HAM RADIO TODAY

NEW

MARCH '83

85p

BUILDING:
a simple HF aerial

WORKING:
Russians

STARTING:
amateur television

QUESTIONING?:
Icom's latest 2m and 70cm black boxes

SPECIAL PROJECT:
DIRECT CONVERSION DSB/CW TRANSCEIVER

HAM RADIO TODAY

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LETTERS

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HAVING A BASH

Sir, I was very interested to see your new magazine, and found it very good, and look forward to future issues. I would like to comment on various points.

First of all, on the subject of the RAE, I must admit that the multiple choice exam is easier than the previous written one, even though I took it myself. In it I have found questions which have no answers and in the "exam" I took, a question with two answers. I readily admit that for part one, I read through the Home Office handout only a few times.

As to channelization and its use by Raynet (although I am not a Raynet member myself), there are reasons, concerned with interference, etc., why these "rules" exist. Also, isn't it common courtesy to think of other users of the frequency bands?

My greatest bone to pick, is with those Class A licence holders who seem to think that Class B licencees are second class citizens. Why do they seem to take great delight in bashing new and young amateurs? My brother and myself are newly licensed, he at 16, and I at 17. Although I say it myself, we have more decency and are more aware of the spirit of Amateur Radio than many G8's and G4's. A lot of G6's are more polite and have a far greater technical excellence, than some of the established amateurs. (Although, I do exclude some of the recent ex-CB'ers.) Why don't old timers explain to newcomers what they're doing wrong instead of bawling them out over the air. Surely this is also part of the "Spirit of Amateur Radio". As to the consistent use of repeaters by G6's, is due to nobody being on the air except during lifts when many came on with the proverbial 400watts. As to the accusations of the G6's speaking drivel with mouths of babes and being full to bursting with boring inanities, perhaps you should listen to some of the Q50's between some of our older members. At least they talk, which is more than can be said of many amateurs.

Why the homebrew bash as well? It is a well known fact that commercial units are a compromise to cover various uses. A homebrew unit has usually been designed for a specific frequency or frequencies, and can make use of individual circuitry; not used in off the shelf products.

Lastly, I get rather annoyed with all the publicity given to the aid given by CB'ers during emergencies. Why is there no mention of Raynet, who after all have been doing a superb job for over 30 years.

ANDREW MUIR G6EIS

All amateur groups should be able to co-exist with their neighbours. I suspect that the bash at RAYNET was aimed at its de facto exclusive frequency allocations at all times, whether in use or not — Ed.

CAN YOU HELP?

Sir, I've just started into the radio ham world, and I've been given an old transmitter, which is the MINIMITTER MODEL No. MR44 Mk II SERIAL No. R801. Would there be any chance of finding a circuit diagram and valve layout? Maybe one of your readers could help me.

K. R. TAYLOR

UNDERGRADUATE

Sir, Congratulations on your new magazine. Let's hope you continue as you have started, and not get bogged down in high sounding theories as other magazines have done.

We need a down-to-earth approach for us humble "hams". We have not all received a university education as some other magazines assume we have. Best wishes.

BOB HOARE G3XQW

I'm afraid we're liable to print anything. Our only proviso is that a quorum of readers will find it interesting — Ed.

QSLs

Sir, Good luck to you on your new publication "HAM RADIO" but — what about all those SWLs? Not a mention.

I was a Radio Op in Royal Signals from 1923 vintage and I am still a SWL because that's how I like it.

Regarding QSL cards in your *letters*. The bloke who wrote that his "go under the leg of the table" is typical of a lot of Hams these days. As to the RSGB they are too toffee nosed for me. A lot of Hams today don't know the meaning of *esprit de corps*. They spend their pounds on equipment and they think that's it.

GORDON BEAUMONT RSARS 213, ISWL

QSLing has got out of hand in recent years. One always wishes to record a spectacular contact but the practice could usefully be given a rest for routine QSOs. After all, the logbook should provide the record — Ed.

CW RULES OK?

Sir, May I say how much I disagree with your remarks on CW. A well operated CW QSO employs real skills; takes less of the precious band and gets through when all the SSB'ers are moaning at the state of propagation. Furthermore it allows contacts between amateurs who have no common language. Why should you expect every Japanese to speak to you in English?

Perhaps your sympathies really lie with the super CBers on the two metre repeaters.

G. ABRAHAMS G4KEJ

P.S. Radio Club of Thanet (Call Sign G2IC) meets every Friday, Buckington Village Centre.

CW is a useful operating aid. However, I'm not sure that it should be the main yardstick for limiting the population on the HF band — Ed.

KITS AND BAND REPORTS

OM, I thought I would write to you to say how much I enjoyed the first issue of HAM RADIO TODAY. At last a magazine about amateur radio that is bright, up to date and prepared to admit that amateur radio is fun.

I think that you have a good balance of articles in the first issue. I was glad to see you have started off with a transceiver design. I think the average amateur likes to see constructional articles for practical equipment that he would use in his shack, rather than esoteric items like stereocode receivers and polyphase SSB generation such as frequently appear in RadCom.

As an inveterate kit builder I was very pleased to see that you will be publishing reviews of kits. I have this year built the G3WPO grid dip oscillator, the Shimizu transceiver and am currently building a two metre transverter based on the Piper Communications TV28144 kit.

The Shimizu was very straightforward to build and lined up with no problems. The only problem I found with it was mobile or with an indoor antenna, on the higher frequency bands; I appeared to be getting RF into the transmit ALC line. However this problem is not apparent on a decent aerial, and I have had very good reports from it.

I have been less pleased with the transverter kit, which has proved prone to regeneration in the TX output stages, and appears to be somewhat non-linear resulting in hard to resolve SSB although it was satisfactory on FM. The design uses a Schottky diode ring mixer and a BF981 front end, although the sensitivity seems only about the same as the FDK750E which I used to have, and the AR240A.

I liked the equipment review. However I think that they could be improved if you could publish full circuit diagrams of the equipment, together with an explanation of some of the more interesting points of the design as in R&EW. I think that this is a good way to learn about circuit design as well as providing useful ideas for things one might be building.

I notice that there were no band reports, nor any mention that there was going to be one. I was speaking on the air to someone who said 'it is of no interest to me this month to read about what happened last month'. However, I am not sure that his views are in the majority. My personal view is that an amateur radio magazine is not complete without a page of band reports and DX news. When I was more active on 2m SSB, I was an avid reader of Norman Fitch's very well written 'VHF bands' feature in Short Wave Magazine. Given that G3WPO says in his article 'that people are coming into ham radio via CB, having never done any short wave listening, how are they going to learn what can be done on bands and modes other than VHF FM, and where will they get the encouragement to try them?

JULIAN MOSS G4ILO

Thank you very much for you kind comments and suggestions. I must confess that I left band reports alone because RadCom and PW already do a very good job. However if there is a demand for such a column in Ham Radio Today, I will start one — Ed.

COMMENT

RSGB Disdainful of Class B Licences

Let me say at the outset that magazines are made from paper and have no opinions of their own. Although I am editor of Ham Radio Today, I offer these comments as an individual. I also offer the right of reply.

I understand that there is a proposal before the VHF Committee that Class B licencees should be allowed to practice and use CW on 432MHz and above with identification on phone. I believe that the Committee has accepted the proposal which will be recommended to the Home Office for underwriting in the licence conditions.

The proposal seems like success for the Class B holders who have been clamouring for the right to use CW on their own bands for years. However, as victories go, it is decidedly Pyrric. The vast majority of Class B licence holders, particularly the newcomers who have the greatest need for CW self training, are equipped for 144MHz only. Put another way, only some ten per cent of those for whom the concession was intended are equipped to operate on 70cm. The remainder will have to fork out very deeply for new equipment. Good for the amateur radio dealers, good for 70cm as a spur to use it but grossly unfair on the majority of Class B amateurs who wish to practice CW over the air.

Insane

It is completely insane that a proscription on CW for the 'B's exists at all. Licence conditions are there to protect other wireless telegraphy users against technical incompetence, guard the British Telecom message carrying monopoly (now breeched in several areas I am pleased to report) while the various Wireless Telegraphy Acts provide remedies against transgressors.

I used to think that the RSGB was a benign, if rather fuddy-duddy group of old men which had the best interests of the amateur radio movement at heart. I felt that it served its members reasonably as the official body for amateur radio in this country in its representations to the Home Office. I don't think that way any more.

In my opinion it is quite disgraceful that the RSGB should seek to keep Class B amateurs off the CW end of 144MHz. There could be exceptions to this corollary. For instance, if the bandwidth of a particular mode were excessive. With any argument relating to CW, this surely does not apply.

Having dismissed technical arguments to support the RSGB's curious stance, you must look for other motives. The only one that I can think of — and I sincerely hope that I am proved wrong — is that it wishes to keep CW operating on two metres as an exclusively Class A preserve. There can be no moral justification for this. Above all others, this band is more closely associated with Class B operation than any other. Apart from the fact that Class A amateurs can operate CW without giving their callsign in phone, there should be no other advantage enjoyed by the sector on 144MHz and above.

Not Representative

One has to assume that the VHF committee of the RSGB with its heavy preponderance of Class A members is promoting self interest in keeping the CW end of 2m clear of Class 'B's. After all, around 70 per cent of 'A's run 2m gear. This assumption about the RSGB's motives (and attitudes) towards the 'B's is given substance as a result of leakages from closed Committee proceedings. One of these reports a two letter callsign member as saying that: "Class Bs will only be allowed to use CW on two metres over my dead body".

Every Sunday you hear the RSGB news broadcasts as saying that "the Society represents the interests of the amateur radio movement in the UK". Well, if this is the case, I no longer wish it to represent mine until it reflects amateur radio as a whole. I would need to see far greater numbers of Class B officers and committee members before I agree to let it make decisions on my behalf.

As a case in point, I understand that the RSGB has been given the job (by the Home Office) of distributing and handling applications for Six Metre experimental licences. With a limited number of these available and an ability to look after its own, the RSGB has now taken on the job of a Government department. The Home Office is clearly abdicating its responsibilities in the matter as the licencing authority in the UK. It alone should control the issuing of licences, the writing of conditions, the apprehension of villains, etc.

Once again I should point out that these opinions are my own and do not reflect the magazine, or its contributors, as a whole.

G4JST

RADIO TODAY: Home Office New Wireless Telegraphy Act

There has been a great deal of discussion of late as to the pro's and con's of the Government's intention to 'privatise' British Telecom, but whatever the rights and wrongs of the matter it seems that there may be some very interesting spin-off as far as amateur radio and its associates are concerned. The Home Office has taken the opportunity afforded by the Telecommunications Bill to make a number of amendments to provisions of the existing Wireless Telegraphy Acts. Provisions which, once the Act becomes law, will make life considerably harder for the average radio pirate, whatever his preference as to frequency band.

For a number of years officials of the Radio Interference Service have felt themselves at a disadvantage in attempting to prevent piracy because of the obvious difficulty of obtaining proof sufficient to lay before a magistrate and one of the main objectives of Part V of the Telecommunications Bill is to simplify this task.

New act

The first effect of the new Act will be to render certain offences under the 1949 Wireless Telegraphy Act subject to trial on indictment. That is to say they may be heard in a Crown Court, in which the possible penalties are considerably more severe than those which can be imposed by a magistrate. These offences will include *'Sending false or misleading messages likely to prejudice the efficiency of any safety of life service'* and *'Using any apparatus for the purpose of interfering with wireless telegraphy'*. While this will have the effect of increasing the maximum penalties for these offences the Bill also contains a clause which states that the new penalties will not apply to any offence committed before the Bill becomes law, which is understood to be sometime during late 1983.

From that date the Act will empower the police to arrest anyone who has committed any indictable offence under the 1949 Act, or who is suspected of having committed such an offence, provided that there are grounds for believing that there may be some difficulty in serving a summons. Other offences which might lead to an arrest will include those under section 1(1) of the 1949 Act which deals with installation and use *'otherwise than under and in accordance with a wireless telegraphy licence'* of any apparatus *'designed or adapted for emission'*. Perhaps this power will be invoked against the squeakies and others whose sole pleasure in life seems to stem from disrupting repeater operation.

Illegal equipment

In the past, the market has always been willing and able to supply a large variety of rigs designed to operate on frequencies for which no licence was available. The Telecommunication Bill seeks to reduce their use in a number of ways. In addition to the present ban on manufacture and importation of certain transceivers, the Home Secretary will be empowered to create a Statutory Instrument prohibiting the *'selling or offering for sale, letting on hire or offering to let on hire, or indication (whether by display of the apparatus or by any form of advertisement) one's willingness to sell or let on hire'*. The provisions of such an order need not be confined to transceivers but may also include *'any apparatus designed or adapted for use in connection with wireless telegraphy apparatus'*. It is expected, for instance, that this provision will be used to prevent the proliferation of power amplifiers outside the amateur bands, though the Home Office states clearly that no decision has yet been taken as to the types of equipment which will fall within the scope of any such order.

Piracy

Piracy, even within licensed bands, may prove an expensive pastime in future, as the Bill also increases the powers of the Radio Interference Service by creating the right to obtain a warrant authorising the seizure of any equipment which has been installed or used without a licence, or for the purpose of interfering with wireless telegraphy. Such a warrant would also permit entry to and search of any specified premises upon which offences against the relevant Acts are believed to have taken place.

Once seized under the terms of such a warrant, any equipment may then be detained for use as evidence for a period of six months from the date of seizure. If the apparatus is considered to fall within a restricted classification then an application for its permanent forfeiture may be made to a Justice of the Peace within this six month period. The grant of a forfeiture order will render the apparatus involved the property of the Secretary of State.

Anyone attempting to prevent the seizure of equipment under the terms of a warrant will be liable to arrest without the need for a further warrant. The right of appeal against forfeiture of any apparatus is written into the Bill and the Secretary of State will have the right to summon witnesses in the event of such appeal.

The full provisions of the Bill will apply to England, Wales and Northern Ireland but it appears that certain dissimilarities between English and Scottish law will need to be catered for separately. A very lengthy document, Part V of the Bill is not recommended for bedtime reading since it goes into considerable detail about such matters as how the Secretary of State may dispose of seized equipment, as well as an almost incomprehensible explanation of the fact that certain categories of equipment will be liable to forfeiture under the 1967 Act following a conviction under the 1949 Act.

No consultation

The result of a single sentence, buried deep within the text of the new Bill, is to remove the statutory duty of the Home Office to consult an advisory committee on interference with Wireless telegraphy. It seems that the last occasion on which such a committee was consulted was immediately prior to the legislation of CB, though scant regard appears to have been taken of its advice.

Clearly some of the provisions of the Telecommunications Bill represent a major change in the way that offences under the various Wireless Telegraphy Acts will be treated in the future. Trial on indictment is a very difficult matter to trial in a magistrate's court. The maximum possible fine is considerably higher, while the most severe penalty imposable could include a two year prison sentence as well as a fine. Of course it remains to be seen whether the new law will be any easier to enforce than were the previous provisions and the possibility of more frequent examination of amateur licences once more raises the question of whether a more durable and less bulky form of licence will be issued. Remember that receipts for licence renewal are, at present, only issued on request and I, for one, am rather dubious about the average policeman's willingness to accept the validity of a licence which appears to be out of date. Neither do I fancy my chances of offering a credible explanation of its validity to a sceptical desk sergeant as he turns the key of my cell. I wonder if they allow handhelds in Wormwood Scrubs? G4PZA

The official Home Office view

The Telecommunications Bill, published recently, includes provisions amending the Wireless Telegraphy Acts 1949 and 1967. Their purpose is two-fold: to rationalise and update the penalties for wireless telegraphy offences; and to introduce new powers to enable more effective enforcement of the law.

The provisions include:

— powers for the police or persons authorised by the Secretary of State (members of the Radio Interference Service) to seize apparatus for the purpose of proceedings;
— a limited power of arrest without warrant for the police in cases involving the illegal use of radio transmitters; and
— powers for the Secretary of State to control the sale and possession of specified wireless telegraphy equipment.

The opportunity has also been taken to implement the Government's decision, taken as a result of a review of "quangos" two years ago, to abolish the Advisory Committee on Radio Interference.

Controls on sale and possession

To reduce or prevent interference, the Secretary of State has powers at present to prohibit by order the manufacture and importation of specified equipment except with his authority. But he does not have powers — which the provisions will give him — to control the sale and possession of such apparatus. This will help control further the availability of illicit C.B. equipment; at the moment, about 1000 complaints a week concerning interference to domestic T.V. and radio caused by illegal C.B. are received by the Radio Interference Service (R.I.S.).

Seizure and forfeiture of apparatus

The proposed powers of seizure will include a provision enabling the police or the R.I.S. to apply to the court by way of a civil procedure for the forfeiture of apparatus illegally possessed. This would give an alternative to prosecution where it appears that nothing useful would be achieved by seeking a criminal conviction. This might be, for example, where a person accepts that he should not have had the apparatus in question and does not appear to be deliberately flouting the law.

Penalties

The provisions in the Telecommunications Bill do not increase penalties for existing offences (other than for two which are made triable-either-way). However, one effect of the Criminal Justice Act 1982 will be to raise the maximum fine for the unlicensed use of a transmitter from £400 to £1000.

Advisory Committee on Radio Interference

The Advisory Committee on Radio Interference was established under section 9 of the Wireless Telegraphy Act 1949. Under the Act, the committee must be consulted about proposals to make statutory regulations on the control of radio interference. It is not a standing body, but when the Secretary of State needs to consult it, members are appointed from nominations provided by the Institution of Electrical Engineers.

NEW RADIO RALLY FOR SOUTH OF ENGLAND

Radio amateurs in London and the Home Counties are to get their own show. This major new event in the rally calendar will take place at the Park Recreation Centre, Horsham, Sussex on Sunday, April 17.

