AN ARGUS SPECIALIST PUBLICATION

HAM NEW RADIO TODAY

APRIL '83
85p

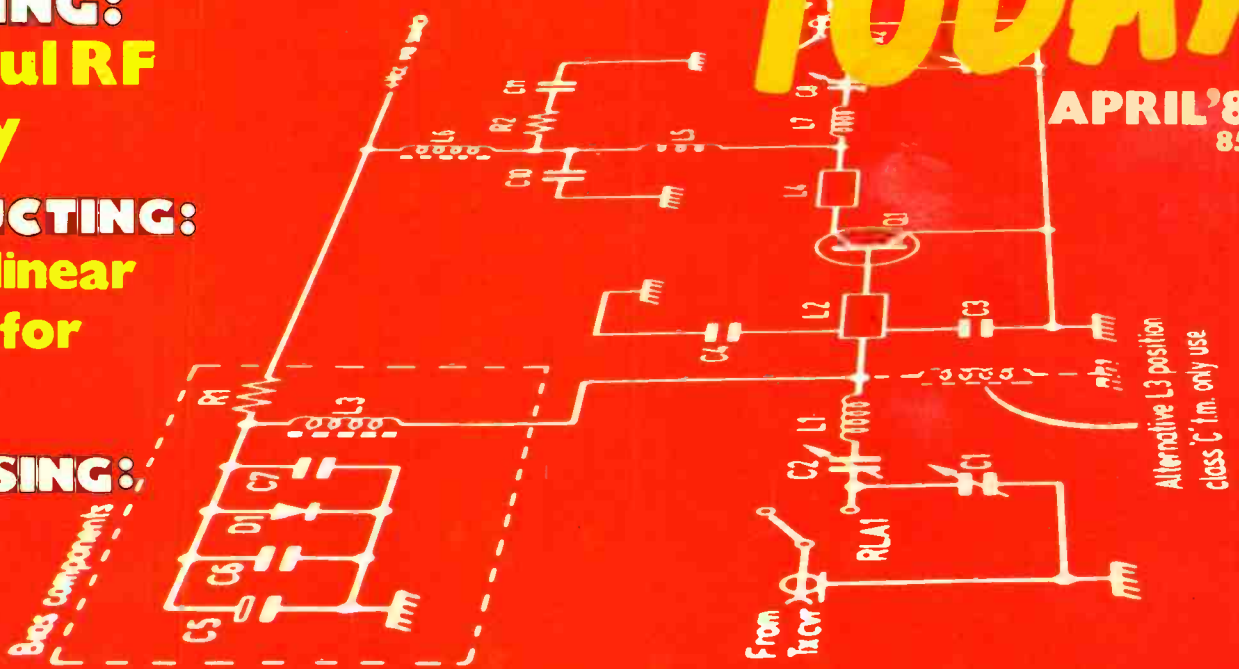
DESIGNING:
Successful RF circuitry

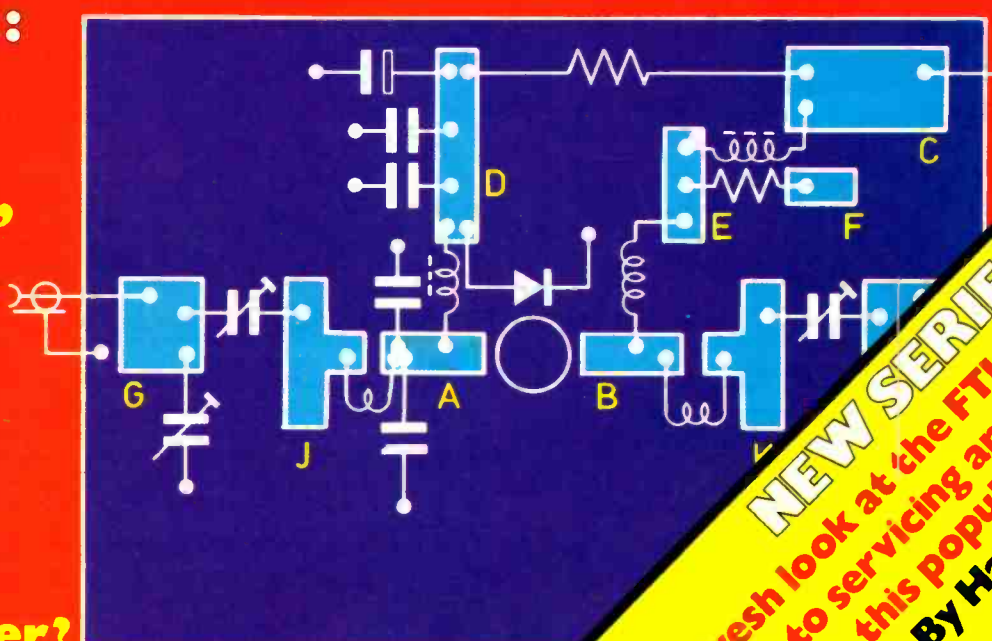
CONSTRUCTING:
A simple linear amplifier for 144MHz

IMPROVISING:
With HF aerial systems

OPERATING:
On 23cm. We look at propagation, aerials and equipment

TESTING:
An RTTY terminal from your CW autokeyer?





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By Harry Leeming G3LLL

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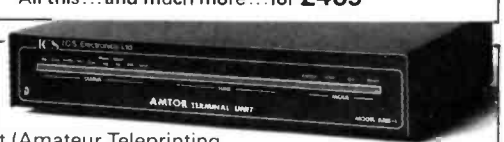

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LETTERS

Please address correspondence to:
Frank Ogden G4JST
Ham Radio Today,
145 Charing Cross Rd,
London WC2 0EE.

TOP BAND

Frank, Thanks for the February issue of *Ham Radio Today*, which I'm pleased to see is just as absorbing as the first. The KW2000 series is excellent.

Could I make this one plan — don't leave out Top Band. It is too dear to the hearts of many people.

In many respects 160m is different from the other amateur allocations. It is the amateurs' only test area for MF propagation, a subject that could no doubt fill a whole chapter of your series on the mechanics of the ionosphere. In home-brewing, the low frequency allows a high standard of construction with easily available and cheap components, yet there are problems in the size of antennas and some tuning elements. It is a band on which dx-working and rag-chewing exist side by side and on which AM is not yet considered 'old'.

Some of the above comments might apply to 80m too, but it is perhaps the area of operating procedures that is of greatest interest. How about an operators' guide to 160m in a future issue? What are those coastal station frequencies to avoid, what are the allocations to overseas amateurs, the DX window, the squiggles and bangs we hear? A lot of this worthwhile information seems thinly spread throughout many publications and some is not easily available to the average amateur.

Maybe I've missed some previous definitive article somewhere, but please don't give God's given band the cold shoulder!

STEVE RICHARDS G4HPE

I wouldn't dream of it. I love Top Band too. You have put forward a great idea for an article. Anybody prepared to take up the challenge? We pay jolly well — Ed.

HELP, PLEASE

Dear Ham Radio Today, I have just read your first magazine and found it very useful expecially the bit on propagation, which helped a lot with my short-wave listening.

My receiver is a Lafayette HA 700 and virtually unknown as I haven't seen any articles on it (hint, hint). But my receiver has a send facility with the SSB, CW and AM modes and I would like to know from your technical staff what modes it transmits on and also how can it be made to transmit as there is no plug at the back saying where to put a microphone or morse key.

There is a small hole at the back and I wondered if a plug was connected here and wires soldered inside.

Please could you help (I'm on my knees) as I'm hoping to take the RAE next yhear after my GCE's and CSE's and it would save me some money if I could have this conversion done.

PAUL MARTIN

Sorry Paul. I don't know your set. Maybe somebody else does and would be kind enough to write in. — Ed.

THE PROFESSIONALS

Sir, Of course the RAE is easy when looked at through the eyes of the electronics and radio professionals who hide behind *amateur* radio call signs. They also have an eye to business, hence the proliferation of radio and electronic magazines containing technical reviews with complicated circuit diagrams which use abbreviated technical jargon which no-one else understands. These people should be called radio *professionals* and issued with an extra prefix in their callsign, eg. GK4XYZ where the K means know it all.

Also, don't forget that no specified qualifications are required to sit the RAE, (Marconi hadn't any). Indeed, it is not even obligatory to have taken an RAE course.

R.T. FINCH G4PNE

Um, Yes. But what exactly is your point, Mr Finch? — Ed.

THE BIG WAIT

Frank, Here's to success on the launching of "H.R.T."!

I am a SWL, currently studying for the RAE for May '83 and fully intending to make a beeline for a G4 ticket. As my practising speed is now around 18 WPM I am going to take a gamble (?!) and apply for a morse-test before sitting the RAE. There are too many delays if you go through the slow sequence of RAE — WAIT MONTHS FOR RESULT — APPLY FOR G 6 — WAIT MONTHS FOR LICENCE — TAKE MORSE TEST AFTER WAITING MORE MONTHS AFTER APPLICATION — APPLY FOR G4 LICENCE — WAIT AGAIN FOR G4 PASSPORT. So I reckon it's worth taking a gamble.

Another reason for by-passing G6 stage is the apparent state of 2 metres. It's becoming another waveband for CB'ers and having to use repeaters isn't my idea of communications. You can't beat the unpredictable HF bands!

I must say I like the look of your new magazine. *Practical Wireless* and *Short-Wave Magazine* are superior to *Radio Communication* for beginners content but it looks as though you may become No. 1 (!!!)

Is it possible for you start a regular feature giving approximate up-to-date value of both valve and solid state receivers, transmitters & transceivers, old or new, as a guide to the less informed SWL/HAM NOVICE etc??? All the very 73's on your new venture.

BRIAN PATCHETT

Thanks for your comments, Brian. We plan a regular 'Glasses Guide' type feature — Ed.

PARROT FASHION

Sir, I am writing to congratulate you on a superb first edition and to wish good luck for the future (not that you'll need it!)

I would also like to make a few points on matters raised in your letters column.

Firstly, I would like to defend CW. It is difficult, indeed tedious to learn morse but it does give a great deal of pleasure in use and is still *the best* mode for effective mode of communication.

As for homebrew, I build all my own equipment. This is partly due to financial considerations but mainly because I enjoy building something with my own hands then hearing it work.

Finally, the RAE. I am disheartened to read in Rad Com this month that while 67% of candidates passed, the C & G noted great weakness in the 'electrical theory'

section and very good performance in 'licensing conditons'.

This seems to indicate that while candidates can learn, parrot fashion all the tiny details of who to send your revoked license to and when to transmit your call sign, they cannot apply very basic electrical theory.

Incidentally, I shall be taking the RAE myself in May, but I have no intention of claiming a Class B license; by this time next year I should have taken the PO Morse Test and got a G4+3.

(Did I see an opinion to the effect that the license should be confined to those over 18?)

MARTIN SMITH RS4962

It's a personal opinion but I would love to see radio amateurs becoming more aware of the technical aspect of our hobby. Power to your elbow, Martin. — Ed.

A very reasonable view

Editor, To quote a phrase "Morse Code is an archaic form of communication": As a professional communications engineer and a confirmed CW addict I couldn't agree more with that sentiment.

The reason I use so much CW., is because I really do enjoy it! I like to loaf along at 35-40 wpm with my contempories on 80 and 40m. Admittedly I use an electronic keyer and paddle or even sometimes a keyboard sender.

My point is, I don't want to force CW on to any guy who doesn't want to use it. CW is another language, full of nuances, varying styles and for me is sheer pleasure. I also enjoy rock music, but loads of people don't. In the end it must be each guy to his own!

As a G3 of 1066 vintage I would like to see Class B licensees given every opportunity to use morse. Perhaps on 144/70/28 and 1.8MHz for starters. Usage is great practice and would certainly keep the CW band segments alive.

I could even go along with the idea of a code free licence for everyone because CW surely doesn't make you any better at mis-operating an SSB TX and splattering over the bands!

On the other hand I get frustrated by people, usually Class B licensees who bleat about having to learn morse etc., etc. My attitude is, please don't knock something unless you have tried it first!

All the standard CW arguments about bandwidth, better DX capabilities and so on are probably true, but amateur radio is a hobby isn't it? There are loads of differing transmission modes available so why not let everyone try their own thing if they so wish.

As a parting shot I must add I favour the American idea of graded licences, that would really improve standards — technically where they need to be raised.

STEVE WILSON G3VMW

I agree completely with everything you say. I must confess though that I don't enjoy CW very much. Occasionally, personal bias creeps in even though you don't intend it to — Ed.

MISTAKEN IDENTITY

Sir, I find your suggestion that the minimum age limit for a licence should be raised to 18 to be detrimental to me and other young op's. I am 14 years old and have had by G6HZU call for nearly a year now. Not only have I (and other young op's I suspect) had to put up with being called a YL by people who know well that I am not, and a young whipsnapper etc., but now the trend is to blame us for every belch etc. on the repeaters. How often have you heard "That's some kid playing music on the repeater"? I have not saved up the money to buy equipment for 3-4 years by doing odd jobs with no 'free gifts' from my parents to be greeted that "all op's under 18 are wallies!"

I hope to take my CW test soon. I'll have to scrimp and save for components for the Homebrew HF CW rig that I'll build. I just hope that I'll get a slightly warmer welcome than I got on VHF from the so-called 'real hams'. This is only half though, the others have been helpful and considerate. I wish they were all so.

J. PELHAM G6HZU

PS What about a simple, cheap, 20 meter CW TX/RX? 10 watts out?
PPS Sorry about the long letter, but I feel very strongly about this.

Sorry, it wasn't my opinion. I've been playing around with radio gear since I was eight. I suspect that the GPO would have called me more than a wally if it had caught up with me then — Ed.

SPEECH PROCESSING

Frank, I read your article on speech processing with great interest.

When I first adopted ssb in 1952 the usual mode was AM. At that time baseband clipping was being widely used by amateurs to increase their AM talk power. Some ssb pioneers tried this form of clipping, but it showed no apparant advantage. The explanation of this finding was later given in an article by Dr D A Tong (1). SSB generated from baseband clipped audio does not have an RF envelope whose amplitude is well defined. To avoid flat topping one is unable to use the hoped for increase in AF gain, when compared with no clipping. On the other hand RF clipping produces an SSB signal of well defined amplitude, so one can keep the average output power high without splatter. (But if the post-clipper gain is too high splatter could be continuous! One should not assume that the ALC will take care of this)

The other important advantage of RF clipping is that the harmonics generated fall at multiples of the sideband frequency and are *all* removed by the second sideband filter, as are most of the intermodulation products. Compare this with the baseband case where the "real nasties" the harmonics of audio frequencies below $f_{ch}/2$ (i.e. below 1.5 KHz) fall in the passband of the second filter. Much of the power in speech lies in the lower frequencies so this is significant. Thus it is clear why RF clipped speech sounds much cleaner than that which is baseband clipped. A 6 to 10 dB increase in loudness can be achieved with little audible distortion. Beyond this level of clipping distortion increases without much gain in loudness. One can play the clipper through a tape recorder to adjust the clipping level. Personally I increase the pre-clipper gain with normal speaking until all syllables sound clipped, then set up the rig for no flat topping with fairly close speaking. I calculate that my legal ssb signal is equivalent to at least 10 kW of AM! The RF clipper seems like the only exception to Murphy's Law.

Good luck with the new mag. I'm glad to see it's not for licensed appliance operators".

JEREMY WHITFIELD G3IMW

(1) AF and RF clipping for speech processing. D A Tong, Wireless World Feb 1975. pp 79-82

I take your point but also take issue in the nicest possible way. The effect of clipping an SSB signal is to increase the phase change rate on the zero crossings as well as flat topping the signal as one expects.

The final 'clean up' filter can only respond to the rate of phase change as a precise function of its bandwidth. The result is that the filter puts back envelope modulation on the 'squared SSB' albeit with improved risetimes on the uncliped SSB signal. What about an article on the subject, Les? — Ed.

RADIO TODAY

War games for RAYNET

RAYNET may be invited to take part in the civil defence excercise , WARMON 83, according to a spokesman for the RSGB.

Originally set up to provide aid in peacetime emergencies, participation in the excercise, scheduled for March 12/13, represents a new departure in the organisation's original scope of operations.

According to sources at the MOD, RAYNET's function would be to pass on simulated data about the position and strength of nuclear explosions and their radioactive fallout, from monitoring posts to Government bunkers.

The organisation would only take part at the invitation of the local CEPO – Local Emergency Planning Officer.

and peace games...

The Home Office has also lifted other restrictions on RAYNET. It is to be allowed to provide radio links for events like sponsored walks and marathons. Each RAYNET group will be limited to one excercise a month.

Radio amateurs will also be able to call for help over the air if they arrive at the scene of an emergency, but only if no other means of communication is available. If, for example there is an accident on the motorway, amateurs can only be used to call for help if the emergency telephones are out of action.

Another valuable change allows people other than licenced amateurs to speak into the microphone in an emergency. Rescue workers can now communicate directly, rather than having everything repeated by the operator. There will however still have to be a licenced amateur keeping an eye on things.

At the moment emergency communications can only be sent on behalf of the British Red Cross, the St John Ambulance Brigade, a CEPO or the police. But the Home office says that it is willing in principle to add other organisations to the licence if requested – so if, for example, a mountain rescue team wanted RAYNET to provide radio facilities for them, the Home Office would consider their request.

G4DYA

Can you help?

Staff and students at the Haywards Heath College are struggling to set up a permanent radio station and general electronics department with, they add, very little cash. They would be 'overjoyed' to hear from anyone who can offer them radio equipment, aerial cable, components, PET/BBC software or anything at all in fact.

If you think that you may be able to help them out please contact Pete Metcalfe G8DCZ at Haywards Heath Sixth Form College, Harlands Road, Haywards Heath, Sussex. Phone 0444 456281 and ask for the Physics Department.

Wrong price

SMC, the Yaesu main agent with headquarters in Southampton asks us to point out that it was not bargain time of the century as may have been believed by reading the company's ad in our March issue (p42/43).

The ad showed the FT902DM priced at £185 when it should have appeared as £885. The price indicated in the advert was a genuine printing error and therefore the company has no obligation to supply any sets at that price even though there were lots of potential customers! In our defence we must point out that the advertising copy was provided for our magazine via Practical Wireless which also carried the same error.

Wireless revival

The East Suffolk Wireless revival 1983, a popular annual mobile rally, will take place on the Bank Holiday Sunday, May 29 at the usual venue of the Civil Service Sportsground, The Hollies, Straight Road, Ipswich. The site is between Bucklesham Road and Felixtowe Road and is adjacent to the Suffolk Show Ground.

The rally will open at 10 am and will be similar to previous events except that the 'bring and buy' stall will be replaced by a fleamarket and car boot sale. The transceiver clinic and aerial testing range will be featured as usual in addition to the traders and stands, displays and other attractions for the rest of the family.

More details will be available nearer to the time and requests for stand space should be addressed to George Spencer G6CRN, 83 Tuddenham Avenue, Ipswich IP1 6PX. Phone 0473 44047.

RAE changes

The people who set the Radio Amateurs' Exam are canvassing for ideas about how the exam could be improved. If you didn't like the May Exam, or any of the other ones for that matter, now is the chance to air your views.

The City and Guilds is setting up a working party to review the exam. It says 'The principle objective of the examination is to ascertain the candidate's ability to operate an amateur station within the terms of the licence and not necessarily to test expertise in particular aspects of the amateur service.'

Ideas for changes to the syllabus should be sent to Mr S Allison, City and Guilds Institute of London, 46 Britannia Street, London WC1X 9RG.

Judging by the postbag which we regularly receive on the topic there are quite a few people with something to say about the matter. If you don't like the RAE, write now (but not to us).

Show postponed

We regret that the SOUTHERN HAM RADIO SHOW, which was to have been held on Sunday, April 17, has had to be postponed to a later date.

The organising of the new Horsham based event has been severely hampered by the short timescale upon which both ourselves, and the organisers, Corinthian Exhibitions had embarked on. Watch this column for details of the new date.

PRACTICE RAE ANSWERS to the papers which appeared in the February edition of Ham Radio Today.

Page 58: licencing regulations
1 b, 2 d, 3 a, 4 d, 5 c, 6 c, 7 d, 8 a, 9 d, 10 b.

Page 59: radio theory
1 b, 2 d, 3 b, 4 d, 5 c, 6 a, 7 a, 8 c, 9 b, 10 c, 11 d, 12 d, 13 b, 14 a, 15 c.

IMPROVISING ANTENNAS

Custom made, fully trapped, multiple band commercial antenna systems look as though they should provide the last word in performance. The idea has been put about that to stand any chance of making worthwhile contacts, you have to part with at least £60. Not true. Any piece of wire will radiate RF with comparable efficiency provided that it is long enough and high enough.

Amateur radio is now comparatively bereft of any substantial element of DIY thanks to the influx of equipment from the Far East, and the ever-expanding TV broadcast service. unless one can construct an effective screened cage it is impossible for the large majority of amateurs to carry out any experiments with transmitters, especially those for the HF bands, without causing unacceptable QRM with neighbouring TV receivers, except during the small hours of the night, when one ought to be DX-ing, anyway.

With the long-overdue demise of the monochrome 405-line TV service (Bands I and III) by the end of 1984 this situation could improve a little. At the moment the lower order harmonics of HF band transmitters can cause havoc to this service.

For the amateur who still hankers after some form of experimentation, playing around with antennas may be the only answer. Given a Japanese "black box" with, usually excellent suppression of harmonics, and a sensible, balanced antenna feeder a lot more fun can be had than might be imagined. Surprisingly, the cost is next to nothing, which is quite rare these days. Wether it be ordinary TV reception, VHF/FM stereo, or any other form of communication by radio, the simplest and cheapest method of improving the performance of the system is by attention to the antenna system.

It is presumed that in addition to the black box there is a standing wave ratio meter (SWR), most likely combined with a power output indicator. This "indicator" in cheaper meters merely shows the relative output rather than the absolute value but is still quite adequate for most purposes. Anyway, there is usually a similar indicator on the transceiver. If one can afford to go to a meter measuring actual power output, and SWR without any preliminary adjustments, so much the better. One small point, ensure that the meter is suitable for the output impedance of the transmitter, normally 50 ohms.

The only other item, which should be an absolute necessity in any AR station, is a "dummy" or artificial load, also of the right impedance and of adequate power rating see **Fig. 1**. This rating need not be thee maximum power output quoted for the transmitter provided the rig is run at that level for only short periods. A suitable design for a dummy load appeared in the January issue of *Practical Wireless*.

Any resistor used in a dummy load must be either carbon or carbon-film otherwise it will show considerable reactance at the higher frequencies and give entirely misleading results.

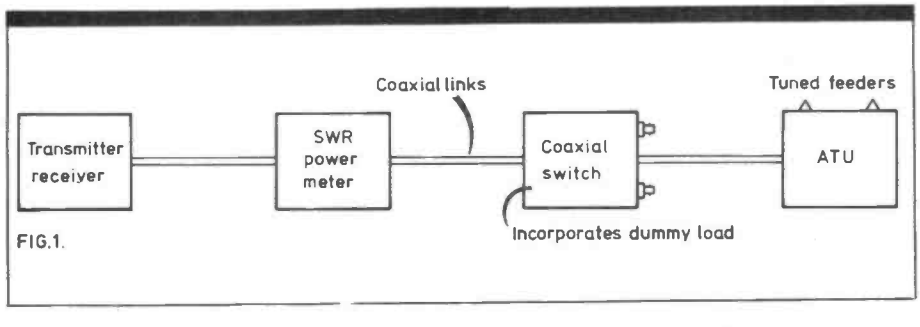


FIG.1.

Fig. 1 Arrangement of equipment which includes a coaxial switch incorporating a dummy load enabling the rig to be tuned up without radiating

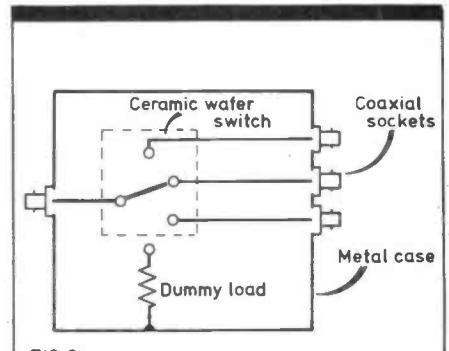


FIG. 2.

Fig. 2 Coaxial switch should have a ceramic wafer to minimise losses. Wiring should be in heavy copper wire and be as short as possible. Several coaxial outlets enable rapid choice of antenna

The initial set-up is as shown in **Fig. 1** which is more or less permanent. The experiments start after the SWR/power meter. The coaxial switch can be a bit expensive so a ceramic wafer switch, using the shortest possible wiring, can be used for the HF bands, **Fig. 2**. With the dummy load in circuit the SWR

meter should show a 1:1 ratio at all frequencies. Checking at 1.8 or 3.5MHz and then on 28MHz should be sufficient to prove this point. DON'T operate the coaxial switch when transmitting!

Wires

Many amateurs seem loathe to experiment with wire antennas, without any good reason. It could stem from their early days studying for the RAE, with books and manuals showing antennas with lovely straight elements, perfectly horizontal, feeders coming away at right angles and of exactly the right length, or the large expanse of lawn under which hundreds of feet of radials must be buried before one can hope to get out on Top Band. Very nice, of course, but really one can get out and work the DX with a lot less perfection.

Having decided on a particular design for an antenna, preferably not too complicated at the start, have a look at where the maximum current will occur on the principal band on which it will be used, assuming it to be a multiband design. The object in life then is to get that part of the antenna up as high as possible and preferrably as far as possible from nearby buildings or obstructions. While the feeder should be kept as short as possible don't forego a good position for the antenna for the sake of a shorter feeder.

Taking **Fig. 3** as an example, if the centre third of the wire is as high as it can be then the ends can droop down vertically, or be part of the guying system, with the centre portion sloping down from a single suspension point such as the top of a pole. Such an arrangement is often called an "inverted-vee" which it is not. If the wire is straight and reasonably horizontal then, if it is a half wave long, the radiation will be mainly at right angles to the line of the wire. If the ends do droop then the pattern of radiation, or polar diagram, will be modified somewhat.

Construction

The cost of experimenting with wire antennas is virtually nothing although it does depend to some extent on whether you are transmitting or just receiving. If transmitting then a little more attention needs to

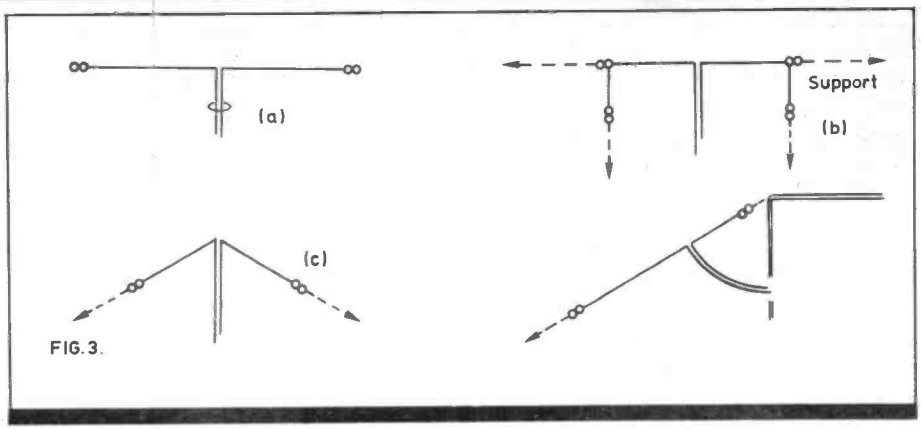


FIG. 3.

Fig. 3 (a) the perfect textbook antenna, in space unaffected by supports or nearby buildings etc. (b) down to realities with as much of the antenna in the clear as possible, with cords to adjacent supports as convenient. In practice it may not even be possible for the antenna to be horizontal at the centre. (c) Both sides of a dipole may be taken down towards the ground, again using any anchoring point available. The included angle at the top should not be less than 90 deg. (d) Wires can slope to fit the site

be paid to the adequate use of insulators at the ends of wires where high voltages appear, and which MUST be kept well clear and out of anyone's reach.

The more usual egg insulator, or expensive pyrex glass equivalent, can be replaced by a piece of plastic tubing a few inches long, with holes drilled at least 1in in from the ends, for anchoring the wire antenna and the supporting rope or string. A similar piece of tubing can be used at the centre of dipoles and the like although a piece of flat plastic is more appropriate, **Fig. 4**. Keep an eye open, especially in offices, for the cast-off bodies of so-called "glue pens" which are ideal for insulators. An insulator must always be used between any point on the wire and a support. There are those who would use nylon string or rope tying it direct to, say, the end of a wire antenna, but I still prefer to be sure of the insulation, especially in wet weather, and fit an insulator.

If open wire feeders are to be used their construction is quite simple, **Fig. 5**, using the discarded bodies of ball point pens for spacers. They are very light in weight and not unsightly. A small hole is drilled near to each end for the thin wire used to attach the spacer to the feeder wire. This method of construction allows the feeder to move about in the wind avoiding wire fatigue and breakage which can occur with a more rigid construction. Generally such open wire feeders will be part of a tuned system so the spacing of the feeder wires is of no great importance, so between 4 and 6in is the usual spacing. The binding wire can be the aluminium wire used around the garden for supporting plants etc and there is also a similar green plastic coated iron wire which is quite suitable.

Actual construction of open wire feeders is best undertaken outside where the two wires can be stretched out straight, tying one end of each, about the correct distance apart, to a convenient support. The spacers are fed on at the other end of the feeder and spaced out roughly at about 2ft intervals. Cut a stick of wood to about 2ft long and use this to adjust the spacing apart fo the spacers as they are wired on to the feeders. There is nothing more unsightly than open wire feeders with spacers at random intervals!

Taking feeders through window frames can sometimes be a problem but for low impedance types a suitably sized hole may be drilled through the frame, perhaps at a point that can be out of sight behind a curtain. Always drill the hole so that it is sloping downwards from the inside to th eoutside and thus prevent the ingress of rain etc. Some form of plastic filler will come in handy here. For open wire feeders the ball pen bodies can be pressed into service once again, making

them a press fit in two holes in the window frame, at the same spacing as the feeder wires. A tidy tip; tie a knot on the inside end of each feeder wire to tkae the strain, adjusting them so that the spacers outside are more or less horizontal.

Choice of feeders

Apart from open wire feeders the remaining choice will be either flat twin feeder or coaxial, the former being either 70 or 300 ohms impedance, the latter 50 or around 70 ohms. Coaxial cable can be quite heavy and will drag down the centre of an antenna unless it can be supported by a mast or other support. On the other hand flat twin feeder is quite light.

Since the input impedance of most receivers (and the output impedance of transceivers) is an unbalanced 50 ohms it seems reasonable to continue the link to the antenna with unbalanced coaxial cable. Ah, ha! say the experts, this is where a balun (balanced-to-unbalanced) transformer should be used, generally at the top of the unbalanced coaxial feeder where it joins the balanced antenna, otherwise the polar diagram of the radiation will be distorted. In practice, however, the chance that the halves of a dipole are balanced to earth is very remote when one takes into account nearby buildings or other obstructions, trees and the supports for the dipole, and the varying composition of the ground below the antenna especially if it is a long one. In such a case a balun is a waste of money.

Baluns tend to be justified in rotary beam antennas which are inherently balanced systems fed by unbalanced coaxial cable, with a fairly narrow forward beam which should be symmetrical but which can "squint" if a balun is not used. but that is another story.

The performance of coaxial cable on a receiver can also be called into question. With a balanced feeder any local interference picked up tends to be cancelled out but on unbalanced coaxial feeder this effect is less pronounced. In particular the radiation of timebase interference from TV receivers has been largely cleared up on many occasions by the use of flat twin feeder. In severe cases screened twin flat feeder has proved to be very effective, the screening being earthed at the receiver.

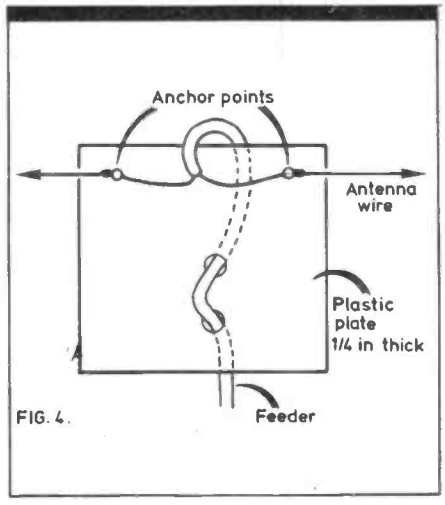


Fig. 4 A piece of plastic sheet, at least ¼in thick, forms base for antenna feed point. The feeder is passed through anchoring holes and over top of plate to anchor posts where the wires are soldered to the antenna wires. This method is absolutely essential with coaxial cable to prevent the ingress of rain and moisture

The copper wire for constructing wire antennas can be obtained from several sources, such as old mains transformers, the smaller diameter wire of some secondary windings being particularly useful. It will be necessary to remove any fittings on the transformer, including the laminations, leaving only the bobbin and windings. Thin plastic-covered bell wire can be bought from Woolworth stores, if necessary, in useful lengths. Any joint made in the antenna wire must be sound mechanically before soldering and covering with insulating tape or compound. The so-called self-adhesive tape is excellent as it will not come undone as ordinary insulating tape does after a while. The soldering of the joint is an absolute must with transmitting antennas.

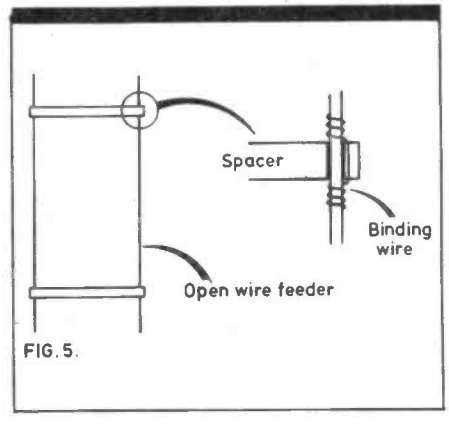


Fig. 5 Method of wiring plastic spacers to open wire feeder

If one already has a long mains lead for use with gardening appliances it is a good idea to make up an adaptor so that the shack soldering iron can be used outside for soldering joints in wire. The iron needs to be something a bit more substantial in terms of wattage than those used with PCBs! 60W or so is desirable, while the soldering gun is probably the ideal, as has been discovered over the years.

If fairly long lengths of multi-way multi-coloured flat cable, as used for the interconnection of modules, can be obtained these can be stripped down and joined together to form one long wire. Short lengths make the number of joints necessary rather burdensome. Other multi-way cables can be treated the same way. After a while quite a lot of copper wire will have accumulated (frequently half waves for 20m complete with insulators!) which makes experimentation with new antennas very easy. A versatile ATU for use with the tuned feeders is essential of course, when one has the comfort of knowing that whatever antenna is up at any moment that it is tuned "on the nose", as they say, and giving of its best. With coaxial cable feeders there is always that suspicion that the matching may not be quite right in spite of what the SWR indicator may show.

