

Amateur

RADIO

For all two-way radio enthusiasts

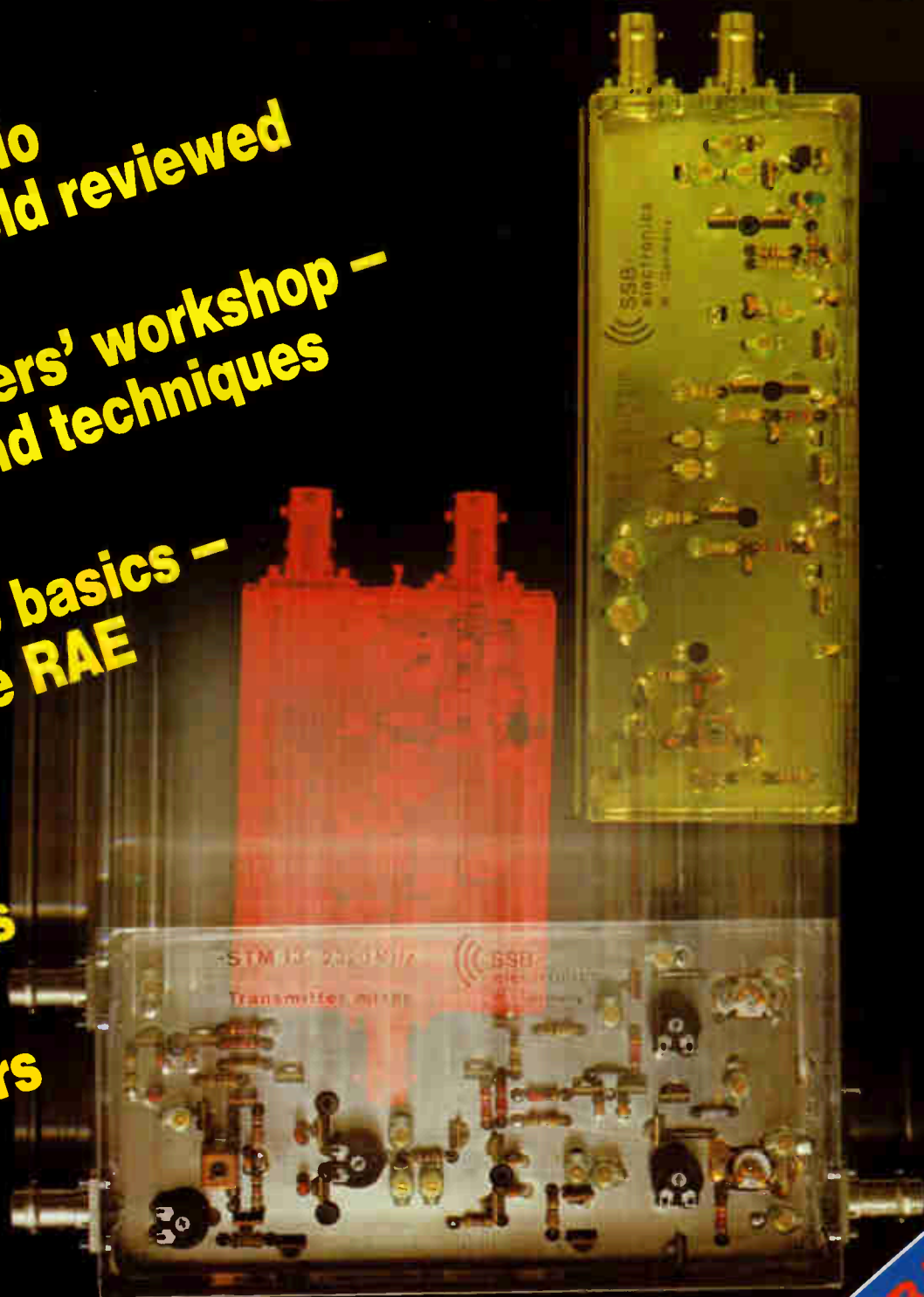
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On test: 13cm equipment

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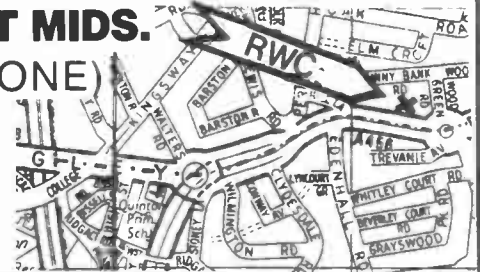
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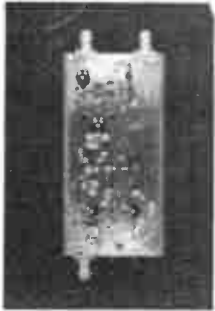


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LOWE SHOPS

Whenever you enter a LOWE ELECTRONICS' shop, be it Glasgow, Darlington, Cambridge, Cardiff, London or here at Matlock, then you can be certain that, along with a courteous welcome, you will receive straightforward advice. Advice given, not with the intention of "making" a sale, but the sort which is given freely by one radio amateur to another. Of course, if you decide to purchase then you have the knowledge that LOWE ELECTRONICS are the company that set the standard for amateur radio shops and after-sales service. The shops are open Tuesday to Friday from 9.00 to 5.30 p.m., Saturday from 9.00 to 5.00 p.m. and close for lunch each day from 12.30 till 1.30 p.m.

In Glasgow the LOWE ELECTRONICS' shop (the telephone number is 041-945 2626) is managed by Sim GM3SAN. Its address is 4/5 Queen Margaret's Road, off Queen Margaret's Drive. That's the right turn off Great Western Road at the Botanical Gardens' traffic lights. Street parking is available outside the shop and afterwards the Botanical gardens are well worth a visit.

In the North East the LOWE ELECTRONICS' shop is found in the delightful market town of Darlington (the telephone number is 0325 486121) and is managed by Don G3GEA. The shop's address is 56 North Road, Darlington. That is on the A167 Durham road out of town. A huge free car park across the road, a large supermarket and bistro restaurant combine to make a visit to Darlington a pleasure for the whole family.

Cambridge, not only a University town but the location of a LOWE ELECTRONICS' shop managed by Tony G4NBS. The address is 162 High Street, Chesterton, Cambridge (the telephone number is 0223 311230). From the A45 just to the north of Cambridge turn off into the town on the A1039, past the science park and turn left at the first roundabout, signposted Chesterton. After passing a children's playground on your left turn left again (between the shops) into Green End Road. Very quickly, and without you noticing it, Green End Road becomes High Street. Easy and free street parking is available outside the shop.

For South Wales, the LOWE ELECTRONICS' shop is located in Cardiff. Managed by Richard GW4NAD, who hails from Penarth, the shop (the telephone number is 0222 464154) is located within the premises (on the first floor) of South Wales Carpets, Clifton Street, Cardiff. Clifton Street is easily found, being a left turn off Newport Road just before the Infirmary. Once in Clifton Street, South Wales Carpets is the modern red brick building at the end of the street on the right hand side. Enter the shop, follow the arrows past the carpets, up the stairs and the "Emporium" awaits you. Free street parking is available outside the shop.

LOWE ELECTRONICS' London shop is located at 223/225 Field End Road, Eastcote, Middlesex (the telephone number is 01-429 3256). The shop, managed by Andy G4DHQ is easily found, being part of Eastcote tube station buildings and as such being on the Metropolitan and Piccadilly lines (approximately 30 minutes from Baker Street main junction). For the motorist, we are only about 10 minutes' driving time from the M40, A40, North Circular Road (at Hangar Lane) and the new M25 junction at Denham. Immediately behind the shop is a large car park where you can currently park for the day for 20p. There is also free street parking outside the shop.

Although not a shop there is on the South Coast a source of good advice and equipment — John G3JYG. His address is 16 Harvard Road, Ringmer, Lewes, Sussex. (telephone 0273 812071). An evening or weekend telephone call will put you in touch with John.

Finally, here in Matlock, David G4KFN is in charge. Located in an area of scenic beauty a visit to the shop can combine amateur radio with an outing for the whole family. May I suggest a meal in one of the town's inexpensive restaurants or a picnic on the hill tops followed by a spell of portable operation.

For many years.....

I have found much pleasure in slowly tuning a receiver across the short wave bands. I remember discovering that the new wireless, just purchased by my Grandfather, had on it a short wave section. So, after the family had listened to "The Archers" and set about the evening's activities, I was left with the set to myself, able to tune around and listen to the world. I am certain that the thing that fascinated me then is still the same today; the fact that transmissions from such exotic places so far away could be heard in my own surroundings. Perhaps I am a romantic at heart but to imagine the sights and sounds of the countries originating the transmissions was special. I find it difficult to describe the feeling. I have since spoken to many people who have shared the same experience, they too find it difficult to explain.

Since those days.....

things have changed and many receivers have come and gone. When compared with the large pieces of surplus equipment once used by the short wave listener in his shed at the bottom of the garden, today's equipment looks "very Hi-Fi". Most of the receivers carry the description "general coverage" meaning that it will tune without gaps frequencies from around 100 kHz to 30 MHz. Such wide coverage means that not only can you listen to amateurs and short wave broadcast stations worldwide, you can also hear Radios 1, 2, 3 and 4 and Laser on 588 kHz. To the short wave listener this is a great advantage over rigs which only have selected bands. It is usually the band you particularly want that the manufacturer had decided you could do without. The receivers which I now describe are all "general coverage", and I might add are each capable of giving you the satisfaction which I describe above.

the R600.....



TRIO R-600

At the start of the range is the **TRIO R600** which costs **£285.26 including VAT**. This is the receiver for the beginner, the person of limited means or the cynic who does not really believe my enthuse. The R600 is a basic receiver covering from 150 kHz to 30 MHz and having switched upper and lower sidebands, wide and narrow am and cw. It has a 20 dB attenuator and a noise blanker fitted as standard. Operation is simple, select the mode of operation, turn the MHz dial to the correct band and, by using the VFO knob, tune to the desired frequency. The clear digital readout makes station selection simple. The TRIO R600 is an ideal receiver for shack, bedroom or lounge.

LOWE ELECTRONICS

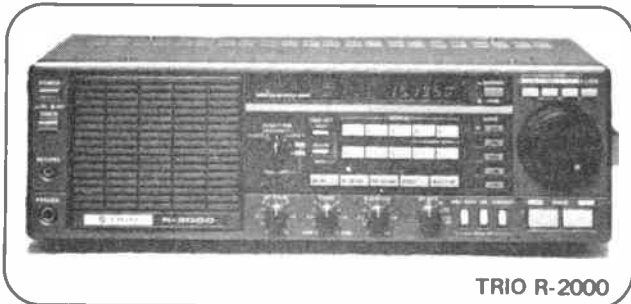
Chesterfield Road, Matlock, Derbyshire. DE4 5LE.

Telephone 0629 2817, 2430, 4057, 4995. Telex 377482.



the R2000.....

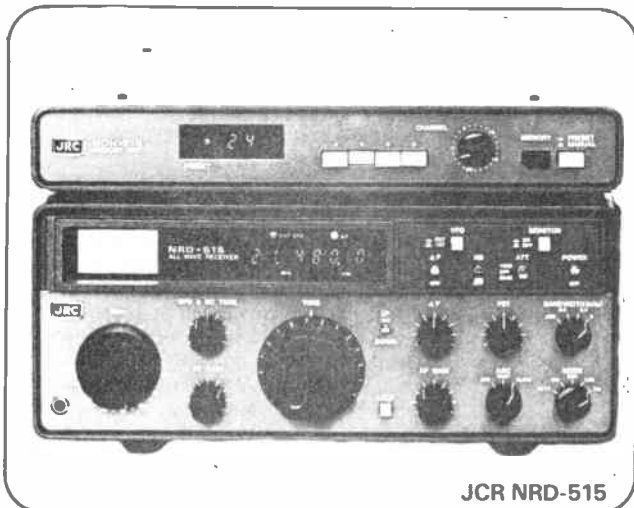
Moving upward from the R600 we find the TRIO R2000. The receiver covers frequencies from 100kHz to 30MHz and has, in addition to the facilities found on the R600, a ten channel memory to hold for quick access your favourite stations. Memory operation is versatile, each memory retaining not only the frequency but the mode of operation. Each memory can be also used as a separate VFO. In addition to AM, USB, LSB and CW the R2000 is fitted with FM which, when used



TRIO R-2000

with the VC10 internal vhf converter, enables the amateur 2 metre band to be fully listened to. Another advantage over the R600 is that the R2000 tunes continuously up the band and not in 1 MHz sections. Three rates of tuning are provided enabling the band to be either searched diligently or quickly "scanned". With the optional VC10 fitted the R2000 adds to its frequency range the VHF section from 118 to 174 MHz and, of course, operates on AM, FM, USB, LSB and CW. Fast or slow AGC can also be easily selected using a front panel switch. Altogether a fine receiver and ideal for today's listener. **The TRIO R2000 costs £456.63 including VAT.** The optional VC10 costs £122.26 including VAT and is easily fitted inside the receiver.

from JRC, the NRD515.....



JCR NRD-515

There are amongst us a discerning few for whom only the best is good enough. For them there is only one receiver: this is the NRD515 manufactured by the JAPAN RADIO COMPANY. The receiver is built to professional standards and is designed to give its owner the ultimate in listening pleasure. Covering 100kHz to 30MHz the NRD515 has pass band tuning, slow and fast AGC and a preselector covering the broadcast bands from 600 kHz to 1.6 MHz. Optional accessories include a 96 channel memory unit (NDH518 £264.00 inc VAT), a remote frequency controller giving keyboard frequency entry, plus an additional four memories (NCM515 £169.75 inc VAT) and a matching speaker (NVA515 £45.41 inc VAT). **The NRD515 short wave monitor receiver costs £965.00 inc VAT.**

and the AR2001....

It is rare to use a piece of equipment so refreshingly new as to be devastating. Although it has been my pleasure to use numerous receivers over the past years nothing has so captured my attention as has the AR2001 from the company AOR. Authority On Radio, AOR, sums them up exactly. In the past there have been several receivers covering parts of the HF/VHF/UHF spectrum but never before a receiver



AR-2001

tuning continuously from 25 MHz to 550 MHz. Never before a receiver having AM, narrow band FM and wide band FM. Never one that could be afforded by all enthusiastic listeners. The AR2001 is the new concept in receiver design combining user friendly controls to aid listening with a carefully designed receiver that actually works. The receiver with its continuous coverage between 25 and 550 MHz enables its owner to listen to a multitude of transmission sources. The provision of three modes, AM, narrow band FM and wide band FM are essential when one considers the variety of information that can be received. AM for the VHF/UHF airband channels, narrow band FM for amateur radio, CB and business radio and finally wide band FM for broadcast and TV sound. Digital frequency readout is combined with visual reminders of receiver state and for night time listening the panel is illuminated. Scanning, memories, memory scan, programmable band scan are all part of the receiver and to aid operating the memory not only remembers the frequency but the mode of operation. **The AR2001 receiver costs £365.00 inc. VAT.**

LOWE ELECTRONICS

Chesterfield Road, Matlock, Derbyshire. DE4 5LE.
Telephone 0629 2817, 2430, 4057, 4995. Telex 377482.



L·E·T·T·E·R·S

YOUNG HAM!

I have been reading *Amateur Radio* since early 1983, and I must congratulate you on an excellent magazine, which is well worth the money every month.

I began attending RAE lessons in September 1983, taking the twenty week course in preparation for the May RAE. I celebrated my fourteenth birthday on the 21st of June this year and in August I received my pass slip. I am now licensed, but have no equipment as yet. Are there any other young hams out there?

I would like to know if there is any software available for the Sinclair ZX81 which can transmit and receive messages (not RTTY), using the simple interface described by Trevor Morgan in the *November* issue. If there is not any software for this, could anyone write any for me? I would not know where to begin!

Could someone also send me conversion details for converting the Microsoft Basic Maidenhead programme for the ZX81.
John Flowers G1HYZ, Lincolnshire

THANKS

Some time ago I wrote to you asking for a copy of reviews on rigs such as the Yaesu 7700 standard (and modified), Kenwood R2000 and the Icom ICR71E. The reviews have certainly helped me decide which of the above rigs not to purchase.

I believe however that despite the 'licking' given to the Icom by your reviewer this eventually will be the rig to be purchased.

A HeInls, Melbourne

RSGB DEMOCRACY

I read the letter *RSGB Democracy* from G3DRN with a mixture of interest and amazement. The fact of the matter is that whilst the RSGB is theoretically a democratic organization, in practice it is quite the reverse. I hope the following will illustrate the point.

1. In any form of democratic election candidates can

publish a manifesto so that voters can decide which candidate will best represent their interests. However, the RSGB Council deny candidates any opportunity to tell members what their views are since only biographical details are allowed. What this means is that, although in theory anyone who has been a member for three or more years may stand for election to the Council, there is a distinct bias in favour of candidates who have been elected previously since these can quote all their past RSGB posts. To put it bluntly the system is one of self perpetuity. New members are not encouraged to stand for election.

2. Although the situation with the Council is bad enough the position of the committees is much worse. The appointment of members of the committees is done by the Council who normally follow the recommendation of the committee chairman! If anyone offers to serve on any of the committees they are inevitably vetted to see if their views are in accord with the existing committee's views. If not they are not invited to join. Note that membership is by *invitation* not election. A clear case of self perpetuating autocracy!

Up to three years ago the RSGB represented approximately 80% of the amateurs in the UK. Despite the soothing tone of this year's annual report from the General Manager as to the growth of membership, the RSGB now represents only 52% of the current licensees! In my opinion the RSGB is in big trouble and an injection of new blood and ideas is essential if the Society is to thrive. The existing 'Old Guard' however, strenuously resists any change with every means at their disposal.

I believe that the survival of the RSGB is vital to the amateur movement in this country. I also believe that it must change in order to survive. Whatever anyone may think about the current state of amateur radio in this country, the RSGB should represent the views of the majority; at the moment it represents the views of those

living in the past. Remember what happened to the dinosaurs who couldn't adapt to change!

P L Crosland G6JNS, Worcester

MISLEADING

I have never before written this sort of letter to a magazine and I expect that after reading this you will just destroy it rather than printing it. However, there are I feel certain things that should be pointed out for the benefit of the prospective RAE candidates among us.

On the whole your magazine is informative and very readable, a very refreshing alternative to the stuffy approach of *Short Wave Magazine* and *Practical Wireless*.

But now to the rub, some of the articles that appear in your pages are, to say the least, misleading, and as a result could spoil the chances of an RAE candidate joining us on the bands.

I call your attention to the articles of Mr Peter Dodson who, although a good writer, seems to be totally misinformed on some aspects of radio theory, and as such should not be allowed to mislead the novice.

In the November issue he has penned a blatant copy of several RSGB diagrams etc and then connected them with a few interesting observations, including the now expected slight on CB operators that many writers in the amateur radio press seem obliged to fall back on for laughs.

Mr Dodson then proceeds to expound a chunk of CB folklore himself. I refer to the old cherry that an SWR meter indicates output power, or the lack of it, which is of course a load of nonsense.

I am not surprised at this because Mr Dodson seems very confused about the whole subject of aerials, SWR, ATUs and power. In fact in the September issue he tells us that 'a high SWR reading indicates lack of radiation, whilst a reading as near as possible to 1:1 indicates the maximum transference of power'. More nonsense.

One can only assume that Mr Dodson's technical library consists of a single volume, '*The Big Dummies Guide to CB*', as he goes on to tell us that 'getting the aerial to resonate exactly as required is the job of an aerial tuning unit' (ATU). Yet more nonsense.

The next little gem is: 'beware, failure to renew an amateur licence (cost £12) requires the retaking of the entire examination'. More nonsense still. He also informs us that the Morse test costs £18, when in fact the correct figure is £15.

Please let me put the record straight. Once passed, the RAE is like any other City & Guilds of London examination, being a qualification for life! If a B licence holder lets his licence lapse then he has only to re-apply and he will get his old callsign re-allocated.

If an A licence holder lets his licence lapse then he will have to retake the Morse test, unless for some reason he took it less than twelve months prior to his application.

Also, a high SWR in itself does not indicate lack of radiation, it only indicates an impedance mismatch between the meter and the ether, which may well have nothing to do with the aerial but could have everything to do with an incorrect impedance of feeder. For example, a 50Ω transmitter output into a 50Ω SWR meter into some 75Ω, 300Ω or 600Ω feeder and then into a perfect 50Ω aerial would cause a high SWR, but the aerial could be itself a perfect match for the transmitter. However, this would not effect the actual radiation of the transmitter and aerial combination because if 100W reaches the aerial then 100W will be radiated; where else could the 100W go? The answer is of course, nowhere.

The purpose of an ATU (better called a transmatch, because that is in fact what it does) is to match the impedance of the aerial and feeder combination to the requirements of the transmitter; its sole purpose is to act as a variable impedance transformer.

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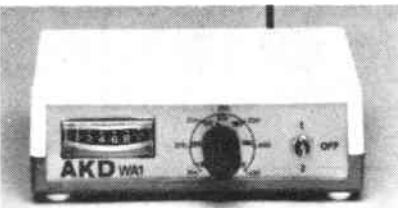
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L·E·T·T·E·R·S

This little box of tricks has no effect on the resonance of the aerial, how can it? It is usually some 20 to 80ft away from the aerial and only connected by a length of fixed impedance feeder.

The only way to correctly resonate an aerial is to do what Mr Dodson tells us the CB type does (obviously they are not that worthy of scorn); that is to make the aerial slightly oversize and trim the elements into resonance. Surely this is the procedure that amateurs have been using for generations? The only difference being that the ham of yesteryear would have probably used a grid dip oscillator (GDO) rather than an SWR meter, and surprise surprise, you still can today. It's just that an SWR meter is, for most of the time, a lot more convenient.

The real reason for the upsurge in the use of SWR meters is because the solid state or transistorised transmitter of today is a lot more load or output impedance conscious than the valve output rigs of yesteryear. Most solid-state rigs today have inbuilt SWR protection, shutting down the power output when badly mismatched into a high SWR load which differs greatly from the designed output impedance. Some rigs are better than others and can stand a short circuit or open circuit for up to approx 5 minutes, but there is a penalty to be paid for such good protection.

When a rig is treated to such a mismatch it has to dissipate all the power as heat, so on a lot of well protected transmitters we find that an SWR of 1.5:1 will cut the output by 25 to 50%.

This is probably where the fallacy about high SWR meaning loss of power originated. As we can see there is only just a grain of truth in it, the rest is down to ignorance.

Still not convinced? Well, let us take an example, a transistorised 28MHz rig running into a 14MHz dipole, ie transmitter impedance 50Ω, coax impedance 50Ω, dipole impedance many hundreds of ohms, and yet the 14MHz half wave dipole is in fact

resonant at 28MHz as a full wave dipole. Result: very high SWR, the Tx shuts down and eventually blows up!

We could insert an SWR meter at the Tx end of the feeder and trim the aerial into resonance but the dipole would then be useless at 14MHz, so what can we do? Simple, insert a transmatch in between the SWR meter and the feeder. Then, by tuning the transmatch up we present the transmitter with a perfect 50Ω load, resulting in maximum power output. There is still a very high SWR on the feeder, but this will not affect the radiated power.

There is just one problem, a high SWR on a coaxial feeder will be likely to cause TVI as a coaxial cable is unbalanced and will radiate when mismatched. The answer to this is not to use a balun transformer at the aerial feedpoint because there would still be a high SWR on the feeder, and it would still radiate. To prevent feeder radiation at all SWR levels just use a transformer coupled transmatch with balanced feeder; there will then be no actual dc connection between the rig and the aerial and any length of dipole can be used on any band provided the transmatch is able to cope with the mismatch.

Result? Maximum power, plus no TVI and yet a possible high SWR. I hope that this will clear up the matter for the RAE hopefuls, and anyone else who has in the past been confused by the folklore of the magic SWR meter.

Why don't you print Peter Dodson's callsign? Or hasn't he got one? If he has not then how is he qualified to write on the subject of amateur radio? Perhaps he is a telecommunications engineer? But then again perhaps not.

It might be a good policy to only print the work of licensed amateurs who will let you quote their callsigns, and also the work of people who are professionally qualified in the field of radio transmission and reception.

Many thanks for an otherwise dynamic magazine.
**Lance Whitelegg G1DJV,
Bristol**

Peter Dodson replies:

First let me respond to the criticisms on my article in the November issue dealing with test circuits.

There was never the slightest intention of presenting my choice as original – in fact the editorial staff went to considerable lengths to obtain permission to reprint the circuits in the magazine.

If Mr Whitelegg would look again at the article he will see that I have used the words '0773' reproduced courtesy of the RSGB from whose publications they have been blatantly filched! Their reproduction was intended, along with those of other authors, to offer a selection of useful tools to the amateur radio fraternity.

Furthermore, I do not consider my remarks about 'breakers' to be in the slightest way offensive and I suspect that it was my reference to CB that touched a nerve. CB is more elementary and (for want of a better word) casual than amateur radio, it is inadequate by comparison and many breakers have transferred their allegiance to amateur radio: so who's laughing!

With regard to Mr Whitelegg's criticism of my remarks about SWR meters, I would say this. Within the framework of 2000 words I attempted to cover the entire spectrum of 'getting started', a subject which, covered in every detail, would fill a very large book.

I am fully aware of the functions of SWR meters and ATUs and maintain that, within the context of the article, as a basic guide the generalisation that 'a high SWR reading indicates lack of radiation etc' is correct. For that matter I failed to mention that a 13 amp fuse is necessary in the mains plug!

Similarly, the use of an ATU is primarily directed towards correct resonance of the antenna system – without launching into the heavy theory which would have been out of place in an article of this nature. I dismiss his remarks about my reading matter as childish.

With regard to the cost of

the amateur Morse test this, in fact, was a typing error on my part and was intended to read as £15. As it happens, we are both wrong, as the correct charge as provided by the City & Guilds head office on Tuesday November 20th 1984 is £16.90!

But credit where it is due, the ever vigilant Mr Whitelegg is correct in saying that failure to renew the 'A' licence does not mean a retake of the examination. My statement resulted from a misunderstanding during a conversation with someone in Chesterfield with regard to 'A' and 'B' licenses.

With such obviously alert watchdogs about, I must double check my information in future! On the other hand, if to err is human, perhaps Mr Whitelegg will find it divine to forgive!

I feel sure that the Editor, Jim Chalmers, would welcome Mr Whitelegg's contributions and, hopefully, he would be able to pen around 20,000 words in a series as I have without making more than one undisputed mistake! Despite every effort towards accuracy journalists are fallible and, by the very nature of their work, set themselves up for public criticism. Whatever profession Mr Whitelegg may follow, it is to be hoped that he is either not open to such widespread – not to say harsh – scrutiny, or that he is always right!

If he insists on talking qualifications, I am a professional, Mr Whitelegg is an amateur. I also hope that he is not a Public Relations Officer!

PLEA FOR HELP

I have just been given an RNB28 receiver, but unfortunately do not have the appropriate manual or instruction book. I am having problems with the gain control and wondered whether any readers of your excellent magazine could give me any information on this gear.

Please send any information to LA Endersby, 3 Glentrammon Gardens, Green Street Green, Orpington, Kent BR6 6JX.

STRAIGHT & LEVEL

All the latest news, comment and developments on the amateur radio scene

USED EQUIPMENT AUCTION

G3RCQ Electronics, after many years of trading in secondhand amateur radio equipment, has launched another service to would-be buyers and sellers of secondhand equipment. The service is to operate alongside 'List-a-Rig' which is an advertising service. List-a-Rig is free to anyone who sends G3RCQ an sae. There is a small charge to enter an ad.

The new service is to be called G3RCQ's Auctions. The auctions will be monthly and conducted in the first instance via post.

Potential sellers of equipment will send details together with a small fee which is returned if the equipment is not sold.

Each month there will be a list of equipment placed in

the amateur radio press.

Further information can be obtained from: David Cole G3RCQ, 65 Cecil Avenue, Hornchurch, Essex.

'MEDIA MONITOR'

A new publication entitled the 'Media Monitor' commenced publication on 9th November 1984.

The eight page newsletter concentrates on short wave radio but it will also include reports on other aspects of electronic media.

The annual subscription is £25 for orders received before 31st December 1984 and single copies cost 50p.

For further information contact: Roger Tidy, 3 Kingsdown Road, London N19. Tel: 01-263 1035.

DEVASTATING

A burglary can be a devastating experience to the victim, but everyone believes that it won't happen to them. In view of this we felt that the following might encourage you all to be more security conscious:

'I recently spent a most enjoyable day helping a friend re-erect his weather battered antenna system. Radio is my second favourite pastime and when this job was completed I spent the 25 mile trip back home in anticipation of a pleasant evening's DX. I find that my XYL's saturation point of irritation with my hobby peaks after about five hours and so I had no fears of retribution in excess of that which I had already let myself in for. But, as is often said, 'The Lord moves in mysterious ways'. My anticipated DX did not take place that evening nor will it for some many weeks.

'As I walked through my front door I heard emanating

from the rear of the house shrieks of anguish from my 16 year old daughter and cries of disbelief from my wife. Rushing through the house, and praying that there had not been an accident, I was greeted with the spectacle of a hysterical daughter and a very pale faced XYL.

'The door of my shack was wide open, my lovely blue carpet covered with muddy footprints and facing me a large empty space usually occupied by my radio equipment. I really couldn't believe it was all gone. This sort of thing only happens to other people. The cold fury I felt towards the perpetrators of this crime can be only appreciated by someone who has had the experience of such an occurrence. My immediate thoughts were 'thank heaven I am insured'.

'The police were called, particulars recorded and the following day the fingerprint chap came along. The chances of recovery are prob-

ably nil.

'My station, my pride and joy, had been a nice set-up comprising of the Icom 740, AT 100, PS15, Microwave Modules 2 metre transverter and linear amp, Daiwa 620 SWR meter and a 24 amp power supply. The thieves left my portable cassette recorder and TV but included in their haul 2 copies of *Amateur Radio*. I have little doubt that the thieves were very familiar with radio equipment and it galls me to think that one day I could be in QSO with my own gear.

'The theft took place at dusk between 6 and 8pm in a converted garage which is usually padlocked at the rear and just a few feet away from my kitchen door. The house was occupied during the entire day. Make no mistake, there are clever thieves around who have an interest in clearing out *your* shack as soon as the opportunity presents itself. Out of my own experience I offer you the following advice.

1. Get insured by a specialist company, I use the scheme offered to RSGB members and advertised in their magazine by Cornhill Insurance Ltd. At the moment I am optimistically awaiting' the

outcome of my claim.

2. If you have means of security, don't keep it for decoration, use it all the time.

3. Keep all your bills and serial numbers in a safe place and don't throw them out when the guarantees expire.

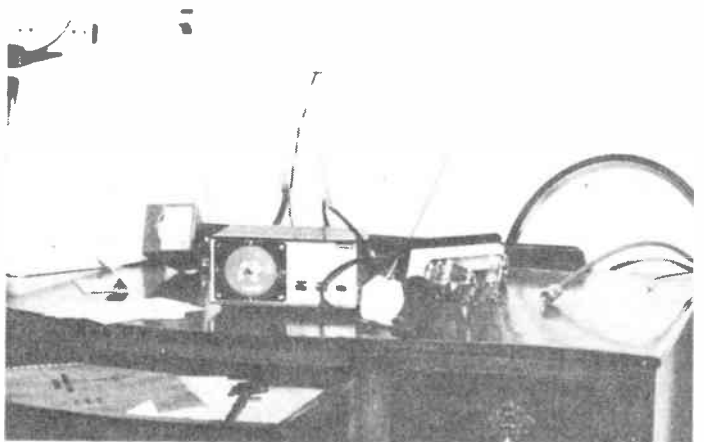
4. Get your local police to come and engrave your gear with a security number. This service is now offered free at your request.