The SOUTHERN HAM RADIO SHOW, sponsored by Ham Radio Today, in association with Corinthian Exhibitions should provide all the interest and attractions of the old Ally Pally show, greatly lamented with its passing to the NEC up in Birmingham. The organisers already report a great deal of interest in supporting this venue, largely, they claim, because the South of the country no longer has its own event.

Visitors to Horsham should find all the old favourites such as equipment dealers with the latest gear on display, new and surplus component sales, upwards of six club junk sales - running simultaneously - together with refresments and eating facilities. The Horsham Club is to provide talk-in on S22.

For those who are a bit shakey on geography, Horsham is situated on the A24, roughly 40 miles out from the centre of London, deep in the heart of Sussex. Unlike all the other major shows, there are no parking problems; the local council has agreed to open up its multi-storey park on the Sunday at no cost to show visitors.

NOTE TO CLUB SECRETARIES If you would like to raise money for your club by operating a junk sale , bring and buy stall, you are very welcome to take advantage of free space being provided by HRT at this show. However, there is only a limited amount available and it will be given on a first come, first served principle. Applications should be addressed to me, Frank Ogden G4JST at our address on the contents page. Alternatively phone 01-437 1002 X251, afternoons only.

All other enquiries concerning the SOUTHERN HAM RADIO SHOW should be addressed to Corinthian Exhibitions, Nyes Hill Estate, Nyes Hill, Wineham Lane, Bolney, Haywards Heath RH17 5SD. Phone 044482-431/636.

YAESU UNVEILS MULTIFUNCTION VHF/UHF MULTIMODE

SMC has announced details of a new multipurpose, multimode VHF transceiver which appears to offer most of the facilities normally associated with HF gear.

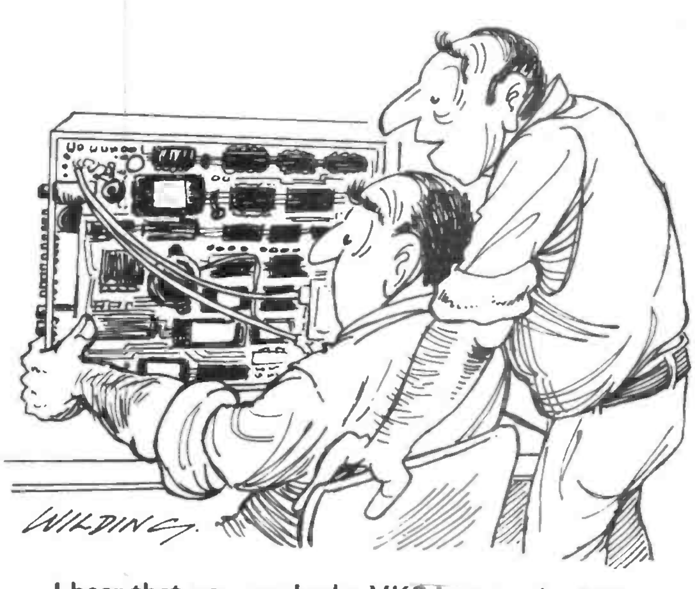
The basic equipment covers the 2m band although add-on options are available for coverage of 70 cms and six metres as well.

It features facilties such as variable IF bandwidth, 20Hz step frequency synthesis, A/B VFOs, etc. The basic transmission and reception modes are SSB, CW and FM.

The company reports that a future option may include an add-on for four metres.

The basic 2m set costs £649, a 70 cm module £208.90 and a six metre board, £157.50.

Further details from SMC on 0703-867333.



I hear that you worked a VK3 just on the RFI

A low cost DSB/CW Transceiver for 80m

By Frank Ogden G4JST and Tony Bailey G3WPO

Question. How do you make a phone/CW HF transceiver for less than £50 complete? The answer is to use direct conversion with a single band, QRP design. By definition, the technique results in double sideband rather than single sideband emissions. However, once the receiving station has tuned to the correct sideband, the signal from this set is indistinguishable from normal SSB.

One may consider that the transmission of an extra sideband is wasteful of spectrum space. Yes, but it must be kept in context. We intended this design for two specific applications. The basic rig is for 80m only (although it is easy to adapt to other bands). During the day the band is relatively dead and good for local chit-chat only. Apart from the various old groaners' nets on a Sunday morning and television line timebase whistles for the rest of the daylight hours, there's plenty of room available for everyone including those with an extra sideband. After dark, you would never stand a chance running QRP phone on 80m so the question of two sidebands doesn't apply. However nightime QRP CW operation is a distinct and interesting possibility and our design is excellent in this mode.

Multimode operation

The transceiver is cheap and simple although the performance is out of all proportion to the cost. The transmitted audio has a clarity exceeding that of most commercial rigs, possibily because there are so few audio stages to distort — there is just one transistor before the double balanced mixer — and also because the TX uses a power MOSFET output stage which, at the 4W PEP level of this design, is exceedingly linear.

The receiver is as sensitive as any commercial unit and, due to the direct conversion DBM technique without RF amplification, the strong signal performance possibly better. There are two inescapable drawbacks though. The reception bandwidth is defined by the bandwidth of the audio amplifier, a parameter which can never be as closely defined as is possible with a crystal filter arrangement. Furthermore it is sensitive to both upper and lower sidbands. This means that the reception bandwidth is at least double that of a conventional SSB receiver. As designed, the same bandwidth also applies in the CW mode. However it would be quite feasible to add narrow bandwidth AF filtering at a later stage. The other disadvantage is that it is almost impossible to add AGC to a direct conversion set.

To make the transceiver easier to operate in CW mode, an incremental tune feature shifts the TX frequency about 800Hz LF of the RX frequency making operation of this direct conversion design compatible with conventional equipment. Direct conversion requires a frequency difference between the VFO/local oscillator and received signal. However the VFO/LO is the transmit frequency and the normal receiving station will be tuned to this, transmitting the same frequency on return. This would produce no output in a normal direct conversion set. However this design adds a few exra pF on the VFO in the transmit mode so that the return transmission will be correctly placed in the receiver passband.

Direct conversion

In its most basic form, a standard receiver or transceiver mixes a VFO output with the incoming (or outgoing) signal to produce a difference frequency, the IF signal. This is typically 9MHz or 10.7MHz. All subsequent signal processing or amplification is carried out a this one frequency. Eventually it will be remixed with a carrier signal in a product detector to produce an output at AF.

Conversely, in the transmit mode, AF is mixed with an IF CW frequency to produce SSB (or DSB). This is remixed with the VFO/LO to produce the output signal frequency. In a direct conversion set, the IF stage is left out. AF is produced directly by mixing the incoming signal with a VFO/LO running at the signal carrier frequency. The result is an IF of zero, ie the AF modulation frequency. The reverse occurs in transmit. AF mixes with the VFO/LO to produce a DSB RF signal. In the normal case all the amplification would be done at IF. In the direct conversion set, all the amplification (in receive) is done at AF and this section of the equipment has to have a very high gain. Our design incorporates more than 100dB of amplification. Just 10 microvolts of recovered audio produces more than a volt across the loudspeaker.

Circuit description

The heart of the transceiver is the double balanced mixer, DBM1 on the circuit schematic, **Fig. 1.** It comprises three ports: RF, LO and IF. The RF and LO ports are electrically interchangeable. The IF port is used for injecting AF in the transmit direction or recovering AF in the receive mode. We make no apologies for commencing circuit description at the DBM because all the other circuitry is built around it. Tr1 and Tr2, the VFO circuit, drive the LO port with around 10mW in all modes. In receive, signals are coupled to the RF port through the preselector/filter, L4, L5 where they are mixed down to AF by the DBM. Audio, appearing at the IF port, passes through the low pass filter R9, C11 through to the AF pre-amp Tr7, Tr8. This couplet is designed to produce about 70dB of gain, the remainder coming from IC1, the LM380 audio amplifier chip.

The AF pre-amp couplet uses a double ganged volume control, RV2. This is to increase the dynamic range of the receiver. If just a single volume pot where included between Tr8 and IC1, there would be a real chance that the pre-amp circuit may overload on strong signals. If just a single control were included ahead of the AF amplifier as a whole, then strong signals would be as noisy as weak ones!

Transmit mode

In transmit (phone) microphone signals are amplified by Tr5 and applied to the DBM via C27. The diode, D4, serves to isolate the collector resistor, R21, in the receive mode. The input impedance is in th region of 5K ohms. Without any adjustable components, the microphone amplifier/modulator circuitry provides enough RF drive to the PA strip (Tr3, Tr4) with normal close talking. Very insensitive microphones may need further amplification though.

In CW transmit, keying is

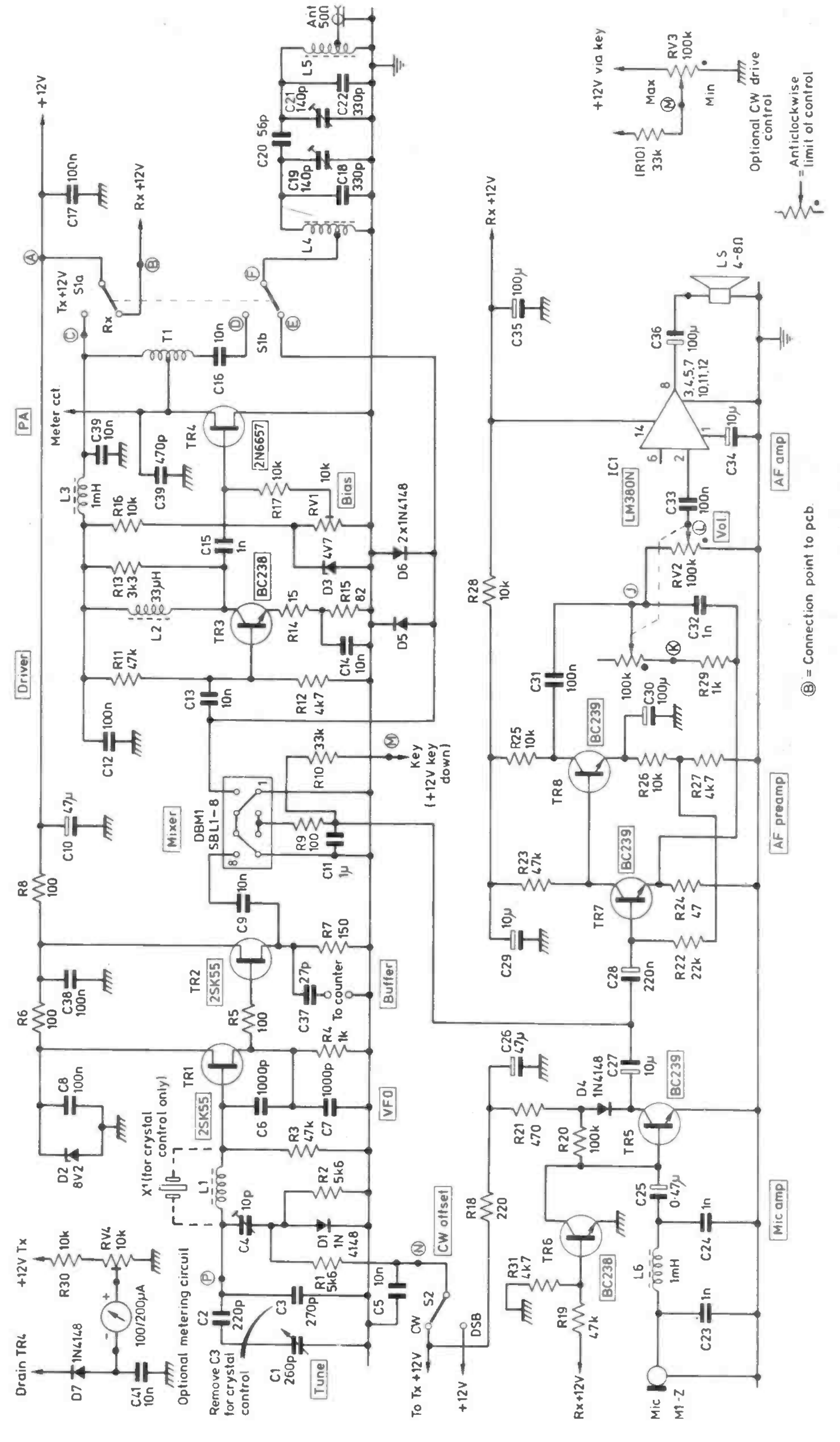


Fig. 1.

achieved by unbalancing the DBM with a small DC current provided by R10, a 33K resistor keyed to the +12V rail. The keying current allows a direct transfer of RF from the VFO/LO direct to the PA strip. As an untried modification, it would be possible to make R10 variable with a much higher nominal value to allow amplitude modulation of the TX if this should be required for any reason. Another modification is to make the +12v keying voltage variable, which will then act as a CW drive control.

The PA strip uses a single bipolar transistor connected as a Class A voltage amplifier coupled to the gate of Tr4, a 2N6657 power MOSFET. Note that the inductance of L2, an RF choke, has been chosen to resonate with the input capacitance of the MOSFET at about 3.6MHz. The bias control RV1 should be set to provide about 100mA of standing current in Tr4. This will rise to around 600mA on key down or speech peaks.

When using the transceiver in the DSB (phone) mode it is important not to drive the output stage too hard if a distortion free output is to be maintained. The optional metering circuit shown in Fig. 1 works by detecting negative voltage swings on the drain of Tr4 which come within a couple of volts of ground. In use, the DSB drive level should just produce a movement on the output meter, but no more. For CW, the output can be wound up as high as it will go.

The MOSFET should see a load of about 12 ohms to develop its 4W of RF at a 12V supply line. Ferrite transformer T1, wound with 2:1 turns ratio, raises the output impedance to the 50 ohms required by the preselector/output filter circuitry. Diodes D5, D6 protect the DBM against high level pulses of RF which can occur at changeover from transmit to receive. Ideally, S1 should be of the break before make type. Many of the small relays and switches are make before break and temporarily connect the transmitter output to the input of the DBM. We discovered this the hard way having ploughed through three devices before the cause of the problem dawned. There have been no more casualties since the diodes were fitted but the correct changeover switch/relay type has to be preferrable.

The MOSFET output stage is

almost totally bomb proof. However, the transceiver will only develop its maximum power when matched into a 50 aerial system or load.

Preselector

The preselector circuit L4, L5 is a symmetrical network designed to handle signals going in both directions. It covers the whole of the 80m band without the need for retuning; the turns ratio and coupling level have been carefully chosen to give a fairly flat top response. However, if a particular part of the band is of interest, for instance the CW end or the top part of the phone band, then the component values could be usefully adjusted to narrow the bandwidth. This action has no bearing on the selectivity of the receiver or its perceived performance, it simply reduces the possibility of swamping from out of band high level broadcast signals or whatever. As an example, the facility could be useful if you lived at a place called Rugby... Remember though that the network has to pass the entire output of the transmitter and that small cores may saturate.

VFO

The design, using the correct cores and capacitor types shown, is very stable maintaining frequency without retuning for the duration of a half-hour QSO. The oscillator circuit of Tr1 will also function with a crystal replacing L1. For reasonable crystal control, you also need to remove C2 and C3 to enable the entire series resonating capacity to reside in C1 which would then become a fine tuning control. The authors envisaged this small transceiver as being ideal for mobile use, particularly with fixed frequency nets. Crystal control, particularly with a switched bank, would be very useful. The preset capacitor, C4, determines the frequency shift on CW transmit. It should be adjusted for about 800Hz increment. Be careful when substituting Tr2, the buffer transistor for an alternative type. A device such as a 2N3819 would not have enough current drive available for the DBM. A 2SK55, with a transconductance of between 5 to 7 mA/V is about the minimum acceptable. A J310 is best of all. Still on the subject of substitution, be wary of using any DBM other than the SBL1-8. Although several other devices including the SBL1 are specified from 1MHz upwards and should therefore be suitable for use at 3.5MHz, performance tends to fall off within an octave of the stated band edge. At 0.1MHz minimum frequency, the SBL1-8 has a particularly good operating margin. Remember too that the balanced nature of the DBM keeps out much of the MW broadcast interference. It is good to have a device which operates as effectively at the interference frequencies as it does at the signal frequency.

Construction

For those of you with little or no experience of printed circuit board construction, this section is fairly important and hence comprehensive. Those more experienced in wielding the soldering iron can probably ignore the next few paragraphs.

To assemble the transceiver board you will need a pair of small sidecutters, 22 swg multicore solder (preferable to 18 swg) and a good earthed soldering iron with a tip diameter of 0.125" or so. If you need to rush out and buy any of these you will be making a good investment for the future.

Components

The majority of the components used are relatively insensitive to heat and handling, except for the PA transistor. Due to its MOS construction, you should avoid handling the pins and preferably work on a well earthed surface. Once it is installed on the pcb it can be treated normally. When soldering, try to achieve a bright joint, and never take the iron to the solder, always having the iron at the joint before the solder is applied.

All of the components mount on the non-track side of the pcb. Note that in certain cases one lead will be soldered to the track on the underside, and the other to the top surface of the pcb, which acts as an earth plane. The layout diagram (**Fig. 3**) shows the latter points as crosses on the appropriate leads. There are also three holes that are soldered on both sides of the pcb using a short length of wire or solder pin through the hole, to bring earth connections through to the top side.

Resistors mount flat against the pcb top surface, except R19, which is vertical. The lead spacing is 10mm, and gently bending the leads of the resistor at right angles to the body will just get this spacing right. Capacitors should mount as close as possible to the pcb, but without deforming the leads where they enter the body. Do not allow components to stand more than 5mm above the pcb surface. The polystyrene capacitors must sit flat against the pcb, and be careful to observe the polarity of electrolytic types. Where the latter need one lead earthed to the top foil, if a radial type then the negative lead will need to be bent out from under the body before insertion. Cut the earthed leads before soldering so that about 5mm remains.