Antenna supports

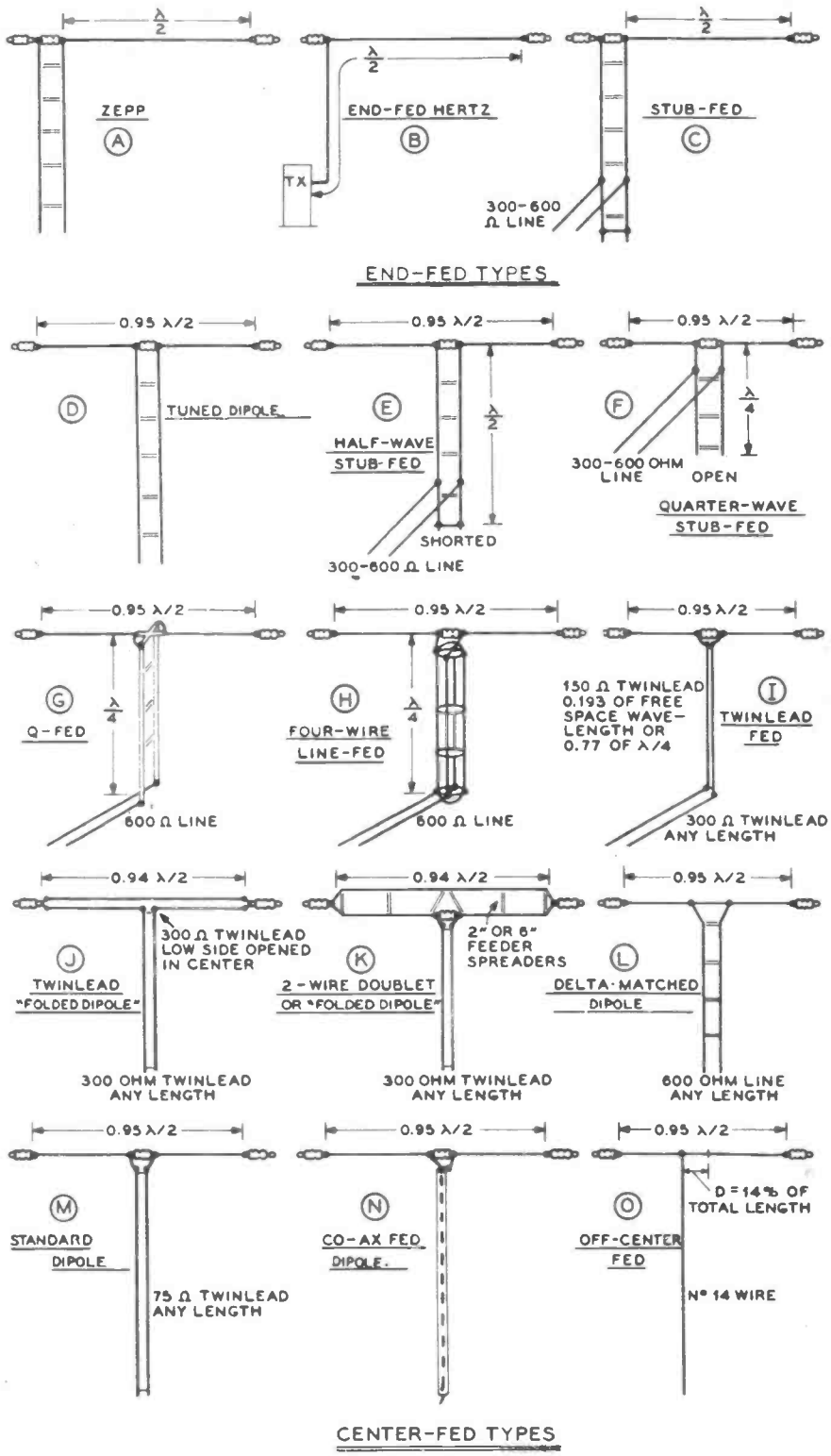
Few of us are able to organise several tall masts at the appropriate locations in a very large garden to suit our antenna plans, so we have to make do with what is available. Obvious supports are chimneys, if you can reach them, trees, garages at the end of the garden to which poles can be fixed to increase the height of a wire, and so on. One end of a wire is generally fixed, as high as possible, to the house with the other end going off down to the end of the garden. It is very important that one end of any wire should be able to move about to take up any

movement of the supports, especially if these are trees. Otherwise the antenna will break and come down in the first strong wind.

While pulleys are highly desirable provided that they can be fitted where they are wanted, which is not very often except at the house end, then a rope or cord thrown up as high as possible over the branch of a tree will suffice, with a weight at the bottom of the rope to take up movement in the antenna wire. Getting the rope over the branch is not too difficult provided one goes about it systematically. Nylon cord is probably the best, making sure that it is long enough to go over the bough and back to the ground at least. Tie a small but heavy object such as a nut from a ½in diameter bolt to one end of the cord and then lay the cord out behind you, free of any knots, so that it will not get caught up when the weight is thrown up. Wearing gloves, or you will get a neat groove cut into your fingers, hold the cord a few feet from the nut and swing it back and forth finally giving it a sharp swing upwards and letting go of the cord. Do not swing it in a complete circle or accuracy will be sacrificed.

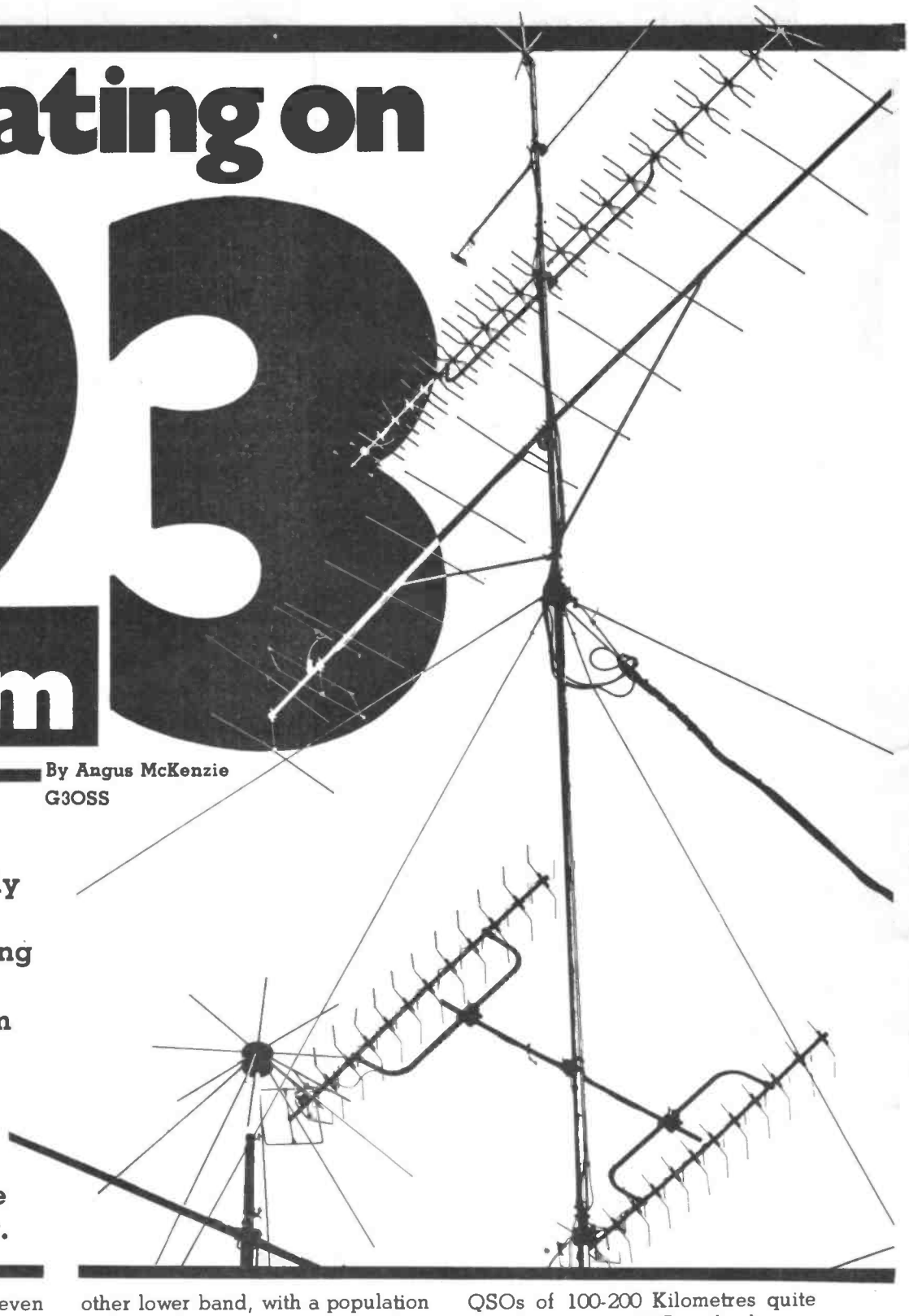
With a bit of luck the weight will fall through the tree back to earth. If necessary, a heavier cord or rope can not be tied to the lighter cord and drawn through. If the right branch was not reached pull the cord through and try again. Do not attempt to pull the weight back up or it most certainly will jam in a branch and be lost. One last point, make sure there are no windows behind you when throwing the weight! Children and cats and dogs are also unwelcome visitors at this time unless a young lad can be persuaded to climb the tree which makes it all so very much easier!

A bow and arrow can be very effective but only in the hands of an expert, with particular emphasis on the safety aspects, such as the landing area of the arrow at the other side of a tree or support. Make sure it is on your own property and away from greenhouses and the like. Again, be careful with animals around. My own cat loves chasing the ends of wires moving across the garden and just won't let go! I'm sure that one day I'm going to find her dangling at the centre of a wire at 50ft!



There are a lot more ways of feeding a basic dipole structure than by just using a balun and standard coax. The disadvantage of the standard balun solution is that it will only cope with aerials operating at around their naturally resonant frequency: ie where the impedance approximately matches between dipole structure and the termination, and the balun unit is not called upon to deal with any reactive components. A dipole of no particular length across the top can often be tuned remotely in the shack simply by using an open wire feeder and a balanced output type ATU. The SWR on the feed line between ATU and dipole is unimportant.

Operating on 23cm



By Angus McKenzie
G3OSS

Many amatuers tend to imagine that 23cm contacts are only made in general by one station telephoning another, arranging appointments on 70cm for beam alignment then switching over to 23cm for a contact which could equally well have been made on a lower frequency.

This legend was indeed true even ten years ago, and the earliest innovators, including such famous callsigns as G5DT, G2RD and G3FP were often heard attempting their link ups using 70cms for talkback in the early 60's. They were pleased to get a useable range of ten or fifteen miles using home made aerials and all valve transmitting and receiving equipment which each stalwart had carefully made in his own home.

In 1983 23cm as a band has changed possibly more than any other lower band, with a population at least ten times greater than it had six years ago. If we contrast a 23cm station of yesteryear with one of today, comparisons are absolutely fascinating. Typical transmitted ERPs are at least 20dB higher and receiving systems, again including aerial gain, are at least 25dB better, if one ignores the very top stations of some years back. These staggering improvements have shed an entirely new light on the band.

It is now not unusual to have QSOs of 100-200 Kilometres quite regularly on SSB which are equivalent to many 2m SSB QSOs. Unusual propagation is often experienced on 23cms allowing contacts with many other countries, and right over obstacles such as very tall hills which would have been regarded as insurmountable ten years ago. 23cm can now be regarded as a very reasonable band. This article was written in the hope that my own enthusiasm will influence you to have a go on this fascinating band.

Operation

Most QSOs on 23cm are on CW or SSB. In past year if telephony was required, eg for class B licencees, FM would be used by tripling up both frequency and deviation 70cm care being taken to avoid over deviation.

Although a sizable proportion of contacts are made on the band by first establishing contact on 70cm, beaming up and then transfering to microwave, today it is more common for QSOs to result by answering CQs on the band, or by calling in during, or at the end of an established contact between two other amateurs. Many regular skeds on the band tend to stir up activity, Sunday Mornings and Monday/Tuesday evenings being particularly active. The 23cm enthusiast tends to look at his barometer and TV weather maps very regularly and will make a run for his gear if he feels that a tropo duct is becoming likely.

Microwave addicts are used to scratching around in the noise for traces of weak signals and will be turning their beams round and round to find that elusive DX contact, and once a station has been detected, no matter how weakly, the odds are that turning the beam will considerably help. By the time he returns to the CQ call he may be fairly easily receivable by the other station who will then turn his beam. For this reason, CQ calls are usually much longer, but with fairly frequent breaks. Patience is undoubtedly a virtue on this band, and it is surprising how frequently a reasonably well sited station will receive a reply to his CQ call on 1296.200 MHz. This frequency is used for both CW and SSB calling.

Beacons

Of tremendous importance are the 23cm beacons transmitting throughout the UK and continent of Europe between 1296.800 MHz and 1297.000 MHz. Note the beacon list from which it can be seen that most stations in the south and Midlands should be able to receive at least two of them. I normally receive at least five under the worst conditions, seven on average, but up to 20 when all hell is let loose! Alas, these beacons have a habit of going wrong, and many an amateur has torn his rig apart when a beacon has blown itself up. GB3DUN has been significantly weaker for around 18 months, than it used to be, whereas several others seem to go on and off several times a year. GB3BPO is supposed to be an extremely accurate frequency standard, but its FSK deviation is both very wide, and wobbles around like a jelly.

These beacons are superb indicators of band conditions, and with me, GB310W can vary from a minimum of S7 to a maximum of 20dB over S9. The one beacon that almost goes through the roof in signal strength in very good conditions is GB3BPO approximating to perhaps 40dB above the level required for S9! When this occurs one starts hunting for continental beacons, and PA9QHN can come up from below noise to 5 and 9 within an hour, similarly ON5SHF can also indicate an opening to the southeast when it becomes possible to work through to Switzerland and even Czechoslovakia and Austria.

In September 1982, I worked four SM stations including one in JR square on an island (Gotland Island) off the east coast of Sweden at around 1340 kilometers. On the same unforgettable evening I worked three OZs, and many PA and DL stations as well as some new counties in Wales. Once you are known on the bands, you will probably find that a friend will call you up to warn you of an opening if you are not heard transmitting. It was G8DKK in Luton who kindly warned me on this occasion.

Portable

There is much enthusiasm for going out portable on 23cm, even if one only has 2W output and a Jaybeam 15/15. Many continentals tend to belt for their highest local pimple at the slightest sign of a duct. It is quite incredible how so many amateurs seem to appear from nowhere when good conditions begin. Whilst many outstanding SSB QSOs occur, the use of CW is almost essential if you want to do really well on the band, and an perusal of the call signs who have obtained the 23cm senior award shows that all five stations are CW operators, although nine class B stations have achieved the standard award without CW. G4KIY has very remarkably achieved a 40 squares award which would be good going for many stations on 2m let alone 70cm.

Lunatic

Many stations in an attempt to work some new county will make regular skeds over a period of a week or so every night with cooperative DX station, and it is amazing how frequently patience is rewarded. I remember how Petra, G4KGC, in Towcester, Northants, managed to work a South Wales Station eventually after many attempts by bouncing off, it is assumed, lurking aircraft flying high up across the path in one of Petra's most difficult directions. I remember my first QSO with Northants, which took around two hours copying one letter at a time on CW! The real DX hounds on this band, including myself, are probably rated by many others as complete lunatics. But everyone has his poison!

Almost all normal operating is between 1296MHz and 1296.4MHz, and even in openings, almost all the activity is within 100kHz of the calling channel. ATV is becoming more frequent on the band, but rather lower in frequency, and there is so much bandwidth available that many new modes are being considered away from the normally used frequencies. While you may get quite a lot of pleasure if you are in a moderate location and running relatively low power, it must be emphasised that really good antenna systems, very high quality cable and good receiving systems are vital if you want to take to the band very seriously. This is not to say that a surprisingly modest system cannot give the odd amazing DX contact in an opening, although such a system would normally give very disappointing results by comparison to what is now regarded as average on the band.

Propagation:

To describe 23cm propagation as "line of sight" is about as innaccurate on 23cm as it would be to use the same definition for 2m. What is particularly fascinating about the higher band is that while auroral and meteor scatter propagation is virtually non-existant (OK, I'll pro-

bably be wrong soon!), 23cm is far mroe susceptible to odd ducting, tropo scatter and hill fringing than is 2m. I regularly work G3WDG and G4KGC in Towcester despite it being only an average direction for me and a very poor one for them because of a large hill immediately to their south. Signal strength can fluctuate by 20dB many times a minute, and we believe these are due to variable contributions from cloud reflections, aircraft, tropo scatter and possibly hill fringing. Other than with tropo ducting, it is vital to have reasonable power available and a superb receiving setup to copy very weak scatter reflections. Very frequently ducts on 23cm occur over great distances of perhaps 500km when conditions on 2m are barely above average, although the really big ducts, such as occured in September 82 have always coincided with major ducts on the lower bands. Under such conditions, the received 23cm signals can actually be stronger than their lower frequency counterpart. It has often seemed to me, since I improved my station in 1981, that most DX is either clearly there, or virtually inaudible. Relatively few QSOs are on the verge of noise at considerable distances. This is totally different in my experience to 2m DX where I have frequently scratched around in the noise to get some rare station.

Fog, mists or rain do not seem to significantly affect local propagation on 2m, but on 23cm some very odd effects can occur. I have known cases in which there is a tropo duct above localised fog with the result that all signals from all directions seem to be very strong indeed, with only minor variations with aerial direction. Having discussed this with some other microwave enthusiasts who have experienced the same oddity we all assume that the top layer of fog refracts microwave signals downwards into the top of the antenna, hitting the diopole from above. On one occassion, when the effect was particularly marked, I actually thought my rotator had broken down.

Equipment

DX stations on 23cm can be remarkably strong, even when they are running only 1W output on SSB, and GU3KFT was up to 5 and 9 +20dB for hours at my North London station. A particular GW portable, running only 1W into an omni directional Alford slot, was received at 5 and 9+. These contacts typify the fact that 23cm conditions are much more variable than they are on 2m, it is this that makes the band so vary fascinating.

The crudest equipment that can be easily used on 23cm is a simple varactor tripler from 70cm to 23cm for TX, and a converter for receive.

Triplers

Most stations have started on the band with a fairly long length of coax up to an antenna which would usually be a single JVL loop Yagi, a Jaybeam 15/15 beam, or perhaps a single 23 element Tonna. All too often the changeover relay between TX and RX is in the shack fed by rather inadequate UR67, which will have a loss of around 5 to 10dB. Transmitted ERPs will be rather low, and the received system noise figure, with no RF pre-amp installed, can be effectively as high as 16 to 21dB!. The average tripler on TX might give an efficiency of 45% at best, but many have been incorrectly set up. Unfortunately, it is useless trying to tune one up using a normal watt meter on the output, for you may tweak it up as a doubler rather a tripler.

If you have a spectrum analyser available to you, then this should be used with a suitable attenuator load in which case you will be able to null out unwanted harmonics as well as peaking up the required one. I have found that the tuning points of the various capacitors in an average varactor tripler vary considerably for maximum output dependent upon the amount of applied power, and a tripler set up at 10W input may well be very much less efficient at 5W input and, surprisingly, vice versa. If you can mount a high power device on a good heat sink, it is possible to get 20W output from a tripler with 40W input. While this is recommendable for CW, the varactor may not last long with FM.

Receiver or system noise?

On the receiver side, it is no use adding an RF pre-amplifier straight in front of a ring mixer for, even if the pre-amp is a very good one, it will not only have to have a very high gain to overcome a normal mixer noise, but both the required frequency and the image frequency will be amplified, and the system noise figure will thus be deteriorated effectively by 3dB. A 20dB gain GaAsFET pre-amp having an inherent 1dB noise figure, interconnected with a ring mixer having 10dB noise figure, may give you only a 5dB noise figure in the system, ignoring coax cable losses. It is essential to use either a cavity, or inter-digital filter in between the pre-amp and the mixer to remove the amplified image frequency noise. Since it is much easier to cope with 2 x 144MHz image offset than 2 x 28MHz, very few stations have persevered with 28MHz IFs.

An enormous improvement can be obtained if the entire receiver pre-amplifier (and even mixer sections) can be put at the top of the mast, driven by a changeover relay of very low loss. The entire system noise figure would become perhaps 2dB, using the same pre-amp and inter digital filter/mixer as opposed to perhaps 12dB equivalent with the pre-amp in the shack without filter. Such a system can be further improved either by using a lower loss coax, eg Andrews LDF 4/50, or by having a higher RF pre-amp gain at the mast head. Around 23dB gain might be required to off-set the loss of a UR67 cable of 25 metres length interconnected with a transverter/-interdigital filter having a noise figure of 3 or 4dB. The formula shown in the figure will enable you to work out your system noise figure from antenna relay through one or two pre-amps into a transverter, and includes allowances for cable losses and any inter-digital filter loss. Note that noise factor and power gain or loss as a multiple should be entered, and not dBs of noise figure or gain.

Up in the air

One useful way of getting started on the band is to put the transverter at the mast head. Very shortly, Microwave Modules will be increasing the output of their transverters to around 2.5W, with a receiver noise figure of 1.9dB. If you have a very long cable between mast head and shack you might even be better off with this configuration, unless you are going to run more than 15W or so in the shack. Don't

forget to weather proof the transverter by using car gasket sealing compound around all screws and in between lids and boxes. Be very careful to weather proof all connectors used as even a slight amount of moisture in 23cm cables can increase losses quite markedly. By having the transverter at the top, you can feed 144MHz signals up the coax with only a fraction of the loss. You will be amazed that even 2½W at mast head and a decent receiver in the transverter will give you good results with a high gain aerial. Having played with many aerials on the band, my own experience is that four 23 element Tonnas on a Tonna frame with a power divider seems to be the best antenna, unless you can put up a large dish.

Running QRO

Although phenonenal DX has been worked by many amateurs with only a few hundred mW at the mast head, there is of course a great advantage in running high power. It is not so much that you need the high power to have the contact itself, but it will help you to be heard if you beam, or another station's beam heading, is well off the direct inter-station line. Almost all stations are using 2C39 valve pa's, or their slightly better 3CX100A5 equivalent. In a well designed cavity tuned circuit, up to 13dB gain can be achieved, although more usually the average gain experienced will be around 10dB. It is unusual to have two valves in series, one as amplifier, while the second is working as a high power PA running at perhaps 50 to 100W PEP output. You will have to make a choice between running a very stable 60W whcih hardly drifts with time, or perhaps 100W, in which case you will have to have easy access to cavity tuning, as they will need retuning as the PA gets hot. I use an extremely powerful fan which blasts much cold air through the entire linear to keep valves cool, and with power set at 60W maximum the PA only requires retuning once or twice a year, rather than every five minutes! Some superb design for very high output linears on 23cm have been published in magazines such as *VHF Communications,* one design giving up to 200 W from two 2C39s running in parallel, whilst another design employs a ring of six which gives at least 400W output, as used by G4GLN and others.

Changeover warning

I should give a word of warning about the use of coaxial relays on 23cm. A high quality relay which might give 50 or 60dB isolation between TX and RX ports on 2M may give only 25dB on 23cm. Some pre-amplifiers are quite likely to blow up if the wrong type of relay is used, and many amateurs hunt for weeks to find a really good relay with 'N' type sockets, and which shorts the RX socket when on transmit. Another useful hint concerns the switching of GaAsFETS. For these to last as long as possible without noise figure degradation, the main gates should be biased slightly negative. If DC power is applied to both the relay and the GaAsFET on receive, the GaAsFET should have a time delay built into its power supply so that only a very small DC voltage appears on it until the relay couples the input circuit correctly. This avoids instability caused by an open circuit as the relay is going over and, once a device takes off, it may continue to oscillate. You may find an entire mast head pre-amp installation working perfectly when you test it in the shack, but the slightly different capacities or inductances in the cabling and antennas may cause a problem when you put everything at mast head. Make sure you check it out completely before you take your ladders away.

Finally, whilst on the subject of equipment, you should get to know your nearest microwave enthusiast before you start fitting pre-amps at the mast head, for in some areas there are various harmonics of UHF TV transmiters, or even specialised radar equipment which can give great problems to some types of pre-amp especially if their input coupling circuit is too wide in bandwidth. It is often better to sacrifice a small amount of noise figure for the sake of stability and a tighter bandwidth.

Conclusions

In comparing 2M with 23cm in 1983 it is fascinating that many microwave QSOs are at considerable distances on SSB, whereas most average 2M ones tend to be more local. This is partly due to the fact that there are far fewer amateurs who are active on 23cm, and therefore you have to look further a field for QSOs, and partly because the average 23cm addict is more likely to have a aerial system with a typical gain of 20dBi. Don't be put off 23cm if you hear no activity; you may have to get used to finding out where it is. As there are more beacons on 23cm than 2M, it is usually easier to ascertain band conditions. There is very little FM activity on 23cm as opposed to 2M, although quite a number of mobile experiments on SSB and FM have been made. You can be sure that you will get a tremendous welcome on 23cm, and technical expertise is easy to find on the band. Interference is minimal, for both household devices and car ignition have hardly any microwave output, and only occasionally do I pick up ignition from an incredibly badly suppressed passing "banger". Thermostats should not give trouble, and because general interference is so low into the aerial, you will almost certainly be able to pick up solar noise, and many amateurs make a point of measuring this in the early morning or at sunset to have a look at the state of the sun. Moon bounce (eme) is very effective, and I have heard some astonishing cassette recordings made by G3WDG in which, using a dish, he received signals at around 20dB above noise bouncing off the moon. I have heard so many stories of amateurs working astonishing DX within a week of starting up on the band, and so I sincerely hope that you will be encouraged to have a go on microwave. Getting going is nowhere near as difficult as you might have thought.

23cm Beacon List

GB3NWK	1296.810	AL51B
GB3BPO	1296.830	AM77J
GB3FRS	1296.850	ZL57J
GB3AND	1296.870	ZL63B
GB3DUN	1296.890	ZL08E
GB3CLE	1296.910	YM48H
GB3MLE	1296.930	ZN32B
GB3EDN	1296.990	YP05G
PA0QHN	1296.990	YP05G
ON5SHF	1296.880	BK39J
DB0JO	1296.854	DL48A
OZ7IGY	1296.930	GP23C
SK6UHG	1296.925	FR29G
DB0VC	1296.920	F051J

Formula and details of use for calculating system noise figure from masthead preamp to transverter inclusive

$$F_t = F_1 + \frac{(1/G_2)-1}{G_1} + \frac{(F_2-1)}{G_1 \cdot G_2} + \frac{(1/G_4)-1}{G_1 \cdot G_2 \cdot G_3} + \frac{(F_3-1)}{G_1 \cdot G_2 \cdot G_3 \cdot G_4} + \ldots \text{ etc}$$

F_t = overall system noise factor from first pre-amp input to transverter.

F_1 = noise factor estimated for first pre-amplifier.

G_1 = power gain of first pre-amp (NB not in dB).

G_2 = gain of cable inter connecting first and second pre-amps (entered either as 1, or as a fraction if cable present).

F_2 = noise factor of second pre-amp.

G_3 = power gain of second pre-amp.

G_4 = gain of second interconnection coax between second pre-amp and transverter input (allow also for inter-digital filter loss when placed here).

F_3 = transverter input noise factor.

NF (noise factor) = 10 (0.1 x noise figure) where noise figure is in dBs.

G_P (power gain) = 10 (0.1 x G_L) where G_L is power gain in dBs. (NB cable loss is negative dBs and G_P would be a fraction below 1.0).

23cm equipment used by G3 OSS.

1. MM 1269/144 transverter with TX output driving at 1.25W feeding linear amplifier.
2. Linear amplifier having three 3CX100A5 amplifier feeding a second 3XC100A5 PA at 60W output.
3. 25 metres Andrews LDF4/50 cable run, then 8 metres FSJ4s for turning radius up to mast head.
4. Through relay box (completely weather proof) to power divider and four 23 element Tonna yagis on square mounting frame at approximately 68ft above ground.
5. Mast head relay box includes Mitusbishi GaAsFET and MRF901 pre-amp.
6. Around 90ft of UR67 receive down lead.
7. Interdigital filter, then receive input to MM transverter.
8. Transverter is fed from another transverter with input on 28MHz and output 144MHz with receive section having very low gain.
9. Basic transceiver is TS830 Trio which controls relay switching box selecting TX RF and RX RF to various transverters for other bands.
10. Independent receiver, NRD505, which can be tuned on any receive converter output for cross band working, or FM reception.
11. 28MHz TX output to transverters feed through RF coaxial potentiometer for setting required drive level. Full power is obtained on all bands when this pot is flat out, with transverter internal gains adjusted accordingly.

A PLAIN MAN'S GUIDE TO MASTS & TOWERS

Part 3

Choosing the right tower

By Alan Barraclough G3UDO*

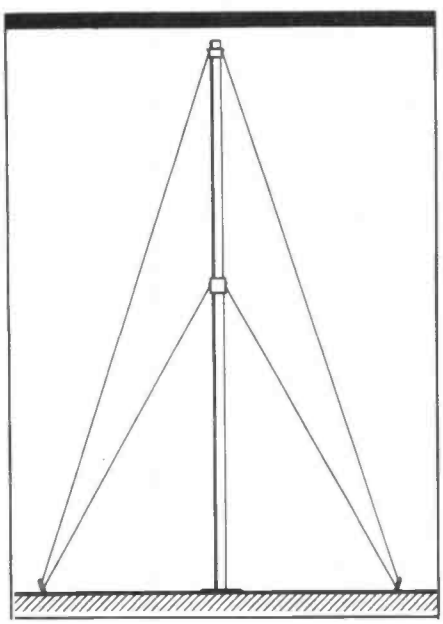
There are a variety of different structures ranging from a simple wooden pole to a multi section, 120 foot tower which could be used to support an aerial. However practicality will generally rule the day and finally dictate the type of structure we can erect. The first thing to consider is whether the mast or tower you are thinking of erecting will require planning permission.

Planning consent

In general, under planning law, any mast over about 3 metres high could be classified as a "structure" and so require planning permission. However, the views of planning authorities on the subject of aerial masts can vary from one local authority to the next so it may be helpful to ask around. Radio amateurs in the local radio club may have already had some experience in trying to get planning permission for an aerial mast and should be able to give you some useful tips. In some local authority areas, the planning laws can be very rigidly applied and yet in others a 'blind eye' is turned on some types of aerial mast that are not too obtrusive, or when the neighbours are not complaining. There are no hard and fast rules to go by and so it is probably best to ask around.

If you feel that you will have to make an application for planning permission, then the following hints might be helpful:

a) Most local authorities produce an explanatory booklet explaining the various aspects of planning law. Try and get a copy to study carefully.

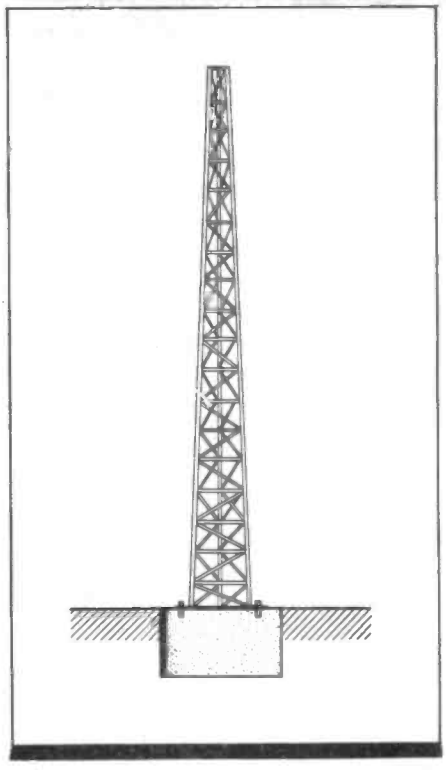


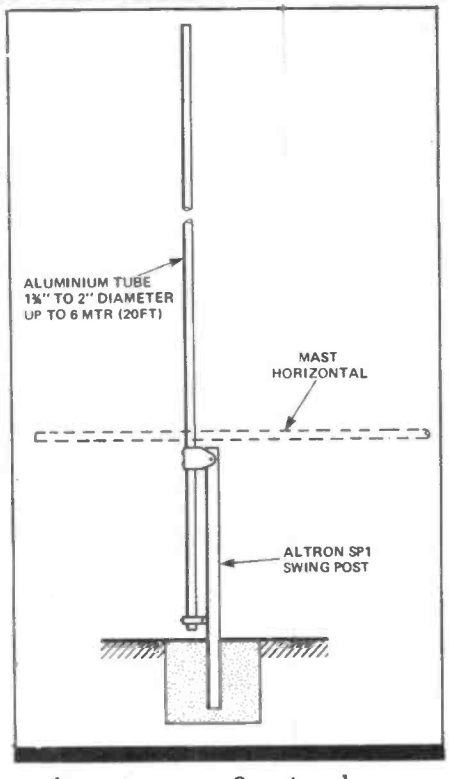
b) Refer to your structure as a **'Mast'**, the word tower may conjure up visions of a large unsightly structure.
c) Explain your intentions clearly and if possible, use scale drawings of your property to illustrate the proposed location of the mast and any trees, etc that are likely to screen the mast from public view.
d) When any structural work is needed to be done, such as foundations, get professional advice.
e) Home made or DIY structures are not always popular with planning officers and should be avoided. Commercially manufactured masts are more likely to be granted planning permission.
f) Try and get the consent of your neighbours.

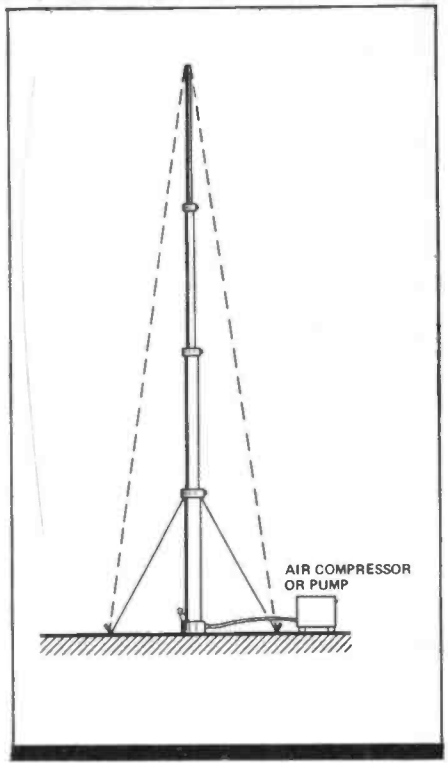
The next thing to have a look at is the various types of masts and 'towers' that are generally available and could be used as amateur radio aerials. It is beyond the scope of this article to deal with each and every kind of aerial mast in detail, so only the most commonly used sorts of mast have been included.

In general, they fall into two categories; fixed masts, either self supporting or guyed; telescopic masts which, like the fixed variety, can be either self supporting or guyed structures. **Figs. 1** to **6** show some typical examples of some popular types of mast that are available. The simplest mast of course is just a tubular pole of aluminium or steel held vertical by a system of guys as in **Fig. 1.** In some instances, when more height is needed, a number of tubular sections can be joined together and guyed to make a taller mast. Simple guyed masts of this type are relatively cheap to put up to heights of 50 to 60 feet but at greater heights, the difficulties in erecting and guying the structure increase thus raising the cost. The real drawback of this kind of mast is that it cannot be easily or quickly raised or lowered and so they are more suitable for 'permanent' installations.

