone.

CO2OK *P.O. Box* 1015, *La Habana, Cuba.* Reports on 1.7, 3.5, 7, 14 and 28 mc phone and CW.

CT1ER *Arthur Dias Cruz, Rua* 23 *No.* 234, *Espinho, Portugal.* Requires reports on 7 and 14 mc phone transmissions.

DJ1DF *Kirchstr* 59, *Muenster/Westf, Germany.* 7 and 14 mc CW, 1500-1900 and 2100-2300 GMT.

DJ1EJ *Lodererplatz* 11, *Erding Obb, Munchen, Germany.* Reports on 14 mc CW, operating 1900-2100 GMT.

DJ1FP *Wrangelstrasse* 34, *Kiel, Germany.* 3.5-3.8 mc phone and CW, 1000 GMT onwards.

DJ1FX *Deckerstrasse* 57, *Stuttgart/Bad Cannstatt, Germany.* 3.5, 7 and 14 mc phone and CW ; 0500 0530 GMT, weekends 0600-1100 GMT.

DJ1JE *Am Roetheneck* 3, *Frankfurt/Main, Germany.* 7 mc CW, Sunday mornings. Critical tone reports.

DJ1MT *Behringstrasse* 14, *Reutlingen, Wuerttemberg, Germany.* 3520-3590 kc CW, 0400-0630 and 1645-1800 GMT.

DL1FQ *Elmshornerstrasse* 100, *Itzehoe, Germany.* 3.5 and 14 mc phone, operating Saturdays 1800-2000 GMT and Sundays 0800-1800 GMT.

DL1QP *Bahnhofstr* 14, *Hamelin/Weser, Germany.* 3500-3550 kc CW, 0700-0800 GMT.

DL2SU *c/o* 64 *Forton Road, Gosport, Hants, England.* 3.5, 7 and 14 mc CW. Stations heard calling DL2SU, at over 500 miles from Hamburg on 3.5 and 7 mc, and at over 1000 miles on 14 mc.

DL3PK *Ungererstrabe* 157/I, *Munich* 23, *Germany.* Reports required on 3.5, 7 and 14 mc CW operation, weekends 0600-2300 GMT.

DL3RK *Ludwigstrabe* 18, *Kaufbeuren, Germany.* 21 mc CW, operating weekends. Details of stations heard calling DL3RK.

DL4YK *SFC E. F. Diehl Jr.,* 512*th Sig Base Maint Co.. APO* 189, *c/o Postmaster, New York City, U.S.A.* 3.5, 14, 21 and 28 mc phone and CW, 1700-2300 GMT.

DL6PI *Burgstr* 44, *Hoven/Duren, Germany.* Reports on 3.5-3.6 mc CW, 2000-2359 GMT.

DL6UH *Lerchenrain* 5, *Rammersweier, Offenburg, Germany.* 3.5-3.8 mc phone, operating evenings. Details of modulation, QRM, QRN, and any QSB.

DL7AD *F. Woletz, Im Heidewinkel* 22*a, Berlin-Siemensstadt, Germany.* 3.5, 14 and 21 mc CW and NB.FM phone, Sunday mornings. Details of modulation and comparative reports.

DL7BB *Kapuzinergraben* 9 *III, Aachen, Germany.* 3.5, 7 and 14 mc CW and NB.FM phone. Speech quality and modulation.

DL7CY *Brettnacher Str* 20, *Berlin-Zehlendorf, Germany.* 3520, 3555, 7020 and 7031 kc CW, 0500-0530 GMT, and Sunday mornings.

DL9BT *Rhalandstr* 7, *Zeven/Bremen, Germany.* Reports on 3.5, 7, 14 and 21 mc phone.

DL9CQ *W.Pfister. Unteressfeld/Grabfeld, Unterfranken, Germany.* Comparative reports on CW and phone operation, all bands. Reports on antenna tests on 14 and 21 mc.

DL9DU *Schwalbenweg* 74, *Hof-Saale, Germany.* 3.5 and 7 mc CW, operating 1900-2300 GMT.

DL9EZ *Schneckenburgerstr* 34, *Munchen, Germany.* 3.5 mc CW, Friday, Saturday and Sunday 1900 GMT onwards. Critical tone reports.

DL9JH *Merkurstr* 271, *Benningen/Neckar, Germany.* 3.5, 7, 14, 21 and 28 mc phone, 1130-1230 GMT and evenings. Details of modulation.

DL9OY *Stockwiesenweg* 11, *Friedrichshafen/Bodensee, Germany.* 3.5 and 7 mc CW, 1700-2300 GMT and weekends. Critical reports on tone.

DL9QG *Am Reiherhorst* 48, *Hamburg-Harburg, Germany.* 3.5, 7 and 14 mc phone and CW, 1800-2100 GMT and weekends. Speech quality and modulation.

DL9SE *Arndtstr* 42, *Bielefeld, Germany.* Reports on 3.5, 7 and 14 mc CW, 1700-2300 GMT.

DL9ST *Pracherdamm* 108, *Tornesch, Germany* 3.5, 7 and 14 mc phone and CW, 1600-2300 GMT, Sundays 0700-1200 GMT. Modulation details.

DL9WE *Gambrinusstr* 5, *Mannheim-Sandhofen, Germany.* 3.5, 7 and 14 mc phone and CW, 1600-2359 GMT. Details of modulation : any QRM.

DL9YA *Werthauserstr* 106 *II, Duisburg-Hochfeld, Germany.* 3.5 mc phone, 2200-2300 GMT.

DL9YX *Braunschweigerstr* 101, *Thedinghausen, Germany.* Reports on 14.10-14.35 mc phone, operating 1500-2200 GMT. Speech quality and modulation.

DM2ABL *Leipzigerstrasse* 14, *Dresden-N6, Germany.* 3.5, 7, 14, 21 and 28 mc phone and CW operation.

EA2DT *Zurbaran* 4, *Bilbao, Spain.* Requires reports on 7 and 14 mc phone and CW.

EA9AM *Post Box* 164, *Ceuta, Spanish Morocco.* 7, 14 and 28 mc phone. Details of Wx.

EI6I 23 *Dargan Street, Bray, Eire.* Operating CW on 7020 kc, 1900-2200 GMT.

F8YE *P.O. Box* 201, *Metz, Moselle, France.* 3.5, 7, 14, 21, 28 ,72 and 144 mc phone and CW, 0700-0800, 1100-1300 and 2000-2200 GMT.

FA3HH *P.O. Box* 60, *Tiaret, Oran, Algeria.* 7, 14 and 21 mc phone and CW. Speech quality and modulation.

G2BGA 5 *Steep Close, Findon, Worthing, Sussex.* VFO-controlled 7 mc phone, occasional CW, 0815-1115 GMT. Modulation details.

G3GNC 47 *Derby Road, Fallowfield, Manchester* 14. 144.3 mc phone, Wednesdays 1600-2359 GMT. Speech quality and modulation.

G3HSW 134 *Saltwell Road, Gateshead* 8, *Co. Durham.* 7 mc CW, VFO-controlled, 1800-2100 GMT, weekends 1400-1700 GMT. All reports except from DL, G, LA, ON, OZ, PA, and SM.

GM3HTH 10 *Ronald Street, Lerwick, Shetland, Scotland.* 1830, 3539, 7019 and 7028 kc CW, 1900 GMT onwards. Comparative reports, and details of keying.

G3HTY *The Bower, Far Forest, Kidderminster, Worcs.* 144.9 mc phone, 2100-2300 GMT. Reports from over 100 miles. No reports required on other bands.

G3HZW 12 *St. Mildred's Road, Ramsgate, Kent.* 3.5 and 7 mc CW and phone, operating weekends. Accurate reports for aerial tests on QRP.

G3IKO 15 *Waverley Avenue, Chingford, London E.*4. 1.8, 3.5, 7 and 14 mc phone and CW, operating evenings and weekends.

GW3INO 34 *Pen-yr-alley Avenue, Skewen, Neath, Glam.* 3.5-3.6 mc CW, 1800-2200 GMT, Sundays 0900-1800 GMT.

HB9OE *Dufourstrasse* 48, *Biel, Bienne, Switzerland.* 3.5 and 7 mc CW, 1200-1400 and 1900-2300 GMT.

HK1DZ *P.O. Box* 59, *Barranquilla, Colombian Republic.* 14135, 14180 and 14330 kc phone. 1700 GMT onwards. Speech quality and modulation percentage.

I1AWQ *S.Marco* 1946, *Venezia, Italy.* 14 mc phone, 0645-0715 and 2030-2300 GMT.

1BVY *Via Cedranio* 27, *Napoli, Italy.* 7 and 14 mc phone and CW, operating 1700-2100 GMT.

I1EC *Via Longoni* 4, *Sondrio, Italy.* Reports required on CW and phone operation, all bands.

I1TAY *Corso Siccardi* 11, *Torino, Italy.* 7 and 14 mc phone, 1100-1400 and 1600-1800 GMT.

JA2AA 26 *Shimizu-cho, Ogaki-shi, Gifu-ken, Japan.* Reports on 14.00-14.15 mc CW operation.

JA2AD *Kan Katayama, c/o Inako P.O., Mieken, Japan.* 14 mc phone and CW, operating 1200-1500 and 1900-2100 GMT.

KL7AON *L. A. Dyson, c/o C.A.A., Biorka Island, Sitka, Alaska.* 3.8, 7, 14, 21 and 28 mc phone, 2200-0800 GMT.

KZ5CH *H. A. Smith, Med. Det., US Army Hospital, Fort Clayton, Panama Canal Zone.* 14150-14225 kc phone, 2100-2359 GMT and weekends.

MB9CA *Franz Kardasch, Gendarmerie-Major, Unterbergen, Carinthia, Austria.* Requires reports on 3.5 and 7 mc CW and phone, 1130-1300 and 1800 GMT onwards.

MP4KAB *E. P. Pout, c/o Kuwait Oil Co. Ltd., Kuwait, Persian Gulf.* 14.1-14.2 mc phone, at 1300 GMT. Details of modulation.

OD5AI *C. Ammar, P.O. Box* 352, *Tripoli, Lebanon.* 14 mc phone and CW, 1200-1800 GMT. Critical reports on speech quality and modulation.

OD5BA *J. Attar, P.O. Box* 493, *Beirut, Lebanon.* 14 and 21 mc phone, operating 1000-2200 GMT.

OD5BH *P.O. Box* 235, *Tripoli, Lebanon.* 14, 21 and 28 mc phone and CW, 1400-2200 GMT. Speech quality and modulation percentage.

OE13WC *W. M. Curry,* 1245 *H.M.A., APO* 174, *c/o Postmaster, New York City, U.S.A.* Requests reports on 14300 kc phone and CW.

OH3QL *Olavi Kilpinen, Nokia* 6 *piiri A* 131, *Finland.* 14 mc CW, and occasional phone, 1400-2100 GMT.

OH3SG *Kaartok* 19, *Riihimaki, Finland.* 3.5, 7, 14 and 21 mc CW, 1400-2000 GMT, Sundays 0700-2000 GMT.

ON4AJ *General Lemanlaan* 14, *Assebroek, Bruges, Belgium.* 7 and 14 mc phone and CW, 0530-0730, 1215-1245 and 2000-2100 GMT.

OQODZ *Dr. Frans X. Vanderick, Medecin Colonie, Kabgayi, Ruanda-Urundi.* 14 and 21 mc phone and CW, 1600-2000 GMT. Comparative reports with other OQ, VQ2 and VQ4-stations.

OZ1LJ *Leif Jensen, c/o Karetmager Jensen, Dostrup, Himmerland, Denmark.* 3.5, 7 and 14 mc CW, occasional phone, 1700-2359 GMT, Sundays 1200-1400 GMT. Details of speech quality : frequency, stability of same, and any QSB.

PJ2AA *S. J. Heeringa, Dakota Airport, Aruba, Netherland West Indies.* 14 mc phone and CW, 2100-2359 GMT : 21 mc phone and CW, 1600-2100 GMT. Comparative reports with other PJ2-stations.

PJ2AF *L. D. McBurney, P.O. Box* 214, *Lago Oil and Transport Co. Ltd.. Aruba. Netherland West Indies.* 14.05-14.20 and 28.40-28.80 mc phone, 1200-2000 GMT. Reports on readability, stability and modulation.

PY6FI *Rua Caramuru* 10, *Salvador, Bahia, Brazil.* Operating 3505 kc CW, at 0200 GMT : 7010 kc CW, at 2300 GMT.

SM3BNL *Brandstationen, Hoosgatan* 22, *Hernosand, Sweden.* 3.6-3.8 mc NB.FM phone, also 14 mc CW and phone : operating 1700 GMT onwards.

SM5BZD *c/o Berlin, Kristallvagen* 121, *Hagersten, Stockholm, Sweden.* Reports on 3.5 and 7 mc CW.

TG9RB *USAF Mission to Guatemala, c/o U.S. Embassy, Guatemala City, Guatemala.* 14002 kc CW and 14155 kc phone, 2000-2359 GMT.

VE1KB 99 *Pleasant Street, Yarmouth, Nova Scotia, Canada.* 3.5 and 14 mc CW, 1700-0200 GMT.

VE1PB *E. H. O'Hara, P.O. Box* 790, *Halifax, Nova Scotia, Canada.* 3.8 and 14 mc phone, 1600 GMT onwards.

VE1WK 616 *Main Street, St. John, New Brunswick, Canada.* 3.5, 14 and 28 mc CW, 1300-1600 GMT and weekends.

VE3AIU *F. H. Bisset, Saltford Heights, Goderich, Ontario, Canada.* 1.8, 3.5, 7, 14, 21, 28 and 144 mc phone and CW, 1330-1430 and 2330-0300 GMT.

VE3ALJ 70 *Renfrew Avenue, Ottawa, Ontario, Canada.* 7 and 14 mc CW and phone. Reports especially required on 14 mc NB.FM phone.

VE3AUK 49 *Dorothy Street, Brantford, Ontario, Canada.* 14.15-15.20 mc phone, 1800-2300 GMT. Speech quality and modulation.

VE3RCS *Vimy Amateur Radio Club, Vimy Barracks, Kingston, Ontario, Canada.* 14150-14200 kc phone, 1630-1730 GMT and weekends. Speech quality and modulation ; stability of frequency.

VE3WY *T. C. Wylie, R.R.1., Glencoe, Ontario, Canada.* 3.5, 3.8, 7 and 14 mc CW, also AM and NB.FM phone : 2100-0500 GMT and weekends.

VE3YV 1522 *Bruce Avenue, Windsor, Ontario, Canada.* 7, 14 and 21 mc CW.

VK3AHH 10 *Belgravia Avenue, Box Hill North, Melbourne E.12, Victoria, Australia.* CW and phone, all bands, particularly 3.5 mc.

VK3ANJ 12 *Hall Street, West Brunswick, Melbourne N.10, Victoria, Australia.* 7 mc CW, 2100-2300 GMT : 14 mc CW, 0500-1000 and 1300-1800 GMT. Mainly require reports of reception in Europe at other times than the above, with critical report on tone. In reports please state whether VK3ANJ was calling CQ East or CQ West when heard.

VK4EL *E. J. Lake, c/o Radio Station 4QN, Clevedon, Queensland, Australia.* 21 and 28 mc phone and CW, 0030-0300 and 0900-1200 GMT. Details of modulation.

VO1D 61 *Prince of Wales Street, St. John's, Newfoundland.* VFO-controlled 3.5, 7, 14 and 28 mc phone and CW, 1100-1400, 1600-1800 and 1900-2359 GMT.

VO6N *Jack Willis, Cape Harrison, Labrador.* VFO-controlled 3.5, 7 and 14 mc phone and CW.

VP4LZ *J. A. Connors, Guest House, Piarco, Trinidad, British West Indies.* Reports on 3.5, 7 and 14 mc CW, and on 1776, 1810 and 21030 kc CW.

VQ2JN *J. P. J. Nortje, P.O. Box* 7, *Livingstone, Northern Rhodesia.* 7 and 14 mc phone and CW, at 0400 and 1800 GMT.

VQ4CW *M. C. Pavely, c/o Standard Bank of South Africa Ltd., Nairobi, Kenya.* 7010, 7084, 14020, 14038 and 14168 kc phone and CW, 1500-2000 GMT. Comparative reports with other VQ-stations.

VQ5AU *E. J. Brice, Box* 355, *Kampala, Uganda.* 14 mc phone, and 14046 kc CW, operating 1700 GMT onwards. Comprehensive reports.

VQ5DU *L. A. Seeley, P.O. Box* 231, *Kampala, Uganda.* 14170-14200 kc phone, 1500-1900 GMT. Check on frequency and bandspread.

VS2CV *E. W. Hunt, Police HQ Signals, Kuala Lumpur, Malaya.* 7 and 14 mc phone and CW, operating 1100-1300 GMT.

VS2DS *L. H. Ferris, Angle-Oriental (Malaya) Ltd., Malim Nawar, Perak, Malay Federated States.* 14 mc phone and CW, 1600-1800 GMT. Details of Wx.

VS7FW 23 *Main Street, Negombo, Ceylon.* 14100 kc CW operation, 0030-0230, 0500-0800, 1200-1400 and 1600-1900 GMT.

VU2AC-VU2BL-VU2CQ 82 *St. Andrews Road, Bandra, Bombay* 20, *India.* 7060, 14100-14350, 21060, 21180 and 28250 kc phone, 1600-1900 GMT.

W1DHO 9 *Fairfield Avenue, Darien, Connecticut, U.S.A.* Reports required on VFO-controlled 1.8, 3.5, 7 and 14 mc CW.

W2AWI 5400 *Fieldston Road, Riverdale* 71 *New York City, U.S.A.* 14202 and 14298 kc phone, 2200-2359 GMT. Reports particularly required when operating mobile, 1500-1700 GMT.

W2EQS 48 *Prospect Avenue, Westwood, New Jersey, U.S.A.* 1.8, 3.5, 7, 14, 21, 27 and 28 mc phone and CW.

W2LYO 196 *Pyle Street, Oradell, New Jersey, U.S.A.* Requires reports on 14072 kc CW, operating 2000-2359 GMT.

W2NI 31 *Azalia Court, Hempstead, Long Island, New York, U.S.A.* Operating fixed and mobile, 3.8-4.0, 14.2-14.3 and 28.5-29.7 mc phone, 0600-2359 GMT.

W2QQ *W. E. Jones, Box* 4, *Bowmansville, New York, U.S.A.* 14010-14100 and 14200-14250 kc phone and CW, 1730-1830 and 2200-2300 GMT.

W2ZVS 266 *Midland Avenue, Montclair, New Jersey, U.S.A.* CW operation on 14 mc, 2200-0200 GMT and weekends. Comparative reports with other W2-stations.

W4AIX *P.O. Box* 178, *Bonaire Motel, Hendersonville, North Carolina, U.S.A.* 7, 14, 21 and 28 mc phone and CW, sometimes QRP.

W4PRM 816 *Melrose Street, Winston-Salem, North Carolina, U.S.A.* Reports required on 14 mc phone transmissions.

K4WAR *MARS Radio Station Building No.* 24603, *Camp Gordon, Augusta, Georgia, U.S.A.* Operating CW and phone, all bands, 1330-0400 GMT.

W5CTM 305 *24th S.E., Paris, Texas, U.S.A.* 7 and 14 mc CW, and 7 mc phone, 0100-0900 and 1700-1900 GMT. Reports on keying and on speech quality.

W7PCZ/4 *c/o* 513 *North Central, Olympia, Washington, U.S.A.* 3.5, 7, 14 and 28 mc phone and CW, 0200-0500 GMT. Readability of signals, and stability of carrier.

W7QDJ 135 *North Lakeview Drive, Clearfield, Utah, U.S.A.* 3.5, 7, 14 and 21 mc phone and CW, 1400-0700 GMT. Modulation details.

W8GDQ *W. W. Waite, RFD.4, Webster Road, Wellington, Ohio, U.S.A.* 1808, 1819, 1878, 1890 and 1897 kc phone, 0300-0830 GMT.

W8LAU 381 *East 7th Street, Salem, Ohio, U.S.A.* Reports on 7 and 14 mc CW, operating 1300-2359 GMT.

W9MEL *H. S. Hart, Rt.* 2 *Box* 45, *Wheaton, Illinois, U.S.A.* Requires reports on 14200-14300 kc phone.

YV1CB *P.O. Box* 389, *Maracaibo, Venezuela.* Operating 14320 kc phone, 1800-2000 GMT.

ZE5JJ *W. S. Carey, P.O. Box* 73, *Salisbury, Southern Rhodesia.* 7, 14, 21 and 28 mc phone and CW, 0400-0500 and 1500-2000 GMT, and weekends.

ZL2BJ 37 *Elbourne Street, Taradale, New Zealand.* Reports on 7000-7050 kc CW, operating 0300-0600 GMT. Comparative reports with other ZL-stations.

ZS4FF 18 *Gluckman Avenue, Wilgehof, Bloemfontein, South Africa.* 7, 14 and 21 mc phone and CW, 1500-2000 GMT.

ZS5GK-ZS5KG *P.O. Box* 1902, *Durban, Natal, South Africa.* 14, 21 and 28 mc phone and CW, operating 1700 GMT onwards, and weekends. Speech quality and modulation.