The PCB

The whole of the transceiver is built on one double sided pcb. This

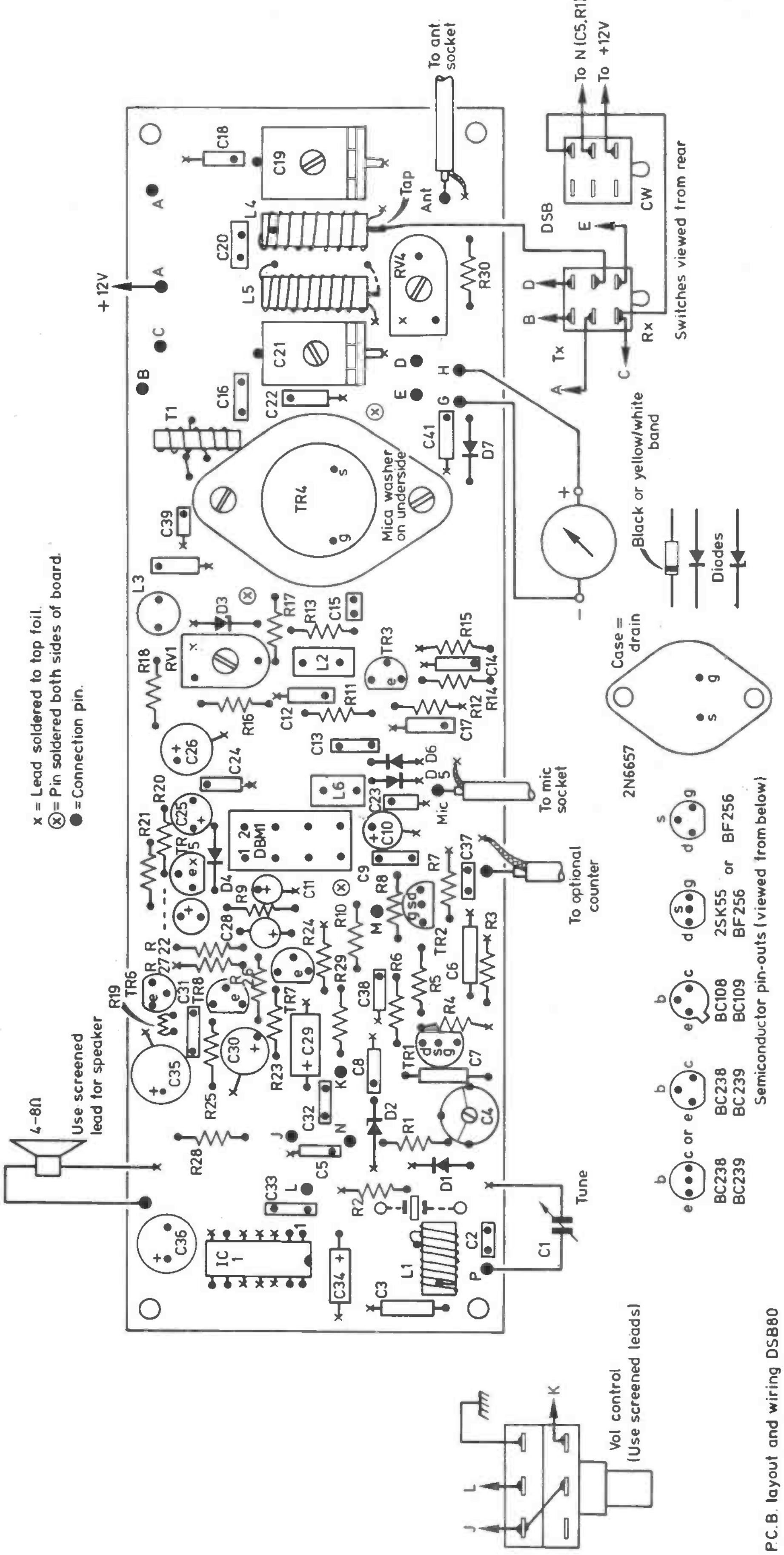


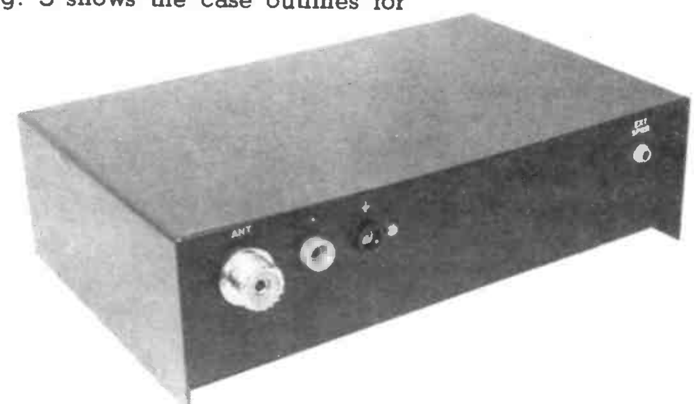
Fig. 3

can be reproduced by any of the normal means from hand copying to photographic. If you want to avoid making it yourself then a ready made one is available. See note at end of article.

Getting started...

Firstly if you have bought the kit, check the pcb for any solder bridges or whiskers from the roller tinning process against the master (**Fig. 2**) before commencing soldering.

1. At each of the external connection points marked with a solid black circle, insert a 1mm dia. connection pin from the underside, push hard home and then solder.
2. Next insert all the resistors in numerical order and solder into place, not forgetting to solder to the top where indicated. Rather than inserting both leads through the pcb when one is earthed, you may find it easier to cut the earthed end to about 5mm in length and solder this direct to the top foil with the body lying in the direction indicated by the diagram. If you have any resistors left over, or the last one is the wrong value, then check all the others again!
3. Insert pins into the three holes marked with crossed circles and solder both sides, and also the short link wire just under R21 shown as dotted lines.
4. Now work round the pcb inserting all the fixed value capacitors in numerical order, observing the polarity of electrolytics.
5. Bend the lead adjacent to the raised part of the mica compression trimmer (C19) so that it is nearly parallel to the body. Insert the other lead into its pcb hole and solder both leads so that the underside of the capacitor is just clear of the pcb surface. Repeat with C21.
6. Insert IC1 (LM380N) with pin 1 correctly orientated, solder all pins to the underside, and the 7 pins marked with crosses to the top foil.
7. Insert the double balanced mixer package (DBM1) with pin 1 correctly placed — depending on the mixer used either pin 1 will have a blue coloured bead, or the letter "M" of "MCL" will be above pin 2 (or both). Then solder.
8. Insert RV1 &RV4 presets, soldering into place, not forgetting that one lead of each is soldered to the top foil.
9. Insert and solder L2,3 & 6 chokes.
10. Insert all the diodes ensuring that the band on each aligns correctly with the diagram, then solder.
11. Insert C4 (foil dielectric trimmer) and solder.
12. Insert each of the transistors (except the PA transistor) in turn and solder, making sure that the underside of the body is not more than 5mm above the pcb, and that the case orientation is correct. Note that Fig. 3 shows the case outlines for 2SK55 at TR1/2. If a J310 is used, the case must be turned through 180° as the pin-out is opposite to that shown.
13. Smear a small amount of heat sink compound on one side of the T03 insulating washer for the PA transistor, and place on the pcb aligning the holes with those on the pcb.
14. Now smear a further amount of compound on the top side of the washer, then carefully insert the MOS power transistor into place, avoiding handling the 2 leads.
15. Bolt the transistor into place using 2 x 6.4mm 6BA bolts, inserted from the top, with a plain washer, then shakeproof washer, and finally a nut, on the underside. Tighten up and then solder the leads, cropping off the excess lead afterwards.



Transceiver rear view

Coil winding

It now remains to wind the 4 coils. All of these are wound on toroidal cores, and are not difficult to make. It is suggested you follow these instructions as this will ensure that the various taps end up in the right place to suit the pcb layout! If the VFO is not being used then L1 can be omitted.

1. L1. This consists of 41 turns of 0.56mm enamelled copper wire (all the coils use the same wire) on a T68-2 dust iron toroid (these are 18mm in diameter and partly coloured red). In this case the turns are simply wound through the toroid, avoiding crossed turns (each time the wire goes through the centre counts as one turn). 41 turns will fill the core completely so keep the turns tightly spaced as you proceed. When finished, crop off the excess leads to leave about 10mm of each, and strip about 8mm of insulation off each lead using a knife or other suitable implement. Then insert into the pcb and solder so that the bottom of the coil is resting against the pcb.
2. L4/5. These are both identical and again wound on the T68-2 cores. So that the taps end up in the right place proceed as follows. Take 15 cm of wire and strip 8mm of insulation off one end. Hold the core in your left hand and the stripped end of the wire against the outside. Then insert the other end of the wire through the centre of the core from the back, then over the top, and continue winding in a clockwise direction round the core until seven turns have been made (i.e. the wire has been through the core seven times).

Now take another length of wire, this time 43 cm long, again strip one end, and then twist and solder this to the stripped end already on the core. Again hold the core in your left hand, but with the already wound part to your left, and continue winding another 18 turns onto the core in a clockwise direction round the core. If you have deciphered the instructions correctly, you should end up with 25 turns on the core, tapped at seven turns, with all the winding in the same sense. Now crop the excess leads at each end as before, and strip the ends.

This coil will be L5 — insert the leads into the pcb so that the wire at the end nearest the tap is near RV4. Solder this lead to the top foil, the other end going to the left hole near C20. A short length of wire can now be used to connect the tap to the hole just to the lower right of the coil (shown dotted on diagram). Carefully space out the turns afterwards so that they are evenly distributed around the portion of the core not resting against the pcb.

3. Repeat the above operation with L4 — the only difference is that the tap is not connected to the pcb as it connects direct to the TX/RX switch later.

4. T1. This transformer is wound on a ferrite toroid (grey in colour and 13mm in diameter). Take two lengths of wire 15cm long and strip one end of each as before. Twist the two stripped ends together and solder. Now hold the junction on top the core and wind on six turns in a clockwise direction as before. Turn the core round and carry on with the other half for a further six turns.

Crop to 10mm and strip off 8mm of insulation. Insert the coil into the pcb, solder into place, then connect the tap to the hole just to the left of the coil using a short piece of wire. Again, spread out the turns as evenly as possible.

This completes the assembly of the main pcb. Before continuing, check that all solder joints have been made on both sides of the pcb, and that all semiconductors have been inserted the correct way round.

Alignment

The various components external to the pcb now need wiring in before checking the board and aligning it. Firstly connect up the Tx/Rx switch as shown in **Fig. 3**, using insulated wire, keeping the leads for points D,E and the tap (F) to about 5cm in length, and the remaining leads to about 8cm. Then connect up the DSB/CW switch. The audio gain control should now be wired up as per **Fig. 3**, using screened leads for each connection. A suitable speaker should be wired in, again using screened lead for its connection.

The VFO capacitor has a number of leads, some of which need removing. On one edge there are three leads — crop off these close to the body. On the other edge are five leads. Looking at the capacitor from the rear with the leads at the bottom, remove the two on the left, leaving one long lead and two shorter ones. Solder the long lead to the upper foil of the pcb adjacent to C2, then connect the other two leads together and then to point P, using a short piece of stiff wire. Set the capacitor to mid travel.

A suitable means of monitoring the output power — either a proper power meter or an SWR bridge — should then be inserted in series with the antenna lead, using 50 ohm coaxial cable, terminating in a suitable dummy load (50 ohm) or resonant antenna (the dummy load is preferable for tuning up). Finally, without switching on, connect up a +12v power supply (12- 15v is suitable) with a meter in series with the positive lead for monitoring the current consumption.

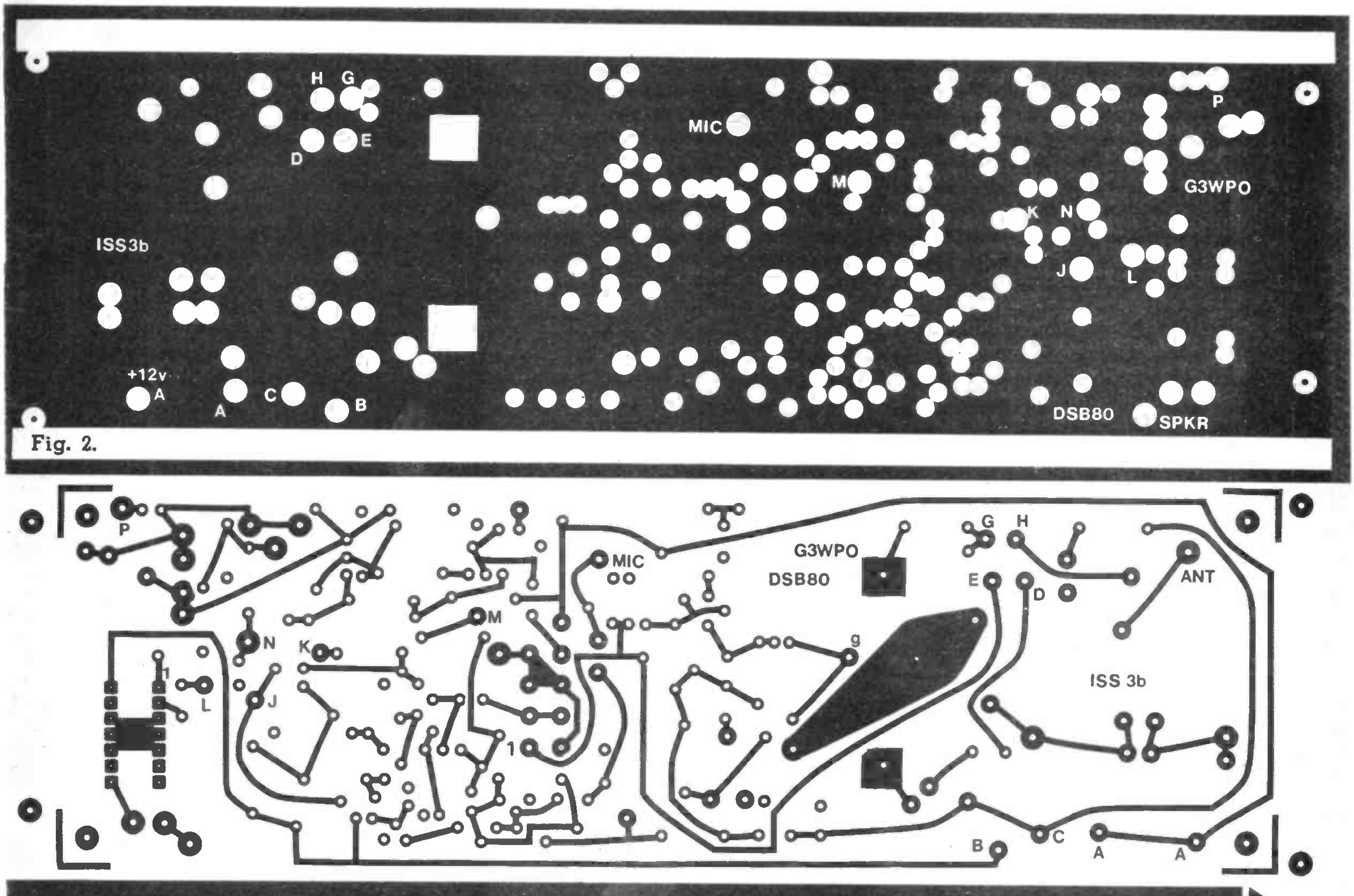
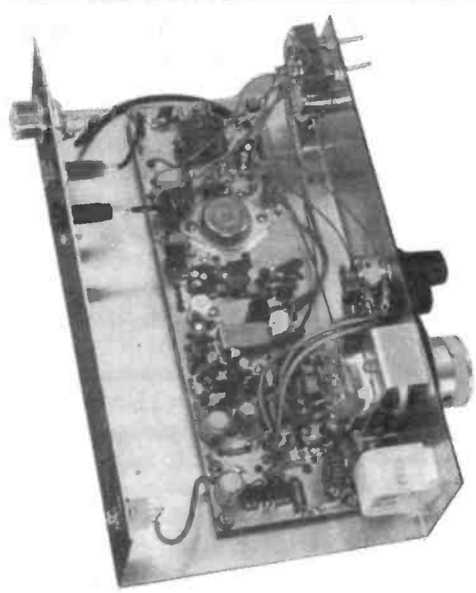


Fig. 2.



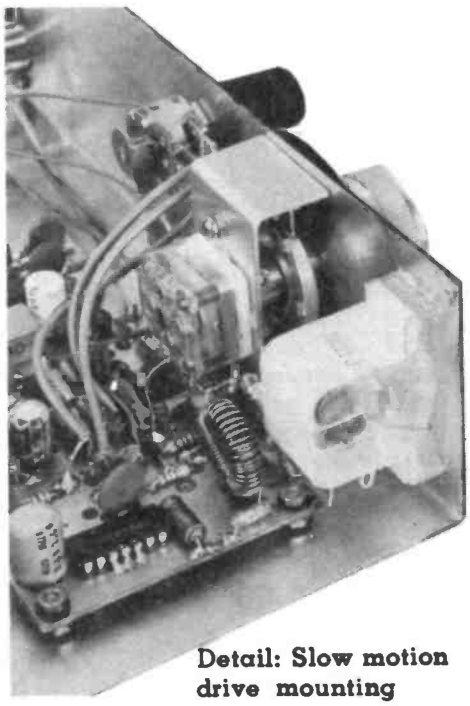
Simple chassis...

Switching on...