Fig. 2 shows a different type of





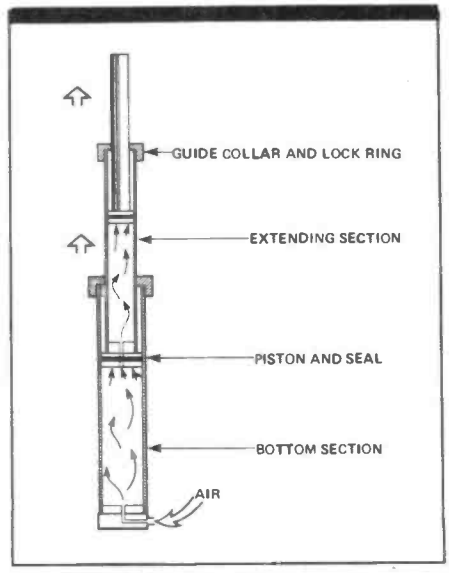


fixed mast which is more commonly called a lattice tower. Generally constructed in a triangular form either pre-fabricated as a welded structure, or made from steel tube with solid rod bracing. Some makes of lattice mast are available as a kit of parts that can be DIY assembled using bolts and nuts, made up of pre-drilled extruded aluminium. A thirty foot self supporting tower of this type can be a relatively light weight structure when assembled. Lattice masts or towers as they are commonly called, offer a much greater wind resistance than a tubular pole and this means that a fairly good concrete base is necessary. Manufacturers specify the size of base required and their instructions should be followed. Althogh no guy ropes are needed to keep this type of tower upright, getting it up and down can be a major problem, particularly with large aerials fitted.

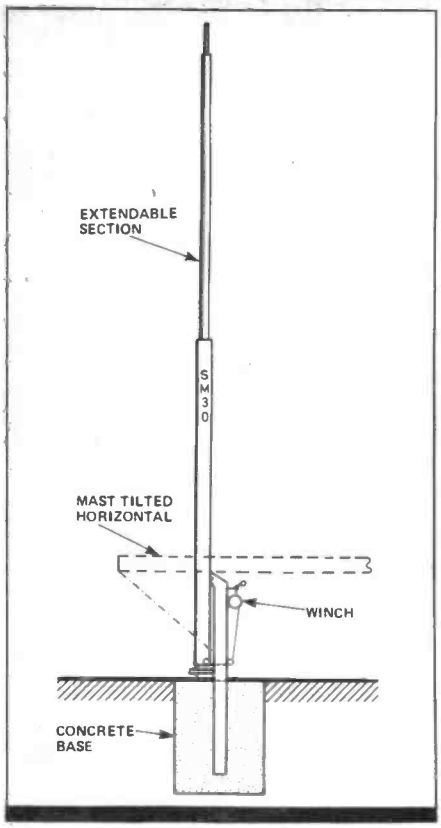
A simple mast that can be easily raised and lowered is shown in **Fig. 3.** This consists of a mounting post with a hinge at the top and a locking arrangement at the bottom. Any length of tube, such as aluminium scaffold tube, can be held in the hinge bracket. This allows the mast to swing down horizontal when the locking device at the bottom of the mouting post is released. The *Altron SPI* is a commercially available unit suitable for tubing from 1¾ " to 2⅛ " in diameter up to 6 metres long.

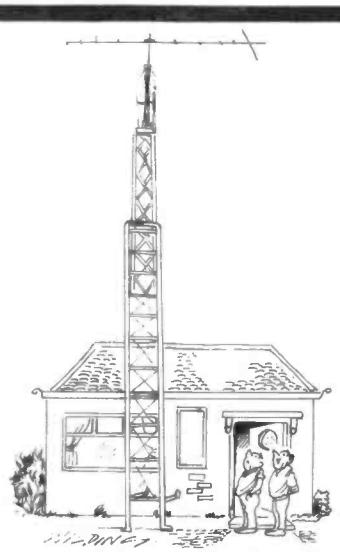
The bottom section of the mouting post can be bedded into a small concrete base and, depending on the aerial size and tube diameter, the mast can be additionally supported by guys. Retailing at £49.50 each, VAT and UK (mainland) carriage, the *Altron SPI* can make a very simple and cheap swing down mast for lightweight aerials.

There are two basic types of telescopic mast or tower: the pneumatic or hydraulic pressure operated type as in **Fig. 4**, and the cable and winch operated types, **Fig. 5 and 6.** The pressure operated mast, **Fig. 4**, consists of a number of tubular sections of reducing diameter, fitting one inside the other, see **Fig. 4A.** Although water pressure hydraulics can be used to operate this type of mast, compressed air is the most common. **Fig. 4A** shows the basic construction of a typical pneumatic mast. The sections are generally of aluminium allay tube with a smooth precision bore. Each section can be six to 12 feet long depending on the overall height when extended and number of sections used.



In operation, air is supplied by a pump from an electrically operated compressor and enters the base of the bottom, largest diameter, section through a release valve. The air pressure builds up beneath the piston at the bottom of each subsequent section, forcing them out so extending the mast. A locking device is sometimes provided to lock the sections together when fully extended. Because of the precision needed in their manufacture and the complexity of construction, pneumatic masts are relatively expensive, ranging from £400 to over £1,200. Although pneumatic masts can be self supporting with light loads, thjey will require guying if any decent sized aerial is to be fitted. Pneumatic masts can be raised up or lowered very quickly indeed and have a fairly low closed down height. They suffer from one drawback when used in amateur application when they tend to lift for





When applying to the local planning authority, it helps to refer to your structure as a 'mast' rather than as a 'tower'

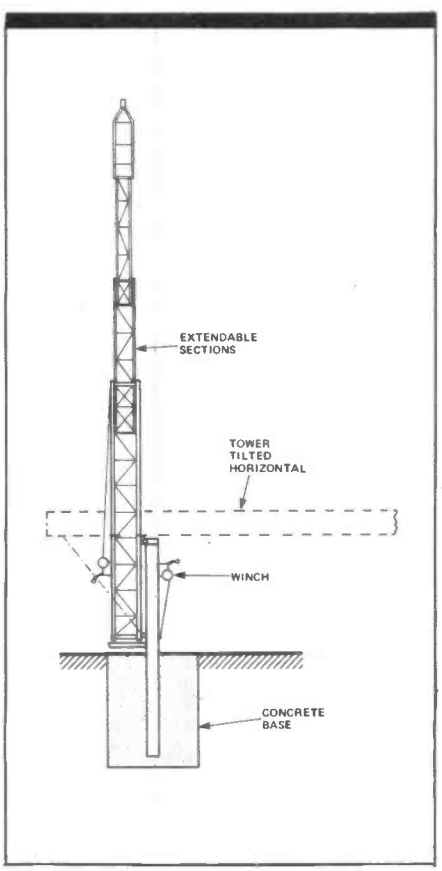
long periods. Under such conditions the piston seal can deteriorate and fail. Replacement of these can be an expensive business.

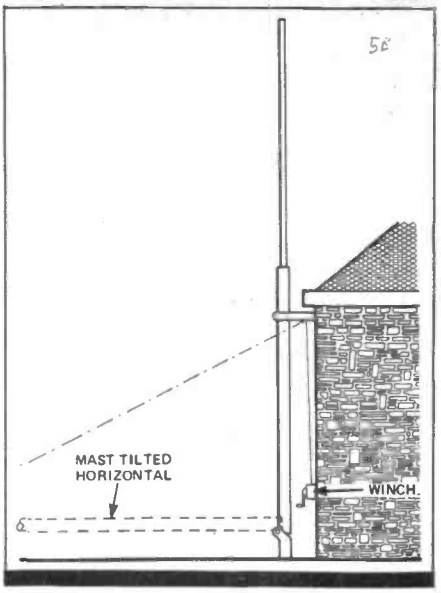
Mechanically operated telescopic masts and towers are the most popular with radio amateurs. See **Fig. 5** and **6.** Winch and cable operating is fairly simple and there is not much to go wrong with the system if it is left extended for long periods.

Fig. 5A and **5B** show a slimline telescopic mast consisting of two sections operated by a cable and winch, mounted onto a ground post set in a concrete base so that the mast, when closed down, can be tilted down to the horizontal. This feature has the chief advantage that the mast and aerial can be quickly raised up or lowered down to ground level even by one person. Telescopic masts of this type, such as the *Altron SM30* are made up of two 15 foot sections of galvanized steel tube, and all extendable up to a height of 30 feet, excluding the rotator and aerial.

This type of mast has a very slim silhouette and can be self supporting with small HF or large VHF aerials, depending on local conditions. **Fig. 5B** shows the slimline mast mounted against a wall so that it can be lowered down away from the wall. In small spaces, this is sometimes a more practical way to mount a telescopic mast. The *Altron SM30* retails at about £240.00 including VAT and UK mainland carriage and is unique in that it is made up of 15 foot sections for easy transportation and low closed height.

If heights over 30 feet (excluding aerial and rotator) are needed or large aerials are to be fitted then a tower is going to be necessary. **Fig. 6** shows a typical





telescopic lattice tower mounted on a ground post so that it can be lifted horizontal. Lattice towers are sometimes referred to as Versatowers which is in fact the trade name of Western Electronics Ltd, a firm that makes lattice towers. They are usually fabricated from steel tube braced with rods and extended, as well as tilted by cable and winch.

When to guy

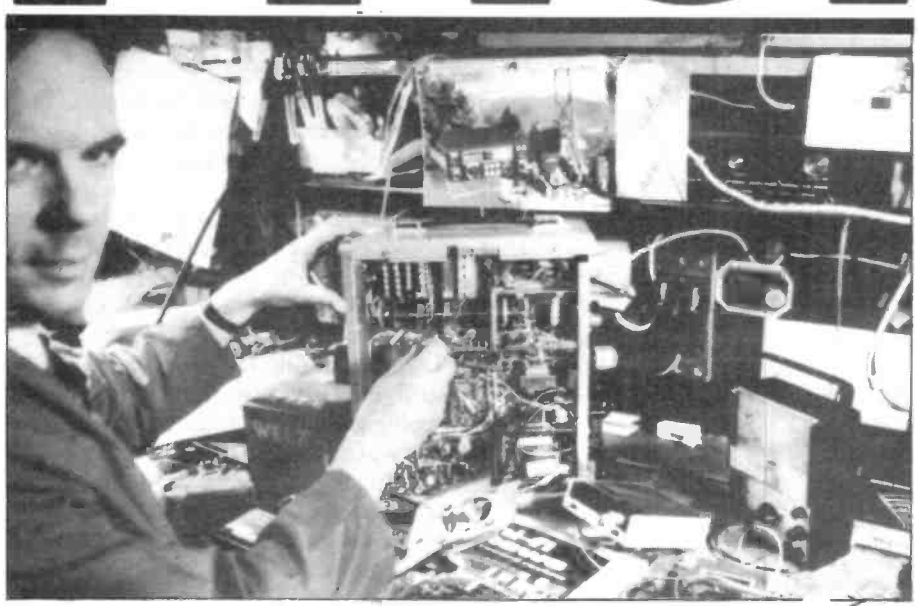
The 'lattice' sections are usually of triangular form parallel over the whole length. These sections can be 20 feet long as made by Western or 15 foot long as in the *Altron* series of towers by Allweld engineering. Although towers are, by their construction, more costly than a telescopic tubular mast price; (ranges from £363.00, the Altron AT32PM mcm tower up to over £1,000) they can carry much larger aerials to heights up to 120 feet. Generally though, at heights over 56 feet, they should be guyed. The ground post needs to be set into a suitable concrete base and manufacturers usually specify what these should be. Some sizes of telescopic tower can be mounted against a wall when space is limited but loads on the wall should be taken into account on this type of installation. Like the mast, the tower can easily and quickly raised or lowered as well as tilted to the horizontal using the appropriate winch.

Like any mechanical structure, a mast or tower is designed to operate within certain load limits; such as wind loads, and in the next part, we will look into these. ●

The FT101 series of transceivers still represent some of the best value for money to be had in secondhand HF gear.

Taking apart the FT101

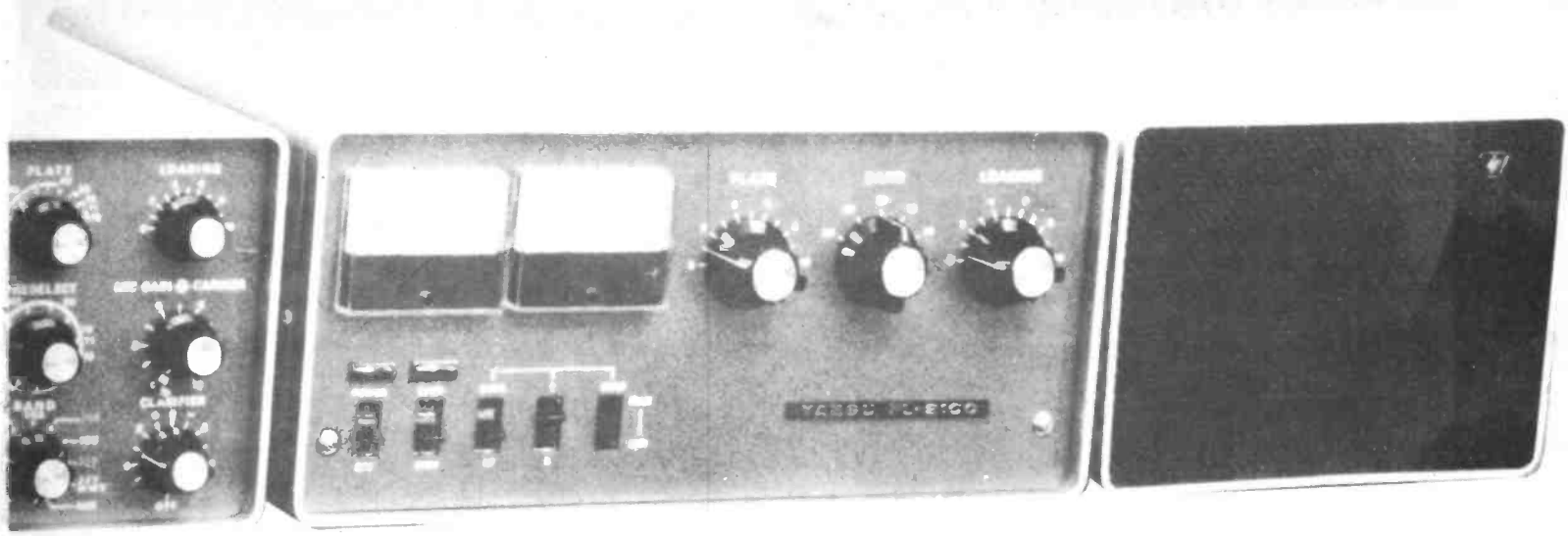
Even the earliest versions are worth acquiring while a few simple modifications will bring the sets up to present day performance standards. *By Harry Leeming G3LLL*



"I'm just ringing up to see if you have any second-hand *FT101s* in stock."

The *FT101** must be the most sought-after piece of second-hand gear on the amateur radio market, and as the line seems destined to come to an end with the demise of the *FT101ZD,* it would seem an appropriate time to look back at, and discuss, this extremely popular unit.

Yaesu's original sales literature seems to indicate that the *FT101* was aimed at the Yank who had two homes, a large automobile, travelled around a lot, and wanted a second rig which would run from DC or AC supplies, fixed or mobile. Considering its power and versitility, the *FT101's* ssize and weight was a revelation in its time. Old heads wagged and predicted that it just wasn't possible, "the power supply is too small". They were wrong. Hundreds of thousands of users including now many of the original doubters have vindicated Yaesu and the *FT101* has proved to be one of



the most popular, reliable, and easy to maintain pieces of amateur radio gear ever made.

A Brief History of the FT101

Yaesu have gradually developed the *FT101* over the years, but have not always clearly indicated the existence of design improvements by altering the model's suffix. When servicing, buying, or selling an *FT101,* it is as well to know exactly what version one is dealing with, hence it is hoped that the following will help. Second-hand values are very approximate but, for what it is worth, they are given as of late 1982 (strange but they seem to be just about what the models cost in the first place; what else in electronics can you get your money back on after ten years' use?) dates apply to UK sales and are also approximate.

1971 Early FT101 Mark 1 (present value £200-£250). The *FT101* was not originally factory fitted with the 160 metre band but many units were modified for this by the importer. The earliest model can be identified by the absence of any "160" markings on the band switch and by the use of two output transistors on the audio unit. The main complaint with this early version of the FT101 is that it suffers from cross modulation and receiver overload — it just "falls to pieces" if used with a full-size aerial on 40 metres after dark. It was probably intended for use mainly with a mobile aerial.

1972 Late FT101 Mark 1 (present value £250-£300). This is as above except that the audio output transistors have been replaced with a 2½" by 1½" Sanyo I.C. which is very easy to spot on the audio unit if you open the lid.

* Marketed as Sommerkamp FT227 in most Continental European countries

Mark numbers are unofficial and are similar to those suggested by the FT Club in the United States — see end of article

Late 1972 FT101 Mark 2 (present value £250-£300). This model looks externally as above except "160" is marked on the band switch, there are larger DC/DC inverter transistors and a larger heat sink is fitted at the rear. Internally new circuit boards give more IF gain and less RF gain and the RF protection diode is removed and replaced with a fuse lamp. The noise blanker circuitry, which was part of the IF unit in the *Mark 1,* is re-designed as a separate board and perches on top of the VFO unit. Together with extra filters to clean up the transmitted signals, these modifications result in a considerably improved receiver and transmitter performance.

1973 Late FT101 Mark 2 (present value £260-£310). This unit is the same as the earlier *FT101 Mark 2* but is fitted with an extra receive audio pre-amplifier. This small printed circuit board, the circuitry of which is given in **Fig 1**, is mounted behind the mode switch.

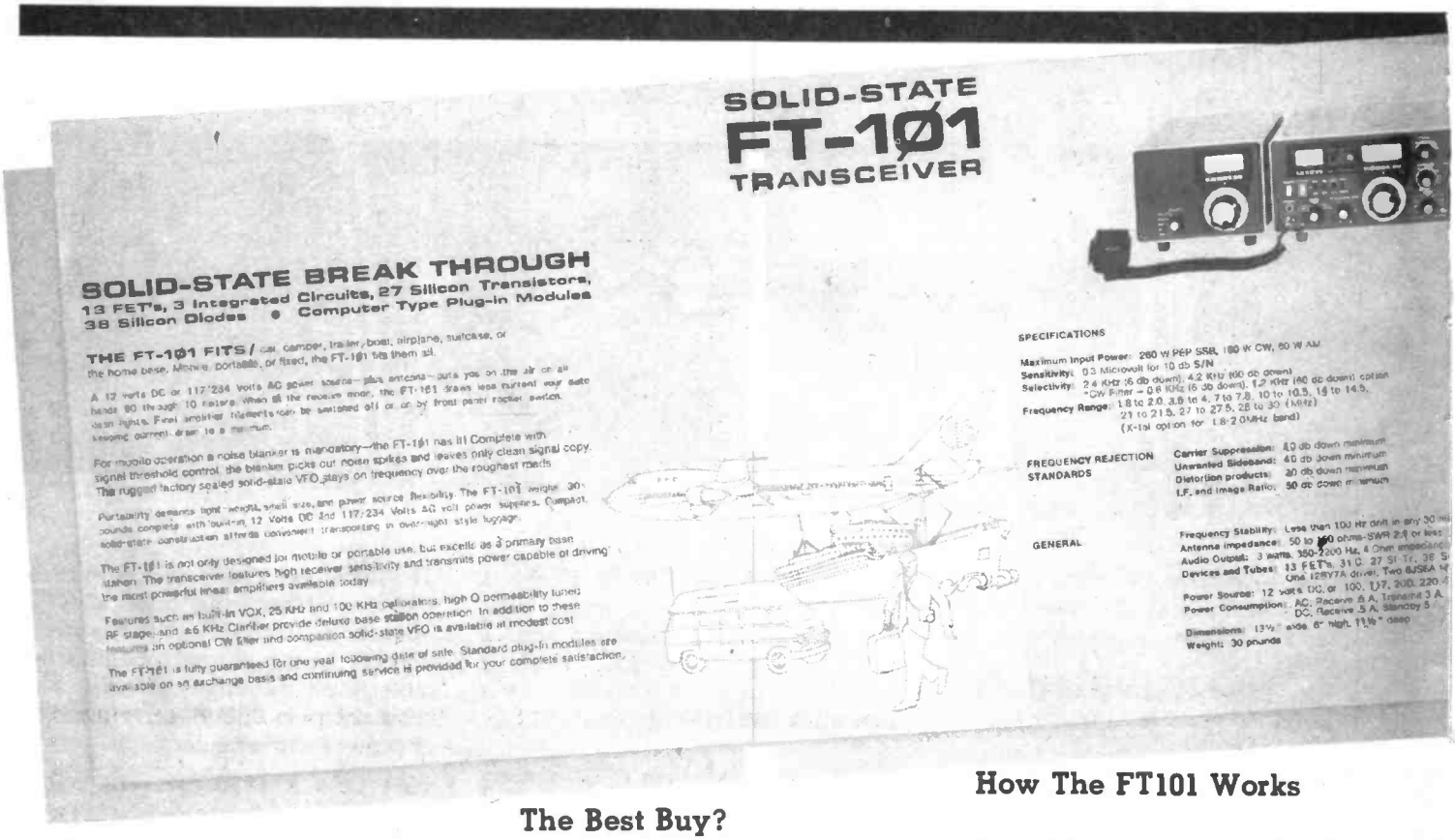
1974 Early FT101B (present value £275-£325). The rig is only slightly different from late *Mark 2s* but is clearly marked on the front panel "FT101B" and sports two LED's to indicate clarifyer and internal VFO operation. Inside the set the noise blanker board plugs in behind the mixer/high frequency IF unit, and an eight pole SSB filter is fitted to improve receiver selectivity.

1975 Late FT101B (present value £300-£350). As above but large Sanyo IC is replaced with smaller unit thus allowing audio pre-amplifier to be removed from behind the mode switch and incorporated in the AF unit.

Late 1975 FT101E Mark 1 (present value £325-£375). This unit is the same as late *FT101B* but is marked on the front panel "FT101E" and is fitted with an early version of Yaesu's speech processor. This early processor is not particularly successful or convenient due to the lack of an external level control.

1976 FT101 Mark 2 (present value £350-£400). In this model, the speech processor is completely redesigned and a dual gang potentiometer is fitted in the clarifier position on the front panel labelled "CLAR/—LEVEL". The processor is more convenient and effective than that fitted in the *FT101E Mark 1.*

1977/78 FT101E Mark 3 (present value £375-£425). DC/DC converter transistors reduced in size as per *FT101 Mark 1.* The power supply and noise blanker circuits are altered. This version can be identified by the noise blanker board which is numbered PB1582 and incorporates a 2.72 MHz. (No crystal, and board marked PB1292 on earlier units).



The first publicity blurb

1978 FT101ZD. This is entirely new design which probably was numbered "101" for marketing purposes. It is a single superhet and is basically an economy version of the *FT901* from which it was presumably developed. It is an excellent piece of equipment. It is not the subject of this article.

FT101EE as FT101E but speech processor an optional extra. FT101EX economy version omitting speech processor 12 volt power supply unit, microphone and fan. 160M, WWV, and three 10 metre crystals also omitted.

The Best Buy?

The basic circuitry and performance has not changed greatly since the *FT101 Mark 2,* and price and condition are the main consideration when purchasing a second hand unit. Some *Mark 1's* have been fitted with an official Yaesu upgrade kit (new noise blanker fitted on top of the VFO, new RF board, new mixer/high frequency IF module, plus extensive re-wiring and modification of other boards) and are more or less equivalent of a *Mark 2* if the work has been correctly done. A few models can be fitted with an external speech processor and with a few small mods, a *Mark 2* or *B* which is in good condition can be made to out perform an unmodified *FT101E.*

How The FT101 Works

The *FT101* uses a classic double superhet arrangement with a crystal controlled high frequency oscillator. This type of circuitry was used by many rigs of it's era, such as the TS510 and TS520 by Trio/Kenwood and the *FT560* and *FT401* by Yaesu to name but a few of dozens. The simplified block diagram in **Fig. 2** shows the *FT101* operating 15 metre band, and using this example let us follow the signal path through the transmitter.

Speak into the microphone and a few millivolts of audio are amplified by PB1315 for application to the balanced modulator circuitry on board PB1184. The output of PB1184 is a set of two sidebands, either side of a suppressed carrier at a frequency just under or just over

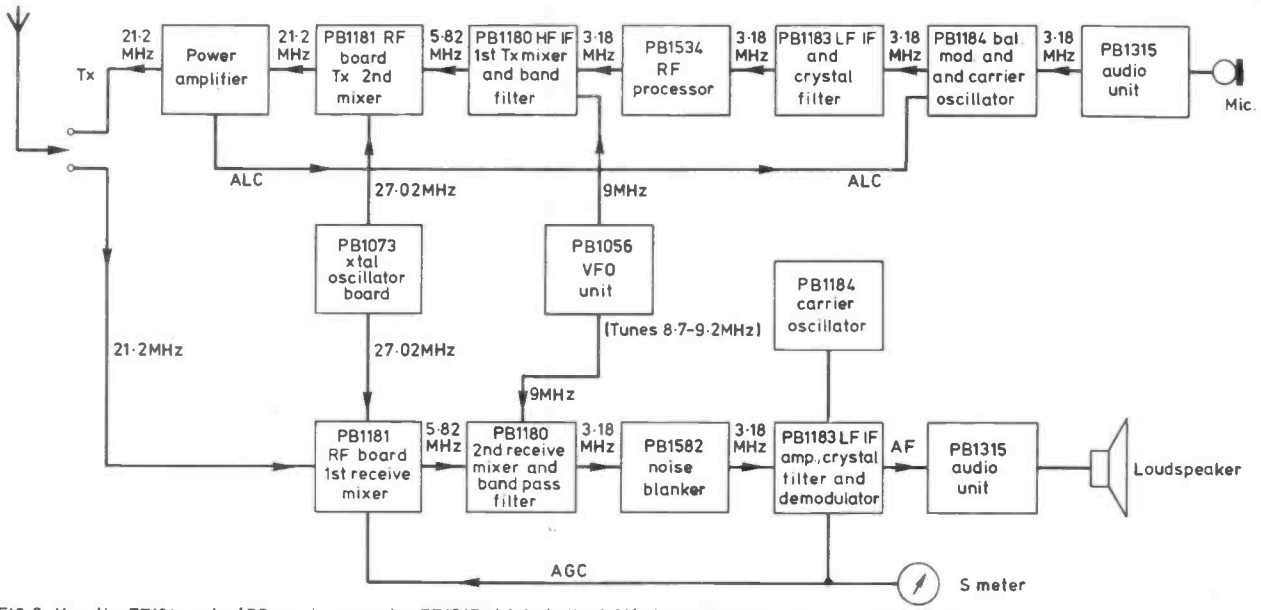


FIG. 2. How the FT101 works (PB numbers are for FT101EMk3 but all FT101's from Mk1–E use same basic set up) Units shown transmitting and receiving at 21·2MHz.

3.18MHz dependent on which sideband has been selected. These two sidebands are applied to PB1183 where the wanted side band is amplified, the unwanted sideband being suppressed by the crystal filter.

The 3.18MHz SSB signal then passes via PB1534, the RF processor, to the mixer unit PB1180 where it is mixed with the output of the VFO to provide a signal at some frequency between 5.520 and 6.020MHz, any mixer products outside this range being suppressed by the band pass filter.

This SSB signal (in the illustrated case at 9−3.18 = 5.82MHz) is applied to the second transmit mixer on PB1181 and is mixed with the output of a crystal oscillator whose frequency is selected by the band switch. In this instance 27.02MHz is selected producing the difference frequency (27.02−5.82 = 21.2MHz) at the input of the radio frequency power amplifier. This signal is then raised to a level of approximately 150 watts PEP by the driver and power amplifier valves, and is applied through the aerial changeover relay to the PL259 socket on the rear of the rig.

The Receiver Mode

The in-coming signal at 21.2MHz is applied via the aerial changeover relay to the RF board PB1181. Here it is amplified and mixed with 27.02MHz coming from PB1073 the crystal oscillator board. The output of the RF board is the difference between 21.2 and 27.02. Hence 5.82MHz is applied to the second receiver mixer via the band-pass filter. the VFO can be tuned from 8.7 to 9.2 MHz to convert any signal in the range of 5.520 to 6.020MHz to the second IF frequency of 3.18MHz. In this case it is tuned to 9MHz (9−5.82 = 3.18) to produce a signal for feeding to the noise blanker circuit.

PB1582 or its equivalent on earlier models is intended to reduce the effect of impulse type interference. Yaesu has swopped and changed with the noise blanker circuitry on the *FT101* considerably, but have never really got it to work well. If used as originally intended in a mobile location with S9 + 20 QRN from one's own engine, it does help, but even the elaborate version on late *FT101E*, which uses an extra stage to convert the noise to 450kHz does not seem to help much on the type of noise encountered on the

average domestic environment. A similar elaborate arrangement is used in the *FT902* which does not seem very impressive either. Strangely the *FT101XD* uses a much simpler circuit arrangement, and the noise blanker on this works wonders!

PB1183 is the low frequency IF amplifier and this contains the crystal filter which provides the receiver's selectivity. Prior to the crystal filter, most stages in the receiver have to handle *the entire radio spectrum for a few hundred kilohertz either side of the wanted station*. As well as ham stations running watts this will sometimes include broadcasting stations running mega-watts so that handling these extremes of signals without some cross modulation is an almost impossible task for the RF mixer and noise blanker stages. Also contained on PB1183 are the AM and SSB/CW detector stages along with the automatic gain control rectifier. AGC is applied to the IF amplifier integrated circuit on PB1183 and is also fed back to the RF stage, while detected audio is passed on to PB1315 for amplification prior to being fed by the loudspeaker.

The Transceiver Principle

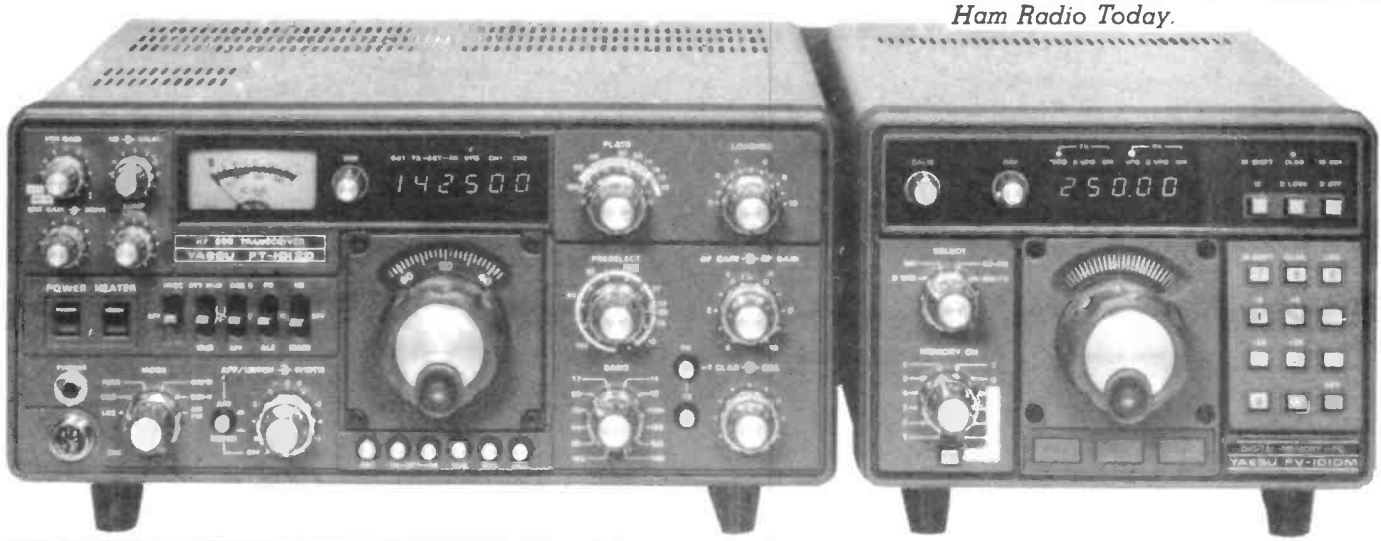
From examination of the above and the block diagram, it will be seen that many transmit stages are turned round and used in the opposite direction on receive, allowing a very considerable cost saving. One has only to compare the number of parts in Yaesu's separate transmitter the *FL101* with the *FT101* transmitter/receiver to realise why it costs almost as much to build a transmitter as it does to build a complete transceiver. While separate transmitters and receivers do have some operational advantages, cost effectiveness has resulted in the almost complete domination of the amateur radio market by the transceiver.

G3LLL asks us to point out that while he is happy to answer brief queries on the FT101 series, correspondence must contain a stamped, addressed envelope to obtain a reply.

FT101 INFORMATION

G3LLL will be covering servicing and modifications in future FT 101 articles. Alignment and fitting 10, 18 & 24 MHz will be covered, together with AGC modifications and other Receiver and Transmitter improvements. But what about you?

"Bright ideas" and servicing experiences should be shared around so let us know what you have done with your FT 101 — please type (or print CLEARLY) and send your contributions to the editor for possible inclusion in part 4 of G3LLL's article. The best contribution will receive 12 months' subscription to Ham Radio Today.



CLUB NET

By Cyril Young G8KHH

Due to production difficulties, we were unable to bring you Club Net in the March issue. However we have a bumper bundle for you in this issue. One or two diary items will be out of date by the time this column appears. Please forgive us and we shall try to ensure that the delay doesn't happen again.

When submitting material for use in our Club Net column, please remember that there is at least a six week delay between receipt and publication. It helps us in no small way to have your news notes as early as possible. All the best. Frank G4JST,

Editor Ham Radio Today.

Here we are almost into Spring, but it's far from Spring as I write this month's Club Net. Then the common cry seemed to be dig deep it's sub's time; that was nearly three months ago, so if you haven't paid up yet what about it lads? Clubs cost money to run you know!

One of the clubs reminding its members to pay up is the **Central Scotland FM Group.** From their multi-page newsletter I have picked just one or two items of interest. One in particular is their strong concern for the loss of the band one and band three television spectrum. It was hoped that some of these would be allocated to ham radio; unfortunately it seems that it is all going to go to commercial mobiles.

In his editorial, Colin Dalziel GM8LBC, raises the question that there is a strong case for 50 MHz and nobody would be averse to a bit of room around 200 MHz; and how about an exclusive amateur TV allocation! He goes on to suggest that Amateur TV in this country needs to lobby the Government on its behalf and is suggested that the RSGB attempts to set up an amateur lobby in Parliament. This is not so difficult as one would assume, Stirling's own MP holds an amateur call sign. (I wonder how many MP's this also applies to?)