ZS6HN 49 *Webber Road, Delville, Germiston, South Africa.* 14 and 28 mc phone, operating mainly at weekends. Reports on speech quality.

ZS6WW 48 *Surbiton Avenue, Auckland Park Johannesburg, South Africa.* Requires reports on 7, 14, 21, 28, 50 and 144 mc phone.

4X4BC 37 *Keren Hakayemet Street, Kiryat-Amal, Israel.* 3.5, 7, 14, 21 and 28 mc phone, 1500-2100 GMT.

SHORT WAVE BROADCAST COMMENTARY

Authentic Information on Long-Distance Broadcasting Stations

Practically every broadcast receiver in use today has a short wave tuning range which will bring in large numbers of distant foreign stations. This can add enormously to the variety and interest of general reception. All over the world, there are many thousands of short wave listeners who spend much of their time tuning round the world's broadcasters. This informative article discusses several important services in detail, and gives a great deal of data of a general nature on short wave broadcast reception. You are missing a lot if you are not making full use of the short wave tuning range on your receiver.

WHEN making a forecast of the expected activities of the various short wave broadcast networks during a particular period there are at least two points to bear in mind.

In the first instance, there are those broadcasters which normally dominate the scene at *any* time during the year. If they are no further distant than, say, the Ural Mountains or the Mediterranean Sea, they can be expected to be audible in the British Isles as well during the autumn or early winter as in the summer months, and probably, their performance will be an improvement with the advent of darkness in the evenings here. It will be noted that these European broadcasters do not, in general, have need to alter their frequencies at any time during the course of a year.

Radio Yugoslavia, for instance, is regularly available for its "Listen To Our English Broadcasts" which are given daily at 0615-0630 (9620 kc, 6100 kc), 1700-1715 (9620 kc, 6100 kc), 1815-1830 (7200 kc, 6100 kc) and 2145-2200 (7200 kc. 6100 kc).

Across the pond, the North American networks with broadcasts directed to the United Kingdom and Europe will be expected to function much in the same manner as before, though there may be recourse to somewhat lower frequencies as the back end of the year approaches. Here again, for the late evening transmissions, we may expect even better performance than during the summer period.

During the early summer months this year reception of Radio Australia broacasts to the United Kingdom was often deporable. On occasions, the early morning session on 9580 kc was quite inaudible, and that in the 16-metre band scarcely readable at 0745.

This was the most unfavourable time of the year for reception of Radio Australia's signals on any frequency, but the situation is likely to have improved to a marked degree towards the end of September and early in October. It has been noticed that, apart from a few occasions during the evenings, the broadcasts from Radio Australia on 11760 kc and adjacent channels have been entirely absent during most of this year. During this present period of minimum solar activity the 9580 kc channel is the best at any time; during the autumn this frequency should be available around 1400 each day, in addition to the breakfast period. Radio New Zealand has not been at all reliable during the summer months but it is hoped that there may be an improvement with a a possible increase of power during the forthcoming visit of Her Majesty the Queen to the Antipodes.

Asian broadcasting stations which have definite directed broadcasts to the British Isles continue to be well received here, and this can again be anticipated during the autumn. In particular, All-India Radio's morning broadcasts and Radio Pakistan's evening sessions will continue to be well heard; the former's external service to the United Kingdom can, at the time of writing, be received at 0730-0830 over 17740 kc and 15380 kc. Radio Pakistan's latest schedule for the British Isles is 2030-2115 daily over 11650 kc and 9645 kc.

Indonesia's broadcasts to the United Kingdom are generally reliable and the evening session should be well received at 1900 both on the 25- (11770 kc) and 19-metre (15150 kc) bands; 9710 kc is a possibility, also. During the summer period, Iran on 15100 kc has been prominent with its English news bulletin at 2000 and until she deserts this channel for a lower frequency, this will continue to be the case. Turkey, as usual, provides massive signals for her directed British Isles broadcasts, and may be classified as ever present, in company with the European broadcasters already mentioned.

African stations, in general, were poor during the early summer here, but this situation is likely to improve gradually as winter approaches. The South African Broadcasting Corporation's "Calling Africa" service, which is directed northwards, is the most reliable signal from South Africa at any time. The SABC is now in the course of installing nine new short wave transmitters at Paradys near Bloemfontein, each of 20 kW power, for the purpose of improving reception of its external and other services.

Rhodesian (4826 kc), Nigerian (4800 kc) and Kenya (4855 kc) broadcasts are likely to be better heard here soon, and of course Radio Brazzaville's English sessions from French Equatorial Africa will continue to give good signals. North African short wave broadcasting stations, too, can be expected to be more clearly received, including the new Forces Broadcasting Station at Tripoli on 4965 kc.

Lastly, South and Central Americans will figure most prominently in the early mornings and in the late evenings, apart from broadcasts directed to the British Isles, such as those from Argentina and Ecuador; these are likely to be quite good at the advertised times of broadcast.

The Real DX

Our second consideration will be of those short wave broadcasters which can be counted as real DX stations; in other words, those which, chiefly because of distance and lesser power and with non-directional aerials, are so much more difficult to log than those which we have previously reviewed. It must be admitted that some of these, however, are quite frequently heard with excellent volumne.

Naturally, because their power is limited, the New Zealand transmissions are not regularly available in this country. The time of day when reception can be expected to be best is from 0700 to 0830 and the transmitters in use are ZL8, 9620 kc, and ZL18, 9520 kc. A one-time favourite and usually audible programme was that given at 0730 on Sundays and entitled: "Your weekly guide to the Land of the Long White Cloud — New Zealand, Pacific Playground." You may still be fortunate to hear one in this series with the title: "High Horizons," describing the thrills to be experienced by a climber scaling the snow capped peaks and icy glaciers of the lofty Southern Alps of New Zealand, the early playground and testing ground of Sir Edmund P. Hillary of Mount Everest fame.

In the continent of Australia we have the Brisbane, Queensland, transmitter VLM4 operating on a frequency of 4920 kc and often audible around 2030 with early morning music and market prices. Then there is VLX4 on 4897.5

kc, sometimes audible at 1500, with late night dance music before closing down at 11 p.m. Western Australia Time. The transmitter is located at Wanneroo, near Perth, and the postal address is: Box D 190, GPO, Perth, W.A.

On the Asian continent an interesting broadcaster is Radio France-Asie at Saigon, Indo-China; at the time of writing there is a news bulletin in English which is audible here on 9745 kc at 1600.

The Voice Of Free China at Taipei represents the interests of the Nationalists at present confined to the island of Formosa. During the latter part of the year their nightly broadcast to the British Isles is on the air from 1820 to 1845 on 11920 kc. From the Philippine Islands you should be able to log signals transmitted by DZH8 of the Far East Broadcasting Company, Manila, operating on a frequency of 15300 kc; this station radiates religious programmes which can be heard here most afternoons up to 1600. During the summer the writer logged this station at 0415 with the direction: "Here is the News from the News Room of the Far East Broadcasting Company in Manila."

The Thailand broadcasting authorities have been operating the following in their Overseas service: HSK5, 5240 kc; HSK7, 11910 kc and HSK8, 15640 kc, between 1000 and 1125 daily. In the Home service relay, HSK5, HSK7 and another transmitter on 7105 kc are in operation at 2359-0100 and 1130-1520 daily. A new 50 kW transmitter HSK9 is now reported to be on the air at 2200-2300 with a special programme in English beamed to Europe; the frequency 11700 kc has been mentioned but it does not appear that this will be a permanent channel. This station is located at the capital, Bangkok. 'Way back in the autumn of 1936 and later, it was possible to listen regularly to programmes in English from the national broadcasting station at Bangkok at good loud-speaker strength; the musical items were usually played by the Royal Military and Naval Orchestra of Siam: perhaps these conditions will again appertain during the coming winter.

The station consisted of a 5 kW transmitter using a crystal controlled oscillator, grid leak modulation and a centre-fed Hertz aerial and was controlled by the Superintendent Radio Engineer, Lieut.-Colonel Phra Aram, of the Post and Telegraph Department, Saladeng, Bangkok.

The Burma Broadcasting Service operating from Rangoon can be heard between 1500 and 1520 daily, at which time it closes down; there is an English news at 1500, followed by a weather forecast and programme summary for the next day's activities. The two frequencies in use are 9543 kc and 4774 kc and signals on both these channels have been heard at the time stated. Reports will be welcomed by the Director of Broadcasting, Burma Broadcasting Service, Churchill Road, Rangoon.

Station RAD, Tashkent, Uzbec, USSR, 6825 kc, is often audible here with clear programmes in English. These are on the air at 1515 and 1615, and you may identify your station by means of its attractive balalaika interval signal. In the Middle East, an excellent English transmission is operated from Damascus at 2130-2230 nightly over a frequency of 11915 kc; the following announcement will be heard: "This is S.B.S., the Syrian Broadcasting Service in Damascus." In Saudi Arabia, Radio Djeddah operates at various times daily using five different beams. Beam I is directed to the Yemen and Haranaut; Beam II to Central Arabia and Bahrein; Beam III caters for listeners in Northern Arabia, Syria, Lebanon and Jordan; Beam IV is directed to Northern Arabia and Iraq; and Beam V is centred on the North Red Sea coast and Egypt. The schedule, with programmes entirely in Arabic, is as follows: 0435-0505 and 1605-1835: 725 kc and 3960 kc (I), 3980 kc (I), 5975 kc (III), 6175 kc (IV), 7245 (V); 1105-1135: 725 kc and 3960 kc (I), 5975 kc (II), 11950 kc (III), 11850 kc (IV) and 7245 kc (V).

An adjacent network which specialises only in Arabic programmes is Sharq-Al-Adna, the Near East broadcasting station operating from Limassol on the island of Cyprus. In a letter from the chief engineer, it is stated that this station can be recognised by its signature tune consisting of nineteen notes of Arabic music followed by the direction: "Mahattat Asharq Al Adna." The present schedule is: 0345-0630 (Daily), 0630-0830 (Fridays and Sundays), 0830-2000 (Daily), and the channels in use for each transmission are: 635 kc, 6120 kc, 6170 kc, 6790 kc and 11720 kc.

In North Africa we have the new Forces Broadcasting Station in Libya on 4965 kc. It operates from 0630 to 2100 daily (cabaret music until 2200 on Saturdays), and is best heard in this country up to the close-down when it can be identified by the words: "The time is eleven o'clock. This is the Forces Broadcasting Station, Tripoli." After a statement of frequencies and the words: "Goodnight, Everybody," the session terminates with the playing of "God Save The Queen."

During the autumn and winter months it should be possible to log that somewhat elusive station ZNB operating from Mafeking, Bechuanaland. Two frequencies are in use, 8230 kc and 5900 kc; we recommend the first named around 1800-1930, at which time the station closes down with the British National Anthem. If you hear this broadcaster with its programmes of recorded music and send in a reception report, you must enclose a Reply Coupon if you want another card to add to your collection. The address is: Mr. W. J. Coombs, Announcer and Programme Manager, ZNB Broadcasting Station, Box 106, Mafeking, Bechuanaland Protectorate.

On the remote island of Sao Tomé in the Portuguese West African colony of Sao Tomé and Principe, the 1200-1300 Sunday broadcast of recorded musical numbers is a good regular on a frequency of 17677 kc. There are other quite reliable Portuguese colonial transmissions, in Portuguese Guinea the broadcaster at Bissau is heard on 5839 kc at 2300, and in Mozambique CR7BU, 4920 kc, offers good English fare around 2030. In the Cape Verde Islands, Station CR4AA is on the air from 2030 to 2200 but its frequency has been changed several times during the summer months; at the time of writing is it using 7395 kc. All announcements are in Portuguese but listeners should be able to pick out the words: "Aqui Praia — Radio Clube de Cabo Verde." The Azores is a regular for short wave enthusiasts; it can be heard between 1900 and 2000 on 11090 kc and later in the evening on 4865 kc over CSA93. The identification is: "Aqui Portugal, Ponta Delgarda, Emissora Regional dos Açores." The Canary Islands being a Spanish possession, the short wave station on 7518 kc closes at 2315 with the words: "Ariba Espana, Viva Islas Canarias."

Cairo, Egypt, still radiates its regular English programme in the evenings at 1830 over 11815 kc but we can expect some improvements here in the near future. Omdurman, Sudan, can be heard broadcasting its Friday English programme at 1730 over 7664 kc and 6438 kc. Radio Addis Ababa, Ethiopia, is a variable station in 15060 kc; when on the air it is audible with musical features and an English News during the early evenings.

Though classified as European, TFJ, Reykjavik, Iceland, on 12175 kc, is a good catch for all collectors of broadcasts from short wave stations. It is on the air only on Sundays for the brief space of ¼-hour from 1615 to 1630; it broadcasts in the Norwegian tongue only.

In the West Indies, Radio Jamaica can best be heard just before it closes down with the playing of: "God Save The Queen" at 0400. It was reported to have changed frequency but on two occasions recently we logged it on its old spot of 3360 kc, giving clear directions just before the close at 0400. In Willemstad, capital of the Dutch island of Curaçao, Station PJC2 on 5020 kc is frequently audible with musical items after midnight. This one's direction is: "Juliana Zender, Curaçao," and the address for reception reports: Curaçaosche Radio Vereiniging (CUROM), P.O. Box 31, Willemstad, Curaçao, Netherlands-Antilles.

From South America

In the Dominican Republic the two outstanding stations are HI2T, 9727 kc and HI4T, 5970 kc, both operated by a company using the direction: "La Voz Dominicana." Their full slogan is: "Al servicio de la Cultura y el Progreso en general, transmite La Voz Dominicana desde Cuidad Trujillo, Distrito de Santo Domingo, capital de la Republica Dominicana." ("The Voice of Dominica broadcasting in the service of culture and general advancement from the city of Trujillo in the District of Santo Domingo and capital of the Dominican Republic.") Both stations

Main studio of the Deutsche Welle network, at Cologne in Germany.

are normally audible around 0330 and before. Another Dominican which is audible here is HI2A, La Voz de la Reeleccion, in Santiago de las Caballeros. This station which formerly operated on 9680 kc is now to be found in the 61-metre band on 4840 kc.

In the Republic of Mexico, short wave broadcasting station XEWW, 9500 kc, can be heard distinctly at 0445 when giving a Spanish News, followed by the slogan: "La Voz de la Latina America desde Mexico" or "XEW y XEWW, Cuidad Mexico." It may be identified, also, by the notes of four gongs in order sounding the musical intervals doh, soh, me, doh. In British Honduras, Radio Belize on 4950 kc has been heard at 0120, but heterodyned by a signal from an adjacent Venezuelan station.

In Panama, HP5E, Radio Programmas Continental, Colon, on 6005 kc, is sometimes audible around 0430. A correspondent has sent us a list of fifteen active Panamanian short wave broadcasters.

In Panama City there are: HO50, 5995 kc (1 kW); HP5B, Radio Miramar, 6030 kc (250 watts); HORT, Radio Balboa, 6060 kc (500 watts); HOO, 6090 kc (300 watts); HP5H, La Voz del Pueblo, 6122 kc (500 watts); HOQQ, Emisora Nacional, 6140 kc (500 watts); HOB, Radio Panamericana, 6175 kc (300 watts); HP5J, La Voz de Panama, 9607 kc (250 watts); HP5A, 11700 kc (500 watts) (on the air occasionally only); HP5G, 11780 kc (800 watts). In Colon we have HP5E, 6005 kc (1 kW); HOLA, Radio Atlantico, 9505 kc (250 watts). Other broadcasters are: HOU31, La Voz del Baru, David, 6045 kc (1 kW); HOJA, Radio Provincias, Chitre, 9645 kc (300 watts); HOM51, Penonome, 15100 kc (250 watts); and Ondas Centrales, Santiago, 11895 kc (250 watts). Missionary station TGNA in Guatemala now uses 5 kilowatts for each of its transmitters. These are active on 5952 kc, 5000 kc, 9668 kc and 11850 kc (1230-1400 in Spanish, 0300-0330 in English). The postal address is: TGNA, Box 601, Guatemala City.

In the South American continent there is a large number of what we might term ever-presents, but you cannot hope to get first-class reception unless you

The Munich broadcasting building of Radio Free-Europe, a large organisation devoted to projecting the Western viewpoint to countries beyond the Iron Curtain.

600 cycles per second are broadcast by WWV on all radio carrier frequencies. The audio frequencies are given alternately, starting with 600 cycles on the hour for four minutes, interrupted one minute, followed by 440 cycles for four minutes, and interrupted one minute. Each ten-minute period is the same; the 440-cycle tone is the standard musical pitch A above middle C. These audio frequencies are interrupted for intervals of precisely one minute. They are resumed exactly on the hour and each five minutes thereafter. They are in agreement with the basic time service of the United States Naval Observatory so that they mark accurately the hour and the successive five-minute periods.

Greenwich Mean Time is announced in code each five minutes starting from midnight; time announcements are given just prior to and are with reference to return of the audio frequencies.

A voice announcement of Eastern Standard Time is given each five minutes from Station WWV: this precedes and follows each code announcement.

In a directive from the National Physical Laboratory, Teddington, Middlesex, England, it is stated that transmissions such as those emanating from WWV enable the user to standardize his equipment, but to be fully effective they must be received in all parts of the world at all times. The WWV transmissions do not entirely meet this requirement and experiments now being conducted under the general direction of the International Radio Consultative Committee are enabling this body to decide upon the best means of securing world wide coverage.

As the United Kingdom's contribution, transmissions with a power of 500 watts are being made throughout the twenty-four hours of each day. The station is MSF, operated by the Post Office at Rugby, and it transmits on 2.5 mc, 5 mc and 10 mc. The carriers are modulated according to the following sixty-minute schedule; each hyphened set of figures represents the minutes past each hour. 0-5, 30-35, 45-50: 1,000 cycles per second; 5-10, 20-25, 35-40, 50-55: 1 cycle per second pulses, the 59th pulse in each minute being omitted; 10-14, 25-29, 40-44, 55-59: unmodulated; 14-15, 29-30, 44-45, 59-60: speech anouncement. For the last named, you may expect to hear the following: The letters MSF in Morse code (three times), followed by: "This is MSF, Rugby, England, transmitting carrier and modulation frequencies within two parts of one hundred million of nominal on 2,500, 5,000 and 10,000 kilocycles per second. A transmission of one hour's duration is also radiated on 60 kilocycles per second at 1429 GMT. Carriers are modulated with 1,000 cycles per second for the first five minutes, and with 1 cycle per second pulses for the second five minutes of each quarter-hour. At 15 minutes past each hour all transmissions are interrupted for five minutes. These are experimental transmissions and reports will be welcomed by the National Physical Laboratory, Teddington, Middlesex, England. This is MSF, Rugby, England."

At the time of writing, MSF is audible on 2.5 mc and 5 mc but not on 10 mc during most of the 24 hours of each day at a listening post situated one hundred miles from the transmitting station.

Listeners are here invited to participate in important radio research; in particular, it can be stressed that the reception of WWV during the break in MSF's transmissions at 15-20 minutes past each hour makes an interesting occupation, and reports on the comparative reception of MSF and WWV will be welcomed at Teddington by the Director of the National Physical Laboratory.

The writer would like to confirm that he has also logged the code signals from WWVH in the Hawaiian Islands on 5 mc and 10 mc during the first half-minute period following 19 minutes past the hour during the early morning and late night sessions.

Royal Visit to Antipodes

With the forthcoming visit of Her Majesty Queen Elizabeth II and the Duke of Edinburgh to the Antipodes this winter, it is anticipated that the broadcasting authorities there will be making every effort to give the world a comprehensive picture by radio of the high-lights of the Royal tour. It is therefore of topical interest to trace over the years the wonderful progress made in the sphere of short wave broadcasting by our friends in this Commonwealth Continent.

Australia's first short wave broadcast was made way back in September, 1927. over VK2ME, Sydney, working on a wave-length of 31.28 metres and owned and operated by Amalgamated Wireless (Australasia) Ltd. Though the writer cannot lay claim to logging VK2ME at that date, yet within a few years this was the first real DX station to be heard by him, a most fascinating programme at 8 a.m. describing the exquisite beauty of the various coral formations in Australia's Great Barrier Reef. VK3LO, Melbourne, followed some months after VK2ME, but it was not generally audible in the United Kingdom.

In 1936, 3LR in Melbourne, which was later to become VLR, Lyndhurst, opened a news service to the Pacific islands. The writer has in his files an account of the broadcasting activities of the Australian National short wave station VK3LR at Lyndhurst, Victoria, when in operation in March, 1935. On one occasion he heard an account of the types of interference to be experienced on the short waves; a speaker mentioned the interference caused by electrical contrivances and suggested the placing of aerials as far away as possible from main thoroughfares. Suppressors as an aid to short wave and television reception had not then been recommended to motorists!

It was the second World War that brought about the establishment of an official short wave service, however, and this came under the control of the Australian Broadcasting Commission (ABC).

Since the war period, Australia has regarded its overseas short wave broadcasting as a means of establishing friendships abroad. Radio Australia, which is the name given to the Overseas service of the ABC, aims at giving accurate information about Australia, at fostering goodwill and promoting trade and commerce with countries overseas, and at encouraging the flow of migrants and stimulating the tourist trade.