The moment has arrived to switch on. Before doing this, preset RV1 and RV4 fully anticlockwise, and the AF gain control also anticlockwise. With the TX/RX switch in the receive position, apply power — the current taken should be in the region of 60mA. If it is a lot more, then switch off and look for shorts, or incorrect component values/positions. If a lot less, or nothing, then there is most likely a missing connection somewhere.

Turning up the volume should give a slight hiss if on dummy load or even some signals if an aerial is connected. Now switch to transmit. The current should be around 50mA — again, if a lot higher or lower then check as for receive. If there appears to be a short circuit, the most likely answer is that the metal case of the PA transistor is shorting to the pcb somewhere.

Noting the current consumption, adjust RV1 carefully until it rises by 100mA, thus setting the standing current of the PA to 100mA. There should be no output showing on your output monitor at present. Now connect point M on the pcb to +12v. The output should increase as this simulates the key-down position on CW. Alternatively adjust C19 & C21 for maximum power output until no further increase is possible — if you can measure the power you should be getting around 3W minimum into the dummy load or aerial. You will find that C19/21 will need to be fairly tightly screwed up when tuned. If resonance appears to occur outside of the range of the capacitors, check that you have the right number of turns on the coils. If there is not quite enough capacity available, then extra capacitors can be soldered across these trimmers if required, but this should be unlikely. You may now want to re-peak the circuits in the portion of the band you are most likely to use.



Detail: Slow motion drive mounting

Disconnecting the lead to point M, and connecting a high impedance microphone to the microphone input should enable you to talk the output power up on double sideband, bearing in mind that normal speech will only peak the meter up to about half the indication given for CW — whistling into the microphone should give the same output. If you can only get a low power output even by whistling, then the microphone is probably unsuitable, or something is adrift around Tr5.

The only remaining task is to check the VFO for coverage, and set the CW offset capacitor. The VFO is of course running at signal frequency, so it can easily be checked on another receiver, or coupled into a frequency counter. Alternatively, a signal generator can be used to provide marker signals. The coverage should be at least 3.5 — 3.8MHz, probably greater. If the lower end of the range is above 3.5MHz, then a small amount of extra capacity should be added across C3 (using a polystyrene type). The bandspread can be adjusted if wanted by changing the value of C2 — decrease to increase the bandspread, but this will also increase the lower frequency at the same time.

To enable the rig to copy CW, the VFO has to be on a slightly lower frequency for transmit than receive, as explained earlier. C4 sets this offset and is adjusted so that the receive frequency, with S2 in the CW position, is about 800Hz higher than in transmit. This can be set using a frequency counter very easily. If you don't have a counter then switching between CW and DSB on S2, while in the receive mode will enable you to set this up by ear on a received signal. The adjustment to C4 should be made while in the DSB position, comparing this to the CW setting.

Then, when working CW, you tune to the high frequency side of the CW signal on receive, to a beat note of about 800Hz, and you will then be correctly tuned for transceive operation with any other stations rig.

Optional meter

In order to monitor the PA for overdriving on DSB, a meter (100-200uA FSD) can be connected between points G & H on the pcb. To set up the meter, apply a potential of +1v to point G while in the receive mode, and then adjust RV4 so that the meter just moves of the stop. Then, when transmitting DSB, do not allow the meter to move off the stop while speaking.

Using CW

To get the rig on CW, the key used needs to apply +12v to point M in the key-down position. A small reed relay may be needed to accomplish this if an electronic keyer is being used. An optional CW drive control can be added as shown in **Fig. 1**, if desired and will enable you to experiment with lower output powers.

Housing the transceiver

The photographs show a simple case that was used for the prototypes, using two U-shaped pieces of aluminium. Any similar enclosure will do, and there are plenty of ready made cases available from various advertisers if you don't want make your own. Alternatively, a ready made case with all the bits for this project is available if you want it from the same source as the kit.

When mounting the pcb, use all four mounting screws, and ensure that the bolts of the PA transistor case do not touch the base of the case.

The only part which may need some explanation is the bracket used for the drive and VFO capacitor. This was used as a means of mounting the capacitor and drive together, such that the body of the capacitor is over C7 on the pcb, and enabling the earthing lead on the capacitor to be soldered to the top foil just to the side of C7. A stiff piece of wire then connects from the other leads to point P. The scale was made by drawing on a piece of card stuck to a circular piece of aluminium screwed to the flange of the drive. For anyone wanting to reproduce the case as shown, the size is 55mm high by 120 deep by 210mm wide. Some space was left in the case for possible add-ons in the future.

There is no reason why an internal speaker should not be used, the prototypes using an external speaker, and this could be mounted on the underside of the lid.

A digital version...

One of the prototypes used a neat little digital readout to give it a state-of-the-art appearance, and get over the problems of the limited calibration available on the normal scale. The frequency meter used is the PCIM 177 module available directly from Ambit International. This type has the advantage of not generating any interference on receive.

This will take an input direct from C37 (use coaxial cable for the connection), when wired as a straight frequency counter, and needs a +5v supply. The latter is best achieved by wiring the output of a 78L05 regulator direct to the +5v input (VDD) connection, decoupling this with a 1uF tantalum capacitor to earth (VSS), also connecting the centre pin of the 78LO5 to VSS. The +12v rail goes direct to the input of the 78L05. Points S3,S4 & AM/FM should be connected to VDD (+5v), with all other pads left unconnected.

A bezel (type BEZ-10) was used to mount the display by affixing it to the back using cyanoacrylate adhesive, after cutting a suitable clearance hole for the bezel in the front panel. If the bezel is not available, an aperture just large enough to view the display through would need to be cut in the panel.

Kit of parts

A complete author designed and approved kit of parts, including PCB, is available for this project. Please see advert on p63 for further details.

COMPONENTS LIST

R1, 2	5k6
R3, 11, 19, 23	47k
R4, 29	1k
R5, 6, 8, 9	100R
R7	150R
R10	33k
R12, 27, 31	4k7
R13	3k3
R14	15R
R15	82R
R16, 17, 25, 26, 28, 30	10k
R18	220R
R20	100k
R21	470R
R22	22k
R24	47R
RV1, 4	10k 10mm horizontal preset
RV2	100k+ 100k dual linear pot.
RV3	22k or 47k or 100k lin pot.
C1	266pF polyvaricon variable
C2	220pF ceramic plaquette
C3	270pF polystyrene
C4	10pF 7.5mm film dielectric trimmer
C5, 9, 13, 14, 16, 34, 40, 41	10n ceramic disc
C6, 7	1000pF polystyrene
C8,12,17,31,33,38	100n ceramic disc
C10, 26	47uF 16v axial lead electro
C11	1uF 16v electrolytic
C15, 23, 24, 32	1n ceramic disc
C18, 22	330pF ceramic plaquette
C19, 21	140pF mica compression trimmer
C20	56pF ceramic plaquette
C25	0.47uF 16v radial electro
C27, 29, 34	10uF 16v axial lead electro
C28	220n 16v radial electro
C30, 35, 36	100uF 16v radial electro
C37	27pF ceramic plaquette
C39	470pF ceramic plaquette
TR1	2SK55, BF256
TR2	2SK55, J310
TR3, 6	BC108, BC238
TR4	2N 66 57
TR5, 7, 8	BC109, BC239
IC1	LM380N
D1, 4, 5, 6, 7	1N4148, 1N914
D2	8v2 400mW Zener diode
D3	4v7 400mW Zener diode
DBM1	SBL1-8, SRA-1
L1	41 turns on Amidon T68-2 dust iron core
L2	TOKO 33uH 7BA RF Choke
L3, 6	TOKO 1mH 7BA or 8RB Choke
L4, 5	25 turns on T68-2 core tapped at 7 turns from earthy end.
T1	12 turns, centre tapped on Fair-Rite ferrite core type 59-61001101
M1 (optional)	100/ 200 uA FSD meter
S1, 2	DPCO miniature toggle
X1 (optional)	3.5 – 3.8MHz HC/ 6-U or HC/ 18-U crystal.

All resistors are 0.25W 5% carbon film.
Coils are wound with 0.56mm dia (24swg) enamelled copper wire.

Also required:

1 6:1 Jackson epicyclic reduction drive with flange.

1 printed circuit board

30cm screened audio cable

150cm 0.56mm enamelled copper wire

Connecting wire.

2x6.4mm 6BA bolts + nuts and lockwashers.

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FDK 750A. Offers VHF operation on FM, SSB, CW. Excellent value for the new operator looking for SSB facility on VHF. Also fitted with dual VFO. The set has the facility to use the optional 'Expander 430' giving full coverage on the 70cms band.

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13 Element portable	£27.25
16 Element fixed	£34.95
17 Element fixed	£34.95
430 MHz	
19 Element	£18.25
19 Element crossed	£31.00
21 Element	£26.00
21 Element ATV	£26.00
144/430 MHz	
9 + 19 Element	£30.00

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A Simple HF Aerial

A loft mounted HF DX system

By Malcolm Healey G3TNO

Having just removed QTH to a house with a small garden, I was stuck with the problem of finding an aerial to use for the HF bands.

A number of aerials were tried including a 132 foot inverted Vee, which was tuned against a number of radials, and dipoles of various types including trapped dipoles and a G5RV. They all were poor for DX working.

After a chat with G3ASG, an old aerial design by W8JK was looked at. It seemed to be ideal in that, the aerial was broad-band with no critical tuning and also had a low angle of radiation.

The W8JK consists of two dipoles side by side, and spaced ⅛ wavelength apart on the lowest band to be used with the two dipoles fed out of phase. The basic W8JK is shown in **Fig 1.** The aerial is fed in the centre using a 300 ohm ribbon or open wire feeder with the feed line to one dipole transposed. The whole array is fed with 300 ohm ribbon or open wire feeder from the shack.

DIMENSIONS FOR 28, 24, 21, 18 and 14MHz USE.

S = 8 feet

L = 33 feet

The dimensions can be scaled up for use on other bands. I have in fact used this aerial on 10 MHz without any changes of dimensions. But for 7MHz use

S = 16 feet

L = 66 feet

Consider the polar diagram of a free space half wave dipole veiwed end on as in **Fig 2**.

It shows that the RF field is circular about the dipole and that the aerial will radiate at all angles, ie both high and low angles equally well.

However, few if any, amateurs

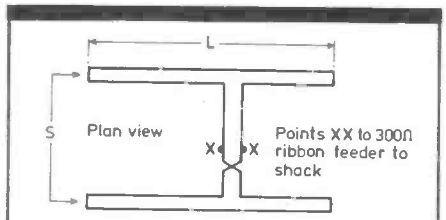


FIG. 1 Basic W8 JK

can erect an aerial at a height great enough to be considered 'free space', and in most installations, the polar diagram is likely to look more like **Fig 3.** This is due to the effect of the earth's surface, beneath the aerial reflecting signals upward, causing the angle of radiation for

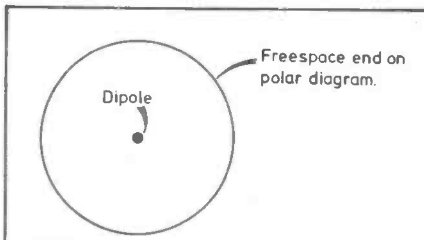


FIG. 2

the majority of power to be raised to far higher values than the optimum for DX working.

The half wave dipole either in a free-space or at most resonable heights always exhibits the expected figure of eight polar diagram at right angles to the direction of the wire, **(Fig 4).**

High angle radiation (as in **Fig 3**)is undesirable because, if the signal hits the reflecting layers of the ionosphere at high angles, the signal will in the main be reflected at equally high angles or not be reflected at all **(Fig 5)**.

In **Fig 6** a signal is shown leav-

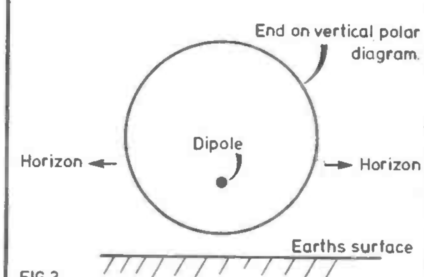


FIG.3

ing the aerial at very low angles and returning to earth also at a low angle many thousands of miles away.

The W8JK dipoles are fed in opposite phase. The effect of this is to cancel the radiation above and

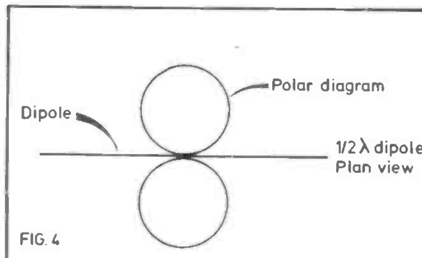


FIG. 4

below the aerial almost completely, due to the fact that the fields from the two dipoles are in the opposite phase to each other. In the horizontal direction this phase cancelling does not occur. This is due to the time the signal takes to travel from one dipole to the other. Thus signals in a plane will no longer be out of phase, ie the fields will add.

Fig 7 shows a W8JK end on view polar plot with its much reduced level of signal radiated in a vertical direction. Thus not wasting precious watts in putting large signals into Europe when trying to work longer distances.

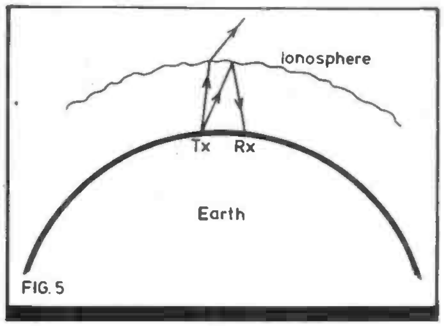


FIG. 5

I decided that 14MHz was the lowest frequency for which the W8JK would be used. My version of the aerial was produced to fit in the loft space of my house, the basic material being 300 ohm ribbon throughout. First of all, two folded dipoles of identical dimensions were produced as per **Fig 8** and lightly tacked to the roof bearers as in **Fig 9.** The ribbon feeder folded dipoles were positioned on the bearers so that the distance between them was exactly 8′.

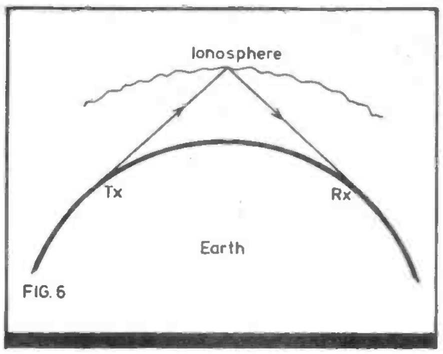


FIG. 6

The phasing harness to the dipoles was another piece of feeder exactly 8′ long, with the insulation removed at the precise centre point. The tinned end of the harness were then connected to the dipoles with a half twist being given to one side of the harness to obtain the phase reversal fundamental to the operation of the aerial. The ribbon feeder to the shack was then connected to the bared centre point of the phasing harness, and the other end connected to a balanced output aerial tuning unit in the shack.

The rig and ATU were tuned to 20 metres and a number of CW DX contacts made. Comparisons with an outdoor G5RV inverted vee whose apex was at 35 feet, demonstrated that DX contact signals both in and out were always better on the W8JK.

After a period of weeks, I had another chat with G3ASG and we discussed the possibility of delaying the signals to one dipole to give the array some directivity.

The aerial was modified to the form shown in **Fig 10** and the switching unit in **Fig 11** built. The only critical part of the switching unit is the delay line. This had to be cut so that the phase delay equalled the space delay caused by the dipoles being 8 feet apart.

A length of ribbon feeder 8 feet long was cut, and a temporary 1 turn coupling link soldered to one end as shown in **Fig 12.**

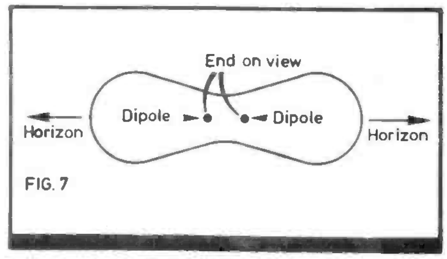


FIG. 7

The One Turn link was offered up to a GDO and resonance at 28MHz looked for. Due to the veloci-

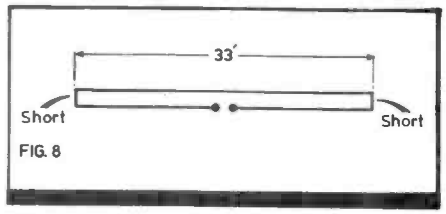


FIG. 8

TABLE 1

SWITCH SW1	POSITIONS SW2	CONDITION	PERFORMANCE	POLAR DIAGRAM
1	1	DIPOLE 2 FED FEED TO DIPOLE 1 SHORTED	LOW-MEDIUM ANGLE	A
2	1	DIPOLE 1 FED FEED TO DIPOLE 2 SHORTED	AS ABOVE	AS ABOVE BUT POLAR DIAGRAM ROTATED 180°
1	2	BOTH DIPOLES FED IN PHASE	BEST FOR HIGH ANGLE	B
2	2	AS ABOVE	AS ABOVE	AS ABOVE
1	3	BOTH DIPOLES FED OUT OF PHASE (W8JK)	LOW ANGLE BI-DIRECTIONAL	C
2	3	AS ABOVE	AS ABOVE	AS ABOVE
1	4	BOTH DIPOLES IN PHASE WITH DELAY TO ONE	HIGH ANGLE SLIGHTLY DIRECTIONAL	D
2	4	AS ABOVE	AS ABOVE	AS ABOVE. MAJOR/MINOR LOBES REVERSED
1	5	BOTH DIPOLES OUT OF PHASE WITH DELAY TO ONE	LOW ANGLE CARDOID	E
2	5	AS ABOVE	AS ABOVE	AS ABOVE. MAJOR LOBE IN REVERSE DIRECTION
1 2	6 6	EITHER DIPOLE FED (DEPENDS ON SW1) THE OTHER BEING O/C	MEDIUM/HIGH ANGLE	F

Polar plot diagram over page

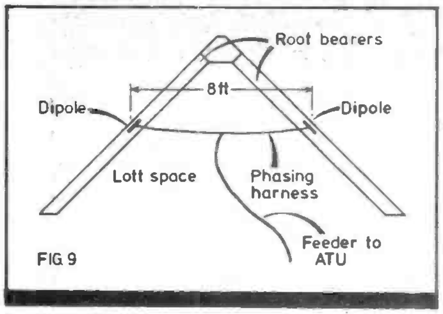


FIG 9

ty factor of 300 ohm ribbon this was in fact well LF of 28MHz. The delay line was then coiled up (approx 6" diameter). The whole coiled line was held firm with nylon lacing cord. The delay line was again checked for a dip at 28MHz. The 1 turn link was removed, all 4 wires of the delay line tinned, and connected to the aerial switch as in **Fig 13.**

NOTE: The numbering at the ends of the delay line in fig 13 refer to the switch positions and wafer identification in Fig 11.