NORTHERN SHOW

The next interesting point is that **the 21st Northern Amateur Radio Societies Association** are to hold their exhibition, previously known as "Belle Vue", to be held on Saturday 19th and Sunday 20th March 1983 at Pontin's Holiday Village, Ainsdale, Southport. The Exhibition opens on Saturday at 11am to 5pm and Sunday from 10am until 4pm. Admission at 60p per day or £1 for the weekend. Pontin's chalet accommodation is offered at prices from £10 to £26 per night. Further details from Colin, or Pontins telephone 0704 77165.

Scottish Convention 1983 will be held in Glasgow on 29th August. The venue will be Gardonald Technical College. The social event is schedule for the Bellahouston Hotel in the evening.

The 2 Metre repeater GB30C is being built to cover the north coast of Scotland and is sited on Wideford Hill, neark Kirkwall on the Orkney Mainland at 742 ft above sea level.

The most northerly GB2RS, heard on Sundays at 0930 on S21 is read by the first all XYL broadcasting staff, namely GM4KNQ and GM4LNN.

The Scottish Repeater Group are to apply for a special 'one off' for high-power licencing for three Scottish 2M repeaters, GB3HI, GB3GN and GB3SS due to a special geographical locations. Also the 2M phase 6 applications GB3PA, GB40C (Orkney) and GB3LU (Shetland).

From this mine of information I find that the City and Guilds Institute *Radio Amateurs Exam* is to be held three times a year in the future i.e. December, 21st March 1983 and 16th May 1983. There is a great deal more interesting information in this publication. Unfortunately space is limited! For further information contact Colin Dalziel GM8LBC, 12 Dunure Drive, Earnock, Hamilton, ML3.

The next club we call on this month is **Rolls Royce Amateur Radio Club** at Barnoldswick. Bill Roberts G4PWC has taken me to task for not knowing the location. However, I have since looked it up and find that I have been there! So much for my geography!! Bill says he has just become the Club's PRO. Well done Bill, let's be having lots of news and photo's from you. Forthcoming events are Wednesday 2nd February — Lecture by Albert Leaver G4ECB — *Computing* and Wednesday 2nd March *Construction Contest* Display and Judging.

One piece of news is the additional Club Call sign to the G3RR already held the Club now holds the callsign G6RRB (Rolls Royce Barnoldswick). This is for use by club members within the existing rules of the Club.

Slow Morse Practice transmissions are broadcast each Friday evening at 8.00 pm on S33 -145.550. Reports are welcomed at the end of the broadcasts from licenced Radio Amateurs or from Short Wave Listeners by QSL.

For further information please contact Bill Roberts G4PWC, who hasn't given his address, but I am sure that letters addressed Rolls Royce Amateur Radio Club, Barnoldswick, Colne, Lancashire, will be passed on.

PROFESSIONAL RADIO

It appears that **the Wakefield and District Radio Society** G3WRS have settled in to their new palatial quarters and there is the additional advantage of a small room which is used as a shack which will make on the air nights much easier for them.

Forthcoming events — 8th February *Visit of Radio Aire Studios* 22nd February Debate on Amateur Radio — 8th March 'Electrical Power Generation — (Films) — 22nd March On-the-Air/Natter Night. The Society meets on alternate Tuesdays at Holmfield House, Denby Dale Road, Wakefield. Meetings start at 8.00 pm prompt and new members and visitors are always welcome. Further details from the Secretary Rick Sterry G4BLT on Wakefield 255515. I've no doubt you can grab him on the air!

Back now to **Glenrothes and District Amateur Radio Club** GM4GRC in Fife, Scotland, who seem to have a bit of a problem on their hands with Raynet. It seems that while everybody is expanding Raynet activities throughout the country, they are having problems getting amateurs interested enough to keep the group going. I find this a great pity as no doubt the useful ness of Raynet in the district has been shown; if not, it should have been. I cannot wholly agree with the defeatist attitude that CB'rs REACT forming a useful and voluntary network. From my personal experience with REACT, Raynet is a considerably better trained body and more suited to the situation. If the CB'rs were to use plain English I might be prepared to go along with it, but imagine trying tp pass messages in CB language. (*Cyril, you think that amateurs speak plain English?* — *Ed*) Come on lads, get together and get that Raynet Group organised. Emergencies have no respect for time or place. You never know when YOU could be doing a powerful job.

A *new award* will be introduced to radio amateurs by the Scottish Tourist Board from 25th November. The award is in three classes: Bronze — 30 districts worked. Silver — 45 and Gold all 56 districts worked. Details and applications from A.G. Anderson, GM3BCL, West Balfour House, Durris, Banchory AB3 3BJ. Forthcoming Events — February 16th — *Visit BBC MW Transmitter, Falkirk* (numbers limited). Meeting on 20th February — to be arranged. For further information contact Club Secretary Gavin Lucas GM4EJI, Provosts Land, Leslie, Fife, Scotland.

Junk Sale

Our next Club is one of several new members to the net and is **Stratford-upon-Avon & District Amateur Radio Club**, who meet at the Control Tower, Bearley Radio Station, Bearley, nr. Stratford on 2nd and 4th Mondays of each month, commencing at 7.30 pm. A talk in is available if required, on 145.550 MHz (S22).

their programme for the year looks very interesting and is as follows. February 10th — *Introduction to 10 GHz microwave equipment and operating* by

Glen Ross, G8MWR. February 28th *Junk Sale*. 14th March — *Review and discussion* of members' equipment. March 28th AGM & Cine film of radio interest. The News sheet is a little sparse on information but further details can be obtained by contacting either the Secretary David Boocock G8OVC on Stratford-Upon-Avon 750584 or the Programme Secretary Ian Opwood G6CWK at 52, St. Mary's Rd, Stratford-Upon-Avon, Warwickshire. Phone S-o-A 68863.

Another new Club to join the net is the **Huntingdon Amateur Radio Society** this is in fact a newly formed club which needs more members. Well folks, here's an opportunity for anyone in the Huntingdon area to join. The club meets every Friday "in term time" at Huntingdon Technical College from 6.30 pm. Membership fee £5.00. The Secretary is Ralph Marchant (RS52609) and the Chairman Barry Street (G3MSU). For further information contact either gentleman by writing c/o P.O. Box No. 1, Huntingdon, Cambs, PE18 7TE and here's wishing the Club every success from all at *Ham Radio Today*.

Keep me informed of Club activities, Barry, so we can get you some publicity around the Huntingdon area.

COMPONENTS FAIR

It seems that big things are happening around the **Pontefract & District Amateur Radio Society**. A deluge of paperwork has come through this month mainly publicising their *Third Components Fair* on 13th March 1983; even more effort has been put into this year's Fair and it is to be held at Carleton Grange Community Centre, Carleton, Pontefract at 11.00 am to 4.30 pm (10.30 am for disabled). There is a licensed bar and refreshments and dealers wilsl be displaying and selling components, test equipment etc., with the subtle difference that there will be no new Black Box Equipment except for station accessories and antennas. The RSGB Book Stand will be there and there is a talk-in on 2M and 70 cm., with ample parking close by. Further information from P.N. Butterfield G4AAQ. Telephone 0977 791071. 43, Lynwood Crescent, Pontefract. WF8 3QT. West Yorkshire.

Having given their Component Fair some advertising, we now return to the club proper which meets on Thursday evenings at 8 pm. *Morse classes* are held on Monday evening at 8 pm. on the top floor of the Carleton Community Centre, Pontefract. I understand the latest addition to the club shack is a 3 element tribander up on the roof of the centre. From the chatty newsletter I am able to relay the following information 3rd February — *A construction Evening* (when members bring along their finished or unfinished projects. 10th February — *On the Air Night*. 17th February — *Quiz Night*. 24th February *Informal Evening*. 3rd March *HF Antennas*... Talk by Ernest Ashby G3HCW. For further information contact Secretary, Niall Whittingham G4ISU, 7 Ridgedale Mount, Pontefract. WF8 1SB.

I have received an interesting and informative letter from A.J. Ryan G6LUD, Secretary of **Leicester Polytechnic Amateur Radio Society** call sign G3SDC, School of Electronic and Electrical Engineering. Thank you for your information and how about some more on the club and its activities. Anyone requiring further information should contact A.J. Ryan, Leicester Polytechnic, P.O. Box 143, Leicester LE1 9BH or telephone 0533 551551.

The British Amateur Television Club, Secretary Trevor Brown G8CJS, sends a letter giving forthcoming goodies. This is your club, you television addicts and it can only be to your advantage to be a member. Contact Trevor Brown at 25 Gainsboro Drive, Adel, Leeds LS16 7PF or telephone 0532 670115. Trevor is currently writing a series of articles for *Ham Radio Today*.

G4CUO.

NEW CLUB

Yet another new club, not just new to the Net but a brand NEW club; **The Inverness Amateur Radio Club**. Its good to hear of new clubs being formed, especially in association with Boys Clubs. Well done Bob, do keep me informed of the future activities and *Ham Radio Today* wishes you every success. The club meets twice a week on Mondays and Thursdays at the Cameron Boys Club, Planefield Road, Inverness. On Mondays they run an RAE course, on Thursdays, a general chat evening and construction night. New members are needed and always welcome. Contact R.H. Brown GM8VIZ, The Flat, 21 High St, Dingwall, Ross-shire, Scotland IV15 9RU. For further information and if you write don't forget to enclose the SAE for your reply.

SINCLAIR CLUB

Yet another new club to join the Net is **SARUG — Sinclair Amateur Radio Users' Group — UK**. Paul Newman, G4INP, the Club Secretary, says that he formed the Group in September 1981 as a result of contact with a similar group in the States dedicated to sharing expertise, problems, circuits and programmes, using the Sinclair micros in ham radio. To

Ron Ray G3NCL and Shirley Hesketh G4HES of Chiltern ARC. Ron and Shirley produced the Ham Radio Today morse course

Yet another and most welcome new club to our Net this month is the **Lincoln Short Wave Club**, their call signs being G5FZ and G6COL. The club meets on 2nd and 4th Wednesdays of each month commencing at 8 pm at the City Engineers Club, Central Depot, Waterside South, Lincoln. On the alternate Wednesdays when no club meetings are held, RAE classes and slow morse code practice are held instead. This certainly sounds like a go-ahead club. Club Secretary Mrs. P.G. Rose G8VRJ tells me that the club is over 60 years old. Forthcoming events are February 9th — *Lecture on RTTY* by G3VRD. March 9th — *Lecture on Satellites* by date, it has a wide range of applications using Sinclair products within ham radio. CW with ZX81, using the same micro in RTTY, teaching morse, coil design, QRA contesting scoring etc. All this and details of the Group and its future activities can be had by sending an SAE to Paul Newman, 3 Red House Lane, Leiston, Suffolk, IP16 4JZ. Enquiries by telephone, or those without an SAE will NOT be answered. Please keep me informed, Paul, of the Group's future activities. It seems that more and more radio and computer clubs are getting together and a large number of radio clubs are sprouting Computer Sections.

I hope that the members of the **York Amateur Radio Society** have recovered from their Annual Dinner. Among other things, numerous cups and awards were made to members of the club for their bold efforts during the year. Keith Cass G3WVO, club secretary, tells me that meetings are held each Friday at 7.30 pm and visitors are most welcome. He says 'If you don't enjoy yourself, he will be very surprised', and as we are adamant that amateur radio is fun and should be enjoyed and if you are in Yorkshire, no doubt you will be enjoying it with a pint! The club meet at the United Services Clubroom, 61 Micklegate, York. Keith can be contacted at 4 Hepworth Village, York. Don't forget to let me have a list of forthcoming events, as soon as possible, Keith, so we can let the visitors and non members know what you're up to!

Here's a warm welcome for another new club to call in on our net, *the Biggin Hill Amateur Radio Club* holds its meetings at 8 pm in the Biggin Hill Memorial Library. Its next meeting, on 15th February, has a lecture *The Secret Listeners* by Pat Hawker G3VA. "This is an excellent programme". On 22nd March is a Junk Sale.

Keep up the good work, Ian and let me have more details of the club so we can encourage new members. Full details can be obtained from Ian Mitchell G4NSD, 37b, The Grove, Biggin Hill, Westerham, Kent. TN16 3TA.

The next club, **The Conwy Valley Amateur Radio Club** is really making the magazine staff blush with congratulations on our first edition etc, etc. It's nice to have all these compliments but I'm afraid it won't get you a GW edition in Welsh, chaps! But this is the sort of flattery you might expect from the oldest established amateur radio club in North Wales. The club meets on the second Thursday of each month at The Green Lawns Hotel, Bay View Rd, Colwyn Bay, at 7.30

pm where all are welcome. The club has a varied programme, Dr David Last of the University of Bangor is to address the March meeting. For further information on the club, contact the Secretary J.N. Wright GW4KGI 46, The Dale, Woodlands, Abergele LL22 7DS. Phone! 823674.

Chichester and District Amateur Radio Club meet in the Green Room, Fernleigh Centre, 40, North St, Chichester, on the first Tuesday and Third Thursday of the month at 7.30 pm. There is a club net on (S11) every Wednesday at 1900 local time. The theme of the next meeting of the club on the 17th February is *Building a QRP CW Transreceiver* and on 1st March, *General Club Meeting* and 17th March, *Wartime Radar* by Les Carden G8HY. (This is a meeting I would like to attend being myself an ex-GCA man).

Thank you Chris for the plug in your magazine review — obviously a man with good taste in literature!

Further information from the Secretary T.M. Allen G4ETU, 2 Hillside, West Stoke, Chichester, Sussex. PO18 9BL. Phone: West Ashling 463.

KEEP 10M ALIVE

If you are a disillusioned CBer wondering what to do with his redundant CB equipment, take heart. There's a club designed just for you. Mind you it'll mean taking your RAE 'A' licence but that's another story. The club in question is another one new to the net, called **10-UK**, which is devoted to consistent use of 10 metres having nearly 200 paid up members and hope the membership will increase in the coming year. This seems to be a cheap and simple band to get on. Antennas are not of ext reme dimensions and there is a lot of cheap CB equipment which can be converted. On 10 metres FM, the use of home built or modified equipment is the 'in thing' in fact its like the good old days, with people doing technical things!! *(Let's have more of it — Ed)* For further information contact Jeff Harris G3LWM, The Oaks, Cricketfield Lane, Bishops Stortford, Herts. CM23 2SR. Phone: 0279 56347.

Now we come to the **Ipswich Group of Radio Clubs** which jointly produce the Club magazine QUA whose call sign is G4IRC. The Club Secretary is Jack Toothill, G4IFF, 76 Fircroft Rd, Ipswich, Suffolk IP1 6PX. Telephone (0473) 44047. Club meetings are held on the second and last Wednesdays of each month at 8 pm in the club rooms of the Rose & Crown, 77 Norwich Road, Ipswich.

This is another one of the massive, excellent publications that some clubs seem able to produce. From the wealth of items covered in the magazine, I must say congratulations to Tony Ward G3WXZ and the 13 member Raynet crew who worked for over seven hours during a large chemical fire on the Ipswich Docks. The Fire Service called on the Salvation Army Emergency Group to supply refreshments and drinks for the 150 Firemen in attendance. Raynet provided, at the Salvation Army's request, a communications link between the incident and the Salvation Army's kitchen at Stowmarket 12 miles away. Raynet also provided illumination for the canteen area with one of their portable generators.

Another item from the magazine which I found extremely interesting was an up-to-date list of coastal radio stations with their frequencies and operating times. I for one find listening to these stations at any time absorbing, especially so during bad weather or when there's an emergency in operation. Another useful item in the magazine is the radio amateurs' diary. To illustrate, here is a couple of items from this month's diary; on 5th and 6th march is the RSGB Exhibition at the National Exhibitions Centre in Birmingham, not at the Alexandra Palace. The other item is that British summer time starts on 20th March.

SAVE A REPEATER

From the club's list of forthcoming meetings on 9th February video tapes of *local amateurs in action* — the mind boggles! 23rd February, **South Anglia Repeater Group** has an open meeting for all those interested in GB3PO, and on 9th March, a *constructional contest*, 30th March — *Spring Sale of members' surplus equipment.*

Other clubs contributing towards the magazine include the Colchester Radio Amateurs who meet at the Colchester Institute, Sheepen Rd, Colchester, at 7.30 pm. On 10th February they are holding a *Construction of Amateur Radio Equipment* 24th February — *Club Motor Racing* — Gerry Hinde, G4LSP. 10th March — *Car Interference Suppression* — D. Boley G4AZR. 24th March, *Maps and Map Reading* — Peter Labalestier G6HIR.

Visitors are always welcome. For further information contact the club Secretary G3FIJ, 29 Kingswood Rd, Colchester. Tel (0206) 70189.

Martlesham Radio Society meet on first Wednesday in the month at 1930 hours in the Lecture Theatre. Contact G3NYK or G3ZNU for further information. February 2nd meeting — Why *GaAs*? by John Regnault, G8FQO.

Norfolk Amateur Radio Club meet at the Crome Community Centre, Telegraph Lane East. Details from Paul Gunther G8XBT. Norwich 610247.

Felixtowe Amateur Radio Club meets at Felixtowe Ferry Golf Club at 8 pm. The Secretary is J.E. Hubbin G3XIX, 61a Cobbold Rd, Felixtowe. Tel: 75676.

Stowmarket District Amateur Radio Society meets at the Red Cross Hall, Stowmarket Railway Station on the first Monday of the month at 7.30 pm. The Secretary: J.C. Lowe G8SCB, 22 Bluebell Grove, Needham Market. Phone: Needham Market 721296. Their next meetings are — February 7th, *Junk Sale* and March 7th — *AGM.*

Lowestoft & District Amateur Radio Club holds its meetings at 7.30 pm at the North Suffolk Teachers' Centre Lovewell Rd. No information given on which day the meetings are held. Further details can be obtained from Paul Godfrey G8JBD. Tel: Lowestoft 60420.

Bury St. Edmunds Amateur Radio Society meets at 7.30 pm on the third Tuesday of each month at the Guildhall, Guildhall St, Bury St. Edmunds. Further information from John Munro G3GBB, 29 Angel Hill, Bury St. Edmunds.

Haverhill and District Amateur Radio Club meet at Copse Hall Farm, Steeple, Bumpstead Rd, Haverhill. Further information from Dave Hickford G6BPS, Haverhill 61207.

Chelmsford Amateur Radio Society meets on the first Tuesday of each month at 1930 hours at the Marconi College, Arbour Lane, Springfield, Chelmsford. Details from G4KQE, also presumed to be QTHR!

Braintree and District Amateur Radio Society meets at 7.30 pm at Braintree Community Centre, Victoria Road. Visitors are welcome and a bar is available at club prices. (Sounds very interesting!) Club net is on S15 8.45 pm Mondays when there are no club meetings. Further information from the Secretary Mick Jones G6DFZ, 26 Anson Way, Braintree. Tel: 44168.

That takes care of all the clubs participating in the Ipswich Radio Club Magazine QUA.

From the attractive December newsletter received from the **Echelford Amateur Radio Society** the members obviously had a good Christmas. Not content with sprigs of holly embellishing the newsletter's front page — which was packed with a good mixture of radio items — they just had to include a Christmas menu page by Angela G4CKO. She at least had a good Christmas if she practiced what she preached!

Unfortunately the programme listed did not run into 1983, but full particulars are available from the Secretary Anton Matthews G3VFB, 13a King St., Twickenham, or phone 01-892-2229. The club meets every second Monday and the last Thursday of the month at 7.30 pm at The Hall, St. Martin's Court, Kingston Crescent, Ashford, Middlesex. Club nets are on Sundays at 1000 local on 1.93 MHz ± QRM and on 2 metre at 2000 to 2100 local on 144.575 MHz FM every Wednesday.

Chiltern ARC month meeting

FORTHCOMING RALLY

June 12th — RNARS Mobile Rally at HMS Mercury from 1000 to 1730 hours. A family outing with entertainment for all ages, plus Trade stands and hot and cold refreshments, also a Grand Raffle with instant prizes — all under cover.

More details from Wally G4DIU, 103 Torrington Road, North End, Portsmouth PO2 QTN.

And yet another club determined to make our staff blush again! **The Radio Amateurs Technical Engineering Club (RATEC)**.

Founded in June 1981, the club shot to fame to the point where attending membership had to be limited to 100 (how many clubs can carry a boast like that), with an overall membership of some 500 world wide.

It appears that the club's aims are to turn back the clock to the good old days of home brew. The group publish an excellent bi-monthly magazine *RATEC NEWS* which only lacks one thing, the Club's name in full, acronyms are fine if you know what they mean! (*I confirm that the mag is excellent. How about letting me join, please — Ed*)

Local meetings are held on Monday evenings at 8.00 pm in the British Legion, Moor Lane, Woodford, Cheshire.

For more information contact the Secretary Bob Marsh, G8TYH or magazine Editor Dave de Souza Kirby G3VFP at 17 Laleham Green, Bramhall, Stockport, SK7 3LJ or phone 061 439 2377.

A new Club Secretary to report in is Chris Young G4CCC of the **Reading & District Amateur Radio Club**. Chris is anxious to get more publicity for the Club and to increase its membership so just keep the details coming Chris and I will do my best to help.

The club meets at 8.00 pm in the club room of the White Horse Emmer Green, Reading on Tuesdays. Their next meeting, march 15th "*RF Hazzards and the Radio amateur*". March 29th "*Radio Interference Department of British Telecom*" For further information contact Chris at 18 Wincroft Rd, Caversham, Reading, 'phone: Reading 471461.

For a Sunday afternoon outing what could be better than a visit to the **East London Group** who meet at Wanstead House (100 yds behind Wanstead Underground Station) Ilford, Essex, at 2.45 pm. Their next meeting, 20th March when they discuss RSGB "*Your Society, which direction?*". I would think the obvious answer to this is 'any which way but up'! For up to the minute information contact Julian Greenberg G6DXW. Who doesn't want to tell you his address or 'phone number. "HI!"

Cunningham & District Amateur Radio Club join the net for the first time. They meet Thursday nighs at 7.30 at 1 Bonnyton Row, Gridle Toll, Irvine, also Tuesday nights which is reserved for RAE instruction. As we are short of a diary of forthcoming events I suggest you give the Club a shout; their call sign is GM3USL. For further information call Rodger Bryce GM3JOB, 3 West Bowhouse Way, Girdle Toll, Irvine, 'phone Irvine 215728.

I had a most interesting letter from Richard Sugden G8IOH of the **Goole Radio & Electronics Society**. Thank you Richard for your few kind words (flattery will get you anything — on this page anyway!)

Don't forget, meetings are held every Tuesday at 7.30 pm in the new club house in Paradise Street. A film night is being held on 15th March and a talk by an RSGB Rep on 22nd March and if the've got the aerials up in time they will have an 'on the air evening' on 29th. Call Richard Sugden G8IOH at 8 Kings Rd, Swinefleet, Goole, North Humberside, for further info.

The newly appointed Public Relations Manager is Keith Pope G6CGZ, you poor devil, who will tell you all about the **Bolton & District Amateur Radio Society** — G8WY, who meet every Wednesday at 8 pm in the Horwich Leisure Centre. This 70 member strong club devotes some meetings to formal lectures, activity nights, morse code practice, etc., and occasionally wind up the HF and VHF transceivers. Further details from Keith Pope, 403 Derby St, Bolton, Lancs on Bolton 62443.

On the first Tuesday in every month at 7.00 pm you can find the **Tynedale Amateur Radio Club** G4IZW in 'the room at the end of the bar' at the Falcon Hotel, Prudhoe-on-Tyne, Co. Durham. What they do in there is anyone's guess as they don't include a list of forthcoming events, but Ken Hatton, 8, Alnwick St, Newburn, Newcastle, 'phone (0632) 678828 will be only too pleased to help.

Thank you Mike for introducing the **Atherstone Amateur Radio Club** to the net, their active call signs are G4LCQ and G6ARC. Meetings are held on second and third Thursdays of each month at 7.30 in the Tudor Centre Coleshill Rd, Atherstone. For information on club activities join the club net any Sunday at 10.30 on S17 or Mike Wooding G6IQM, 16 Hilltop New Arley, Nr. Coventry.

Now finally settled into their new abode, the **Fylde Amateur Radio Society**, hold their meetings on the second and fourth Tuesday of each month at 2000 hours at the Queens Hotel, Central Beach, Lytham.

Their next meeting on March 8th is on '*Aircraft Instrumentation*' by G4AHZ and on 22nd they are holding an '*Informal Evening*'. Harold Fenton G8GG the Programme Secretary will be pleased to see any new members.

The action packed Newsletter from the **World Association of Christian Radio Amateurs & Listeners** made interesting reading, but unfortunately due to space limitations I cannot include all Len Colley G3AGX packs into it. He is already planning the Association's 1983 Conference which he hopes will be even better than last year's. I hope your rig is back on the air now Len; keep up the good work! Details and information of the Club can be obtained from Len at Micasa, 13 Ferry Rd, Wawne, Nr. Hull.

(AND BY THE WAY CHAPS, WHEN WRITING FOR INFORMATION TO CLUBS, DON'T FORGET THE S.A.E. IF YOU WANT A REPLY. POSTAGE COSTS MONEY!!!)

From the 'Carpet Country' comes an interesting letter from Peter Peach G3GOS, the new Secretary of the **Axe Vale Amateur Radio Club**, who meet on the first Friday of every month at 7.30 pm at the Cavalier Inn at Axminster, where all are welcome. Peter tells me the club members have done trojan work on the 70 cm repeater at Stockland Hill and also run a local RAE course. Keep the news coming Peter and good luck with the 'many changes'. New members and visitors can contact Peter on (0297) 34259.

I am pleased to hear the **Rhyl & District Amateur Radio Club** is 'alive well and flourishing', they meet at the 1st Rhyl Scout Headquarters, Tynewydd Rd, Rhyl, on the second and fourth Thursday of each month. The second Thursday is usually an informal meeting. Forthcoming events include an '*Activity Night*' on March 10th and on 24th March is an RSGB Film Night'. Further information contact Bryan GW8OYT on Rhyl 37284 or Paul GW4NLD on Rhyl 31227.

Of course the winter edition of **RNARS** newsletter is choc-a-bloc with goodies from throughout the world. To mention just a couple '*If in doubt, short it out!*' is the title of an article by G4DEP who writes of his experiments with a long wire antenna shorted to deck at each end!!! Naturally a number of the club's members were involved in the contretemps in the South Atlantic last year and a resume of the action from the communications point of view is given by Commander Ian Anderson-Mochrie G3VCM.

There is a gentle reminder from the Club of the RSGHB Exhibition in Birmingham on the 5th-6th March, also HMS Belfast Activity Week from 2nd-9th April. Contact CRS M Puttick G3LIK on Waterlooville 55880 — weekends only — for further information.

SPECIAL EVENT STATION

To celebrate the 500th anniversary of the granting of the Royal Charter to the City of Gloucester, **Gloucester Amateur Radio Society** will be operating special event station GB2ROG (Richard of Gloucester) on the second and third of September 1983. To further mark the Charter of Incorporation, which was granted by Richard III, the Society is organising an award for contacts with any "GARS" stations.

Stations claiming points for QSOs held with GARS stations between 1st January 1983 and 31st December 1983, will be awarded points as follows: GB2ROG — 15 points. G4AYM = 10 points. All other GARS members = 5 points. 15 points are required for the award working all bands up to 432 MHz in any mode. Each station may only be worked once.

GENERAL

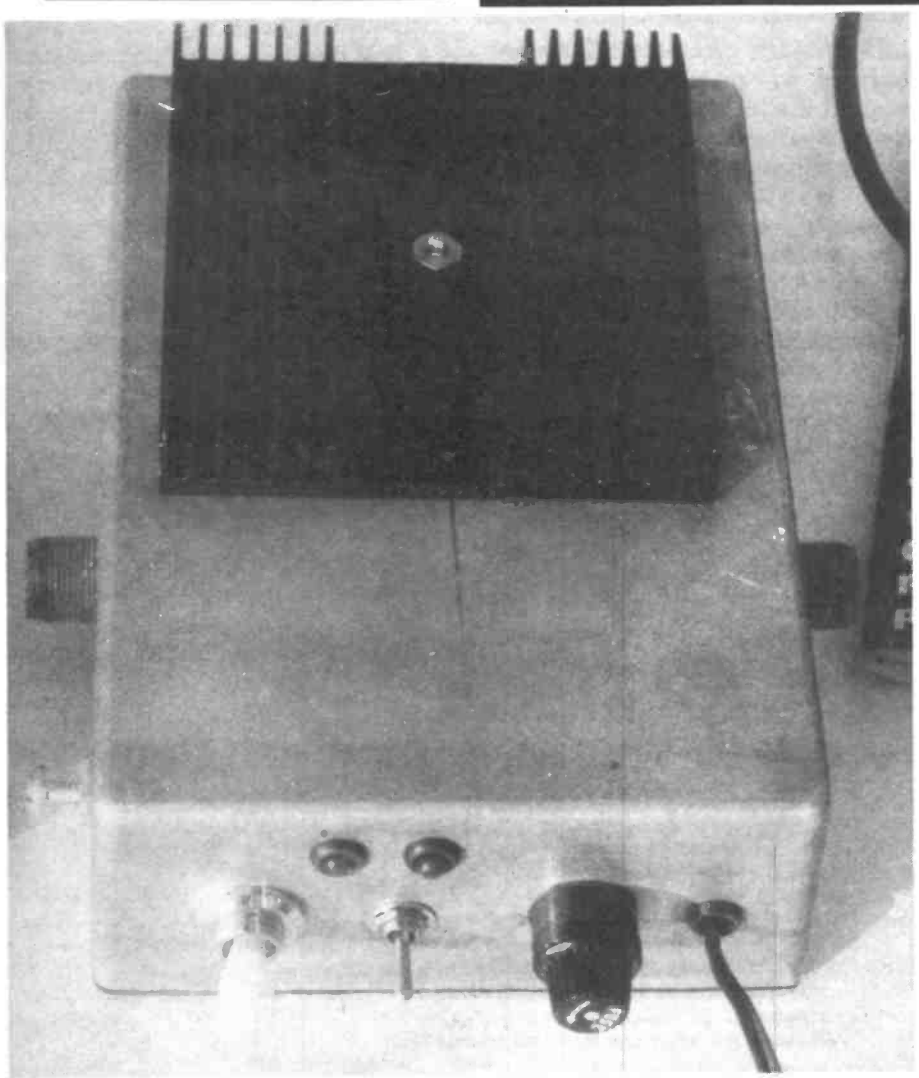
CBer's in various stages of disenchantment with 27 MHz are finding a lot of interest in Ham Radio Today. To those who have written regarding graduating from CB to Ham Radio, I would simply say if the Amateur Radio Bug has bitten you, join your local Amateur Radio Club. They will help you over the RAE hurdles. It's nowhere near as hard as it sounds!

Raynet has been featured in the Club news several times this month, so one more mention won't hurt. I propose compiling a directory of Raynet Groups and make a request to all group Controllers — Please let me have the following details of your group as soon as possible — Controller's name, address, telephone number and call sign. Group's name, number and zone.

Thank you to all contributing Secretaries. Please do keep us informed of your forthcoming events and as many letters as you like to send us. Don't forget the challenge for photographs of your Club events. We want to make the pages lively. 73's 'til next month from Cyril Young G8KHH.

A simple 2m linear

It is a fact that most amateurs take to the air on two metres with a low power black box of some description. Take up the soldering iron and add interest to the hobby with this simple but effective power amplifier. By Mel Evans GM6JAG



The complete module mounted in an aluminium diecast box.

The author, after some twenty years of Short Wave Listening and a brief flirtation with 11 metres, finally decided to take the plunge and the Radio Amateurs Examination. As a prelude to taking the exam it was felt that a spell of listening on 2 metres might be to advantage, and, rather than buy a receiver only to sell it again, hopefully within a short time, an *ICOM 215* transceiver was purchased. Well, the exam results were successful and the Icom started to earn it's keep. Since the writer operates mobile to a large extent, it soon became obvious that a few more watts would be useful and so the design to follow was evolved.

In fact there is nothing particularly novel or "state of the art" about the circuit, and no claims to great orginally are made, rather it is hoped that the article might serve to introduce some G6+3's to RF construction and at the same time offer a comfortable saving over the purchase of a comparable commercial unit. By careful shopping around this is one area of amateur equipment that can definitely be built more cheaply than bought! As an added "bonus" the Beginner's linear is to some extent also a universal linear in that the circuit has been successfully built using five different devices, with differing outputs of course, and this may help further in reducing costs as suitable transistors may be to hand or available from club sales or other sources. See **Table (a)** for details of

Table (a)

List of alternative devices used and outputs

Type No.	Input from txcvr	Output	Remarks
BLY 88	2W	13W	—
BLY 88c	2W	16W	Higher power version
TP 2320	3W	18W	—
2N6083	3W	23W	Best Buy?
CV type	3W	10W	was in box that cost 40p! at junk sale

Please note above are typical outputs at normal drive levels only, it would undoubtedly be possible to produce more than this from these devices if overdriven.

the different devices used and typical output powers.

Fig. 1 shows the circuit biased for linear operation. If you are confident that you will never use the unit on SSB, then it can be built less the biasing and SSB switch components, and this is discussed in the text as necessary. For use in linear applications there are no surprises, as already stated, and a simple form of biasing is used featuring a diode in physical and thus thermal contact with the transistor. Any heating in the transistor alters the characteristics of diode which in turn alters the biasing. Heatsinking is provided by a standard heatink and contributed to by the use of a die-cast box which of course also performs an RF shielding function. The input and output of the unit are matched to 50 ohms, and the RF 'VOX" sensor detects and rectifies the incoming RF resulting in the BFY51 switching "on" the TX/RX relay coils as necessary. For use on sideband a suitable "hang" is provided by a 100MFD electroytic to prevent the relays chattering in and out. The unit is straight through with no power applied and, with reasonable care in construction, has a negligible insertion loss.

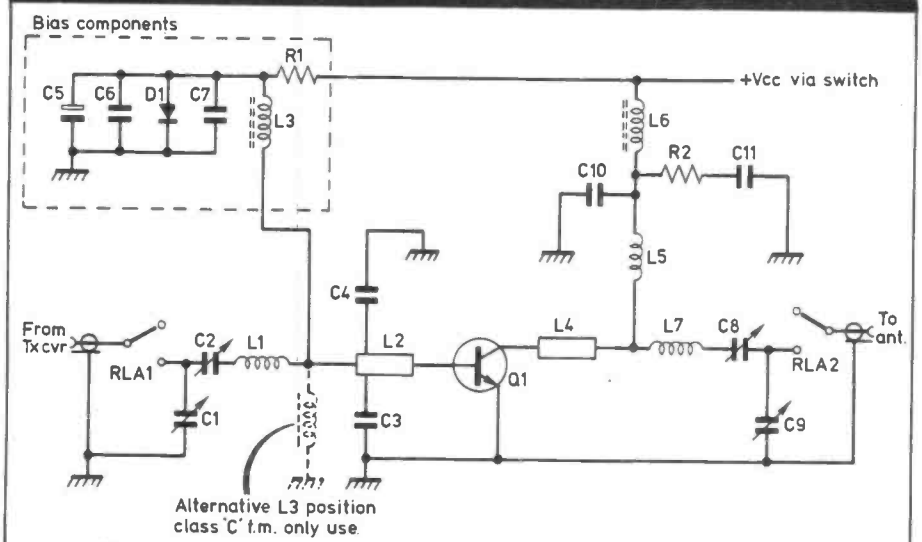
A word about choice of components. Purists might quite rightly sit down and with the aid of Ohm's Law correctly calculate that the wattage of R1 could be reduced to around the 2½ to 3w mark and still be satisfactory. At the 3w level R1 tends to run a bit warm, and this is why the writer prefers to use "overkill", upping the rating to a more comfortable 9w. The relays used in switching were available locally and were originally used in the Pye Bantam for antenna and power changeover. At just under £1.00 each, they offer a good compromise between power and performance at the power levels and frequency involved. A suitable alternative if these cannot be found is the OM1 from Ambit International.