5. If your shack is an out-house get it fitted with a burglar alarm system. I have now, and yes I do know about bolting horses.

'It is difficult to hide a radio station if you use a large antenna and I am looking for ideas on mounting my three element tribander underground! BCNU I hope. 73 G4XEW.'

NEW YAESU TRANSCEIVERS FT2700R

Practically two transceivers in one case, the FT2700R is designed to be the ultimate in convenience for FM mobile and base operation on the 2m and 70cm bands. Utilising Yaesu's new one piece die-cast aluminium chassis concept for optimum circuit shielding and efficient heat dissipation, this is the first



transceiver of its size designed to easily handle 25 watts continuous power output in full-duplex crossband operation (of course 3 watt low power operation is also switch selectable).

Two 4-bit CPUs provide simple and convenient control of 10 memory channels, dual VFOs and two calling frequencies, with lithium cell backup. Dual independent receiver front ends, local synthesizers, IFs and transmitter RF stages make this the first mobile transceiver of its kind, capable of true full-duplex (bi-directional) communication when using both bands.

Convenient tuning and scanning features include Yaesu's 'PMS' (programmable memory scan) system, which permits scanning (or skip-scanning) between two memory channels in the same band, a MHz stepping switch linking both bands, and priority channel checking while operating on another band or frequency.

Independently programmable transmit and receive frequencies (as well as automatically programmable standard shifts) plus one-touch reverse allow the operator total freedom in all kinds of repeater operation. A burst tone generator is built-in, and when the optional FTS8 tone squelch unit is installed, any of 37 standard CTCSS (sub-audible) tone frequencies can be displayed, selected and programmed into the memory channels for either silent monitoring or encode-only operation.

A deluxe scanning microphone is supplied with the FT2700R.

FT270R/RH

The FT270R/RH's extremely rugged construction includes a unique diecast aluminium duct-flow heat sink, which serves as the main chassis for the transceiver. This innovative design technique results in a 45 watt transceiver smaller than competing designs of much lower power capability.

The FT270R provides 25W RF output, while the RH version provides 45W in the high power mode. The 'Low' switch on the front panel allows reduced output power, 3W or 5W, respectively.

The FT270R/RH utilises an easy-to-read backlit LCD that

indicates frequency or CTCSS tone information in large 5mm digits for quick recognition. The latest wide-angle LCD and green illumination for the display assure good readability.

The voice synthesizer provides an easy-to-understand aural indication of frequency, memory channel number, VFO selection, and CTCSS tone (FTS8 option required). Ideal also for the visually impaired, the FVS1 may be turned on and off via a bottom panel switch as required.

The optional FTS8 CTCSS module allows independent tone frequency and mode programming for each channel. The CTCSS tone plus encode-only or encode/decode selection are easily programmed from the front panel.

South Midlands Communications Ltd, S M House, Rumbridge Street, Totton, Southampton SO4 4DP.

1985 RANGE

R Withers Communications will shortly be marketing a modification kit to convert any current FM CB transceiver which uses the Sanyo LC137 IC to the amateur ten metre band. The kit uses six chips and five wires and will retail at approximately £15.

RWC have also released details of their 1985 range of VHF/UHF power amps designed to match handheld or portable, two metre or 70cm transceivers.

All units feature Mitsubishi or Toshiba RF power modules and have RF relay changeover, switchable SSB/FM hang time and status indication using LEDs.

Input is factory adjustable from 100mW to 5W: the units are set up for input of 1/2W but other drive levels can be set to order.

At present the range available covers eight models with prices from £39.50 and all the amplifiers carry a twelve month guarantee.

For further information contact: R Withers Communications, 584 Hagley Road West, Oldbury, Warley B68 0BS. Tel: (021) 421 8201/2.

'PROFESSIONAL AMATEURS'

An interesting proposal has come in from Martyn Thompson G1KIA concerning

mobile operation:

'I personally spend a good deal of my time on the road, and encounter a large number of amateurs who are, like myself, HGV drivers or otherwise employed in service or sales related fields.

'The idea of forming some kind of association was not, I must admit, wholly my own. It started some weeks ago when in QSO with a small group of mainly HGV drivers through the Motherwell repeater GB3CS. Another station suggested that we form our own club for 'Truckers', not a term I relish, but it started the seed of an idea.

'A few weeks later when in QSO through the Barnsley repeater GB3NA, again with a group of mostly HGV drivers, the idea of a giant repeater for HGVs was joked about. I promptly passed on the idea of our own association.

'The idea was received with an enthusiasm I did not expect, the only change to the original idea being the inclusion of 'all' professional drivers, ie anyone who spends his, or her, working hours at the wheel.

'The outcome of this discussion is this letter, in order to feel the ground as it were. Although it is not intended to be too formal in structure any ideas etc from any amateurs interested in such an association would be most welcome.

Initially write c/o: PO Box 122, Earls Barton, Northampton, NN6 0DE (please enclose sae).

'Lastly I would like to thank some of the stations involved in the various discussions on this subject over the air: G6VYC John, G1EPP Peter, G1EAN Alf, G4XQV Terry, G6LLM Keith, GM1FHF Archie, with apologies to any I forgot'.

ANTRIM DISTRICT ARC

The Antrim District Amateur Radio Club is inviting all radio amateurs and short wave listeners in the area to join.

The club holds a licence (callsign G14SIW) and in 1984 operated several special event stations under the callsign GB2AAD (Antrim and District).

They have arranged a number of interesting lectures and presentations in the past and are looking for fresh ideas. The next AGM is on

Monday 11th March 1985 and if you are interested in joining the club they can be contacted through the PO Box used for direct QSLs to club members.

For further information please write to: Antrim District Amateur Radio Club, PO Box 3, Antrim, Northern Ireland.

BROMSGROVE ARS

Formed in May 1983, the Bromsgrove Amateur Radio Society (G4TUI) meets at 8.00pm on the second and fourth Tuesdays of the month at the British Legion Club, Birmingham Road, Bromsgrove, Worcs.

In addition to normal club activities, the society specialises in outdoor demonstrations and special event stations generally promoting the further interests of amateur radio in the area.

The current membership, now standing at about twenty-five members, sports a wealth of interests across the broad spectrum of amateur radio, with activities including RTTY, ATV and microwave. New members and visitors are, of course, welcome and must usually be 'sponsored' by an existing member if wishing to join the society.

A monthly newsletter, 'QRV', is published by the society to which members may contribute written articles which they feel may be of interest to other members. A 'Sales and Wants' section is also included.

At the time of writing a full itinerary of events is being prepared for 1985 and will be published at a later date.

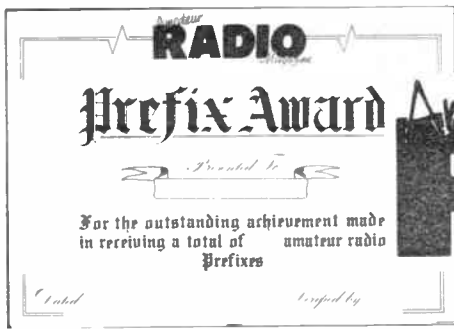
For further information on society activities and forthcoming events contact: The Secretary, John Rowlands G4OJS, 70 Braces Lane, Marlbrook, Bromsgrove, Worcs. Tel: (021) 445 3207.

CORRECTION

In last month's *Amateur Radio* the article entitled 'Building Loaded Vertical whips using CAD' contained an error in the program printed on page 31.

Line 390 should read: PRINT "CENTRE LOADING COIL ="; LB; "OH" and not; "CB;" as printed. We hope this has not caused you any inconvenience and apologise for the mistake.

NEW FOR 1985



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The opening date is 1 January 1985 and further details are available in *SWL* (page 37)

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Gold	21	50	60	1200 Km
432 MHz				
Bronze	5	15	15	400 Km
Silver	10	25	30	600 Km
Gold	15	40	45	900 Km
1296MHz				
Bronze	3	10	10	300 Km
Silver	6	15	20	500 Km
Gold	9	20	30	700 Km

The opening date is 1 January 1985 and further details are available in *On the Beam* (page 44)

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OR IC271E (rrp now £699) £699 — fitted with FREE Mutek RPCB271ub Front-end.	
IC745 (rrp now £898) AN ASTOUNDING £799 (microphone included).	
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DX DIARY

News for HF operators compiled by Don Field G3XTT

When writing a column such as this, it is difficult to know the level at which to pitch the information I provide. On the one hand I like to keep you informed about the latest DXpeditions to remote spots. On the other hand I am conscious from letters I receive personally and from others I see in the letters page that many readers are still struggling to work, for instance, their first Japanese or Australian station.

In view of this I would like, for part of this month's column, to address the relative beginners to HF operating. These may include those of you who have come into the hobby from CB, or others who have been licensed for some time but active only on the VHF bands. Either way, the freedom of the HF bands can be both stimulating and frightening. Stimulating because it opens up the possibility of worldwide contacts almost around the clock, but frightening because there is so much to learn about propagation, foreign call signs, band planning and so on.

Indeed, it never ceases to amaze me that dealers seem to prosper through the sale of HF transceivers, and yet there are relatively few UK amateurs to be heard on the bands, especially in the evenings.

Antennae

I am sure that all would-be HF operators recognise the importance of an effective antenna, although they do not always understand which qualities they should be look-

ing for. Obviously HF antennae are of such a size that an HF version of your 16 element 2 metre beam is out of the question. This need not be a cause for alarm. I worked my 5 band DXCC and my first 200 countries from a tiny suburban garden and achieved great satisfaction in doing so.

Specific interests

If, however, you are short of space then it is essential that you use it to the best advantage. This means thinking long and hard about exactly what your interests are and maximising your antenna system to suit those interests.

As an example, suppose your interest was in achieving the Worked All Britain Award. Your attention would need to be concentrated on the low frequency bands (probably 40 and 80 metres) and you would be aiming to maximise the high-angle radiation from your antenna on those bands (the steeper the angle at which the radiation leaves your antenna, the less distance it will have travelled before its reflection returns to earth). For such an application a low dipole (half-wave or G5RV) will probably suit admirably.

Real DX

If, however, your aim is to work over long distances, regardless of band, some different factors come into play. At the peak of the sunspot cycle I would recommend 10 or 15 metres for DX working. They are less crowded than 20 metres, and the wavelengths are short enough that a beam antenna

(perhaps one of the various mini-beams currently available) can be squeezed into all but the smallest gardens.

Unfortunately, we are now well past the peak of the sunspot cycle and propagation will be in the doldrums for the next 5 years or so. During this period 20 and 40 metres will be the most reliable bands for long distance working.

20 metre antennae

Suppose, then, you set out to work DX on 20 metres. Do you have room for a directional antenna? If you want to work only to one part of the world (eg to keep skeds with a friend in South Africa) then consider putting up a wire beam. If you have some suitably located trees plus perhaps a mast on the house such an antenna can be put up easily, will work effectively, and will be almost invisible except after a sharp frost. I have had considerable success with wire beams for both 20 and 40 metres cut to the dimensions which can be found in any reputable antenna handbook.

As far as rotary beams are concerned, my own experience is that the various mini-beams are practically worthless on 20. They are far too small in respect of a full-sized antenna to be at all efficient, and a wire dipole will probably give much better results and do away with the need for a rotator.

As a general rule of thumb, any antenna less than two-thirds of full size, whether we are talking about a beam, a vertical or whatever, is likely

to be very inefficient unless extreme care is taken in the way it is fed. I have long been convinced that there is a market demand for an in-between size of beam, smaller than full size, but still large enough to be reasonably efficient. Designers and manufacturers of 40 metre beams have long since taken this on board, but although designs for a compact 20 metre beam have appeared in some of the US journals, I have not yet seen a commercial product which fits the bill.

Roll your own

Having said my piece, perhaps I should add that, on the whole, I believe amateurs should make their own antennae. Tuned traps, such as those found on tri-band beams or on the commercial multi-band verticals, are hard for the home-brewer to make effectively. This is where the decision to stick to one or two bands can help.

A single-band beam can be put together quite easily using suitable lengths of aluminium tubing bought from the local dealer. So can a simple vertical antenna. What is more, on the band concerned it will probably outperform the commercial multi-band competitors. This is because, firstly, it can be optimised for the band concerned and, secondly, that even the best-made traps are lossy to some extent.

When planning your aerial farm there are plenty of other antenna configurations you could use. In the 20 metre example, for instance, those not wishing to go to the

trouble and expense of a rotatable antenna might find that a vertical of some sort or perhaps a delta loop would be worthy of consideration. I hope in future columns to take this discussion further. I have in mind discussion of the principles which underlie the choice of antenna system for a particular location. If, however, it would be useful to readers to have design details of specific antennae, then please let me know and I will see what I can do.

Mellish Reef

The October expedition to Mellish Reef appeared on the bands on October 26th using the callsign VK9MR. In five days of operation the group managed about ten thousand contacts, including a major effort in the CQWW Contest. Unfortunately they had to leave the Reef rather earlier than expected, which meant that many amateurs (including yours truly) failed to get them in the log. Despite this, they were worked in the UK on 15, 20 and 40 metres.

The reason for the early departure was that high tide was retreating day by day until there was a real danger that the group would be marooned on the reef for anything up to one month. This was something the group had failed to appreciate when they selected their anchorage and operating location, and was all to do with the phases of the moon. The Australian group who went to so much trouble to put VK9MR on the air realise that there are many disappointed amateurs who failed to catch them and are already talking about a possible return to the Reef next autumn.

Mellish Reef lies about 350 miles out beyond the Great Barrier Reef and covers many hundreds of square miles of ocean. Much of it is, however, submerged, which makes it a rather difficult area to sail around because parts of it lie only just below the surface. In view of this we can sympathise with the decision to leave early which the recent visitors made but I, for one, am certainly keeping my fingers crossed that they can make the return visit.

News from the USA

One or two items fall under this heading. Firstly, you will recall that in the July column I

mentioned the 4U1VIC station at the Vienna International Centre. At the time I said that DXCC country status seemed very unlikely. News is now in that the Board of the ARRL has ordered the DX Advisory Committee to review its decision on 4U1VIC by January 20th at the latest. This stems, it seems, from political pressure being applied to the ARRL from outside. We shall have to wait and see what the outcome is, but a decision to make 4U1VIC a new 'country' could, conceivably, open the door for country status for a host of other UN sites around the world.

10MHz stateside

Also from the USA comes news that the entire 10MHz band is now available to US amateurs who were previously restricted from using the segment 10109-10115KHz. As far as the 18 and 24MHz bands are concerned, however, it looks as though it will be at least 1989 before these bands are released to our American brethren.

GB4DIS

Early in 1985 the Royal Research Ship *Discovery*, operated by the Natural Environment Research Council, will be in the Antarctic waters of the Scotia and Weddell Seas to carry out geophysical research. For part of the expedition the team will include three radio amateurs; Charlie (GW4SBB), Dave (GW4JAD) and John (GW3RNP).

They will join the ship at Punta Arenas (Chile) at the beginning of February and have been allocated the callsign GB4DIS/MM to use until the ship returns to Montevideo on 12th April. It is conceivable that a brief operation may take place from South Georgia, where the ship will call between 7th and 9th March, in addition to the /MM operation.

The operators will be using an FT102 transceiver, with dipole antennae. UK stations should look for them especially between 1800 and 2000GMT on either 14023 or 14123KHz. A special QSL card will be sent out for all contacts.

Those of you who are keen to improve your CW abilities might like to know that the Royal Naval Amateur Radio

Society transmits a Morse proficiency test on the first Tuesday of each month starting at 2000 hours local time. The frequency used is 3520KHz, and the callsign is either G3BZU or GB3RN. The test consists of three-minute passages of plain language text at speeds of 15, 20, 25, 30, 35 and 40 words per minute, calculated on a basis of 5 characters per word.

A certificate is available for 100% correct copy at 20wpm and endorsements are available for the higher speeds. A charge of 50p is made for the basic certificate, endorsements require only an sae. In each case apply to *P Bowen G3TSL, 34 Jubilee Road, Waterlooville, Hants PO7 7RD*. These transmissions have been going now for many years and are a useful addition to the nationwide slow Morse transmissions programme run by the RSGB. Why not have a go?

CQWW CW

I am writing this column on the Sunday of the CQWW CW Contest. Propagation seems to be on a par with that which we had in the SSB event, with some of the best DX being found on the LF bands. 40 metres in particular has produced astounding signals from the Caribbean and South America as well as a nice bonus in the form of 5H3BH, a special contest activity by SM0DJZ and SM0AJU from Tanzania. I worked this last one at 0216GMT.

80 metres gave me contacts last night with, once again, a range of Caribbean stations including FG/K3VW/FS7 from French St Martin. Imagine sending that on CW! The reason for such a strange callsign is that ITU rules currently recommend that reciprocal calls start with the prefix of the host country followed by the home call.

In the case of St Martin, however, the French authorities consider the island to be part of the overseas department of Guadeloupe, and FS is an unofficial prefix which has been used by amateurs over the years to distinguish what, for DXCC purposes, is a separate country. Thus FG/K3VW to satisfy the authorities, followed by an unofficial suffix to indicate the DXCC country!

To my mind 160 metres once

again proved to be the most interesting band of the contest. During Saturday night I heard 44 countries and 11 zones, including such exotica as FY0GA (French Guiana), HH2VP (Haiti), S22COT (special Greek prefix to celebrate the Chess Olympics at Thessaloniki, QSL to SV2SV) and YV3AGT (Venezuela), as well as many US and Canadian stations.

G3LCS is now operational as A61AA and expects to be there for two years. He will, however, be back in the UK over the Christmas period. His favourite spot seems to be around 21240KHz on Wednesdays and Sundays.

Plans are now forming for a renewed attempt to put Clipperton Island on the air. The group expect to depart from San Diego on March 27th and return on April 18th. There may be a brief operation from Revilla Gigedo (XF4) en route. It is anticipated that the cost of the expedition will be around 60,000 dollars.

Finally, OH6PU reports that there is now a dial-up electronic mailbox in Finland for DXers. The telephone number is: 358 41211562. The bitrate is 300 baud, even parity, with one stop bit.

Contests

My personal favourite in January is the CQWW 160 CW which starts at 2200GMT on Friday 25th January and runs to 1600GMT on the Sunday. The French CW contest (80-10 metres) takes place over the same weekend, starting at 0600GMT on the Saturday (see *G3TXF in this month's AR for more details*). A number of other interesting contests also take place in January including the RSGB's AFS, 40, 80 and 160 metre SSB events organised by the American '73' Magazine, and the Hungarian DX Contest.

If contesting doesn't suit you, then why not set some targets of your own for 1985? How about aiming for a particular award, building a QRP transceiver, reaching that 200 countries target? Why not write and let me know? After all, if you make the target public you will have a greater incentive to achieve it!

My new address, with immediate effect, is *105 Ship-lake Bottom, Peppard Common, Henley-on-Thames RG9 5HJ*.

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 IS 921..... 10p
 IS 3011a..... 10p
 IS 3072a..... 10p
 IS 5024a..... 50p
 IS 5030..... 50p

ITT 210..... 10p
 ITT 921..... 10p
 ITT 923..... 10p
 ITT 1075..... 10p
 ITT 2001..... 10p
 ITT 2002..... 10p
 ITT 4150..... 10p

ZE 1.5..... 10p

ZF 3..... 10p
 ZF 3.3..... 10p
 ZF 4.3..... 10p
 ZF 10..... 10p
 ZF 11..... 10p
 ZF 12..... 10p
 ZF 15..... 10p
 ZF 33..... 10p
 ZF 43..... 10p
 ZF 47..... 10p
 ZF 82..... 10p

ZPD 3.9..... 10p
 ZPD 4.7..... 10p
 ZPD 5.6..... 10p
 ZPD 10..... 10p
 ZPD 47..... 10p

ZPY 6v2..... 10p
 ZPY 12..... 10p
 ZPY 12..... 10p
 ZPY 16..... 10p
 ZPY 24..... 10p
 ZPY 43..... 10p
 ZPY 47..... 10p
 ZPY 56..... 10p

ZTE 2..... 10p

ZTK 22..... 10p
 ZTK 33..... 10p
 ZTK 33a..... 10p

ZW 13..... 12p
 ZW 27..... 10p
 ZW 4.3..... 10p
 ZW 310..... 10p

ZX 68..... 30p
 ZY 47..... 10p
 ZY 72..... 10p

AA 113..... 10p
 AA 119..... 8p
 AA 144..... 8p

BA 102c..... 10p
 BA 157..... 8p
 BA 159..... 8p
 BA 173..... 8p
 BA 182..... 8p
 BA 201..... 8p
 BA 202..... 8p
 BA 243..... 8p
 BA 248..... 8p
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BAW 21..... 10p

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BRC 83c13..... 10p

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 BUY 71..... £1

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 T 6036..... 30p
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 T 6051..... 40p
 T 6052..... 40p
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13cms: GETTING STARTED

Angus McKenzie G3OSS

I suppose I have reacted in the past partly with jealousy and partly with fascination when I have listened on 70 or 23cm to crossband QSOs with 13cm from other stations before I, myself, took the plunge to go on the band. It was always a little infuriating if some strong rare DX station disappeared from 23cm up to 13, not to reappear, resulting in my tearing my hair out as I lost a rare square!

Unless you are a plumber or an aerial genius you may find it difficult to make a 13cm antenna for yourself which will compete well with the all too few commercially available products. As far as construction goes I am fairly useless with my fingers, and Chris Bartram of muTek supplied me with a 1.2m dish from Sweden covered at the back with chicken wire and fitted with a superbly made dish feed and dipole.

Once you have purchased or made an effective aerial, somewhat surprisingly, half the battle is over, the remainder being to convince one's bank manager and 'other half' that the expense of a transverter is well justified. Some are fortunate enough to have green fingers and, whether by hunch or not, seem to be able to make their own transverters to give an output at 2320MHz without aggro.

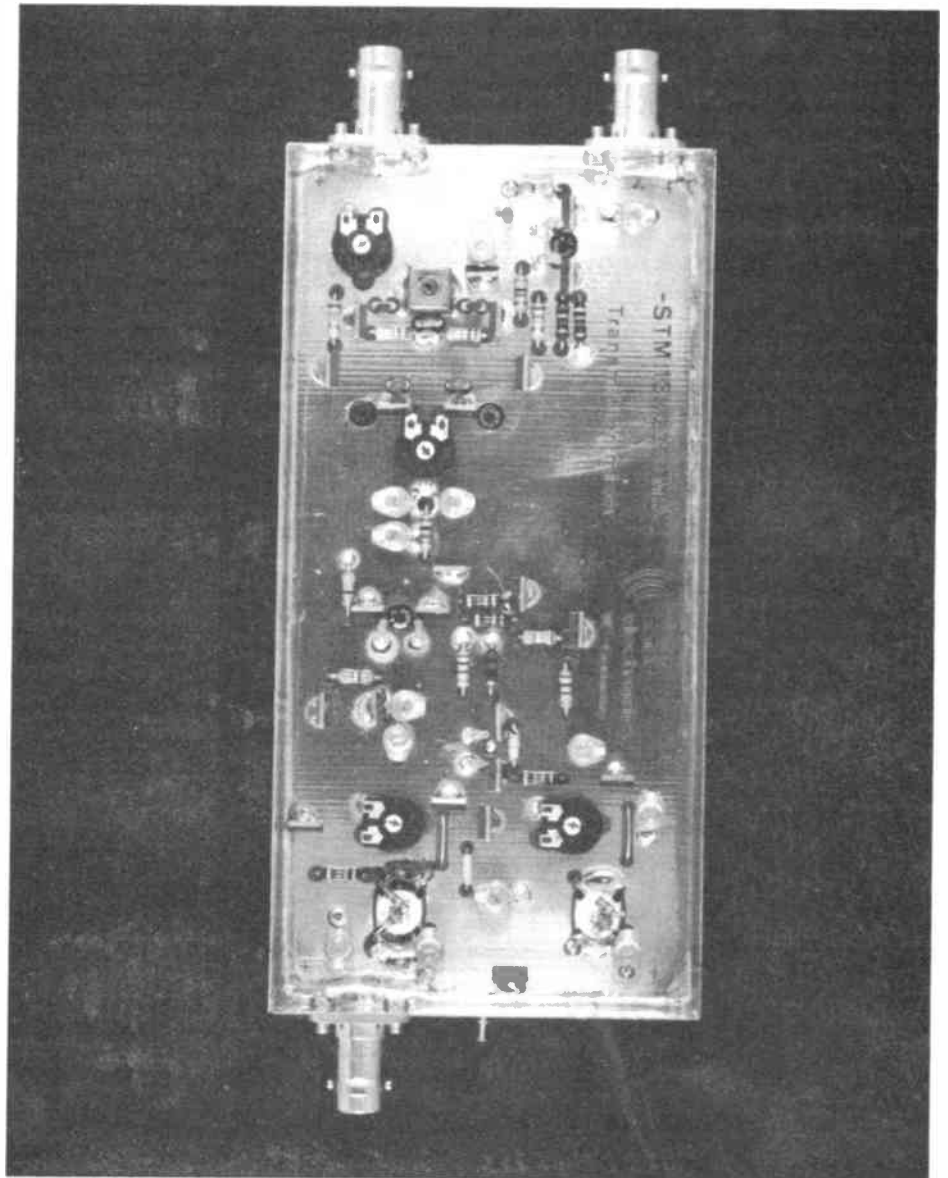
Transverter

I decided to go the SSB Products' way and purchase the transverter, which is supplied in three separate parts: the transmit mixer and output stage, the local oscillator with outputs to feed the transmit and receive mixers, and the receive converter. The intermediate frequency is at 144MHz and this transverts up to 2320MHz, the conversion being very broad-banded.

The local oscillator, type SL013, requires a nominal 13-14.5V dc, and gives outputs simultaneously on two BNC sockets of the correct level to drive the mixers. It is recommended that the oscillator is kept running all the time the equipment is in use, and even on occasions when you are *likely* to want to use the equipment. This keeps drift down to a minimum during periods of operation, as it does take many minutes to stabilise. Let's have a look at each individual part of the transverter with its specifications.

The transmit converter, STM13, costing £98.90 inc VAT, has BNC sockets for 144MHz input and 2320MHz output. The input has a drive level potentiometer allowing a range of input levels to give full output of around 500-600mW. This allows input levels from 20mW up to 500mW to be catered for. The input impedance will vary between a maximum of 100 ohms down to around 50 ohms dependent on the position of the pot. The slider feeds a transformer whose balanced output feeds directly into the double balanced mixer, two BFR91A NPNs being used here.

The 2176MHz local oscillator injection at a level of approximately 20mW after



amplification is fed to both bases in phase, and the outputs from the mixer then feed through to the output amplifier which includes four devices, an S3030 dual gate FET driving an MGF1200 GaAsFET. The latter drives a BFQ34 NPN which then drives the output PA which is another BFQ34. The transmit converter also includes a 10dB gain FET to lift the local oscillator input level from 2mW to 20mW, the device being another S3030 dual gate FET. 13-14.5V dc is all that you have to add to get the thing working.

The local oscillator, SL013, £58.30 inc VAT, starts with a 90.667MHz overtone crystal oscillator which uses a U310 low noise FET. This frequency is trebled up to 272MHz, and then feeds through a series of doublers up to the output stage at 2176MHz. The two outputs are fed separately from different sections of the tuned output line which is driven by a BFR91A NPN transistor. An integrated

circuit regulator is provided so as to get an extremely stable dc voltage on the crystal oscillator.

The receive converter SRM13, £58.30 inc VAT, takes the input RF at 2320MHz into an MGF1200 GaAsFET. The pre-amp output feeds into an active mixer employing the same device, via an interdigital filter which is present to cut out any image noise from the pre-amp and earlier masthead stages that may be added. The image frequency is at 2032MHz which is probably of no interest! The output from the mixer is taken directly to the 144MHz output socket, another BNC.

Gain

The converter has just enough gain without a masthead pre-amp for its noise to overcome the input noise of a reasonably good 2m rig RF input, and a Microwave Modules or SSB Products

converter would most certainly be good enough for the noise figure not to be degraded. In the remote chance of there being several strong stations on the band, the fact that the converter has just enough gain (20dB), will be an advantage in avoiding RF intermodulation products, but I have yet to hear more than two stations transmitting simultaneously on 13cm! The local oscillator input is at a level of around 1.25mW, which is a fairly low level although it seems adequate. A supply of 13-14.5V dc is required by the receive converter.

Piper Communications, the importers of both SSB Products and EME Equipment, can supply a very high quality relay with N-sockets, which is energised with 13V. This can be fitted with two changeover contacts, which can switch the dc supply through to either the Tx or Rx converters. The other pole can be used to switch 13V separately to the solid-state linear, or this could be commoned with the Tx converter leaving the other pole free to change over a valve linear.

A few months ago SSB Products introduced a solid-state linear booster which was specified to give an output of 4W, SLA13, £135 inc VAT. The dc working voltage is recommended to be in the range 13.8 to 14.5V dc. This amplifier uses an input device type BLU99 which drives two similar devices which form the PA output. Pre-sets are provided for setting quiescent currents, driven from a stabilised 5V supply, which is also in the linear. Input and output connections are on N type sockets. The linear is fitted with a healthy heatsink, and takes 2A under full output conditions, so you will have to bear resistive losses in mind on the dc leads if you use it at masthead.

Subjective trials

I can well remember my very first contact, having set up the system without the SLA13 amplifier. The 600mW output from the transverter, checked with an EME UHF LVR power meter fed through the relay and via 25 metres of Pope coaxial cable to the 1.2m dish placed at only 3m above ground level in my back garden. The 2m drive power was obtained from a 28/144MHz Microwave Modules transverter feeding through an attenuator to the transmit converter input. The 2m transverter was run at about 1W output PEP. For convenience, the receive signal was fed into an FT290 with the muTek front end.

I telephoned G3JXN, John Tindall, who transmitted a very strong signal indeed at me, which, to my delight, I received within a matter of seconds. He was well over S9, despite the Pope cable having an estimated loss of around 10dB, the SSB Products converter noise figure being specified at 2.8dB with an overall gain of 20dB. We spent much time fiddling with the dish feed to obtain optimum gain and found that the dipole position was not too critical on the centre axis, a movement of around 1cm giving only a very small gain change.

John's QTH in Ealing is around 13Km away and almost line of sight. I could not have been putting more than around 50mW into the dish and my signals were around 5 and 8. This was most encouraging and so a few days later, having found a niche on the main aerial mast above the house for the dish, Mike, G1DEW, put the dish up and connected it through with the Pope cable, in a lunch-hour. We tried again in the evening and reports became '5 and 99+'. It was thus fascinating to see the remarkable difference between reports from 10ft and 40ft above ground level.

Low power

I had many QSOs at this very low power with stations around London; the best DX was G8TFI in Gloucestershire and one solitary PA0 who only just heard me. The next step was to add the SLA13. We built this into the plastic box containing the transverter and relay which was, again, at the shack end.

I fully appreciate that I would have achieved better results by putting the water-proofed box at the masthead but, as I intended to add a valve linear and use much better coax, I decided to plan for the entire equipment to be at the shack end.

The solid-state linear, even running at 14.5V dc, would only give an absolute maximum of 3.5W, but with the loss of the relay and short cable, only around 3W was achieved into the aerial coax. I thus reckoned that I could not have been running more than around 300mW into the dish. This greatly improved reports though and I began to see what the band could do.

The next step was to change the Pope cable for Andrews LDF5-50, an amazingly low loss heliax which resembles an incredibly stiff hosepipe. After much pushing and shoving, my colleagues managed to get this through a bug hutch cover in the shack roof provided for cable entries and right up to the platform underneath the dish, connecting with a very short length of UR67. The Andrews gives around 2dB loss and the UR67 length around 2.5dB with connectors, so I am now probably getting around 1W into the dish.