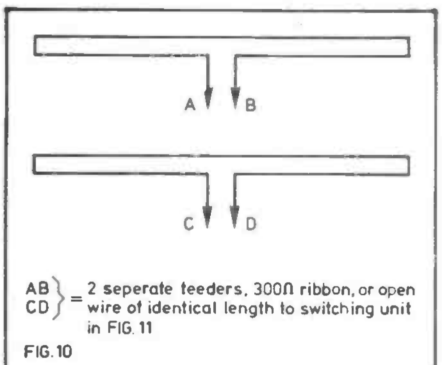


FIG. 10

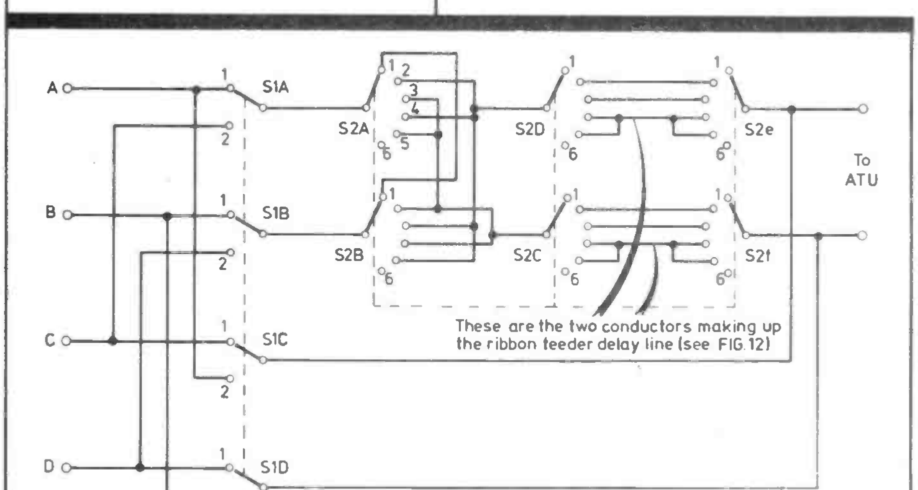


FIG. 11

The aerial, feeders, aerial switch were then connected as in **Fig 14**.

The whole set-up was again tuned to 20 metres, and a period of time spent just listening to incoming signals, while trying the various

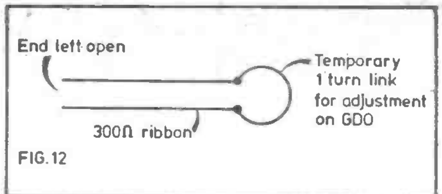


FIG. 12

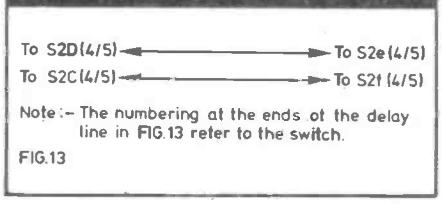


FIG.13

combinations of S1 and S2 on the aerial switching unit and comparing the results with the G5RV dipole. It

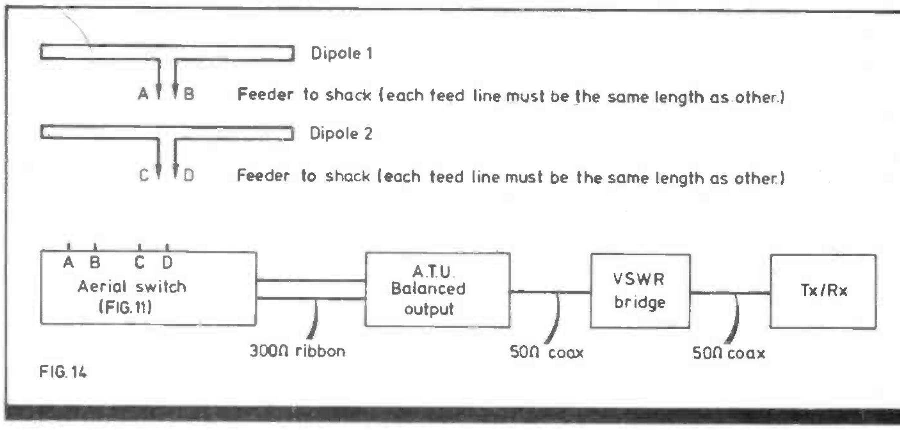


FIG. 14

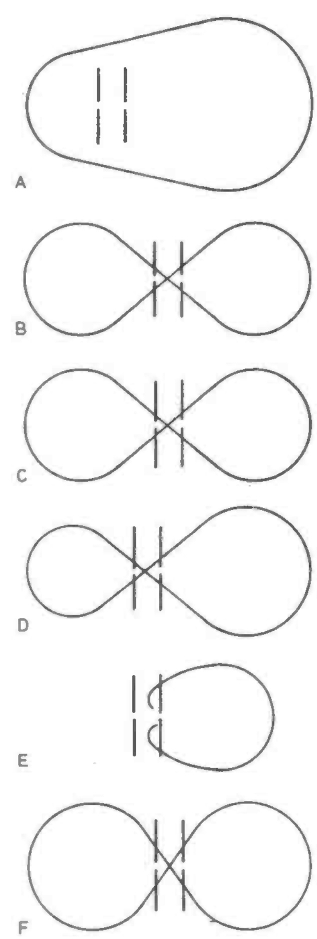
all appears to work much according to plan, and a number of DX contacts have been made on 10, 15, 20 metres.

It is very interesting to observe the attenuation of short skip signals in antiphase switch positions; conversely, the same signals come in much louder when the dipoles are run in phase or with one open circuit.

Also the directional properties are quite apparent when using switch positions giving delay to one or the other of the dipoles. **Table 1** gives an idea of the results to be expected from the completed aerial.

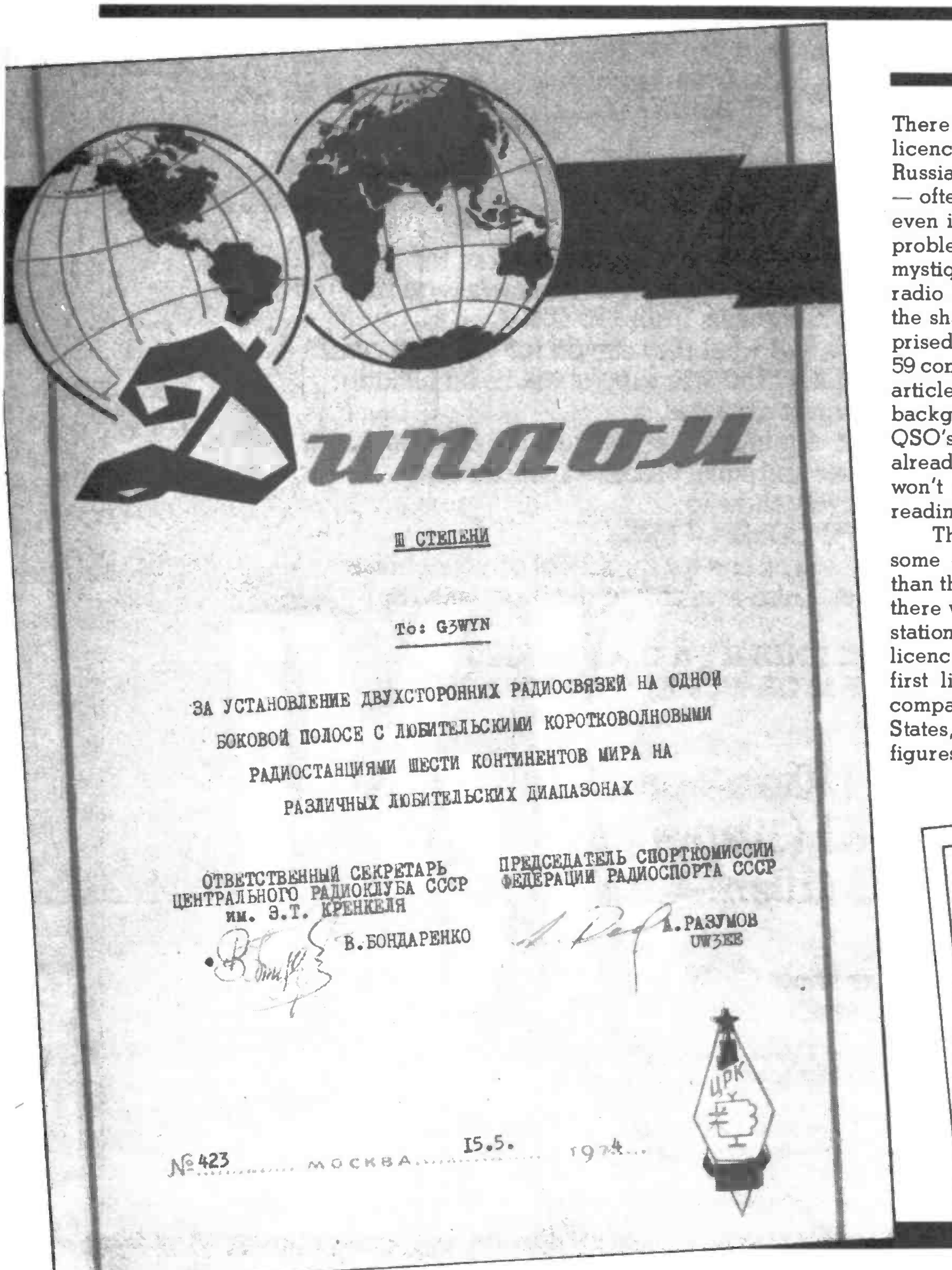
From observations it would appear that the array can give up to 3-4 'S' points front to back ratio, and at times appears even more

I have used the aerial as described since January 1982 but while I would not claim it to be as good as my old tri-band Quad at 50 feet at a previous QTH, it has enabled me to work a lot of DX from a most unpromising QTH.



Amateur Radio in RUSSIA

By Tony Bailey
G3WPO.


Диплом

III СТЕПЕНИ

To: G3WYN

ЗА УСТАНОВЛЕНИЕ ДВУХСТОРОННИХ РАДИОСВЯЗЕЙ НА ОДНОЙ БОКОВОЙ ПОЛОСЕ С ЛЮБИТЕЛЬСКИМИ КОРОТКОВОЛНОВЫМИ РАДИОСТАНЦИЯМИ ШЕСТИ КОНТИНЕНТОВ МИРА НА РАЗЛИЧНЫХ ЛЮБИТЕЛЬСКИХ ДИАПАЗОНАХ

ОТВЕТСТВЕННЫЙ СЕКРЕТАРЬ ЦЕНТРАЛЬНОГО РАДИОКЛУБА СССР им. Э.Т. КРЕНКЕЛЯ
В.БОНДАРЕНКО

ПРЕДСЕДАТЕЛЬ СПОРТКОМИССИИ ФЕДЕРАЦИИ РАДИОСПОРТА СССР
А.РАЗУМОВ
UW3EE

ЦРК

№423 МОСКВА 15.5. 1974

There must be very few Class A licencees who have not worked a Russian station at some time or other — often very difficult to escape this, even if you try! Due to the political problems, there seems to be some mystique attached to their amateur radio activities. Non-ham visitors to the shack are likely to be more surprised at a QSO with a UA, than a 59 contact with Australia. This short article attempts to give you a bit of background, culled from many QSO's and information which has already been in print. Hopefully you won't be quite so in the dark after reading this.

The number of licencees causes some debate with estimates higher than that of the USA. In fact, in 1981 there were just over 30,000 amateur stations, split between individual licencees and club stations, with the first licences issued in 1927. This compares with over 400,000 in the States, and 25,000 in the UK (1981 figures).

In addition to the actual licenced stations, some 100,000 plus SWL's are allowed to operate the Club stations giving the impression that with all the Club activity the majority of stations are of the Club type. They in fact constitute less than 15% of the total.

The international Call Books list around 20,000 Russian calls. As most of you will know, all QSL's have to go via P.O. Box 88, Moscow, which is the address of the Central Radio Club. Consquently, the Call Books only list the actual Oblast in which the amateur lives.

Russian Call Areas

Table 1 lists the existing call areas. For European USSR, stations are located in Zones 15, 16 & 21, and for Asia, Zones 17, 18 & 19, of which the later is the rarest in terms of working from the UK. By taking the callsign number, plus the 1st serial letter of the call suffix (i.e. the 3A from UK3AAN), you have a means of discovering exactly where the station is located, as this gives the Oblast (in the example, Moscow City itself).

There are a number of licence classes in the USSR, the first of which is the 'Novice', aged 14 and up, and who are allowed to operate in the 1850-1950kHz portion of Top Band. All modes may be used, but power input must not exceed 5 watts, and they are limited to working their fellow countrymen only. If you listen carefully on 160M you may hear the prefix EZ, which belongs to these novices.

At the age of 16, application may be made to upgrade to the VHF

TABLE 1

UA, UK, UN, UV, UW, UZ, RA — 1,3,4,6	European RSFSR
UA2, UK2F, RA2	Kaliningradsk
UC2:UK2A,C,I,L,O,S,W:RC2	White RSSR
UP2:UK2B,P:RP2	Lithuania
UQ2:UK2G,Q:RQ2	Latvia
UR2:UK2R,T:RR2	Estonia
UB5, UK5A-N & P-Z, UT5, UY5, RB5	Ukraine
UO5, UK50, RO5	Moldavia
UD6:UK6C,D,K:RD6	Azerbaijan
UF6, UK6F,O,Q,V:RF6	Georgia
UG6, UK6G, RG6	Armenia
UL7, UK7, RL7	Kazakh
UH8, UK8H, RH8	Turkoman
UI8, UK8, RI8	Uzbek
UJ8, UK8J,R:RJ8	Tadzhik
UM8, UK8M,N:RM8	Kirghiz
UA, UK, UV, UW, RA — 9 & 0	Asiatic RSFSR
Also	
UA1 (Antarctica)	Franz Josef Land

licence. As with our Class B licence, operation is 144MHz up, but also with 10 metres and Top Band operation allowed. The prefix used is 'R, and these calls will be familiar to 10 metre operators. There are a number of grades within the VHF licence, which permit varying powers to be used.

The full Shortwave licence requires the knowledge of Morse code, and allows use of all bands and all modes, except RTTY, for which special permission has to be obtained. Again, there are 3 subclasses of the licence, restricting bands and modes. Morse tests and the equivalent of the RAE are held at Regional centres. Full shortwave licence holders use the familiar U prefix.

The SWL's mentioned earlier can operate the club stations, which use the UK prefix. One of the favourite activities is Contests, an activity which is encouraged by the Radio Sports Federation of the USSR, and who work out their own internal contests which are extremely popular.

As with most other countries, the USSR has further callsign blocks allocated by the ITU, the only other the writer can remember being used is 4L1, from the 4JA-4LZ series.

Equipment

As many operator will know, much of the equipment used in the USSR is home brew, with very little of the transceivers we are used to available. The magazine "RADIO" publishes designs, including the Radio 76 and Radio 77 transceivers which many stations use. Contrary to what you may think, some of these designs are very state-of-the-art, with high dynamic range — a contrast to the transmitters which often chirp and buzz around the bottom end of the bands!

Satellites

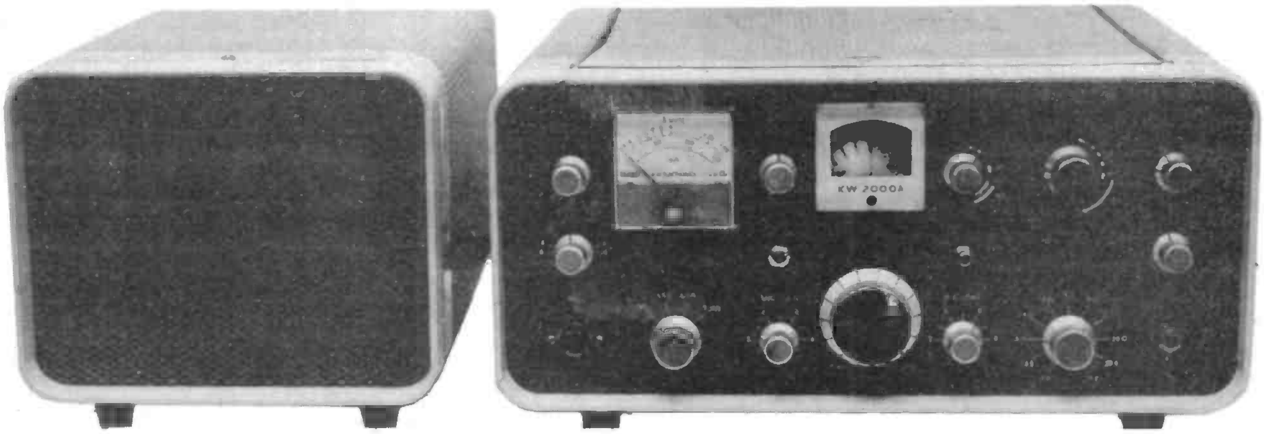
The Russians were first in the satellite field with the Sputnik, and also have their own series of amateur satellites. The first two of these were launched from the Plesetsk site, 475 miles north of Moscow in 1978, and in all 8 have now been launched, their use being similar to the AMSAT series. The latest of these carry ROBOT, and automatic QSO machine and log keeper on board. Automatic announcements along the lines of the AMSAT Codestore are also possible. The method of communicating with these can be found elsewhere, but you need to send good CW, otherwise you won't get very far.