In construction generally the writer prefers to adhere as far as is possible to the KISS philosophy (keep it simple, stupid!), and adds his own as BIB — build in bits. Modular construction enables the home constructor to test each section out before final assembly. Should a part of the circuit go wrong, then that particular board can be completely rebuilt from scratch at minimal cost if no other method of fault-finding or degliching proves successful.

Making the PA board

The PA board is made up using PADS of double-sided PCB material stuck to the base with superglue, and the dimensions and layout of the islands so formed are given in **Fig 2 a & b** together with drilling details for the PCB and the transistor mounting. Note that the physical size of R1 will determine the final position of the strip carrying C5,C6,C7,D1 and L3.

If the PA is to be for FM use only, ie class C, then the strip with the associated bias components R1,C5,C6,C7 and D1 can be



Notes:
Area within dotted lines–bias components.
Miss out if p.a. to be used 2m f.m. only but note L3 still used in alternative position.
Alternative poles RLA1 and RLA2 joined by a co-axial link not shown on diagram in interests of clarity
(The 63wpo 2m pre-amp will fit in here nicely)
(Between the relays and still in the die cast box)

FIG. 4. 2m linear amplifier p.a. circuit.

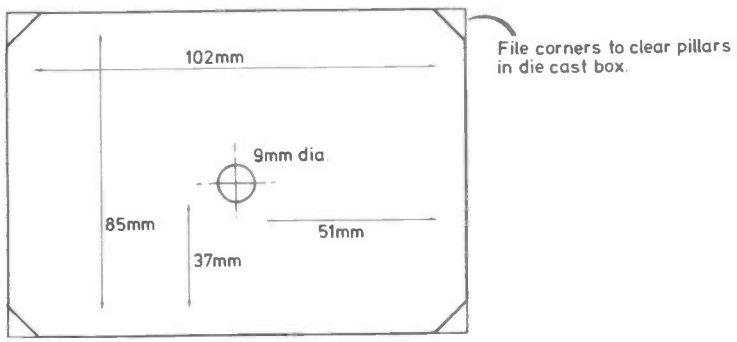


FIG. 2a. Drilling details and sizes of p.c.b.

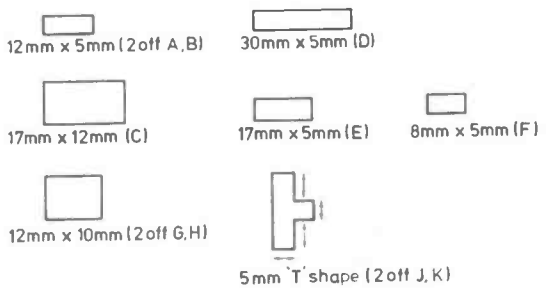


FIG. 2b. Sizes and shapes off pads.

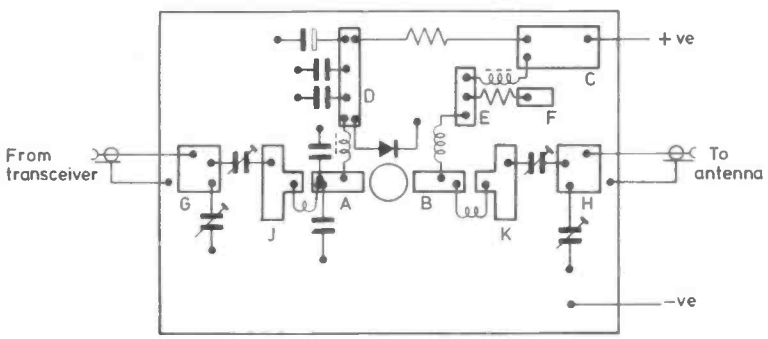


FIG. 2c. Positions of pads - fit alphabetical order - from top.

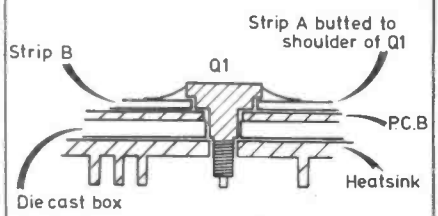
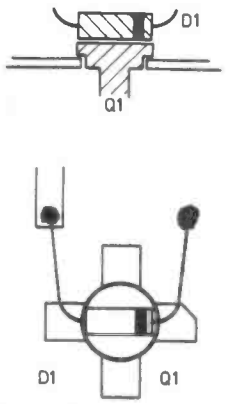


Illustration of mounting method of Q1 and strips A and B.

FIG. 3a. Q1 fitting.



Fit D1 using full length of leads then bend down into contact with top of Q1.

FIG. 3b. Details of Q1/D1 fitting.

discarded completely and L3 connected directly to the foil ground. Of the other strips and pads, note that strips A and B are in fact also 'coils', being part of the inductance requirements of the circuit and should be as accurately cut as possible. It is perhaps best to cut them oversize and then to file them to the correct size with them held inthe vice. The transistor determines the placing of these strips A and B, as they should just butt onto the transistor as in **Fig. 3.** Offer up the strips to the transistor, which has been placed in position but not fo course soldered, mark the position in pencil, remove the transistor and then and only then, commit the strips with superglue. From there it will be found best to fix the pads in alphabetical order as per **Fig 2c.** Those readers experienced in producing PCB by etching will have no difficulty in adapting the above details to their requirements.

PLEASE OBSERVE RECOMMENDATIONS regarding use of SUPERGLUE, especially if there are young children in the household.

The other two coils should be wound over suitable drill shanks and the leads on these and the ferrite beaded coils kept to a maximum length of 5mm. All other component leads should be kept as short as possible. The power transistor should be fitted last. Note that any device containing Beryllium Oxide should be treated with care and in the case of breakage, follow the suppliers or manufacturers instructions for returnand additionally make sure you wash your hands thoroughly. First fit the heatsink to the die-cast box using countersunk bolts FROM THE INSIDE so as to allow the PCB to sit flat on the base of the box over the whole of it's area. Place the PCB in position, offer up the transistor into its mounting position and tighten the nut finger tight only. Check and trim if necessary the base and collector leads to approximately 6mm from the shoulder of the transistor. The writer likes to continue the manufacturers' identification by cutting the collector strip at around 45°. Bolt the PCB through the heatsink and place the transistor in its final position with the nut finger tight again. Tighten the nut one half turn further only and then solder. Note that in the event of the PCB needing worked upon the reverse procedure should be followed. A smear of thermal compound, not too thick is advantageous in helping the heatsink perform well.

One of the side benefits of the island pad method of homebrew for the newcomer or beginner is that the circuit diagram and the circuit more nearly corresponds and is not in-

Components List. RF 'vox'

R 20 100R
R21 47K pre-set
R22,23 330R

C20 4.7pF
C21 470pF
C22 1000mFd 16V electrolytic
C23 2nF

D20,21 1N4148
D22 1N4002

Q20 BFY 51

2 off LED (colours to preference)

Misc: Fuse & holder, panel mount
2 off spst on/off switches
Die cast box approx 200x110x60mm

Relays are listed in PA section
S0239 or other RF sockets nuts etc.

Heatsink Type 4M 229 approx 101x94x14
(available from Ambit Int.)

Components List. PA board.

R1 120R 9w
R2 10R ¼w

C1,2,8,9 100pF Trimmers (foil compression or plastics types)
C3,4 68pF
C5 470uF 16V electrolytic
C6 4n7
C7, 11 150n
C10 150pF

D1 IN5401

L1 2.5 turns wound on 6mm dia drill and then stretched out to approx 8mm long. 18swg

L3,6 4 turns through an FX1115 ferrite bead. 25swg
L5 6 turns on 6mm dia, close wound. 22swg
L7 3.5 turns on 6mm dia close wound. 18swg
L2,4 Inductances formed in double sided PCB **see Fig 2**

RLA1,2 Pye type 7705 (available from "Brown's Wireless Store, 44 George IV Bridge, Edinburgh 1) double pole changeover 12V approx 400R

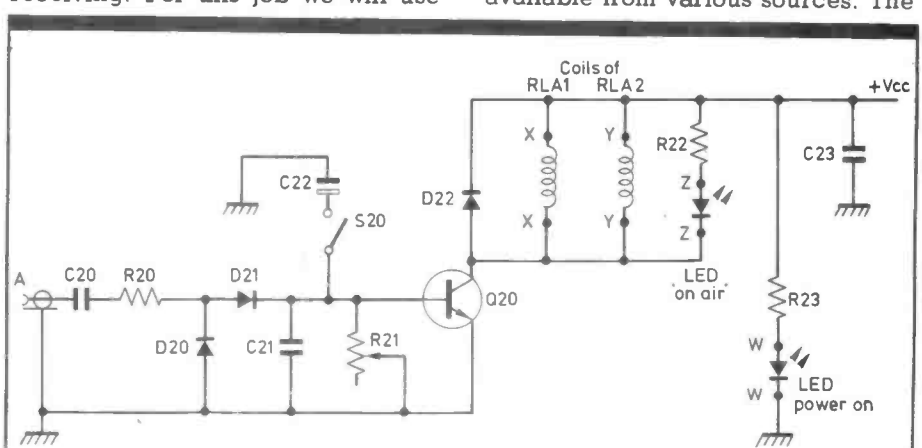
2 off FX1115 beads.

Tr1 2N6083 see also Table *

volved in mirror images. This enables checking of the circuit to be more easily completed and this is the next stage before test and tune. Double check your circuit against both **Fig 2** and **Fig 2** before moving on. Note that the most dangerous period in the life of an RF power transistor in during tune-up. Do try to follow the directions for test and tune and do not key the mike for long periods until you are sure the unit is on tune and ready to go. Initially the transistor should not be run for more than a few seconds without a check on temperature. Try the fingertip!

Connect the unit via co-ax and the preferred sockets to an FM tx-cvr, power supply, power meter and dummy load. If no power meter is available, then one of the small inexpensive SWR meters as used on CB will suffice as we are tuning for maximum "smoke" or output. Set C1,C2, C8, and C9 to their approximate mid points and switch on, but do not key the mike. Check voltage and current at points * on Fig 1, but note these are for the 2N6083 device specified. Assuming there are no major problems, key the mike and adjust C8 for maximum response followed by C9, C1 and C2 in that order. Give the transistor a rest, and then do it all again at least twice or unitl you are sure no further improvement can be made.

Now having got a working PA on FM, the problem is to switch it on and off when transmitting and receiving. For this job we will use the circuit of **Fig 4.**, a simple RF "vox" type switch. This should be done on a small etched single sided PCB and the layout is shown in **Fig 5.** Since this is a fairly uncomplicated unit, it can be drawn out by hand using a Dalo or similar etch resist pen, or for a neater job, you can use the dry transfer method available from various sources. The



Note. For use on f.m. only — miss out S20, C22 replace R21 with fixed 47k resistor.

X–X Coils of RLA1
Y–Y Coils of RLA2
Z–Z 'On air' LED
W–W 'On' LED

FIG. 4. R.F. 'vox' switch.

prepared board is etched and drilled and the components soldered in as per the overlay. For the benefit of other, more experienced constructors, this unit works well at various HF frequencies also. Test the unit by connecting the LED's and relays to points X-X, Y-Y, Z-Z and W-W respectively, observing the LED polarity. Feed in some RF and the "on-air" LED should come on whilst the "power" LED should indicate as soon as power is available. A single pole on/off switch adds in the electrolytic to provide the delay or hang time on SSB and this should be checked whilst the pre-set is adjusted to suit. The pre-set simply adjust the rate at which the electrolytic performs, and has no effect when the unit is on FM. Connect the "vox" into the circuit by feeding RF from the txcvr into A and the relay contacts as per Fig 1. The author uses sticky fixers to hold both the relays and the "vox' board in place, and the LED's, switches and a Fuse holder are mounted on one end of the die cast box.

The writer feels that far too many homebrew projects are crammed into enclosures that are patently too small, and this situation is most probably the result of conditioning by our far eastern friends. When working on the shack bench we do not have the factory assembly facilties enjoyed by the black box builders, and it is for this reason that the diecast box specified is larger than might be strictly required, but it does allow the weilding of a hot soldering iron without a magnifying glass and without the destruction of the insulation of nearby wiring.
co-axial connections from the relays to the board, and form and to each other, as short and symmetrical as possible.

On air

Finally, on-air reports for the unit on both FM and SSB are very good, and although the unit should be re-peaked for SSB use, in practice using the 2N6083 device, no noticeable difference can be ascertained from on-air reports. I hope for those of you who have never constructed anything, this article may be the spark, I find that a lot of hobby is construction, especially when the junk box can provide a lot of the parts. Perhaps I will hear you on the air soon, I certainly hope so. ●

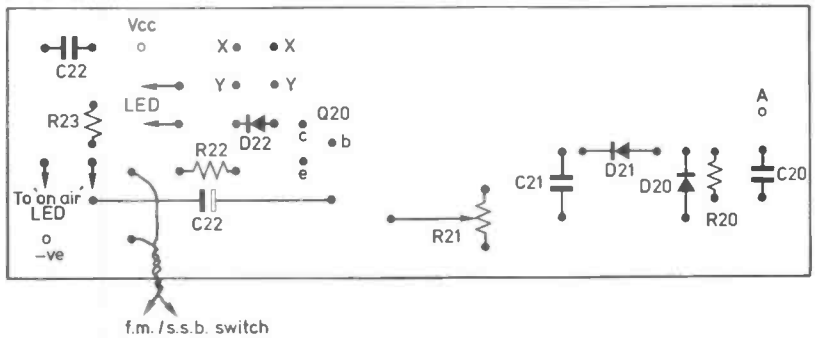


FIG. 5b. Component layout (from top).

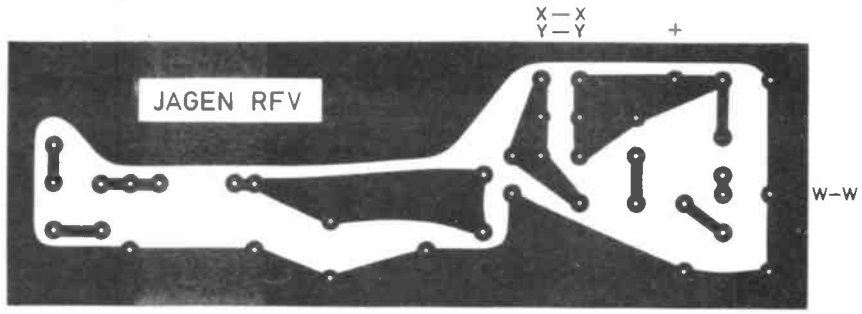
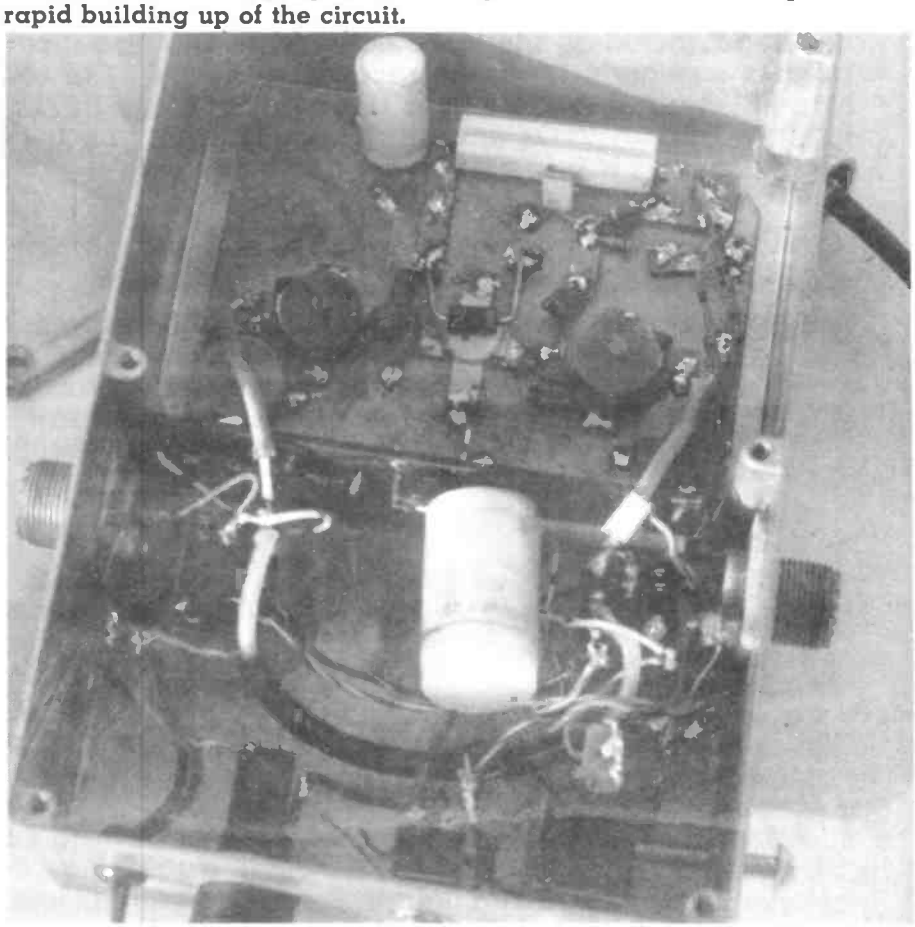


FIG. 5a. P.C.B. etch pattern (from foil side)

Interior view of the linear amplifier. Although the quality of the picture leaves something to be desired (our apologies!) the author's simple 'pad' construction technique can be seen. The PCB conductors are cut out separately and stuck to a groundplane copper PCB using superglue. Not only does this allow easy modification of the circuit without scrapping the basic layout, it also offers a very rapid building up of the circuit.



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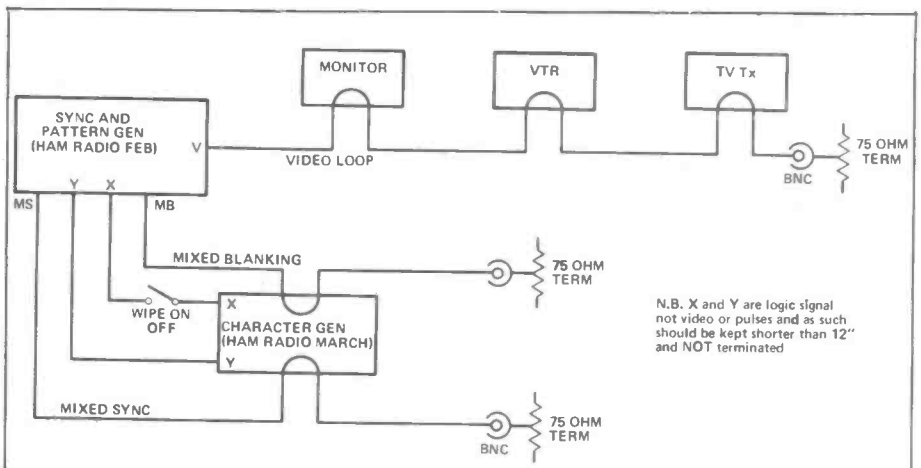
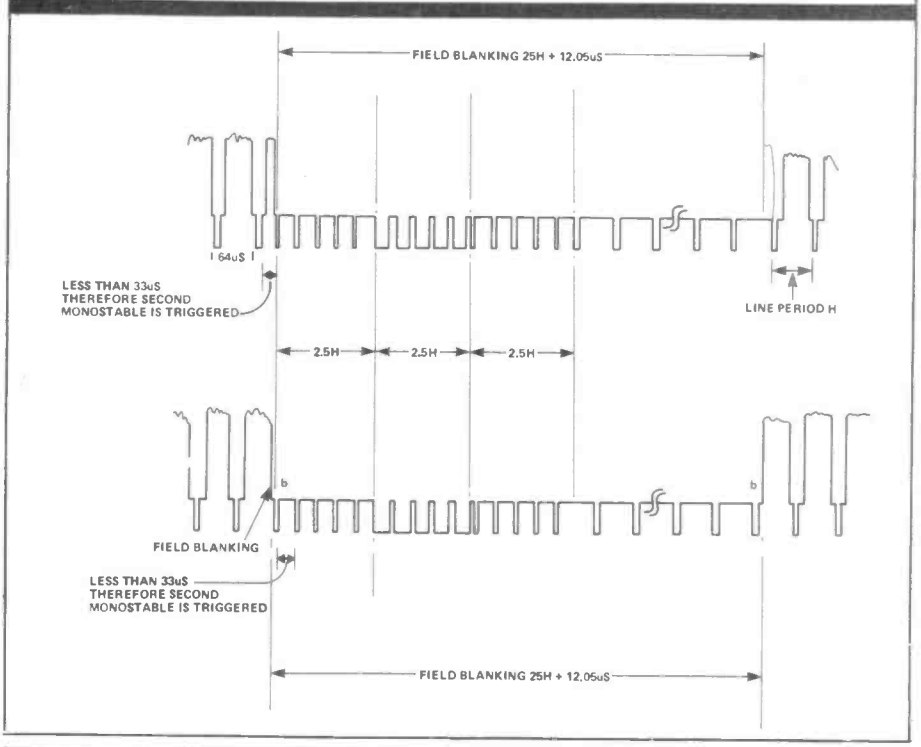
A Simple Amateur Television Station

Part 2

This month an electronic caption generator, capable of displaying 16 letters or numbers

By Trevor Brown G8CJS



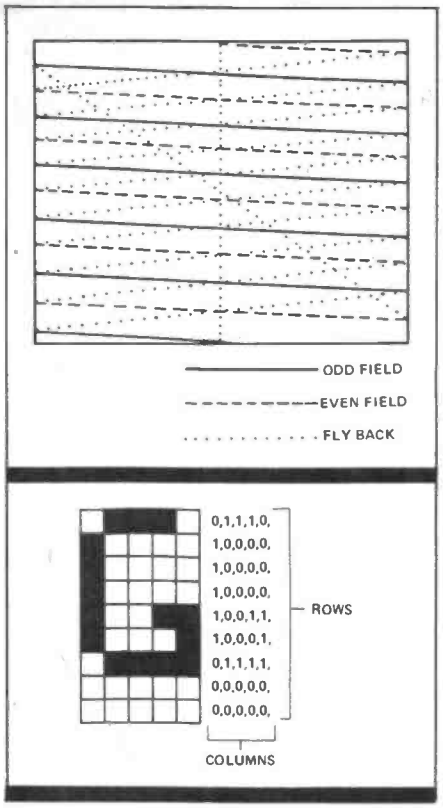


In the February issue I showed you how to generate the electronic test waveforms necessary for adjusting an amateur television link. It also provided mixed sync and mixed blanking. This month I would like to show you how to positively ident that test signal by electronically superimposing your callsign QRA or QTH across it.

If you think electronic identification unnecessary when a TV camera and black board would suffice, I would like to point out the following.

The articles in this series have deliberately been kept simple to encourage the beginner, who might not as yet own a TV camera. These articles have also been designed for simple power requirements, ie positive supply lines of not more than 12 volts. This should enable the equipment to work in a portable location. Portable working often means contest work. (Yes even Amateur TV enthusiasts have contests). In a contest, a 4 digit number is exchanged in vision only and contests run 24 hours so night working takes place. Need I say that TV cameras don't work too well in the dark, at least not the standard home video kind.

The electronic character generator requires to be fed with the mixed blanking and mixed sync. This is standard practice in television in order to keep all the circuits in synchronisation: they must generate same line number at the same time. This reduces disturbanc-



ces when cutting between different vision sources and also permits mixes and split screen effects between two vision sources.

Sync distribution

Television sync pulses can be distributed around several pieces of equipment by looping as in **Fig 1.** It is essential that the end of the loop is terminated in 75ohms. Television equipment is often fitted with switches labelled bridge and term, ie 75ohm on or off. All equipment in the loop is switched to bridge except the last item which is switched to term.

In our system we will not be using switches and the last item will be two sockets for feeding other equipment. If BNC sockets are used, these will be fitted with blanking plugs fitted with a 75ohm resistor.

All leads over 6" long must be coax in a pulse distribution system. Video can also be distributed in the same way, so one video feed can connect several pieces of equipment, for instance a monitor, 70cms TX and video tape recorder.

The 75ohm resistor stops reflections which would happen if the end of the loop were left open. This would show up as a ghost in the case of video loop.

The 2V mixed sync pulses are fed into a window clip circuit which slices the centre section of the pulses and converts them to TTL level. The positive going edges of the sync pulses cause one half of a dual monostable to trigger for an unstable period given by its time constants 47K × 1nF where C × R = 0.7T, ie about 33μS. During the period where this monostable is unstable, it allows the second half of the dual monostable to be triggered by a negative transition. This should only happen on the end of a frame scan. See **Fig. 2.** Every 312½ lines of a television scan is succeeded by a chain of pulses as per Fig 2 which are decoded by a TV receiver as a command to return the spot to the top of screen and recommence scan. Perhaps you thought television was 625 lines per picture. Well it still is, but two scans are required to make the complete picture. These scans are called fields and two fields are required per frame of TV picture. The two fields are interlaced to give 625 lines. The two fields are called odd and even fields and are proceeded by slightly different field sync waveforms as in Fig 2.

Positioning the characters

At the end of the unstable period of the second monostable we start the character generator. The position of the characters in the frame can be varied by altering the value of time constants associated with that monostable. The 47K marked * can be decreased in order to move the characters up the screen.

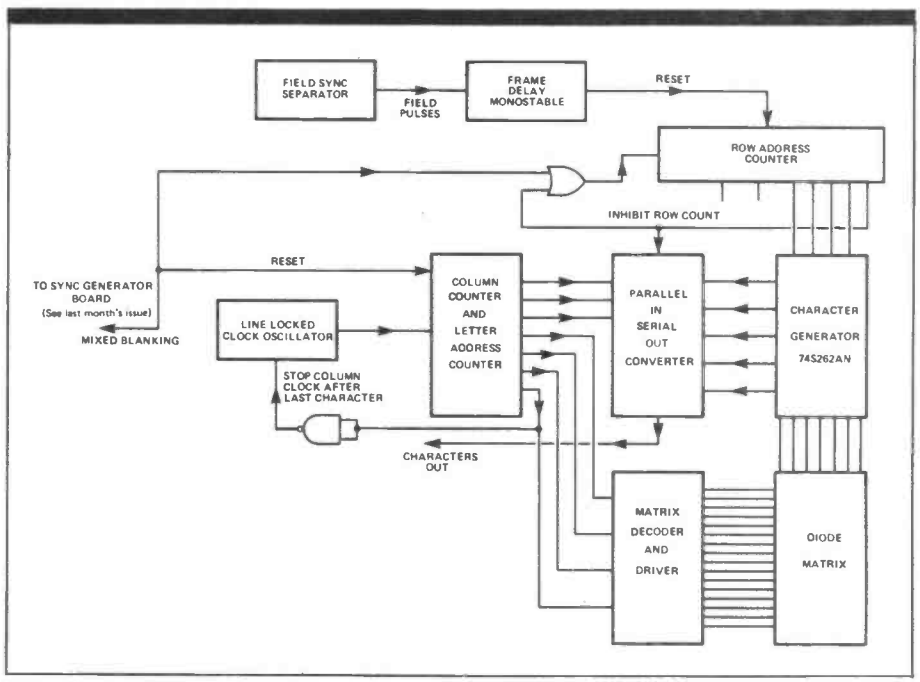
This monostable is brought out via a diode to a terminal that can be connected to terminal X of last month's generator in order to suppress the video behind the characters with a black horizontal wipe.

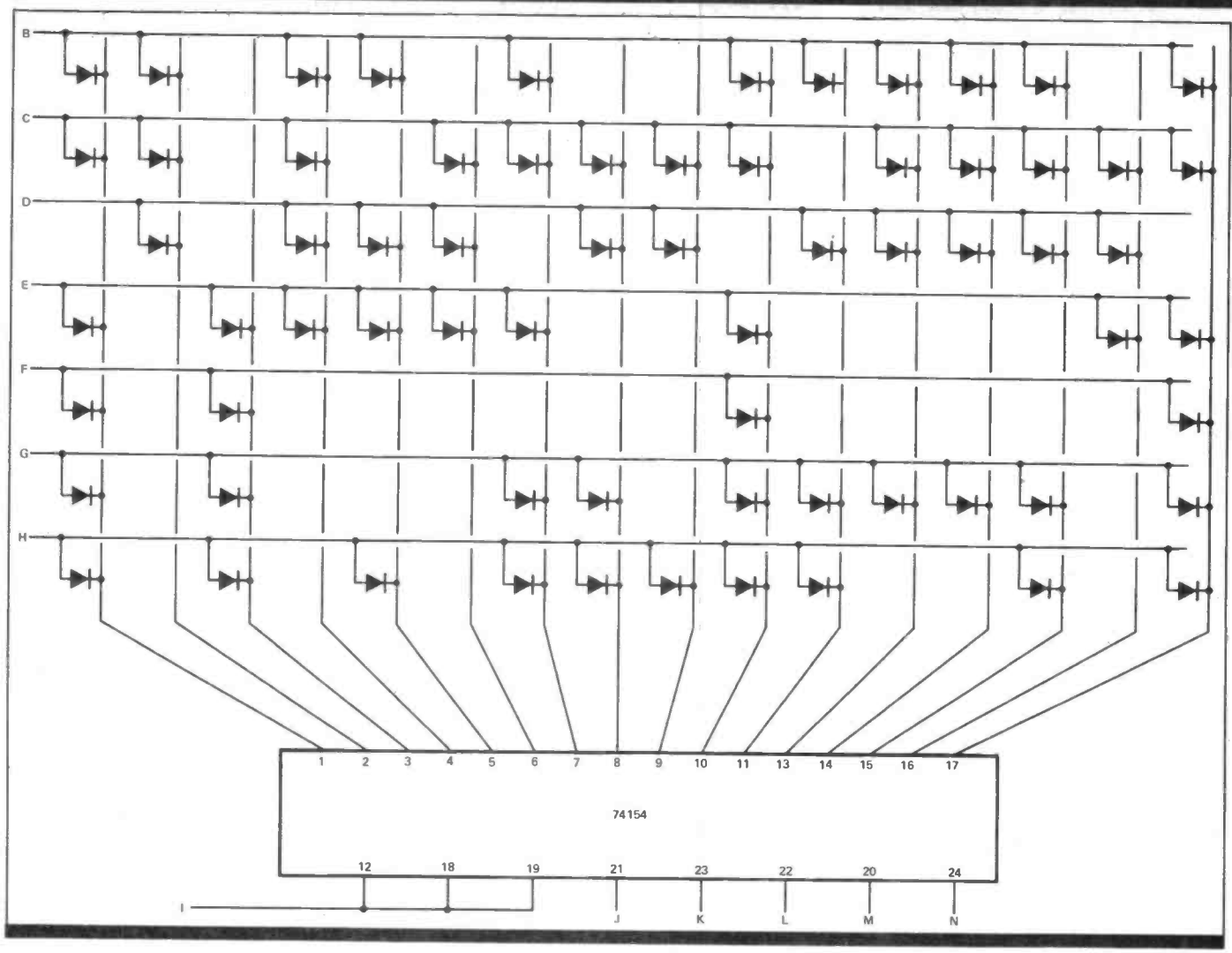
Having positioned the characters in the TV frame, they must be generated. **Fig 4** shows an example character which is positioned in a 5 × 9 matrix.

Circuit description

This matrix has two dimensions, 5 vertical columns and 9 horizontal rows. The characters are contained within the 74S262AN chip in the form of a large addressable matrix of pre-programmed characters, 128 in all. The required character is selected by the matrix board which puts a code on the board edge connector pins B, C, D, E, F, G, H.