13cm DX

DX contacts have been quite numerous and I have obtained quite good reports on SSB from G3AUS in Devon, who I reckon I can work virtually any time, G8TFI in Gloucestershire and G4KDH in Hockley, Essex.

During a contest a few months back I worked GW and South Yorkshire, and yet more PA0s, but my best DX so far was in the very remarkable north/south tropo duct on Monday, October 15th when I was delighted to work G8PNN in Northumberland at 5 and 1. On that evening I first heard the Leicester Beacon and was amazed to receive it at 5/9.

I must here declare my dismay that there is still, at the time of writing, no 13cm beacon anywhere near London,

though one is promised shortly. I am very much of the opinion that beacons are vitally necessary on microwave for amateurs to tune up their receivers, for who can afford a signal generator at 2.3GHz? Many are the times when amateurs have spent hours trying to readjust their receive converters on 23cm because they could not hear some beacon or another, and too late have discovered through a desperate telephone call that the relevant beacon is off the air!

The conditions on 13cm are absolutely fascinating, for whilst virtually all signals from stations within a radius of 30Km or so are likely to be incredibly strong, DX signals are subject to far greater and more frequent QSB than on lower frequencies.

There is no doubt that some propagation modes which are fairly significant on 23cm are much more so on 13cm, including bouncing off friendly jumbos, troposcatter, and even reflections from clouds. It is very surprising how many 13cm DX contacts have been made in just enough time to capture an aircraft reflection, and this is all part of the fun. Of course, 13cm today is a very esoteric band, but so was 70cm twenty years ago, and 23cm is now becoming extremely popular.

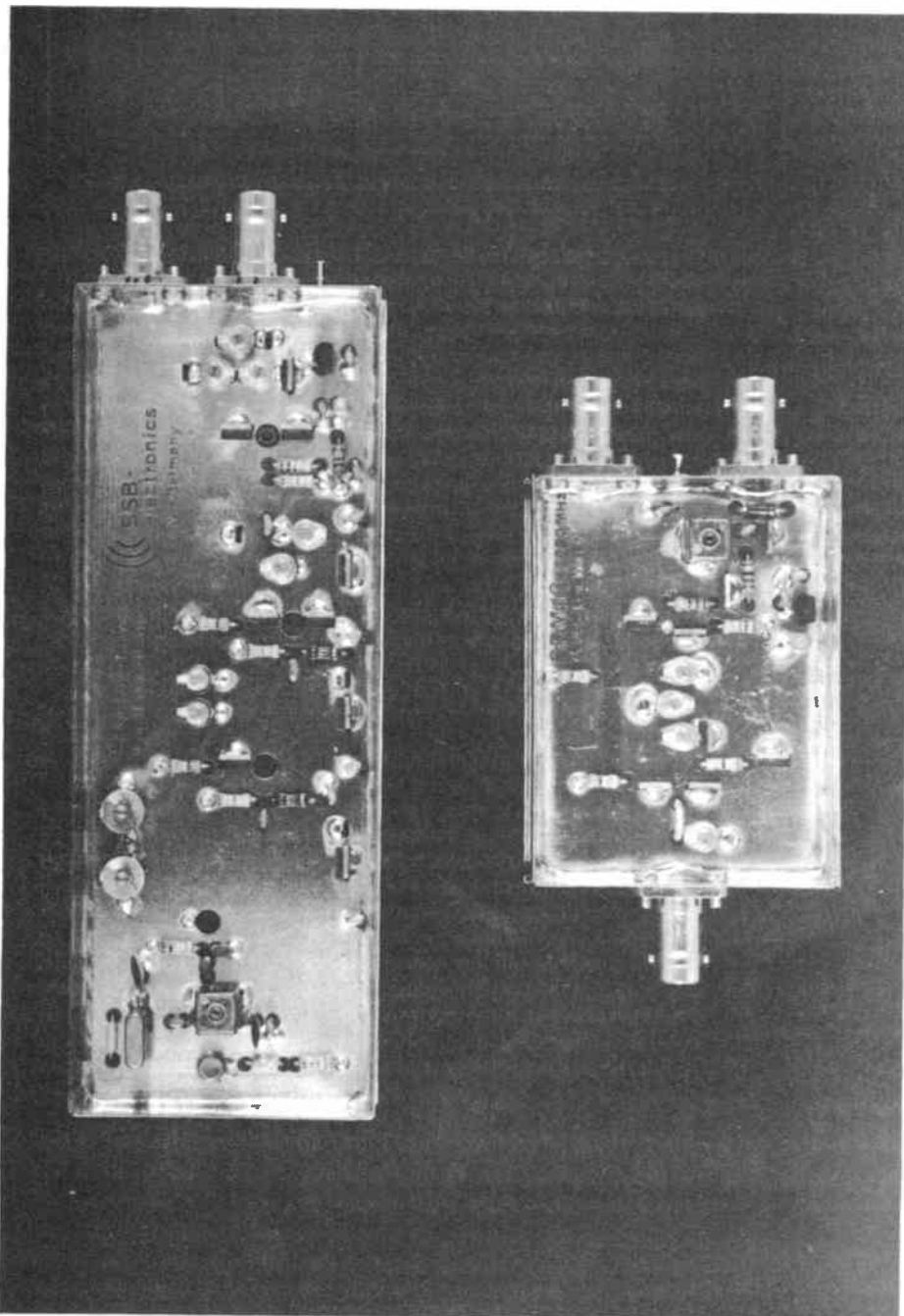
The band allocation now runs from 2310 to 2450MHz, the band being granted on a secondary user basis. Above 2400MHz we have been warned to expect interference from ISM (Industrial, Scientific and Medical) allocations including the inevitable microwave ovens. I have even heard it suggested that you might try coaxial cable drilled through the walls of your oven to a pick up loop and try it on the band with CW by turning the mains on and off very slowly! Perhaps the main use for this non-recommendable system would be for cooking birds in passing for a *cheep* Sunday lunch!

Danger

Of course this is a jest, but I am very serious indeed about the danger of running QRO into a large dish facing slightly downwards towards a neighbour mowing the lawn. I suppose it is one way of removing neighbours who are always complaining about TVI, but the next one may be more awkward still!

Don't forget that a large dish can have a gain of at least 30dB, and so a whistle on an SSB transmitter giving 400W PEP into the dish (this will need some linear!) would in fact be achieving perhaps 600KW EIRP which is a fair directional power! Don't forget that above 1GHz antenna radiated powers are normally quoted versus the gain of an isotropic source (EIRP), whereas below 1GHz ERP is conventionally quoted as power gain reference that of a dipole.

I had hoped to be able to include details and subjective trials of the EME 13cm valve linear, but as yet I have not got it properly working – so more anon. The main problem is finding suitable valves which work satisfactorily in the



EME cavity. The EME linear is claimed to give an output of 25W with a good valve and 1200V dc on the plate. However, the manufacturers specify a 2C39BA which has a lower inter-electrode capacitance than the ubiquitous 3CX100A5/7289.

I have heard many stories about preferred valves for 13cm, but analysing all the comments it seems that one station shows a strong preference for a particular type, whereas another will find an alternative valve giving much more welly. A valve which has a lower capacitance will obviously require a larger cavity, and vice versa. If you start pouring molten lead into your beautifully silvered cavity you may achieve better resonance but the efficiency is likely to drop, so it is a good idea to use the right valve.

When trying a 3CX100A5 in the EME we had to go for minimum capacity on the

tuning, which was still not low enough, and so this is probably why the machine was not working particularly well when I last had a go with it.

The EME UHF LVR power meter

Ordinary power meters, including Birds, just will not do on 13cm, and even the SSB Products meter which I reviewed earlier this year is very inaccurate on the band, as it seems to over-read by around 3dB. Piper Communications market a very good meter by EME which covers 70, 23 and 13cm. The coupling line is as described a few months ago, with N-type sockets for the through connection to the aerial or dummy load and take-off points both forward and reverse for feeding through to the meter, the head being very similar to the EME in-line directional coupler. Within the head though are the appropriate 50ohm loads

for the sample output line and also very high quality diodes.

The interconnecting lead between the head and the meter is 1.5m and is terminated into a special plug which has to be screwed into the front panel of the meter. This meter has a three position switch which selects 70, 23 or 13cm. Another switch selects the power range or SWR. A spring-loaded push button is used for reading SWR and both a three position sensitivity switch and a ten turn POT are provided for very accurately setting FSD forward to allow an accurate SWR reading to be indicated.

Power ranges of FSD 5W to 2KW are provided for 70cm, but on both 23 and 13cm these ranges become 0.5W, 5W, 50W and 200W FSD. The power range knob and meter have clear indications as to which of five scales on the meter should be used for the correct indication, the SWR scale being quite clear. The scales vary in length from 75mm on the 200/2KW range to 42mm on the SWR scale.

We first checked the power reading accuracy of the meter on 433.475MHz using a Trio TW4000A transmitter on low and high power ranges. The EME power head was placed directly on the output of the Trio and on the output of the head we placed 23dB of calibrated attenuation followed by a Racal 9303 power meter which had been very carefully calibrated. To my astonishment, the power readings of 6W and 34W respectively coincided within the thickness of the needle on the EME!

Gentle persuasion

We persuaded the Trio to give the higher power using a somewhat higher voltage than usual - 14.5V for around 10 seconds at a time. On 23cm various tests revealed an accuracy that is almost certainly within 5%, but on 13cm I cannot quote better than 10% accuracy as my other measuring equipment is no better than this. All I can say is that the actual readings obtained happened to coincide within 5% on 13cm at power levels between 500mW and 3.3W.

The SWR indication gave an extremely good reading with virtually no reverse power into a normal microwave dummy load, but as I do not possess a 75ohm calibrated microwave dummy load I could not test the SWR reading accuracy on 13cm, although on 70 and 23cm it seemed to be excellent. I certainly strongly recommend the EME meter for use at frequencies up to 13cm. The importers claim that the meter is also useful on 9cm.

We decided to see how the EME would react to 144.8MHz. Several power levels were checked and readings on the 70cm range (there is no 2m range) under-read by 9.5dB. In effect, this means that the instrument would seem to be perfectly usable on 2m by multiplying the 70cm scale readings by 9. This is actually quite logical, for the output of the coupling line should give a voltage output proportional to frequency if one ignores

various additional losses which come in at microwave. I can, therefore, see no reason why this meter cannot be perfectly satisfactorily used on 2m, although I have not checked the SWR readings on this band, which may be inaccurate.

This also raises the point that the EME UHF directional coupler rated for 70, 23 and 13cm can, of course, also be used on 2m, and instead of an average coupling loss of 29.5dB on 70cm, the loss will then be 39dB on 2m. The only snag using the EME meter on 2m will, of course, be that the most sensitive range will become 45W full scale. I dread to think though of what the 2KW range represents, for I am sure there will be a giant burn-up if you were able to put 18KW through on 145MHz!

The dimensions of the meter are 122 x 182 x 81mm excluding feet, and so it will sit neatly almost anywhere around the shack. The pick-up head measures just 119 x 32 x 59mm excluding feet. The meter costs £185 inc VAT, and whilst this is expensive it is a most recommendable product which is easy to use and accurate.

Conclusions

Now that muTek have unfortunately ceased importing the superb Swedish dish, the only suppliers of 13cm antennae would seem to be G3ZUD (L wave) and

G3JVL, the former supplying a 1.2m dish with feed, and the latter supplying the appropriate version of his long loop yagi to special order. I feel that the antenna is the main problem, but the next decision you will have to make is whether to lose the proverbial cost of an arm and leg by purchasing Andrews LDF5-50, or put the transverter and perhaps solid-state linear at the masthead and be content with around 3.5W maximum.

Dave Aram, of Piper Communications, informs me that SSB Products have had some difficulties obtaining output devices for the linear which meet the manufacturers' specifications, but that in the New Year the SLA13 should be supplied with a full 4W output capability. A 26dB gain dish would therefore give 1.6KW ERP or around 2.6KW EIRP which is just enough to stir up the pigeons slightly! This power at masthead is most certainly enough to work many countries and a lot of DX.

Cable

If you do have everything down in your shack and use heliax up to near the dish you absolutely must have a much more pliable cable for the turning loop, and you will have to choose between a shorter length of UR67 or a much less lossy, but longer, length of pliable Andrews FSJ4-50. This will allow you to

build a valve linear and obtain around 25W in the shack and perhaps 15W at the dish, if you are lucky. With such a station you should be able to go far, and have a lot of fun.

Experiment

The band, of course, would be fabulous for all types of experimental data, PCM, and fast scan TV, and I have no doubt that we will see quite a lot going on on this band in the next few years. I just wonder how long it will be before 10GHz will become just as popular as 13 and 23 are now.

Summing up, I feel that the SSB Products transverter system and linear are a good buy, for they are well made, and seem very reliable. Many stations have come onto the band by purchasing the same set up that I have reviewed, and virtually everyone has achieved very encouraging results. Just a few stations regretted coming on the band a year ago, but they now tell me that they no longer regret the expense, as activity is rising steeply.

It seems more usual, incidentally, for 70cm or even 2m to be used in duplex with 13cm, rather than 23. However, most of my 13cm contacts have been established by first contacting a station on 23, so it is advisable to have 23cm capability before considering 13.

TRIO TH21E 2m FM HANDHELD

THE FIRST EFFECTIVE POCKET-SIZED 'TALKMAN'

New models of walkie-talkie seem to be sprouting up like mushrooms from all directions, but this new Trio rig is very different indeed for it is the first that I feel I can take out with me virtually anywhere, and keep it in my pocket until I need to use it without any discomfort whatsoever. There are occasions, such as professional meetings that I have to attend, when I do not wish to charge around with a heavier rig attached to me with a belt clip as if I were a policeman.

The Trio TH-21E is no larger than a Sony Walkman, and only slightly larger in length and depth than a packet of twenty kingsize cigarettes. The dimensions are, in fact, 65.5mm wide by 127.5mm high by 32mm deep, and weight is 280gm, including battery and whip.

Comfort

I decided to see exactly how comfortable the rig would be when positioned in various places. It was a little bulky for a trouser pocket, but reasonable in a jacket pocket. The whip had to be



unscrewed for comfort, and it was just a little too long to rest horizontally in my jacket pocket; 1cm less would have been fine. It easily dropped into my inside breast pocket, even with the whip attached. However, the best place for it in my case was actually in the outside breast pocket, with the whip unscrewed

and pushed down in the same pocket.

It was not immediately obvious that I was 'wearing' a walkie-talkie, and the unobtrusiveness of this rig must be one of its big selling points. My XYL, Fiona, found that it easily went into her handbag, but for a while it seemed that the whip had disappeared forever



amongst the other contents!

The rig covers the entire 2m band in 5KHz steps, frequency being selected with three thumb wheels and a 5KHz-up button. On the back of the rig are two switches: a 3 position one giving simplex, normal minus repeater and a true reverse repeater position, whilst the second switch selects high and low power output. On the top of the rig is a beautifully finished phono type socket which has a thread around the base so that the miniature whip, when pushed into the socket, can be screwed home to make it an excellent fit. Two miniature rotaries are provided for on/off with audio gain and squelch. I found the latter a little difficult to adjust.

The thumb wheels are easier to use than many, and the 5KHz button presents no problem. To its side is another button for selecting 1750Hz tone for repeater use, the usual burst coming on each time the PTT is depressed (on the left side cheek). By the side of the antenna socket are two miniature jacks for external mic (3.5mm stereo jack giving audio and PTT) and a 2.5mm jack for external speaker.

An optional miniature speaker mic type SMC30 is available, with a spring clip allowing it to clamp onto a pocket or belt. This microphone just has a PTT on it, which is easy to use, and interconnects with the rig with a double plug and a coily cord which can extend to about 1.5m. An alternative option is a head set which can



be vox operated (HMC1), but this was not supplied for review.

A mains charger comes with the rig, which accepts the nicad pack type PB21, but this has to be pulled off the rig for charging. This takes around 8 hours to charge the battery fully.

Extras

Other options include a manganese battery case type BT2, a battery case for extended operation type EB2, a dc/dc power supply for mobile operation type DC21, a soft carrying case SC8, an earphone HS8 and an antenna conversion plug to BNC type AJ3.

Unfortunately, it is not possible to recharge the rig with the battery *in situ*, and battery life is obviously somewhat less than on larger walkie-talkies, but I found that I obtained at least an hour of use without the battery failing.

Subjective trials

I have used this rig for the last two weeks or so to talk to many locals, all of whom have been full of praise for the excellent transmitted quality. I reckon that the received quality is above average and particularly clear, although it is perhaps marginally less sensitive than larger units. The miniature rubber duck antenna is after all rather short, 165mm, and also very thin, 7.2mm, which is of course less efficient than a larger one. I get the feeling that the unusual phono plug with screw is in fact more substantial than many a BNC socket, and it is simplicity itself to pop the aerial on and off when necessary.

Repeater operation worked splendidly, and the toneburst accessed repeaters without trouble. The reverse repeater facility is far more useful than the +/- one which is fitted to some other models. I tried the rig on my 8/8 vertically polarised 2m beam, 17m above ground, and much to my surprise there seemed to

be no interference from very strong out of band signals, and so the rig seems eminently usable as a low power base station. However, you would find the dc/dc converter accessory almost a necessity for station use because of the battery life.

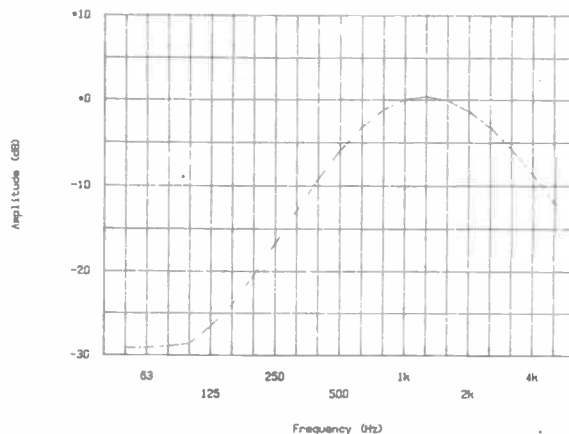
I have normally been somewhat prejudiced against thumbwheel tuning, but the ones used in this rig seemed easier to use than usual and, in the context of real and not pseudo miniaturisation, they seem quite sensible. For the UK market the first number has to be either a 4 or 5, other numbers just causing the rig to mute completely. I dare say, though, that it would be fairly simple to fiddle internally and obtain wider coverage.

Lab tests

The receiver input sensitivity proved to be quite reasonable in the context of such a small unit, although it was around 1 or 2dB less sensitive than the best of the competition. The receiver seemed to tune right on frequency as there was no improvement to the sinad rating by offsetting the generator. RFIM was much better than usual for a walkie-talkie, and an intercept point of -14dBm should mean that under normal use you should not get any interference from strong local signals.



Trio TH-21E
FM received
audio response
(750µS pre-
emphasis) 16/11/84



Indeed, on one occasion, I had connected the TH-21E to my 8/8 whilst running 400W PEP output on the bottom end of 2m and, during an over, I remained transmitting on SSB whilst opening up the receiver on the FM channels and heard no interference at all on various repeaters. There are not many rigs that will allow this!

The IF selectivity is not particularly good, but quite acceptable for 25KHz spacing, although 12.5KHz spaced stations did break through slightly.

Audio distortion was quite acceptable at normal levels and the available output, whilst being quite low, was adequate for the purpose, although I don't think there would be enough of it for serious use in the average car.

The FM capture ratio measured very well, showing that weaker unwanted stations would be swamped by wanted stronger ones on the same channel without any evidence of serious interference. FM limiting was achieved for RF levels well below the usable sensitivity point.

The received frequency response showed considerable bass cut below 500Hz, and HF cut was quite steep above 3KHz. This seems about ideal in the circumstances.

The current taken on receive when squelched was around 28mA, and 65mA unsquelched, whilst on Tx high power it reached 560mA, low power taking considerably less at 290mA. The nominal battery voltage is 7.2 at 180mA hours, whilst external voltages of 5.8 to 10V can be accommodated (nb not 12V). There is no external volts socket on the normal rig, so you will have to add the optional dc/dc converter/lead for this. In the lab we had to use crock clip leads to interconnect an external 7.2V, and these did have a habit of falling off!

The maximum Tx output power was well above that specified, in fact virtually double, and low power was also double that specified, so presumably spec power is delivered until the battery is virtually exhausted. The transmitted frequency, when on simplex mode, was unfortunately 540Hz low, although on duplex it was only 30Hz low which was strange. No one moaned about the slight offset though, so the inaccuracy prob-

ably doesn't matter much and there are tweaks inside for setting it more accurately anyway. Maximum speech deviation was just over 5KHz whilst toneburst deviation was just under 5KHz, and its frequency was just 5Hz high, which should be within the specification of virtually every repeater.

We had a good look at the spectrum analyser when the rig was transmitting and could not see any harmonics at all, the noise level of the analyser this time being at around -60dB.

Conclusions

Having used this little rig quite a lot, I am of the opinion that it makes much of its competition look a little silly, for the TH-21E seems to have on it all the really important facilities that one needs in a handy-talkie without it being cluttered

with facilities which many users do not really need. It is thoroughly practical, and very simple to operate, and it is easier to carry around than any other rig I have used. I feel it is the sort of rig which I would want to take with me on many occasions on which I would find virtually any other that I have tried rather a nuisance.

Its performance is surprisingly good for its size and it seems very reliable, although the toneburst button just occasionally did not pop up again properly and required one or two presses to disengage it. The PTT had a fairly light spring, as opposed to the vice like grip that some rigs require!

Cost

Sub-miniaturisation does seem to increase cost a little and I feel the price is slightly high. However, there are so many advantages in such a small unit that I feel it will become extremely popular. In the market place, its closest competition is probably the IC2E, FT203 and the Standard walkie-talkie. Perhaps I need say no more than that I would personally go for the Trio every time rather than its direct competition, and once again my bank balance is going to be reduced somewhat as I will be purchasing the review sample.

Many thanks to Lowe Electronics for loaning the review sample, and to my colleague, Jonathan Honeyball, and many local amateurs for all the help in preparing this review. The UK price is £179.50 inc VAT, which includes nicad, charger and whip.

TRIO TH-21E LABORATORY TESTS

Receiver Tests

Sensitivity (12dB sinad)	
144.025MHz	-120.5dBm
144.950MHz	-121.6dBm
145.975MHz	-120.2dBm

Selectivity; blank carriers off channel to degrade sinad by 3dB	
+/-12.5KHz	26.8/26dB
+/-25.0KHz	50/43dB

RFIM performance; carriers off channel for 12dB sinad product (ref 12dB sinad)	
50/100KHz spacing	71dB
100/200KHz spacing	69dB

Calculated intercept point	-14dBm
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FM capture ratio	4.2dB
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Audio quieting (at 12dB sinad)	16dB
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3dB limiting point	-125dBm
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Maximum audio output (10% THO into 8 ohms)	0.31W
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Audio distortion (125mW into 8 ohms)	
3KHz deviation	2%
1KHz deviation	2%

Transmitter Tests

RF power output (high/low)	
144.5MHz	2/0.35W
144.8MHz	2/0.35W
145.5MHz	2/0.35W
145.8MHz	2/0.34W

Tx 2nd and 3rd harmonics	less than -60dB
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Tx frequency error	540Hz low
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Repeater shift	30Hz low of true frequency
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Toneburst deviation	4.86KHz
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Toneburst frequency	1755Hz
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Typical deviation	4.7KHz
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Shout deviation	5.2KHz
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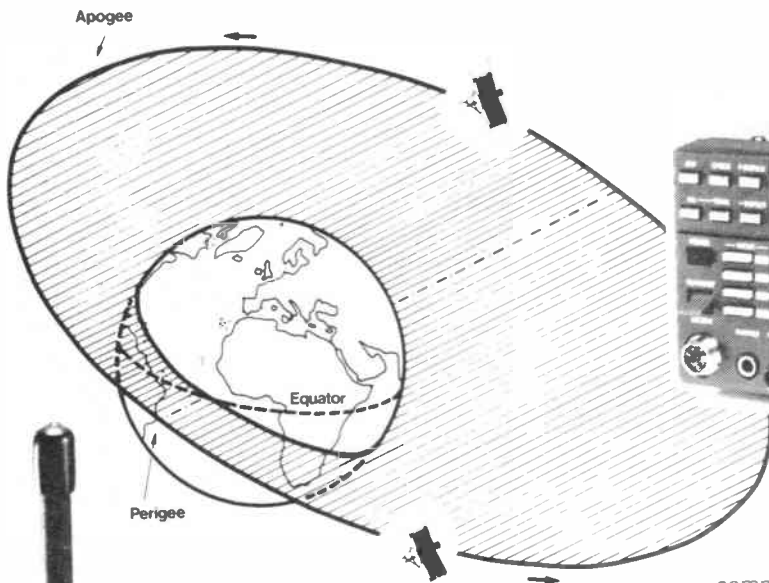
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The easy modifications needed to give you this unique communications opportunity are published in the December '84 issue of OSCAR NEWS. Back issues of OSCAR NEWS can be obtained from AMSAT (UK), LONDON, E12 5EQ.

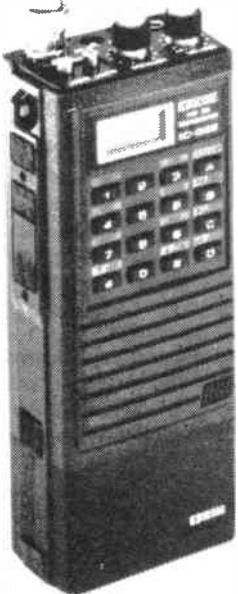
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The IC-02E has an LCD readout indicating frequency, memory channel, signal strength, transmitter output and scanning functions. New HS-10 Headset, with earphone and boom microphone, which operates with either of the following: - HS 10-SB Switch box with pre-amplifier giving biased toggle on, off and continuous transmit. HS 10-SA Voice operated switch box, with pre-amplifier, mic gain, vox gain and delay. The IC-2E and 4E continue to be available.



Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM

JANUARY CONTESTS

by Nigel Cawthorne,
G3TXF

AND NEWS

FROM FRANCE

The last weekend of January will be a busy time for HF contest operators, because there are two major HF contests running at the same time!

CQ Worldwide 160m Contests

Top Band enthusiasts always find plenty to work during the CQ Worldwide 160m Contests. The CW (SSB) event is on the last full weekend in January (February) each year. Worldwide activity on 160m has increased enormously over the past few years as more and more countries have been allowed to use the band.

The timing of these Top Band contests is a little different from many other worldwide contests because they start at 2200Z on the Friday evening and run through until 1600Z on the Sunday.

Top Band is a night time band and in order to give stations in different parts of the world a similar amount of darkness hours operating, the timing of the contest is staggered over the weekend. The CQ Worldwide 160 metre contests run for 42 hours, but this does not mean to say that you need to be operating for anything like this length of time to enjoy the contest!

As Top Band is a darkness band, there are in effect two operating periods available to the UK entrant. The first is from the start of the contest at 2200Z on the Friday evening through until a little after dawn on the Saturday morning, with the second period from around tea-time on the Saturday afternoon through until after dawn on Sunday morning.

Other than for a very serious entrant determined to work absolutely everything on the band including all the locals, there is generally no point in being on the band at all outside these two periods. During the hours of darkness Top Band

CQ Worldwide 160 Metre Contests

When:	CW 2200Z Friday Jan 25 to 1600Z Sunday Jan 27, 1985 SSB 2200Z Friday Feb 22 to 1600Z Sunday Feb 24, 1985
Where:	Top Band only: 1810-2000KHz
Scoring:	QSO with own country: 2 points QSO with own continent: 5 points QSO outside own continent: 10 points
Multiplier:	DXCC countries + States + Canadian Provinces
Logs:	40 QSOs per sheet and summary sheet showing score calculation, station details and declaration to be sent to N4IN, 3075 Florida Ave, Melbourne, Fla 32901 by Feb 28 (March 28) for CW (SSB).

can come up with a lot of DX surprises.

What makes the CQ WW 160m Contests very attractive to both the hardened 160m enthusiast and the newcomer to the band is the amount of activity brought onto the band by the contest. Many of the less active European countries on 160m will show up during these contests.

Reports after the 1983 event showed that there were over 55 countries workable in the CW leg of the contest from the UK.

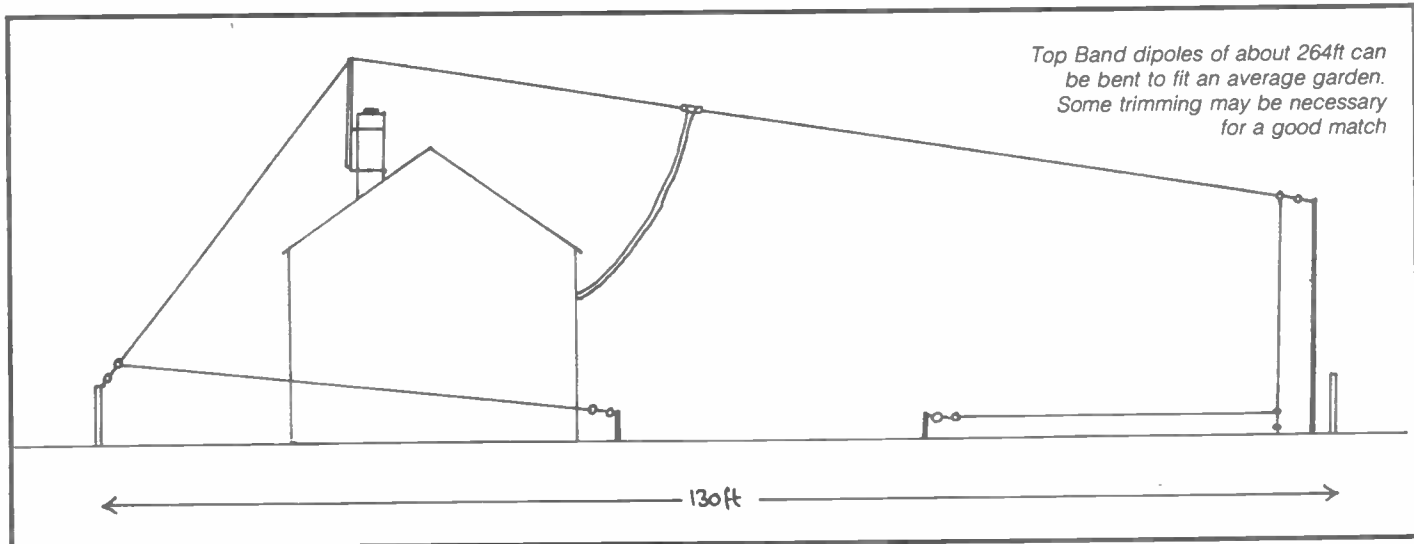
Entering

The contest exchange is an RS(T) report plus serial number starting at 001. W/VE stations will, in addition, be giving their state or province. The multiplier is the number of DXCC countries worked

on the band plus the number of different US states and Canadian provinces.

QSOs with stations in the same country count 2 points, with stations in the same continent, but not in the same country, 5 points, and with stations outside the same continent (DX) 10 points.

DX working on 160 metres does require a reasonably large antenna. Vertical antennae are favoured by some 160m DX operators, but for European working and for just making a few interesting QSOs in the contest, a simple 160m dipole (265ft centre fed) will do very well even if it is nothing like in a straight line! Many 160m operators use very 'bent' dipoles for this band. The ends of the antenna may have to be wrapped around the garden at a relatively low height, but provided that the feed point is up in the clear there will



JANUARY CONTESTING

be plenty to be worked on 160 metres during these contests.

Unless you have an exceptional signal, much of the contest will be spent searching for stations rather than calling CQ. A useful operating aid while doing this is a QSO check sheet. Duplicate QSOs are easily avoided by using one.

As a check on the multipliers worked it is also useful to have a multiplier checklist. A typical CQ WW 160m Contest multiplier check sheet is shown here.