The world famous laugh of the kookaburra, or laughing jackass bird, is well remembered as an interval signal back in the days of VK2ME, and it is still a clue in the identification of Radio Australia's transmissions. For those who have not yet heard Radio Australia's programmes let it be said that this bird utters a medley of raucous notes resembling laughter, interspersed with rich, throaty chuckles. You will probably discover that its laughter is infectious! In addition, the musical box rendition of the Australian folk song "Waltzing Matilda" is used regularly as a means of identification by Radio Australia.

A little more than fifteen hours of programme material is relayed daily by Radio Australia from the Home service of the ABC — sporting commentaries, radio plays, actuality broadcasts, symphony concerts and the like. The remaining time is occupied with news bulletins, talks and commentaries, dramatics and sporting events, and certain features from some of Australia's sponsored commercial stations find their way into the Radio Australia make-up. Radio Australia supplies a nine-hour broadcast for the Commonwealth Forces serving in Korea, and its present foreign language transmissions include Indonesia (to Java and Malaya); French (to New Caledonia, Tahiti, French Indo-China and France itself); Thai (weekly to Siam); and standard Chinese (rebroadcasts from the United Nations at Lake Success).

The transmitting side of Radio Australia is the responsibility of the Postmaster-General's Department. The VLA and VLB transmitters, designed and constructed in Australia during the war, are each capable of radiating 100-140 kilowatts of RF power. VLC is a 50 kW RCA transmitter imported from America in 1942. The site of these transmitters is at Shepparton, Victoria, 120 miles north of Melbourne in the fertile fruit growing district of the Goulburn Valley. Programmes are fed over lines from Melbourne and, in addition, two studios have been provided within the attractive transmitter building for use in the event of interruption to the programme lines. The aerials are half-wave stacked arrays with reflectors. Those in the European and American beams are reversible and slewable while those on the North Pacific beam are non-reversible. The arrays are supported on steel towers, 210 feet high, fourteen such towers being required to provide the requisite number of aerials. Each of the nineteen aerial arrays is connected by radio frequency transmission lines to out-door automatic switching centres. The whole of the switching system is controlled from the main transmitter hall by means of push-buttons which operate half-horse power three-phase motors within the switching boxes. The push-buttons are grouped on an aerial control desk in the transmitter hall, one desk for each transmitter. By this means, transmitters or radiating systems can be rapidly switched, and the whole system is electrically inter-locked for safety.

A fourth transmitter used for the

Broadcasting House, Cologne, Germany, in the shadow of the famous cathedral.

Australian short wave service is VLG at Lyndhurst, twenty-four miles south-east of Melbourne.

This is a 10 kW transmitter designed and constructed by the engineers of the Postmaster - General's Department. Aerials used in conjunction with VLG are mostly of the rhombic type, and the transmitter is chiefly used for Radio Australia's general service to Asia and for beaming programmes to the islands adjacent to Australia.

Reputations are frequently made by artists whilst making their debuts in the realm of short wave broadcasting, and there are a number of personalities who have enhanced their reputations whilst operating with Radio Australia. Graham Chisholm is perhaps one of Radio Australia's best known announcers; his cheery voice seems to possess some sort of magnetic attraction so witty and entertaining is it. Reginald Drake presents the regular feature: "News From Home" and prepares many of the "Calling Asia" programmes of Radio Australia. Beloved of short wave broadcast fans is Graham Hutchins who conducts the well-established Sunday feature: "Australian DX-ers Calling." In writing to us about this programme, Graham mentions that he will very much appreciate receipt of regular DX notes by air mail (an ordinary 6d. blue air-letter is sufficient) from listeners in the United Kingdom and Europe. The DX editor explains that he does not personally acknowledge such letters but any listeners sending in DX data to his session is requested to take the inclusion of items on the programme as an acknowledgement of his or her letter. He adds that only occasional letters are received from this area and that he would like to see British listeners participating more regularly in the DX session. Other Radio Australia personalities are Russ Tyson who presents: "The Breakfast Session" at 2115 and "The Hospital Half-Hour" at 2215; and Keith Smith, who has built up a big audience with home listeners to his weekly programme: "A Word From Children," presents these interviews to the British Isles at 1940 on Thursdays and 0700 on Saturdays. It is noted that this evening session has been suspended during August and September.

Overseas listeners write to Radio Australia in praise of the Sunday quarter-hour choral service: "In Quires and Places Where They Sing," the feature which was inaugurated in 1946. Heard regularly is the choir of Saint Patrick's Catholic Cathedral, Melbourne; it is considered to be one of the finest cathedral choirs in Australia and owes much to its competent direction by Dr. Percy Jones, the gifted composer, pianist, organist and conductor.

The Australian Broadcasting Commission's Domestic Service is operated by the transmitters VLH and VLR, Lyndhurst, Victoria; VLI, Sydney, New South Wales; VLQ and VLM, Brisbane, Queensland; VLW and VLX, Perth, Western Australia; VLT, Port Moresby, Papua. As previously mentioned, VLM4, 4920 kc, and VLX4, 4897.5 kc, are sometimes audible here around 1500, and VLQ9, 9660 kc, when in the clear, has produced excellent signals around 1310 with the Queensland regional news from Brisbane. During the late autumn period, it is possible that VLB21, 21540 kc, will still be heard here in the early hours of Saturday morning with all kinds of sporting commentaries from the Australian State capitals. You may hear about an Australian football game between South Melbourne and Richmond in the Melbourne League or a Rugby match between St. George and Manly from the Sydney Cricket Ground, or there may be a horse racing commentary on the Commonwealth Steeplechase at Victoria Park, Adelaide, South Australia. Running commentaries on Test matches other than cricket are frequently available in this service. For instance, at 0510 on July 25, we noted the Chinese Consul-General kicking off in the Soccer game between Australia and China, played on the Sydney Cricket Ground. You will be able to identify your programme by the announcement at 0559: "The time is one minute to four in the ABC Sporting Session."

All correspondence for Radio Australia should be sent to: GPO Box 780 H, Melbourne, Australia; for reports on the Australian Broadcasting Commission's Internal services write to: ABC, 264 Pitt Street, Sydney, or GPO Box 487, Sydney, New South Wales.

Obtaining BC Verifications

We have referred often to verification cards, the collection of which to the average short wave broadcast listener is just as fascinating as QSL cards are to those who are specialists in the world of Amateur Radio. There are those who keep elaborate files for the different countries in the respective continents and there are those who are proud to display their gains on the walls of their radio dens.

Should you aspire to either of these practices, we would urge you to submit to the radio stations concerned clearly written (or typed) and concise reports. These must be accurate in detail and should include (1) Name and address of the listener; (2) type of Receiver in use; (3) name of station and call-sign, if known; (4) frequency and wave-length; (5) hour of reception, GMT; (6) essential facts about the broadcast, such as language, type or name of programme; (7) strength of signal in the range S1-9. For the last named, signal strength (1) is Impossible to read with any degree of accuracy, (2) is Very Poor, (3) Poor, (4) Fair to Poor, (5) Fair, (6) Fair to Good, (7) Good, (8) Very Good, and (9) Excellent.

When reporting to foreign broadcast stations in particular, always enclose an International Reply Coupon, which is obtainable (price 8d.) at any main Post Office. Your own postage stamp will cost you 4d. at ordinary surface rate, with correspondingly higher rates if the letters are sent by air-mail.

Some BC QSL's

Some verification cards are elaborate affairs, often executed in the most tasteful of colours. The Lebanese Broadcasting station at Beirut offers a card in red and green, the latter depicting the famous cedar tree of Lebanon; the Far East Broadcasting Company, Manila, sends a blue card showing a picture of the transmitter DZAS with its subsidiaries; and Radio France-Asie, Saigon, verifies with a black-and-white representation of a native driving a yoke of oxen in the paddy fields. The Mozambique Radio Club's card for its Lourenço Marques station portrays in green and black the setting of this Portuguese colony in a map of the entire African continent; the bold letters SABC in green are printed on the South African Broadcasting Corporation's yellow card.

The Swiss Short Wave Service offers a card with a map of Europe on which the Swiss white cross on a red background indicates the heart of the continent, whilst Radio Vaticano's latest verification gives a magnificent view of its principal vertical aerial in a background of verdant foliage. The writer's oldest card from Canada is dated February, 1936, and is far the Maritime Broadcasting Station VE9HX (now CHNX); from the Voice of America in Honolulu came a red, white and blue card showing part of the earth's surface, an aerial mast, two pandanus trees and the bold letters KRHO.

From Latin America we have the Argentine International Broadcasting Service's blue and grey card with an imposing photograph of the skyscrapers of the capital city, Buenos Aires. From this progressive organisation the reporter may receive an attractive diploma in which he "is hereby nominated to the fellowship of SIRA, the Argentine International Broadcasting Service, in appreciation of his kind attention when listening-in to our transmissions aimed at spreading news and relating events pertaining to life in Argentina."

Their most recent gift is a triangular white silk pennant on which is depicted the Western Hemisphere and a microphone, with the words "Atención del Servicio Internacional Radiofonico Argentino, SIRA."

TGNA, Guatemala's missionary station sends along a card showing a green and red parakeet speaking into a microphone and "Telling the Good News Abroad." The Mexican XEXA card gives a view of the ruins at Chichen-Itza, Yutatcan, and that of the Nicaraguan YNQ, La Voz de la Victoria, shows an aerial view of the capital, Managua. Radio Martinique has perhaps the most vivid card of all, in yellow, red, blue, black and white with a vivacious female indicating this station in a central position on an extensive world map. This collecting of verification cards has its humorous side, too. Many Latin-Americans reply in Spanish and use the title "Señor" before a male name. One enterprising Central American once translated the writer's address into English, but much too literally, with the result that an amused postman rang the door-bell to ask how long ago we had received the accolade of knighthood!

Some broadcasting authorities issue letters of verification instead of a card; we have received such from Poste Radio-Tananarive, Madagascar; the Imperial Ethiopian Government Press and Information Department controlling Radio Addis Ababa; and Jacob S. Grone in control of Greenland Radio, Godthaab. A somewhat ancient verification letter is headed: "Isle of Dreams Broadcasting Corporation, WIOD News Tower, Miami, Florida," and dated August 23, 1935, for a correct report on the reception of W4XB on 6040 kc.

Other unusual ones have arrived from the Director-General of Radio Azerbaijan, Iran; in these the message is given in two columns, one in the English language, the other in Persian characters.

From the Director-General of the South African Air Force at Pretoria there was a verification for Radio station ZRB of the SAAF. This broadcasting station is dedicated to the service of safety for the airman, whether he is flying in civil or a Service capacity; its main function is to broadcast weather information and airfield and radio aids serviceability reports. The Commanding Officer of the Royal Canadian Signals sends a detailed verification letter containing information relating to the North West Territories and Yukon Radio System, whose signals for the isolated northern settlements of Canada emanate from a 5 kilowatt transmitter at Edmonton, Alberta.

Keen collectors will doubtless get the chance to receive letters which they will always treasure. Our own two most valuable ones are (1) from Commander H. H. Holton, United States Navy, for a letter reporting signals of "Nave," the radio station on board U.S.S. *Mount Olympus* when with the Admiral Byrd Expedition at the South Pole, and (2) from Andrew Young, native radio operator on Pitcairn Island.

Though VR6AY on Pitcairn was not strictly a broadcasting station, we used to hear intimate talks about life on the island, how the pineapples, lemons and other tropical fruit were cultivated, and the hazardous business of rescuing men from an overturned boat in the neighbourhood of the precipitous cliffs once familiar to the mutineers of the Bounty. Incidentally, it has lately been reported by Radio Australia that a new radio station with the call-letters ZBP is being put into final working order on Pitcairn Island. Using 500 watts, the power source is an Australian windcharger-unit; ZBP will operate both on medium and short waves.

There are other short wave broadcasting systems of the world which are very much in the news at the present time.

Cold War Stations

Radio Free Europe began its broadcasting operation to the Communist satellite nations in July, 1950, with a single station situated in the Frankfurt area of Western Germany. In that year the Crusade for Freedom organized by General Lucius D. Gray of the United States installed in Berlin the famed Freedom Bell; at the conclusion of each Radio Free Europe programme four notes of the bell can be heard, with the words: "That was the Freedom Bell to remind you that this is Radio Free Europe." Today, with twenty powerful transmitters located in Germany and Portugal, its primary purpose is to broadcast the truth to the peoples of Albania, Bulgaria, Czechoslovakia, Hungary, Poland and Rumania.

Radio Free Europe has its headquarters in Munich, only a short distance from the Czech frontier, and is financed by contributions from the United States people. It is controlled from New York, yet it is quite independent of the American Government. In Munich it has twenty-one studios, each having a control room equipped with tape recording machines, two gramophone turntables and a central mixing panel. News broadcasts are done live, with about two-thirds of the rest of the programming recorded on tape. The Czechs and Slovaks, Poles and Hungarians have editorial desks and direct programmes emanating from Munich, whilst Rumanian, Albanian and Bulgarian languages maintain news desks in Munich, with their other broadcasts prepared in New York and sent to Europe for transmission. The Master Control Room is the centre in which all outgoing programme circuits are adjusted, measured, and volume levels maintained before the broadcast material is fed to the RFE transmitters in Biblis and Holzkirchen.

Radio Free Europe operates through a host of frequencies; at the time of writing these include 5960 kc, 5970 kc, 5985 kc, 6095 kc, 6105 kc, 6130 kc, 7105 kc, 7140 kc, 7145 kc, 7155 kc, 7165 kc, 7192 kc, 7300 kc, 9607 kc, 9655 kc, 965 kc, 9718 kc, 9725 kc, 11725 kc, 11745 kc, 1885 kc, 15115 kc, 15145 kc, 15185 kc and broadcasting is carried out between 0700 and 2300 each day. Is it small wonder that the jamming of RFE transmissions is intense?

The network draws, relative to its size, far more jamming than other similar Western organizations broadcasting to the Iron Curtain countries. In spite of this, there is satisfying proof that the majority of the transmissions penetrate the barrier and reach their objective. It is estimated that even a minimum of one jamming transmitter for each RFE transmitter would permit only partial jamming success. To ensure more complete jamming would require at least several jamming transmitters for each RFE transmitter; with the addition of other similar services meriting the opposition's jamming attentions, the cost of this vast amount of equipment required for jamming would be well-nigh prohibitive.

Any reader who in any way wishes to contribute to the well-being of Radio Free Europe should write to: National Committee for a Free Europe. Inc., 110 West 57th Street, New York 19, N.Y.

" Die Deutsche Welle " is the name of the new short wave overseas broadcasting service now operated by the German Federal Government. In its initial broadcast on May 3, 1953, this direction was made in English: "This is the Voice of Germany sponsored by the broadcasting systems of the German Federal Republic; it is on the air every day from 7 p.m. to 10 p.m., Central European Time.",

Deutsche Welle has extended its schedule recently; five three-hour broadcasts in German are now being transmitted daily, to the Far East on 15275 kc at 1030-1330, to the Near East on 17815 kc at 1430-1730, to Africa on 17945 kc at 1800-2100, to South America on 11795 kc at 2200-0100, and to North America on 11795 kc at 0130-0430.

One interesting item which is a regular in the programme is: " Wie Wir leben " (How we live), which is on the air at 1230, 1630, 2000, 2400 and 0330. " Deutsche Welle " broadcasts a mailbag programme every Monday at 1900 and 2300, and every Tuesday at 0230, 1130 and 1530; it is understood that correct reports are verified by a new card.

The writer's own verification card from Deutsche Welle depicts Cologne Cathedral as a magnificent background to the post-war Broadcasting House of the Nordwest deutscher Rundfunk; on the reverse is given the following cryptic message: " Dr Frd, We are vy gld to confirm ur fb rprt, Date: 3.5.1953; QRG: 11.795 mc/s; Pwr: 20 kW. Mni tks fr ur ltr. Vy 73 Good Luck es DX; Deutsche Welle. Köln Funk haus NWDR, Wallrafplatz 5, i.A. Krieger."

The 20 kilowatt transmitter is situated at Norden Osterloog in the north of Germany, and it is from here that the various transmissions are beamed. The administrative headquarters and main broadcasting centre is housed in the ultra-modern Cologne broadcasting house. Reports are welcomed and should contain details concerning frequency, time, receiver, aerial, quality and strength of signals, details of any interference and fading, and a note about general reception conditions at the time of listening. For their pains reporters will receive the attractive verification card aforementioned.

Radio Nederland, Holland, has an international broadcasting service which has been world famous since the early days of broadcasting. Nowadays, English transmissions are given on weekdays as follows: 1600-1640 to South Asia and Africa on 17775 kc, 15220 kc and 6025 kc; 2145-2225 to Europe and North America on 11730 kc, 9590 kc and 6025 kc; 0230-0310 to North America, Australia and New Zealand on 9590 kc and 6025 kc. Complete and up-to-the-minute details of the following week's programmes are broadcast in Programme Parade at the end of each transmission on Saturdays.

On Sundays, the " Happy Station " programme is on the air at 1030-1200 over 21480 kc, 17775 kc, 15220 kc and 6025 kc; 1600-1730 over 15220 kc, 11730 kc and 6025 kc; 2130-2300 and 0230-0400 with 6025 kc probably the best channel for listeners in this country.

Produced and presented by the cheerful Edward Starz, these sessions offer a bright musical show interlaced with pithy comments and information in several languages.

Radio Nederland makes the query: " Do you want to have your favourite records played in ' By Request ' (Tuesdays) or to have your questions about the Netherlands answered in ' Letterbox ' (every other Thursday) or to receive the printed bulletins every month? " If so, write to Radio Nederland, International Service, P.O. Box 137, Hilversum, The Netherlands. They also announce that they have prepared an illustrated pamphlet containing hints on the erection of aerials; if you would like a copy, just drop them a line and ask for it.

Pakistani Broadcasting

From Mr. Agha Bashir Armad, Public Relations Officer of Radio Pakistan, we learn that this broadcasting service is a State monoply, having emerged as a full-fledged national broadcasting organisation after the first six years of its existence. Today, it is an organic system of broadcasting with a central directorate at Karachi, a central news organization, a directorate of external services, one of monitoring and one of staff training; and there are departments of research, installation and maintenance.

Radio Pakistan comprises a network of five broadcasting stations operating nine transmitters, four of them short wave, with a total power of 148 kilowatts. Radio Pakistan's aerial system is one of the three largest in he world and the first of its kind to be installed in Asia as far as automatic operation is concerned.

Listener research units have been set up at Karachi and Dacca for the West and East wings of the country, and a receiving-cum-monitoring centre has also been established at Karachi.

The high power short wave transmitters at Karachi, the federal capital, provide a radio link for all the zonal stations for the broadcast of national programmes. They also carry the Voice of Pakistan to foreign countries through six external programme services in Arabic, Persian, Afghan - Persian, English, Burmese and Gujrati, and the total time devoted to these broadcasts amounts to about four and a half hours a day. Programmes on an experimental basis are also being broadcast for listeners in the United Kingdom, Turkey, Indonesia, South and South-East Asia.

The linking of East and West Pakistan has been made possible with a short wave transmitter at Dacca, and West Pakistan is linked up with teleprinter services between Peshawar, Rawalpindi, Lahore and Karachi. Karachi station broadcasts to schools four times a week, and Lahore and Dacca provide educational broadcasts twice a week. Other fixed point broadcasts include religious services, women's programmes, university broadcasts, a Forces feature and other composite programmes in regional languages for rural and tribal areas. Altogether, it is estimated that Radio Pakistan's listeners number some eight million. Its budget is balanced by the collection of licence fees and from a grant voted by the Government each year.

In its home services, broadcasts to West Pakistan are carried during the day over 7010 kc, 15270 kc. 11885 kc. 7096.6 kc and 5990 kc; for East Pakistan the following frequencies are used: 15335 kc, 17710 kc, 15270 kc, 17750 kc and 11885 kc. Zonal services are conducted from Lahore on 3915 kc, 346[illegible] kc and 6138 kc, and from Dacca on 3325 kc, 4807 kc and 7150 kc.

Radio Pakistan's external services are as follows: 0115-0200 to South-East Asia, 11885 kc and 15335 kc; 0415-0500, to East and South Africa, 15335 kc and 17750 kc: 0945-110. to South Asia, 11885 kc and 17835 kc; 1130-1215, to Indonesia, 15270 kc and 17770 kc; 1330-1415, to Burma, 11885 kc; 1600-1700, Afghan-Persian programme, 6235 kc and 7010 kc; 1710-1730, general overseas service, 7010 kc and 6235 kc; 1730-1815, Iranian programme, 7010 kc and 6235 kc; 1815-1915, Arabic programme, 7010 kc and 6235 kc; 1930-2015, to Turkey, 7010 kc and 6235 kc; 2015-2100, to the United Kingdom, 7010 kc and 6235 kc.

All reports should be addressed to the Director - General of Broadcasting, Radio Pakistan, Karachi.

Development in Burma

Broadcasting in Burma gained its inception in 1937 when the Marconi transmitter used by the Telecommunications Department in the telephone link with India was allowed to be used every morning and evening to provide a restricted broadcasting programme on an experimental basis. Both the transmitter and the studio were housed at Mingaladon, which is thirteen miles north of Rangoon.