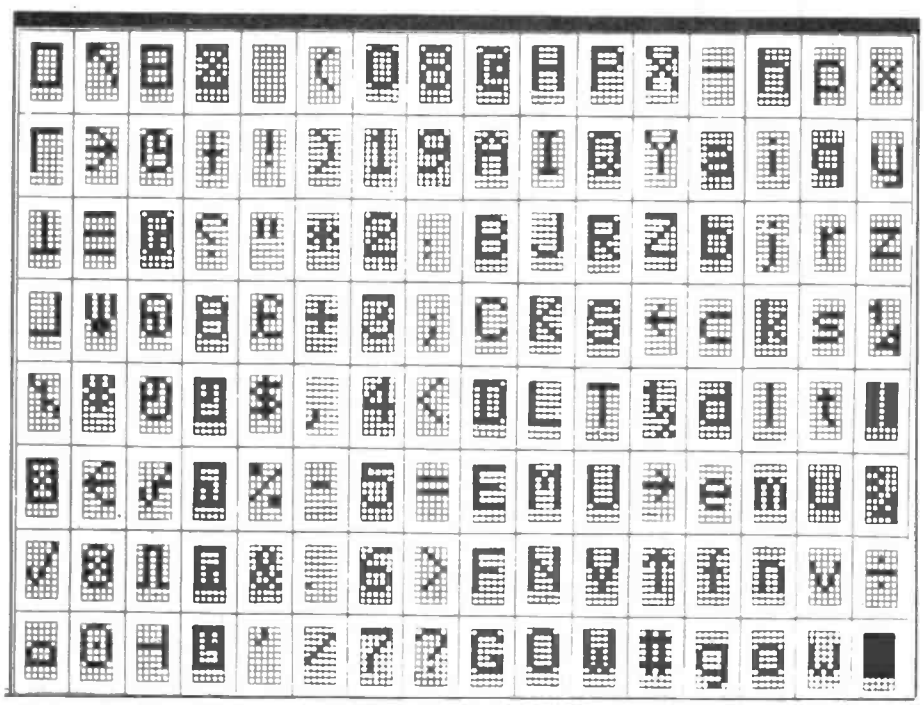
The top row of the character 'G' is present when B is equal to logic O, C equal to logic O, D equal to logic O, and E F G H is equal to logic 1. The top row of the 'G' is present on the output pins of the 74S262AN in the form 0, 1, 1, 1, 0. The 74151 looks at this data in sequence and during data 1 causes Q5 to turn on and clamp the picture to peak white via the port Y on the pattern generator. In order for the 74151 to scan each column in row 1 it requires a binary code supplied by the column counter which is advanced by the line locked clock oscillator. When the top row of the



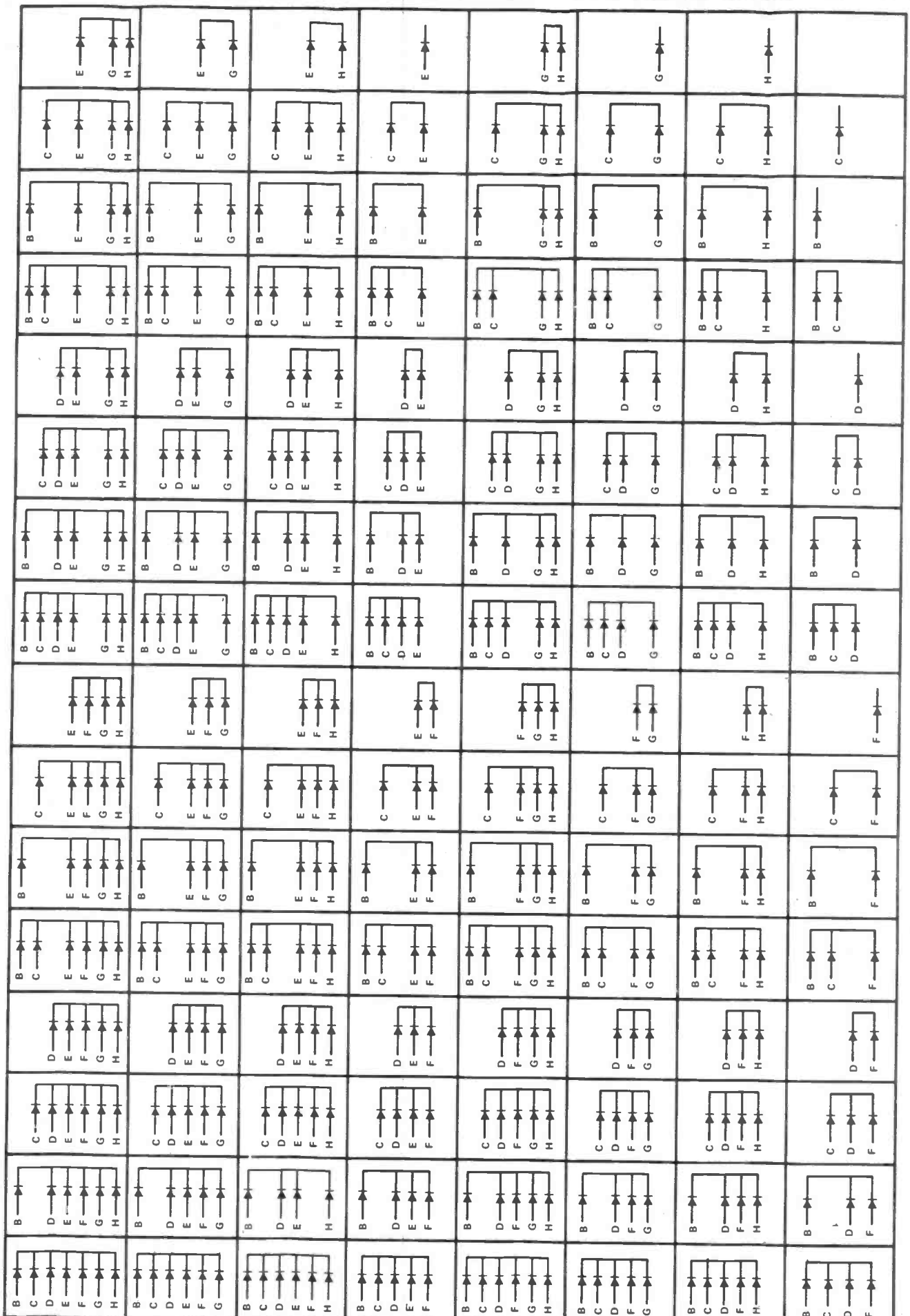


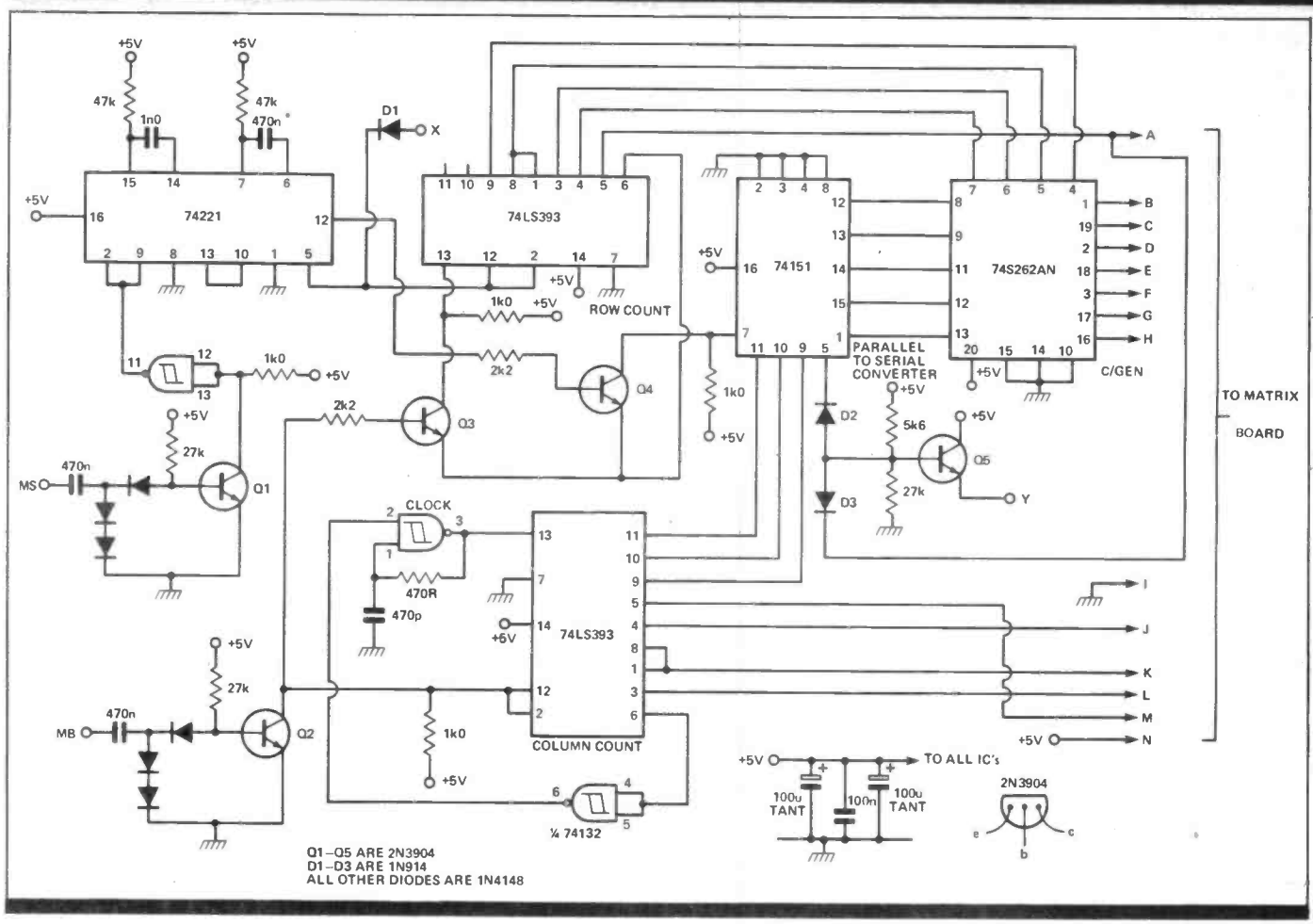
first character has been clocked out it proceeds to the next character by advancing the matrix address to select the next character and repeating the process. When character 16 row 1 has been scanned the process is repeated four times to make the top bar of the example 'G' four TV lines thick.

Now we require the second row of the 'G': 1, 0, 0, 0, 0. It requires the 74S262AN to present row 2 at its output data lines. Row code address on pins 4, 5, 6, 7, is incremented. The row address comes from another 74LS393 counter which is clocked by line rate pulses derived from mixed blanking via another window clipper. The QA and QB are not used so the code advances every four lines. Row 2 of all 16 characters is now clocked out followed by row 3 etc. until row 9 is complete. When row 9 is complete Pin 6 of the row clock is coupled into Q3 emitter where it switches off the clock pulses to the row counter. Q4 emitter is also pulled high which in turn switches off the 74151 so no further data is generated. **Fig 5** shows the block diagram of the character generator and sequence of events.



The first thing that happens is our first monostable detects frame sync and triggers our second monostable which gives frame delay so as to position our text somewhere down the picture. When this monostable has finished its unstable





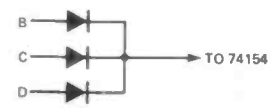
period the row counter is reset which in turn enable the 74151 parallel to serial converter.

The column clock has been kept running all the time so the column addresses of the first character will be generated. When the column addresses of the first character have been generated the diode matrix address is advanced in order to select the next letter and the column address is repeated until we reach the end of one line. This process is repeated for four lines until we advance the row code and repeat four lines for each row code until the end of row 9. The 74151 data converter is switched off and stops the row counter from being advanced.

Fig 6 shows the circuit of the diode matrix which is on a separate card to enable plug-in pre-programmed matrix boards to be constructed.

Connectors J, K, L, M carry the character address code. They feed a 74154 where they are decoded into 16 separate outputs. When an output pin of the 74154 goes to logic O it brings one location of the diode matrix on line there are seven diode positions possible in any one of the matrix locations. Fitting a diode will cause a logic O when that location is scanned; omitting a diode will cause a logic 1 in that location. The possible permutations of seven diode positions is 128 each one corresponds to a character in **Fig 7.**

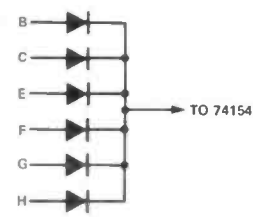
Programming is simple. First locate the character you require in Fig 7. Next transpose its position to the chart in **Fig 8** which shows how to programme it. For our example 'G':



we use the position on the far right of the P.C.B. first ie Pin 1 of the 74154 for the first letter. The diode cathodes connect to the bus bar on the component side of the PCB while the anodes go through the PCB and connect to the B, C, D, E, F, G, H bus which are on the underside of the PCB.

Fig 9 shows a programmed matrix which carries the legend 'G8CJS — TV LEEDS'.

In order to keep the circuit of the character generator as simple as possible, the characters start right at the far left of the screen. This could result in the first character not being seen on a badly adjusted television. It is good practice to programme the first space blank ie O.S.C.



Construction

The PCB used for the character generator is double sided but unfortunately cost prohibited the use of plated through holes. The symbol * on the layout denotes where the PCB requires connecting through from component side to track side. It is also important to solder components at both sides of the board. This includes 'IC's. To this end I have kept the component side artwork to an absolute minimum as it does make the use of sockets for the 'IC's difficult. The 74S262AN should be

socket mounted if possible.

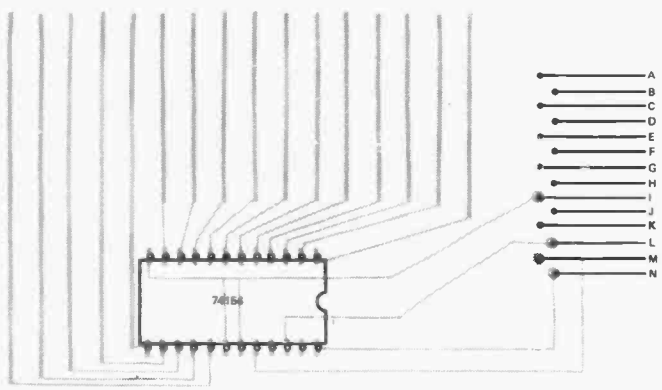
Upon completion of the character generator check all the tracks for solder splashes etc. Connect the Y port to the pattern generator, connect up the mixed sync and mixed blanking and the +5 volts and ground connections, but omit any connection to the matrix board. 16 small white blocks should be visible across the test pattern. Connect up X to the X port and a black wipe behind the characters should appear.

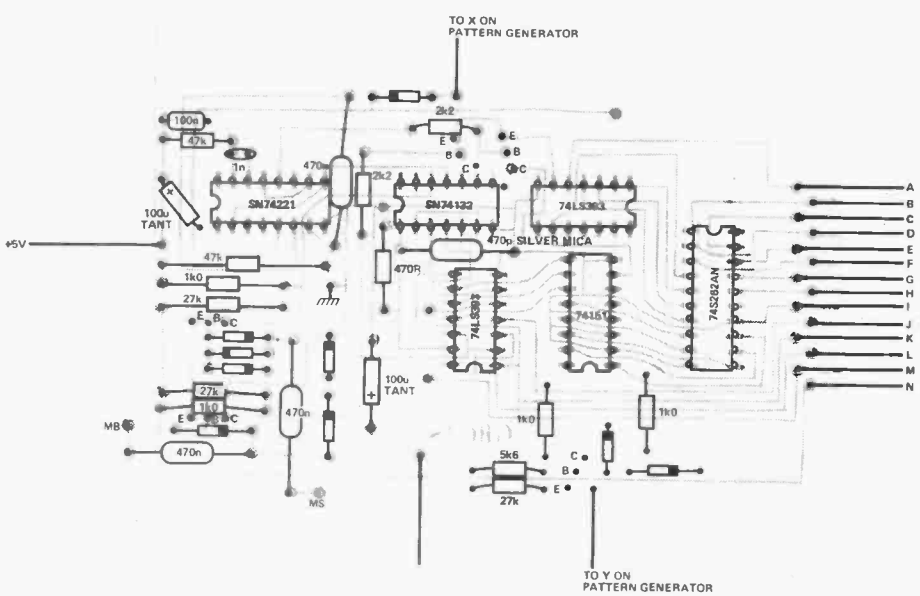
Now check the matrix input by grounding B. The 16 white blocks should change to 0. Moving the ground to C should change the blocks to 'w'. Grounding D should bring up the sign 'E' and so on.

If all this checks out, build and install the matrix card. This board is designed to fit above the main character generator PCB and connect with either plug and socket or wire.

Both printed circuit boards used in this project are available from The British Amateur Television Club, 13 Church Street, Gainsborough, Lincs. Please enclose an S.A.E. for details.

Next month – how to add a keyboard.





This is RAYNET

Amateur radio is always ready to lend a helping hand.

By Cyril Young G8KHH

Norfolk Raynet operator G3PYN (inset) net controller working a temporary station located in a railway building.
Exercise Fox a simulated train crash on a Norfolk railway where Raynet worked in conjunction with the combined emergency services.

It is said that out of every disaster comes some good. That can most certainly be said of the 1953 East Coast floods; a disaster when three hundred people died with thousands more made homeless and the safety of ships at sea was put in jeopardy when Humber radio went off the air!

One such ship was the SS Levenwood, a coaster battling with enormous seas, too close to the shore for comfort. She was in contact with Humber radio who was giving her captain instructions not to attempt to enter port. Before further information could be passed, the Humber coastal radio station, itself hit by the storm, went off the air!

The SS Levenwood radio operator called in vain . . . Humber radio was unable to reply. Instead the voice of a radio ham crackled in the radio officer's headphones. "SS Levenwood, this is G3AXS, an amateur radio station. How do you read me?" "G3AXS, this is SS Levenwood . . .". The seed of an idea was sown. Reg Collins G3AXS, risked having his licence revoked, in an attempt to help the ship in distress!

Despite vigorous attempts by the RSGB, two years earlier, to offer the Government a complete emergency network consisting of dedicated hams, the proposal was refused in the House of Commons by the Postmaster General on the advice of his office, stating that they were completely capable of handling any foreseeable disaster and

there was no room for amateurs!

This short sighted jealousy by the Post Office was to be recalled only two years later when the disasterous storms hid hundreds of miles of the coast, causing havoc with all public services and, in only a few hours, communications were at a standstill and were unserviceable for several days.

So it was just one year later, the Radio Society of Great Britain launched the Radio Amateurs Emergency Network (RAEN), designed, in theory at least, to be a communications back up service for emergency use only. It was very soon realised that without some pretty drastic changes being made to the amateur radio licence, RAEN was going to be a little more than a weekly net with a controller.

Another immediate problem was the design and construction of mobile and portable equipment — it was obvious that to be of any use in an emergency the Hams had to be right there at the site of the incident, not back home in their shacks.

At its inception, RAEN, as it was then known, was to be of little assistance in an emergency, as the passing of third party traffic was very restricted and it was still too easy to exceed licence regulations in its limited capacity. the RSGB and the Home Office commenced a slow but continuing round of negotiations to make the emergency service viable. As the service has grown, it has repeatedly proved its ability to organise an emergency communication service, so the Home Office have added special licence dispensation to the Raynet Members licence for use under live or exercise conditions. The first move by the RSGB was to change the name to Raynet; the letters R.A.E.N. being a ship's call sign.

Flexible Communications

The flexibility of the Raynet system often makes it more versatile than many of the user services' own communication systems. As an example, an ambulance has its radio link firmly mounted in the vehicle, so if the crew have to leave the ambulance to go a few hundred yards into a wood they are out of contact with their base. Whereas, a Raynet member would most likely have a walkie-talkie, which could simply be unhitched from the car for use on foot. This is just one example where the Ham can be more versatile than the professional user!

Since it's formation, Raynet has been involved in many real (live) emergencies, from forming a communications link with the Hampshire police when an overwhelming number of volunteers arrived to hunt for a lost baby in a forest or, for over 70 hours, relays of Raynet members passed 999 calls when a telephone exchange was badly damaged by fire.

Emergencies have no respect for time, weather or location. A couple of Raynet members were enjoying a quiet summer's afternoon nap in their cars by a South Coast beach, when a light aircraft plunged into the sea. Raising the alarm they had the rescue service there in minutes; then continued to handle messages for sometime until the rescue services were able to establish their own communications links. The full local Raynet force was put on Yellow Alert ready to handle any back up required.

The incidents that Raynet has been involved in is endless. Of course not all call outs are as exciting; sometimes there have been hours of waiting with just routine signal reports — waiting for high tide, to see if a river will break it's banks; or one I was involved in sometime ago, when the telephone and fire alarm lines to the exchange were cut by contractors working in the grounds of a large remote boarding school, built mainly of timber. The Science Master G8PGY called for assistance. The local Raynet Group kept an all night vigil over the 500 boys, in case of an emergency.

So what does it take to be a Raynet member? If you are, or have been a scout or in any of the cadets or forces; if you can accept orders and carry them out to the best of your ability; if you don't get fed up waiting for something to happen and don't panic when it does; if you're prepared to spend some time each week training and go on the occasional exercise — then you are the type they are looking for!

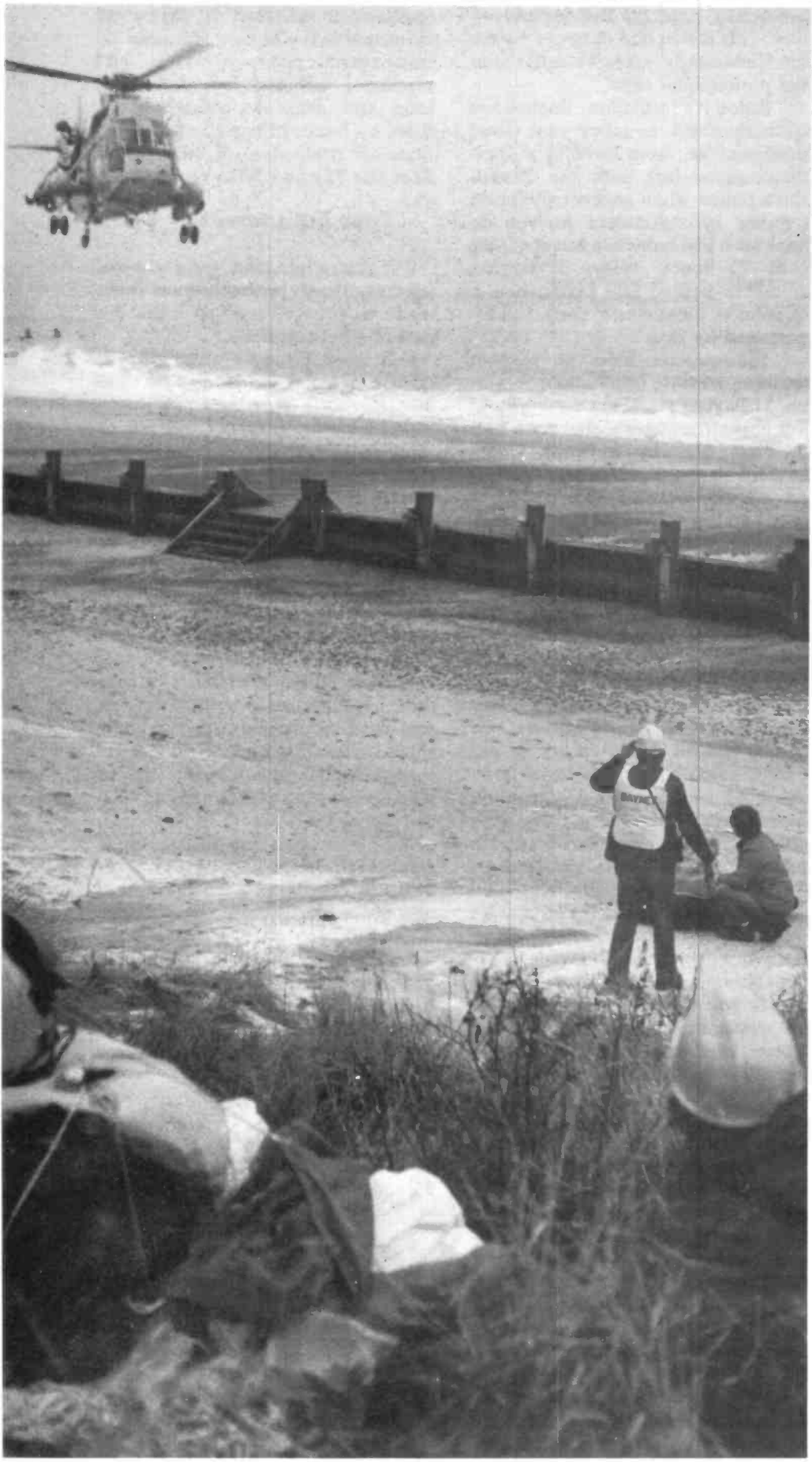
Most groups are organised so that every member gets the opportunity to experience the conditions of being controller — relay station — base or mobile outstation. There are so many jobs to be done at a live incident or exercise. If you're not licenced yet, you can still play an important part, writing out messages, keeping log, delivering food and drink to outstations — there's a hundred and one jobs to be done. A great deal of help comes from the YLs and XYLs too!

Your Equipment

If you're licenced, the choice of equipment will probably have been made so you will have to make the best of what you have.

A good Group Controller will have organised his team such that the less agile members and those without motor transport will act as relay stations, or general monitoring stations or base control station. Mobile stations should have equipment permanently, or easily installed in their cars. All stations will be expected to have O.S. maps covering their area and any neighbouring areas you may be called into to help.

Handheld transceivers have been a boon and a curse to Raynet members; their portability makes them ideal for use away from the car and in difficult country, but their short battery life can be an embarrassment. Imagine walking half a mile across rough terrain in blizzard conditions to get to a stranded group; you press the PTT... your signals are not heard... FLAT BATTERIES! Therefore, a must is at least one spare set of batteries and take them with you! If you use nicads, there are circuits designed to enable you to charge your batteries from the car. All batteries rapidly lose their efficiency in cold weather; keep the spare set in an inside coat pocket!



The User Services

The first services to request co-operation with Raynet were the Red Cross Society and the St. John Ambulance Brigade, both having very limited radio communications of their own. Numerous exercises highlighted the versatility of the ham possessing mobile and portable equipment with his ability to be right at the incident centre. Despite the teething troubles the exercises did not go unnoticed. Today Raynet has an excellent working relationship with both first aid groups, the Police, Fire brigade, the Coastguard and the County Incident Officers of most areas of the UK. Of course some areas are better organised than others — the best usually being districts where live incidents frequently occur. This is typical of the Englishman. Something has to happen on his doorstep before he is pushed into action — then completely unprepared — so Raynet means training. This is no more than an extention to the transmitting licence which is issued to promote self teaching and training.

Most groups hold message handling nets one evening per week, with a full scale exercise every couple of months. The Home Office have just granted permission for Raynet to exercise with the user services once a month. This should put more realism in to the operation with the opportunity to meet members of the user services.

The evening nets are often arranged such that every member takes his turn at being Controller; map reading ability is helped by the controller giving each member an NGR (National Grid Reference) in turn, after which each station is called in again to give the name of his NGR spot. Any other ability or training the member may have, such as a good knowledge of First Aid, climbing or caving will be of immense use. One thing that every Raynet member must have is an intimate knowledge of his immediate district and a good working knowledge of a larger surrounding area. This is what makes you most useful to the user service. Well organised groups will check the radio paths across

A Sea King helicopter 202 Search and Rescue squadron from R.A.F. Coltishall arriving to lift a casualty from a Norfolk beach in exercise 'Search' in which Raynet, Rover Rescue and the local Coastguards took part.

their own and into the neighbouring areas. Suitable relay sites will be known to all members; these will most probably be used for manned talk through stations.

It must be fully understood that in no way can Raynet operate without the request of one of the user services or County Incident Officer.

If you should happen to *walk* into an incident you could temporarily become controller. Your first step would be to raise preferably, a Raynet operator, requesting him to contact the relevant user service or the Police to authorise Raynet operation. Your chances of being involved in a remote incident are slight, but you should be prepared for such a situation. The Home Office has just granted permission to hams to pass third party messages in the event of a remote road traffic accident.

Storm and tempest are the major incidents in which Raynet has been involved. Groups covering the coast or who have rivers constantly liable to flooding in their areas are always alert to weather conditions; especially during Spring tides and high winds. The dates of tides and their height can be obtained from local tide tables.

When the possibility of flood conditions arise, Raynet groups on the coasts and especially at the estuaries are put on 'Yellow Alert' a couple of hours before high tide, allowing mobile and portable stations to be set up in strategic positions and radio paths to control checked. When one of the user services request Raynet aid, the system goes to 'Red Alert' a couple of hours before high tide, allowing mobile and portable stations to be set up in strategic positions and radio paths to control checked. When one of the user services request Raynet aid, the system goes to 'Red Alert' and all stations are involved.

Permanent Raynet Stations

In a number of areas where Raynet has been repeatedly valuable to the public services, much consideration has been given to help the local groups by the County councils. One such group is the County of Cornwall Raynet Group, (in fact there are seven groups in the area). Cornwall, with its miles of uninhabited moorland, criss crossed with narrow roads through valleys and over hills, makes communication difficult, even when using the repeaters, as many will know from their holidays.

Local District Health Authority Ambulance Service and personnel exercise with Cornish Raynet in Truro.

After several years trojan work by the 150 Raynet members covering the County during heavy snow, appreciation of the service given by the groups was shown by the County Council in their joint venture with Raynet in helping to provide permanent emergency communication stations at vital points in the County.

At Raynet Headquarters in County Hall Truro an emergency communications control room has been set up with transmitters and receivers operating on 70-144 and 432MHz, also on HF bands for out of County operating. Tape recorders operate on both transmit and receive and have been found to be invaluable at debriefings. The station is backed up by a standby generator and 12 volt heavy duty batteries. Another station has been set up in the Incident Centre of Truro City Hospital, where a 2 metre 25 watt tranceiver feeds a colinear on the roof.

Going mobile

Apart from the regular bad weather call outs, the Cornish Raynet teams were active during the Torry Canyon incident and more recently with the Penlee Lifeboat disaster, so it's not surprising that they have twice been awarded the RSGB Raynet Trophy!

Most groups have their glories to tell and not always as a direct result of a disaster (in this country anyway!) A number of Raynet Groups are joining forces with the Land Rover Rescue Teams that are

springing up throughout the country.

Norfolk Raynet, in conjunction with the local Rover Rescue Team, organised in three days (and raised the money to cover fuel expenses) for six vehicles (including one YL) to make the three thousand mile journey to an Italian earthquake disaster zone; amid plague, more tremours, impossible weather conditions and just to make it more interesting . . . Mafia activity!

And so we could go on around the counties . . . it's obvious from the incidents quoted that the motto of Raynet members must be 'be prepared' . . . and not just radiowise. It's advisable to have a container of some sort ready packed so you can pick it up and 'go' when called out; knowing you have with you some food, in the form of chocolate/peanuts (or whatever you fancy) in a sealed box, plus a couple of cans of lemonade or similar (not beer — apart from affecting your operating it makes you thirsty); a change of clothing (particularly socks). There's nothing worse than working in cold wet feet and when the going gets really cold an extra jumper and dry gloves will help to keep you at maximum efficiency while you are helping the less fortunate. Remember it could be a long time before you are relieved or get any food. Always wear your hard hat and any other Raynet identification you have. If you're at the site of an incident mark your car with large Raynet posters, better still an illuminated sign and, while you are stationary, a flashing green lamp is permissible.

How Do I Join Raynet?

Simple, just ask your local Club Secretary or Raynet Controller; otherwise a note to the RSGB, enclosing a SAE will bring full details and the necessary forms. You will require a couple of passport size photographs of yourself; one for Raynet records and the other your ID card.

If you're still not sure if you would enjoy working with a Raynet Group, and you must enjoy doing the work (after all it's your hobby), talk to your local Raynet Controller and join in some of their activities for a few months, no one will complain or think any the less of you if you drop out after a while; if it doesn't grab you, you probably wouldn't have become a useful member of the group anyway!

Keeping It All Together

It's obvious, where groups are spread over a large area, contact must be maintained between members; meetings are usually no more than monthly. Most Groups hold a weekly net. Nets give everyone the opportunity to try their hand at being controller and teaches the art of message handling, map reading, and the opportunity to report equipment and personal status etc. Recognising a familiar voice could be of immense use and comfort in a live civil defence operation, something else in which Raynet will no doubt play a large role. (It is under consideration by the Home Office now).

There are several national frequencies allocated to Raynet, for live, exercise and net use:—

144.260 70.355
144.775 70.375
144.850 433.200 (RB/SU8)
145.200 (S8)

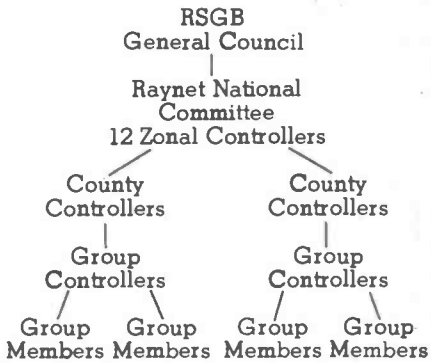
There is also a controllers' net every sunday at 08.30 hours on 3.790MHz.

The Home Office have recently granted permission for Raynet to participate as an exercise, if requested by user service in charity walks, marathons etc and have also granted permission for third party operation of your equipment i.e. it could be easier and quicker for a doctor to talk direct to a colleague than via a message pad, but you will remain in strict control of the radio equipment and it's at your discretion as to who uses this facility.

Organisation

Naturally it took time to organise a nationwide network of this calibre and there have been many changes during the course of its lifetime. The present arrangement is still being adjusted from time to time in an attempt to reach the ultimate structure.

Governed by the RSGB General Council, the Raynet National Committee, consisting jointly of RSGB Council Members and a member from each of the twelve Raynet zones, on through zonal controllers, county controllers to group controllers and Raynet members.



The structure gives the impression of being heavy in executive control, however, it does work and is much appreciated by the user organisations.

As already mentioned, emergencies have a habit of happening at inconvenient times. It's a good idea to explain to your employer what Raynet is all about, or show him this article and ask if he is prepared to release you from your place of employment without loss of pay to attend live emergencies. Proof of live incident and your attendance will be provided by your controller.

Most companies agree to this, as they do for Territorial Training Camps, the excellent publicity they receive as a public spirited company is good for their local image.

As a registered Raynet member, attending a live emergency, you are insured against accident by the RSGB.

If you think you fit the bill, Raynet needs you. A well organised and trained service is far superior to any untrained volunteer group. ●

Technicalities

Electronic countermeasures against Russian over-the-horizon radar — Successful RF design: a better CW IF strip. By Frank Ogden *G4JST*

Shooting a woodspecker

The theme for this month's column is 'successful RF design' but first, let's look at a most ingenious little box to come onto the market. No apologies for changing the subject just as soon as it is started but this new HF receiver add-on is very much a case of successful design.

Anyone who has ever listened to the upper reaches of the HF bands will have heard the 'woodpecker', a megawatt pulse over the horizon radar which the Russians use to detect incoming American (one supposes... With Pres. Reagan at the helm, anything goes) missiles. Unfortunately for Europe, placed as it is halfway between Russia and the USA, these massive pulses of frequency agile RF come to earth on the short skip obliterating everything during their short duration. With regular repetition rates of 10's per second they probably do more damage to receiver front ends than the EMP event which they were designed to fore-stall!

As every amateur knows, this wretched menace comes up when the bands are at their most interesting and always when you are about to answer a CQ put out by a ZL3. Some modern HF transreceivers have incorporated special types of noise blankers which reduce the anti-social woodpecker to manageable proportions. People with older sets will not be so lucky. The American company AEA has come up with an add-on box connecting between the aerial and receiver which should shoot the woodpecker. Just how well it works we shall tell you later. We have a unit on loan from the UK importers ICS Electronics and we shall publish the review just as soon as we have completed it.

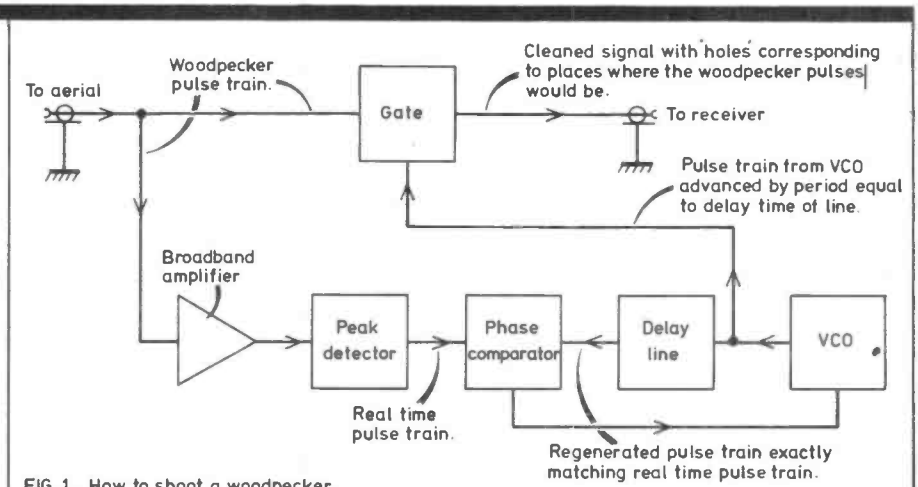


FIG. 1. How to shoot a woodpecker.

It is the way that we think the AEA box works which intrigued us. The *Moscow Muffler* (which is what the company calls it) makes use of the fact that the radar transmissions comprises a very accurately spaced pulse train. The box listens for the woodpecker by amplifying the aerial signal, broadband and then detecting it like a wideband TRF set. An internal oscillator is then phase locked to the incoming pulse train. This accurately re-timed signal — which maintains accuracy even in the presence of lots of other signals — triggers a gating pulse to turn off the signal path to the receiver for the time that the *Moscow Mufler* expects a woodpecker pulse to be present.

The clever thing is that the gating pulse is arranged to blank off the receiver path just a little in advance of the arrival time of the woodpecker. This would be done by delaying the VCO signal to the phase comparator so that the VCO is forced to run just a little bit ahead of time if it is to keep up with the woodpecker pulse train. **Fig. 1** illustrates this.