The countries listed are those that were active in the contests last year and which are likely to be on again this year. Spaces have been left for adding other countries to the list. The countries shown should all be workable from the UK by a station with an average 160m antenna. Serious Top Band DXers using very high antennae will probably need a much longer multiplier checklist!

The REF Contests

The REF Contests are annual HF operating events organised by the French national amateur society: Réseau des Emetteurs Français. The objective is for amateurs worldwide to contact amateurs in France and in some of the French-speaking parts of the world. For the UK operator these contests are an excellent opportunity to work many of the rarer French 'départements' on 80m and 40m. There is also some exotic DX active during these contests such as FO8 in French Polynesia or FY7 in French Guiana, but for UK operators the majority of the QSOs to be made are those with France and Belgium on the LF bands.

In line with the general tendency to reduce the length of contests, the REF Contests have been reduced from a full 48 hour contest to a 36 hour contest. Both sections (CW and SSB) start at 0600Z on the Saturday morning and run through until 1800Z on the Sunday evening. Single operator entries are limited to 26 hours of operation and the 10 hours off may be taken in up to 3 periods.

Scoring

The score is 3 points per QSO, and there are a large number of multipliers to be worked. Each of the 95 metropolitan departments of France (01-95) count as a multiplier, as do the 9 provinces of

CT1		I		UR		W1	:CT
CT2							MA
		LA		Y2			ME
DL		LX		YU			NH
		LZ					RI
EA				ZB2			VT
EA6		OE				W2	:NJ
EI		OH		9H1			NY
		OH0				W3	:DL
F		OK		DX:			MD
FC		OY					PA
		OZ		EA8		W4	:AL
G				EA9			FL
GD		PA0					GA
GI		SM		PY			NC
GJ		SP					SC
GM				UA9			TN
GU		UAe		UH8			VA
GW		UA2		UL7			
		UB					VO :NF
HB		UC		4X		VE1	:NB
HB0		UP					NS
							PEI

CQ WW 160 Contest multiplier checklist

Belgium. The 9 French territories overseas (FB8W, FB8X, FB8Y, FB8Z, FG7, FM7, FO8, FP8, FW8) count as multipliers.

The French speaking countries of Switzerland-HB, Haiti-HH, Luxembourg-LX, Lebanon-OD, Quebec Province-VE2, Mauritius-3B, ITU Geneva-4U, Congo-9Q, Burundi-9U and Rwanda-9X also count as multipliers, although since most of them are never active in the contest anyway, they are only notional ones!

For the UK operator, the large number of French stations that can easily be contacted during these contests on the LF bands can be useful for working towards the French DDFM award.

DDFM Award

Metropolitan France is made up of 95 departments and the REF sponsors an award for working different numbers of departments on the same band. The basic award is available for having QSLs from 20 different French departments on the same band (either all CW or all SSB). Additional credits are given for each additional 10 departments on the same band and 'excellence' is given for working all departments on the same band/mode. The REF Contests are a useful occasion for filling in on some of those missing departments, or even for working for the basic award from scratch.

New calls for old!

French amateurs are up in arms! Late in 1983, the French government department that handles amateur radio in France issued a notice to the effect that, as of the beginning of 1985, French amateurs would be required to use new callsign prefixes. Newly issued calls already use the new prefixes.

The new callsign structure reflects the class of licence held. A highest class licence holder will use the FE prefix instead of F, so that F5QQ would become FE5QQ. The five categories of licence would be identified by FA, FB, FC, FD and FE.

One of the immediate effects of this change was to reshuffle some of the French overseas territories: FB8 now uses FT8! Corsica, which for many years has used FC, has become TK! Newly issued HF licences are in the series FD1.

The prefix letters FA, FB, FC and FD have all been used before. Algeria used to use FA, other overseas territories FB, Corsica FC, and Mauritania and other French West African colonies used to use FE.

To put it mildly, there is considerable resentment among French amateurs over this seemingly unnecessary tampering with the callsign structure. Perhaps one of the worst aspects of this whole saga is that the French national society, REF, was not involved in these changes. The changes just came as a directive from the ministry without any consultation with French amateurs.

It remains to be seen if French amateurs start using the new prefixes or not. The REF Contests in January and February will be a good time to find out!

Telecom 1 blasts off

France's new national telecommunications satellite was launched from the French Space Centre in Kourou, French Guiana (FY7) last August. Incidentally, it is because of the presence of the Space Centre that there is a relatively high level of amateur radio activity from FY7.

REF French Contests

When: CW 0600Z Saturday Jan 26 to 1800Z Sunday Jan 27, 1985
SSB 0600Z Saturday Feb 23 to 1800Z Sunday Feb 24, 1985

Where: HF Bands

Scoring: QSO with France and 'French' countries: 3 points

Multiplier: French Departments, Belgium Provinces, French overseas territories (FB8W, FB8X, FB8Y, FB8Z, FG7, FM7, FO8, FP8, FW8), and the French speaking countries: HB, HH, LX, OD, VE2, 3B, 4U, 9Q, 9U and 9X.

Logs: Logs, score summary, multiplier checklist to be sent to Réseau des Emetteurs Français, 2 Square Trudaine, 75009 Paris, France



Satellite receiving dishes at the SICOB exhibition, Paris

Designed as a multipurpose craft, Telecom 1A will provide much needed telephone and television links at 4-6GHz with France's far flung overseas departments (FG7-Guadeloupe, FY7-Guiana, FM7-Martinique, FH8-Mayotte and FP8-St Pierre et Miquelon). Four transposers are available for linking these outlying departments with France, as well as with

each other.

At 7-8GHz there are two transponders for military use. However, over half of the bulk of the satellite's traffic will be business communication services on the six 12-14GHz transponders.

Telecom 1A is positioned at 8° West and will be joined in 1985 by a second satellite, Telecom 1B, operating in hot-

standby at 5° West. A third standby satellite will be kept on the ground.

The French PTT were demonstrating many of the services that will be available to the business user through Telecom 1 at the Paris exhibition SICOB in September, very soon after the launch. The PTT's demonstration earth terminal equipment was housed in two containers, next to the 3.5m dish (see photo).

The French PTT is hoping to sell a wide range of communication services to business users throughout France as well as through other PTT's to those in neighbouring countries that lie within the footprint of Telecom 1.

Because of the need to continue commissioning tests on Telecom 1A during the exhibition, the French PTT also had available a link on the ECS-1 satellite at 13° East.

Declining sunspots

The rapid decline in sunspot activity over recent months is bad news for DX operators on the higher DX bands, but for 160m and 80m the declining sunspot number can mean better conditions rather than worse.

For UK stations the activity in both the major contests in January, the CQ WW 160m CW and the REF CW Contest, will be predominantly on the LF bands. Declining sunspots could mean better than average conditions.

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BEGINNERS' WORKSHOP

Have you ever had that feeling before you begin a piece of work that whatever you do its not going to be quite right? Introducing beginners to amateur radio construction through a series of articles is exactly that sort of situation. Radio constructors are, by nature, a singular group of people and no doubt many seasoned constructors are going to raise eyebrows or shake heads at some of the advice I will give.

This series is merely a distillation of some twenty-five years of wielding a soldering iron in attempts to build amateur radio equipment. If you are an experienced radio constructor, stop reading this article now, go away, put your soldering iron on and do something useful.

Change

During the last few years the nature of amateur radio as a hobby has changed. Some say for the worse, but I am just content to say it is different. One of the chief differences has been the entry of people into the hobby, often from CB operation, who want to enjoy an appliance-users hobby: just buying and using equipment for communication. That's fine, after all communication is what the hobby is about, but in the past most of the people who entered the hobby did so through the wish to be an experimenter or fiddler with pieces of equipment. Very often they had some, albeit simple, experience of building or modifying equipment, but today many amateurs exist in the hobby who have never had this sort of experience, and some do not even own a soldering iron.

This has been a natural progression in the hobby now that commercial rather than home built equipment is the norm. A casual look into the innards of any piece of modern amateur radio equipment is enough to convince most newcomers that they cannot compete with Far Eastern technology, nor do they want to spoil the resale worth of their expensive equipment by causing GBH with their soldering iron.

Simple advice

The first piece of simple advice is *don't be daunted*. You may not be capable of building an all-singing, all-dancing, bells and whistles multi-band transceiver but the average radio amateur can derive great pleasure from simple construction projects to use around the amateur shack.

The next piece of advice is *don't be worried if you are not a technical wizard*. I have no paper qualifications in electronics or radio but I have been happily constructing for over twenty years and even have the cheek to write articles in radio magazines about it.

The third piece of advice is *don't assume that an extensive workshop is required*. During my time as a constructor I have worked from student hostels, small flats, conventional houses and a



A series for the would-be constructor PART ONE: SETTING UP

Rev George Dobbs G3RJV

large vicarage with enough space to lose the children, the latter being a distinct advantage for the constructor. This series will assume an average amateur in a meagre dwelling on an equally meagre income. Amateur radio construction is for anyone.

How to start

Like most other fields of human endeavour, radio construction requires the beginner to equip himself with the basic tools for the job (the 'himself' is of course a gender-less figure of speech, for some of the best construction of electronic equipment I have seen has been done by women). In this first part of the series I will concern myself only with a few simple hand tools and items of soldering equipment which are essential to do even the simplest of radio projects. The workman is only as good as his tools etc... I will not bore you with all the adages about buying equipment but merely say they are all true, and a few more pounds spent in the early days will save a lot of extra spending at a later date. Thankfully these days most large supermarkets and DIY chains do stock good tools at reasonable prices. Many of the tools required double for other tasks about the house and are probably part of the existing household tool box.

My absolute minimum tool list to begin with would be:

- flat blade screwdrivers, medium and small;
- Philips (cross-headed) screwdrivers, medium and small;
- small pair of good quality pointed-nose pliers;
- small pair of good quality wire cutters

- (side cutters);
- small spanners, open or socket, for nut sizes used in radio work – sometimes BA sizes, sometimes metric sizes (these are important if only to stop the use of pointed nose pliers as spanners – they don't like it);
- soldering iron and accessories – we will look at those later;
- a small knife.

That is not much, for the list could be almost endless with wire strippers, desoldering pumps, clamps, lead formers and so on. This list contains all the tools I have at hand when I begin soldering work and simple mounting of equipment.

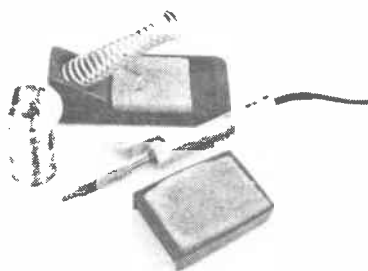
The soldering iron

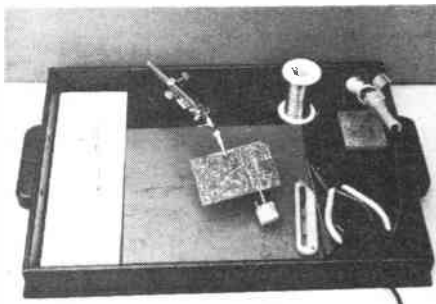
The soldering iron is the primary tool for the radio constructor and therefore ought to be chosen with care. There are a lot of cheap soldering irons about but most of them are unwise buys. Look for a branded and well known name. Opinions vary as to who manufactures the best soldering irons, but I have used those made by Antex for many years and have been happy with their performance.

The iron required for electronics work should be low wattage, say 15 to 18 watts, as some components can be damaged by overheating, especially by beginners who tend to apply the iron bit for rather longer than necessary. It is also very useful to choose a soldering iron with a range of interchangeable bits so that the size of bit can be chosen for the work in hand.

A good choice for the beginner could be an Antex model C or model CS. With this and two bits, say an 1/8 inch (3mm) diameter and a 1/4 inch (6mm) or 3/16 inch (4.7mm) diameter, most electronic soldering jobs should present no problems. The very small bits which look ideal for getting into those small corners can be useful but they do have a very short life.

With the soldering iron there are two other essential items: a soldering iron stand and a sponge cleaning pad. Oddly enough I have not found the Antex stands as good as their soldering irons. The spring stand I use does tend to put the bit shaft under strain from the weight





of the handle and it can work loose. The little 'magic sponge' is important. Even if the constructor fabricates his own soldering iron stand, somewhere close by ought to be a suitable sponge to keep the bit clean. In spite of what the old hands say, a cloth is not as good as a wet sponge. Buy the special high density sponges sold for the purpose; these are sometimes included as part of the stand.

Do not hook the soldering iron onto convenient places and edges instead of a holder. I have done this in the past but there again I have burned carpets, sweaters, table tops and hands by not having the correct safe home for my iron. *Wives don't like it!*

Tinning the bit

Before the soldering iron is used it must be prepared. The bit requires 'tinning' to ensure a smooth flow of solder. Tinning means adding a coating of solder. Sometimes bits are supplied already tinned but it is wise to repeat the operation for yourself. Heat up the soldering iron and while it is hot carefully clean the tip to bare metal with a small smooth file or piece of emery cloth. Then melt solder over the clean bit and smear it along until the bit is well coated and wipe it clean with a cloth or wet soldering sponge. This will leave a fine layer of solder over the tip of the bit.

The type of solder used for electronic soldering is important. It should be the resin cored solder wire sold specially for the purpose. This contains a core, or cores, of flux. Plumbers' solder, with applied flux is *not* suitable. A 'cost nothing' solder aid I often use is a small piece of polystyrene tile to hold the components prior to soldering them into the circuit. They can even be arranged in order of use or order of value to aid the speed of construction.

Soldering

Soldering is *the* basic skill in amateur construction. If you do not master successful soldering forget about successful construction. Over the years I have found that at least 95% of the problems I have been asked to sort out in my own and other peoples' home-built equipment have been due to poor solder joints. Don't worry about it because after a little while you will know, as soon as you have made it, if a solder joint is a good one or a poor one. There are a few basic rules about soldering and once these are understood and mastered it becomes the simplest of operations.

Soldering is not welding, nor is it glueing. The solder must flow easily across both of the surfaces to be joined. The finished joint must look clean and bright. A dull grey blob is the surest indication of the dreaded dry joint. The dry joint is the bane of the constructor; the joint has stuck but it may be a very poor electrical connection. The causes of the dry joint provide an excellent indicator of what is required for a good joint. The commonest causes of these poor joints are dirt or grease, insufficient heat on both or one of the components being soldered, movement of one of the components during soldering or insufficient preparation of the joint.

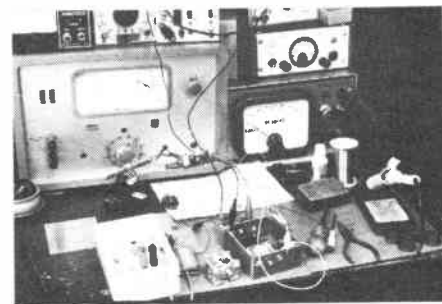
The rules

Rule number one – the joint must be clean. Solder will not adhere to muck and grease. Even new components, usually with nicely tinned leads, will have a residue of dirt and probably some grease from handling. Clean both components of the joint first. Emery paper, a pen knife, small files, all are useful tools to scrape the job clean. Look for shining metal, since that's the stuff to solder. I usually run wire ends of components through the jaws of my pointed-nose pliers before I solder them. If wires are not tinned, tin them before soldering. Just heat up the lead and melt some solder along its length, using the heat of the wire to melt the solder.

Rule number two – the joint must be firm before it is soldered. Soldering is not glueing. The two parts to be joined ought to be held firm together in connection without solder, *before* the solder is applied. When soldering a wire to a tag, wrap the wire around to make a physical join first. If a wire is inserted into a printed circuit board, bend it slightly over to jam it against the side of the hole so it holds physically before the joint is made.

Rule number three – heat the job, not the solder. The only way to make a satisfactory joint is to ensure that the parts to be soldered together are *both* hot enough to cause a smooth flow of solder and proper bonding. The best way to ensure this is to apply heat to the junction of the two parts and then melt the solder by touching it onto one, or both, of these parts. If the job is hot enough it will melt the solder. Touching the solder onto the iron bit to transfer the heat or carrying solder to the job on the iron tip are both bad practice.

Soldering is a *three handed job*, so a third hand is useful. Some people just position the work against whatever is to hand but I like to use a holder to make the job firm before the iron is applied. I require one hand for the iron, one for the solder and another to hold the job. Ideal for this purpose are the little clamps which are based upon crocodile clips (see photograph) which are inexpensive and easy to obtain. I have made these in the past by soldering a large crocodile clip to a length of thick wire (18 to 20swg) and securing the far end of the wire to a



weighty object – I used an old transformer. *Remember:* if the components of the joint move during the soldering, a dry joint is almost certain.

Rule number four – know when to stop. Once the solder has melted and run onto the junction of the joint do not continue to feed it with solder. This just forms unsightly large blobs. These can run onto parts not requiring solder and perhaps cause short circuits, or they can balloon up and cause poor joints.

When soldering is complete, inspect the finished joint. It should be smooth and reasonably shiny. If the joint is just a large blob or is a dull grey colour, remove the solder by applying the iron again and remake the joint. If in any real doubt check the connection using the ohms range on a multimeter. Having said this, take care: some components in some types of circuit could react badly to the voltage from a meter used to measure resistance. Clip off any surplus wire ends to tidy up the finished joint.

The work place

Some people assume that a lot of space is required for electronic construction. Although that may have been the case in the days of larger equipment and valves, low voltage, modern circuitry is convenient and compact and very little space is required. One of the methods I have used for many years in the past is to have a tea tray as a work bench (see photograph). It is possible to have all the equipment for most small electronic jobs on one tray. This can be used on a kitchen table and taken away complete, to be stored until the next time the work is taken up again.

My tray for many years was an old wooden one bought for a shilling at a jumble sale, with a Marley floor tile left over from a household job as a solder drip catcher. I have used the tray on tables, desks, the edge of a kitchen work surface and, in my student days, on a bed (!) covered in a thick layer of newspaper.

Naturally such an arrangement can only be used for the small construction work of soldering and assembly. The metal work and larger scale jobs have to be taken elsewhere. I have usually done these in a garage or shed. Only in recent years have I been able to have two work areas. I now have a cellar workshop for the large scale work but prefer to come up to the warmth and civilisation of the radio shack for the soldering and smaller work.

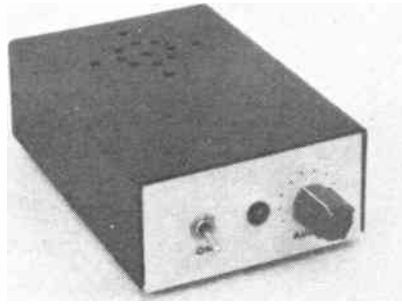
Even now my soldering and assembly

BEGINNERS' WORKSHOP

Figure 1. The oscillator (around TR2) is a sine wave oscillator and so produces a pleasing tone, far better than many of the square wave or sawtooth wave oscillators used for this purpose. The circuitry around TR1 provides RF triggering from a small transmitter signal to allow monitoring of a signal without connection to the transmitter. The audio amplifier is built up around the well known LM380 integrated circuit and can provide over 1 watt of audio output... enough to tell the neighbours you are on the band!

The whole of the circuitry is contained on one printed circuit board provided with the kit, as is the volume control potentiometer, VR2. To keep the costs down the constructor has to provide the loudspeaker (a conventional 8 ohm speaker), the case, if required, and the sockets to and from the circuitry.

The instructions are clear and the unit can be built by a beginner. I know because the prototype shown in the photographs was built by my wife. She had never handled a soldering iron before so I thought it a good test to let her loose on the kit. It worked first time. Once the board has been built the constructor will not only have had practice in building up a circuit board but will also have learned to recognise some types of components, if these are not already familiar.



The completed board can be used in several ways and these are outlined in the circuits in Figure 2. Depending upon what uses are required, several plugs and sockets will be required. I used the cheap and easy to obtain 'phone' plugs and sockets for all the terminations.

I did not want to use the unit as a Morse code practice oscillator so I wired it as shown in Figure 2. The antenna point is a single socket to take a pick-up wire and the in and outlet points are phone sockets. I also added a switch for on and off and a simple LED as an 'on' indicator. These are not essential but the circuitry required is shown in Figure 3. I was most impressed by the RF pick-up facility. I added a few inches of wire to the antenna socket and was able to switch the tone on and off using my 1 watt 2 metre handheld

rig with its rubber-duckie antenna several feet away.

The photograph shows that I placed my ST2 in a small case. I will deal with mounting equipment into cases later. If the reader wishes to duplicate my version of the ST2, the case I used was the type A20 aluminium box by Minfford Engineering which costs less than £1. The result is a neat compact unit which does produce a very pleasing sound. It would be ideal for a Morse class as the tone is not only clean but capable of filling a large room when the volume is tuned up full.

Have a go at construction, try a kit, buy some tools if you haven't already got them. It is great fun and a new facet of the hobby for those who have never tried it. But be warned - it is addictive.

Next month we will consider that old problem, where to get components, and we will build an essential item of amateur radio equipment - a wavemeter.

Sources:

The ST2 kit is available from C M Howes Communications, 139 Highview, Vigo, Meopham, Kent DA13 0UT. Tel: (0732) 823129.

The A20 aluminium box is available from Minfford Engineering, Sun Street, Ffestiniog, Gwynedd LL41 4NE. Tel: (076676) 2572.

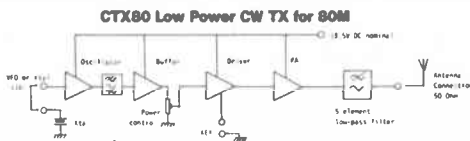
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CTX 80 KR £12.95. Not yet available in assembled form.

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The CM2 has an on-board voltage regulator, so that the unit can work from 8 to 14V DC. There is a miniature relay incorporated in the design for transmit/receive switching of the associated transceiver, yet the total current consumed by the unit is only about 30mA from a 9V battery. The quality of the audio produced by the HOWES CM2 has been favourably compared over the air with some of the most expensive mics on the market. It is ideal for both FM and SSB, CB and Amateur use. A bass roll-off option is included that helps keep down low frequency bumps, thumps and car noise when used under mobile conditions. You could easily build this unit into a small case for dash or sun-visor mounting in the car, with a remote transmit switch mounted on the gear stick. The facility for remote transmit/receive switching is built into the CM2.

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73 from Dave G4KQH, Technical Manager.

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T1154/R1155

Another look at this wartime installation by AH Cain G3DVF

Although there have been, over the years, innumerable articles covering this Air Ministry aircraft installation, and in particular the receiver section R1155, these have been mostly concerned with changing it, with varying success. There has been little written about the T1154, and its usual fate was to be broken up for the wide-spaced tuning capacitors it contained.

Enthusiasts

There is a growing minority of enthusiasts who are interested in the equipment as it was, together with the ancillary electrical parts and other electronic items which made up the complete installation. This interest seems to be, in the main, to make up an installation as fitted to one of the 'heavies' of the RAF, the Lancaster and Halifax of Bomber Command. These were not, of course, the only aircraft to use the equipment but are typical of the layout in the bigger aircraft of the period.

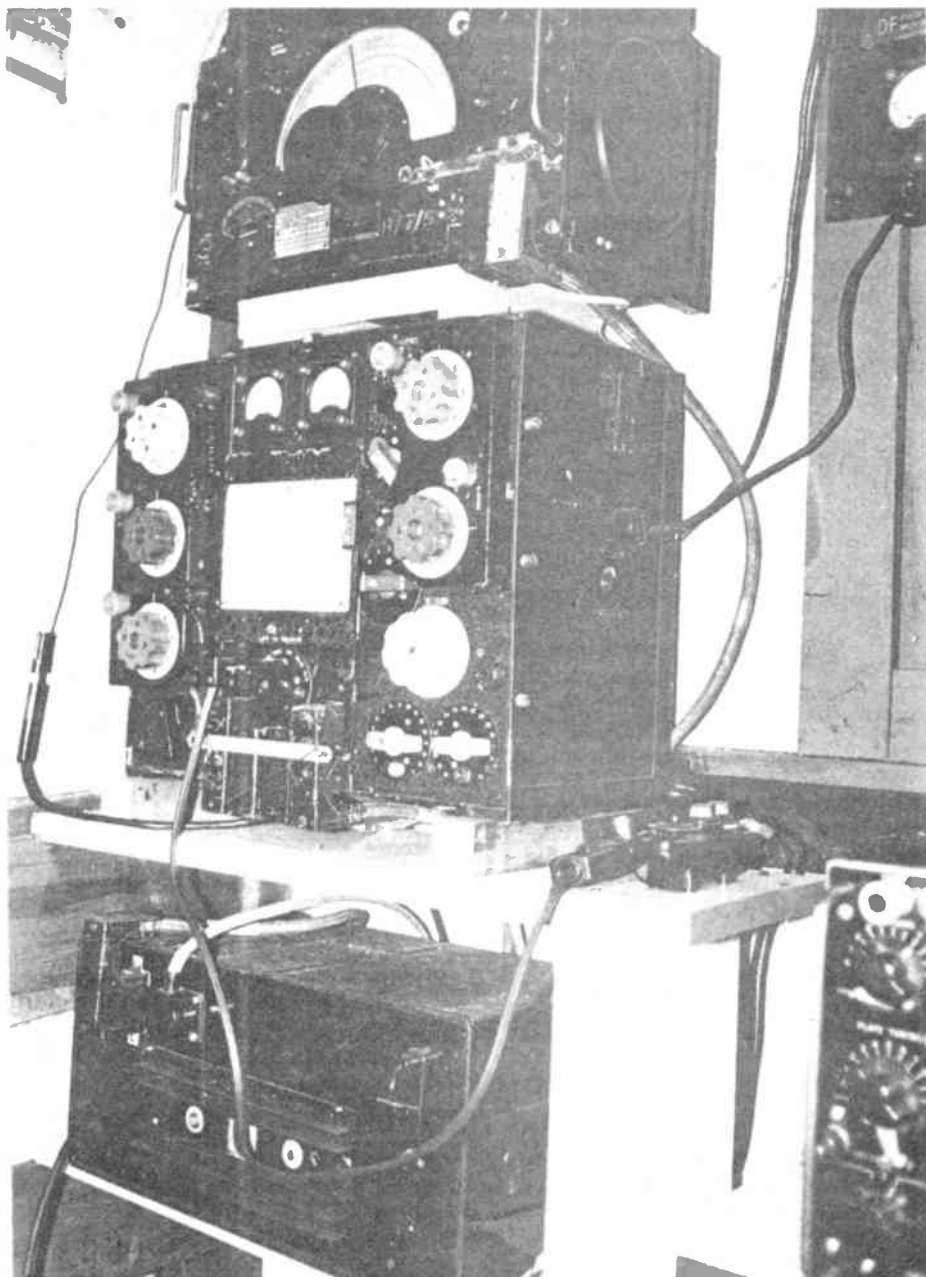
This type of installation is not by any means the easiest to achieve, and anyone considering the re-creation of an 'operational' installation will have to decide for themselves just *how* exact physically and historically they want the layout to be. Considerable latitude can in fact be allowed, as the T1154/R1155 found its way into Marine ASL's, 'Spoof vans' (operating around the airfields using aircraft callsigns) and a variety of aircraft too numerous to mention.

It was also used as a ground point to point station installation, using a massive 230V ac PSU. It will be appreciated that in this variety of roles, many of the more exotic items of ancillary equipment were not needed and not fitted, eg D/F Loop, A1134 intercom unit, and so on.

Before proceeding any further, it should be pointed out that the setting up of the T1154 requires the operator to hold an amateur licence before making any transmissions, even into a dummy load. If one is not held and a friendly licensed amateur is not at hand, then the transmitter side of the installation will have to be of a static nature (although this imposes no great disadvantage from a display point of view).

History

Before going into some suggested layouts, it might be of some interest to have a look at the origins, usage and



eventual replacement of this Marconi inspired equipment.

The forerunner of the equipment was an installation by Marconi, immediately pre-war, in some aircraft of Imperial Airways. The writer has not at this time looked further into this aspect but, for a keen historical enthusiast, this particular line of research may prove interesting and rewarding.

At that time the typical 'big' RAF installation was the T1083/R1082. Note that the R1082 was a TRF with reaction, and there is no doubt that even with well trained operators the equipment was difficult to set up and operate, although it continued to be used in aircraft into the middle forties. It was certainly in use at RAF signal schools in the 1942/43 period, and some of the earlier 'heavies', Stirling, Halifax 1 and Manchester, came out of the factories with harness and

looms fitted for the 1083/1082 installation.

The basic T1154/R1155 was the result of an approach by the RAF to the Marconi Company in October 1939 for an improved version of the equipment fitted to the aircraft of Imperial Airways. By January 1940, an approved installation had been fitted to a test bed and accepted. Production was carried out at Marconi Air Radio Works at Hackbridge in Surrey, and 1154/1155 were being fitted to some aircraft of Bomber Command in June 1940.

As aircraft production increased and the magnitude of equipment needed became apparent, it was necessary to bring in subcontractors such as EK Cole, Plessey, Mullard and EMI. Marconi retained overall control of the five companies concerned and at the end of the day over 80,000 units had been

T1154/R1155

produced, the majority being for use by Commonwealth air forces, but variants were also produced for the Royal Navy.

It is of some interest that the knowledgeable can distinguish the product of one company from another, eg EK Cole units by the *type* of wiring used.

Although the installation is generally associated with fairly large aircraft (for the period), it did find its way into aircraft where space was so limited that the receiver had to be mounted sideways and vertically, which must have made for some difficulties in reading out the frequencies being used. Some DH Rapides were also fitted with the T1154/R1155 installations, which must have caused problems both in weight and operation when the aircraft was a one man charter job with no radio operator.

The T1154/R1155 continued in use for some time after WWII and some Vickers Vikings were fitted with this installation (circa 1953). A little known modification was applied to the transmitter which consisted of a crystal drive unit. The unit type 859C provided 12 crystal controlled frequencies, using a simple plug-in unit, which was basically a crystal oscillator using a KT61 valve. Reversion to master oscillator control was obtained simply by unplugging the unit. This gave a limited number of crystal controlled spot frequencies on the HF bands. It is the writer's opinion that somewhere there will still be a 1154/55 installation in operation probably in some far corner of the Third World!

The transmitter could also be found operating as a low power MF beacon on several airfields throughout the world.

Construction

However critical one is of the R1155 in comparison with its USA counterparts (eg BC348), it is a fact that it entered service in 1940, was used in a variety of roles through the 1940s and 1950s and was still in operational use in Air Sea Rescue launches up to 1980. Spares presented little problem, usually something could be found or even made, which would get the receiver back on the air. The use of fairly thin sheet aluminium in the construction, rather than the typical die castings of the USA equipment, didn't look too good but could be patched up, cut and reinforced etc. A cracked die-cast sub chassis meant a new unit had to be obtained, not always possible.

The wiring of the R1155 isn't pretty, but in fact heat dissipation due to the point to point wiring is good, and accessibility of components and circuit tracing is also good. The removal of the PSU from the Rx proper was also helpful.

The T1154 appears to have been particularly free from maintenance problems, constructed as it was on a fairly massive scale, with a relatively simple circuit (master oscillator driving a pair of power pentodes as the final amplifiers, plus a speech amp/MCW/sidetone valve). Anyone looking at the transmitter

construction will be struck by the massive dropping resistors and the steel used throughout the frame.

Obviously in the light of experience the equipment went through various modifications, but these tended to be of a minor nature, and the similarity between the 'A' models and the later Marks is striking. The slow motion drive on the receiver of the earlier models was a bit lumpy after usage and the modified offset drive unit was a great improvement.

The T1154 through the various marks were basically the same, offering R/T, CW and MCW. The upper frequency range was increased in later models to about 18MHz. There was, however, a transmitter T1154A which was restricted to CW and MCW only. The writer cannot ever remember seeing such a transmitter and by far the most numerous of the marks available on the surplus market is the T1154M.