By 1938 the demand for a proper broadcast service had made itself felt with the result that the Burmese Government ordered the installation of the latest type of Philips 10 kW transmitter and the construction of a proper studio. A few rooms on the ground floor of the Central Telegraph Office building were re-conditioned into a broadcasting studio; regular programmes took the place of the experimental broadcasts in 1939. The new transmitter served listeners throughout the whole of Burma with programmes in Burmese, English and Hindustani on a frequency of 6007 kc. Listeners in the Rangoon municipal area received the programmes on 86 metres through a small 500 watt transmitter designed and constructed by the technicians of the Wireless Division of the Posts and Telegraphs Department.

The broadcasting service of the prewar days was under a system of dual control; the technical staff were from the Wireless Division and the programme staff under the control of the Director of Public Information. The numbers in the latter case were extremely small as the technical staff of the studio in their enthusiasm also took over the work of organizing and announcing the English programmes. The news bulletins were supplied by Reuters and were edited, translated, and read by the announcer.

A Burman was under training for the post of Director of Programmes and plans were already under way to expand the service when the outbreak of war in South-East Asia in December, 1941, ultimately led to the demolition of the Philips transmitter at Mingaladon and the studio at the Central Telegraph Office building in February, 1942.

A group of technicians and announcers evacuated to Maymyo where they were able to set up a small emergency broadcasting station sending out news and recorded music to listeners in Upper Burma. However, the rapid advance of the Japanese Army made it no longer possible to continue the service, with the result that this emergency station also had to be closed down by the end of April, 1942.

Realising the effectiveness of radio as a means of spreading propaganda, the Japanese lost no time in reviving broadcasting in Burma. A German 1 kilowatt mobile medium-wave transmitter was brought in and broadcasting recommenced with programmes in Burmese, Japanese, English, Hindustani, Bengali and Chinese on 263 metres.

In the year following the studio was shifted to Ching Tsong's Palace, providing more accommodation for the staff which had increased in number. At the same time the German transmitter was replaced by a Japanese 10 kilowatt medium-waver operating simultaneously with a low powered Marconi short wave transmitter on 25 metres. The special transmission directed to India through a .5 kilowatt Japanese short wave transmitter in the 25-metre band consisted of news in the English, Hindustani and Bengali languages and recorded music. When the Japanese evacuated Rangoon in 1945 they demolished their transmitters at Yegu, but apart from removing essential equipment, left the studio at Ching Tsong's Palace intact.

After the British re-occupation of Burma the broadcasts from Rangoon were for a time carried out by the broadcasting unit of the Psychological Warfare Division of SEAC, and later by the Civil Affairs Service, Burma. The Telecommunications Department was in charge of the two 7.5 kilowatt Marconi short wave transmitters and one 5 kW medium-wave transmitter and the studio. The broadcasts were primarily intended for the Allied occupation forces and as such the bulk of the programmes was in English, whilst broadcasts in Burmese were restricted to news bulletins and recorded music.

In February, 1946, broadcasting was handed over to the Civil Government, and with this transition began the career proper of the Burma Broadcasting Service. The aims and objects of the present BBS are to carry out its responsibility to the country in the political, cultural, educational and religious fields.

Both the technical and the programme staff are under the control of the Director of Broadcasting, Mr. U. Khin Zaw, who has as his Chief Engineer, Mr. U. Pu Doe. The latter is also in charge of the Radio Engineering and Rural Broadcasting Department which deals with sales, distribution, and maintenance of radio receivers belonging to the Government.

The Burma Broadcasting Service is still using the three transmitters left behind by the Psychological Warfare Division of SEAC. The 7.5 kW short wave transmitters are being used for the broadcasts on 9543 kc, 6034 kc and 4774 kc, while the remaining 5 kW medium-waver is being operated on 314 metres especially for listeners in the Rangoon area. The studio is housed in a residential building in Windermere Crescent, Rangoon, and it is so small that it is only possible to have one big studio for "live" musical items. The present daily schedule on short waves is: 0100-0230 (not Mondays) on 9543 kc; 0530-0730 (not Mondays) on 9543 kc and 6034 kc; 1200-1515 (daily) on 9543 kc 4774 kc.

The English broadcasts are at 0115-0130, 0615-0645, 1415-1515 with news at 0125, 0630 and 1500. The signature tune played before English broadcasts is Eric Coates' "Calling All Workers;" that for all Burmese broadcasts is a short musical interlude incorporating the Burmese oboe, gongs and drums.

Swiss Network

Switzerland's short wave service with its studios in the capital city of Berne and transmitters near the village of Schwarzenburg just to the south of the federal city, beams its programmes in eight languages daily to all corners of the world.

Over its transmitters, four of 100 kW, two of 25 kW and one 10 kW, the short wave branch of Schweizerische Rundspruch Gesellschaft began in 1936 as a precious link between the Swiss abroad and their homeland. Since then, it has grown until now it presents Switzerland to the world; many readers may well remember that epic broadcast from the summit of the 14,780 ft. high Matterhorn.

In English there are nine daily transmissions from the studios in Berne: two to North America, and one each to Great Britain and Ireland, South Africa, Eastern Australia and New Zealand, Western Australia and the Far East, South-East Asia and Japan, India and Pakistan and finally, completing the 24-hour cycle, one to the Middle East. Each of these broadcasts, lasting, with two exceptions, one and three-quarter hours, consists of news and objective commentaries on home and foreign affairs, fifteen-minute feature programmes giving sidelights on Swiss activities, and hour-long musical programmes of Swiss folk and popular music and of classical music, presented by Swiss or visiting artists.

The feature programmes include an "Information Desk" presentation, "Music from the Mountains," a programme for women, and a special World Youth Magazine. This last named programme for younger listeners exchanges pen - friends for under twenty-five years of age on application, free of charge. Write to the Swiss Shortwave Service, 23 Neuengasse, Berne.

Another recent presentation is: "Students See Switzerland," a documentary series on Swiss life and institutions by Swiss and foreign students of the University of Berne. We have previously referred to the short wave DX programme which is presented by an old friend, Russell Henderson, for United Kingdom listeners at 1905 on the first Tuesday of each month; the frequencies allocated for the British Isles are HEU3, 9665 kc and HER2, 6055 kc.

In the matter of foreign language broadcasts, these are now offered in Portuguese and Spanish, including two daily programmes to the peoples of Latin America.

The Home Service in French and German is presented to Europe over HER3, 6165 kc, and HER4, 9535 kc, on the following schedule: Monday to Friday: 0515-0640, 1000-1330, 1500-2230; Saturday: 0515-0640, 1000-2230; Sunday: 0555-0640, 0745-2230.

Additional frequencies are reported to be in operation for this service: HER22, 3961 kc; HER33, 3981 kc; HER44, 3989 kc.

The writer has had good reception of HER 22 with Saturday night dance music at 2145 and Sunday morning news headlines in German at 0600 and in French at 0615. In the station identification given at these times, mention is made of the transmitting headquarters at Schwarzenburg.

And in conclusion, if anyone wants to investigate some real DX, it is reported that in Alaska, Station ALF on 9915 kc has been conducting test broadcasts at 0330. We hope to be giving you another summary of short wave broadcast news in the December issue of RADIO QUARTERLY.

THE RADIO AMATEURS' EXAMINATION

Typical Questions and Specimen Answers

To obtain an amateur transmitting licence, it is necessary either to have certain exempting qualifications or to take the Test known as the Radio Amateurs' Examination (R.A.E.) This is based essentially upon first principles and can be passed easily by those prepared to study basic theory and the practice of Amateur Radio. The authority for the issue of amateur licences is the Engineer-in-Chief, General Post Office, the responsible branch being: Overseas Telecommunications Dept., (Radio Branch), Headquarters Building, General Post Office, London, E.C.1., to which all enquiries regarding the issue of licences, conditions of issue, exemptions, arrangements for examination and requests for Morse testing should be directed. General conditions for the issue of licences were dealt with in the June RADIO QUARTERLY, to which reference should be made for further information. Here we give a selection of the questions actually set at recent Radio Amateur Examinations, with specimen answers. The next R.A.E. is in May 1954, and applications to take it (arranged at local centres throughout the country) should be made to the City & Guilds of London Institute, the examining authority, at the address given in the article below.

THOSE who wish to take out an amateur licence, unless they are exempted from the written test by Service or other special qualifications, normally have to sit for one of the Radio Amateurs' Examinations held twice yearly at the City and Guilds of London Institute, and at other centres in various parts of the country.

The first approach, normally, is to the local Education Authority or the local Technical College. In any cases of doubt or difficulty, application may be made to the Superintendant, Department of Technology, City and Guilds of London Institute, 31 Brechin Place, South Kensington, London, S.W.7.

As a general indication of the type of questions which the candidate will be called upon to answer, we present herewith several specimen questions taken from the examination papers set during the last five years, with suggested answers.

These answers are, possibly, not the type that the average candidate would attempt in the examination room, but they have been written with the purpose of showing would-be applicants the kind of knowledge with which they should arm themselves in order to face any sort of question that the examiners may set. In other words, they are "ideal" answers, and something shorter would in practice satisfy the examiner.

The questions, also, have been chosen from a wide range of papers in order to show as well as possible the different types of problems that have been posed.

Intimate knowledge of the licence

conditions is required, and one question in each paper always deals with one of these conditions—such as the method of keeping a log, precautions against interference, and the type of work which is allowed to be carried out at an amateur station. Furthermore, there is nearly always one question involving simple mathematics.

Questions on aerial systems have, intentionally been omitted, as another article in this issue deals with that subject in a broader manner than would be possible in the answer to a single question.

QUESTION 1: ***What is meant by modulation? Describe a method of modulating a typical low-power RF amplifier.***

Answer: The *modulation* of a continuous wave implies the superimposition on it of audible frequencies, whether continuous tone, speech or musical sounds. Thus a CW transmission, as in Fig. 1, may have an audible 500-cycle sine-wave superimposed upon it, the resulting signal in a receiver being simply a pure 500-cycle tone.

If the signal is fully modulated, its amplitude will vary from twice the amplitude of the unmodulated signal down to zero, the condition which is shown in the diagram (B). With undermodulation the variations would not be so great, and with over-modulation the signal would vary from more than twice its normal amplitude to a figure "less than zero"—in other words, the carrier-wave would be completely broken at the negative peaks of modulation.

To modulate a low-power radio frequency amplifier the audio frequencies may be introduced into its anode circuit in series with the normal DC high-tension feed, through the secondary winding of a modulation transformer, as shown in Fig. 3. The modulator valve is simply an audio amplifier capable of giving sufficient output to produce the necessary variations in the HT to the RF power amplifier.

To obtain full modulation, the audio power must be half as great as the normal DC input to the RF amplifier. As an example, the modulation of 50 watts of RF will require 25 watts of audio.

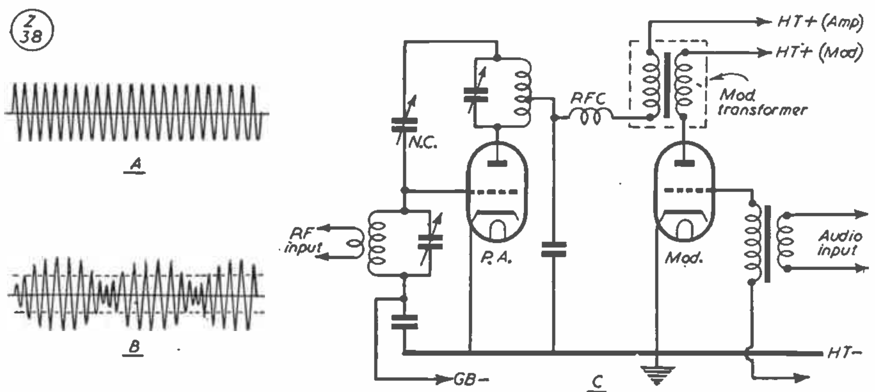
QUESTION 2: ***An alternating voltage of 10 volts at a frequency of $\frac{100}{2\pi}$ mc is applied to a circuit consisting of the following elements connected in series:***

(1) an inductance of 10 micro-henrys;
(2) a capacitance of 10 pico-farads;
(3) a resistance of 10 ohms.

(a) What current flows through the circuit?

(b) What voltage appears across the inductance?

Answer: First dealing with the inductance, we have to find its *impedance* (or inductive



This sketch illustrates the answer to Question 1, sections A, B, C, being Figs. 1, 2 and 3 respectively. "A" is the unmodulated carrier, "B" a carrier wave with modulation on it, and "C" a suitable modulating circuit.

reactance) from the formula $X_L = 2\pi fL$,

where X_L is the inductive reactance in ohms

f is the frequency in megacycles,

and L is the inductance in micro-henries.

Substituting 10 for L, $\frac{100}{2\pi}$ for f, we obtain the answer $X_L = 1000$ ohms.

Dealing similarly with the condenser, we use the formula for capacitive reactance,

$$X_C = \frac{1{,}000{,}000}{2\pi fC}$$

where X_C is the capacitive reactance in ohms,

f is the frequency in megacycles,

and C is the capacity in pico-farads.

Substituting 10 for C, $\frac{100}{2\pi}$ for f, we obtain the answer $X_C = 1000$ ohms.

We now obtain the figure for the total impedance of the circuit, with its three elements connected in series. The formula for this is $Z = \sqrt{r^2 + (X_L - X_C)^2}$

where Z is the impedance in ohms,

r is the resistance in ohms,

X_C is the capacitive reactance in ohms

and X_L is the inductive reactance in ohms.

As X_C and X_L have both been found to equal 1000 ohms, these terms will cancel out, and we obtain the result

$$Z = \sqrt{r^2} = 10 \text{ ohms.}$$

Now answering (*a*) and (*b*), it is obvious that since the impedance of the entire circuit is 10 ohms, the alternating voltage of 10 volts will cause a current of 1 ampere to flow.. (*a*)

Since a current of 1 ampere is flowing, and the impedance of the inductance is 1000 ohms, the voltage appearing across it must be 1000 volts.. (*b*)

QUESTION 3: ***How is a low-power transmitter likely to interfere with broadcast reception? What steps would you take to prevent such interference?***

Answer: Interference to broadcast reception by a low-power transmitter working in the amateur bands falls into two categories (*a*) Interference due to a faulty receiver, and (*b*) That due to a faulty transmitter. The "faulty receiver" category includes old and in-selective receivers which, even if working normally, are "faulty" on account of their lack of the necessary discrimination against unwanted trans-missions.

This interference in category (*a*) can generally be described as "wipe-out," and may occur up to fairly long ranges, particularly with receivers using no RF amplification. Signals from an amateur transmitter perhaps 200 yards away can produce quite high voltages on the grid of the detector valve, resulting in a complete disappearance of the wanted transmission when the unwanted one breaks in.

Such interference can sometimes be cleared by the installation of a wave-trap in the aerial lead, and can nearly always be lessened by the use of a loose-coupled tuned circuit instead of the usual direct aerial coupling in such a receiver. A suitable wave-trap consists of a coil and condenser tuned to resonance in the band on which the *transmiter* is operating, usually constructed with a good air-dielectric trimmer and a compact coil directly across it.

The trouble caused by a faulty transmitter usually takes the form of key-clicks on CW, or "splash" on telephony. Key-clicks, caused by too abrupt a make-and-break of the keyed circut, can be suppressed by the use of a keying filter such as shown in Fig. 4. The LF choke slows down the building-up of current at the "make," and the condenser prevents too quick a "break" by rounding off the wave-form at that end. The two RF chokes suppress any undesirable radiation of RF caused by slight sparking at the key-contacts.

Telephony "splash" is nearly always due to over-modulation, and the remedy for this is obvious. But the use of a negative peak-clipping circuit will also be beneficial, allowing the use of the fullest possible modulation without the risk of breaking the carrier-wave.

Interference from telephony can also be due to a transmitter operating on the

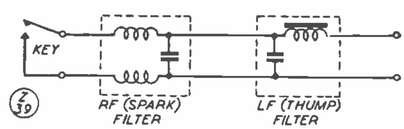


Fig. 4. Circuit for eliminating, or reducing, effects due to sparking at the key contacts.

verge of instability. Such a transmitter may be just about to radiate parasitics, but will not actually do so until modulation is applied. This will cause the phenomenon usually known as "whiskers," and the only remedy is to cure the unstable condition with anti-parasitic chokes or resistors in grid, anode or screen circuits. Trial and error will usually show the circuit that is causing the trouble.

After this there remains the possibility of the radiation of unwanted harmonics, but these will cause interference with television rather than with broadcast, and their suppression is not a matter which can be covered in a few paragraphs.

QUESTION 4: ***What is the effect of connecting two condensers (a) in series, and (b) in parallel? What is the total effective capacitance when four condensers, each of 100 pf, (or μμF) are connected in a series-parallel arrangement consisting of two parallel paths, each of which contains two condensers in series?***

Answer: Two condensers of capacities A and B, when connected in parallel, will give a total capacitance C = A + B. When they are connected in series the total capacitance will be less than that of either A or B and is given by the expression

$$C = \frac{1}{\frac{1}{A} + \frac{1}{B}}$$

For the combination quoted, the total effective capacitance must be worked out for each path separately (see Fig. 5). Since C1, C2, C3 and C4 are all of 100 μμF capacity, the capacitance along path "A" is 50 pf, and that along path "B" is also 50 pf. These two being in parallel, the combined capacitance is 100 pf (or μμF).

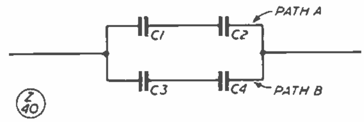


Fig. 5. Series-parallel condenser connections, to illustrate the answer to Question 4.

QUESTION 5: ***What type of message may be exchanged with other amateur stations? For what purposes is the use of the station prohibited?***

Answer: All messages exchanged with other amateur stations must be in plain language, and may relate to the private (but not business) affairs of one or both the amateurs concerned, and, of course, to the technical matters usually discussed by amateurs. Test records of modulated tones and so on may be used, and also an ordinary commercial gramophone record may be employed for test purposes, but only *one* record per day, with playing time limited to ten minutes.

The station may not be used for advertising, business purposes, the reception or transmission of news, the reception or transmission of messages from persons other than the two amateurs in contact, the transmission of broadcast programmes or of social or political propaganda. The licensee is not allowed to receive payment in any way for the use of his station.

QUESTION 6: ***Describe a method of obtaining the high-tension supply for an amateur transmitter from alternating current mains. Include particulars of the smoothing circuit. Illustrate your reply with a diagram.***

Answer: The power supply described and illustrated (Fig. 6) is intended to supply the high-tension for a final PA stage capable of running at about 100 watts and using, for example, two 807 valves in push-pull or in parallel. The HT needed is about 550-600 volts at 180-190 mA, and a tapping for the screen supply is also provided.

It is recommended that the preceding stages of the transmitter should be supplied by a separate unit—similar, but of lower rating. For simplicity only the one power supply is shown.

It consists of the conventional full-wave rectifier, and a single-section filter unit with capacity input. Such a filter.

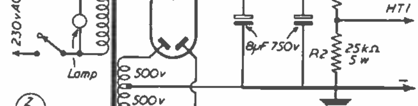


Fig. 6. Circuit diagram in detail for a suitable amateur transmitting HT power supply unit, as required by Question 6.

worked into a load resistance of not less than 10,000 ohms, will reduce the percentage of ripple to about 0.05; and with a load resistance of 5,000 ohms, not more than 0.1 per cent. of ripple should be present.

A rating of 5 watts each is normally sufficient for the two resistors R1 and R2, which will take a drain current of 12 mA if a voltage of 600 DC appears across C2. The centre point of these resistors is used for the screen supply, and R1 therefore passes a somewhat heavier current than R2. For this reason its rating has been fixed at 10 watts.

The chief points to note in a power supply of this type are (*a*) adequate smoothing; (*b*) the provision of a double-pole switch in the mains input; (*c*) the use of a warning lamp across the transformer primary; and (*d*) the continuous use of a bleeder (formed by R1 and R2) across the output terminals.

For the earlier stages of the transmitter a similar power supply, the transformer being rated at 250-0-250 volts, will be suitable, and the screen voltages may be supplied by potential dividers within the transmitter itself.

QUESTION 7: ***Describe a heterodyne frequency meter and explain how it is used to measure the frequency of a transmitter.***

Answer: A heterodyne frequency meter is basically, a stable and accurately-calibrated oscillator. Any such oscillator may be used, in conjunction with a receiver, to produce a heterodyne beat with a transmission. The zero-beat position, in which both the oscillator and the transmitter are tuned to the same frequency, may be detected with considerable accuracy, and the frequency read off directly from the calibrated frequency-meter scale.

In practice, the building of a suitable stable oscillator, and its accurate calibration present certain problems. Many oscillator circuits are inherently stable enough for the purpose, but the quality of the components used therein must be sufficiently good for the calibration to remain reasonably accurate.

Thus it is not the usual practice to attempt to calibrate the oscillator with extreme accuracy once and for all, but rather to produce a circuit with a nearly straight-line characteristic which can easily be corrected from time to time. The sub-standard from which these corrections are made is usually a crystal oscillator using a 100 kc bar and followed, if necessary, by a harmonic amplifier.