Successful RF design

This is a fairly wide topic to discuss in the two or three thousand odd words allocated to this monthly column. RF design takes in so much that, to tackle the topic at all, you must discuss it in terms of a specific system to reduce it to dimensions which can be (only just) handled.

Unfortunately my time is too limited to produce design examples purely to illustrate this article and others in the same series. I therefore propose that I shall kill two birds with one stone by designing a piece of gear which shall then be offered as a constructional project in this magazine.

We have received correspondence to this mag and seen lots of it in others asking — even begging — for a low cost, high performance HF transreceiver for CW only. Now I don't particularly like CW as an operating mode simply because I'm not very good at it. On the other hand purpose built CW gear is very straightforward, there is a demand for it, and it offers the most easily understood vehicle for demonstration purposes. The finished transceiver will cover all bands, CW only, produce about 50W of RF, and cost in the region of £100 to build. I shall do the basic design and my mate Tony G3WPO will put the project onto boards.

A CW transreceiver

Fig. 2 comprises the block diagram of the complete transreceiver. There is nothing unusual about the overall

concept. It shows a single conversion superhet running with an IF of 10.7MHz (because components for that frequency are cheap) and the synthesised VFO local oscillator running at 10.7MHz above signal frequency.

The whole design has been oriented towards maximising the strong signal performance in the receive mode. There are relatively few design considerations or constraints about the TX part. . .you either transmit a nice pure carrier wave or you don't.

The part of the system which we will use for this discussion is the IF board; the full circuit diagram for this is shown in **Fig. 3.** Ignoring the role of the double balanced mixer DBM1, the entire strip from IFT1 onwards processes 10.7MHz signals, 10.7MHz being the IF frequency (yes, I know that I have just written **I**ntermediate **F**requency frequency but it seems appropriate somehow) of this single superhet transreceiver.

Wideband signals

The first thing to note is the role of IFT1 and IFT2. Signals coming in from DBM1 will cover a spectrum of perhaps a MHz or so either side of the wanted signal now centred on 10.7MHz and the same amount of signal again at 2f + 10.7MHz. A case in point. You are trying to listen to a weak signal on 7MHz after dark; it may have a peak strength of a few microvolts. The preselector will also allow through the 41m broadcast band where I have measured signal strengths of nearly 100 millivolts. Exactly the same signals will also appear in a band centred on about 25MHz, the inverse image signal produced by the DBM. With two high level spectra present simultaneously, the potential for intermodulation products is endless. Intermodulation products, it should be remembered, are signals which are not harmonically related to anything in particular, and the receiver can 'hear' this mush in an otherwise quiet part of the band masking the real low level signals which are there. IFT1 and IFT2 cut the potential problem in half by rejecting the inverse image signal.

Ideally, an attenuator pad should have been included between the double balanced mixer and IFT1. See **Fig. 4.** Although IFT1 and IFT2 will accept the wanted signal and its spectrum, the inverse image spectrum, much higher in frequency, will bounce off the filter combination and head back towards the DBM causing intermodulation problems inside the mixer itself. Unfortunately an attenuator, while it would have cured the reflection problem, would have cut the wanted signal level. This could have been made up with an RF amplifier stage but then that would have introduced a fresh set of problems. This impasse has been tackled in a different way. Instead of making the IF port of the mixer resistive — the ideal solution as in Fig. 4 — the LO buffer amplifier, not shown on the schematic, will have a resistive output. A DBM is a bit like a pressure vessel with three holes in it. If you stop two up, then you must leave the third open

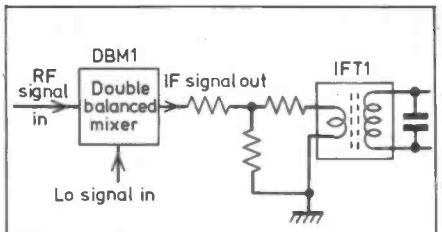


FIG. 4. Ideal mixer arrangement.

or it will explode. Since it is possible to generate any amount of LO power, we can afford to lose some through a resistive attenuator as in **Fig. 5.**

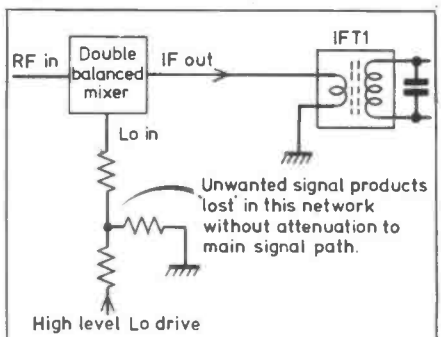


FIG. 5. The practical solution.

IF pre-amp

IFT1 and IFT2 have cut down high level interference to within about 200kHz of the wanted signal. However their main job was to deal with the inverse image spectrum. Q1, the IF pre-amplifier, could still be faced with high level interference and therefore must be very linear in design. The purpose of Q1 is to maintain a reasonably low signal to noise performance: it boosts the signal to a high enough

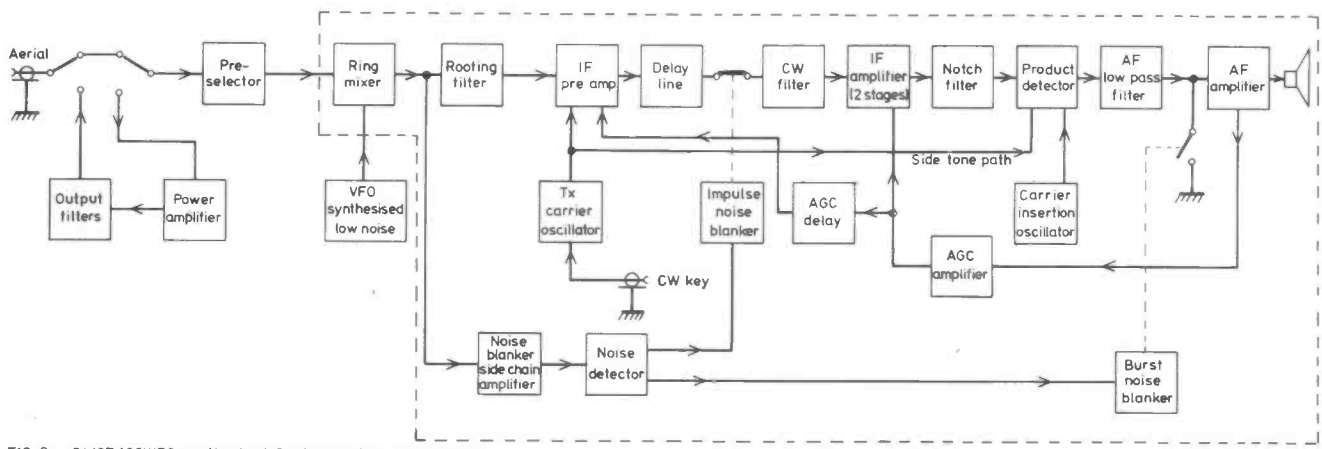


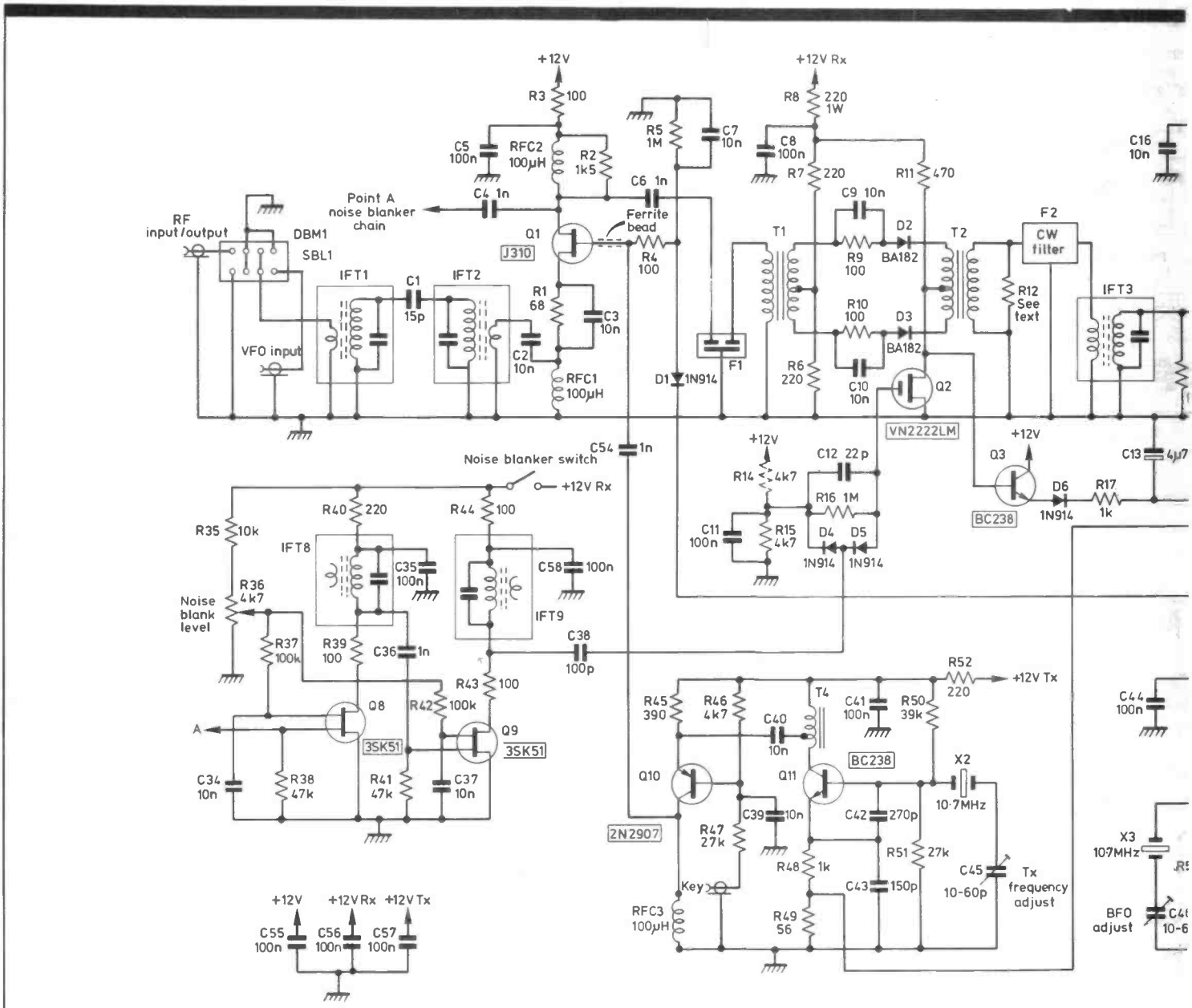
FIG. 2. G4JST/G3WPO synthesised CW transceiver block diagram.

level to face subsequent attenuation by the noise blanking circuitry and crystal filter. It will receive no further amplification until it reaches Q4. FETs in general and junction FETs in particular show some of the best linearity of any semiconductor amplifying device. The grounded gate mode is the most linear of all because negative feedback is inherent in its operation. The other point about the grounded gate mode is that the input at source terminal is almost purely resistive providing a good termination for any filter combination.

The output from IFT1 and IFT2 will be in the region of 50 to 100 ohms. The FET should be able to match this. The parameter which controls this is device transconductance. In the days of valves it used to be quoted in mA/V, a nice comprehensible unit. These days millimhos, micromhos and siemens are all the rage but they amount to the same thing. The J310 device quoted for Q1 has a transconductance of between 10 to 18 millimhos, in English 10 to 18 mA/V. As a complete aside, I always think to myself of some spotty youth, somewhere in the development labs of Silicon Valley inadvertently rechristening something which had been known and understood by the valve world for ages. Anyway, if the current increases by, say 10mA for every volt, then the equivalent source resistance would be 100 ohms. A 5 millimho device such as a BF256 would have an input resistance of 200 ohms, too high for the intended application.

For linear operation, the FET should be biased to a fairly high operating current. R1 in the source circuit should set the standing current to about 15mA although the absolute value will vary from device to device. There are a few comments to make about the gate circuit. Normally with 'grounded gate' it should be just that. Effectively it is, in the receive mode. In transmit, the TX carrier is injected onto the gate. Q1 then acts as a source follower and the signal travels backwards over the receive path to the double balanced mixer.

The other point about the grounded gate mode is that the input at source terminal is almost



purely resistive providing a good termination for any filter combination.

The ferrite bead on the gate terminal inhibits VHF and UHF oscillation, an ever present possibility when using high gain FETs. The gate circuit is also used to inject AGC control voltage but more about that later.

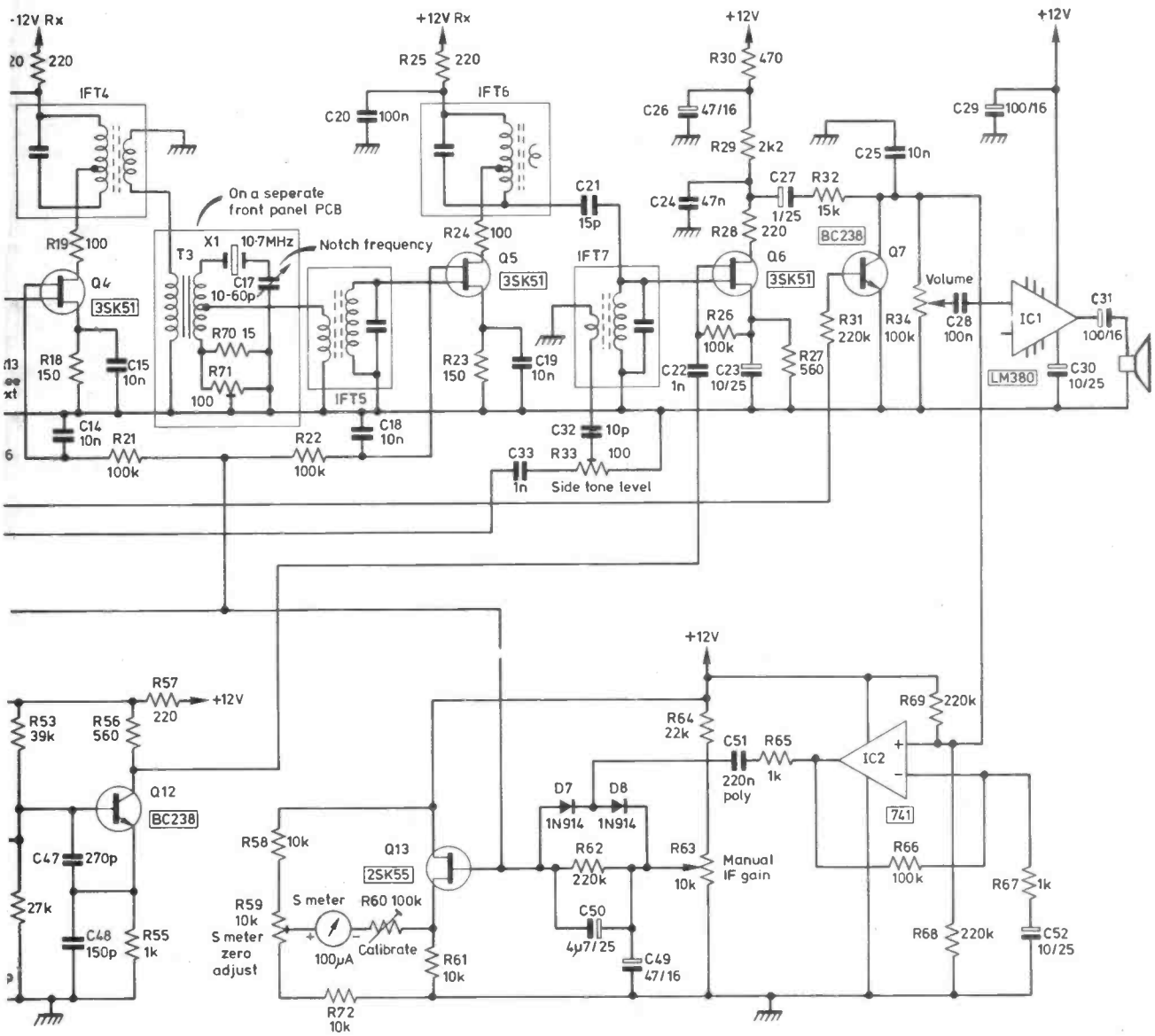
Noise blanker

This has to cope with two kinds of interference: the impulse type such as the Russian woodpecker or car ignition noise, and the static crash type associated with thunderstorms, etc. Equally, the removal of this type of noise should not impair the circuit's ability to handle normal signals.

Most noise signals are of the short pulse type. They are typically of very high level but of microseconds' duration only. If you allow them to reach a narrow band filter such as the CW filter F2, they will cause it to ring producing a pulse at the output of much longer (and noticeable) duration than the pulse which caused it. The noise blanker circuitry shown here turns off the signal path to the filter for the duration of the interference path.

The wideband signal present at the drain of Q1 is split into two parts. The first part — the main part — passes through ceramic filter F1, through T1, D2 and 3, T2 to filter F2. The second path is amplified wideband by Q8 and Q9. This *sidechain* as it is called amplifies both the signal and the interference pulses. However, the interference pulses will be of much higher amplitude and will be rectified by the high speed peak detector circuit D4 and D5. The gain of Q9 and Q10 is adjusted by varying their gate 2 voltage such that the pulses or interference crashes produce negative peak voltages just large enough to turn off Q2, an enhancement mode FET.

Q2 is normally held on by a steady voltage present at the junction of R14 and R15. The rectified pulses turn it off for slightly longer than the duration of the pulse. Most of the current normally flowing through Q2 comes via R7, R9, R10. D2 and D3 are PIN diodes which conduct RF signal voltages perfectly



all the time that they are forward biased with a vairly substantial DC current. From the RF point of view the signal coming out of F1 connects directly with the input of F2 ensuring the normal state signal path. If Q2 turns off during an interference pulse, R11 will reverse bias D2 and D3 cutting off the signal flow to the filter. R6 establishes the reverse bias at 4V.

Although filter F1 is shown as a ceramic resonator of the cheapo type associated with domestic FM tuners, its function in this circuit is as a delay line. A signal input on F1 takes roughly 1½ microseconds to reach the output terminal. That offers quite enough time to turn off D2 and D3 thus blocking the signal path before the arrival of the interference pulse.

You may ask where good RF design comes in. The answer is simple. Sticking diodes in the signal path is generally a recipe for intermodulation distortion unless you are very careful. As far as the signal is concerned, the diodes operate in push pull reducing the residual distortion to a very low level. There is also another reason for using a pair of diodes in this manner. Q2 switches off fairly fast. With circuits of this type, you have to be careful that the induced switching transients aren't actually worse than the pulse interference that you are trying to suppress. Since both diodes switch simultaneously — they are DC balanced by the series resistors R9 and R10 — switching transients cancel out, in theory at least. The transformer construction and circuitry layout require considerable care to achieve this in practice.

Filter

Filter F2 is a standard monlithic crystal filter of whatever bandwidth the user wants. Generally 500Hz bandwidth is adequate for CW although there are no special techniques required for using filters of other bandwidths. The important note about the filter is the termination resistance. The input to F2 would already have a resistive element reflected all the way back to the drain circuit of Q1 via the noise blanker switch circuitry. However some trimming by R12 will almost certainly be necessary. F2 would typically have an input/output impedance of around 500 ohms.

On its own, the input impedance of Q4, the first narrow band IF amp would be in the order of 100's of kilohms when resonated at 10.7MHz. The reflected impedance through to the filter from the IF transformer will probably need adjustment. R13 provides this and would have a value possibly in the region of 50K ohms. This would of course appear as several 100 ohms across the filter.

The output from Q4 goes to the notch filter circuit via IFT4. This notch circuit has an insertion loss of less than 1dB but is capable of providing a 50dB null. Interfering signals in the passband of the CW filter can be effectively removed with this type of circuit. The question has been asked: "Why not use a varicap diode for the notch tuning capacitor (C17)?" Well, you could do but the bandwidth and depth of the notch would be seriously impaired because varicap diodes of all types are very lossy devices. At series resonance, the crystal X1 represents pure resistance in the region of 10 ohms. This is balanced by a real resistance on the opposite end of the centre tapped transformer. At resonance, both cancel out the signal path very sharply, eliminating an interfering signal almost completely. R71 allows fine adjustment for maximum notch depth.

AGC circuitry

Things are fairly straightforward up to the product detector, Q6, A small amount of RF from the transmit oscillator circuitry (Q10, Q11) is injected into the product detector to provide sidetone on transmit. Q7 is a bipolar transistor driven from the noise blanker line. If there is enough high level interference present, the drain voltage of Q2 will spend more time up than down and charge up C13 through Q3. Q7 will then go into conduction and short circuit the audio signal to the power amplifier. This gives protection against static crashes of the type which otherwise take out the eardrums.

Why am I pointing this out? Well...it's a case of good design which is what this article is supposed to be about. High level interference signals are unable to find their way to the AGC amplifier IC2, (as well as the ears) allowing the AGC to respond only to the signal and not to the interference. Another point. The circuitry as shown enables the AGC line to swing negative of the earth rail offering a control range of about 80dB when applied to the gate 2 structures of Q4 and Q5. Hopefully, the complete transreceiver will boast a dynamic range of better than 100 dB which means that the AGC line would fall short by some 20dB of control range. The difference is made up by applying AGC to the IF pre-amp transistor Q1. This stage operates with delayed AGC. Signal levels need to be in the medium to high range before the AGC rail will be sent negative of ground. The AGC diode D1 ensures that AGC will affect Q1 only for high level signals. This is done to maintain strong signal performance in the presence of weak signals and maintain Q1 in the state for optimum signal to noise ratios while permitting gain controls.

Other considerations

There are a couple of critical signal paths which require careful layout of the PCB if the overall board performance is not to be jeopardised.

The first of these concerns the BFO circuitry, Q12. The beat frequency oscillator provides a carrier which is a few 100's of Hertz away from 10.7MHz to provide an audible tone when mixed with the incoming signal in the product detector, Q6. The BFO signal, with an amplitude of around a volt, is almost at the same frequency as the incoming signal, typical level in the microvolt region. Careless layout can cause the BFO signal to find its way into the front end of the IF strip causing blocking with subsequent degradation of the system noise figure.

Like all RF circuitry, this type of unwanted coupling can be minimised by using double sided circuit board material even though groundplane design rules need not be applied for impedance matching purposes.

The same comments about unwanted coupling apply to the crystal filter. A good quality component may exhibit upwards of 90dB out of band rejection. However, unless very careful screening procedures are used to separate the input/output circuitry, all those dB's will be wasted. **G4JST**

NEWCOMER'S

Licence conditions, how often should you utter your callsign, thieves, rotators, aerial design and decibe- -ls are just a few of the topics covered this month

Letters

Kathryn Jackson, G6LHY, queried whether I knew my Licence. Well, I knew I had one somewhere, and eventually found it, so I can confirm that mine reads the same as yours! I can see the reasoning behind your query, and it all hinges on the actual wording used in the Licence. It says "each period of sending", and not "each transmission", which is subtly different. The latter would make it obligatory to use your callsign at the start and finish of each individual over. The words "period of sending" are quite a lot less demanding, and I believe were substituted to this form somewhere in the 1960's to reflect the problems raised by the growing use of SSB and VOX. These made telephone style conversations possible, whereas previously with most activity being on AM, the overs tended to be complete in themselves, as they are now with a lot of FM.

The "period of sending" can encompass a complete QSO, from start to finish, hence the requirement for repeating the callsign if the time exceeds 15 minutes. It allows natural conversation without callsigns being repeated ad-nauseam every few sentences, which is the point I was trying to make in the January issue.

In practice, very few people will go a whole 15 minutes without callsigns, and it is very much up to you how often within the 15 minutes you do state you call. Certainly in a net of several stations, you would be advised to use it more often, otherwise it is difficult to know when a station has finished his (or her) over.

Also, there is no requirement in the Licence for the callsign of the station being worked to be repeated at any particular interval. In fact, it doesn't ask you to say it at all, ecept indirectly under section 2(d), when it requires you to establish communication initially with each separate station contacted. Of course, it must be entered in the log book. Again, a relaxation for Nets, so that a large one doesn't get bogged down with regurgitated callsigns every over.

Of course there are stations who don't use their callsigns very often, or if they do, omit the prefix for some reason best known to themselves, witness a certain nightly net on 80m. Besides making it very annoying to listen to, you should hear the number of times one station stops talking, and several others then all chirp in at once for instant chaos!

dbW	Power (W)
9	8
15	32
16	40
20	100
22	160
26	400
0	1

Table of dbW terms used in amateur licence vs actual power (50Ω system)

Morse methods

Roger Stroud, G4PSJ, writes to say that he found the best way to learn Morse was to take it in 15 minutes periods maximum at a time, but lots of these, filling up your tea and dinner breaks with practice sessions, and adding at least an extra two sessions in the evening. This method got him the pass slip in the period between the RAE and the results of same coming out. I would agree — don't do too much in one sitting or you will probably end up slowing down rather than speeding up.

Another of Roger's tips was the result of having a 10 metre dipole up, but finding that the band had closed the time he got home. So, armed with the right lengths of wire and some croc clips, he lengthens the dipole the right amount for 15 metres and then works the DX there! A useful idea, and one which could be usefully extended to the other bands, even if space is short. Providing the main centre portion of the dipole is in the clear, this being the high current part which does the majority of the radiating, then what you do with the rest won't make a lot of difference to the signal. bending it around will tend to mean the aerial needs to be shorter than the calculations will tell you, but this can be determined with the aid of an SWR Bridge (preferably one using some form of transformer coupling, as these tend to be more accurate than the cheap trough line type) for general use.

Watch what you say

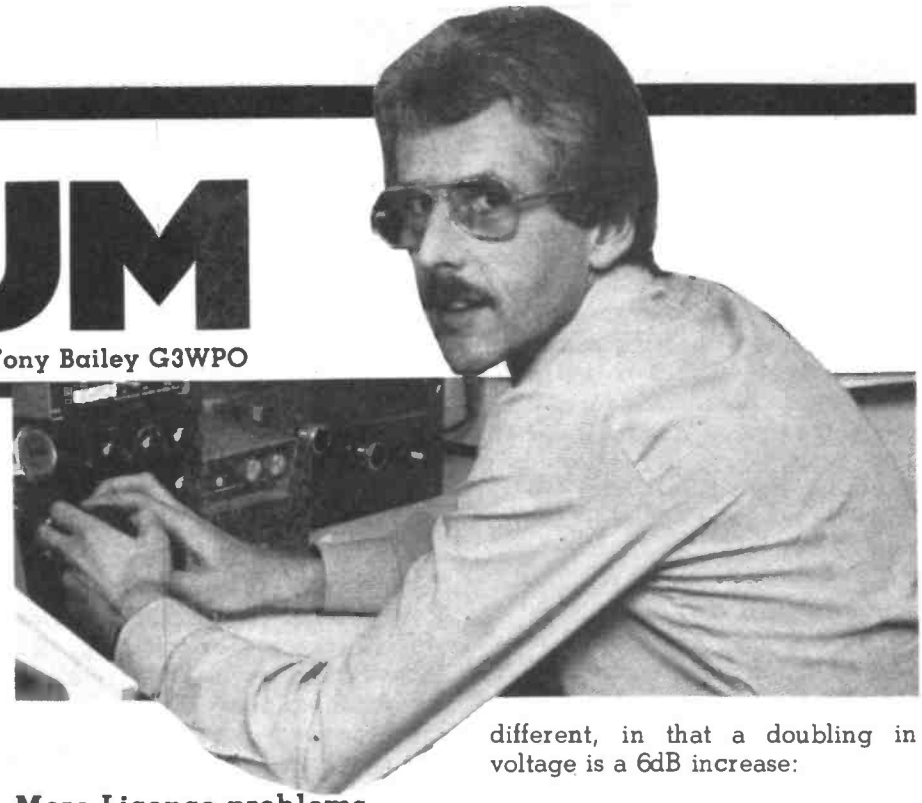
Very few of us stop to consider who might be listening when we are gaily chatting away on the air. Most of the time it doesn't matter, but there are occasions when you may later regret particular statements. I am refering in particular to those stations who happily inform the world on one of the 2m FM channels (and heavily monitored if you think about it) that "I'm out for the day, got the XYL and kids with me, be back late this evening".

There are those who will delight in this type of information, and later relieve you of much of the contents of your house, and or shack. 2m rigs are cheap to buy and provide an ideal monitor for theives. So don't make the sort of statement above over the air, no matter how tempting it is to tell your mates where you are going.

On the above subject, one of my locals, Mick, G6MYB, recently awoke to find that he had been visited in the night. The shack is outdoors, luckily the rig was

FORUM

By Tony Bailey G3WPO



indoors. However, and this is the first time I have heard of this happening, they took down the mast (guyed), removed the top five feet complete with rotator and 4 ele beam, and added the control unit and an SWR Bridge to complete the haul. So, it appears, nothing is sacred anymore.

If anyone is offered a Hirshmann HR250 Rotator, with the colour codes of the connections scratched on the casing, locally, you know who to contact. On a lighter note, I did suggest that maybe the neighbours were fed up with the TVI, and had decided on drastic action . . .

Mentioning Rotators . . .

What have you got on top of your rotator? Yes, a beam(s). Have you considered whether it/they will stay there during the next gale? Many people don't worry too much when they use a fairly small rotator, often intended for a TV type array, to carry a largish VHF array. As the rotator seems to turn it OK, there doesn't appear to be a problem. However, if you think about how the rotator is constructed, and then consider where the stresses are when a heavy wind blows, you may see that it is possible that the gearing used will not withstand this force. The result of the turning motion applied by the aerials can be that the gearing strips, and allows the top half of the rotator to run freely. Braking systems are not usually fitted to small rotators, so this is a distinct possibility.

It is even possible that the rotator housing may part company with the rest of the system. If either of these happens, you could have a distinct mess on your hands, especially if the gale keeps going. So, give some thought to using the correct rotator to the job, adn take the advice of your local dealer, it could save a lot of heartbreak and effort in the long run.

More Licence problems

There seems to be some confusion over the recent Licence changes with regard to the specifying of the power levels in dBW, rather than the rather more straightforward statements of actual power in watts, so I thought it might be useful to cover the area of dB's and how you are most likely to meet hem in Amateur activities. As well as dBW, and straight dB's, you will also come across dBi, and dBd, not to mention dBm!

The decibel is a RELATIVE power unit — a statement of 12dB doesn't mean anything unless you also state what you are referring to. It is a logarithmic unit, and arose from the fact that the human ear has a logarithmic response — if you listen to a signal say running 5W output (RF or Audio) and then increase this to 50W, you might guess that the apparent loudness had increased by a factor of two. If you conducted the same test running 1W initially, and increased this to 10W, you would make the same estimation (or 500W to 5kW, etc). The formula for decibels equal to a POWER ratio is:

$$dB\ (power) = 10 \log 10 \frac{P2}{P1}$$

So, the increases above are 10dB or a ten times increase. 3dB is twice the power, 6dB four times, 20dB is 100 times etc, etc. The word POWER was emphasized above, as voltage or current ratios are slightly different, in that a doubling in voltage is a 6dB increase:

$$dB\ (voltage) = 20 \log \frac{V2}{V1}$$

The important thing to remember is that the second formula can only be used for comparing voltage ratios if the impedance across which each voltage is being measured is the same.

If the answer is positive, you have gained in the system, if negative, a loss.

Relative dBs

As we said earlier, the decibel is a relative unit, and when used in this manner needs a reference value. The term "dBW", now used in the licence to specify transmitter output, means "dB's relative to 1 watt", so that 0dBW is the reference level (NOT 1dBW) of 1 watt. Then you just factor it up depending on the number preceding the reference. 10dBW would be 10W, 20dBW = 100W, 22dBW = 160W etc. You can use log tables to get the actual factors, or much easier use a calculator.

dBm's are another one — this time the reference is 1 milliwatt (0dBm). You will sometimes see levels of spurious radiation specified as not exceeding XdBm — so that 15dBm would refer to 32mW of power. Incidentally, the +ve sign ahead of these ratios is omitted by convention, but a negative sign would be used if needed. A figure such as −3dBW would indicate a power drop by a factor of 2 — in this

case to 500mW (−3dB on 1 watt). 100mW could be expressed as −10dBW, or even (+)20dBm.

Sound levels are often quoted on the relative dB system, ideal for reasons already mentioned, with the reference as 10-16W/cm³, which is the threshold of hearing at 600Hz. Pain starts at +130dB on this level. Have you ever considered the dynamic range of the human ear on this basis — it is better than anything Yaesu will ever do at 130dB, or a ratio of ten trillion to one!!

Aerials and dB

The other reference terms you will meet ar dBi, and dBd, which have relevance to aerials. The former is gain relative to an Isotropic radiator, adn the altter, to a dipole radiator. You will remember that the Isotropic radiator is the one that radiates equally in all directions at once, usually represented as being a point source within a sphere, and equally illuminating all of its internal surface.

As there is no practical version of the isotropic radiator, ALL aerials have gain by comparison with one! This does make dBi popular with the manufacturers, but I suspect confuses the average purchaser, who would rather have dBd, as at least the dipole exists! A half wave dipole (in free space) has a gain of 2.1dBi, so remember to deduct this figure if you want to compare with a dipole.

Power or antennas

One station was heard to comment the other day that he was running 50W output, and was going to build a new linear to get 100W. This would increase his signal, he thought, and maybe at a later stage he would change his 5 element beam for something larger.