Awards

If you do work a lot of USSR stations, then you can apply for some of the awards available, via P.O. Box 88 of course. These consist of the R-6-K Award, for one contact with each of Europe, Africa, Asia, North and South Americas, Oceania, plus three QSO's with Europan RSFSR, and three with Asiatic RSFSR. Each of these awards is available in three classes, the First class for all contacts on 3.5MHz, Second for 7MHz, and Third for any bands.

The R-100-O Awards is for 100 confirmed QSO's with different Oblasts, and the R-150-S Award for a DXCC type award — 150 countries confirmed plus 15 Soviet Union Republics.

Upgrading the KW2000 series of HF transceivers



Part 3

Alignment procedure

by M.T. Healey, G3TNO
and R. Charles

The previous articles in this series have dealt with the location of faults in the KW2000 series of HF transceivers. If the procedure given has been followed it is likely that the rig will now be working reasonably well. This article describes the procedure to be adopted necessary to realign the transceiver.

Let's start with a caution: In the majority of cases, alignment will probably not be necessary, and if the rig seems to be operating satisfactorily it is best left alone! Having decided to tackle the job, the following tools should be available before beginning:

1. Hexagonal trimming tool, nylon/ plastic.
2. Acetone to dissolve the coil sealing compound (nail varnish remover is suitable).
3. Clear nail varnish to lock to cores.
4. Dummy load — filament lamps

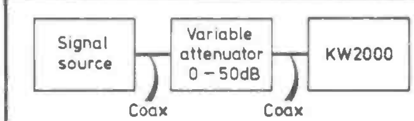


FIG. 1. Typical test set-up for Rx alignment.

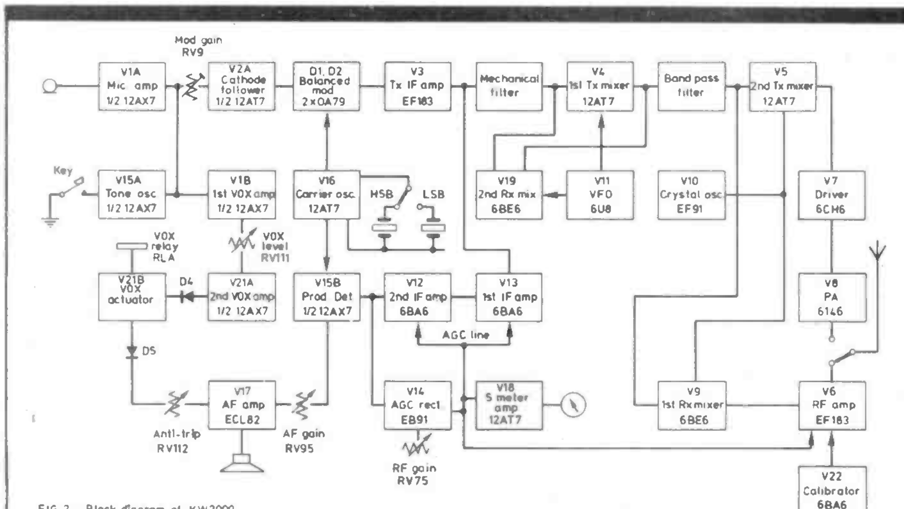


FIG 2 Block diagram of KW2000

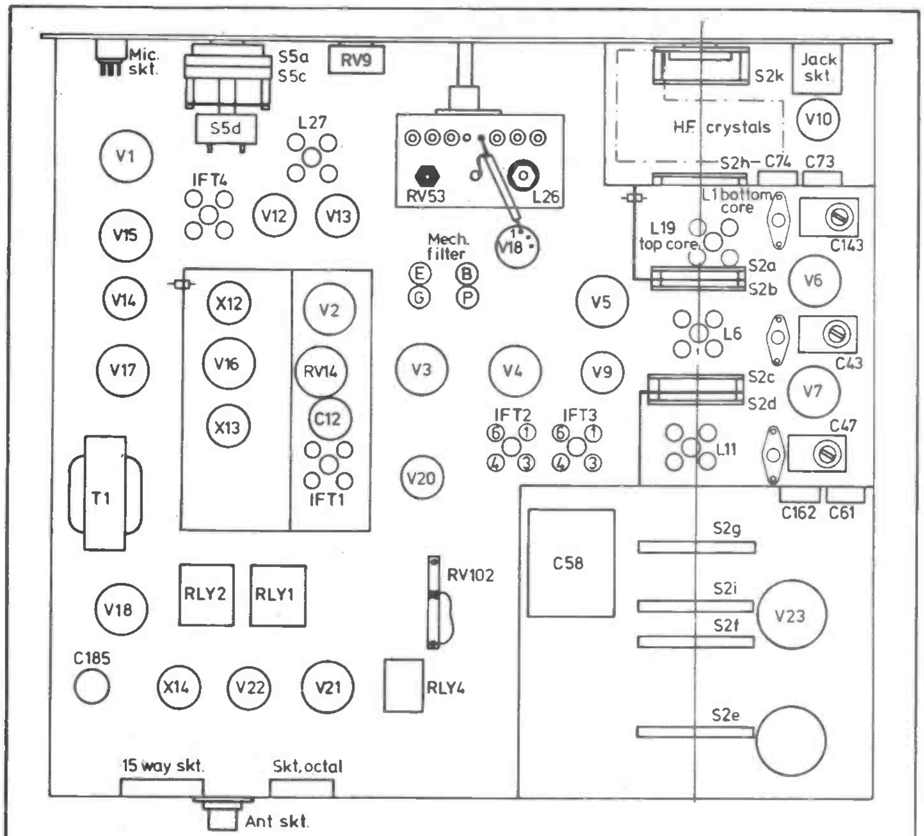


FIG. 3. Component location – below chassis.

should not be used as they are inductive, and their impedance changes with temperature.

5. Means of indicating RF power, eg. 'Thruline' wattmeter or SWR bridge.
6. Swamping tool consisting of a 0.01 uF 400v capacitor in series with a 1k ohm, ½W resistor.

If the rig is a long way out of adjustment the following additional items may be required.

7. Signal generator, or some other means of producing a 455kHz signal.
8. Band edge markers, ie. signals at 1.8MHz, 3.5MHz, etc.
9. Variable attenuator 0-50dB.
10. A general coverage receiver is useful for checking VFO, crystal oscillator frequencies, etc., and also for monitoring the final completed equipment on transmit.
11. RF milivoltmeter with probe.

The following instructions may not all need to be followed. It may be, for example, that the receiver is performing well but the transmitter suffers from low drive on one band only. In this case only part of the procedure need be carried out but **BEWARE!** Adjustments carried out to, say, the 28MHz coils will affect the alignment on 21MHz and, to a lesser extent, on 14MHz, so make sure that adjustments carried out to the alignment on the higher frequency bands have not drastically upset the alignment on the lower bands. The rig should be allowed to warm up for at least 15 minutes before any adjustments are made.

Checking 100kHz calibrator.

Tune a spare receiver (the family portable will do) to the BBC Radio 4 transmission on 200kHz, and place it close to the rear of the KW2000 adjacent to V22 and X14. Press the calibrator button on the KW2000, and adjust the coupling between the external radio and the rig until a satisfactory beat-note is obtained. The lower this is in frequency, the nearer the calibrator is to 100kHz. Adjust C158 to obtain zero beat on the external receiver.

Alignment of 455kHz IF stages

It is assumed that the receiver section of the KW2000 is now working to some degree and showing some signs of life. If it is totally dead, go back to the voltage checks listed earlier, as slight misalignment will not make the receiver totally dead.

The rig should be set up as in **Fig. 1**, with the RF gain at maximum and the AF gain midway. Tune the receiver to a stable signal (the author uses a harmonic of the shack frequency standard), and adjust the tuning so that the signal is in the centre of the passband (see **Fig. 2**). Adjust the core of L27 and the upper and lower cores of IFT4 for maxi-

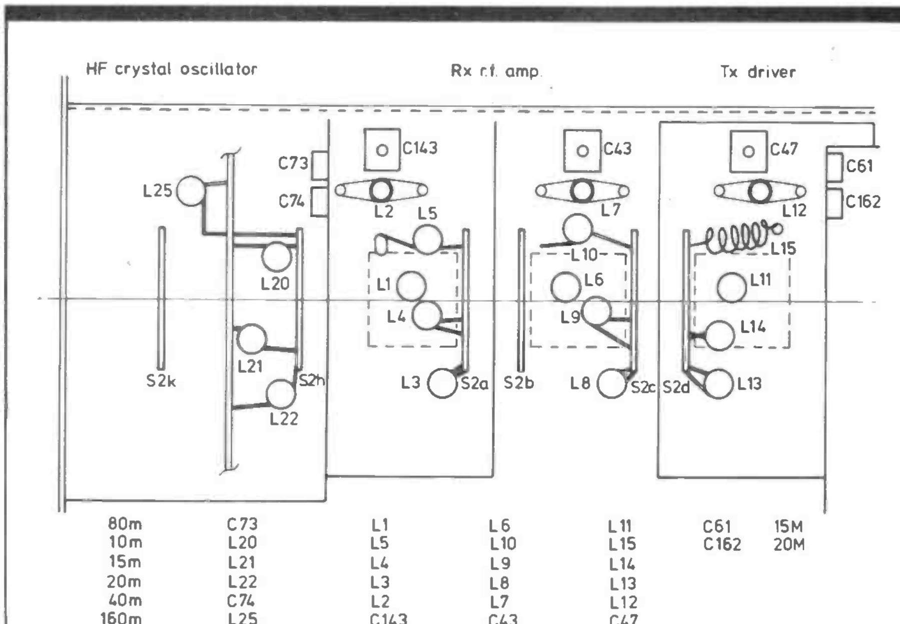


FIG. 4. Location of tuned circuits.

mum S-meter reading, reducing the level of the input signal as the receiver comes into alignment so taht the meter does not read above S5. Repeat these adjustments until no further improvement can be obtained. **Fig. 5** shows the location of the tuned circuits concerned. It is important to use the minimum possible signal level for alignment purposes, since with high levels, the peak of the adjustment may be masked due to AGC action or, in extreme cases, limiting!

If the receiver is a long way out of alignment if may be necessary to inject a 455kHz signal into the input of the second mixer V3 (pin 2) via a 0.01 uF capacitor.

VFO alignment

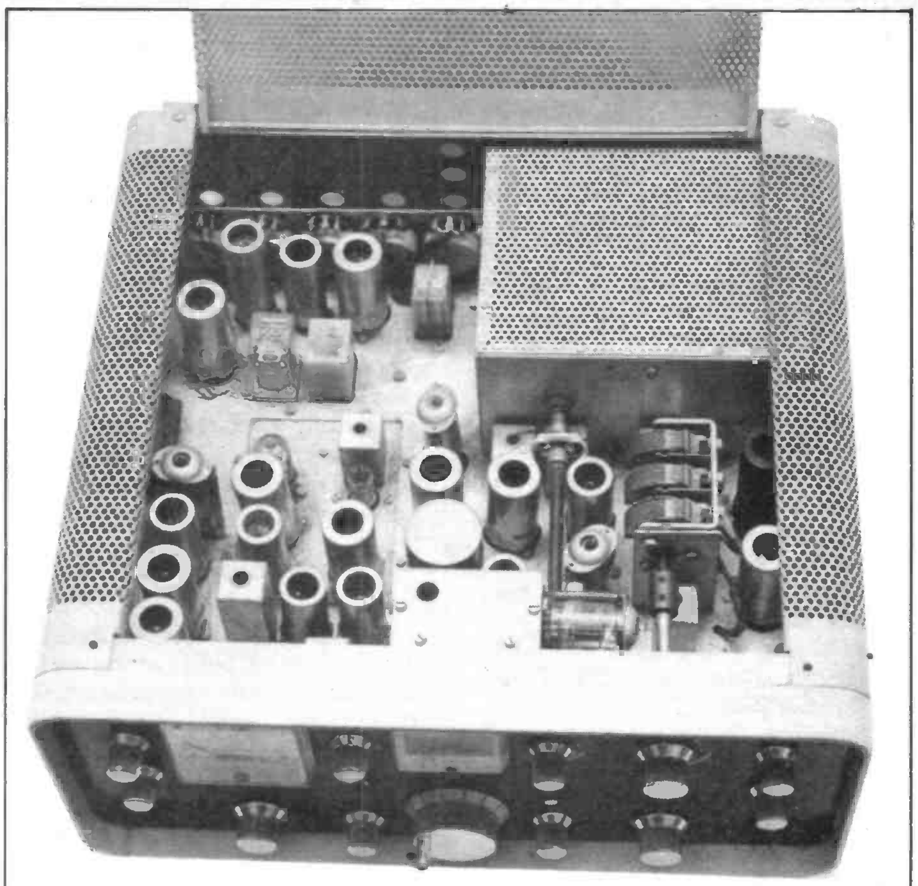
Set the KW2000 to the 3.5-3.7MHz band, tune to 3.5MHz and peak the preselector, using the internal calibrator as a signal source. Ensure that the IRT is turned off. Tune the VFO to 000, 100 and 200 in turn and look for zero beat and accuracy of the dial indication. If errors exist, procede as follows:

1. Set VFO to 000 and switch IRT on. Set IRT tuning accurately to 0.
2. Using an insulated probe (e.g. a knitting needle), adjust C80, which is accessible via a hole in the top of the VFO unit, for zero beat with the calibrator signal.
3. Reset VFO to 200. Adjust the core of L26, which is on the lower side of the VFO, for zero beat with the calibrator signal. See **Fig. 3** for the position of L26.
4. Repeat steps 1 to 3 until the calibration is correct at 000, 100 and 200.
5. Set VFO to 100. Switch IRT off and adjust RV53 for zero beat with the calibrator signal. See **Fig. 3** for position of RV53.

If the VFO is a long way out of adjustment a band edge marker signal at 3.5MHz may be needed to identify which of the harmonics of the calibrator you are tuned to. This marker signal should be injected into the aerial socket of the KW2000.

USB/ LSB switching

Set the KW2000 to 3.6MHz on USB with the IRT off, and tune to zero beat with the calibrator signal.



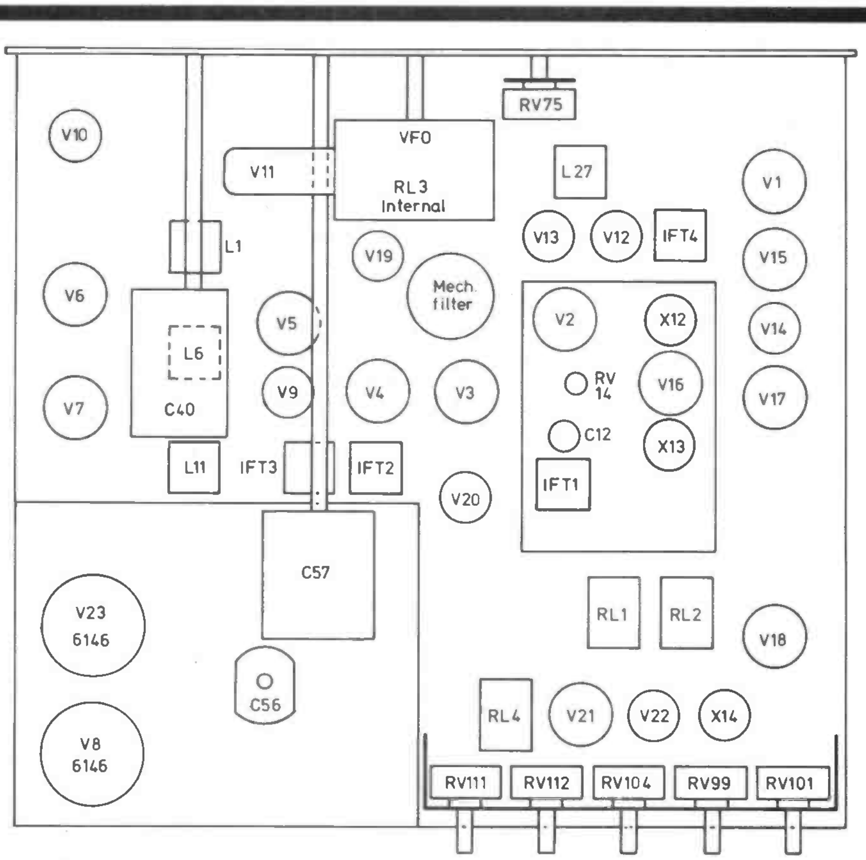


FIG.5. Component location – above chassis.

Now switch to LSB, and, if zero beat is not obtained, adjust the link on L28, which is accessible through a hole in the side of the VFO, for zero beat. Re-check for zero beat on USB and then LSB, adjusting main VFO tuning on USB and the link on LSB, until zero beat is obtained in both positions.

Adjustment of wide-band coupler

Tune the receiver to 3.6MHz and inject a signal at 3.6MHz into the aerial socket.