The installation

Most aircraft installations had the transmitter mounted above the receiver on anti-vibration mounts, but separation of the units in various configurations could also be found. The power supply units, mounted separately, were: (a) the LT Unit, providing 6.3 volts dc for valve heaters and keying relay, plus receiver 220V dc and (b) the HT Unit providing 1200V dc for the transmitter. Both 12V and 24V input units were available. When used as a ground station, a massive almost unliftable 230V ac PSU was generally used.

The units were interconnected by multi-core cables with large Jones plugs at both ends. These cables were heavily screened, a very necessary precaution in the electronically dirty environment in which it had to operate.

The A1134 (receiver output amplifier, microphone amplifier, intercom unit) was invariably used in the bigger aircraft. In some aircraft two R1155 receivers were used, the second one by the navigator who could use the D/F facilities built into the receiver when supplied with a suitable input from a loop aerial.

For marine installation the R1155 was mounted above the T1154 (as in photo) in a cabinet type 20. Apart from that, and some wiring installation changes, the units were interchangeable, although it should be noted that frequency ranges were slightly different for marks such as the 'N' and 'L'.

When installed in civil aircraft the T1154/55 became the AD87 transmitter and AD8882 receiver. Some receivers were modified slightly to operate on frequencies just outside the normal coverage of the R1155. This entailed a modification of the dial size, although the frequencies required could be obtained by trimming the tuned circuits without any additional components.

The rebuild

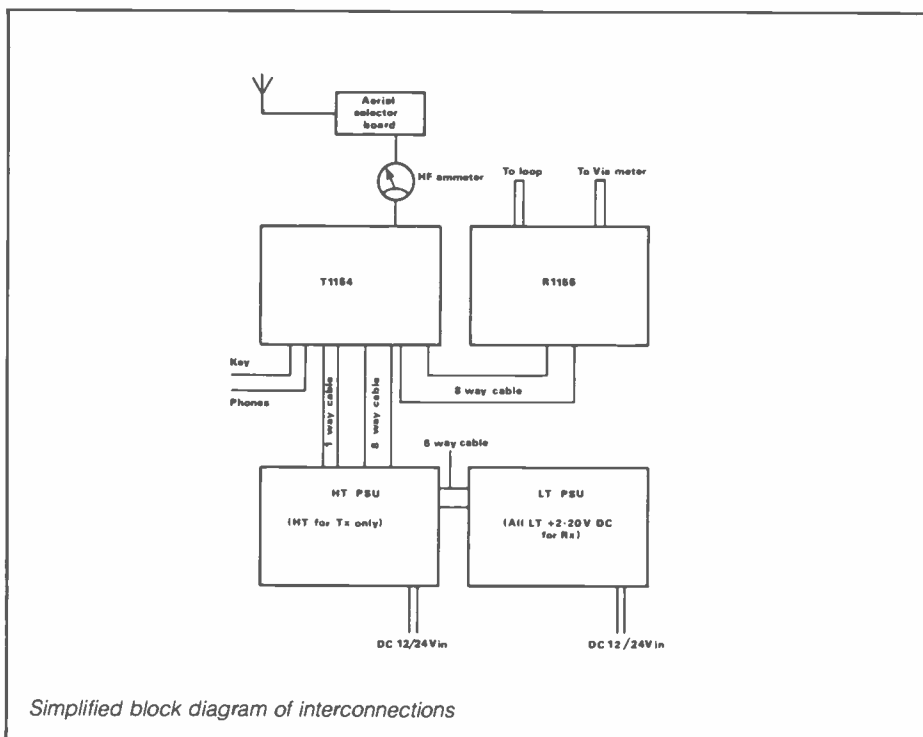
Probably the best way to commence any such project is to start from the 4 blocks:

1. Transmitter
2. Receiver
3. LT PSU
4. HT PSU.

The following information is written on the assumption that the transmitter can be operated, at least into a dummy load of some sort. For enthusiasts who cannot legally use the transmitter, some of the instructions will have to be ignored.

The acquisition of the air publications covering the T1154/R1155 will be enormously helpful and photostat copies are available at reasonable cost.

If it is intended to make a carbon copy



of the aircraft installation, then the four items listed above are a *must* to begin with, and the various ancillary items can be added as they become available. However, it should be recognised that the dc input to the LT and HT PSUs is 250W and 500W respectively, which is about 30 amps at 24V dc. Although this high current can be supplied using available components, it will be by no means cheap or easy to construct. Nor are the original PSUs readily available.

Latitude

Where some latitude of installation becomes permissible, by not insisting on a faithful copy of the original, then the whole project becomes easier to manage without losing the essential flavour of the original. What we would be aiming at is a reasonable compromise between what one would like and what is technically acceptable when viewed as a showpiece!

The PSUs are, in any case, usually tucked away to eliminate the noise associated with rotary converters, and it would appear that it is in this area that the compromise would be most easily acceptable. This line of thought was acceptable to the writer and it was decided to make up a PSU operating from 240ac, tucked away under the bench. The circuit is shown in Figure 1 and the reasons for the configuration given in the text.

As both the transmitter and the receiver that I have are ex-Air Sea Rescue launches it was also decided to go for the marine installation but, as indicated earlier, the difference between this and the airborne installation is one of detail only.

Careful check

The transmitter (block 1), when obtained, is unlikely to have been used for some years and a careful examination of the HT wiring should be undertaken. It is highly likely that the insulation will have deteriorated, and some rewiring will have to be undertaken. At this point the HT requirements of 1200V should be given some consideration. It presents a problem of both smoothing and insulation, either in the PSU or the transmitter, and a supply line of less than 1200V would be preferable.

It was with some interest that, after the connection of a temporary 6.3V dc supply to the heaters and relay of the transmitter, a variable HT supply 0-600 volts dc was applied at the 600 level and the transmitter keyed.

The transmitter worked very well, with the MAG feed indicating normally, but obviously with reduced RF output. Out of curiosity the HT supply was gradually reduced to 350 volts before the AF oscillator/mic amp ceased to function, but even at this level the oscillator and PA continued to function with an estimated output of 4 to 5 watts. With these results a value of about 500V HT

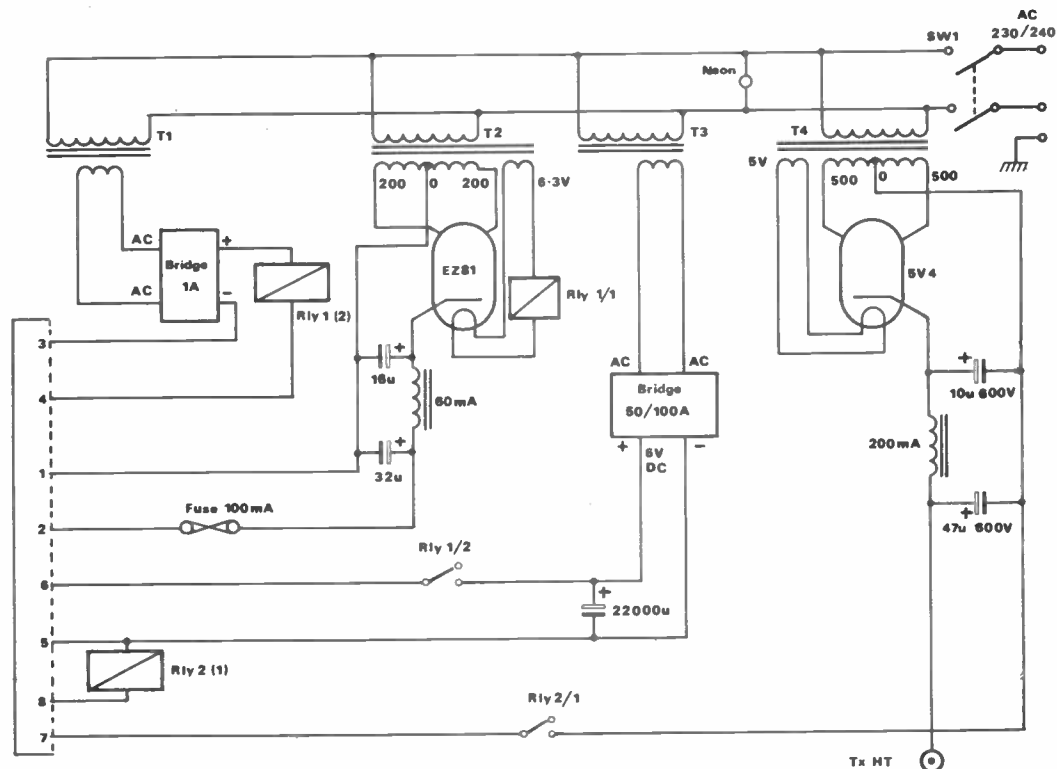


Fig 1 The circuit diagram of the power supply unit

was chosen for the transmitter. A suitable transformer can be obtained and both chokes and electrolytic capacitors are available capable of handling these values without any trick circuits.

The receiver (block 2) could well have been in use over a number of years and the main faults, if any, would be leaking decoupling capacitors. It is highly likely in view of the numerous modification circuits that have appeared that the D/F components will have been removed. It *might* be possible to restore the circuitry, depending upon what has gone before.

However, the receiver is still acceptable, even without the D/F, as in the original installation where D/F was not used (or a separate receiver was installed) a blanking block was used to fill the gap on the front panel where the D/F and VIS plugs fitted. This blanking block, made of wood, was marked 'Communications Receiver', with its own AM reference number.

The power supply unit

A chassis was available which fitted into a No 19 set case and a front panel was made up to suit. The transformers, chokes, capacitors and other units of the PSU were juggled around to fit. There would be little point in showing the layout, as it is almost certain that the size of components would not be the same as those of anyone else. Many of the items were recovered from various other projects.

Although the R1155 will work happily on a 6.3V ac heater supply, the transmitter has directly heated valves in the final stages, and in any case the main keying relay requires a 6V dc supply. In view of this, it was decided to supply dc to all heaters.

A multi-tap LT transformer was available rated at about 15 amps and a 100 amp bridge rectifier obtained from one of the surplus sources. The bridge was mounted on a finned heat sink on the front panel and runs mildly warm when

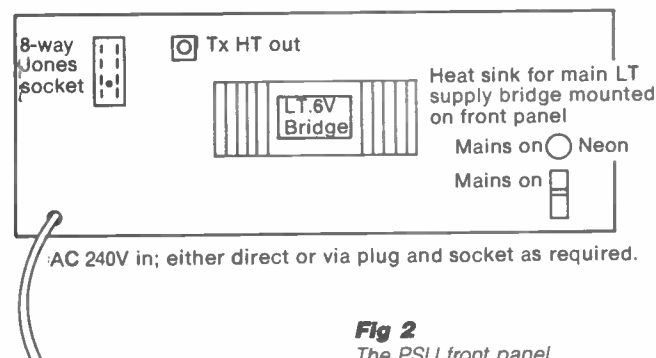
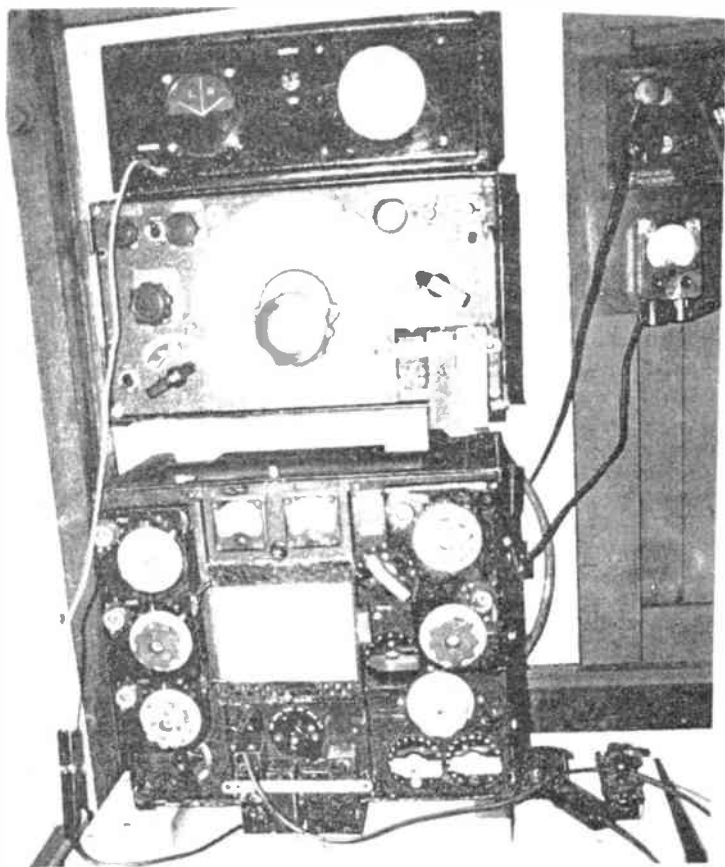


Fig 2 The PSU front panel



all the units are on. By adjusting the taps it was possible to obtain 6 volts dc on load.

The front panel also carries the 8 way Jones socket, the transmitter HT socket, ac fuse holders, mains supply switch, neon mains indicator and the ac in cable. Rudimentary smoothing of the LV dc supply is achieved by using 22,000 μ F 25V dc working. This appeared to be the lowest value, to give an acceptable level of hum on transmit. Some consideration has been given to constructing an electronically regulated 6 volt supply, but at the time of writing this had not been taken any further.

Valves have been chosen as HT rectifier elements and, particularly for the HT supply to the R1155, when the use of silicon diodes results in an 'off-load' voltage of 350/400 volts. This is much too high for the capacitors fitted to the receiver, and in addition it may well be that some out of the way wiring may have suspect insulation. Valves are also much less demanding than solid state elements as far as surges and voltage spikes are concerned, and space here is not a limiting factor.

The R1155 will function well with HT supplies of 175/200, and wherever possible a suitable transformer, eg 200-0-200 secondary, should be used. The use of a higher value HT, by using an unsuitable transformer and then dropping the extra volts by means of a resistor, is not really satisfactory.

In the manual position of the receiver, the bias, and hence the current, is varied, resulting in a variation of HT supply to the HF oscillator and a following change

of frequency of received signal. Smoothing is conventional and no attempt has been made to use a regulated supply.

The transmitter HT supply also uses a valve and any of the usual rectifiers, eg 5U4, 5R4, are suitable. The measured HT is just under 600 volts off load, falling to 550 volts with the key down. As previously stated, the HT supply can be as low as 350/400V, and had such a transformer been available at the time of construction, would have been used.

Operation of the PSU

Mains switch SW1 puts 240V ac onto the primaries of all the transformers. T1 and its associated metal rectifier energises Relay 1 when the transmitter control switch is put from off to 'Std Bi'. This is the sole function of this supply and relay and in practice any supply and matching relay can be used. 24 volts is used in this case because a suitable 24 volt relay was available, as was a small 24 volt transformer.

The contacts of Relay 1 *must* be capable of carrying the full surge and load currents of the LT system. Automobile relays can be pressed into service here, or contacts can be strapped to provide the necessary current carrying capacity. Note also that Relay 1 has a set of contacts that switch the heater supply to the receiver HT rectifier valve. This allows the HT supply to rise slowly and in step with the heaters of the receiver.

Relay 2 must have a 6 volt (or near) coil, as it is energised from the dc supply inside the transmitter. The transmitter master switch connects one side of its

coil to the LT + inside the transmitter. The single contact on this relay closes the negative HT supply line. This function is performed when the master switch is moved from 'Std Bi' to any of the transmit positions.

Connecting leads and plugs

The original Jones plugs with underlips for back and bottom cable entry are difficult to obtain, as is the multi-core screened cable. Bottom cable entry Jones plugs are still available and can be used, the difference being hardly noticeable.

Should any of the screened leads be located, examine carefully the insulation of the cores. Without exception, and understandably, the rubber will have perished. The screening on the cabling is not really necessary and perfectly satisfactory cabling can be made up of stripped out 3 core mains cable.

Some care is needed in soldering up the plugs if only three colours are available. Some of the older mains cable with Red/Black/Green would be useful and give another three colours. Although the 8 way cable from the receiver to the transmitter contains two coaxial leads for the aerial inputs, no real problem exists in simply wiring ordinary cable in its place.

The 8 way cable can be tidied up by covering with sleeving from a piece of the outer cover of larger diameter coaxial cable. (It is usually easier to pull the core out first then the insulation, followed by the screening). If, of course, 8 way cable of suitable current carrying capacity is available so much the better.

The HT for the transmitter is run in a separate lead. If reduced HT is being used, then the insulation of this lead presents little problem. Coaxial cable or non resistive spark plug lead can be used. If the full 1200 volts is to be used then it is essential to ensure that the cable being used has adequate insulation.

With hindsight, the writer would have used two PSUs rather than put everything in the one case. Even with reduced HT requirements for the transmitter, the PSU is a weighty box and difficult to handle.

Ancillary equipment

Aerial connections, fixed and trailing, went via a 'J' switch or an aerial selector board. Either can be used, but it is possible to make up an aerial board almost identical to the original, should the 'J' switch or board be difficult to obtain. An RF ammeter was used for the HF Bands, on MF the RF ammeter is built into the Tx. The A1134, although part of many installations, is not really necessary. Carbon microphone input can be direct into the front panel, after making certain that the mic selector plate (inside, back of transmitter) is set to carbon.

The output from the R1155 is adequate for up to three sets of phones, and will in a pinch drive a small speaker via a

SHORT WAVE LISTENER

TREVOR MORGAN GW40XB

Well, I hope you all had an enjoyable Christmas and received lots of goodies for the shack.

I've had quite a lot of mail over the past few months and much enjoyed reading of your exploits in the hobby.

We haven't received as many entries for the QSL card competition as we would have liked so we're holding the result up for another month to give you a chance to get your entries in. Even if you can't draw, please let me have your ideas and I will attempt to put them into a design for you. I'm sure many of you could do with a couple of hundred free cards!

Award

Many enquiries have been received about the *Amateur Radio 'Prefix Award'* so to clarify a few points, here are the details again.

The *Amateur Radio Prefix Award* will be presented for entrants having heard a given number of prefixes. The prefix is the first letter or group of letters of a callsign, which usually denotes the country or area in which the licence was issued eg GW4, IT9, 9H1, VE3 etc.

To qualify for an award, you have to have heard and logged 250 prefixes for the class 'B' award, 500 prefixes for the class 'A' award and 1000 prefixes for the 'Premier' award. The A and B awards are certificates while the Premier award is an engraved plaque which you can display in the shack.

The awards can be endorsed for mixed, all SSB, all CW, or RTTY as claimed if you wish. You do not have to have received QSL cards to claim, but a copy of the log entries must accompany the claim which is sent to me for verification.

Conditions

The weather in October has hardly been conducive to good short wave listening or working in the garden on those antennae. Gale force winds presented many stations with the problem of

untangling yards of wire from the remnants of the rose beds or straightening lengths of alloy tube that were left describing shapes they were never designed for.

Freak

However, some freak conditions around mid-month gave us some good listening periods, especially during the week prior to the annual Jamboree on the Air when a high pressure area over the channel presented the 2 metre enthusiasts with some good DX, with a positive feast of European stations and some hilarious moments on the repeaters when foreign stations were heard calling on local repeaters.

The HF bands were very lively with ten metres giving a good account of itself for the first time for some weeks.

Unfortunately, things didn't hold up for the Jamboree weekend when, once again, gale force winds invaded much of the country and a massive depression left the bands terribly flat. DX was hard to come by and with the higher frequencies virtually out, 80 metres was like the proverbial sardine can. The game was to find a gap and sit on it!

Forty metres took a bit of the load but twenty was pretty flat with contest operating making even the Europeans reluctant to answer the GB stations calling.

Enjoyment

Nevertheless, I'm sure the Jamboree participants thoroughly enjoyed themselves working whatever was available. I know I did and my thanks to those who sent SWL reports to GB2WFF... much appreciated!

The main reason for mentioning this particular month was to demonstrate how propagation conditions can change over a very short period. When setting up my station in preparation for the Jamboree on the Thursday, test transmissions using my own callsign fetched in quite a few American, Canadian

and South American stations, with Europeans coming in from all areas. However, on the Saturday the picture had changed completely.

Yet, despite the conditions, plenty of prefixes could be worked so our award could be claimed yet!

BC bands

Another point raised in your letters is that of broadcast band listening. I don't intend going into a long spiel about the subject as this magazine is amateur radio orientated. However, anyone who has listened to the many stations on these bands will be aware of the excellent DX programmes presented by some of them. These can be heard at any time of the day and night as, unlike domestic stations like Radio 1, these are international stations which broadcast worldwide for 24 hours a day.

These bands were my happy hunting ground for many years and I joined many of the listeners clubs promoted by these stations. To this day I still receive up to date information on propagation conditions, contests etc from many of them. Even if you haven't got a specialised short wave receiver you can still tune in to these stations on your portable or the tuner on your hi-fi.

Reception reports

Broadcast stations are pleased to receive reception reports from regular listeners and some actually offer many inducements to encourage regular listening. If you disregard the fact that many of the stations are religiously or politically biased to one side or another, the DX or listeners' programmes are well worth the effort and some very useful information is available.

Look for Radio Berlin International, Radio Prague, Radio Sweden, Radio South Africa, Finnish Radio, Deutsche Welle, Radio Nederland etc around the bands. I've found the best time for listening is after about 7pm and around

5.5MHz upwards. In particular, Radio Nederland presents excellent programmes on short wave listening and has a number of leaflets and other offers for the regular listener. You can hear their 'Happy Programme' on Sunday afternoons.

If you want more in-depth coverage of the broadcast bands, let me know and I'll speak nicely to the editor.

Contact

Quite a bit of interest is being shown in the idea of having a listing of readers who wish to contact others for exchange of information etc, but I know that some of our readers are a bit reluctant to give their details to an open list for reasons of security.

However, to try to make the idea work yet relieve you of any concern with regard to security, I put forward the following idea. A list of the interested parties giving details of interests, equipment etc will be circulated amongst the group, but addresses will be withheld and reference numbers given. I will then act as a PO box and mail will be passed on to the person concerned, which will prevent any unsolicited mail going the rounds and keep the addresses in my hands only.

So, if you wish to join in with the scheme, let me have your details including the type of equipment you use, any particular interests you have and any queries or problems you need help in solving. I will let all interested parties have a copy of the information in due course. My address is: 1, Jersey Street, Hafod, Swansea SA1 2HF.

Coming soon...

Well, that's about it for this month. Over the next few weeks I'll be looking at the amateur bands under winter conditions and seeing how many prefixes I can hear. I'll give you a run down next month. Also, I hope to review some more SWL orientated equipment for you. Meanwhile, good listening.

Having busted a gut to build up an amateur rig from the antenna down with a view to pulling in the faintest of signals from the far flung corners of the globe, it would be less than logical to reject at least half of the available transmissions. Yet, without having the facility of a BFO, all the wonders of the Morse code will be denied to you, and without a filtering device of some kind you must be prepared to struggle with masses of QRM to extract the signal of your choice.

With communications receivers the problem does not arise as both of these facilities are built-in, making CW reception both available and comfortable. Complicated though it may have been, the old national HRO with its crystal gate was one of the most effective filtering arrangements ever devised.

Of more recent vintage, the Racal range of receivers provide a variety of switchable bandpass filtering systems. The RA17A has 8, 3 and 1.2KHz filters, with additional crystal controlled values of 300 and 100Hz; the RA17L, on the other hand, starts at 13KHz, through 6.5, 3.0 and 1.2KHz with crystal controlled values of 300 and 100Hz as on the 17A.

For some reason best known to themselves, many designers of amateur receivers and transceivers have not been so generous; CW facilities they may well provide, but the width of the bandpass is usually too wide for comfortable reception under conditions of interference, with no recourse to making it any narrower.

Radio transmissions

Radio transmissions require various values of bandpass according to their content and speed of operation: perhaps the most commonly known to everyone from CB enthusiasts to British Telecom being the 'voice-grade channel' of 4KHz. At the other end of the scale, a satellite

DODSON AT RANDOM

CW Reception – two technical aids for the home-constructor

TV transmission on 1GHz requires no less than 3MHz of bandpass! Whereas telegraphic speed is measured in 'bauds' (being the number of transmitted elements per second) the speed of Morse is normally quoted in words per minute. For bandwidth calculation however, it is first necessary to find the fundamental keying frequency, which is the keying rate expressed in cycles per second, or hertz.

The basic difference between telegraphic code and Morse code is that the former represents characters in uniform length, whilst the latter does not. Because of this, the first step is to define the standard by the use of the word 'Paris' in Morse code. A count of the number of elements used, including the word-space, shows that there are 50 elements in the word, given that the 'dot' is the basic element from which all others spring:

spacing = 1 dot

dash = 3 dots

letter space = 3 dots

word space = 7 dots.

Therefore, transposing the Morse code for the word 'Paris' we have:

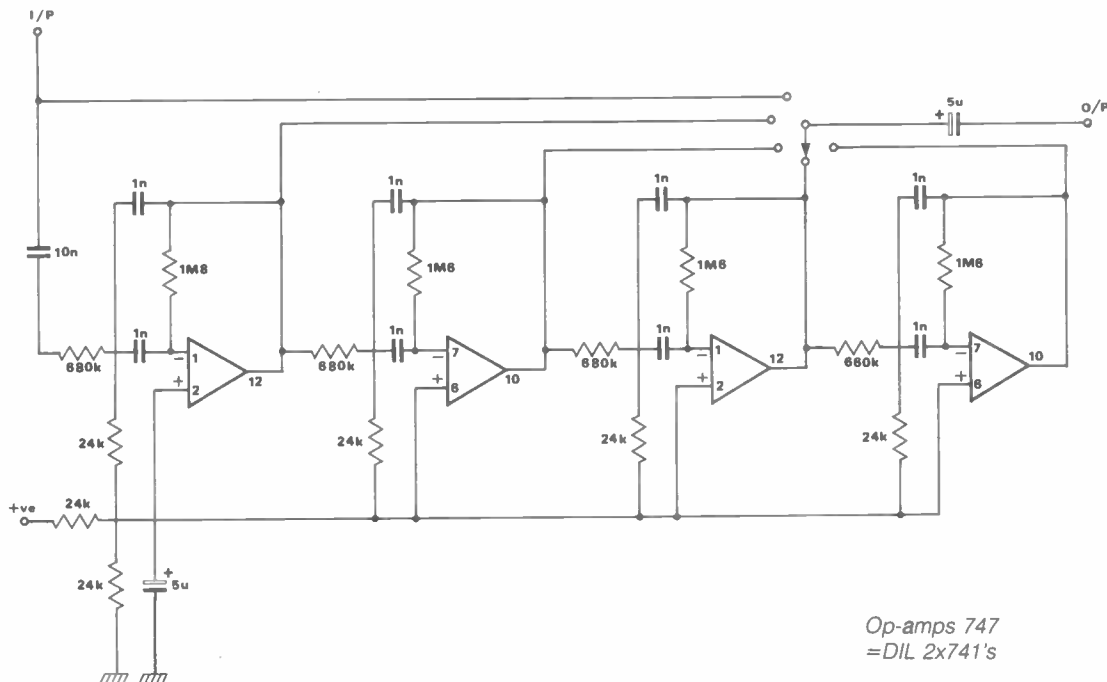
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It follows, then, that if the Morse speed

is 30wpm (ie 30 'standard' wpm) the simple formula of $(30 \times 50) \div 60$ will provide the speed in one second, or 25 bauds. Furthermore, as there are two elements per keying cycle, then the 25 bauds divided by two will give the 12.5Hz bandwidth necessary for reception of Morse at a speed of 30 words per minute. Therefore, if the keying speed is doubled, then so is the required bandwidth.

Too wide

As a result of this calculation, it can be seen that a band pass of 4KHz – or even 1KHz for that matter – would be far too wide for a Morse channel, having consideration for the fact that in 1KHz there could be an awful lot of unwanted Morse transmissions! So, a variable bandpass filter would be highly desirable, and one of the best available is the MFJ CWF-2, no longer available as an off-the-shelf unit in this country, but which can be built with a little expertise – and a bit more in the way of patience. It consists, basically, of a series of four active filters operating in cascade, having first been checked to ensure that each stage 'peaks' on the same frequency, giving a resultant 'Q' factor of 4 with a centre frequency of 800Hz.



MFJ CW filter circuit diagram

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From the unit a series of bandwidths can be derived at 80, 110 and 180Hz. It is claimed that there is a skirt rejection of at least 60dB down one octave from centre frequency for the 80Hz bandwidth. Similarly, no insertion loss should be present, with a typical gain of 1.2 at 180Hz, 1.5 at 110Hz and 2.4 at 80Hz bandwidth. A components list is provided (Table 1) for constructing the unit, which can either be built-in to the receiver cabinet or be free-standing. The former method tends to produce more 'jangle'.

HW7

One amateur transceiver which would benefit greatly from the addition of a CW filter is the HW7. Not being over-selective, it employs a direct conversion receiver, the bandwidth of which is quoted as being 1KHz at 6dB down. As previously explained, a CW signal at 30wpm has a bandwidth of 12.5Hz; it follows therefore, that with a bandwidth of 1KHz, it should be possible (according to the handbook) to hear no fewer than 80 CW signals at any point on the dial!

Certainly, in no way can it be said that the HW7 is over-sensitive or selective as it is notably lacking in ability to distinguish between adjacent and required signals nor, for that matter, is it able to detect weak signals at all! Having said that, it would be only fair to add that the successors to the HW7 are a vast improvement, with the addition of an 80 metre facility on the HW8, together with RIT (receiver incremental tuning), which provides for the off-setting of the transmitter frequency.

RIT

The advantage of RIT is that it is necessary to have your transmitter frequency zero-beated onto the frequency of the station with which you wish to communicate. It follows that if your receiver is on the same frequency, ie zero-beat, you will not hear anything. RIT allows you to offset your receiver frequency to give the required pitch of CW note without altering the transmitter frequency.

**TABLE 1
COMPONENTS LIST**

Resistors

R1, 6, 9, 12	680K Ω
R2, 3, 4, 10, 13	240K Ω
R5, 8, 11, 14	1.8M Ω

Capacitors

C1	.01 μ F
C2-9	.001 μ F
C10, 11	5 μ F electrolytic

ICs

4 x 741 or 2 x 747 or 1 x 3403

Miscellaneous

Single pole 4-way switch
Phone jack and socket
Veroboard

Pin connections for alternative op-amp ICs

1458		3403		4136	
Pin 2	Inv I/P A	Pin 2	Inv I/P A	Pin 1	Inv I/P A
3	Non inv I/P A	3	Non inv I/P A	2	Non inv I/P A
1	I/P A	1	O/P A	3	O/P A
5	Non inv I/P B	5	Non inv I/P B	5	Non inv I/P B
6	Inv I/P B	6	Inv I/P B	6	Inv I/P B
7	O/P B	7	I/P B	4	O/P B
8	VCC	9	Inv I/P C	8	Inv I/P C
4	VEE	10	Non inv I/P C	9	Non inv I/P C
		8	O/P C	10	O/P C
		12	Non inv I/P D	14	Inv I/P D
		13	Inv I/P D	13	Non inv I/P D
		14	O/P D	12	O/P D
		4	VCC	11	V+
		11	VEE	7	V-

However, simplicity is the keynote of the HW7, with only three main controls to worry about - namely the main tuning dial, receiver pre-select and the peaking of the transceiver on the required band. On the other hand, it is a rig which almost invites modification, such as a 6:1 reduction gear slow-turning dial on the receiver pre-select control and the addition of an RIT facility or a CW filter. It is even possible to rebuild the entire front end without too much trouble.

All these modifications, incidentally, have been published in the American QST magazine, and membership of the G-QRP club (only £3.50 a year) will bring all the assistance to low-power enthusiasts that they want!