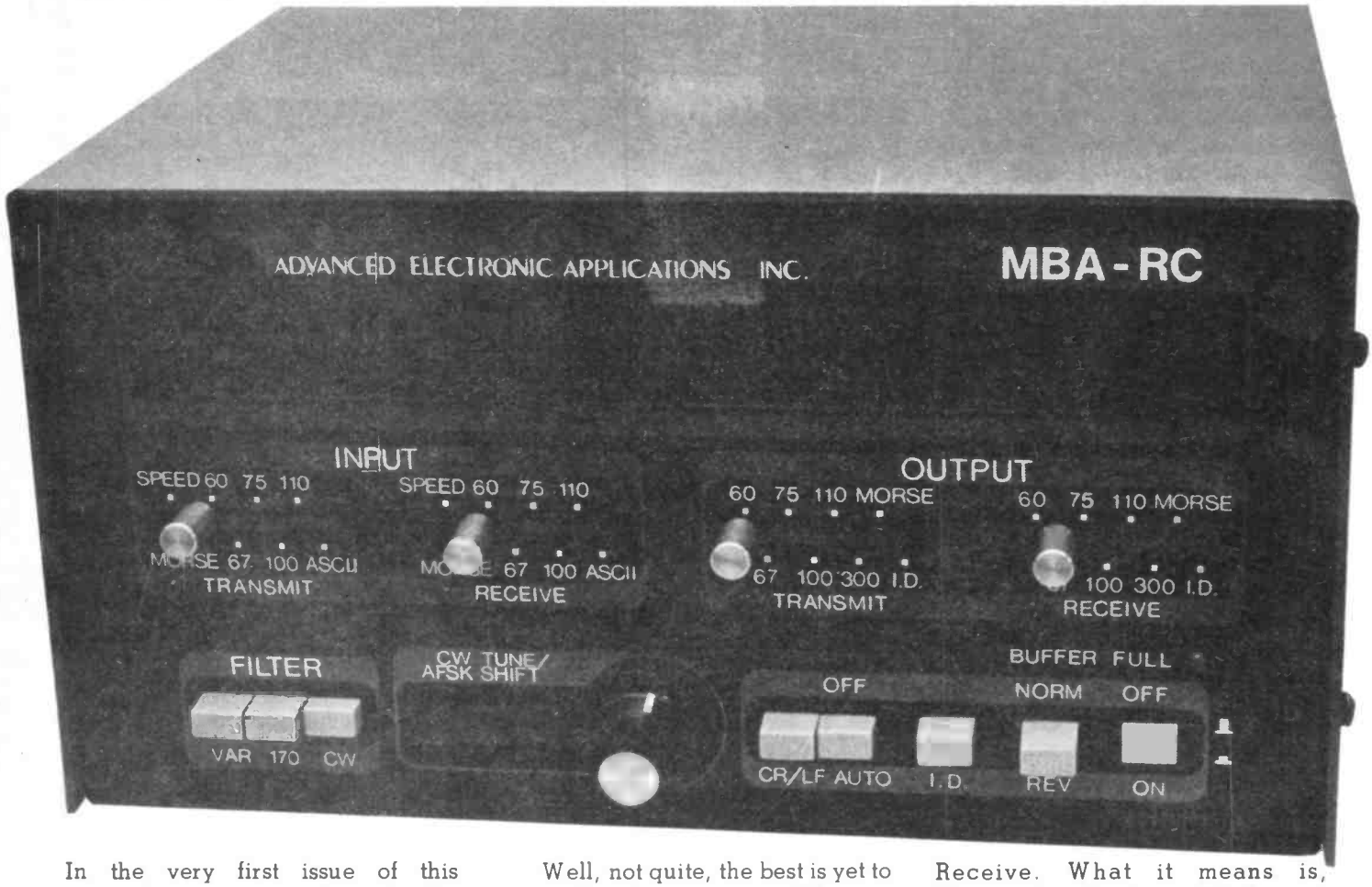
To my mind, he was going about this the wrong way. The increase to 100W, is of course a voltage increase of 3dB. As you probably know, the usual reckoning for 1 "S-point" increase in signal strength is 6dB, so he would be better off by ½ an S-point.

Adding a further 5 elements to his antenna would have gained him about the same increase, but also have the advantage of increasing the received signal strength by the same amount. In fact, the increase in both directions will probably be more, because the angle of radiation of the antenna will be lowered, adn this in itself will increase the strength of the more distant stations. Adding 5 elements on HF is a bit more difficult, but the same thing still applies — the better the aerial the better the signal in both directions (well, almost always . . .). If you are already running high power on VHF, then the antenna changes must be the most cost effective way of getting out a better signal.

If you run an omni-directional antenna on FM, think about a beam — you will find the increase in signal strength very worthwhile, even with a two or three ele, and be putting all your hard earned power in the right direction, not wasting it warming up the ether. For general monitoring, collinears and the such are good, but they are a bit anti-social on transmit, especially in Licencees on VHF/UHF, the use of directional beams does extend the number of stations that can use a channel at any one time. ●

MBA-RC Review

By Tony Bailey G3WPO



In the very first issue of this magazine, we reviewed the *CWR-600* morse/RTTY decoder This somewhat larger box of tricks from a different stable will do exactly the same thing, with the advantage of having a 32 character alpha-numeric display built in to it, so you don't have to tie it up to a monitor or TV. It is one of a range of units, and is the top-of-the-line version.

However, as it costs somewhere around twice the price of the *CWR-600*, you might guess that it has a few tricks up its sleeve — and you would be right. For a start, it is also a Transmit as well as Receive unit, coping with RTTY, Morse and ASCII transmissions. So that's what the extra money gets you then?

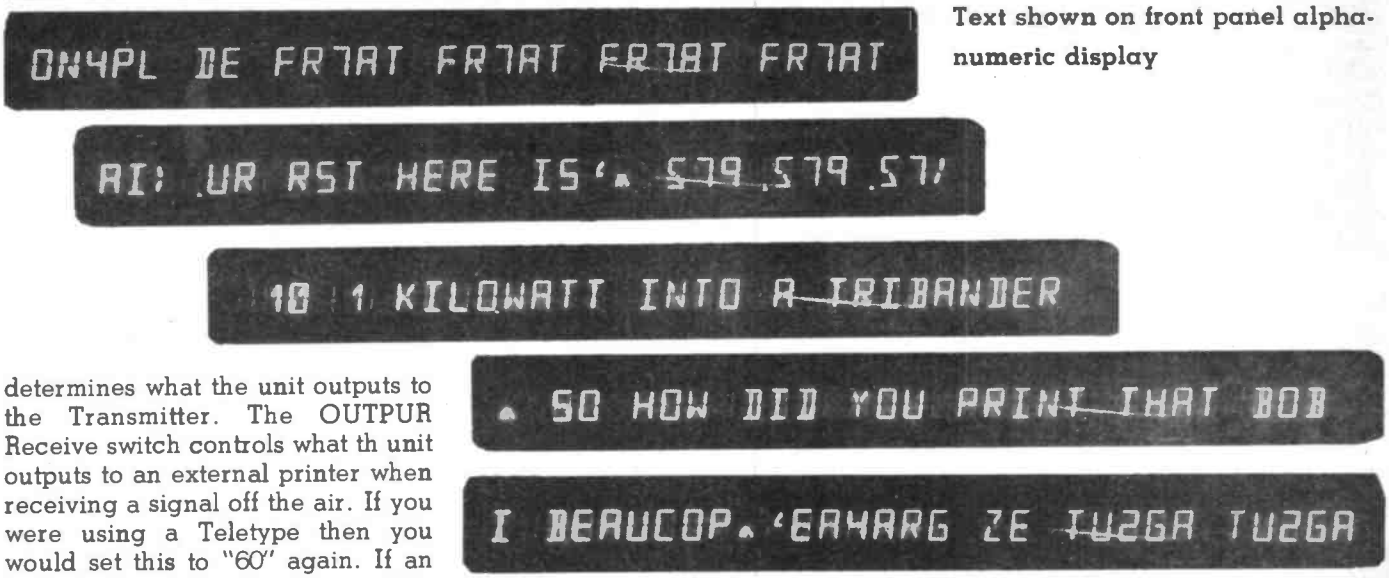
Well, not quite, the best is yet to come. Frank said to me "Want to review an RTTY decoder?". "Of course, but I can't send RTTY with it, unless it'll hook up to my TRS-80", replies I. "Want a bet", replies Frank, "You've got a Morse key, haven't you?".

RTTY with a morse key?

That's exactly what I said . . . but it does just that. You will notice from the front panel illustration that there are four separate slike switches, each marked with similar sets of mode information. The left hand side pair sets what happens in the receive (INPUT) mode. Slightly confusing because the left switch is marked Transmit and the next one Receive. What it means is, "Receive" is the input TO the unit FROM the receiver audio output. i.e., if you are receiving Morse Code, then you set the INPUT Receive switch to "MORSE".

By Transmit it means what YOU are transmitting TO the unit. The reason for this is that these two settings don't have to be the same, as we will demonstrate in a moment. So, if you are inputting 45.5 Baud RTTY from a teletype machine into the unit, then you set the INPUT Transmit switch to "60" (which is 60 wpm RTTY = 45.5 Baud).

Moving onto the OUTPUT side, you will have guessed that this si the transmit side, except why two switches? Well, the OUTPUT Transmit switch is what you would expect — it



Text shown on front panel alpha-numeric display

determines what the unit outputs to the Transmitter. The OUTPUR Receive switch controls what th unit outputs to an external printer when receiving a signal off the air. If you were using a Teletype then you would set this to "60" again. If an ASCII printer, then 110 or 300, depending on the printer. In the "MORSE" position it translates the received signal into Morse Code (no matter what it was in the first place).

No, the manual isn't much better at explaining it either, and also admits to it being confusing, but you should have the hang of it by now!

Mixing modes

Going back to our hand key, it is perfectly feasible — and this was how the reviewer had all his RTTY QSO's — to plug an electronic or hand key into the unit, and while sending morse code at whatever speed you could manage into the unit, leave it to happily output RTTY to the transmitter. The station at the other end is none the wiser, of course, until you tell him that you are sending with a Morse Key. As it was around Christmas that the review was done, a few stations must be forgiven for thinking the Christmas Spirit had got to at least one G!

This mixed-mode operation is the best feature of this really clever unit. It is possible to mix virtually all of the combinations shown on the panel — the unit also has its own internal speaker and this can be quite unnerving to visitors. The average visitor gets a little confused at hearing the station receiver tuned to an RTTY signal, the same signal decoded on the units display, also hardcopied to a printer, and at the same time being re-encoded and sent out of the unit in Morse Code!

Facilities

Having whetted your appetite at the sort of things possible, we will have a closer look at the multitude of controls available to aid operation. It has to be said that a period of playing around with the unit on receive only HAS to be gone through first, otherwise you can get in an awful muddle very quickly!

Taking the front panel controls first:

SLIDE SWITCHES: the basic settings have been mentioned above. In addition, there is a "SPEED" setting which allows the unit to display (in MORSE code only mode) the speed of both received and transmitted Morse signals. This appears on the very right of the display, and appears to be accurate, as it agreed very closely with the W1AW test transmissions.

Also, the "ID" setting allows transmission of an identification signal, such as "de G3WPO G3WPO K". This may be sent in either RTTY or Morse Modes, and is programmable into a 40 character memory. The programming can be done either using a morse key, or keyboard (either Baudot or ASCII), and an LED illuminates when the memory is full.

Note that this is the only actual programmable memory available — the unit will not allow complete messages to be stored such as equipment details (unless you use the I.D. facility for this).

FILTER: The unit has three modes of audio filtering available. In the "CW" setting, the bandwidth is approximately 900Hz-950Hz, and fairly sharply peaked in practice. In "170" position, the unit is peaked for amateur and commercial 170Hz ASCII/Baudot transmissions with MARK at 2125 and SPACE at 2295Hz.

In "VAR", the MARK tone stays

H EEH EE,SOWL GIVE HIMA RING FOR SURE= MNI TNX VERY PLEASANT 73ESWL CUSN IF NOT BEFORE THEN IN MARATHON IN WHICH I MAY BE OPERATING AS G W 3XTJ IN N OR T5 WALES = GMIII ST ILL THINK IT IS MORNING BEC: GOT UP SO LATE H EE G A G A NENEOT CUL F9UO DEG3XT ET 5 EE E E AT GA ALTTE W TMTU EEI = HOPE U GETTHAT CQ TIL COPY FEED ALE HI AR SKEE EU CIED EE FUEGVB TNBTNEC T MIFB G3IFB DE F9UO F9AO GA N S FA TIR TMM ES TKS FOR CALL = ETR RST579 57 579 = QTEI IS BUEIES BURES N AR PARIS ES FO KE IS 1336 3IM6 = WELL FRANK VY PEEED TO TUSO U TO HEOTE THIS BAND OB = HW? G3I FB DE F9UO KN E EE UETNBRBWTRCHERRENE= E VYPSEDTTM TTTTU5NEWBNDESTNBRPRT=RST5555 FB=FATTTAHPEUHADBTTAS=ESWISHUESDEDEEFBNEWYEAR=FETNBK R TT N EITEXTE UO AU E E N

Typical reception of hand-keyed Morse Code on 3.5MHz band

peaked at 2125Hz, but the SPACE tone can be peaked anywhere between 2225 and 3125Hz, thus allowing virtually any other shift on RTTY to be tuned in.

CW TUNE/AFSK SHIFT: This small window conceals a bargraph type LED display which is used for peaking signals. It is far easier to use on RTTY than describe, and the manual deals with this adequately. Once familiarised, you can tune in an RTTY signal in a second or so.

The knob to the right controls the frequency of the audio filter in "VAR" mode.

CR/LF — AUTO: These two controls allow for control of printer carriage return/line feeds. The first will send a CR/LF when depressed once, either when receiving or transmitting Baudot/ASCII, and is useful for generating missed instructions on receive.

The second activates an internal character counter which will generate a CR/LF character at the first space following 60 characters, or after 71 characters have been sent. This saves having to keep tabs on what you have sent when using a key to send RTTY, and stops the chap at the other end having to insert CR's.

NORM/REV: The usual switch to allow reversal of the Mark/Space conventions. Normal is with the Space tone higher than the Mark. Sometimes the other station will have his tones reversed, usually in error, or the receiver may be set to the wrong sideband for correct tone recovery, and this switch allows this to be corrected.

OFF/ON: Controls power to the unit.

BUFFER FULL LED: Besides indicating the I.D. Buffer is full, there is also a 1024 character receive buffer used for the output device. This LED will light when there are only 25 characters left. If the buffer does fill completely, the display blanks, but none of the buffer contents are lost.

The reverse of the unit has an additional five pushbuttons, two presets, and 13 sockets. The two presets allow the volume level to the internal speaker, and the output level of the AFSK tone to the transmitter to be set.

The pushbuttons cater for control of the external hard copy printer, which may be disabled on Trnasmit or Receive or both; a "down-shift on space" (both transmit and receive to help prevent garbled copy) facility; and the Transmit AFSK Tone shift, at either 170 or 850Hz.

The next set of sockets are all phono type. Tone Output, two transmit key outputs (one positive, one negative), the Transmit/Receive input (close external contacts to transmit), and two more for Mark and Space outputs to a Scope for tuning purposes. The remaining phono outputs a TTL level teletype signal, low during Mark.

Audio input to the unit is via a 3.5mm jack socket. This input is quite sensitive and happily allows direct connection across an existing speaker. An additional jack also allows audio output from the unit (it is in fact paralleled with the other jack).

Printers & keyboards

A 26 pin connector allows interface with an ASCII printer and keyboard if desired. This is a parallel Centronics compatible, for Centronics, Epson, and almost any of the other popular printers. The connector type isn't defined, but is available from RS Components if you need to get one. Also the connection details given on page 32 of the manual have got one pin number wrong — under OUTPUT PINS, pin 1 should read pin 7, otherwise one of the data lines will end up at 0v.

For the review, an EPSON MX80 was used for hard copy, wired exactly as per the manual (except pin 1!). This worked perfectly satisfactorily, although generating an extra line feed (which could have been removed internally by resetting a DIP switch internal to the printer).

Standard current loop input and outputs are also provided for teletype machines, with these isolated from the rest of the units electronics by opto-couplers. The manual luckily warns you that the external supply MUST be limited to 60mA, as this is not done internally.

The remaining socket is that for the key, a standard 0.25" jack. It may be connected to a key, or a positive keyed output from a keyer, or to a keyboard unit's output.

Interfacing with a micro

If you want to go the whole hog and interface the unit with your microcomputer, then an RS-232C interface could be hung onto the current-loop input/output terminals. However, if you have a computer, you probably won't be using this unit anyway, as the majority of the electronics will already be in your possession. For somewhat less than the cost of this unit, you would be able to buy a very comprehensive RTTY/CW program, complete with message storage facilities etc. and the facilities such as sending RTTY using a morse key would have little relevance.

If you do use this facility, note that the MBA-RC, although it will output 300 baud ASCII to a printer or the Transmitter, will NOT accept it as input either from a keyboard or receiver. If you're going to input ASCII, you will have to configure your RS-232C interface for 110 baud, and the other station will also have to send at this speed. This could be a positive disadvantage, as a lot of ASCII activity in this country is on 300 or more Baud.

Manual

A 45 page photocopied instruction manual is supplied with the MBA-RC. Although the instructions are comprehensive, and include nine

```
A FARM WHERE GODA CHEESE IS MADE AND BECAUSE I LIKE CHEESE
VERY MUCH I BOUGHT MANY KILOS OF CHEESE AND BROUGHT IT
BACK WITH ME TO GERMANY....AND WE VISITED THE CHILDRENS
PARK I BELEIVE IN THE SUBURBS OF AMTERDAM CANT REMEMBER
BUT I AM SURE YOU KNOW THG PRRCQX UMBTBHEUVMTED TO THE
CHILDREN AND DID WE HAVE FUN THER ....VERY INTERESTING....
 AND OF COURSE ZHE HOUSE OF PARLIMENT IN THE HAUGE .... AND
```

Copy from external printer

illustrated examples of using the unit in various combinations of output/input, it does need careful reading to digest properly (*you're not kidding — Ed*). Even the manufacturer admits that the explanations do not come simply "due to the tremendous flexibility" of the unit. If you do intend interfacing with a micro-computer, you won't find much help in the manual.

A circuit diagram is provided of both the analogue and digital sections of the circuit, together with parts lists and pcb layouts. No explanation of the circuit operation is given, so unless you are into the subject, you may not be able to service the unit yourself. Two microprocessors are used to provide the facilities (3870's). The unit requires 13v DC +/— 3v at 1.2 amps maximum.

Only two phono plugs were supplied — if you need any of the other connectors you will have to supply these yourself, including the coaxial DC input plug — the one supplied didn't fit the socket. The socket has a slightly smaller coaxial centre than the ones easily obtainable in this country. Also beware that the centre pin is the positive connection — other equipment uses the outer sleeve as positive, so check before plugging in if you do have one that fits already.

Construction

The decoder is housed in a substantial steel two-part cabinet — the cover can easily be removed by undoing a handful of screws — and reveals a very well engineered piece of equipment inside. There are two major pcbs on the lower chassis, one above the other, and a further set up against the front panel for the display and switches. If you do need to remove the cover, take care as the internal speaker is on a flying lead, attached to the top cover.

The circuit boards are screen printed with component positions, which should aid any attempted servicing. The review sample did manage to fail at one point, and was returned promptly with a blown transistor replaced.

The MBA-RC on the air CW

In a similar manner to the CWR600 reviewed earlier, when the MBA-RC is used for decoding Morse, it is very dependant on the quality of the input for accuracy of decoding. The speed at which code is transmitted from the unit can be programmed into the decoder, necessary when using a keyboard or teletype for input. If you are using a straight key, this would normally key the transmitter directly, without the MBA unit being involved. However, it is possible to say input at 15wpm from a key into the decoder, and get it to retransmit at a higher speed. If using the ID storage facility, this might be useful for MS work, but you are limited to 40 characters of message. Otherwise one of the less useful facilities.

It was rather interesting watching the decoded output versus the type of sending. Best accuracy of decode was with machine sent code, as might be expected, followed hard by well sent hand or electronic keyed morse.

Brain vs machine...

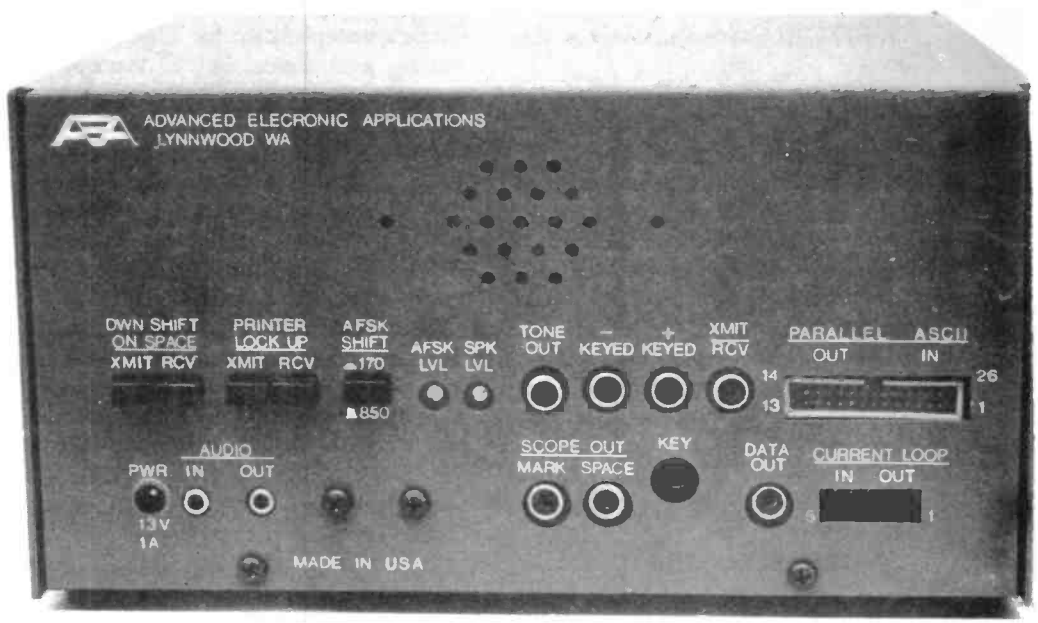
The one variety it didn't like was the Vibroplex type of semi-automatic keyer, the error rate being very high. The human brain gets used to decoding this type of sending, where the operator inevitably puts an accent on the dashes, and adjusts itself accordingly. The machine on the other hand just cannot cope with it, as the long dashes do not conform with any code groupings in its memory. It will immediately try to readjust the speed, then find the dots don't match the dash which it just received, so it gives up in disgust.

Even poorly sent hand keying, provided the spacing and dot/dash ratio were somewhere around the right regions, was reasonably well decoded, but the human brain would win most times. One of the problems is with the abbreviations used in amateur traffic.

When a station sends "TNX FER QSO ES WILL QSL SURE VIA BURO", your brain can almost tell you what is coming before it is sent, even if the keying is less than perfect, through familiarity. To the machine, which only tells you what it actually received, it may appear as "GX FER MASO ES WILL Q SL SUL VV TSURO". All because the spacings were a little out. Result: Human Brain 100% copy — Machine: Dismal failure!

This problem is common to all machine type decoders, and not just to the MBA. I doubt whether the human brain will ever be beaten at decoding hand sent amateur CW (or a lot of commercial traffic) so the MBA is no worse than any other in this respect. Given perfect machine sent code, it will return flawless copy.

Signal strengths needed to be fairly high for reliable copy, much below about S6 and errors were



Rear panel showing connections

increasing. The presence of QRM or QRN also pushed up the error rate. This phenomena is very much less apparent on RTTY — there is always a tone for the unit to refer to on RTTY, But on CW, no equivalent to the Space tone, so any form of interference during the key up times is likely to be decoded as part of the signal.

RTTY

As mentioned earlier, all RTTY QSO's were conducted using an electronic key as the input to the MBA-RC, rather than any keyboard as such. The unit will accept an ASCII keyboard input, use of a micro via an RS-232C, or a standard teletype, and can use any of these to output CW as well as RTTY, of course.

Using the key as input is obviously somewhat slower than a true keyboard, but it does have the same end results. Keying accuracy is essential, as the same circuitry is used as for decoding on receive. The input code can be seen on the alphanumeric display as it is being sent, which helps a great deal — also hard copy can be kept on a printer. Mind you, unless you already possess such a printer, you are unlikely to want to fork out £300+ for one for this purpose only.

The CW speed input is immaterial (the MBA will cope with up to 80 wpm+ in either transmit or receive modes), automatically adjusting to the speed. Very few people will be able to key sufficiently fast to keep up with RTTY output (60 wpm). Judging by the average typing speed of amateurs, this isn't a problem! In practice you may actually do better.

Considering the facilities offered by the unit, it is a shame that no proper message storage facility exists, such as would be obtained using a dedicated micro program, enabling you pre-program in CQ's, QTH and equipment info etc. There is a 1024 character FIFO buffer, used when the output device is slower than the input, for instance when receiving 110 Baud ASCII, but outputting to a 45.5 Baud teletype unit, or converting to CW. Conceivably this could have been used as an optional buffer for the purpose.

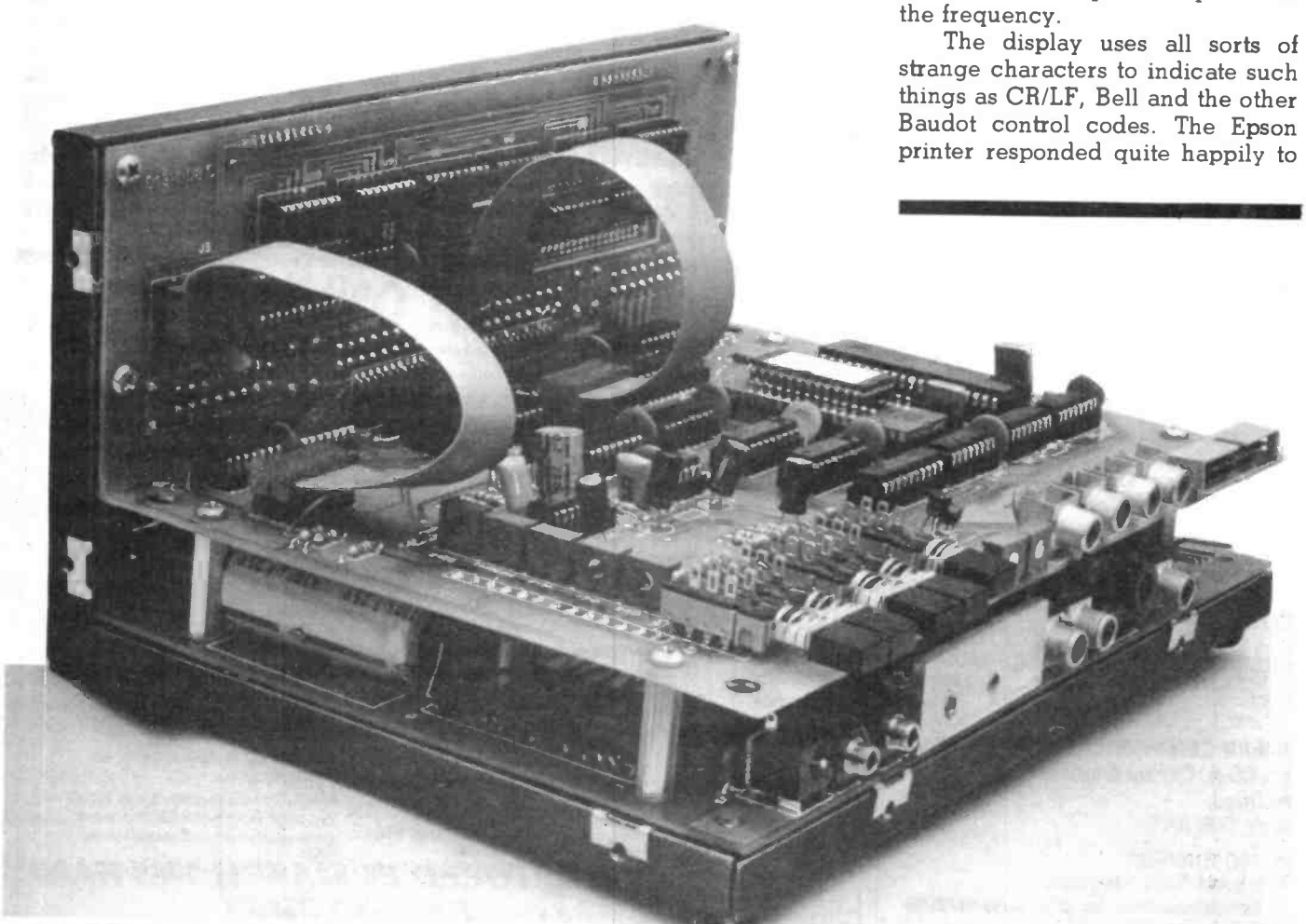
Tuning RTTY

The bargraph LED display is quite easy to use, once the technique of tuning is mastered. The trick is to start tuning across the signal at a low beat note, and gradually increase until the bargraph totally illuminates and does not flicker between mark and space. This is easy on 170Hz shift, but on other shifts entails tuning to the Mark tone first, then adjusting the variable control for closure of the display.

Copying RTTY

Given almost any sort of signal, the unit copes very well, even in the presence of QRM/QRN, returning virtually faultless copy. Signals fairly close to the noise can be recovered, but you do need a stable receiver (and received transmission) — a shift of a few 10s of Hz will introduce errors. The input filtering is via active filters, with no phase locked loops to keep hold of the frequency.

The display uses all sorts of strange characters to indicate such things as CR/LF, Bell and the other Baudot control codes. The Epson printer responded quite happily to



all these, without any signs of spurious controls being sent to the printer, or unwanted characters, even during corrupted decoding. The usual symptoms of this are changed print modes, but will depend on your actual printer.

Trying to copy commercial RTTY transmissions led to some fun and games. Besides finding the speed and sense of the transmission, yo are often dealing with an encrypted code (to stop people like us seeing it!), so the majority of the time will see garbaged output. When you do find one that is compatible, the copy is generally faultless, and a good way of using up your stock of paper on hard copy.

Incidentally, there is no facility provided in the unit for driving a video monitor, or TV, directly, presumably thought superfluous by virtue of the built in display and other options offered.

Transmission of RTTY doesn't really raise any problems, as the once you have set up the switches for your correct input/output modes, adn programmed the I.D. the transceiver controls the Rx/Tx function. Getting an I.D. at the end of the transmission entails shifting the OUTPUT Transmit switch to MORSE, and pressing the I.D. Button once.

Caution...

The manual correctly warns that you should be careful of the power input on your transmitter, as with RTTY you are running 100% duty cycle, instead of the much lower cycles demanded by CW and SSB. They suggest 40% of your normal power rating, but it would be sense to check the handbook, and see what is recommended for FM or AM use. More than adequate gain is available from the AFSK output socket on the rear to drive virtually any rig via its microphone socket.

Conclusions

With no reason to suppose that the unit will not perform as specified with keyboard inputs, the MBA-RC is an intriguing answer to coping with the various modes of transmission now available. For those stations not already possessing any form of computer, it could be a very versatile means of getting onto RTTY, together with CW and ASCII facilities, although you would really still want to get hold of some form of keyboard if you are going to use it a lot. At the price you could invest in a quite reasonable micro, and maybe even get a RTTY program for it, if it si specifically RTTY you want — and also have the benefit of the micro for other applications.

One of its few limitations is not being able to copy 300 Baud ASCII, which will limit compatibility with many other stations using ASCII.

The MBA-RC does appear to have an element of being an answer looking for a problem to solve. While it can cope with all sorts of mixed modes, and it is great fun playing with it, in the long run its benefits seem limited for serious applications.

Taken for the facilities offered, it performs its decoding and other functions very well, and would be a useful addition to any shack, providing you can make use of all the facilities. ●

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R3	4.0298	8.0597	12.0895	14.9972	18.1343	44.9916
R4	4.0305	8.0611	12.0916	15.0000	18.1375	45.0000
R5	4.0312	8.0625	12.0937	15.0027	18.1406	45.0083
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R7	4.0326	8.0652	12.0979	15.0083	18.1468	45.0250
S8	—	—	12.1000	14.9444	18.1500	44.8333*
S9	—	—	12.1020	14.9472	18.1531	44.8416*
S10	—	—	12.1041	14.9500	18.1562	44.8500*
S11	4.0354	8.0708	12.1062	14.9572	18.1593	44.8583*
S12	—	—	12.1083	14.9555	18.1625	44.8666*
S13	—	—	12.1104	14.9583	18.1656	44.8750*
S14	—	—	12.1125	14.9611	18.1687	44.8833*
S15	—	—	12.1145	14.9638	18.1718	44.8916*
S16	—	—	12.1167	14.9667	18.1750	44.9000*
S17	—	—	12.1187	14.9694	18.1781	44.9083*
S18	—	—	12.1208	14.9722	18.1812	44.9166*
S19	—	—	12.1229	14.9750	18.1843	44.9250*
S20	4.0416	8.0833	12.1250	14.9777	18.1875	44.9333
S21	4.0423	8.0847	12.1270	14.9805	18.1906	44.9416
S22	4.0430	8.0861	12.1291	14.9833	18.1937	44.9500
S23	4.0437	8.0875	12.1312	14.9861	18.1968	44.9583

SR Series Resonance *HC25 only

Also in stock: R0 to R7 and S8 to S23 for following: Belcom FS1007, FDK TM56, Multi 11 Quartz 16 and Multi 7, Icom IC2F, 21, 22A and 215, Trio Kenwood 2200, 7200, Uniden 2030 and Yaesu FT2FB, FT2 Auto, FT224, FT223 and FT202.

Also in stock: 4 and 8MHz TX in HC6/U for 145·8MHz. Icom crystals TX for 145·6MHz (RRO), 44MHz RX crystals in HC6 for 145·8 and 145 (RRO). All at above price.

RB4, RB6, RB10, RB11, RB13, RB14 and RB15.

4 METRE CRYSTALS for 70.26MHz in HC6/U at £2.25. TX 8.78250MHz. RX 6.7466 or 29.78MHz in stock.

70cm CRYSTALS in stock 8.0222 and 12.0333 in HC6 £1.85. Pye Pocketfone PF1, PF2, PF70 and Wood and Douglas £4.50 a pair or TX £2.25, RX £2.50, SU8(433.2) RB0, RB2, RB4, RB6, RB10, RB11, RB13 and RB14.

CONVERTER CRYSTALS in HC18/U at £2.85. In stock 38.666, 42.000, 70.000, 96.000, 101.000, 101.500, 105.666 and 116.000MHz. 26·000 HC6 £2.00

TONE BURST AND I.F. CRYSTALS in HC18/U at £2.25 in stock. 7.168MHz for 1750kHz and 10.245MHz for 10.7MHz IF's.

FREQUENCY STANDARDS in stock £2.75, HC6 200kHz, 455kHz, 1000kHz, 5.000MHz and 10.000MHz. HC13 100kHz. HC18 1000kHz, 3.5000MHz, 7.000MHz, 10.700MHz, 48.000MHz and 100.00MHz. 4.000 HC18 £2.00

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	2	200 (total)	20 to 29.999 kHz	—	£16.50
	3	200 (total)	30 to 159.999 kHz	—	£10.50
	4	200 (total)	160 to 999.999 kHz	—	£6.00
	5	50	1.00 to 1.499 MHz		£6.00
	6	10	1.50 to 1.999 MHz	£4.75	£4.40
	7	10	2.00 to 2.599 MHz	£4.75	£4.40
	8	10	2.60 to 3.999 MHz	£4.55	£4.10
	9	10	4.00 to 20.999 MHz	£4.55	£4.00
	10	10	21.00 to 25.000MHz	£6.00	£4.00
	10A	10	25.00 to 30.000MHz	£8.50	
3rd OVT	11	10	21.00 to 59.999 MHz	£4.55	£4.50
5th OVT	12	10	60.00 to 99.999 MHz	£5.00	£5.50
	13	10	100.00 to 124.999 MHz	£6.15	£5.20
5th, 7th & 9th OVT	14	20	125.00 to 149.999 MHz	—	£6.00
	15	20	150.00 to 225.00 MHz	—	£7.50

Unless otherwise requested fundamentals will be supplied with 30pF load capacity and overtones for series resonance operation.

HOLDERS – Please specify when ordering – 10 to 200kHz HC13/U, 170kHz to 170MHz HC6 or HC33/U, 4 to 225MHz, HC18 and HC25.

Where holders are not specified crystals above 4 MHz will be supplied in HC25/U.

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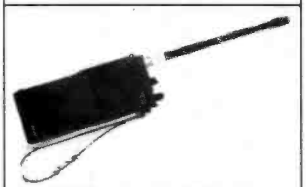

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