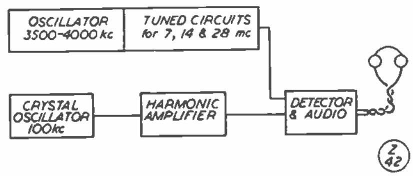


Fig. 7. Block diagram to illustrate the answer to Question 7.

From this, 100 kc "markers" are available on the calibrated scale, and the entire calibration can be shifted slightly, to one side or the other, to ensure that it lines up with these 100 kc points which are regarded as "infallible" since their stability and accuracy is, of course, of a very high order.

No detailed circuit has been drawn, as so many different types of oscillator circuit exist. The block diagram (Fig. 7) shows the layout of a typical frequency meter, consisting of (*a*) the 100-kc crystal oscillator; (*b*) a variable frequency oscillator covering 3,500-4,000 kc; (*c*) an amplifier-multiplier for the harmonics of the crystal oscillator; and (*d*) a detector-amplifier unit to serve as "mixer" for the outputs of the two oscillators.

It is recommended that the VFO should be one of the very stable arrangements such as the series-tuned Colpitts, or the Clapp oscillator, with high-grade components used throughout. The coil must be wound with great rigidity and very solidly mounted and wired. The dial should have an open scale, for the most accurate calibration may be nullified if inaccurate readings are taken by the operator.

The procedure of measuring the frequency of the transmitter is as follows: Let us assume that it has been roughly set for 14150 kc. The frequency meter has been switched on for long enough to be thoroughly warmed up. Switch on the crystal oscillator, set the tuning dial to 14100 kc and listen for the 100 kc beat. Set the oscillator correction condenser so that this comes to zero-beat, and check also for the next marker on 14200 kc. Switch off the crystal, and switch on the transmitter without power on the final stage. Rotate the main dial of the meter, listening for the beat, and tune this carefully to zero. Take a direct reading of the frequency from the calibration chart.

Conversely, to adjust the transmitter to a known frequency, set the frequency meter to the desired frequency and slowly rotate the VFO dial of the transmitter (with the power removed from the final stage) until the zero-beat condition is reached.

THE G2IQ CONVERTER FOR TWO METRES

Discussing an Outstanding VHF Design

One of the best two-metre converter designs ever published, either in this country or America, is the 6J6 push-pull arrangement which has become known as " The G2IQ," after its originator. Over the years, we have had countless requests for further details from those who missed the original article. Reproduced here is some collected material on the G2IQ VHF converter, which will give the experienced constructor all the information he needs for building himself a fine receiver for the two-metre band.

IN an article describing a method of measuring signal-to-noise ratio in VHF receivers ("Comparing Receiver Performance," SHORT WAVE MAGAZINE, June 1949), the author referred to an all-triode converter with the extremely low noise factor of 4 dB. The following is a description of this converter, the performance of which may justly be claimed as being well in the forefront at the present stage of VHF technique.

Simplicity and Stability of the Push-pull Converter

For purposes of comparison, about half a dozen different versions of this receiver have now been constructed, and without exception every one worked first time without the slightest sign of trouble. Indeed, despite the rather complicated appearance of its circuitry, this converter is simpler to construct and to get working than any other type. Its perfect balance makes it inherently stable; the only possible trick adjustment is that of neutralising the RF stage, but if the instructions are carefully followed, this will present no difficulty. Compared with receivers using a pentode RF stage such as the 6AK5, this converter is as docile as a lamb, gives slightly higher gain, and much better signal-to-noise ratio!

Some Advantages of the Push-pull Triode

The main advantage of the triode over the pentode in VHF RF amplifiers is that it has no screen. The noise energy in pentodes is higher than in triodes of similar characteristics because of the added noise caused by the screen current. A pentode is usually between three to five times as noisy as a triode producing equivalent amplification. For example, the Equivalent Noise Resistance of a 6AK5 is approximately 1,500 ohms, whereas that of the 6J6 is only about 400 ohms. However, in single-ended circuits, full advantage of the triode superiority cannot usually be taken. In the push-pull mode, however, the triode demonstrates its superiority because of the following factors: The push-pull connection halves the input capacity (it becomes here only 1 $\mu\mu$F), making it possible to use a comparatively large inductance in the grid circuit, a step-up aerial transformer and a truly balanced input circuit. In addition, the input resistance is doubled so that the damping of the grid coil is halved, with consequent improvement in the gain. In point of fact, the input resistance of a properly neutralised 6J6 is better than 10,000 ohms at 145 mc, whereas that of the 6AK5 is as low as

3,000 ohms. One further big advantage of the push-pull 6J6 is that this valve has only one cathode, common to both triodes. In the push-pull Class-A mode no RF current flows in the cathode lead ; in other words, the cathode is cold to RF and consequently the evil effects of cathode lead inductance are eliminated.

When added together, the foregoing advantages make a properly designed push-pull 6J6 RF amplifier approximately 5 to 6 dB better than a well-designed 6AK5 stage on the score of signal-to-noise alone. This may not look much on paper, but consider to what lengths we are willing to go to get another 6 dB gain from our beam aerials! Moreover, the gain we are getting from the 6J6 is better than that we could get by increasing the beam gain by 6 dB, because it represents pure signal gain without any additional noise. Increasing the beam gain also increases the noise component to some extent!

Further Design Considerations

Having decided on the balanced RF amplifier stage, it is as well to carry the symmetry throughout the converter and use a balanced mixer and balanced oscillator. A push-pull mixer has the disadvantage of requiring balanced output, and as the single-ended output coil was easier to construct, a push-push mixer was decided upon with plates strapped. A crystal controlled oscillator was regarded as an unnecessary complication, as stability at 144 mc is easily attainable with self-excited oscillators *when carefully designed.* Balanced injection to each side of the mixer is essential, and for this reason the oscillatory circuit shown was chosen. With stabilised power supply, this oscillator has no tendency to drift after the initial warming up period and gives a pure DC tone, a most desirable but not often encountered characteristic of oscillators at VHF.

Construction of Two Units

The components are spaced across the chassis in "chronological order," starting with the RF grid circuit and ending with the oscillator plate tank. This type of construction has the necessary symmetry and is, perhaps, easier than the second type. Both converters, however, have identical noise factors. The first was constructed almost entirely of surplus components on a home-made chassis: the second uses well-known types of components and a commercially made cabinet and chassis. In order to get everything into the commercial chassis, it was necessary to use a different layout, but the balance has not been impaired.

The input circuit in both converters uses a pre-set butterfly-type condenser. The input circuit is sufficiently broad-band to allow the grid condenser to be tuned to the middle of the band and left there. The neutralising condensers lie on each side of the tuning condenser, making the grid leads as short as possible. The neutralising condensers are midget 30 $\mu\mu$F air-spaced trimmers with all the plates removed except one rotor and one stator. Neutralising is fairly tricky, and experiment with various types of neutralising condensers led to the adoption of these as the best for this application. It should be remembered that everything connected with the tuned circuits should be of as small dimensions as possible so as to reduce inductance external to the tuned circuit and capacity to earth. These tiny condensers, when modified as suggested, provide the required capacity variation (2 to 3 $\mu\mu$F) with least circuit losses.

The grid leads to the tuning condenser are crossed over at the valve socket, so that the plate neutralising leads may come straight across to the neutralising condensers. A metal shield screens the input and output circuits, with a cut-out for the valve socket. Keep all leads as short as possible ; cup type mica by-pass condensers are an advantage in keeping down lead inductance. The cathode resistor is not by-passed for the reasons enumerated above. The grid coil is mounted direct on to the tuning condenser.

All earth returns are taken to a tag secured to the chassis by the valve socket bolt. The plate tank is similar to that of the grid, with HT fed to the centre tap of the coil through an RF choke. Condensers from each side of the coil feed to each mixer grid, which has no tuned circuit. The mixer grid resistors are raised about ¼-in. from their respective socket pins to allow injection to be obtained by home-made condensers. These consist of parallel insulated wires from each oscillator grid

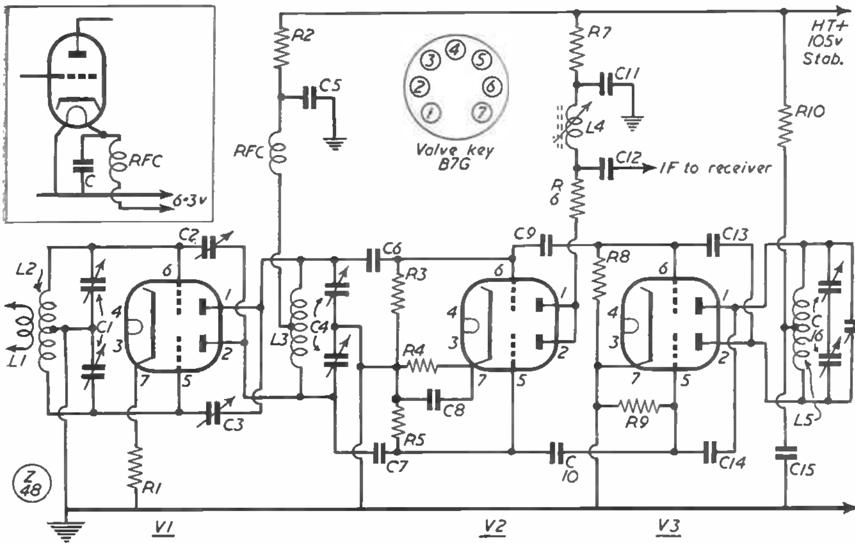


Fig. 1. Circuit of the two-metre converter using 6J6's, as described in detail in the article. The symmetry of the electrical layout should be noted — this should be translated into practice in the actual construction, of which one possible form appears at Fig. 2.

pin brought to each mixer grid pin and looped once around the ¼-in. resistor lead. The mixer does not appear to be unduly critical as to oscillator power, and varying amounts of injection have been tried with little or no variation in the noise factor.

SOME FURTHER PRACTICAL CONSIDERATIONS

Considerable simplification of the original has been achieved by dispensing with the grid tuning condenser in the RF stage and making the grid coil "self-resonant." This means that the only capacity across the coil is that of the valve (about 1 μμF) plus strays, and a worth-while increase in inductance is obtained. Instead of the original 6 turns, the coil may now be increased to 8 turns ¼ in. inside diameter with the turns spaced the diameter of the wire (20 SWG). It will be found that by judicious squeezing or opening of the turns the coil can be resonated within the band. By over-coupling the aerial—that is, by using a comparatively large aerial coil of 3 or 4 turns wound over the centre of the grid coil—the resonance curve is further broadened, and it will be found possible to peak up the response at 145 mc and rest assured that the circuit is effective from 144 to 146 mc. Incidentally, there is very slight

Table of Values

Circuit of the G2IQ 145 mc Converter using 6J6's

C1	=	8 × 8 μμF " Butterfly "
C4	=	15 × 15μμF " Butterfly "
C2, C3	=	1/4 μμF trimmers (*see text*)
C5, C8, C15	=	500 μμF mica
C6, C7	=	30 μμF Ceramicon
C9, C10	=	*See text*
C11	=	.01 μF mica
C12	=	50 μμF mica
C13, C14	=	10 μμF Ceramicon
C16	=	5 × 5 μμF split-stator
C17	=	30 μμF trimmer (Philips)
R1	=	56 ohms ¼ watt
R2, R7, R10	=	2,000 ohms ½ watt
R3, R5	=	100,000 ohms ¼ watt
R4	=	470 ohms ¼ watt
R6	=	56 ohms ¼ watt
R8, R9	=	15,000 ohms ¼ watt
All RFC	=	20 in. of 26 SWG enamelled on ½-watt resistor or 3/16 in former
L2, L3	=	6 turns ¼ in. diam. centre tap
L1	=	2 turns over centre of L1
L4	=	7 mc IF coil
L5	=	4 turns ¼ in C.T.

improvement in the signal-to-noise ratio with this over-coupled aerial coil, although the stage gain will be down a little.

Neutralising

In every case of difficulty over non-neutralisation it has been revealed that condensers other than those originally described have been used. Only a very small capacity of between 1.5 and 2 $\mu\mu$F is required, and this was obtained by using condensers with miniature plates of about ½ in. × ½ in. spaced approximately ⅛ in. Anything bigger than this adds to the external inductance of the tuned circuits and makes neutralising more difficult. The writer can only repeat the description of the condensers originally specified and advise their use against any other type. The type number is AP.52487, and the condensers consist of three fixed and four moving plates. All but one of each of the plates are removed and the remaining pair prised open until the spacing is approximately ⅛ in. The required capacity for correct neutralising is then obtained with the plates somewhere near three-quarters in.

There is no need to stress that the oscillator depends for its stability on the mechanical strength of its parts. Short, rigid leads are particularly vital here. The coil should be wound with not less than 18 SWG wire, and its centre should receive added support by a short rigid wire from the centre tap to the by-pass condenser. The tuning condenser requires a rigid supporting bracket and should be connected to the slow-motion drive by a flexible coupling. Use a concentric condenser for trimming the oscillator, as this type may be rigidly supported in the wiring. If desired, the VR105/30 stabiliser may be mounted on the same chassis with no ill effects.

Putting the Converter into Operation

There should be no difficulty in getting the converter working satisfactorily in a short time. The first step is to peak up the IF coil, and this may be done by turning up the main receiver gain and trimming the IF coil for maximum hiss at the frequency chosen. The next step is to trim the oscillator coil to approximately 138 mc—that is, 145 less the intermediate frequency. With the HT to the RF valve temporarily disconnected, rock the RF plate tuning condenser. Two positions of increased hiss in the receiver output will be noticed corresponding to frequencies of 131 mc and 145 mc. The latter is the correct one—that is, the one using less capacity. Now apply HT to the RF valve, and in all probability (unless you have been very lucky) the receiver will become distinctly unstable! With the neutralising trimmers at maximum, reduce the capacity of each uniformly, a little at a time, until tuning the grid coil into resonance does not produce self-oscillation in the RF stage. When the receiver is properly neutralised, tuning the grid coil should produce a slight increase in hiss at resonance, but the tuning should not be sharp, neither should the increase in hiss be pronounced. Pronounced hiss and sharp tuning denote that the receiver is working on the threshold of instability, and whilst the gain will be higher, the signal-to-noise ratio will suffer. If this condition exists, it is as well to experiment with the neutralising condensers until the RF stage becomes more docile. When properly adjusted, the stage should remain stable, even with the aerial disconnected.

The Input Load

The converter works better with a balanced aerial system with an impedance of between 300 and 600 ohms. The use of coaxial cable with one side of the aerial coupling coil earthed upsets the balance somewhat. Many VHF workers are coming to the conclusion that symmetrical feeders are to be preferred to coaxial (asymmetrical) lines, but for those who are using the latter the following suggestion may be of help: it is not always recognised that when the aerial is used for reception its function is reserved and the receiver becomes the load and the aerial the generator. Therefore, matching the aerial to the receiver must be done at the receiver end. In this case, the 70-ohm coaxial line may be matched to the 300-ohm input of the converter by means of a quarter-wave matching transformer of 150 ohms impedance, and the need to earth one side of the input coil is obviated. This transformer may take the form of two lengths of 70-ohm coax 13 in. long (*i.e.* 20 in. times the velocity factor) with the outer braid connected together at each end and the inner conductors connected to the aerial feeder and receiver input. Alternatively, two lengths of 300-ohm twinlead, each 16 in. long, may be used in parallel to effect the desired balance. Attention to small points like this are well worth while and will help achieve the near-perfect reception of which this type of converter is capable.

Do not be disappointed, during the first few hours' work with this receiver, at its apparent lack of liveliness. Its abnormal quietness is not due to sensitivity, as it will soon demonstrate when a signal appears on the band.

The Oscillator

Some trouble has been experienced with squegging from the oscillator. This can be recognised by the presence of "birdies" as the oscillator tuning is varied. This should not be confused with the self-oscillation caused by faulty neutralising and may be easily recognised by taking out the RF and mixer valves, when the trouble will persist if the cause is squegging. Apparently the manufacturers' tolerance for types 6J6 is wide; the writer has no data as to 6J6 tolerance, but it is known that the type 6AK5 is issued with a tolerance in *gm* of about 3,500 to 6,500! So in the case of the 6J6 squegging, the trouble may easily be remedied by increasing the decoupling resistor to either 5,000 or 10,000 ohms; one or the other is always effective.

The oscillatory circuit used in the original converter (known, the writer believes, as the "Kallitron" oscillator) is remarkably stable under varying conditions and, moreover, is very tolerant of widely different component values. For example, the grid-to-plate capacities may be varied from 2 to 10 $\mu\mu$F with no noticeable difference in performance; likewise, the grid resistors may be any value between 10,000 and 25,000 ohms.

Incidentally, if anyone obtains other than an extremely pure T9 note from this oscillator, then there is something wrong. The only occasion when an impure note was encountered turned out to be due to a faulty 6J6.

Oscillator and Mixer Coupling

This is not at all critical, and the capacity from the oscillator grids, consisting of stiff wires, may be wrapped around the mixer grid pins or may be left lying within an inch of them. The gain is slightly higher with the tighter coupling, but the noise factor is not affected. Indeed, provided that the RF stage is properly neutralised, there is nothing critical at all about this receiver, and it may safely be left for months on end without further attention.

CONSTRUCTION OF THE G2IQ CONVERTER

In general, all writers on VHF stress the need for short, direct wiring, and it is felt that this point requires very special emphasis. The advice is not given idly. In wiring up a two-metre circuit which you want to work, consider most carefully every step, decide how you can save a *quarter of an inch* here or a quarter there by careful arrangement of the components. Let this basic fact be engraved on your mind. Never forget it. Pay the most careful attention to the supply leads, particularly those carrying heater voltages. Keep these right up against the panelling and by-pass them to earth as close as possible to the valve holder tags. The low inductive T.C.C. "Micadiscs" are very useful in this connection. They provide at one and the same time a feed-through connection at chassis level and a low inductive capacity to earth. Bond all earth leads, valve holders and so on firmly to the chassis. A single earth lead fed through a bare hole in the chassis will cause untold trouble with unexplained and sudden alterations in oscillator frequency. Follow most carefully the advice given with regard to coil size and gauge of wire advised. To those accustomed to the more usual frequencies, these coils are microscopic in size and look utterly absurd!

Turning now specifically to the 6J6 converter in the G2IQ version, the oscillator gave little trouble once the above-mentioned points were grasped and firmly understood. Trouble was encountered in the first place due to obtaining oscillation which was beyond the range of the grid-dip instrument, but which showed up on the Lecher wires to be within the range of 270-300 mc! A bit higher than expected! Tuning alteration made little difference, and, in fact, it was only when it was discovered that *shorting out* the inductance also made little difference that it was realised what was wrong. The wiring itself contained sufficient inductance to form its own oscillatory circuit at this much higher frequency! One of the first lessons was thereby learnt and a re-arrangement of the components cured this particular trouble. The oscillator is now remarkably stable once the initial warming up period is over, albeit it is still rather more T8 than T9 in character.

The next trouble came, rather naturally, from self-oscillation of the RF stage. The exact neutralising condensers specified by the designer were not available and many were tried without success. Eventually success was attained by realigning the valve holder slightly in relation to the dividing screen so that the plate lead tags on the valve holder were completely screened from the remaining elements. The grid leads were fed through small grommetted holes in the dividing screen and small home-made neutralising condensers attached directly from these points to the opposite anode leads—that is to say, the cross-over takes place on the mixer side of the dividing screen. The home-made condensers each consisted of two lengths of No. 20 gauge enamelled wire overlapping each other to an extent of 1 in., pushed into a 1 in. length of Systoflex from opposite ends. A certain amount of careful juggling is necessary to attain stability, and in this connection some form of load should be applied to the grid coil—preferably the aerial! The grid coil was settled finally as a six-turn, with four aerial turns overwound in the centre. A 350-ohm resistor was temporarily fixed across the latter during neutralising operations, to form the load. No grid tuning condenser is fitted, but until such time as the existing long-wire end connected aerial is replaced by balanced feeders to the projected beam, considerable benefit was obtained by using a two-plate midget condenser across the aerial coil itself. (This will be discarded when the beam feeders are connected.)

Approximate resonance of the RF anode coil and the local oscillator was checked by the aid of the grid-dip oscillator, the former as near as could be judged in the centre of the 144-146 mc band and the latter at 135 mc, to give the IF of 10 mc which was selected; final touches were effected using the grid-dip oscillator as a signal generator on 145 mc and peaking up on the communications receiver S-meter.

Even then no signals could be heard from outside, and what was equally ominous was the complete lack of car ignition noise — with a main road not far away. Followed a period of intense cogitation to decide upon the next move. The only unknown factor left for investigation appeared to be the degree of injection from the local oscillator.

Success!

The original injection consisted of a quarter-inch overlap of bare wire air-spaced about 1/32 in. on each grid circuit. This was increased to an inch, using the same technique as was employed in the construction of the neutralising condensers and — Lo! ignition noises became apparent. Signals rapidly followed and we felt that we had really arrived on Two Metres at last. There is some degree of regeneration occurring in the RF stage, because the RF anode tuning is *very* critical, and with the degree of injection now applied some pulling of the oscillator is noticeable. However, this is not really serious, as once the RF anode is peaked it need not be touched.