2. Connect the swamping tool between pin 4 of IFT2 and chassis (see Fig. 3 for location of IFT2). Adjust lower core of IFT2 for peak on S-meter, reducing input signal if necessary to keep reading below S5. *SWITCH OFF KW2000.*
3. Connect swamping tool between pin 6 of IFT2 and chassis. Switch rig back on, and adjust upper core of IFT2 for peak on S-meter. *SWITCH OFF.*
3. Connect swamping tool between pin 4 of IFT3 and chassis. Switch on, and adjust lower core of IFT3 for S-meter peak. *SWITCH OFF.*
4. Connect swamping tool between pin 6 of IFT3 and chassis. Switch on, and adjust upper core of IFT3 for S-meter peak. *SWITCH OFF.*
5. Repeat steps 1-4 in that order until no further improvement can be obtained.

NB It is important to switch off between steps in the above procedure as there is 250 volts HT on some of the IFT pins mentioned above!

Receiver front — end alignment

The following points should be remembered when aligning the front-end:-

1. As the receiver comes into alignment the input signal should be reduced to keep the S-meter reading below S5. For the final 'touch-up' below S3 is preferable.
2. Use acetone to free the cores of the inductances without formers. After freeing, allow at least half an hour for the coils to dry out before commencing alignment.
3. Set pre-selector control to just short of the LF edge of the appropriate band marking on the front panel, except on 160m, where it should be set to the centre of the band segments.
4. **Table 1** gives the sequence of adjustments to be followed, and **Fig. 4** shows the position of the various tuned circuits. Always tune to the first peak arrived at by screwing the tuning core into the coil, ie. nearest the top of the coil former for the upper core; nearest the lower edge of the former for lower cores.

Alignment of IF trap

Set KW2000 to 3.5MHz and inject a low level 3.5MHz at the aerial socket. Set RF gain to maximum AF gain midway, and tune the preselector for maximum signal. Now remove the 3.5MHz signal and inject a 3.155MHz signal to the aerial socket; tune L19 for *minimum* signal.

An alternative method, which can be used if no signal generator is available, is to set the controls as above and connect the rig to an aerial. If the pre-selector is rotated clockwise from the 80 meter peak and the VFO is tuned HF by a few kHz non-amateur signals should be heard. Having tuned to such a signal, adjust L19 for minimum signal level. Note that L19 is on the same former as L1, but is the upper core whereas L1 is the lower. After tuning L19, retune rig to 3.5MHz and retune L1 and L6 for maximum signal.

4.190MHz trap

Set KW2000 as above except for the frequency which should be 3.8MHz. Inject 4.190MHz to aerial socket of rig. Move VFO back and forth a little to locate the signal and adjust L29 for minimum signal on S-meter.

Transmitter alignment

The transmit and receive alignment have deliberately been separated since it has been found easier to get the receiver going first. When adjusting the transmitter alignment it is important that, prior to aligning the driver stage tuning, the pre-selector control is peaked for optimum on *receive* and is then left untouched whilst the PA grid circuit and the neturalising are adjusted.

The rig should be set up as shown in **Fig. 6** and switched to TUNE. The MIC GAIN should then be set to give a PA current of 50mA or less, and the PA tuned for maximum output into the dummy load. The PA grid coil is then adjusted for maximum PA current, reducing the MIC GAIN as necessary to keep the PA current below 100mA. After this, the neutralisation is checked, and the PA grid circuit readjusted if it has been necessary to alter the neutralisation setting, since this will affect the tuning of the grid circuit. Neutralisation adjustment is not necessary on 7, 8.5, and 1.8MHz. **Table 2 gives the sequence of adjustments,** and **Fig. 4** shows the position of the components concerned.

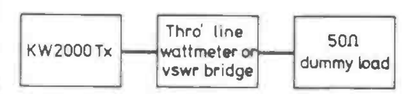


FIG.6. Typical test set-up for Tx alignment.

After alignment has been completed and before re-locking the cores in the various tuned circuits, it is as well to re-check the transceiver performance by giving it an on air check. The following should be noted:

General receive performance
Transmitter drive
The transmitter should not have any signs of instability or poor neutralisation.

It is also important to note that the setting of the pre-selector for optimum receive performance should coincide with that giving maximum transmitter drive.

HF crystal oscillator alignment

The tuned circuits associated with the HF crystal oscillator are very stable even over a period of years, and hence very rarely require adjustment. However, if alignment is required, procede as follows:-

1. Connect an RF milivoltmeter to

the junction of C70 and C69.

2. Loosen the cores of the coils with acetone, and allow at least half an hour for them to dry out.
3. Adjust as in **Table 3** with KW2000 in receive mode. Fig. 4 shows the coil locations.

Carrier balance adjustment

Connect KW2000 to a dummy load, switch on and allow at least half an hour for warm up. Tune rig to 3.6MHz. Tune up and then switch to LSB and select INT MOX. Set MIC GAIN to minimum. Tune a second receiver to 3.6MHz when a signal should be heard. Reduce the level of this signal to as low a level as possible by adjusting RV14 and C12 in KW2000 for minimum carrier. These two adjustments interact, and so they should be adjusted alternately until no further improvement can be obtained. Having done this, switch to USB and compare the carrier level with that obtained in LSB. It has been found that with some KW2000s a compromise has to be made between the two as regards carrier balance.

S-meter adjustment

KW Electronics state in their handbook that with a signal input of 50mV at 3.6MHz the S-meter should read S9, and with 5mV it should read S9+40dB. To set the meter for these conditions procede as follows:-

1. Set RV102 to the centre of its travel.
2. With no signal input, adjust S-meter to zero using RV101.
3. Inject a 3.6MHz signal at 50uV into the aerial socket, and tune pre-selector for maximum S-meter reading.
4. Adjust RV99 so that the meter reads S9.
5. Increase the input signal to 5mV and adjust RV102 so that the meter reads S9+40dB.
6. Remove input signal and re-adjust meter to zero with RV101.
7. Repeat the above procedure until readings are correct at all three specified levels.

Now that the KW2000 is working correctly it is safe to start carrying out modifications. Next months's article will give details of some of these.

RX ALIGNMENT (RF STAGES)

Table 1

Input frequency	Adjust for max 'S' meter readings
28.1	Adjust L5, L10 (Repeat 2-3 times)
21.1	Adjust L4, L9. *Note:* If L4 has no core. Rock pre-selector back and forth. Peak with L9 ONLY
14.1	Adjust L3 and L8 (Repeat 2-3 times)
7.1	Adjust L2 and L7 (Repeat 2-3 times)
3.6	Adjust L1 and L6 (Repeat 2-3 times)
1.9	Adjust C143 and C43 (Repeat 2-3 times)
NOTE	Always align RF stages **HF** bands first. Never in reverse order!

TX ALIGNMENT

Table 2(a)

Frequency	Adjust for maximum drive	Neutralising adjustment
28.1	L15 Repeat this adjustment if neutralising has been adjusted.	Max output from P/A should be at 'Dip'. If max o/p is obtained with P/A current meter, then reduce valve of C56. If max is on HF side of Dip, increase value of C56 (neutralising capacitor).
21.1	L14 Repeat this adjustment if neutralising has been adjusted.	**Note:** If max o/p from P/A is at 'Dip', if max o/p is LF of Dip. Increase C61. If max o/p is HF of Dip. Decrease C61
14.1	L13 Repeat if neutralising has been adjusted	**Note:** If max o/p from P/A is at 'Dip'. If max o/p is LF of 'Dip' increase C162. If max o/p is HF of 'Dip' decrease C162.

Table 2(b)

Frequency	Adjust for max drive
7.1MHz	Adjust L12
3.6MHz	Adjust L11
1.9	Adjust C47

Table 3

Band	Adjust for max reading on RF mA meter
28.4	L20
21.0	L21
14.0	L22
7.0	C74
3.5	C73
1.8	L25

NEWCOMER'S

Circular polarisation reaches the parts other polarisations cannot reach...

The subject this month is the use of circular polarisation at VHF/UHF, particularly 2m prompted by several new licencees interested in my own resurrected use of this method at the new QTH.

Most of you will have read of the need for this type of polarisation for satellite communications, where the polarisation is constantly changing, partly due to spin and changing satellite attitude, and partly to Faraday Rotation imparted by the ionosphere as the signal passes through it. If you have tried receiving one of the OSCAR series of satellites using your normal beam or HF antenna, you will have noticed that the signal regularly peaks as the received signal first matches the polarisation of your antenna, then fades as the opposite occurs.

It is not only when using satellites that the advantages of circular polarisation show up as I hope to demonstrate, without too much recourse to complicated theory. Normal communications on 2m or 70cm can reap the benefits, sometimes in a quite spectacular manner. How many of you out there have a crossed Yagi, but only use it for either vertical or horizontal polarisation? With a bit of switching, you can have four types of polarisation available with much better chances of QSO's at distance.

The normal vertical or horizontally mounted antenna radiates linearly polarised signals in the direction of its main lobe ie, the electrical field is vertically or horizontally polarised in space, and will maintain this polarisation as long as it meets no obstructions, or is not being reflected off the ionosphere. However, the fun starts when, as inevitably it will, the signal meets an obstruction.

There are two effects from such an obstruction. One, there will be a loss of signal strength, depending both on the frequency of the signal (more loss at 70cm than 2m) and the polarisation of the obstruction relative to the signal polarisation. As one would expect, a vertically polarised signal meeting a tall clump of trees, would suffer more loss than if the signal were horizontally polarised.

Two, the obstruction will reflect the signal, and in so doing part of the radiated wave will change polar-

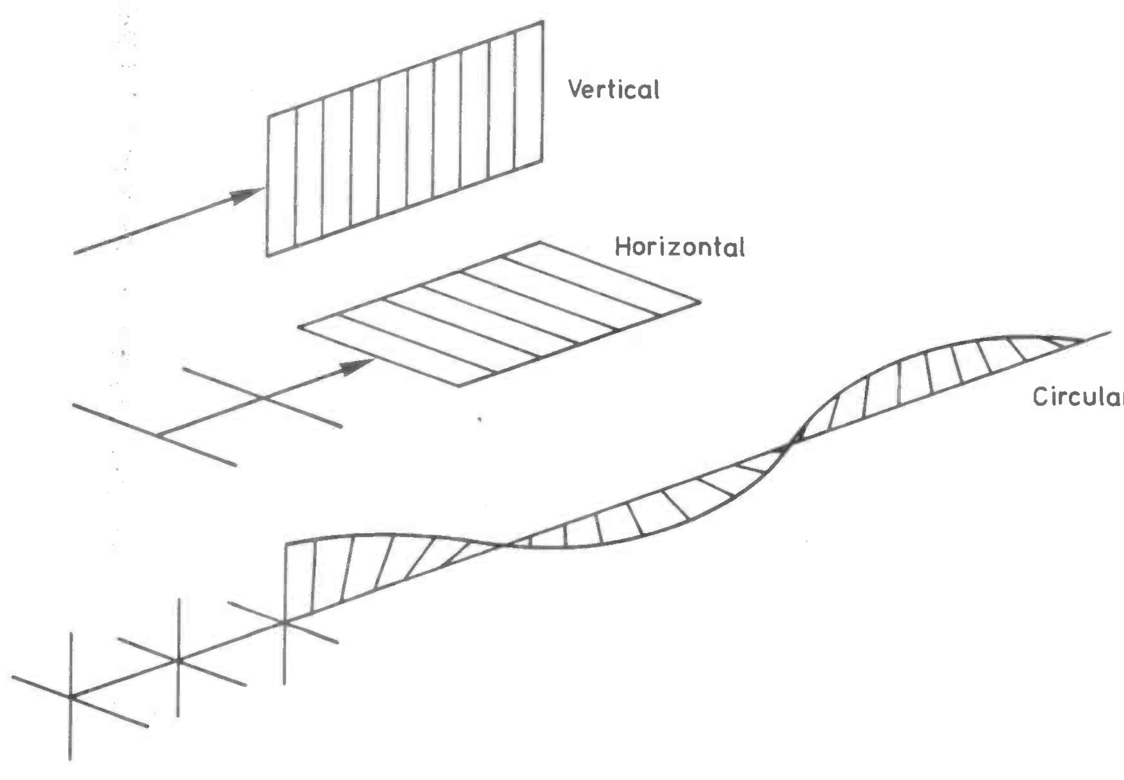
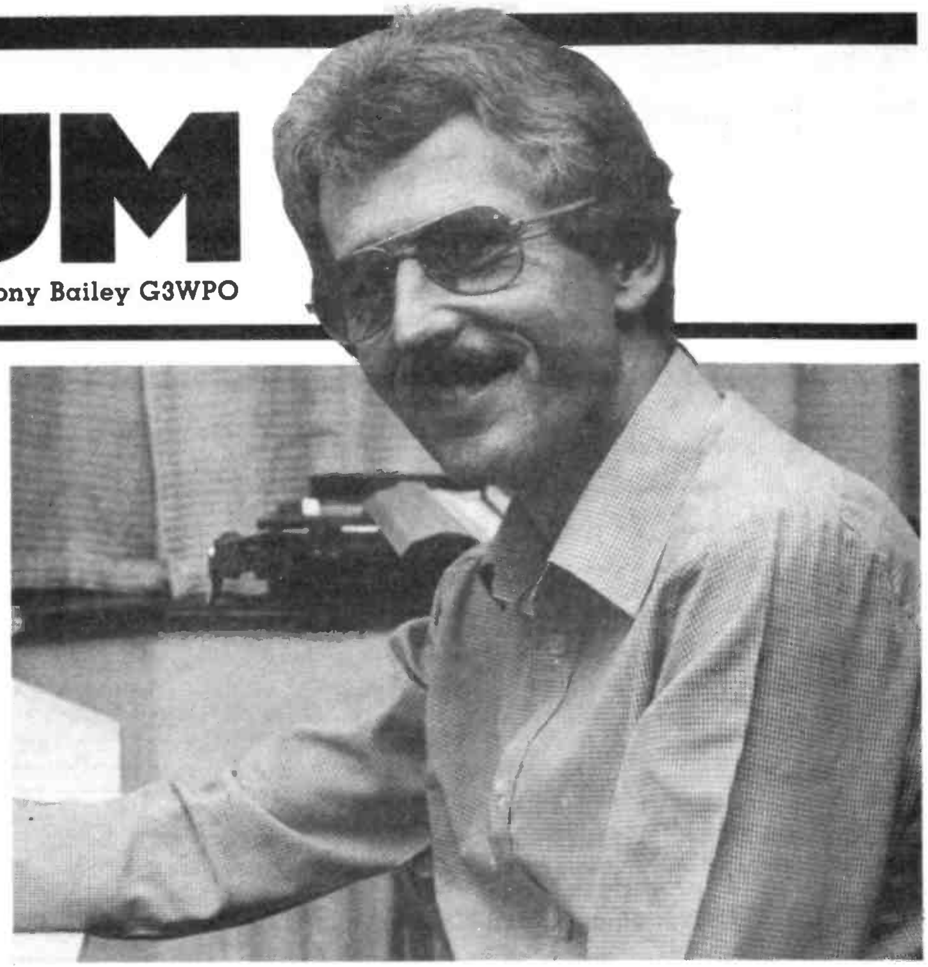


FIG.1. Representations of varying polarisations

FORUM

By Tony Bailey G3WPO



isation depending on the nature of the object. As this change occurs at every reflection, by the time the signal reaches you it will be anything but how it started off.

Long distance repeaters

If you do have the means of switching between vertical and horizontal polarisation, try listening to a distant Repeater, and see which polarisation modes gives the best received signal. You may be surprised that sometimes you will achieve a higher signal strength on horizontal polarisation, as all repeaters use vertically polarised antennas. The London repeaters (if you really want to listen to them) are all audible at the writer's QTH, and frequently equally as strong on horizontal polarisation, due to the changes in polarisation of the signal on route to the antenna.

The effect on your S-meter

What sort of effects on received (and transmitted) signal strengths due to these polarisation changes can one expect? Well, a vertically polarised signal that has had its polarisation shifted by 45 degrees, can be expected to produce a loss of 3dB (or half an 'S'-point) when received on a similarly vertically polarised aerial. In theory, shifting through to 90 degrees (the signal would now be horizontally polarised) will produce infinite loss, but in practice the signal is never exactly 90 degrees out, and losses of 15-25dB would be normal, or 2-4 'S'-points. This is in fact the sort of difference you will notice at fairly short ranges when you are using the opposite polarisation to the transmitting station, and where little opportunity has occurred for reflections.

For some reason, horizontally polarised signals are less likely to change their mode than vertical, a factor which may have influenced the choice of horizontal for SSB communications on VHF/UHF. The choice of vertical for FM use was of course intended for compatability with mobiles, but with so many fixed stations using FM, why not go circular and enjoy the best of both worlds, plus some advantages?

With mobile stations, the same situation holds, in that the polarisation will be changing continually, especially when travelling through built up areas. One recent QSO with G4GPW/M about eight miles distant, stopped in a notorious radio 'hole' amongst the South Downs, produced no copy at all on vertical, but S7 on horizontal!

Circular waves

When using a circularly polarised signal, usually derived from a crossed-yagi, or a helix on the higher frequency bands, the electrical field rotates around the axis of the direction of propogation, such that it rotates through 360 degrees in one wavelength.

The consequence of this is that when such an antenna receives a linearly polarised signal, it doesn't matter what the instantaneous polarisation is, the loss will be 3dB. Compare this with the situation when both aerials are linear, and instead of possible losses of up to 20-25dB when the signal is cross polarised, there will be a constant loss of 3dB. This does of course assume that the antenna used for receiving is perfectly circularly polarised and that there are no other effects producing fading.

If both stations are using circular polarisation, then the signals between them can be expected to suffer very little polarisation induced losses. There is one other point though — there are of course two types of circular polarisation! It is probably simpler to use the helix antenna as an example, as it is easier to visualise, and the 'thread' of the antenna, when viewed from the rear, and in the direction of propogation, will give the sense, which will be clockwise (right-hand) or anti-clockwise (left-hand). If the two stations are using opposite sense antennas, or the sense has become reversed during propagation of the signal (more likely with satellites than terrestrially) then there will be a large loss of signal between them, of the order of 30dB — more than the horizontal/vertical linear case loss.