Perhaps the biggest shortcoming of the HW7 is the susceptibility to broadcast break-through. This is an annoying phenomenon that a CW filter will eradicate. The function of the MFJ filter is to take the incoming signal from the normal phone pick-up point, pass it through a series of tuned circuits, each allowing a progressively restricted bandwidth, to emerge through this cascade of filters giving a choice of three bandwidths. The output is via a normal phone jack to earphones.

We found that the simplest method of construction was to build the unit around the four individual op-amps by laying out the components as shown in the circuit diagram. Problems arose when using a 747 (2 x 741) in that the wiring tags were not in a position to give a circuit 'replica' of the diagram due to the complicated wiring. The situation was further confused if a 4 x 741 component in the shape of a 3403 was used. Nevertheless, a conversion diagram is shown for the more adventurous! Also shown are the voltage connections.

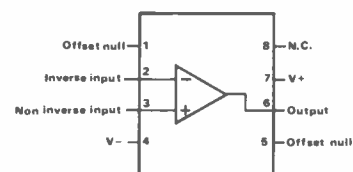
ICs first

Again in the interests of simplicity, it was found to be an advantage to mount the ICs first *using holders*; not only does this prevent heat damage to the components during soldering operations, but it also ensures easy replacement should the necessity present itself. Care should be taken, of course, to mount electrolytic capacitors the correct way! With a little

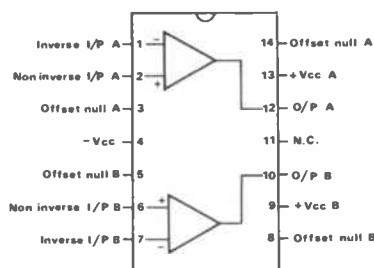
ingenuity it is possible to assemble the necessary components on a piece of 3 x 2 inch Veroboard which would fit inside the cabinet of the transceiver - paying attention to the possibility of jangle.

Low cost

Converting a receiver to CW reception can cost as little as a pound for the smaller components, the biggest outlay being for a variable tuning capacitor; for that matter, a small trimmer would probably suffice, but it would tend to be somewhat less than sensitive. Malcolm Robinson of Cheltenham paid £40 for a PCR2, a 'communications' receiver of somewhat vague Pye/Philips origin, that had been fitted for military vehicle-mounting, being the same size and shape as the famous '19-set'. It had been enhanced by a dealer by the addition of a mains transformer (in its original 12 volt guise it would only have cost twenty quid!) with the availability of a 6 - 22MHz short wave range, together with a medium and long wave facility - but no BFO!



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TABLE 2
COMPONENTS LIST

Resistors

R1 1.2M Ω
R2 1K Ω

Capacitors

C1 47nF
C2 27pF
C3 10pF
VC1 50pF

Transistors

Tr1 BC109

IF transformer 470KHz

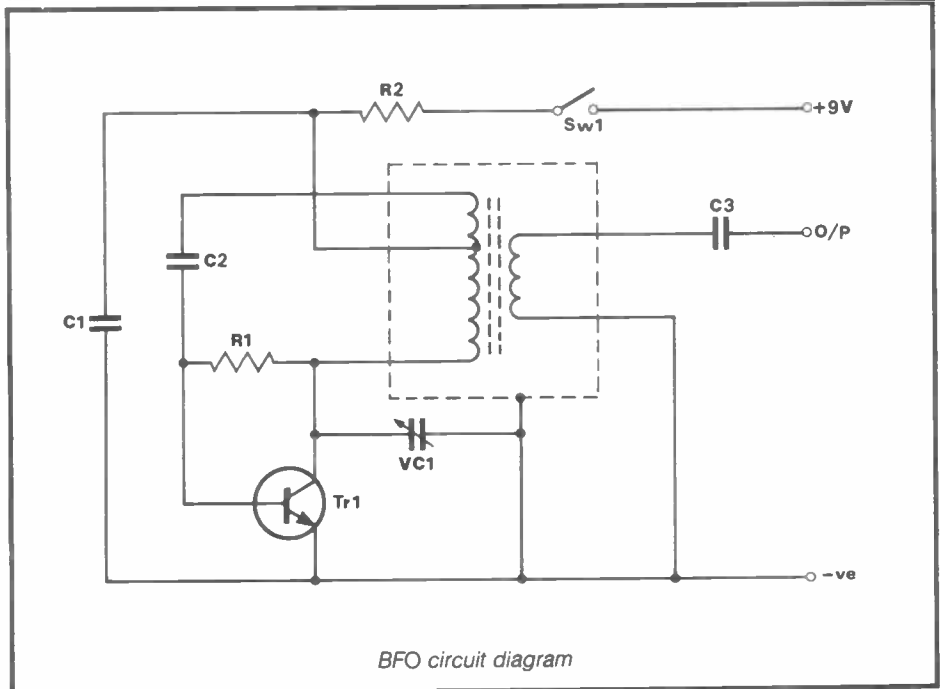
Output was by way of a loudspeaker socket rated at 2.5ohms, which suffered a big loss when high-impedance (2000ohms) phones were plugged in. 8ohm stereo phones made for an improvement, but produced a high level of mains hum.

To listen to CW, Malcolm used a Russian built Vega commercial set that sported five short wave bands apart from medium, long and FM. This he placed in a position adjacent to the PCR and, by tuning to an appropriate spot on the long wave band of the Vega, caused the sets to 'beat' together. It worked but was obviously not an ideal arrangement if only for the fact that the two tuning dials had to be operated independently – and it was a bit of a waste of thirty quid's worth of broadcast receiver!

So, eventually, Malcolm decided to build his own beat frequency unit – and at a surprisingly low cost.

Normally

On a normal communications receiver, the Rocal for instance, a local oscillation is inserted into the signal path immediately before the audio frequency output, modulating the output of the 100KHz bandpass filter. On the RA17A, the BFO range is ± 3 KHz and on the 17L it is ± 8 KHz. Less sophisticated than this, Malcolm Robinson's BFO utilises 'stray capacitance', his local oscillator unit, powered by a 9 volt dry-battery, being



free-standing within the receiver cabinet. Primarily, the unit was moved to different positions to find the best available, and only the control knob together with an on/off switch was mounted permanently on the set facia. The parts for the construction of this beat frequency oscillator are listed in Table 2.

The effect of using this simple circuit is, to all intents and purposes, the same as the 'plumbed-in' BFO on commercial sets in that it radiates an RF frequency that can be varied between 460KHz and 470KHz to beat with the second intermediate frequency of the set – namely 465KHz. For many enthusiasts it is just a matter of digging a few components out of the 'bit-box', glueing them onto a bit of Veroboard and finding the optimum position within the cabinet.

Quids In

So you see, in much the same way that you don't have to be mad to be an amateur radio enthusiast, so you don't have to be a millionaire either – but it

helps! Having said that, for the saner among the ranks of amateur radio enthusiasts, there is a CW filter available in kit form at £5.80 or tailor-made at £8.55 from Wood & Douglas. The firm have been good enough to send us one of the kits, and its performance will be duly reported in these pages in the fullness of time. No, we're not daft either!

Too much eating and drinking over Christmas? Make a New Year's resolution: get *Amateur Radio* every month – it's tasty, easy to digest, and smoother on the palate than any other radio magazine currently on the market.

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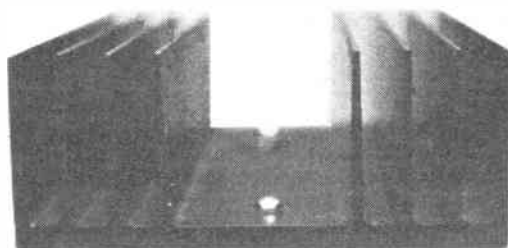
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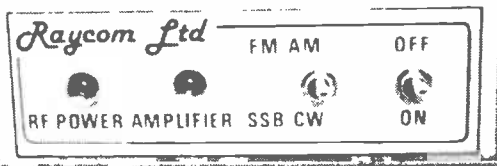
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IDEAL FOR
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TX40G
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News from Glen Ross G8MWR

Happy New Year

This is a traditional wish at this time of the year but, being the kind hearted big spenders that we are, we are going to go further and provide you with something new to play with. Elsewhere in the magazine you will find details of the new 'Amateur Radio Awards'. Before launching these a lot of thought went into whether the metrowave world needed any more parchments to add to the collection. It was felt that only if they offered something new could they be justified and we think we have come up with the goods.

Most awards are rather narrowly based and therefore tend to concentrate activity in one particular direction, say square chasing; to get ours you need to do much more. Each one is based on a requirement to work a certain number of countries, counties and squares plus a minimum distance, and they are set at three levels. You will therefore have to put a lot of enjoyable work in on several different fronts to get the results required, but we feel that this is the best way to get more activity going particularly on the higher bands. No contacts made before the 1st January 1985 will count, so everyone is in with the same chance.

Full details are in the main write up, we hope you will think the entry levels are reasonable and that you will support the new venture; perhaps a better aerial... maybe I could get... who will be the first in your street (sorry, wrong blurb!). Good luck to you all.

Maldenhead locators

These new locators come into use from the first of January and from reports received it seems that many people still do not know their new locator. As a service to readers we will supply your new locator for you. Simply send me an SAE and enclose your own latitude and longitude detail as accurately as possible, and your new locator will be computed and returned to you. We can give you your Maldenhead locator based on your current QRA locator but, whilst this may be good enough for most purposes, it is not as accurate as the lat/long method. If when you write you enclose a few comments or news items they will be well received (address at end of article).

Review time

We do not normally offer a complete rundown on individual stations' activity unless it is something rather out of the ordinary. However, it is perhaps an appropriate time to look back over the scene during 1984 and to have a look at what might be coming our way in 1985. To maintain some order in what you must admit is a very wide field, let's look at the bands in ascending order of frequency.

50MHz

The good news about this band is that we have at least got a foot in the door! The original 40 permits have now been augmented by another 60 stations who received their permits (not licences) within the last few weeks. There is a rumour going around that there may be the possibility of another 100 permits 'coming soon' but this is a matter for 'wait and see what happens'.

At the RSGB's '83 AGM it was stated that the intention was that if or when the band is available on a more normal basis, it will be available to both class 'A' and 'B' folk. The big problem is that continental TV is not closing down and the problems of TVI, particularly in the south east, cannot be forgotten.

Another good sign is that Norway has recently agreed to issue 25 permits on a similar basis to our own. Some of the countries known to have been worked or heard on the band include W; VE; TF; GJ; G; GU; GW; GM; GI, C31; ZB2; SM6; OZ; OX. The RSGB beacon GB3NHQ is now on 24hr operation running 15 watts to crossed dipoles, and you could also keep an ear open for ZB2VHF and 5B4CY.

70MHz

Anyone care to beat this? GM3WOJ uses a 14 element beam built on a 35 foot boom. It looks as though his contact with GJ3YHU at a distance of 1079Km may well be a MS record on the band. He also holds the auroral record with a distance of 906Km. The number of countries workable on this band is at least seven, this having been achieved by G8VN running just 10 watts to a three element beam.

144MHz

What can one say about this band? Sooner or later it *all* happens. This year there was some doubt as to whether we

were going to get any sporadic-E but on 8th June all hell was let loose with excellent tropo, a minor meteor shower opening and a fantastic 'E' opening all running at the same time.

Many newcomers to the band just did not appreciate how fantastic it all was. Hundreds of British stations worked into Russia and chaos reigned supreme. It seemed that at some point or other you could work just about anywhere on the continent by making use of the appropriate mode.

There is no point in giving a list of the countries worked but distances in excess of 2000Km were fairly normal, G1ARU working into QL square with 3 watts and an eight element beam.

There has also been the usual auroral and MS operating, the latter becoming increasingly popular as it becomes known that high power is not essential, although it certainly helps. Probably the choicest bit of DX worked was EA8XS in the Canary Isles.

432MHz

That stalwart of a beacon, GB3SUT located at Sutton Coldfield, has at last called it a day. Advanced age and a change of mast has forced the retirement. One of the more noticeable aspects of 70cm operating has been the number of new repeaters busily sending their call signs: many of them seem to do little else, and the need for these must be questioned.

Activity is now reaching a fairly high level and it seems that most of those moving up are more interested in working SSB and having civilised simplex contacts than repeater operating. Several good openings have occurred and much good DX has been worked. Many people find this band open when two metres is only normal.

Recent new arrivals include TV and data repeaters and these seem to be much more popular. As on two metres, EA8XS provided the icing on the cake in 1984.

1296MHz

This band starts to sound more like two metres did four or five years ago, particularly under lift conditions, when the results obtained with a couple of watts can be very surprising. Contacts of over 800Km are no great surprise and lifts are much more frequent than you might expect. The influx of repeaters into this band seems to have been a non-event, and the remarks referring to 70cm units apply with even more force here.

There has been a considerable increase in ATV interest on the band with those involved being agreeably surprised by the results obtained. The latest tropo record on the band is in excess of 4000Km.

2.3GHz

Activity continues to increase on this band and countries known to have been worked include G; GW; PA; ON; DL; LX and OZ. There has also been an increase in moonbounce activity on the band, one of the more interesting being between the OE9XXI group and LX1BD who was

ON THE BEAM

running only 25 watts. The possibility of working 40 squares on this band is certainly on. One thing that is urgently required is a better spread of beacons, as they are usually the only signal source available for lining up the gear.

3.4GHz

The activity on this band is rather sparse but there are some people up there, G4BYV having worked over 11 squares on the band. Contacts into PA and DL are regularly achieved from the east coast region.

10GHz

This has to be the fastest growing area in this end of the hobby and has been brought about mainly by the ready availability of the 'Solfan' microwave head, which provides all the plumbing 'ready made' and makes possible the construction of a complete transceiver for around £40.

It seems that many people want to put the 'amateur' back into amateur radio and this is an ideal way of doing it, since the results you get depend on your own efforts. Paths of up to 100Km are nothing to get excited about and many people are now running 'home to home' links for computer use. Amateur TV is also gaining ground and the interest in SSB is increasing slowly.

The amount of activity this year

exceeds anything previously seen and it is now becoming difficult to find a weekend when there is not some activity going on.

The world record for FM is now nearly 1800Km and this was achieved with a few milliwatts to small dishes with both sites at sea level. There are proposals to build repeaters on the band, these coming from repeater groups, who seem to want repeaters everywhere, and not from 10GHz operators who in general certainly do not want them.

24GHz

A new world record of 289Km was set in April by I4BER and I3SDY, using 10GHz as talkback! Operation in this country remains at a low level but there are signs of an increasing interest. The availability of some 'in line' heads, similar to the well known 'Solfan' 10GHz unit, at a reasonable price will certainly provide an easy way on to the band.

Satellites

The various Russian satellites started the year off well but we are now down to two operating units. UoSAT had a very sticky patch at the start of the year but control was regained in May and we are told it continues to fulfil its function (whatever that may be), and the clock now tells the correct time! Oscar 10 seems to have had a fairly good year and

the 'Alligators' (all mouth and no ears) seem to have learnt some sense.

Space

This, to say the least, was not one of our best efforts and the operating standards during flight of Owen Garriot was distressing to say the least. We will soon have a chance of a second bite at the cherry with the new operator being Tony England and possibly AN Other. One can only hope for better things than last time.

Looking forward

Will we get those extra 100 50MHz permits? There seems to be a real possibility that we might. Class B Morse looks as though it could arrive, perhaps a lot sooner than you think, and the availability of crossband working from VHF to HF must be a distinct possibility. Some work has been done on an 'international' licence to replace the present reciprocal system.

The specialist societies all report increased membership, both BARTG (4000) and the Microwave Society (500) having doubled their numbers in a year. This must show a healthy future for the hobby.

The final

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THE 11m CB TO 10m AMATEUR BAND CONVERSION GUIDE

Motorola MC145106

A common PLL chip found in some early American CB sets is the Motorola MC145106 (Figure 1a). It is a universal PLL chip intended to be adopted for a multitude of communication applications. The reference divide can be altered from being 'divide-by-2⁹' (divide by 512) to divide by 2¹⁰ (divide by 1024) by adjusting the logic level on the reference oscillator frequency division select pin 6.

For example, with a capital reference oscillator running at 10.24MHz, a logic 1 on pin 6 selects a reference of 10KHz and a logic 0 a reference of 5KHz. Don't forget that this is also a 'divide-by-2' circuit, always connected to the reference divide circuit such that the overall 'divide-by-R' is in fact either divide by 1024 or divide by 2048.

Mixers

The 'divide-by-2' output can be used for driving mixers to arrive at the required operating frequency. If a crystal is connected between pin 3 and 4, the internal reference amplifier forms part of a crystal oscillator and it is possible to obtain your reference frequency with the minimum of additional external components. 'Fin' from the VCO is divided by N, the value of which is selected by the P₀ through to P₈ programmable divide inputs. Figure 1b shows the truth table.

Please note that by having zeros on all the programmable pins, the designers have prevented the user selecting N = 0 or, with only P₀ being held at logic level 1, selecting N = 1. If these logic combinations are selected, Motorola have preset the 'divide-by-N' to be either 2 or 3 as shown in Figure 1b.

The other programmable combinations conform to maximum 2⁹ - 1. For

ROGER ALBAN GW3SPA
BSc. C ENG, MIEE

PART TWO

A look at the PLL02 chip and modifications to the DNT M40FM rig for ten metre amateur use

example, if P₇ is set to logic 1 and the remaining programmable pins remain at zero, a 'divide-by-N' number of 128 will be selected. When all programmable pins are set to logic level 1, then the maximum 'divide-by-N' number of 511 is obtained.

However, because this device was designed some years ago, the maximum 'Fin' that can be reasonably achieved is around 4MHz. Therefore, if this PLL chip is to be used to control equipment

operating at frequencies above 4MHz, then mixing will have to be used to ensure that 'Fin' remains below 4MHz.

Using the MC145106

Figure 2 shows a block diagram of a transceiver designed for 10m FM using the MC145106 PLL chip. The VCO frequency is down-mixed with 6 x 5.12MHz, to obtain an operating frequency which also remains below 4MHz. On transmit, the VCO operates at the transmit frequency. On receive the VCO frequency is mixed with 10.24MHz reference frequency and injected into the receiver first conversion mixer. The programmable divider ratio must be altered between receiving and transmitting.

The phase detector reference frequency had to be set at 5KHz in order that the programmable divider would divide by a whole number to cater for the 'Fin' during receive (ie 'divide-by-R' being 2048). Using the configuration shown in Figure 2 it can be seen that it is relatively easy to construct a 40 channel transceiver using only one crystal oscillator. The adjacent block of 40 channels can be selected by altering the 'x6' multiplier connected to the 512MHz output of the PLL chip.

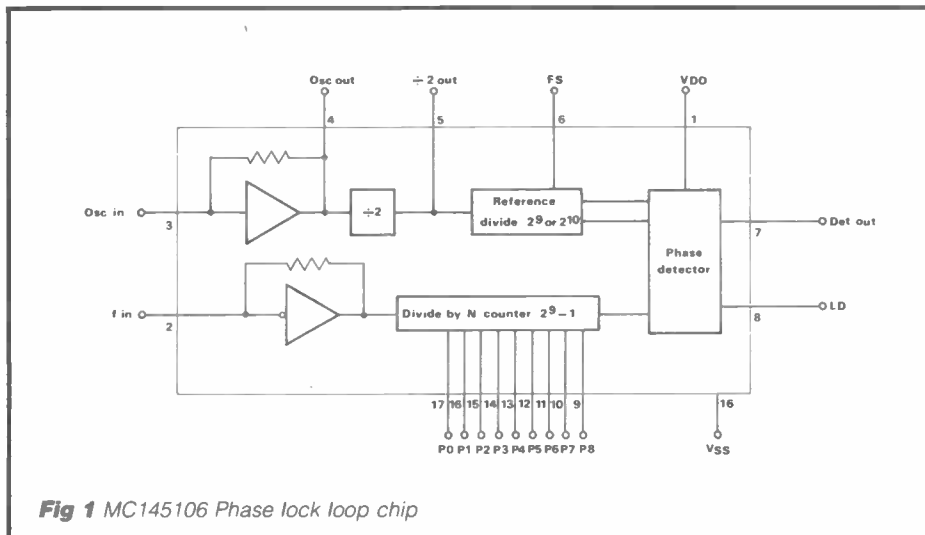


Fig 1 MC145106 Phase lock loop chip

Fig 1b Truth table

SELECTION									DIVIDE BY N
P ₈	P ₇	P ₆	P ₅	P ₄	P ₃	P ₂	P ₁	P ₀	
0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	1	3
0	0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	0	1	1	3
0	0	0	0	0	0	1	0	0	4
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
0	1	1	1	1	1	1	1	1	255
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
1	1	1	1	1	1	1	1	1	511

CONVERSIONS

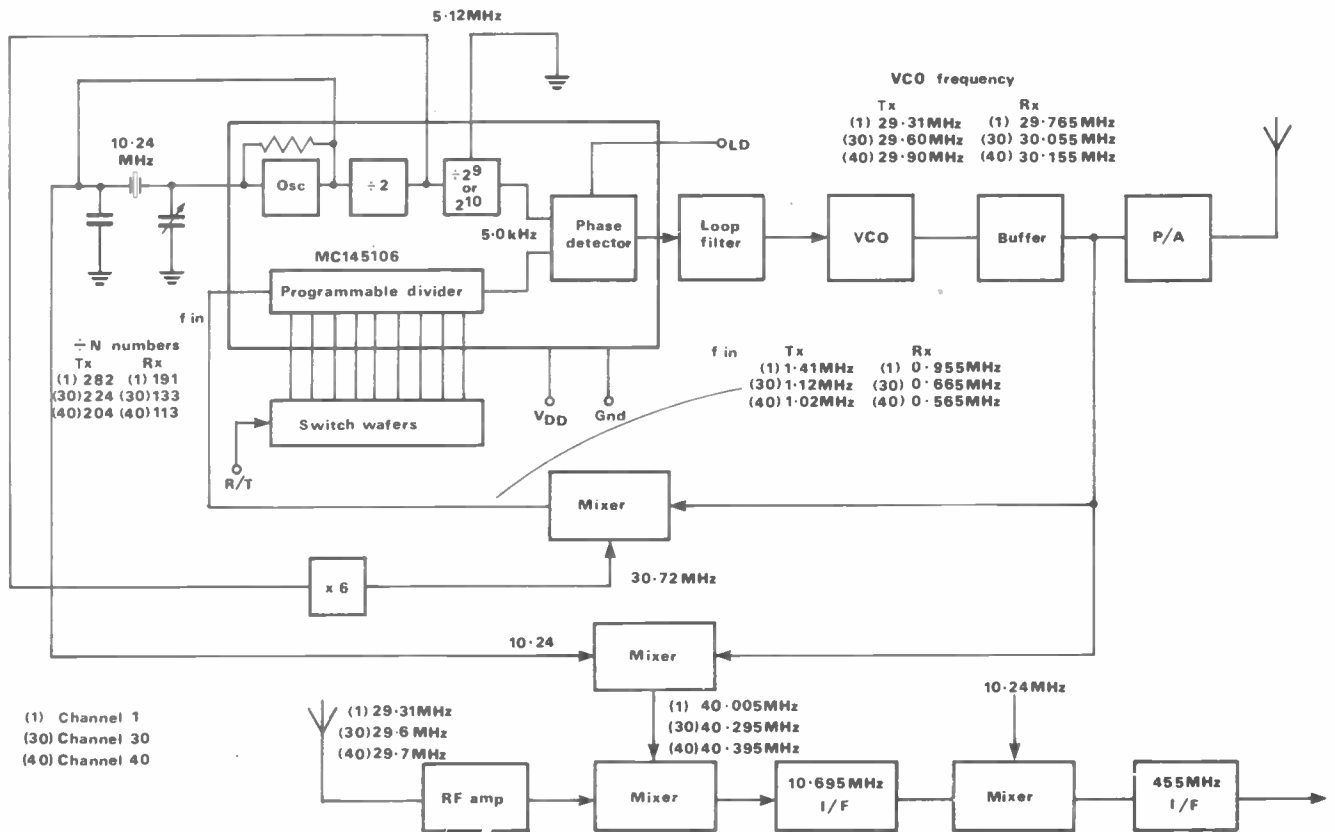


Fig 2 Block diagram of MC145106 10m FM transceiver

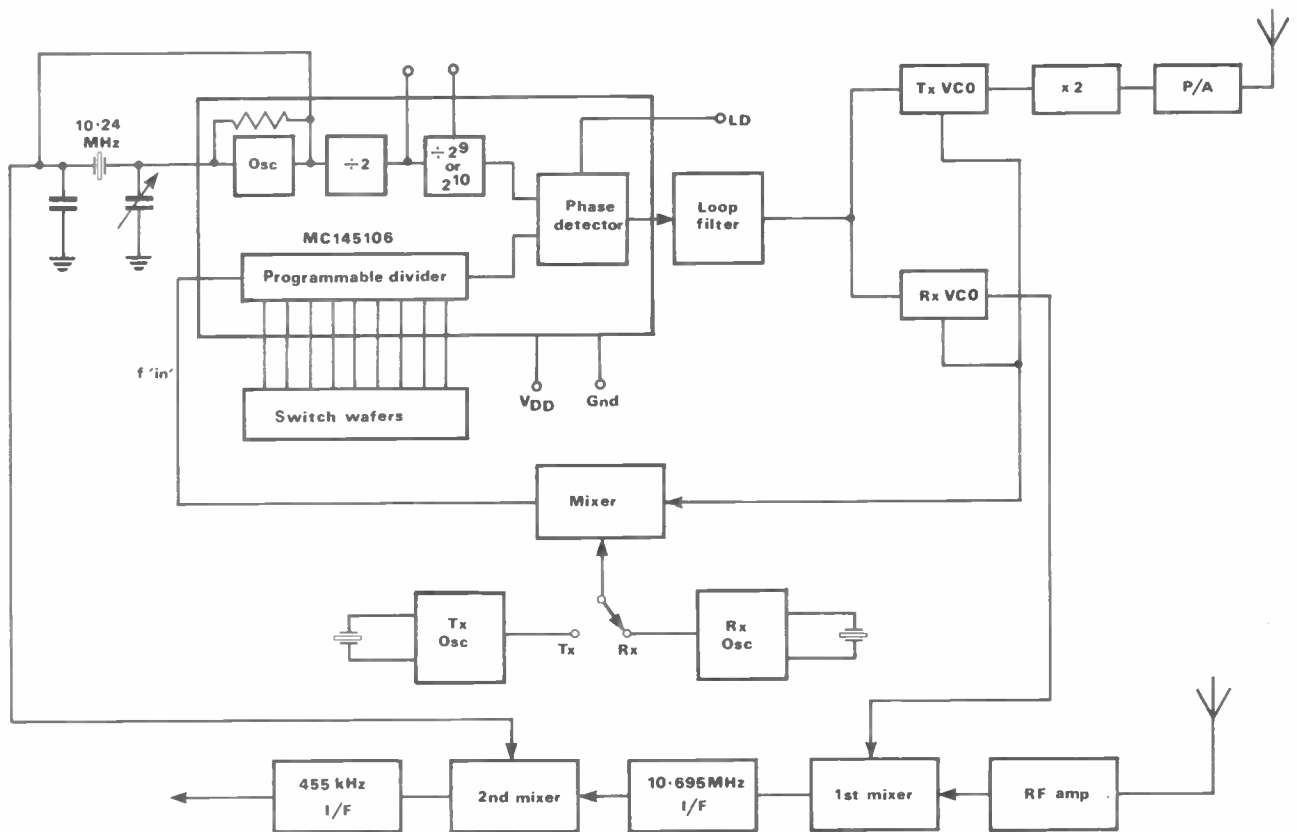


Fig 3 Block diagram of DNT M40FM UK CB rig

CONVERSIONS

It should also be noted that the inputs to the programmable divider are internally connected to pull down resistors which normally set their inputs to ground, enabling these programmable inputs to be controlled from a mechanical switch or electronic circuitry. The phase detector yields a high level dc output when 'Fin' at the phase detector is lower than the reference frequency, and a low dc output when 'Fin' is higher than the reference frequency. An out-of-lock signal is provided from the on-chip lock detector with a logic 0 level being presented to pin 7 when the loop is not locked.

The MC145106 chip can be used on a supply rail varying from 4.5V up to 12V, and this makes it useful for mobile or portable operation. The main disadvantage of using this device is the need to adjust on each channel with 'divide-by-N' number between transmit and receive. There are ways of overcoming this problem, which will be described later.

DNT M40FM rig

The DNT, LCL, type M40FM CB rig, designed to meet the UK specification, uses a Motorola MC145106 PLL chip in a rather complicated way of obtaining the required frequencies and overcoming, to a certain extent, the difficulties of having different 'divide-by-N' numbers for transmit and receive. Figure 3 shows the block diagram of the set.

The 'Fin' is kept within its operational frequency range by down-mixing, using different crystal oscillator frequencies for both transmit and receive. However, this solution does not yield the same 'divide-by-N' number for transmit and receive.

In Figure 3, if the unmodified rig is tuned to channel 30, which corresponds to a transmit frequency of 27.89125MHz, the transmit VCO is operating at half the transmit frequency, ie 13.945625MHz. The VCO frequency is down-mixed with the transmit crystal oscillator running at 11.680625MHz giving an *Fin* to the PLL of 2.265MHz. The 1st mixer in the receiver does not conform to the convention of having the mixer injection frequency being the sum of receive frequency plus the frequency of the 1st IF. In this set, and the majority of CB rigs using phase lock loops, it is convenient to have the mixer injector frequency being the receiver frequency minus the frequency of the 1st IF.

This is the method used within the DNT set. Hence for the receive frequency on Channel 30 (27.89125MHz), the injector frequency is 27.89125MHz - 10.695MHz, giving the receiver VCO frequency of 17.19625MHz. One will now appreciate why the designer, with a VCO frequency swinging some 3MHz between transmit and receive, has plumped for two separate VCO oscillating circuits.

The receiver VCO frequency is down-mixed with the receiver crystal oscillator of 15.2262MHz giving an 'Fin' of 1.97MHz. This is where the real problems commenced for the designer of the DNT

mode of operation	Operating Frequency MHz	Tx VCO MHz	Rx VCO MHz	Tx xtal osc MHz	Rx xtal osc MHz	Tx 'fin' MHz	Rx 'fin' MHz	Tx ref freq KHz	Rx ref freq KHz	Tx +N	Rx +N
UK CB Chan 1	27.80125	13.800625	16.90625	11.680625	15.22625	2.12	1.68	5	10	424	168
UK CB Chan 30	27.89125	13.945625	17.19625	11.680625	15.22625	2.265	1.97	5	10	453	197
UK CB Chan 40	27.99125	13.995625	17.29625	11.680625	15.22625	2.315	2.07	5	10	463	207
10m FM Chan 1	29.31	14.655	18.615	12.535	16.935	2.12	1.68	5	10	424	168
10m FM Chan 30	29.80	14.80	18.905	12.535	16.935	2.265	1.97	5	10	453	197
10m FM Chan 40	29.70	14.85	19.005	12.535	16.935	2.315	2.07	5	10	463	207

Fig 4 Frequency table for DNT rig

circuit. It was hoped that the provision of two separate crystal oscillators for transmit and receive would yield the same 'divide-by-N' number for transmit and receive. In the example given this has not resulted.

Calculations

One may well ask, why not alter the transmit or receive mixer crystal oscillator frequency to ensure that in the above example the 'divide-by-N' numbers for transmit and receive become the same? You will find with the new mixer frequency that when you come to do the calculation for the frequencies associated with Channel 1 that the 'divide-by-N' number for transmit and receive will unfortunately not be the same. Try the calculation!