Lastly, a word on the physical layout employed. The writer has departed, somewhat unwisely perhaps, from the original G2IQ layout, but the design appears to lend itself to neatness and a clean arrangement. The chassis is 6 ins. in depth with 1 in. clearance below. A back vertical panel carries the three valves with their bases facing the front and the valves in a horizontal position. The two dividing screens are suitably disposed, and their front ends form supports for the front panel, which contains only the slow motion drive to the local oscillator. It is thus possible, by removing the front panel, to carry out innumerable adjustments without difficulty with all RF wiring in full view. All feed leads drop straight down and through the chassis, suitably by-passed as recommended, and the IF transformer is located under the chassis just below the mixer compartment with a screened take-off to the co-axial socket for connection to the main receiver input. No

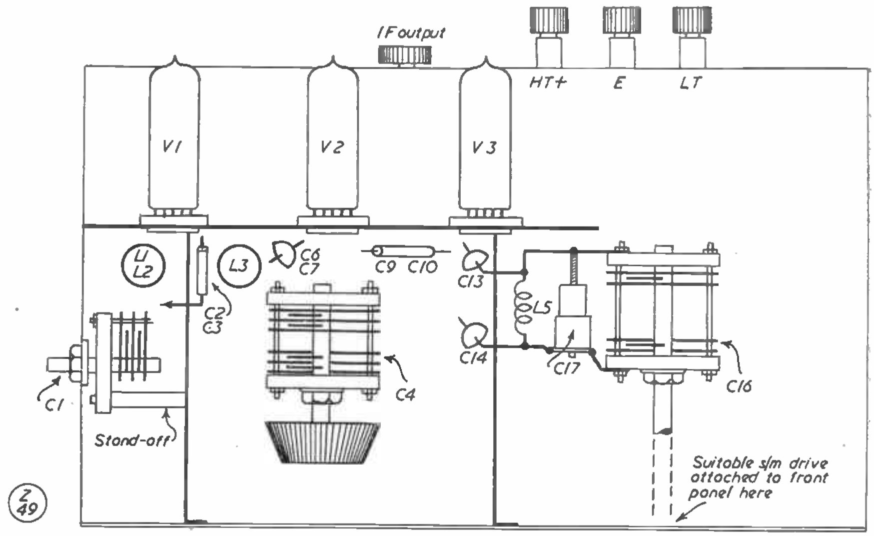


Fig. 2. Physical layout for the G2IQ two-metre converter; the oscillator stage is to the right, the mixer in the centre, and the RF stage at left. Some valuable practical advice on construction is given in the article.

IF break through is experienced, and only the barest trace of IF pick-up, and then only on very strong signals.

In conclusion, let it be said that the easy way to VHF reception is to ask "the chap down the road" to fix up one's converter and to make it work. In the writer's case, there was no "chap down the road" (nearer than 15 miles), and in consequence, willy-nilly, he has had to plough his lone furrow. Having done so (and in all humility it can be said that by so doing) he has probably learnt a great deal more about VHF technique in a given time that could possibly have been hoped for had the easier path been available. There is a moral in that somewhere.

And now you are handed over to the man who really knows something about VHF for *your* next move in the game. The writer will be right alongside you!

CLUB STATION G6HH/A

At the Hastings Hobbies Exhibition

This article will be of particular interest to all who have organised an exhibition station, or contemplate doing so. Local Clubs are frequently called upon to provide a live Amateur Radio demonstration for a Town Exhibition and these efforts vary from an elaborately staged affair to something quite simple and straightforward. But whatever the scale, organisation is necessary and it is only detailed planning that will make the undertaking a real success. The experiences of the Hastings Amateur Radio Club at a recent exhibition are discussed here, with some of the problems they had to overcome, the results achieved and the lessons learnt for the next occasion.

IT seems way back in the dim and distant past when in February the Hastings and District Amateur Radio Club decided to participate in the Hobbies Exhibition to be held on July 4-11. Looking back over the intervening period, one realises that even with five months to prepare for the event, life often seemed too short to ensure that our exhibit would materialise: so much had to be prepared and taken into account that at times it appeared doubtful whether we could beat time.

The Hobbies Exhibition is an annual event forming one of the many attractions of Hastings Carnival Week, all proceeds from the week's activities being devoted to charities. This was the first time that Amateur Radio would be in the show; in addition, it was the first time that the Club had ventured on such a project. It was therefore necessary and most desirable that the best possible show should be put on, not only to do the Exhibition credit but to ensure at the same time that the Club should bring no discredit upon itself from a mediocre effort. As there was obviously a can just asking to be taken back, a sub-committee was elected to shoulder the responsibilities of organising the event in all its aspects. Although its terms of reference are not given here, they amounted to instruction to produce the goods—or else . . . . !

Some of the Problems

It was not long before the sub-committee came to realise the complexity of its task. All sorts of things had to be intelligently anticipated and suitable arrangements made accordingly. Where were the Club's stands going to be—how much space could we use—how much space would we be allotted—what other stands would there be around us—could we get a mains feed to our stand, and where from—where could we put up aerials and masts—what aerials would we need—who could provide apparatus and such-like for exhibits, and what sort of stuff would it be—who would decide whether the standard of workmanship was tolerable—what about transport for all this gear—who can provide aerial masts—will the police let us haul a couple of 50-footers through the streets—who is going to operate the /A station—what days, and what times, could operators attend—what precautions should be taken against failure of equipment—how much will it all cost? These, and dozens of other matters, loomed up and had to be grappled with and a solution found for each. Not the sort of thing the amateur normally takes in his stride, albeit the very kind of problem he revels in and surmounts even if he does tear his hair out in the process. (There are five bald heads in the club now).

It was decided to function mainly in the 80-metre band, and G5RO doctored up his all-band rig for use at the exhibition. This transmitter was to be operated remotely from a control console which would also contain the receiving equipment, and serve as an operating position. In its final form the console was 6ft. long, 5ft. 6in. high and 2ft. 6in. in depth, the operating desk being a little over 1ft. wide. The panel containing the control gear and receiving apparatus sloped back from the desk at an angle of 45°. (A photograph of the console appeared on p.441 of the September issue of SHORT WAVE MAGAZINE).

The console comprised a wooden framework covered in hardboard, which latter was wax polished. Due to its appearance, it soon became known as "The 'ighly-polished Console." It was made in sections for ease of transport, so that it could be assembled on site, and later dismantled and stored for future use. Considerable credit is due to our member, R. G. Ford, who spent many hours of his spare time constructing it, and to the members who expended much elbow grease producing the polish. (XYL's who dare mention anything about giving the floor a doing-over run the risk of having something thrown at them).

Aerial System

It so happened that the exhibition buildings were in a clear, open space, on a hill behind the White Rock Pavilion, overlooking the sea. Adjoining the buildings were two bowling greens, one of which was not turfed. Permission was obtained to erect aerials and masts on this ground. Two masts were set up in diagonally opposite corners; one was a 50ft. wooden pole, the other a screw-jointed 2in. diameter steel mast 52ft. high. Between these was suspended a 130ft. span of wire, centre-fed with co-axial cable which dropped straight down to the ground and then ran underground to the exhibition building, gaining access to the transmitter through a convenient window. A horizontal dipole for 10-metres was also erected, and the receiving aerial was a long-wire 20ft. high and fixed to the remote mast. A five-element Yagi on a 30ft. pole was mounted beside the building for 2-metre reception, and the earthing system was four 3ft. spikes driven into the ground immediately below the aforementioned window. From the consistently good reports received, there is no doubt that the 80-metre dipole produced the goods.

There certainly seemed to be no difficulty in securing contacts; our main trouble was how best to handle the queues of stations when conditions were good. The QRM from the fun-fair right alongside us made our receiving conditions a bit grim, for we could not get our aerial out of the interference field produced by a mass of DC machinery, dodgem cars, flashing signs, pin-tables and such-like abortions. Our best results were always secured before 3 p.m., when the fair was QRT—any time after that we suffered from a continuous heavy background, and it wasn't flea-power either!

Getting Going

The exhibition opened at 10 a.m. on Saturday, July 4. We set up our aerials on the evening of the 2nd, and installed the transmitter and the rest of the gear on the afternoon and evening of July 3. Of course something would have to go wrong. G5RO's rig, which had behaved itself up to now, apparently took umbrage at being carted through the streets and saw fit to develop a fault almost at zero hour. At midnight on the 3rd we were searching for a missing HT supply for the modulator, and as everybody had just about had enough of it for one day, it was decided to let the rig sulk, and tear it apart the next morning. Having just settled down to put things right, in blows G3CMN, sizes up the position in a flash and straight away offers the use of his transmitter with an 813 in the final running 150 watts, provided that the rack-mounted gubbins can be got down to the show. No sooner said than done: hordes piled into G5RO's car, round to

G3CMN's shack, dismantled the rig and brought it down to the Stand. Once there, it was assembled, wired up, and was on the air within a couple of hours. And thus started the great sizzle—G3CMN's gear saved the situation, did yeoman service without complaint, and made the show a success.

In order that onlookers could hear what was going on, the HRO in the control panel was fed into two 5in. speakers mounted in the panel. This was later augmented by a third speaker which stood on top of the console. Our own transmissions were picked up on a monitor receiver situated on a distant stand and worked into a Williamson amplifier, running at low level. Even so, there was a certain amount of echo effect in our transmissions which brought comment from various operators. The building is of concrete throughout, with a glass roof (and didn't we stew!); it is about 120ft. long, 50ft. wide and over 20ft. to the roof peak. Acoustics were therefore conducive to reverberation effects which enabled the operator to be heard with ease all over the building. One of our operators, G3HRI, seemed to produce what was described by more than one contact as a "metallic modulation." There seemed to be no apparent reason why this should be so, but to account for it G5RO did suggest on one occasion that John had got his gold teeth in for a change, whilst G6QB proffered the explanation that he was munching chocolates without first removing the silver paper.

Talking of operators recalls one of the snags that was encountered with regard to the licence. In past years the Club had held the call-sign G6HH, but for various reasons the licence had been allowed to lapse and had, in fact, been pretty well forgotten. At one time it was decided, for the purposes of the exhibition, to request /A facilities for G2RG, one of the Club members, with permission for alternative operators to be recognised. The snag here was that G2RG could not be in full attendance whenever the station was operating, and the rota of alternative operators produced what amounted to Club licence conditions. We therefore resolved to have G6HH taken off the hook, with a /A tacked on, which put the thing in official order and permitted our licensed members to be cited as alternative operators without fear of running into trouble. Of course, the call-sign G6HH happens to be rather apt, and the Town Dignitaries who visited us were agreeably impressed with our phonetic "Happy-Hastings-stroke-Able." (Well, wasn't Hastings in merry mood during Carnival Week?)

Some of the Results

During the week of operating, 246 QSO's were obtained, the majority of these taking place up to the Wednesday. Conditions tailed off on the Thursday, Friday and Saturday and produced only about 50 or so contacts. The way things had been going up to the Wednesday, it looked as though we could chalk up about 400 before we went QRT on the Saturday, but it was not to be. Of course, the HRO had to fade out on us early on the Saturday afternoon just when the crowds were gathering, so another receiver had to be pressed into service. Naturally, it didn't fit in the Console—what else do you expect! Anyway, with a bit of BF and BI, we won. This particular receiver, belonging to a Club member, is one of only a few that were produced a few years ago by a firm now defunct, and though perhaps not in the top rank so far as communications receivers are concerned, it had its uses. If nothing else, it looks most impressive with its two 6in. circular tuning scales and the host of knobs to twiddle—a conglomeration of things which made spectators goggle a bit.

Some Experiences

In the course of a QSO with G6QB on the Thursday morning, a crowd of schoolgirls breezed in and invaded the stand. Unknown to them, and to us, G6QB got it all down on a tape-recorder, and caused a mild flutter when he played it back to us. The look of consternation on some of those girls' faces when they heard their own voices coming back at them had to be seen to be believed. They thought their remarks were in the background, and it was the last of their thoughts that stations far and wide might hear them. Having listened to it all, they seemed to agree among themselves that these electrics are wonderful.

When we were talking to some French amateurs in French and English, some of the onlookers appeared mystified, apparently wondering how we could make our gear talk in foreign languages! During one such QSO, the Carnival Queen and her four attendants—Beauty, Glamour, Charity and Gaiety—paid a surprise visit. G3BDQ was operating at the time, and had a few awkward moments trying to explain to the French op. that the C.Q. was *not* his XYL! The large crowd that had followed her in and gathered round the console literally whooped with glee at all the frantic explaining that was going on. G3BDQ got a bit warm round the collar, the "Queen" looked coy, her attendants did some quiet sniggering, while the Club members promptly grasped the opportunity to utter the usual spontaneous remarks. Throughout it all the French op. seemed to be completely indifferent to the stir his repeated references to "*Your wife, John*" were causing.

Some 30 QSL cards were received and displayed during the week, and several letters from SWL's came in. It was the Club's intention to QSL all contacts, and certainly to those who asked for cards. Particularly does this apply to the SWL's, some of whom sent in very fine detailed reports. (If cards have not yet been received by these folk, we hope they excuse the delay, but they will get them in time). We tried to convince certain people before the event that to provide us with QSL cards would be to their advantage, but they could not see it. Now that the exhibition is over, they realise that there was some truth in our view, so now we are awaiting the cards. In the meantime, there is not much point in our purchasing cards if we are likely to get some without cost.

One interesting report arrived from ZS5QV who was holidaying in Yorkshire. Extracts from his note read:

"*North Riding, Yorks. July 8th '53. Dear OM's,—Just a line to let you know that I have been listening to you on my car radio, in the forecourt of this hotel. Time 8.58, called by PAØIZ Amsterdam who I received Q5-S9. His report to you the same and you gave him Q4/5-S7. Your signals have been consistent Q5-S8/F, definitely the loudest signal on the band. Cheerio, best 73, ZS5QV, Tom. P.S.—I have only a 5′ 0″ car aerial fitted.*"

It seems that G6HH/A was getting over pretty well, for almost every QSO revealed that we were riding over the QRM. Some of the reports like S9 + 40 made our ears tingle, but we suppose that those who gave us + *umpteen* over S9 were greatly impressed with our signal strength. We suggest the S-meters are now reset to their normal zero and pointers straightened out if they can be got at.

There are lots of other things we could discuss here if only space permitted. It goes without saying that everyone in the Club put up a fine show and willingly gave 100% co-operation. We have gathered in some new members, including our first YL, who, it seems, is a keen SWL. Apart from this achievement, we think we created the desirable impression that Amateur Radio is not a thing to set aside for people with a kink who talk in mumbo-jumbo, but is something enjoyed by reasonably intelligent people—something that creates good friendships and encourages happy relationships.

Some of the Lessons

We have learned some useful lessons, too, for, notwithstanding the careful preparations and the fond hopes that perfection had been attained, a review of the event shows that there are quite a few loose ends to be tied up the next time we make a similar effort. Most of these seem to be peculiar to our own circumstances, so will not be laboured here. One of the things which might be of general interest is the *appearance* of stands and exhibits. Good as our lot turned out to be, with 60ft. of stands crammed with gear of all sorts, it soon looked like a still-life study in a shop-window dressing. The few oddities that worked or did something to catch the eye created enormous interest. More of this sort of thing will be a "must" for another show. As instance of the popularity of things-that-work, G5RO's rotating 70-cm Yagi with a meter to indicate the cardinal point to which the aerial was directed was drawing good crowds; his demonstrations of sharp directivity, nodes and absorptions with a 1200 mc klystron and ground plane aerial had quite a small procession following him around the hall, watching the effects of moving the tiny Yagi as they were displayed on the GDO.

RECEIVING MORSE SIGNALS

Beat Frequency Oscillator Circuits

The June issue of RADIO QUARTERLY gave a good constructional design for a beat frequency oscillator (BFO) for CW reception. This was a unit separate from the main receiver, though powered from it. In this article, other methods of obtaining BFO action are discussed, with further notes on a separate BFO unit. A beat frequency oscillator enables Morse to be received on any set not normally designed for CW telegraphy.

EXCEPT with TRF receivers, where the detector can be brought into a state of oscillation by advancing the reaction control, a Beat Frequency Oscillator is necessary for the reception, in intelligible form, of CW Telegraphy (Morse). An interrupted carrier wave does not produce an audible signal, though its interruption may be heard as a series of clicks, or "breathing" sounds in the receiver. When the carrier is combined with a secondary RF oscillation, however, a beat frequency tone is produced, and this can be made to lie within the audio-frequency band. This is exactly the result desired, and it may be brought about in one of a number of ways. Receivers of specialised type will already have a BFO, but most ordinary commercial superhets have no such oscillator, even when one or more short wave ranges are provided. With such receivers, and home-built receivers without BFO, one of the circuits discussed here may be employed. Morse will then be heard. In addition, a BFO can prove useful in accurately tuning in weak voice or other modulated signals. Though the circuits, as shown, are for mains valves, they may be used in the same way with battery-operated receivers.

Oscillating IF Stage

The simplest type of BFO circuit is shown in Fig. 1. Though having its limitations, it is exceedingly simple and can be reasonably satisfactory. Here, the IF stage is brought into oscillation by adding a *small* capacity between signal grid and anode, this capacity being switched out of circuit when not required. All other wiring in the receiver is unchanged.

The additional leads must be short and direct, or oscillation may continue when the switch is opened! The latter should have a low internal capacity and be mounted right up against the valve or IF transformer, panel control being obtained by means of an extension spindle. A small, low-capacity pre-set can be used for coupling, or two insulated wires twisted for a short distance. The most suitable capacity will depend upon the gain of the stage, and the amount to which ordinary wiring contributes towards oscillation. The capacity is best adjusted to the *smallest* value which brings the valve into oscillation, and the IF transformer cores or trimmers may then require final adjustment to produce a satisfactory audio tone.

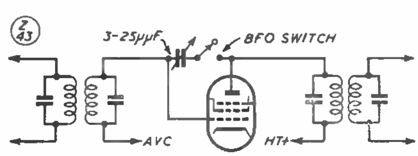


Fig. 1. An external BFO unit can be avoided by producing oscillation in an IF stage of the receiver, as shown here.

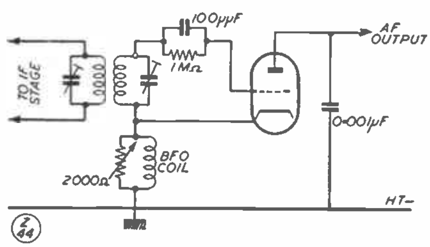


Fig. 2. A triode valve connected to operate as a detector and beat frequency oscillator stage. The variable resistor controls the oscillation.

With Triode Detectors

Some superhets employ triode detectors in the interests of simplicity and high sensitivity, especially when only a limited amount of RF or IF amplification is available. Such a valve may be brought into oscillation by using a feed-back winding on the IF transformer, exactly as reaction is obtained in a TRF receiver. A further method is to employ a cathode BFO coil, as illustrated in Fig. 2. This has the important advantage that the IF transformer may be left untouched.

The BFO coil can consist of a winding from a disused IF transformer, and may be parallel tuned, if necessary, by adding a suitable pre-set condenser. The variable resistor in parallel with the coil enables control over the intensity of oscillation to be obtained. Violent oscillation is *not* required, and should be avoided, as weak signals may be over-ridden, and background noise increased.

If a feedback winding is to be added to the IF transformer, it can consist of about 40 turns, pile-wound near the secondary, for 465 kc transformers. The "reaction" condenser can be pre-set, with a series switch for BFO control. Transformers for higher frequencies will require fewer turns on the feed-back winding.

Separate BFO Valve

The use of an additional valve for the BFO is undoubtedly the ideal method and a suitable constructional design was given in the June issue of Radio Quarterly. Alignment of the IF or other stages is not upset, and the audio pitch, or tone, can be controlled at will. A suitable circuit for this type of BFO is shown in Fig. 3.

Assuming that the IF transformers are tuned to 465 kc an audio tone of 1,000 cycles would be obtained with the BFO tuned to 464 or 466 kc. By employing a small trimmer of about 25 μμF maximum capacity, full control of the audio tone can be obtained. A second condenser is wired in parallel with the BFO

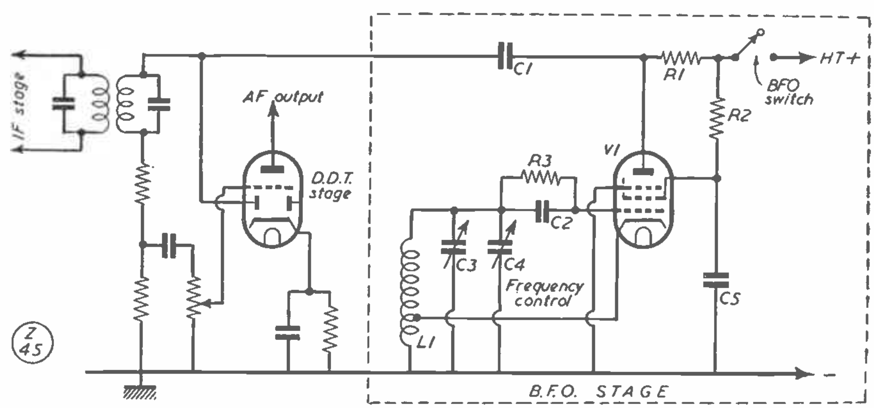


Fig. 3. Using a separate Beat Frequency Oscillator, as described in the text. To the left is the existing receiver output stage, showing the point of connection for the BFO injection. Values are: C1, 2-5 μμF; C2, 100 μμF; C3, 100-500 μμF variable, as required; C4, 25 μμF, variable; C5, 0.1 μF; R1, 27,000 ohms; R2, 220,000 ohms; R3, 47,000 ohms.

coil, to increase the C to L ratio, for improved frequency stability, and to enable initial adjustment of the BFO frequency itself to be made.