However, the designers of the DNT M40FM rig used a bit of ingenuity. If you make the divide reference 1024 for receive and 2048 for transmit, this will give a reference frequency at the phase detector of 1024 divided by 10.24MHz or 10KHz for receive, and 2048 divided by 10.24MHz, or 5KHz for transmit. This in turn gives a 'divide-by-N' number of 2.265MHz divided by 5KHz, or 453 for transmit, and 1.97MHz divided by 10KHz, or 197 for receive. The difference between the two 'N' numbers is 256, and remains the same irrespective of which channel you happen to select. It also happens to occur that if you make P_8 logic 1 on transmit only, then you will observe that you are adding a divide of 256 to the transmit 'divide-by-N' number.

You will need the circuit diagram for the M40FM rig. If you look closely you will observe on the transmit logic of IC4 that pin 6 (FS) and pin 9 (P_8) are made to become logic level 1 on transmit.

Procedure

If you happen to own one of these rigs and you wish to convert it to 10m FM, you will need to replace the two crystals in the crystal mixer oscillator.

From Figure 3 you will observe that to satisfy the PLL chip we need to keep 'Fin' at 2.265MHz on transmit and at 1.97MHz on receive. It is advisable to make Channel 30 become the calling frequency of 29.6MHz. Channel 40 will become 29.70MHz - the top end of the 10m band - and Channel 1 will be 29.31MHz.

On Channel 30 transmit the VCO will be on 14.8MHz. 'Fin' must be 2.265MHz, and therefore the transmit crystal oscillator figuring required will be 14.8MHz - 2.265MHz or 12.535MHz.

On Channel 30 receive the VCO will be

10.695MHz lower than the receive frequency, ie 29.6MHz - 10.695MHz or 18.905MHz. The 'Fin' must be 1.97MHz to satisfy the requirements of the PLL chip, therefore the receiver crystal oscillator for the down converting mixer requires to run at a frequency given by 18.905MHz - 1.97MHz or 16.935MHz.

To carry out the following procedures, it is necessary to refer to the original circuit diagram.

Before changing these two crystals it is advisable, with the aid of a digital voltmeter, to measure the dc voltage that appears at the output of the phase detector on Pin 7. This is best carried out at mid band, ie Channel 20. Measure the voltage on both transmit and receive and make a note of the readings.

Now change the two crystals on it and adjust CV2 and CV3 to give the correct crystal oscillator frequencies. Please note that you can only adjust the transmit crystal oscillator when the mike switch is being pressed on transmit. Adjust L18 on Channel 20 receive to give the same dc reading on Pin 7 that you observed before the crystal change. Do the same for transmit by adjusting L6.

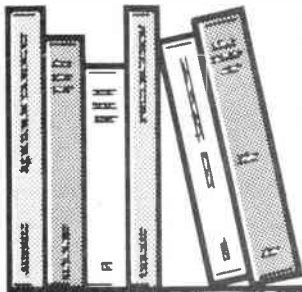
Next step

Having obtained the same dc reading on both transmit and receive, the PLL should now be functioning correctly. The next step is to adjust L1 on Channel 20 receive for maximum sensitivity and adjust L17, L16, L15, L13, L11, L10, L9 for maximum power into a dummy load on Channel 20. After this procedure, the rig should be operating correctly on 10m FM. You may need to adjust R84 to increase the deviation offset.

With this rig it is quite simple to add the transmit offset for operation with the American repeaters. For example, if the transceiver is tuned to Channel 30, (29.6MHz), to work the repeater it is necessary to have the transmit operating at 29.5MHz. The transmitter VCO will be operating at 29.5MHz divided by 2 or 14.75MHz. The 'Fin' must remain operating at 2.265MHz to ensure that the loop remains locked. Therefore, the transmit crystal oscillator must be oscillating at 14.75MHz - 2.265MHz or 12.485MHz. The existing transmit oscillator can be switched with a 12.485MHz crystal by means of a small relay, and controlled by one of the switches on the front panel. Figure 4 shows the frequency table for the DNT rig.

Next month

The PLL02 chip and modifications to the Colt 295 and Binatone Route 66 rigs.

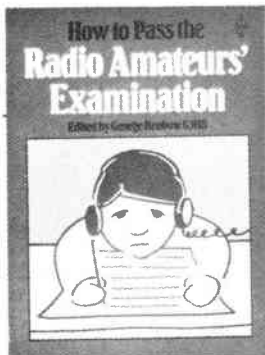


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BACK TO BASICS

Bill Mantovani G4ZVB continues his common-sense approach to passing the RAE. This month: **SEMICONDUCTORS**

Chapter 3 in your *Radio Amateurs' Examination Manual* deals with solid-state devices, mostly in fairly simple terms even if a field-effect transistor or gate-protected MosFET does sound a little daunting to the newcomer. Solid-state devices are often termed *semiconductors* because they are based on conducting material which has had measured degrees of impurity introduced into it in order to reduce its conductivity to within defined limits. Semiconductor material is neither a pure conductor nor a pure insulator, and one of the more common semiconductor devices is the transistor.

From valves to solid-state

In the early days of radio and into the early 1960s communications equipment was based on valve designs, but with the advent of the transistor semiconductor devices began to find their way into radio equipment, with certain advantages. Unlike a valve, a transistor does not require a heating element and can operate on very low voltages, thus not only making it safer when delving inside live equipment whilst fault-finding, but also rendering solid-state designs more readily suitable for battery operation.

Because of the physical size of a transistor, considerably smaller than a valve, the new generation of transistorised radio equipment was far less bulky (and often much lighter, for those with experience of lifting AR88s and the like!) than the trusty valve sets. But transistors too have their drawbacks. Their characteristics are more readily affected by changes in temperature than those of a valve and they are rarely tolerant of misuse, which is why most of today's all-solid-state transmitters and transceivers have in-built high VSWR protection that cuts off the drive to the output section if the mismatch in the antenna system is too great – the consequences of which will be explained when we cover transmitters.

Current handling

Exceeding the current handling capabilities of a transistor can quickly result in one dead device, whereas a valve can be pushed to the point where its insides are glowing cherry red and still work, albeit at reduced efficiency and with its life expectancy a little shorter. The fact that the power handling capabilities of transistors are *not* as great as those which can be achieved with valves can become a problem when attempting to design a solid-state power output stage for a high power HF transmitter. Today's all-solid-state transceivers and transmitters usually have a power output rating of about 100 watts PEP (peak envelope power), though some do go as high as a claimed 200W PEP.

One common solution to the above problem is to use solid-state devices for

all but the driver and PA output stage, for which the trusty valve is once again pressed into service. The Yaesu FT102 and Trio TS530s are two such *hybrid* HF transceivers.

Other changes due to the introduction of solid-state components include the reduction in size and weight of a lot of equipment, hence the trend for the current VHF and UHF handheld portables, and the replacement of the vernier dial or scale with digital readout for frequency display. Memories and even computer interfaces have now become a 'normal' feature for the manufacturer to offer on the very latest models.

Silicon and germanium

Most of you will have heard of silicon, germanium and NPN and PNP transistors. For the RAE the candidate is expected to be able to explain, in simple terms, the characteristics and operation of the above, and the use of transistors and other solid-state devices in radio equipment. Let's start at the beginning.

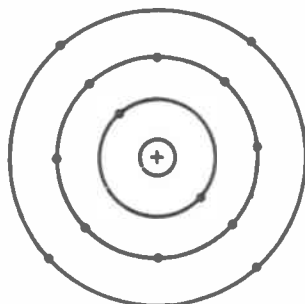


Fig 1 A silicon atom

The most common semiconductors in use are silicon and germanium. The silicon atom (see *Figure 1*) consists of a positive nucleus with three rings containing negatively charged electrons around it. The atom is very stable, ie the negative charge of all the electrons balances out the positive charge of the nucleus. The first and second rings each contain two and eight electrons respectively and will not accept any more, but the outer ring has only four electrons which join with the electrons in the outer ring of adjacent silicon atoms to form a

crystal lattice from which electrons cannot normally escape. This makes pure silicon a very good insulator, but it is possible for the electrons to become detached and move freely away from the crystal lattice and hence allow a large current to flow by the use of high temperatures.

The germanium atom has four rings around its nucleus, each ring having two, eight, eighteen and four electrons respectively. Just like the outer electrons of the silicon atom, the four outer electrons of the germanium atom also join up with those of neighbouring atoms to form a crystal lattice. The outer electrons in the germanium atom are one ring further away from the nucleus than in the silicon atom, and so at high temperatures they become more easily detached and allow a larger current to flow.

By refining silicon and germanium until extremely pure and then adding precise amounts of *impurities* (known as *doping*), it is possible to produce semiconductor material that has either an excess of free electrons (N-type) or has gaps which could be filled by free electrons, termed *holes* (P-type).

N-type and P-type

N-type material is where the lattice is made to appear negative due to doping, with atoms having an outer ring containing five electrons. This causes an excess of electrons.

In P-type material, an impurity with only three electrons in its outer ring is introduced into the crystal lattice to create a hole in the lattice. This is known as P-type material and because it has an electron missing appears positive.

In practice, P and N materials are formed side by side to make *PN junctions*. A *diode*, for example, consists of a small piece of P-type and N-type material fused together. There then takes place an exchange of free electrons and holes between the two materials until an excess negative charge builds up in the P-type material and an excess positive charge in the N-type material. This stops any further movement of electrons and holes across the junction, but if a battery is connected

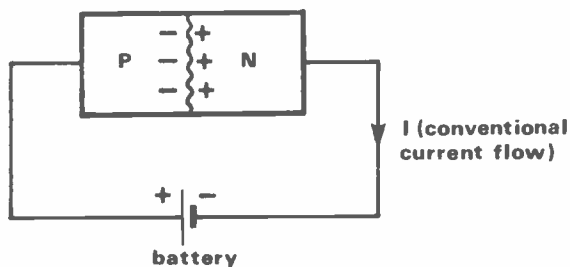


Fig 2 A forward-biased junction diode

across the diode as in *Figure 2*, electrons will be attracted from the P-type material by the positive pole of the battery and forced round the circuit into the N-type material, setting up a conventional current flow (I).

This is called *forward biasing*, but if the battery is reversed the junction becomes *reverse biased* and no current will flow. A silicon junction diode needs a forward voltage of about half a volt before a current begins to flow, whereas a lower voltage (approx 0.1 volt) is required to make a germanium junction diode conduct. Junction diodes are used in power supplies to rectify ac voltages and to demodulate signals in receivers.

Zener and Varactor diode

By changing the manufacturing process junction diodes with different characteristics can be produced, such as the *Zener diode*, which normally allows only a small current to flow up to a certain voltage, but then allows a large current to flow when that reverse bias is exceeded. This useful feature is put to good use where a fairly accurate voltage level is required, such as in regulating a power supply.

By special doping a diode can be turned into a form of variable capacitor, where changing the reverse bias on the diode causes the capacitance across the junction to be varied. This type of junction diode is called a *Varactor diode* and offers a voltage controlled means of altering the frequency of a tuned circuit. Varactor diodes are used for VHF and UHF frequency control where stability is especially important.

Bipolar transistors

If P-type material has two N-type junctions manufactured on it, the bipolar transistor is produced, (*Figure 3(a)*). N-type material either side of P-type material is known as an NPN transistor, whilst N-type material can be manufactured with P-type material either side of it to make a PNP transistor. Considering the NPN transistor in *Figure 3(a)*, the P-type material becomes the *base* of the transistor and the two N-type materials the emitter and collector (b, e and c respectively).

Figure 3(b) shows each junction biased simultaneously, with the emitter-base junction forward biased (low resistance) and the base-collector junction reverse biased (high resistance). The forward biased e-b junction allows a large current to flow into it and therefore

is negative due to the flow of electrons. Normally, these would flow into the base, but because the base is manufactured out of very thin P-type material a lot of the electrons are attracted to the collector, which as you can see is positive with respect to the emitter.

Thus, for a very small increase in the bias voltage on the base, the collector current may be caused to increase by an appreciable amount. Current amplification has occurred and the current *gain* of a transistor is a measure of its amplifying capability. In the example in the RAE manual, collector current is 1mA when the base current is $5\mu\text{A}$ so the gain of that particular transistor is $1\text{mA} \div 5\mu\text{A} = 200$. By placing a load resistor in the collector circuit of *Figure 3(b)*, it is possible to obtain power or voltage amplification. The above also holds true for a PNP transistor when biased as in *Figure 3(b)*, provided that the battery polarities are reversed.

Here are some of the more important characteristics of a transistor:

Current amplification factor (α) – rarely less than 0.98, it is the ratio of a small change in the collector current to the change in emitter current causing it.

Current gain (β) – silicon transistors normally have a higher current gain than germanium ones and the value of β is usually between 50 and 100. This is a measure of the change in collector current for the change in base current which caused it.

Transition frequency (f_t) – denotes the highest frequency to which a transistor can still amplify.

Germanium transistors were the first to be developed and tend to be PNP-type, whilst silicon transistors are usually NPN. The germanium transistor has a larger base current than a silicon device, and the maximum temperature at which it will safely work is only about half that for a silicon transistor, making the latter more popular for most uses today.

If a *heatsink* is fitted to a transistor to reduce the temperature of the junction, then the transistor can be made to handle a greater power than normal without fear of damage to the device. Some heatsinks are simply small fins that clip over the transistor, whilst in high power applications the case of the equipment may actually be the heatsink.

Field-effect transistor

The *field-effect transistor* or FET is a piece of N-type material with a ring of P-type material formed around it. The ends of the N-type material or *channel* are referred to as the *source (s)* and the *drain (d)*, whilst the P-type ring is called the *gate (g)*.

Figures 4(a) and *4(b)* show the FET and its symbol, whilst *Figure 4(c)* gives the symbol where the FET has a P-type channel and an N-type ring. The FET is different to the transistor in that the current consists of electrons moving only in one direction, with no holes moving in the opposite direction as in a transistor. Thus the FET is a *monopolar device* and is called the *junction or junction gate FET*, and its operation should be noted from Chapter 3 of the *RAE Manual*. It is worth remembering that the input impedance of the reverse biased FET is very high and that the FET can be regarded as a voltage operated device.

Use of solid-state devices

The application of the solid-state devices just covered have already been mentioned in the above text. The *RAE Manual* however, covers their application a little more thoroughly than we have space for here, so the remainder of Chapter 3 should be carefully read.

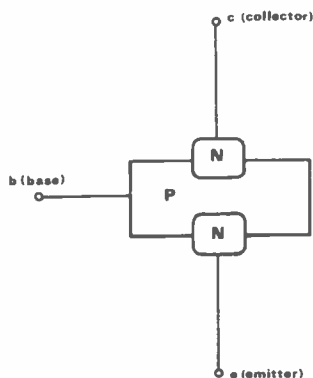


Fig 3a The NPN bipolar transistor

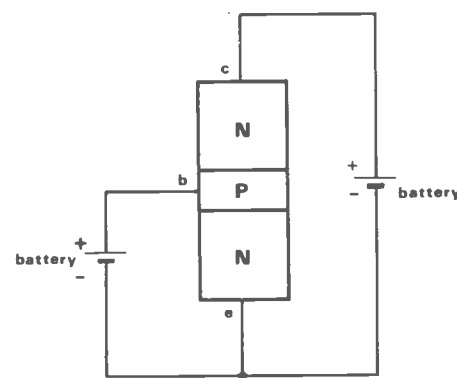


Fig 3b Biasing an NPN transistor

BACK TO BASICS

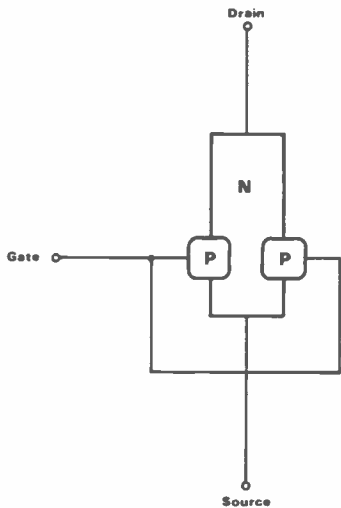


Fig 4a A field-effect transistor

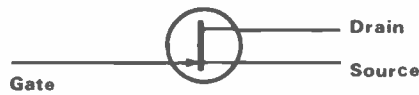


Fig 4b N-channel FET symbol



Fig 4c P-channel FET symbol

FET, and these should be remembered.

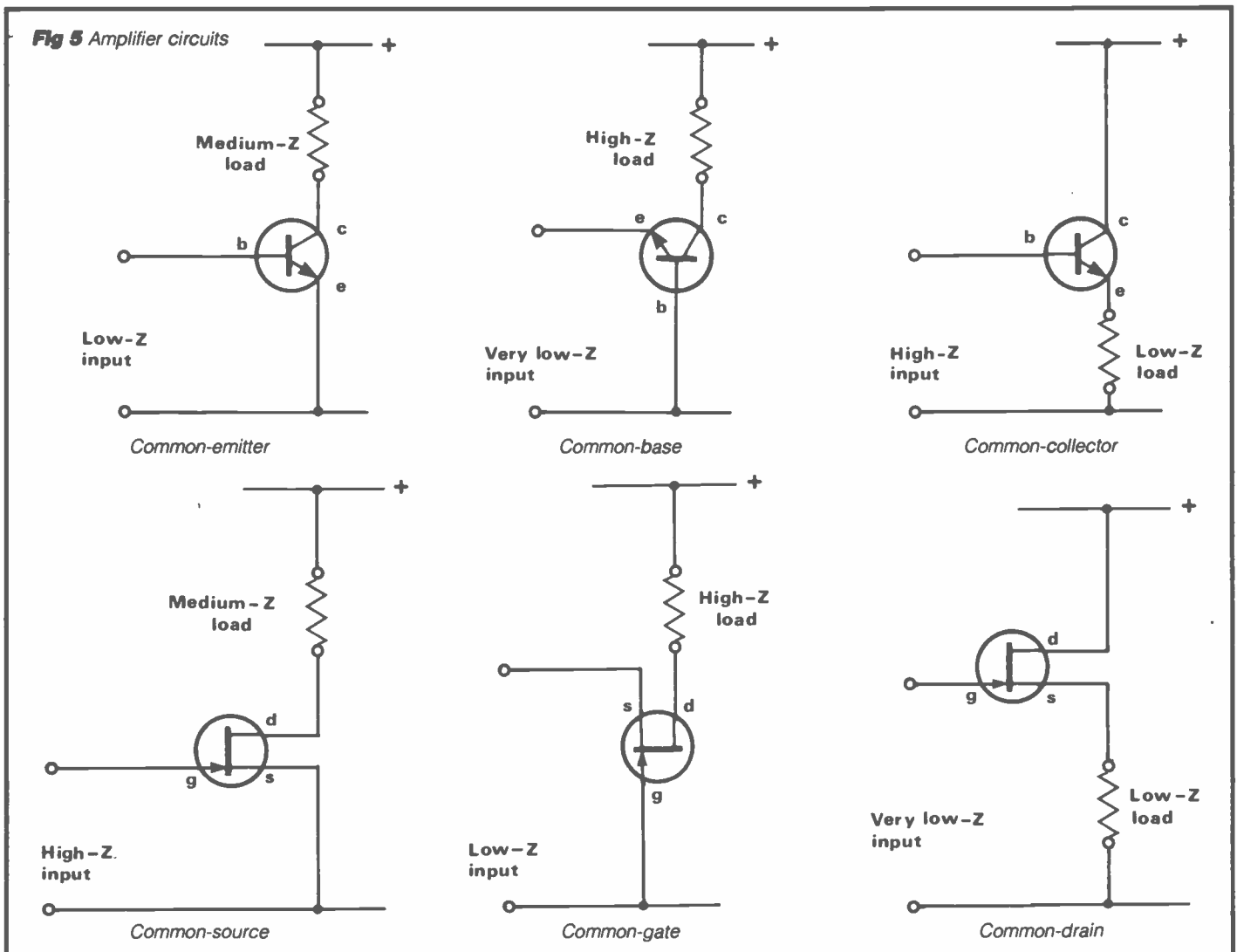
The most-used arrangement in transistor amplifier circuits is the *common-emitter* configuration, which features a low input impedance of between 500Ω and 1.5KΩ and a medium output impedance of 1KΩ to 10KΩ. The input impedance of the *common-base* circuit is very low (50Ω or less) but its output impedance is high (50KΩ and greater). This arrangement is used when connecting to tuned circuits. The *common-collector* (or *emitter follower*) circuit would be used where a degree of isolation is required between two stages because its input impedance is very high

(250KΩ and more) but the output impedance is low (about 1KΩ).

Transistor operating conditions

Class A operation is where a transistor is biased to operate with a steady collector current flowing at all times. If you were to look at a graph of the characteristics of the transistor, as shown in the *RAE Manual*, then the transistor would be operating along the straight part of the curve and the application of a small signal at the input of the class A amplifier causes the output voltage to vary. The characteristic curve though is not usually a proper straight line, so some distortion of the output voltage waveform will be noticed.

Distortion in a class A amplifier can be reduced by the use of *negative feedback*, that is, by feeding back just a fraction of the signal at the collector into the base. This serves to alter the bias on the base as the output voltage swings between its two peaks and hence reduce the distortion somewhat. This is called *voltage negative feedback* but it is also possible to use *current negative feedback*, both of which help to reduce distortion and increase the amplifier's input impedance, although this does reduce the amplifier's gain.



BACK TO BASICS

Class B operation is when a circuit is biased to allow only the flow of collector current when the input signal is in its positive half-cycle. Class B amplifiers are used in audio applications, where they are connected in a *push-pull* configuration which serves to appreciably reduce distortion in the output waveform. This type of amplifier is normally biased to operate just short of the class B state, so that there is still a very small collector current flowing at all times, even with no input signal present.

In a *class C* amplifier, no current flows in the collector circuit until the input signal hits its peaks on positive-going cycles. This does cause very severe distortion but the supply only has to deliver the current in pulses. Class C amplifiers are used at radio frequencies and normally incorporate a *tuned load*.

Oscillators

If a sufficient amount of the output signal is fed back into the base of a transistor amplifier so that it is amplified and again appears at the output etc, then the circuit eventually breaks into oscillation. There are a number of ways in which this feedback can be arranged; by the use of a tuned circuit as the load and a coupling coil taking the signal back into the base, or by the use of a single tapped coil. Two of the more commonly used oscillator circuits are the Clapp and the Colpitts oscillators, both named after their designers.

Frequency multipliers

Because the characteristics of a transistor are non-linear, the output of an amplifier circuit may not always be sinusoidal, that is, the collector current waveform may be distorted and contain harmonics as well as the fundamental frequency of the input signal. These harmonics, if required, can be made use of and the circuit then becomes a *frequency multiplier*.

If a tuned circuit that is resonant at the second harmonic is used as the collector load, then a small output voltage which is at twice the input frequency is obtained which can then be made use of. A push-pull amplifier stage makes an effective frequency tripler. Frequency multiplica-

tion stages are often used in transmitters to provide output on different bands, harmonically related, from one low frequency oscillator. This will be covered when we look at transmitters.

There are many other types of solid-state devices, though for the RAE you would not be expected to go into detail about such things as the metal-oxide semiconductor field-effect transistor (MosFET), or the gate-protected MosFET. It is wise to remember what the term MosFET stands for, and what the circuit symbols are for MosFETs.

Integrated circuits

Progressing on from the fabrication of one single transistor it is now possible, and often desirable, to produce a complete circuit on a single P- or N-type silicon substrate. These are known as *chips* and come in various packages such as a transistor-sized can, or encapsulated in a plastic or ceramic case. As well as digital ICs (integrated circuits), which were the first to appear and in amateur applications are used in frequency counters, keyers and control systems, there are also linear ICs, the diode array (a number of diodes inside one package) and similarly, the resistor array.

Linear ICs, thus called because they operate in a linear mode as compared to the on-off mode of the digital IC, are often used in amplifier, oscillator and mixer circuits etc, whilst for power supplies it is possible to use one single chip to do all the regulating. The *Darlington pair* circuit, where two transistors are connected in cascade mode,

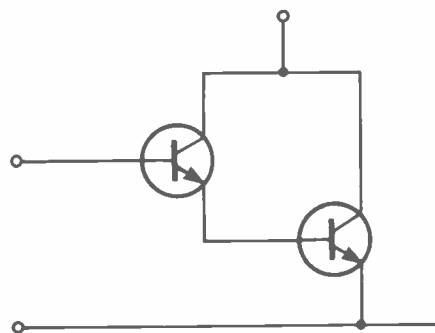


Fig 6 Darlington pair circuit

also comes in an IC package and it will be useful for you to remember the Darlington pair circuit shown in *Figure 6*. Darlington pair transistors are often used in power regulating circuits.

CMOS, or complementary-symmetry metal-oxide devices are now widely used in a lot of equipment as they generally consume far less power at lower supply voltages than normal ICs.

CMOS devices exhibit much higher impedances and again, it may be useful for you to remember what CMOS stands for.

You should now have some idea of how a transistor and a transistor circuit works. Next month we look at how these circuits can be used to form a radio receiver, the principles of radio reception and the reception of various modes such as CW, SSB and FM. Meanwhile, don't forget that you can always do some homework by referring to REG Petri's book *'The Radio Amateurs Question and Answer Reference Manual'*, which contains questions on what we have just covered on solid-state devices in the chapter entitled 'Semiconductors'. Have a Happy New Year and here's hoping that 1985 brings an RAE pass!

Acknowledgements and references

A Guide to Amateur Radio - Pat Hawker G3VA (RSGB)
Radio Amateurs' Examination Manual - GL Benbow, G3HB (RSGB)
City and Guilds of London Institute The Radio Amateurs Question and Answer Reference Manual - REG Petri (G8CCJ)

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AERIALS AND PROPAGATION

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PART 4

This month we return to aerials to see how we can maximise their performance in the light of what we have discovered about propagation

Figure 1 shows the constant variation between current and voltage which occurs in a half wave aerial. This detailed analysis indicates that at point A the current is at a minimum and the voltage at a maximum. Because of this we have a situation of very high resistance. Also, since the change in direction of the waves as they go through the horizontal axis is zero, there is no phase difference, so the impedance is pure resistance containing no reactance. At point C the reverse situation appears, in which current is a maximum and voltage is a minimum, thus giving a low value of resistance, again with no reactance.

In the quarter wave section between A and B the current increases so that a capacitive reactance is present, while between B and C the reverse applies and the aerial becomes inductive. By plotting the effective values of impedance along

the length of the aerial, a rapidly increasing impedance value is found as we move away from the centre.

From first principles, in order to transfer maximum power from the transmitter to the aerial one essential factor must be met: the impedance of the load must be matched with the impedance of the generator (see Figure 2). This is OK for the dc circuit, but for complex circuits carrying RF it is necessary for the cable carrying the power to have an impedance equal to that of the generator and load, to ensure maximum efficiency or minimum power loss.

Speaking in Ohm's Law terms the impedance of the line is the relationship between the current flowing in the line and the voltage across it, and this should be constant along the line for maximum power transfer.

Figure 3 shows a typical electrical analysis of a length of coaxial line in its simplest form. The energy stored in the line will be equally divided between the capacitive and the conductive fields so: $Z_0 = L/C$. Obviously the determining factor is the relationship between L and C, and this is fixed largely by the ratio of the two diameters as shown, and the dielectric constant of the insulating media used as the separator.

Varying Impedances

By suitable adjustments of these factors, lines of varying characteristic impedances can be manufactured and generally speaking the limit of impedance on this type of line is about 180ohms. For lines of higher impedance, open parallel lines are used (although sometimes a thin layer of plastic bridges the lines, as in 300ohm feeder). In this case, the areas facing between the two wires creates the capacity and the wire the inductance (Figure 4a).

The ratio of the wire diameter to the separating distance determines the line characteristics. Coaxial cable has two different relationships to earth from its separate conductors (Figure 4b), and is thus called an unbalanced feeder. On the other hand, the open wire line (Figure 4a) shows equal relationships to earth from its two feeders and is known as a balanced line.

During the progression of a wave front down the coaxial cable the voltage field puts a strain on the molecules in the dielectric, creating a displacement of electron orbit into an elliptical form with the nucleus being forced to one end and the electron charge concentrated at the other.

In solid dielectrics the number of particles affected is greater than in air or semi-air spaced dielectrics, so that an

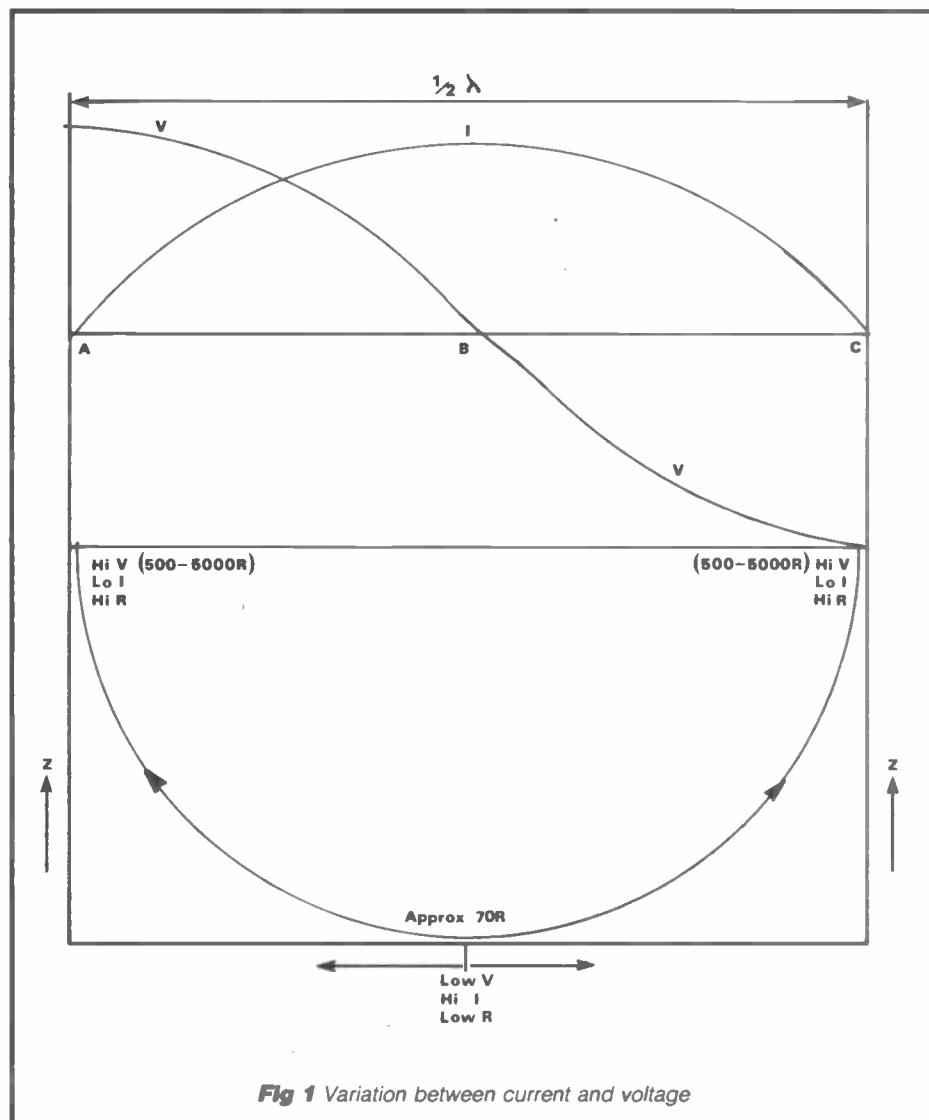
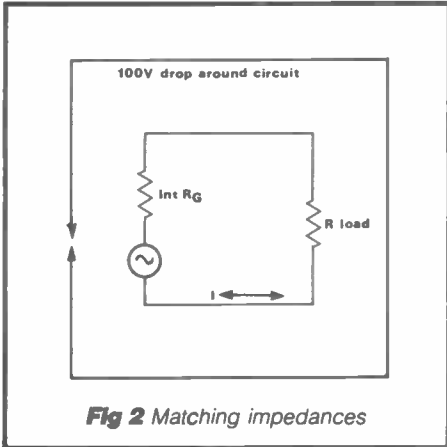


Fig 1 Variation between current and voltage

AERIALS & PROPAGATION



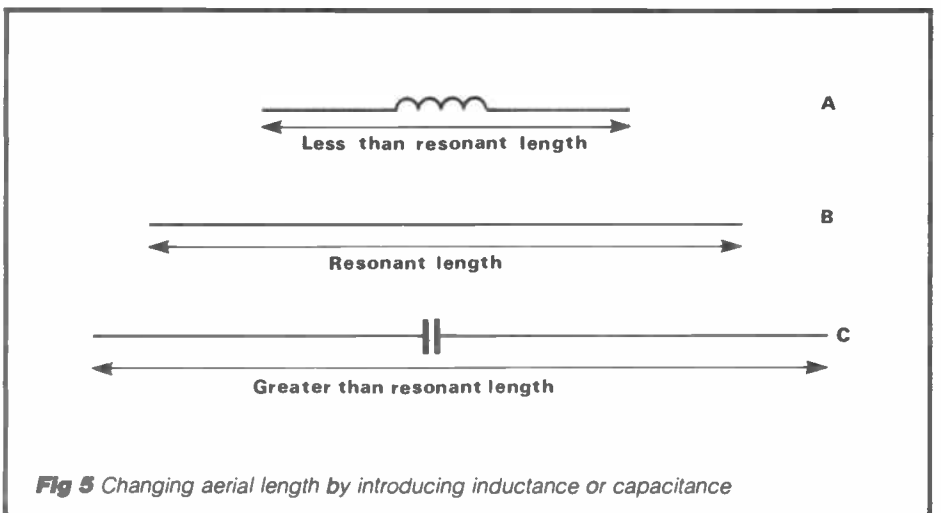
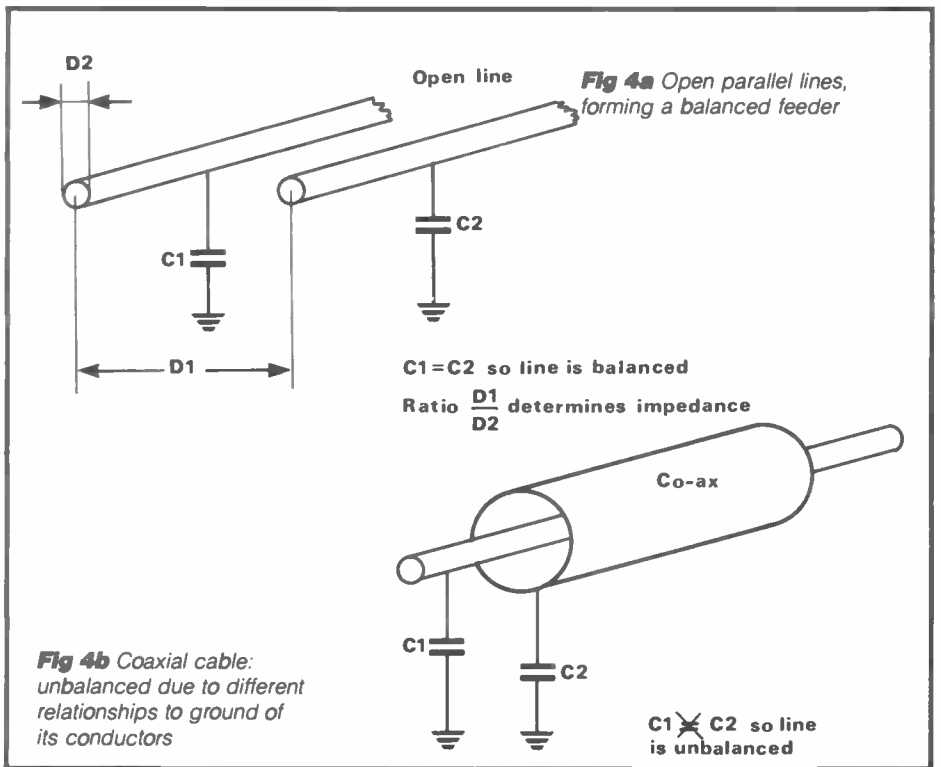
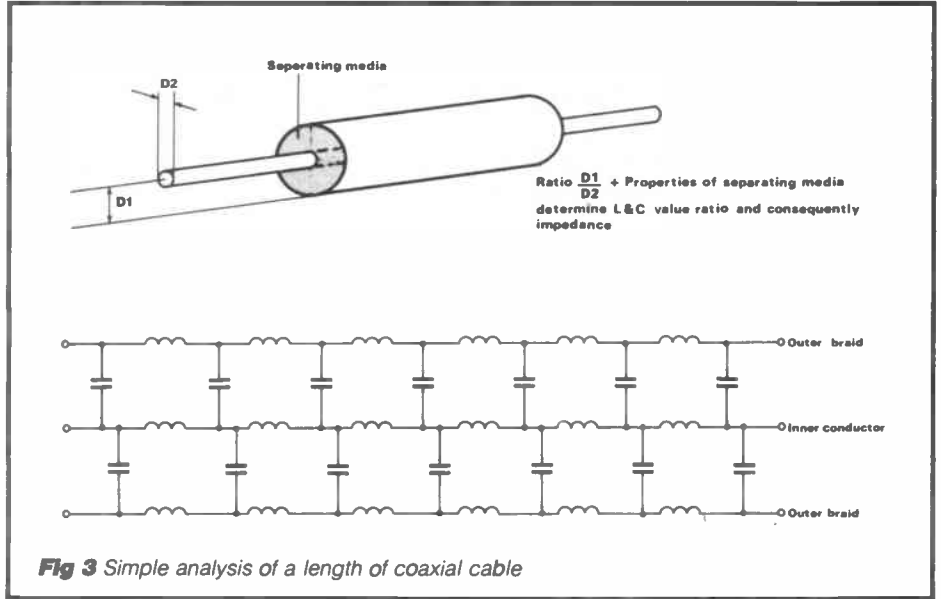
increased delay to the wave front is caused by this build up and reversal of field as the front passes down the cable. This delay results in a factor being applied to the cable called the 'velocity factor'.

This is a measurement of the rate of slowing down of the propagation velocity. For solid cable it is usually about 0.68, for semi-air spaced about 0.80 and for 300ohm ribbon about 0.86. The general effect of this propagation delay means that the physical length of a section of coaxial cable is the electrical length times VF, eg a 1/4 wavelength on 20 metres with a VF of (0.8) coax = 5 x 0.8 = 4 metres.

The previous discussion on characteristic impedance indicates that this value is of vital significance in matching circuits. It is important to recognise that true matching can only be achieved with resistive circuits, and that reactance has an effect on the final value since reactance is frequency dependent. The classical expression for the characteristic impedance resistance of a feeder is that 'it is equal to that value of pure resistance which, if applied to the end of the line, will absorb all the power proceeding down the line'.

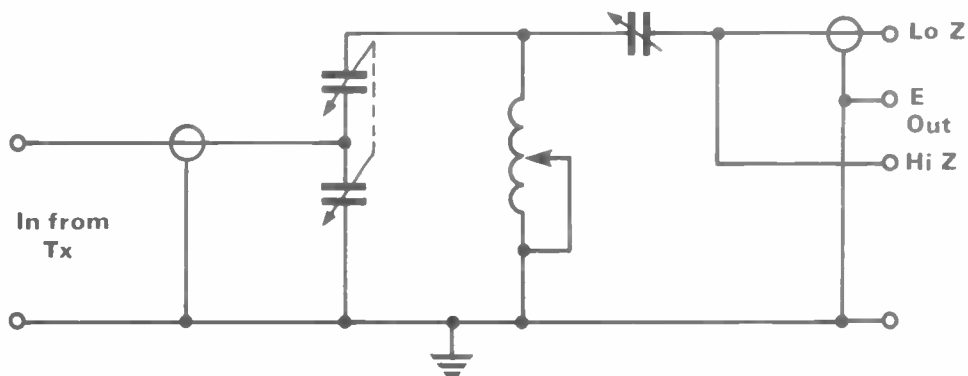
Considering this point it is apparent that if we extend the line to infinity in a theoretical sense (ie assuming no resistive losses), since the impedance of the line at any point is constant and always equal to the value of the terminating resistor, then, providing the line is properly matched to the load, the line length is of no significance. In real life attenuation occurs mainly due to resistive losses. It is only when mismatched loads are applied that line length assumes a degree of significance.

The effect of electrically controlling the length of an aerial is shown in Figure 5. B is a true electrical length. By introducing inductance into the aerial the physical length can be reduced as A, and by introducing capacitance into the aerial the length can be increased as C. This is a simple manner in which aerials can be brought to resonance! A typical example is a 5/8 whip which is actually a 3/4 wave aerial electrically shortened. The importance of this fact will be obvious shortly.



AERIALS & PROPAGATION

Fig 6 The basic circuit configuration of a Transmatch



Balancing

The effect of feeding the aerial at any point other than at either the centre or the ends means that some method of balancing out the reactance present in the feeder will be necessary, and also some method of transferring one value of resistance to another will have to be incorporated.

In order to balance any value of reactance an equivalent amount of reactance of the opposite sense must be incorporated in the circuit, ie if capacitive reactance is present it can only be cancelled out by the introduction of an equivalent value of inductive reactance and vice versa.

The value of reactance at any one time

is, of course, frequency dependent, so that if matching over a range of frequencies is required some form of adjustable matching device is necessary. The usual technique is to incorporate a so called aerial tuning unit in the feeder line, the range over which the tuner will operate being adjusted to permit either capacitive or inductive reactance to be added to the circuit to cancel the reactance remaining in the aerial. This gives a resistive-only variation and further values are introduced into the tuner to compensate for this effect also. The net effect of this is to allow the tuner to (a) cancel out excess reactance, then to (b) transform resistive values as shown in *Figure 6*.

In effect the unit is transferring the impedance presented to the feeder into one acceptable to the transmitter output, as a load capable of accepting full power. The units in general use for this application are called aerial tuning units, but this is a completely wrong description since they tune the transmission line to suit the load presented at the aerial end. The correct name is a transmitter matching unit or Transmatch.

Next month

Part 5 of *Aerials and Propagation* deals with the often misunderstood subject of standing wave ratios, and (hopefully) clears up some of the confusion surrounding the matching of installations.

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Amateur RADIO

ANGUS MCKENZIE G3OSS
reviewing the new Icom IC741H 70cm base station

JOHN HEYS G3BDQ
with a look at multi-band grounded antennae

GOING 10m MOBILE
John Petters G3YPZ with some tips for this low-cost form of operation

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AMONG MY SOUVENIRS: Marconiphone V2A

by Old Ham

Well worth rescuing from someone's ancestral loft was my Marconi V2A two-valve receiver which takes pride of place among other historical working models of yesteryear.

Although a little weakened by age, it still manages to hold its own alongside many other receivers of relatively modern times. When one considers the age of the instrument, it is easy to reflect upon a few modern failures.

The old set needed just a few repairs, two dry joints and a DER valve, to get it operational. I was so impressed that I decided to seek out some history with a view to writing this article.

The first Marconiphone model V2, made its debut in October, 1922. In those days, radio equipment had to be registered with the GPO who allocated the number 2001.

Withdrawn

However, the set was quickly withdrawn from the market due to its lack of sensitivity for, at that stage, it was minus its regeneration system. Not many of the original models found their way into public circulation which was as well, for soon afterwards the improved version, the V2A, appeared under GPO registration No 0175. This receiver was called the 'Long Range Model' and it incorporated the new capacitive regeneration unit which added greatly to its sensitivity.

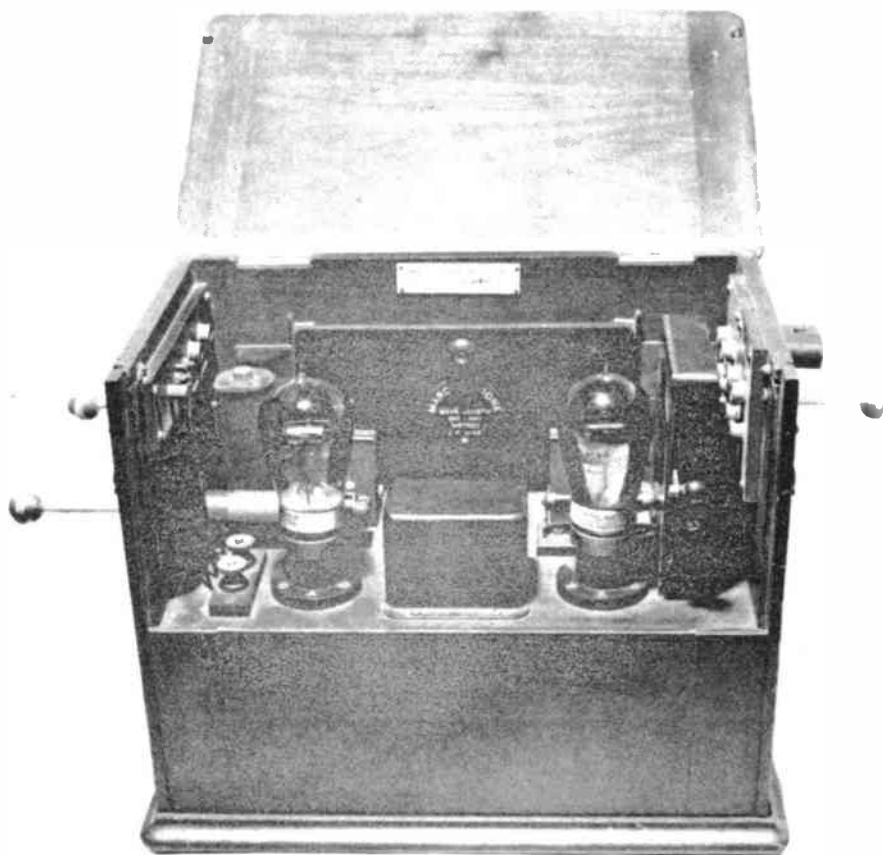
Basically, the V2A employs reflex circuitry. A short description will not be out of order, reflexion being a somewhat dated technique. The circuit diagram reveals a stage of HF amplification choke-capacity coupled to a leaky grid detector. The signal, once demodulated (forgive the modern term) appears at the anode of the detector valve to be fed back to the HF amplifier grid via the LF transformer; the audio frequencies being amplified and the resultant signal being fed to the earphones. It saves an extra stage and is reasonably stable.

The object of the regeneration unit was to enhance the sensitivity of the equipment, this being achieved by the coil in the anode circuit of the detector valve. This coil had its inductance varied by means of a thin copper plate which



was made to move over the coil surface whilst being electrically insulated from it. This variation in capacity caused a potential variation across the coil which was capacity-coupled to a tuned grid parallel circuit of high impedance, thus was the regeneration applied.

Looking at the picture of the wireless receiver, you can see on the extreme right the regeneration unit which is plugged in to facilitate easy change. This was standard practice in the early days, the aim being to eliminate complex switching systems, HF losses, and



SECONDHAND EQUIPMENT GUIDE



Since this column started I have received dozens of letters asking for help in repairing various amateur radio related items. These requests have ranged from the humble Rigonda portable Russian TVs (a very popular request since I let it slip that I knew my way around them, and circuits for these seem particularly hard for some people to obtain) up to complex supply problems within a Yaesu FT980. Although I do not wish to become an 'agony aunt' for owners of wayward radios, a lot of the letters are of use to me since they remind me that common faults, or logical approaches towards repairs that I have learnt over the years, may not be known by all.

Another common request I receive through the post is for circuit diagrams or service manuals. Although I help out where I can, many readers may be surprised to learn that, although I normally repair at least one rig a day, circuit diagrams are often not used.

Repair log

I have found that a log of 'repairs done' can come in handy. I started keeping one when I knew I had had a similar fault on a piece of equipment and couldn't remember what had caused the failure (until I found it of course!). It is interesting to note from this list that just over half the faults (60% actually) are what I classify as power supply related.

Several times I have been asked to repair rigs and, upon connecting them up on the workbench, found them to be working OK. Even a living legend such as your scribe cannot repair a fully functioning rig. The causes of this happy event are either faulty line connectors (be it a dodgy mains socket in the owner's shack or a duff fuse-holder in the owner's car) or an inability on the owner's part to get it working. One well known professional supplier used to supply new equipment with a bag attached to it labelled 'When all else fails the instruction book is in here'. However, let us assume that equipment which has functioned well for years suddenly goes dead.

How dead is dead?

Does it light up when turned on? This may seem so obvious that it doesn't seem worth pointing out, but somehow owners just have to run round in a state of panic when their mega-pound rig ceases to function, normally the day after the guarantee runs out, when a few minutes thought might well solve the problem. If you turn it on and the lights come on, and on to their normal brightness, then it is a



by Hugh
Allison G3XSE

reasonable assumption that the power, be it mains or 12V, is getting into the rig.

The comment about 'normal brightness' is worth noting, by the way. I have recently repaired three TR9000 2 metre multi-modes all with the same fault, viz good receive and poor transmit, especially on SSB. The clue was the severe dimming of the metre illumination on transmit, which turned out to be poor contacts in the 12V input plug/socket on the back of the rig.

Do not touch!

So it has been established that the power is getting to the rig, and you want to have a go yourself. My definition of someone who is competent to try a repair at home is someone who knows what *not* to touch. This falls into two categories, things not to touch due to danger to the person, viz mains sockets, high voltage points etc, and things not to touch that will make things worse, viz the CBER whose rig dies so he lifts the lids off and tightens up all the ferrite cores in the coils (they do, honest).

A little word of warning about voltages, by the way. Do not assume that a 12 volt rig will not have any high voltages in it, and hands can be inserted at will. I have had several burns from 4 watts of RF at 430MHz, so take care. If you are uncertain, don't do it!

As previously stated, the highest proportion of faults are power supply related. As the covers come off, have a quick look round for signs of burning or obvious distress (bulging capacitors, charred components etc). It is also amazing what a quick sniff round can reveal - if the rig has recently died, your nose may well lead you to a charred component. A transistor in a metal can

that looks duller than others may well have over-heated.

Power supply

No luck with the physical examination? Then its volts on time. Suppose you have mains powered equipment and no handbook, how can you check out the power supply? The trick is to look at the 'voltage working' rating on the capacitor cans. As a rule of thumb, most designers allow a 50-70% safety margin, so a capacitor rated at, say, 18 volts will probably have 9 to 15 volts on it. Similarly, one rated at 500V dc will probably have 300 to 400 volts across its terminals. If the voltage is considerably lower, non-existent or reverse connected (ie it has the positive up the negative end), then you are close to finding your fault. A voltage considerably in excess of the working voltage is obviously bad news. A lot of designs have the power supply all in one corner, so find the mains transformer/rectifiers/smoothing capacitors and check the voltages.

Regulators

Regulators, stabilisers, call them what you will, constitute the biggest single fault area in a rig. Follow the output of the 'raw' supply, ie the voltage across the capacitors above, and it's odds on that it may be dropped to a lower, stabilised voltage by a series device.

In the days of valves, big high wattage wire wound resistors were often encased in a ceramic housing. A lot of these are hydroscopic - they absorb moisture. A valve rig stored in a shed, or even a damp shack over night, can absorb water into these resistors. On turn-on the heat expands the water and may break the ceramic. Early Telequip-

SECONDHAND

ment 'scopes are particularly prone to this by the way – resistors in the HT circuitry are often unmarked, but 300 to 500Ω seems suitable!

Back to more modern equipment. If you have a series regulator transistor, see what you have on its collector, base and emitter. Normally the collector is at full 'raw' volts, the base about 0.7V higher than the required rail (again, capacitors across it may give a clue) and the emitter is at the requisite voltage. If there is nothing on the emitter, turn off and check if the regulator is hot. If it is, the short/fault is elsewhere, but on that rail. If it isn't, the regulator transistor is

probably open circuit.

A good tip in a simple regulator that is not variable is to check the zener voltage with an AVO and then allow 0.7V drop for each transistor between it and the stabilised rail. Incidentally, you can often (but not always) see some correlation between the voltage across a zener and its part number, viz ZD5.6 is a 5.6 volt Zener.

When written down, all of the above seems painfully simple, but statistically you have a 60% chance of a successful repair by following it through. The other 40% will be exclusively revealed to you next month.

COMPETITION

RADIO GASTRONOMY

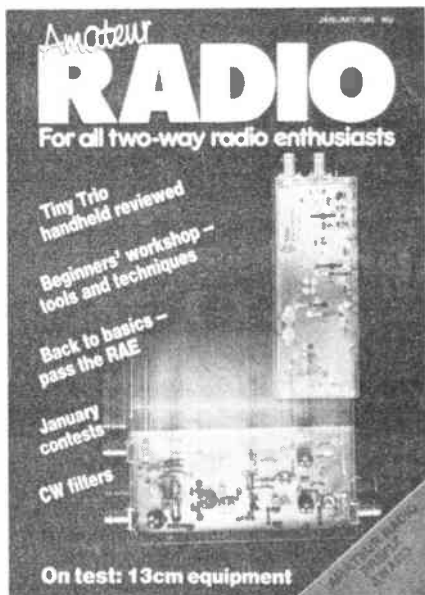
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FOR SALE

■ HRO senior communication receiver with assorted coil packs full working order £75.00. Also B40-D SSB adaptor with some paper work £60.00. Ask for Derek. Tel: (021) 744 8042.

■ Ten Tec Argonaut 509 in mint condition £240 ono. Astatic D104 mic with UGB stand as new £45. Servomex voltage stabiliser 195Vac to 265Vac at 32amps. Weighs 140lbs. Buyer collects, offers. Martin Wills G3ZZS, 21 Woodford Road, Glenholt, Plymouth P26 7HX. Tel: Plymouth 707550.

■ 2 metre handheld's 2 Belcom LS20XE with amp batts Vox mic car mag aerial, the lot £190. Tel: (041) 429 2841.

■ Microwave converter 144MHz to 28-30MHz-IF. Microwave converter 144MHz to 50-54MHz-IF. Both in new condition, £15.00 each ono. Tel: 01 889 4431 any evening.

■ Yaesu FP700 power supply £85, also FC700 ATU £75, both items unmarked still under guarantee. Contact Steve, Tel: Walsall 640861 (West Mids).

■ Yaesu FRG7 comm receiver good condition with instructions £100. Mizuho ultra loop UL1000 fitted with mains power and instructions good order £30. C H Fern, 25 Fullylove Court, Bolsover, Chesterfield S44 6EZ. Tel: 824257.

■ Yaesu FT102 HF Tx/Rx, AM/FM unit fitted. Also workshop and instruction manuals. 11 months old. For sale or exchange for Trio TS780 or IC471E. Tel: Gravesend (0474) 57795.

■ Racal R117E. Perfect condition £215. Part exchange for mobile 2m or 70cms WHY. Tel: 029 922 279 (Clows Top, Worcs).

■ Ten Tec Century 21, CW, 5 band Tx/Rx, full break in, £130. Icom 2E, £115. Icom 4E, £115. Base charger, £30. Tel: Ashford Middx 44265 anytime (G4VZZ not QTHR).

■ Eddystone communications receiver model 750. Vintage 1956 complete with original instruction manual, S meter and speaker. Very good condition and powerful working order. £70. Charles Homan. Tel: (0926) 494530 (evenings).

■ Daiwa search 9 marine band receiver, perfect cond plus telephone set D ex-WD, suit collector. Also perfect cond Slim Jim 2 metre antenna. £55 the lot, or will consider splitting. Buyer collects or pays postage. David Burton, 100 Garden Hill, Hollingbury, Brighton, Sussex, BN1 8DB.

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■ FT208R 2m handheld complete with spkr/mic one month old, unwanted gift mint £190 or exchange HF linear or HQ1, or any HF beam. Cash adjustment either way. Tel: (0792) 401058. GW3XCR.

■ Yaesu FT77 with FM board fitted, complete with MD1 microphone as new condition £360 ono. Steve, Tel: Walsall 640861 (West Midlands).

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■ Trio R600 comm Rx, mint condition, £169. Could deliver up to thirty miles. G8DEE, Mike Woodhouse, 24 Hurst Park Avenue, Cambridge, CB4 2AE. Tel: (0223) 64251.

■ National Panasonic RF2800 LBE, 6-band portable radio; FM, LW, MW, 3 SW 3-30MHz, BFO digital readout, with operating instructions, £75. Yaesu FRG7, with instruction manual, £75. Regency Digital Flight Scan, AM Scanner (Airband) £150.

Tandberg TCD310 cassette tape deck with Dolby, £75. Tandberg Cross Field, Series 3641, Dolby reel-to-reel tape deck, 7½, 3¼, 1½ ips slight defect on one recording channel, otherwise OK, £150. Binatone Long Ranger 6, hand held CB transceiver, in new condition, £10. Enquiries to J McIntosh, Tel: (0309) 72101.

■ Sphinx SSB transmitter 160/80 metres £20. R107 good cond £15. Creed 7B printer £5. G4FGP QTHR Tel: (0922) 53680.

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■ Yaesu digital receiver FR101 amateur bands short wave bands 2m CW, RTTY, LSB, USB, AM, FM modes crystal calibrator £250 ono. Yaesu FR50B receiver 160-10 AM, LSB, USB, some short waves £80 ono. Wanted Trio R820 Rx or Trio R599 Rx. J P Wright, 12 Norn Hill, Basingstoke, Hants, RG21 2HD. Tel: Bas 468649.

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Amateur RADIO

ADVERTISING RATES & INFORMATION

ABC membership approved pending first audit Jan-Dec 1985

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April 85	28 Feb 85	5 Mar 85	8 Mar 85	28 Mar
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CONDITIONS & INFORMATION

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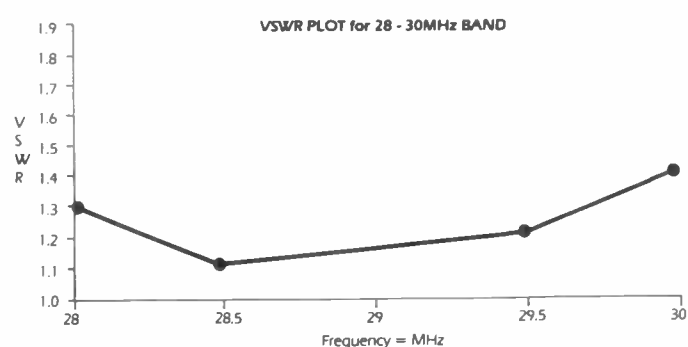
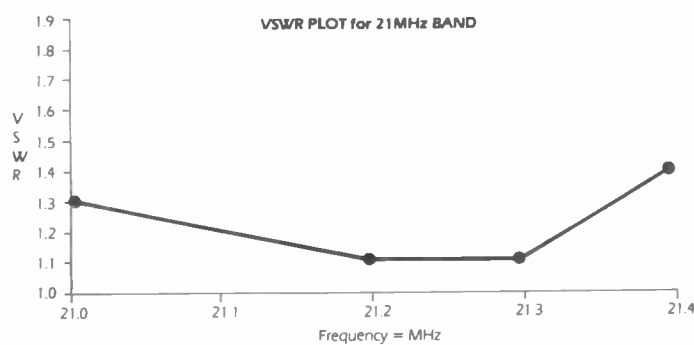
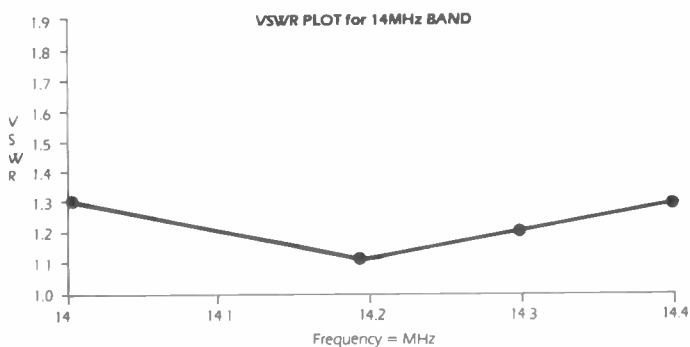
No need for the purchase of baluns.

A complete break with the coil and capacitor trap arrangement with, of course, its associated losses, restricted bandwidth etc.

Expandability: Extra parasitic element (director)

Extra absorber element for even greater front to back ratio.

With the conversion kits available, a 3 element, 3 band beam with an enormous front to back ratio will become the standard for others to follow.



H I G H T E C H Antennae (Scotland) Ltd

To: HTA (Scotland) Ltd., 24 Gremista Ind. Est., Lerwick, Shetland Is. ZE2 0PX

Please Supply MBFr80 Antenna(e)
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MICROWAVE MODULES LTD



2 METRE MULTIMODE TRANSVERTER MMT144/28-R

NEW RELEASE

FEATURES

- ★ 25 watts Tx output
- ★ GaAsFET RF stage
- ★ Transmit ALC circuit
- ★ 13.8V DC operated
- ★ Repeater shift (normal, simplex, reverse)
- ★ High level DBM mixer
- ★ LED Bargraph Power Meter
- ★ RF Vox – Adjustable delay & manual override

SPECIFICATION

General

Input freq range	: 28-30MHz
Output freq range	: 144-146MHz
Repeater shift	: Simplex, normal, reverse
DC requirements	: 13.8V DC & 6 Amps

Transmit Section

Output power	: 25 watts +/- 1dB
Input level range	: ¼ to 300mW
ALC range	: 20dB
Modes of operation	: SSB, FM, CW, AM
Spurious outputs	: -65dB or better

Receive Section

Gain	: 20dB min
N.F.	: 2dB or better
3rd order intercept	: +19dBm (output)

DESCRIPTION

This new transverter has been designed to allow users of existing HF band transceivers to establish a first-class transceive facility on the 144MHz band. The MMT144/28-R incorporates many new and exciting features which combine to make this product simply superb.

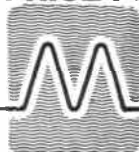
Receive Section

An NEC GaAsFET is employed in a noise-matched configuration feeding a high level double balanced mixer via a bandpass filter. IF gain is achieved by a JFET post amplifier. This combination produces a good signal to noise ratio, excellent immunity to overload and cross modulation, resulting in a rugged receive system having a third order output intercept point of +19dBm. Two separate low-noise oscillators, operating at 116.00 and 115.40MHz are included, running from a regulated 8.2 volt supply. Selection of the wanted oscillator is achieved by a quad op-amp circuit, controlled by the front panel mounted 'MODE' switch. This provides simplex, repeater and reverse repeater operation. The output of each oscillator feeds a JFET buffer amplifier via the quartz crystal which acts as a filtering element to reduce amplitude noise and reciprocal mixing products. The resultant high level injection is extremely pure and free from harmonics.

Transmit Section

The incoming 28MHz signal, in the range ¼ to 300mW, is initially fed to the RF VOX circuit, ALC control circuit and the input level control. This signal is then fed into a pair of MOSFETs in a balanced mixer configuration, together with the local oscillator injection, to produce the wanted signal in the range 144-146MHz. This signal is then amplified by several linear stages up to the specified output power of 25 watts. A visual indication of relative output power is provided by a front panel mounted LED bargraph display. A rear panel mounted level control allows the user to adjust the sensitivity of the transverter to suit the transceiver in use, and a front panel mounted RF VOX delay control allows adjustment to suit SSB/FM modes. The ALC circuit has a 20dB dynamic range and has been incorporated to ensure that a totally clean signal is produced by the transverter. This is a particularly useful feature which will virtually eliminate compressed signals and the resultant problems caused to local stations.

PRICE : £215 inc VAT (p+p £3.50)



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England.
Telephone: 051-523 4011.
Telex: 628608 MICRO G.



HOURS:
MONDAY – FRIDAY
9-12.30. 1-5.00
REW