Though a 6K7 is shown, almost any kind of RF pentode can be used. Triodes are also suitable. The intensity of the BFO oscillation can be controlled by moving the cathode tap, or by reducing the screen-grid or anode voltage. The coupling capacity present from BFO anode to diode should be very small, and looped wires are suitable.

A stage of this type may be made up in a screened can of suitable size, or the valve may be outside the can, as shown in Fig. 4. In the latter instance, the BFO coil and other components can be accommodated in a disused IF transformer shielding of moderate size, wired up as a separate unit, and afterwards secured to the chassis. Screening is highly desirable to avoid interference between the BFO and other stages. The range of audio tone which may be obtained by operating the panel control knob can be adjusted suitably by means of the preset condenser.

A disused IF transformer coil of the same frequency as that used in the double-diode triode stage is suitable, and can be tuned to an appropriate higher or lower frequency by increasing or reducing the parallel capacity. A cathode tap may be made by unwinding a number of turns, or by carefully lifting a turn and soldering a thin flexible lead thereto. This additional lead should be taped to avoid it being pulled away. A point about 10 to 20 turns from the earthed end of the winding will generally be suitable.

If no BFO note is produced, it should be checked that the BFO can be tuned to a suitable frequency. If this is in order, the valve may not be oscillating. This can be checked by connecting a meter in the HT lead to this stage and shorting the 25 $\mu\mu$F condenser. No change in current shows that the valve was not oscillating, and this could be due to the tapping being too near the earthed end of the coil, or by the direction of winding having been reversed when replacing the turns. Any coil which can be tuned to approximately the IF frequency is suitable. For the circuit in Fig. 2, with 465 kc transformers a coil can be made by winding 70 turns of 28 SWG wire on a ½in. dia. former.

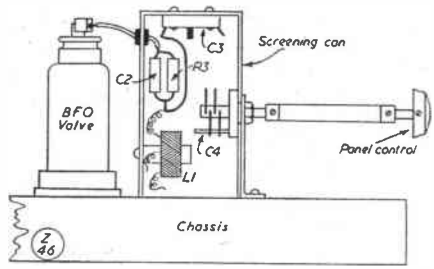


Fig. 4. In Fig. 3 is shown the circuitry for a useful BFO unit, external to the receiver, but for which space could usually be found on the average chassis. This sketch shows a suitable constructional layout.

With VHF receivers and other receivers employing a higher intermediate frequency, an appropriate coil must be used. An IF of 1,600 kc, for example, requires a coil tuning to about 1,599 or 1,601 (roughly 185 metres). Except for this change, the circuit in Fig. 3 may be used.

LATEST ZONE LISTINGS

For operating convenience, and as an interesting and challenging DX yardstick, the Amateur Radio world has been arbitarily divided into 40 different Zones. To hear or work all these — and to be able to show QSL cards in confirmation — is the objective of many an operator keen on DX for its own sake. It is no mean feat to achieve WAZ (Worked All Zones) or HAZ (Heard All Zones). About 280 of the amateur operators of the world are credited with WAZ, the leading British station being G6ZO with 244 countries worked in the 40 zones. Below is an up-to-the-minute list of the Zone areas, with all recent additions and amendments, showing the full prefix allocation for each Zone. How many Zones have your heard or worked — and how many countries ?

ZONE 1

North-Western Zone of North America

Alaska	KL7, WL7
Canadian Province of Yukon	VE8
Canadian North-West Territories	
District of Mackenzie	VE8
District of Franklin west of 102°W, including Islands of Victoria, Banks, Melville, and Prince Patrick	VE8

ZONE 2

North-Eastern Zone of North America

Canadian North-West Territories	
District of Keewatin	VE8
District of Franklin east of 102°W, including Islands of King William, Prince of Wales, Somerset, Bathurst, Devon, Ellesmere, Baffin, and the Melville and Boothia Peninsulas	VE8
Canadian Province of Quebec north of 52°N	VE2
Canadian Province of Labrador	VO6

ZONE 3

Western Zone of North America

Canadian Province of British Columbia	VE7
United States of America	
California	W6
Arizona, Idaho, Nevada, Oregon, Utah, Washington	W7

ZONE 4

Central Zone of North America

Canadian Provinces	
Ontario	VE3
Manitoba	VE4
Saskatchewan	VE5
Alberta	VE6
United States of America	
Alabama, Kentucky, Tennessee	W4
Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma, Texas	W5
Montana, Wyoming	W7
Ohio	W8
Illinois, Indiana, Wisconsin	W9
Colorado, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota	WO

ZONE 5

Eastern Zone of North America

St. Pierre and Miquelon Islands	FP
Canadian Provinces	
New Brunswick, Nova Scotia, Prince Edward Island	VE1
Newfoundland	VO
Canadian Province of Quebec south of 52°N	VE2
Bermuda Islands	VP9
United States of America	
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	W1
New Jersey, New York	W2
Delaware, District of Columbia, Maryland, Pennsylvania	W3
Florida, Georgia, North Carolina, South Carolina, Virginia	W4
Michigan, West Virginia	W8

(Note: In Zones 3,4,5, some stations of the United States of America have the prefix K, KN, or WN instead of the letter W. This does not affect their status as amateurs.)

ZONE 6

Southern Zone of North America

Mexico	XE/XF

ZONE 7

Zone of Central America

Panama Republic	HP
Honduras	HR
Swan Island	KS4
Panama Canal Zone	KZ5
Guatemala	TG
Costa Rica	TI
Cocos Island	TI9
British Honduras	VP1
Nicaragua	YN
Salvador	YS
Clipperton Island	

ZONE 8

West Indies Zone

Cuba	CM/CO
Guadeloupe	FG
Martinique	FM
Haiti	HH
Dominican Republic	HI
Guantanamo Bay	KG4
Puerto Rico	KP4, WP4
U.S. Virgin Islands	KV4
Leeward Islands, including Antigua, Barbuda, British Virgin Islands, Montserrat, St. Kitts-Nevis, Anguilla	VP2
Windward Islands, including Dominica, Grenada, the Grenadines, St. Lucia, St. Vincent	VP2
Jamaica	VP5
Cayman Islands	VP5
Turks and Caicos Islands	VP5
Barbados	VP6
Bahama Islands	VP7

ZONE 9

Northern Zone of South America

French Guiana and Inini	FY
Colombian Republic	HK
Dutch West Indies	PJ
Dutch Guiana (Surinam)	PZ
British Guiana	VP3
Trinidad and Tobago	VP4
Venezuela	YV

ZONE 10

West Central Zone of South America

Bolivia	CP
Ecuador	HC
Galapagos Islands	HC8
Peru	OA

ZONE 11

East Central Zone of South America

Brazil	PY
Paraguay	ZP

ZONE 12

South-Western Zone of South America

Chile	CE
Easter Island	CEØ

ZONE 13

South-Eastern Zone of South America

Uruguay	CX
Little America (Antarctica)	KC4
Argentina	LU
Falkland Islands	VP8
South Georgia	VP8
South Orkney Islands	VP8
South Sandwich Islands	VP8
South Shetland Islands	VP8
Graham Land (Antarctica)	VP8

ZONE 14

Western Zone of Europe

Portugal	CT1
Azores Islands	CS2, CS3, CT2
Germany	DJ/DL
Spain	EA
Balearic Islands	EA6
Eire (Irish Free State)	EI
France	F
England	G
Channel Islands	GC
Isle of Man	GD
Northern Ireland	GI
Scotland	GM
Wales	GW
Switzerland	HB
Liechtenstein	HE
Norway	LA/LB
Luxembourg	LX
Belgium	ON
Faeroe Islands	OY
Denmark	OZ
Netherlands (Holland)	PA/PI
Sweden	SL/SM
Gibraltar	ZB2
Monaco	3A
Andorra	7B
Saarland	9S

ZONE 15

Central Zone of Europe

Trieste	AG2, I/Trieste, MF2
Corsica	FC
Hungary	HA
Vatican City	HV
Italy	I
Sardinia	IS
Sicily	IT
San Marino	M1
Austria	FKS, MB9, OE
Finland and Lapland	OH
Czechoslovakia	OK
Poland	SP
European Russian Socialist Federated Soviet Republic Kaliningrad (East Prussia)	UA2
Lithuania	UP2
Latvia	UQ2
Estonia	UR2
Yugoslavia	YU
Albania	ZA
Malta	ZB1

ZONE 16

Eastern Zone of Europe

European Russian Socialist Federated Soviet Republic	UA1, UA3, UA4, UA6
Asiatic Russian Socialist Federated Soviet Republic Bashkir, Chkalov	UA9
Ukraine	UB5
White Russia Soviet Socialist Republic	UC2
Karelo-Finnish Republic	UN1
Moldavia	UO5

ZONE 17

Western Siberian Zone of Asia

European Russian Socialist Federated Soviet Republic Novaya Zemlya	UA1

Asiatic Russian Socialist Federated Soviet Republic	
Chelyabinsk, Komi, Kurgan, Molotov, Omsk, Tyumen, Sverdlovsk	UA9
Turkoman	UH8
Uzbek	UI8
Tadzhik	UJ8
Kazakh	UL7
Kirghiz	UM8

ZONE 18

Central Siberian Zone of Asia

Asiatic Russian Socialist Federated Soviet Republic	
Novosibirsk, Tomsk, Altai, Kemerovo	UA9
Krasnoyarsk, Irkutsk, Chita, Buryat-Mongolia	UAØ

ZONE 19

Eastern Siberian Zone of Asia

Asiatic Russian Socialist Federated Soviet Republic	
Khabarovsk, Yakutsk, Primorsky, Sakhalin Island (north)	UAØ
Wrangel Island	

ZONE 20

Balkan — Asia Minor Zone

Transjordan	JY
Bulgaria	LZ
Lebanon	OD
Greece	SV
Crete	SV
Dodecanese and Aegean Islands	SV5
Turkey	TA
Syria	YK
Roumania	YO
Cyprus	ZC4
Palestine	ZC6
Israel	4X

ZONE 21

South-Western Zone of Asia

Baluchistan	AP
Iran (Persia)	EP/EQ
Bahrein Island	MP4B
Trucial Oman	MP4H
Kuwait	MP4K
Qatar	MP4Q
Saudi Arabia (Hedjaz and Nejd)	HZ
Azerbaijan	UD6
Georgia	UF6
Armenia	UG6
Aden, including Kamaran and Perim Islands	VS9
Sultanate of Oman	VS9
Afghanistan	YA
Iraq	YI
Yemen	4W

ZONE 22

Southern Zone of Asia

Sikkim	AC3
Pakistan	AP
Goa (Portuguese India)	CR8
French India	FN
Nepal	NE1
Maldive Islands	VS9
India	VU
Laccadive Islands	VU4
Ceylon	4S
Bhutan	

ZONE 23

Central Zone of Asia

Tibet	AC4
Chinese Republic Provinces	
Sikang, Sinkiang	C5
Suiyuan	C7
Ningshia, Ala-Shan, Kansu, Chinghai	C8
Asiatic Russian Socialist Federated Soviet Republic	
Tannu Tuva Republic	UAØ
Mongolian Republic (Outer Mongolia)	

ZONE 24

Eastern Zone of Asia

Chinese Republic Provinces	
Kiangsu	C1
Chekiang, Anhwei, Hupeh	C2
Kwangsi, Kwangtung, Fukien, Hainan Island	C3
Yunnan, Kweichow, Hunan, Kiangsi	C4
Szechwan	C5
Shensi, Honan, Shantung	C6
Chahar, Shansi, Hopeh, Jehol	C7
Formosa	C3
Manchuria	C9
Macao	CR9
Hong Kong	VS6
Changkiang (Kwangchow)	

ZONE 25

Japanese Zone of Asia

Korea (Chosen)	HL
Japan	JA, KA
Ryukyu Islands (Okinawa)	KR6
Asiatic Russian Socialist Federated Soviet Rebublic	
Sakhalin Island (south)	UAØ

ZONE 26

South-Eastern Zone of Asia

French Indo-China	FI
Siam (Thailand)	HS
Andaman and Nicobar Islands	VU5
Burma	XZ

ZONE 27

Philippine Zone

Philippine Islands	DU
Bonin (Iwo Jima) and Volcano Islands	JAØ, KAØ
Caroline Islands	KC6
Palau Islands	KC6
Mariana Islands	
Guam	KG6, WG6
Saipan	KG6S
Tinian	KG6T
All Islands, east of Philippines, west of Long. 163°E, north of Lat. 2°N, south of Lat. 40°N, south-east of line from 153°E. 40°N to 131°E. 23°N	

(Prefix as allotted — normally no amateur population)

ZONE 28

Malayan Zone of Asia

Portuguese Timor	CR10
Java	PK1, PK2, PK3
Sumatra	PK4
Dutch Borneo	PK5

Celebes and Molucca Islands	PK6
Dutch New Guinea	PK6, PK7
Papau Territory	VK9
Territory of New Guinea, including Bismark and Admiralty Islands	VK9
Solomon Islands	VR4
Singapore	VS1
Federation of Malaya	VS2, VS3
Sarawak	VS4
Brunei	VS5
British North Borneo, including Labuan	ZC5

All Islands, west of Long. 163°E, south of Lat. 2°N, north of Lat. 11°S

(Prefix as allotted — normally no amateur population)

ZONE 29

Western Zone of Australia

Commonwealth of Australia	
Northern Territory	VK5
Western Australia	VK6
Cocos (Keeling) Islands	ZC2
Christmas Island *(off Java)*	ZC3

ZONE 30

Eastern Zone of Australia

Commonwealth of Australia	
New South Wales, Australian Capital Territory and Lord Howe Island	VK2
Victoria	VK3
Queensland	VK4
South Australia	VK5
Tasmania	VK7
Macquarie Island	VK1

All Islands west of Long. 163°E, south of Lat. 11°S

(Prefix as allotted — normally no amateur population)

ZONE 31

Central Pacific Zone

Baker, Canton, Enderbury, Howland and American Phoenix Islands	KB6
Hawaiian Islands	KH6, WH6
Johnston Island	KJ6
Midway Islands	KM6
Jarvis and Palmyra Islands	KP6
Wake Island	KW6
Marshall Islands	KX6
Gilbert and Ellice Islands and Ocean Island	VRI
British Phoenix Islands	VR1
Fanning Island, including Christmas and Washington Island	VR3
Tokelau (Union) Islands	

All Islands, east of Long. 163°E, west of Long. 140°W, south of Lat. 40°N, north of Lat. 11°S

(Prefix as allotted — normally no amateur population)

ZONE 32

New Zealand Zone

New Caledonia	FK
French Oceania	FO
New Hebrides	FU, YJ
Wallis Island	FW
American Samoa	KS6
Norfolk Island	VK9
Fiji Islands	VR2
Tonga (Friendly) Islands	VR5
Pitcairn Island	VR6
Cook Islands, including Raratonga	ZK1
Niue	ZK2
New Zealand	ZL
Western Samoa	ZM

All Islands, east of Long. 163°E, west of Long. 120°W, south of Lat. 11°S

(Prefix as allotted — normally no amateur population)

ZONE 33

North-Western Zone of Africa

Tangier	CN2, KT1
French Morocco	CN8
Madeira Islands	CT3
Canary Islands	EA8
Spanish Morocco	EA9
Ifni	EA9
Rio de Oro	EA9
Algeria	FA
Tunisia	3V

ZONE 34

Northern Zone of Africa

Anglo-Egyptian Sudan	ST
Egypt	MD5, SU
Tripolitania and Cyrenaica (Libya)	5A

ZONE 35

Western Zone of Africa

Cape Verde Islands	CR4
Portuguese Guinea	CR5
St. Thomas and Prince Islands	CR5
Liberia	EL
French Togoland	FD
French West Africa, including Senegal, French Guinea, Ivory Coast, Dahomey, Niger, French Sudan, Mauritania	FF
Sierra Leone	ZD1
Nigeria and British Cameroons	ZD2
Gambia	ZD3
Gold Coast, including Ashanti and British Togoland	ZD4

ZONE 36

Equatorial Zone of Africa

Angola	CR6
Spanish Guinea (Rio Muni)	EA0
French Cameroons	FE
French Equatorial Africa, including French Congo, Gabun, Ubangi-Shari, Tchad	FQ
Belgian Congo	OQ5
Ruanda-Urundi	OQ0
Northern Rhodesia	VQ2
St. Helena Island	ZD7
Ascension Island	ZD8

ZONE 37

Eastern Zone of Africa

Mozambique	CR7
Ethiopia	ET
French Somaliland	FL
Italian Somaliland	I5
Eritrea	I6, MI3
Zanzibar and Pemba Island	VQ1

Tanganyika	VQ3
Kenya	VQ4
Uganda	VQ5
British Somaliland	VQ6
Socotra Island	VS9
Nyasaland	ZD6

ZONE 38

Southern Zone of Africa

Tristan da Cunha, and Gough Island	ZD9
Southern Rhodesia	ZE
Union of South Africa	
Cape District	ZS1
Cape Province	ZS2
Orange Free State	ZS4
Natal and Zululand	ZS5
Transvaal	ZS6
Marion Island	ZS2
South-West Africa	ZS3
Swaziland	ZS7
Basutoland	ZS8
Bechuanaland	ZS9
Bouvet Island	

ZONE 39

Madagascar Zone

Madagascar	FB
Kerguelen Islands	FB
New Amsterdam and St. Paul Islands	FB
Reunion Island	FR
Heard Island	VK1
Mauritius	VQ8
Chagos Islands	VQ8
Seychelles and Amirante Islands	VQ9
Aldabra Islands	
Comoro Islands	

ZONE 40

North Alantic Zone

Jan Mayen Island	LA/LB
Svalberg (Spitzbergen)	LA/LB
Greenland	OX
Iceland	TF
European Russian Socialist Federated Soviet Republic	
Fridtjof Nansen Land (Franz Josef Land)	UA1

TELEVISION TRADE TEST TRANSMISSIONS

The BBC Television Service radiates transmissions daily for the benefit of the radio industry. Some of these are at fixed times, and the times of others are liable to change. Generally speaking, transmissions are at the following times daily (Sunday excepted):—

TIME	VISION	SOUND
10.00-12.00	Morning demonstration film	Speech and music associated with the film
15.00-15.08	Test Card 'C'	900 c/s tone
16.15-16.45	Test Card 'C'	Recorded music
19.45-19.53	Test Card 'C'	900 c/s tone

It may be necessary from time to time to depart from this basic schedule for a number of reasons. For example, the periods of Test Card "C" at 1500 and 1945 are intended to precede the afternoon and evening transmissions in order to facilitate technical adjustments, but the times of these transmissions, and particularly the evening transmission, may vary. It will normally, however, be the practice to precede the afternoon and evening transmissions, at at whatever time it starts, by eight minutes of Test Card "C," accompanied by 900 c/s tone.

The object of the period of Test Card "C" shown above at 1615—1645 is to fill in the gap between the afternoon programme and the beginning of Children's Television. Thus if this gap varies the period of test transmission will correspondingly vary.

It may be necessary for a number of reasons to alter the content of these transmissions. For example, the morning demonstration film consists usually of 15-minute periods of normal film pictures and their associated sound, interspersed with 15-minute periods of Test Card "C" accompanied by recorded music.

At times it may be necessary for this transmission to consist wholly of Test Card "C," together with either recorded sound or 900 c/s tone. Again it is not always easy to radiate recorded sound as an accompaniment to the period of Test Card "C" radiated between 1615 and 1645. Sometimes 900 cycles tone is substituted.

Lastly, it sometimes happens that internal technical needs or special programme arrangements make it necessary to cancel a test transmission.

The BBC, however, appreciates the value which the radio industry attaches to these transmissions, and they will not be abandoned unless necessary.

SHORT WAVE BROADCAST STATIONS

Giving Frequency, Wavelength, Callsign, Location and Schedule

This list covers the 13-41 metre section of the waveband within which the short-wave broadcasting services of the world operate. Only those stations normally receivable in this country are included, and the schedules given are for English broadcasts or transmissions beamed on Europe. The list comprises a total of more than 300 stations and is the most comprehensive and authoritative of its kind yet published. It should be noted that many of these stations are liable to unannounced frequency (wavelength) changes, or alterations in schedule. Amendments will appear in future issues of RADIO QUARTERLY.

Frequency *Kilocycles*	Wave-Length *metres*	Callsign	Location	Schedule *GMT*
21730	13.81	LLQ	Oslo, Norway	
21710	13.82	GVS	London	
21700	13.82	VUD10	Delhi, India	0700-0920
21675	13.84	GVR	London	
21660	13.85	VUD10	Delhi, India	
21640	13.86	GRZ	London	
21560	13.89		Rome, Italy	
21550	13.92	GST	London	
21540	13.93	VLB21	Shepparton, Australia	0255-0545
21530	13.93	GSJ	London	
21510	13.95	VUD5/11	Delhi, India	
21470	13.97	GSH	London	
21460	13.98	KRCA2	Dixon, Calif.	0130-0215 0315-0345
18040	16.62		Moscow	
18025	16.64	GRQ	London	
17890	16.77	HCJB	Quito, Ecuador	2100-2200 (Ex. Mon.)
17870	16.79	GRP	London	
			Munich, Germany (VOA)	1130-1300
17865	16.80		Damascus, Syria	1445-1545
17860	16.80	ORU	Wavre, Belgium	1000-1100
17850	16.81		Paris, France	
			Moscow	
17845	16.82		Cologne, Germany	1800-2100
17840	16.82	VLC17	Shepparton, Australia	0255-0945
		WLWO6	Bethany, Ohio	1500-2215
		VUD5/10	Delhi, India	
17835	16.82		Karachi, Pakistan	
17830	16.83	WDS13	Brentwood, New, York	1330-2130
17825	16.83	LLN	Oslo, Norway	
17820	16.84	CKNC	Sackville, New Brunswick	1700-1730 1845-1900
17815	16.84		Cologne, Germany	1430-1730
17810	16.84	GSV	London	
17805	16.85	DZ16	Manila, Phil. Is.	1200-1400 1500-1530
17800	16.85		Rome, Italy	
17790	16.86	GSG	London	
17784	16.87	HER7	Berne, Switzerland	
17780	16.87	WRCA5	Bound Brook, New Jersey	1500-2215
		VUD10/11	Delhi, India	
17775	16.88	PHI	Hilversum, Holland	1030-1200 (Sun.)
17770	16.88	WDS15	Brentwood, New York	1615-1800
			Tangier (VOA)	1130-1600
			Rome, Italy	
			Karachi, Pakistan	
17760	16.89	WGEO3	Schenectady, New York	1330-2200
17755	16.90		Singapore (BFEBS)	
17740	16.91		Lisbon, Portugal	
			Delhi, India	0730-0830
17730	16.92	GVQ	London	1330-1600
17720	16.93	LRA	Buenos Aires, Argentina	
17715	16.93	GRA	London	
17705	16.94		Delhi, India	0730-0830
17700	16.95	GVP	London	
17677	16.97	CR5SB	Sao Tome	1200-1300 Sun., Thurs.
15595	19.23		Brazzaville, French Equatorial Africa	
15550	19.29		Moscow	
15450	19.42	GRD	London	
			Moscow	
15440	19.43	WRCA1	Bound Brook, New Jersey	1600-2245
			Moscow	
15435	19.44	GWE	London	
			Singapore (BFEBS)	
15400	19.48		Rome, Italy	
15390	19.49		Moscow	
15380	19.51		Delhi, India	0730-0830
			Lisbon, Portugal	
15375	19.51		London	1500-1845

Frequency *Kilocycles*	Wave-Length *metres*	Callsign	Location	Schedule *GMT*
15370	19 52	ZYC9	Rio de Janeiro, Brazil	
15360	19.53		Moscow	
15350	19.54		Luxembourg	1100-1300
			Paris, France	
15345	19.55		Tangier (VOA)	1100-1600 1630-2030
15335	19.56		Karachi, Pakistan	
15330	19.57	WGEO1	Schenectady, New York	1330-2200
15320	19.58	CKCS	Sackville, New Brunswick	1700-1730 1845-1900 2230-2305
		VLG15	Lyndhurst, Australia	0845-1355
		OLR5B	Prague, Czechoslovakia	
		OZF9	Copenhagen, Denmark	
		WRUL1	Scituate, Mass.	2245-0015
15310	19.60	GSP	London	
15305	19.60	HER6	Berne, Switzerland	
15300	19.60	DZH8	Manila, Phil. Is.	1200-1400 1500-1530
		GWR	London	
			Singapore (BFEBS)	
15295	19.61		Tangier (VOA)	1200-2145
			Moscow	
15290	19.62	LRU	Buenos Aires, Argentina	
15280	19.63	WRCA2	Bound Brook, New Jersey	1700-1900
		ZL4	Wellington, New Zealand	
			Munich, Germany (VOA)	0600-1600
15275	19.64		Cologne, Germany	1030-1330
15270	19.65		Munich, Germany (VOA)	1100-1930
			Karachi, Pakistan	0700-0715
15260	19.66	GSI	London	
15250	19.67	WLWO5	Bethany, Ohio	1130-1445
15245	19.68		Manila, Phil. Is.	1315-1730
15240	19.68		Tangier (VOA)	
15230	19.70	WDS12	Brentwood, New York	1330-1400 1500-2215
			London	1415-1445
			Johnnesburg, South Africa	0830-1215
15220	19.71	PCJ	Hilversum, Holland	1030-1200 1600-1730 (Sun.)
		ZL10	Wellington, New Zealand	
15210	19.72	WRCA2	Bound Brook, New Jersey	1330-1600 1615-2145
			Munich, Germany (VOA)	0500-1100
			London	
			Moscow	
15205	19.73	GWU	London	
15200	19.74	WLW05	Bethany, Ohio	1530-2000
			Tangier (VOA)	1130-1300
15190	19.75	CKCX	Sackville, New Brunswick	
		VUD11	Delhi, India	0700-0820 1330-1345
		OIX4	Pori, Finland	1215-1235
		PRK9	Belo Horizonte, Brazil	
			Moscow	
15180	19.76	GSO	London	
			Moscow	
15170	19.78	LKV	Oslo, Norway	
		TGWA	Guatemala City	
		VUD10	Delhi, India	
15165	19.78	WLW07	Bethany, Ohio	1530-2130
		OZF7	Copenhagen, Denmark	
15160	19.79	TAU	Ankara, Turkey	
			Munich, Germany (VOA)	1330-1400
15155	19.80	ZYB9	Sao Paulo, Brazil	
15150	19.80	YDC	Djakarta, Indonesia	
			Tangier (VOA)	1615-2200
15140	19.82	GSF	London	1700-1715
15135	19.82	PRB23	Sao Paulo, Brazil	
15130	19.83	WRCA6	Bound Brook, New Jersey	1130-2130
15125	19.83		Lisbon, Portugal	
15120	19.84	HVJ	Vatican City, Rome	1500-1515
			Colombo, Ceylon	0430-0730
15115	19.85	HCJB	Quito, Ecuador	2100-2200 (Ex. Mon.)
15110	19.85	GWG	London	
15100	19.87	EPB	Teheran, Iran	2000-2015
15090	19.88	CKLX	Sackville, New Brunswick	1220-1405 (Sun.) 1345-1405 (Weekdays)
15085	19.89		Delhi, India	
15075	19.20	ZJA6	Georgetown, British Guiana	1800-2000
15060	19.92		Addis Ababa, Ethiopia	1000-1100 1815-1930
			Peking, China	2230-2300 0900-0930 1330-1400
15000	20.00	WWV	Washington, D.C.	TimeCheck every 5 minutes
12175	24.64	TFJ	Reykjavik, Iceland	1615-1630 (Sun.)
12095	24.80	GRF	London	
12040	24.92	GRV	London	
12032	24.94		Bucharest, Rumania	
11975	25.05		Colombo, Ceylon	1430-1645

Frequency Kilocycles	Wave-Length metres	Callsign	Location	Schedule GMT
11970	25.06		Brazzaville, French Equatorial Africa	1845-1900
11964	25.08		Lisbon, Portugal	
11960	25.09	MCT	London	
			Moscow	
11955	25.09		London	2000-2115
			Singapore (BFEBS)	
11950	25.10	ZPA5	Encarnacion, Paraguay	
			Saigon, Indo-China	1600-1630
11945	25.12	MCQ	London	
		CE1173	Santiago, Chile	
11940	25.13		Tangier (VOA)	1230-0600
			Lisbon, Portugal	
11937	25.14		Johannesburg, South Africa	1600-2005
11930	25.15	GVX	London	
11925	25.16	CE1190	Santiago, Chile	
11920	25.17	BED4	Taipei, Taiwan	1915-1940
11915	25.17	HCJB	Quito, Ecuador	
			Damascus, Syria	2130-2230
11910	25.18	MCO	London	
			Budapest, Hungary	
11905	25.19		Moscow	
11900	25.21	WGEO2	Schenectady, New York (AFRS)	1530-2245
11895	25.22		Manila, Phil. Is. (VOA)	0715-0830 2200-0715
			Dakar, Senegal	1900-2200
11890	25.23	WRCA2	Bound Brook, New Jersey	1600-1630 1930-2130
		GWW	London	
			Manila Phil. Is. (VOA)	0900-1600
			Moscow	
11880	25.25	LRS	Buenos Aires, Argentina	2000-2100
		GRE	London	
11875	25.26	OLR4C	Prague, Czechoslovakia	
			Munich, Germany (VOA)	0515-1700
11870	25.27	KRCA3	Dixon, Calif.	0030-0600
		KCBR5	Delano, Calif.	0700-1600
11865	25.28	HER5	Berne, Switzerland	
			Tangier (VOA)	1800-2230
11860	25.30	KWID2	San Francisco, California	1000-1600
		GSE	London	
11850	25.32	ORU	Wavre, Belgium	
		VUD4/7	Delhi, India	
		TGNA	Guatemala City, Guatemala	0300-0445
		LLK	Oslo, Norway	
11845	25.32		Karachi, Pakistan	0230-0245
			Paris, France	
11840	25.34	OLR4A	Prague, Czechoslovakia	
		GWQ	London	1415-2030
11835	25.35	CXA19	Montevideo, Uruguay	2200-2230
11830	25.36	WDSI1	Brentwood, New York	1130-2200
		WGEO2	Schenectady, New York	0000-0015
			Tangier (VOA)	0300-1100
			Saigon, Indo-China	
11825	25.27	ZYK3	Recife, Brazil	0005-0025
11820	25.38	GSN	London	
11815	25.39		Cairo, Egypt	1830-1900
			Warsaw, Poland	
11810	25.40	KCBR2	Delano, Calif.	0600-1445
			Rome, Italy	
11805	25.41		S.S. "Courier"	1400-1800
11800	25.42	GWH	London	0130-0430
11795	25.43		Cologne, Germany	2200-0100
11790	25.45	WDSI1	Brentwood, New York	0030-0100 0315-0345
		WRCA3	Bound Brook, New Jersey	1615-2215
		VUD3/7	Delhi, India	1330-1345 1530-1545
		GWV	London	
			Honolulu, Hawaii	0900-1600
			Moscow	
11785	25.45	YDF2	Djakarta, Indonesia	1900-2000
11780	25.47	ZL3	Wellington, New Zealand	
		WRUL2	Scituate, Mass.	1730-2130
11775	25.48	WRCA3	Bound Brook, New Jersey	1500-1600
			Munich, Germany (VOA)	0500-1030
11770	25.49	YDF7	Djakarta, Indonesia	1900-2000
		KCBR5	Delano, California	1200-1415
11765	25.50	GVU	London	1615-1645
		ZYB8	Sao Paulo, Brazil	
			Moscow	
11760	25.51	VLB11	Shepparton, Australia	0645-0815
			Tangier (VOA)	1100-1745
		CKRA	Sackville, New Brunswick	
		OLR4B	Prague, Czechoslovakia	
11755	25.52	KRCA1	San Francisco, California	0500-1600
11750	25.53	GSD	London	1615-1645
11740	25.55	CE1174	Santiago, Chile	
		HVJ12	Vatican City,	1500-1515
		WRUL4	Scituate, Mass.	2015-2115
			Warsaw, Poland	
11735	25.56	LKQ	Oslo, Norway	
11730	25.58	GVV	London	1415-1445
		CE1173	Santiago, Chile	
			Hilversum, Holland	1600-1730 (Sun.)

Frequency Kilocycles	Wave-Length metres	Callsign	Location	Schedule GMT
11724	25.58		Baghdad, Iraq.	1915-2000
11720	25.60	CHOL	Sackville, New Brunswick	2230-2305
		OQ2AA	Leopoldville, Belgian Congo	
11718	25.61		Athens, Greece	1745-1755
11710	25.62	WLWO7	Bethany, Ohio	1130-1300
			Tangier (VOA)	1415-2200
11705	25.63	SBP	Stockholm, Sweden	
11700	25.64	GVW	London	1500-1930
		HSK9	Bangkok, Thailand	1000-1200
		HP5A	Panama City, Panama	
			Paris, France	
11690	25.66		Peking, China	2230-2300 0900-0930 1330-1400
			Karachi, Pakistan	1230-1245
11685	25.67	HVJ11	Vatican City, Rome	1500-1515 1815-1845
11680	25.68	GRG	London	
11650	25.72		Karachi, Pakistan	1945-2115
11630	25.79		Moscow	
11090	27.05	CSA92	Ponta Delgada, Azores	
10260	29.24		Peking, China	2230-2300 0900-0930
10000	30.00	WWV	Washington, D.C.	TimeCheck every 5 minutes
		MSF	Rugby, England	14, 29, 44, 59 min. past each hour
9975	30.07		Kabul, Afghanistan	1645-1725 (Sun., Wed.)
9970	30.08		Brazzaville, French Equatorial Africa	
9915	30.26	GRU	London	
9825	30.53	GRH	London	
9800	30.61		Moscow	
9780	30.67		Moscow	
9770	30.70	MCN	London	
9760	30.74	TGWA	Guatemala City Guatemala	1230-0600
		MCR	London	1615-1645
9755	30.76		Paris, France	
9746	30.78		Lisbon, Portugal	
9745	30.78	HCJB	Quito, Ecuador	
9740	30.80		Moscow	
9735	30.82	HI2T	Trujillo, Dominican Republic	
		MCP	London	
			Saigon, Indo-China	1600-1630 2230-2255
9730	30.83		Berlin, Germany	
9720	30.86	PRL7	Rio de Janeiro, Brazil	
			Moscow	

Frequency Kilocycles	Wave-Length metres	Callsign	Location	Schedule GMT
9710	30.90	YDF6	Djakarta, Indonesia	1900-2000
			Rome, Italy	
9700	30.93	CE970	Santiago, Chile	
		WLW06	Bethany, Ohio	0030-0230
		KCBR3	Delano, Calif.	0900-1445
		GWY	London	1600-1845
			Tangier (VOA)	0315-0600
			Sofia, Bulgaria	2300-2315
9690	30.96	GRX	London	
		LRA1	Buenos Aires, Argentina	
			Tangier (VOA)	0315-0415
9685	30.98	WLW08	Bethany, Ohio	0115-0400
		4VEH	Cap Haitien, Haiti	0200-0300
			Tangier (VOA)	1900-2100
			S.S. "Courier"	1400-1730
9680	30.99		Tangier (VOA)	1900-2245
			Paris, France	
9675	31.01	GWT	London	
968 9670	31.02		Munich, Germany (VOA)	2000-0045
			Lisbon, Portugal	
9668	31.03	TGNA	Guatemala City, Guatemala	0300-0445
9665	31.04	HEU3	Berne, Switzerland	1845-1930
			Vienna, Austria	
9660	31.06	VLQ9	Brisbane, Queensland	
9650	31.09	ZJM8	Limassol, Cyprus	
9645	31.10	WDSI3	Brentwood, New York	0115-2000
			Tangier (VOA)	0315-0700
			Honolulu, Hawaii	1130-1600
			Karachi, Pakistan	1515-1530 1945-2115
9640	31.12	GVZ	London	
9635	31.14		Tangier (VOA)	1200-0630
9630	31.15	CKLO	Sackville, New Brunswick	
		VUD3/11	Delhi, India	
9625	31.17	GWO	London	1615-1645
		XEBT	Mexico City, Mexico	
9620	31.19	VUD5/7	Delhi, India	
9618	31.20		Belgrade, Yugoslavia	0615-0630 1700-1715
			Paris, France	
9617	31.20	KZCA	Salzburg, Austria	
9615	31.20	WRCA5	Bound Brook, New Jersey	0115-0200 2345-0000
9610	31.22	LLG	Oslo, Norway	
		TIDCR	San Jose, Costa Rica	0200-0455
		CR8AB	Goa, Portuguese India	1500-1730
9600	31.25	KCBR1	Delano, Calif.	0800-1600
		GRY	London	
			Johannesburg, South Africa	
		CE960	Santiago, Chile	
9595	31.27		Tangier (VOA)	1800-2230

Frequency *Kilocycles*	Wave-Length *metres*	Callsign	Location	Schedule *GMT*
9590	31.28	VUM2	Madras, India	0700-0915 1030-1130
			Hilversum, Holland	
9585	31.30	CKLP	Sackville, New Brunswick	2230-2300
9580	31.32	VLA9	Shepparton, Australia	0645-0815
		GSC	London	1630-1645 1900-2030 2045-2130
9570	31.34	GWK	London	1800-1930 2000-2115
		KCBR4	Delano, Calif.	0100-0600 0700-1145
			Colombo, Ceylon	1330-1800
9565	31.36	ZYK3	Recife, Brazil	2130-2155 (Sun.)
9555	31.40		Warsaw, Poland	
9550	31.41	HVJ8	Vatican City, Rome	1600-1615 1815-1845
		GWB	London	1545-1615 1900-2000 2115-2145
		OLR3A	Prague, Czechoslovakia	
		LKJ	Oslo, Norway	
9545	31.43	VUB2	Bombay, India	0715-0900 1110-1130 1200-1415
		WLW08	Bethany, Ohio	0315-0345
			Tangier (VOA)	2315-0300
9543	31.44		Rangoon, Burma	1415-1515
9540	31.45	ZL2	Wellington, New Zealand	0700-0830
			Munich, Germany (VOA)	0515-1530 1615-2245
			Paris, France	
9535	31.46		Stockholm, Sweden	
9530	31.48	WDSI3	Brentwood, New York	0115-0200 0315-0345
		WGEO1	Schenectady, New York	2300-0000 (Mon. Fri) 0030-0100
		VUC2	Calcutta, India	0700-0900 1130-1300
			Manila, Phil. Is.	1200-1600 2200-0000
9525	31.50	ZBW3	Hong Kong	0730-1000 1200-1430
		GWJ	London	
9520	31.51	WLWO8	Bethany, Ohio	2345-0000
		OZF5	Copenhagen, Denmark	
9515	31.53	KRCA4	Dixon, Calif.	0500-0645 (Tue., Sat.) 0700-1600
9510	31.55	GSB	London	
9505	31.56	HOLA	Colon, Panama	
		PRB22	Sao Paulo,	
			Belgrade, Yugoslavia	
9500	31.58	XEWW	Mexico City, Mexico	

Frequency *Kilocycles*	Wave-Length *metres*	Callsign	Location	Schedule *GMT*
			Tangier (VOA)	1745-1900 2130-2215
9480	31.65		Moscow	
9465	31.70	TAP	Ankara, Turkey	2100-2145
9440	31.78		Brazzaville, French Equatorial Africa	
9410	31.88	GRI	London	
9363	32.04		Madrid, Spain	2015-2045
9340	32.10		Alma Ata, USSR	
9210	32.57	OTH	Leopoldville, Belgian Congo	
9000	33.30	4XB21	Tel-Aviv, Israel	2015-2030
8955	33.50	COKG	Santiago, Cuba	
8825	33.92	COCQ	Havana, Cuba	
8230	36.45	ZNB	Mafeking, Bechuanaland	1800-1930
8036	37.34	FXE	Beirut, Lebanon	1500-1600
7940	37.78		Alicante, Spain	
7935	37.81	HLKB	Pusan, South Korea	
7860	38.17	SUX	Cairo, Egypt	
7850	38.20	ZAA	Tirana, Albania	2100-2130
7670	39.11		Sofia, Bulgaria	2100-2115
7664	39.24		Omdurman, Sudan	1730-1800 (Fri.) 1615-1645 (Sun., Tue.)
7547	39.75	ZNX32	Bridgetown, Barbados	
7500	40.00		Peking, China	2230-2300
7420	40.50		Athens, Greece	1800-2205
7350	40.81	3AM4	Monte Carlo, Monaco	0600-0830 1100-2300
7320	40.98	GRJ	London	1615-1645
7300	41.10		Athens, Greece	1730-2100
7295	41.12		Munich, Germany (VOA)	1645-2200
7290	41.15		Hamburg, Germany	
			Delhi, India	0700-0900
7288	41.17	TAS	Ankara, Turkey	
			Vatican City, Rome	1815-1845
7280	41.21	GWN	London	
7270	41.27		Salonika, Greece	1400-2145
			Tangier (VOA)	2230-0630
			Srinagar, Kashmir	0700-0830
7260	41.32	VUM2	Madras, India	1030-1130
			Lisbon, Portugal	
			Moscow	
7250	41.38		Munich, Germany (VOA)	0500-1100 1615-1845 2200-0045
			London	1900-2130
7240	41.44	VUB2	Bombay, India	0715-0900 1200-1350 1430-1730

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