There is a situation under which opposite sense circular polarisation will be achieved, and that is when two stations are using the same sense, but one is receiving the other off the back (or even the side) of the beam! So having both sense circular polarisations available makes sense.

of HF antennas where the antennas being compared have differing polarisations, as unless the comparitive signals have been averaged over a period of time, any quoted results could be very misleading. This is because due to these effects, one antenna could have been receiving a favourable polarised signal, the other unfavourable — five minutes later as the ionosphere shifts about, the position may well

would not penetrate. Of course, obstructions large enough to attenuate the signal will still cause flutter, but this is very much reduced over a linearly polarised signal.

Those of you in poor radio locations, especially in cities with most of the surrounding buildings higher than your aerial, may find that circular polarisation is the best thing since sliced bread!

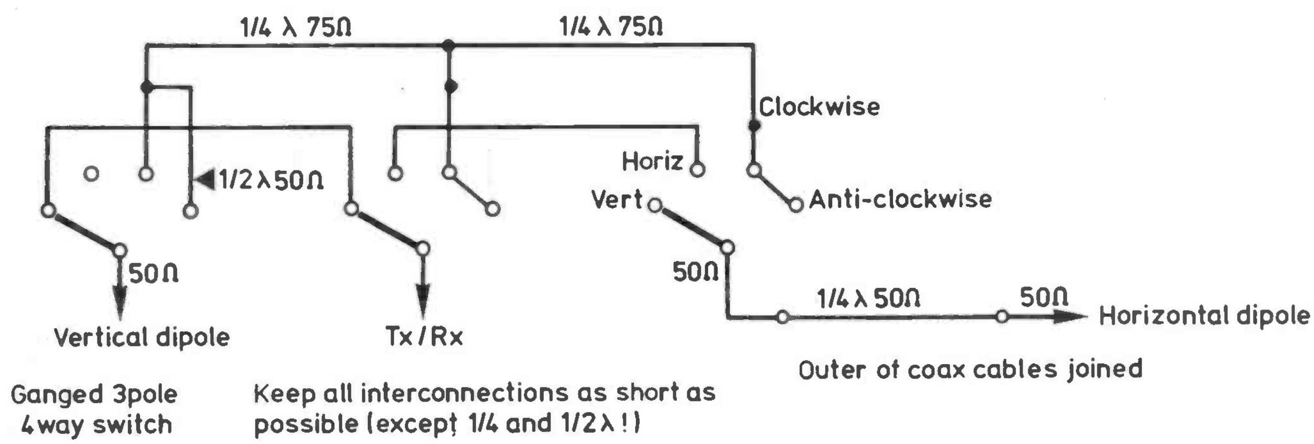


Fig. 3. Polarisation switching circuit.

The sense can also be inverted by reflection from a large surface acting as a mirror. such as a mountain, or even a very large building.

There was a proposal some time ago that VHF stations used clockwise for terrestrial communications in the Northern Hemisphere, and this would be worth continuing.

So, thus far we can show that a circularly polarised receiving antenna will actually give a GAIN in signal strength of in excess of 20dB, when compared with the worth case linear cross polarisation, and at worst, a loss of 3dB, the latter more likely to occur only with more local signals, where it would be acceptable. So, most of the time, you should find a gain in signal strength.

Beware of aerial comparisons...

There is one other result of all the foregoing. This changing polarisation will also occur at HF frequencies, although it is difficult to do much about a circularly polarised HF antenna in the average garden (except possibly at 28MHz). Be cautious when reading comparisons have been reversed and a different result put to paper!

Other gains

We mentioned earlier that obstructions, besides causing polarisation shifts, will also cause a loss in signal strength. With circularly polarised signals, these losses will probably not exceed 3dB at the worst as, in the case of trees, only a very small proportion of the signal is at the same polarisation as the obstruction.

The other advantage of circularly polarised waves is that they have much better penetration into built-up areas, and into dips in the terrain, than linearly polarised waves due to there being much more opportunity for a circularly polarised wave to be reflected from a compatibly polarised reflecting surface.

The result is that mobile communications are much enhanced when the base station is circularly polarised, and you will find that the signal is much steadier, and will travel a greater distance. Often, communications will be possible where a linearly polarised signal

Practicalities

There have been a number of articles published on the construction of the Helix antenna, more usually used on 70cm for satellite rather than terrestrial contacts, and there is no reason why this same antenna should not be used on that band, or 2m, for normal earthbound contacts. It does have the disadvantage that the sense of the circular polarisation cannot be switched as it is fixed by the thread of the helix when built.

As many stations will already have crossed Yagi's — these are easily obtainable commercially — but may not be using them circularly polarised, then some details on how to set up a switching system are called for.

If you are putting up a crossed antenna for the first time, you will probably have some debate as to which way to mount it, i.e., with the elements vertical and horizontal, or in an X-configuration. If you are going to use circular polarisation exclusively, then the X-configuration is the best, but as most people will want to convince themselves about the results, you will probably feel that the other way is preferable so that vertical and horizontal polarisations are still available. You can in fact still have these polarisations when in the X-configuration by suitable switching but it is a bit more complicated, and needs a lot of adjustment for optimum results so we will stick with the H/V method.

If at all possible, use a fibreglass pole to mount the antenna, as a normal aluminium one will upset the radiation patterns of the vertical elements to a large extent, with the result that the final polarisation will not be exactly circular (and your linear vertical polarisation will also suffer, with a non-theoretical radiation pattern and impedence). In fact, it is very unlikely that it will be entirely circular anyway due to the constructional methods normally used, but more elliptical. We will have to accept this, but the results are still very worthwhile.

Feeders

You will no doubt already have two feeders coming down from the two dipoles. The first point is that it is important that both feeders are the same physical length. By length, we mean from the point at which each connects with the driven element, to the termination in the shack. They should also be of the same type of coax (as well as the same impedance of course), if this is possible, so that you can be sure the velocity factors are the same, although most cables do vary slightly along their length. The actual length doesn't matter. If your antenna is already up, you have a problem if you didn't measure this in the first place!

Going circular...

Having established that, the next part is how to get the radiated signal circularly polarised. This is usually achieved by lengthening one of the feeders by an electrical quarter-wave of cable and this will have the effects of giving a 90 degree phase shift to the dipole which has the extra 1/4 wave in its feeder, and producing the circular polarisation required when the radiated signal gets into space.

However, its not quite that easy! The next part depends on whether you aerial feed impedance is 75 or 50 ohms nominal. As the majority of

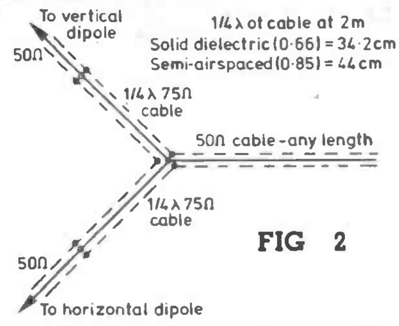


FIG 2

Phasing harness. Adding a ¼ wave of 50ohm cable in either dipole feeder will produce circular polarisation.

people will be using 50 ohm systems. There are now two lengths of feeder which have to be paralleled, to get the single feeder needed for the transmitter end. Connecting them together will of course result in an impedance half that of the feeder, or around 25 ohms — cable of this impedance is a little difficult to come by.

This is easily overcome by using two 1/4 wave transformer lines of 75 ohm coaxial cable in each feeder to transform each feeder impedance up to 100 ohms, then connecting the two free ends together so that we are back at 50 ohms again.

If we now make up a fixed set of cables as per the above, we will have a circularly polarised signal, or as near as we can get to circular without recourse to a lot more adjustments, bearing in mind the points made earlier. Which sense polarisation is it? Well, if you put the 1/4 wave delay line in the feeder to the horizontal dipole, the radiation will be clockwise circular. Putting it in the other feeder will change this to anti-clockwise.

The best way to make this change is to leave the 1/4 wave delay line in place and introduce an additional shortable 1/2 wave of delay line into the other feeder, which will have the same effect as shifting the 1/4 wave delay line between the two feeders. Bear in mind that all these various 1/2 and 1/4 waves have to be electrical lengths and not physical, taking into account the velocity factor of the cables used. These would normally be 0.66 for solid dielectric, and 0.85 for semi-air spaced, if you lack the actual figures for your cable.

All that remains is to fabricate a switching unit to move between the various polarisations. A suitable method is shown, and you can omit some of the switching if you only want the two circular modes. The actual switch unit should of course be coaxial for the optimum results. However, most people will not be able to afford a number of these switches, and like myself, would prefer something cheaper! Whenever using such systems, I have always used a normal Yaxley wafer switch (3 pole 4 way) with satisfactory practical results at powers up to 100W output, since we are working at low impedance, avoiding switching while actually transmitting.

If possible, use a ceramic type with the rallies being good hunting grounds for such items. Some inaccuracies will be generated using this type of switch, due to the varying distances between the contacts, and the lengths of the contacts themselves, but again, you will have to put up with these.

When making up the switches and cables, try to keep the screening as intact as possible at the joins, with around 1/2 inch of pigtail only, and make the various lengths of coax into gentle loops where necessary. Make sure that you preserve the correct lengths when making up the cables and any connectors etc.

Let us know

There is just one further point. All the above assumes that your aerial is of the type where the two dipoles are mounted next to each other on the boom. If they are spaced by 1/4 wavelength already, then the above still holds, but omit the 1/4 wave delay line — it is already present in the antenna physical construction. There is also the point that the small physical separation between the actual dipoles on the boom will introduce a phase discontinuity, although this could be allowed for in the length of the feeder.

So armed with the above, go off and try the world of circular polarisation. If you care to let us know the results, with specific examples of any notable results, with specific examples of any notable results, these will be published to spur others onto trying the same. If there is enough interest, we will also show how to optimise the system for best results by a little pruning.

Next month I hope to answer some of your letters, providing I receive them of course!

WORKING ME

The second part of the article by John Matthews G3WZT covers the practical aspects of meteorscatter operating. As with the first part, John's approach brings a new, popular appeal to the subject.

Part 2

CULMINATION TIMES

The only other unknown factor is the culmination time and is defined as the local time when the meteor radiant point crosses the observer's meridian between the pole star and the southern horizon. It is also termed transit or upper transit. Although it is possible to determine culmination times from Right Ascension angles it was not considered necessary to go into such depth as all the relevent timing details of each shower are shown on the individual plots of **Fig. 8**.

OPTIMUM CONDITIONS

Normally, meteor scatter contacts are established using forward scatter. In this case the optimum condition for reflection exists when the trail forms a tangent to an ellipse focused on both the transmit and receive aerials.

For a station which is located to the east, optimum propagation conditions exist when the radiant point is located mid-way between both stations and at the same time is crossing the path at right angles i.e. North to South or vica versa. It is also important to ensure that the meteor shower radiant elevation lies between 45 and 60 degrees. If these rules are followed by correct use of the plots shown in **Fig. 8** optimum results will be achieved provided the shower is suitable.

See the notes on page 39 and 40 for an extended explanation of the radiant path plots.

THE SITE

One big advantage for the ms operator is the fact that a good VHF site is less important than it would be for other forms of propagation. Almost any site with aerials in the clear and no obstructions in the immediate vicinity will give satisfactory results.

RECEIVER

The most important features for the receiver in a meteor scatter station are good long term frequency stability, frequency accuracy, and a low noise figure. Almost all modern day synthesised transceivers have excellent stability after the initial warm-up period. Although many types have digital readout for frequency displays it should be realised that the accuracy is only as good as the reference oscillators in the synthesiser and the system used for generating the digital readout. As the displays are not true fre-

TABLE 1 MAJOR SHOWERS

SHOWER & DATE	NORMAL LIMITS	CELESTIAL CO-ORDINATES RA°	DEC°	HOURLY RATE	CULMINATION (LOCAL TIME)
QUADRANTIDS JAN 3-4	10 Hours	232	+ 50	80	08.6 Hours
LYRIDS APRIL 21-22	2 Days	271	+ 33	8-15	04.2 h
ETA-AQUARIDS MAY 5-6	5 Days	338	+ 1	55	07.6 h
ARIETIDS JUNE 7-8	8 Days*	46	+ 21	60	10 h
ZETA-PERSEIDS JUNE 9	8 Days*	62	+ 24	40	11 h
PERSEIDS AUG 12-13	4 Days	46	+ 58	100	05.7 h
DRACONIDS OCT 9	6 Hours	262	+ 54	5-10	16.2 h
ORIONIDS OCT 21	2 Days	95	+ 15	20	04.4 h
TAURIDS NOV 8	20 Days	56	+ 14	5-10	0.6 h
LEONIDS NOV 17-18		152	+ 22	10	06.4 h
GEMINIDS DEC 13-14	3 Days	113	+ 32	60	02. h
URSIDS DEC 22	24 Hours	207	+ 74	5	07.7 h

TEORSCATTER

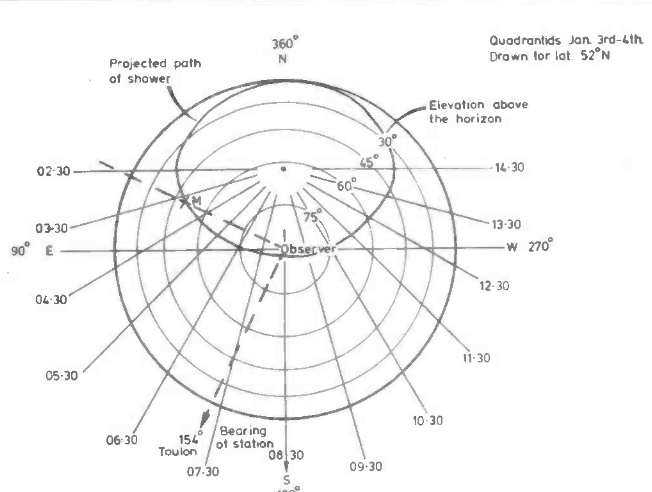


FIG. 8a

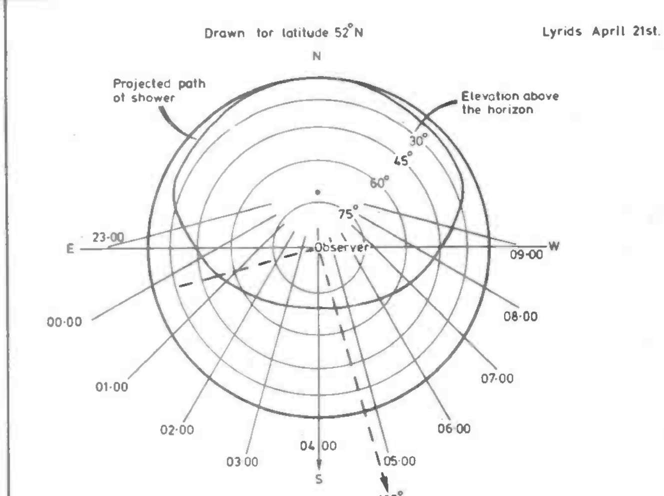


FIG. 8b

quency meters at signal frequency quite large errors may exist (1-2khz) which is not adequate for ms operation. An accuracy of 500Hz for CW operation and 100Hz for SSB should be aimed for. The most satisfactory and simple way to ensure frequency accuracy is by using a quartz crystal in a proportionally controlled oven with frequency dividers giving markers down to 5khz. This will also provide sufficient accuracy for those stations without the facility of digital frequency readout.

Most commercially manufactured transceivers for 2m exhibit noise figures which are rarely better than 5dB; although results will be obtained with these values it is wise to improve performance by the addition of a low noise pre-amplifier, preferably mounted at the masthead. Using readily available devices noise figures of 1.5dB should be achieved without difficulty. The addition of a pre-amplifier will of course degrade the strong signal handling capability of the receiver but in the context of meteor scatter this is of secondary importance. *(Please see 0.7dB NF pre-amp article in January's Ham Radio Today).*

RECEIVER BANDWIDTH

Although a reduction in bandwidth will provide improved signal to noise ratios there are certain limitations due to the high speed of the CW and the need to decode it at reduced speeds. For example a tone of 1.6khz recorded at 19cms/second tape speed will be only 200Hz when played back at 2.4cms/second. This makes weak signals very difficult to read, particularly if accompanied by severe fading. A means of eliminating this problem and enabling reduced bandwidth to be used if required is mentioned in the section dealing with CW decoding. It is always wise to commence a QSO using maximum bandwidth; this will improve the chance of hearing signals that are not exactly on the designated frequency.

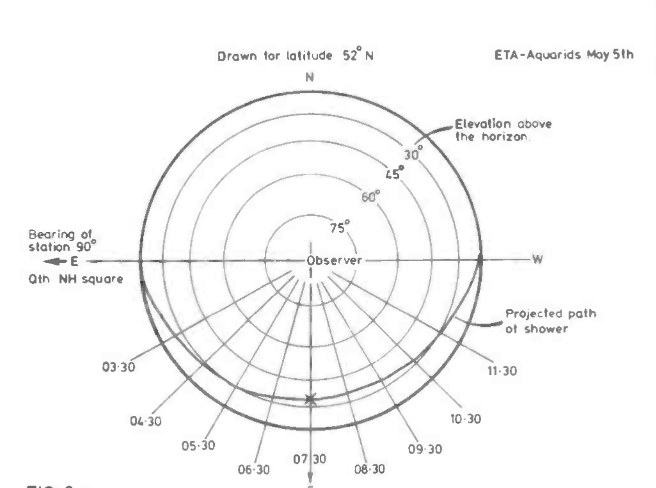


FIG. 8c

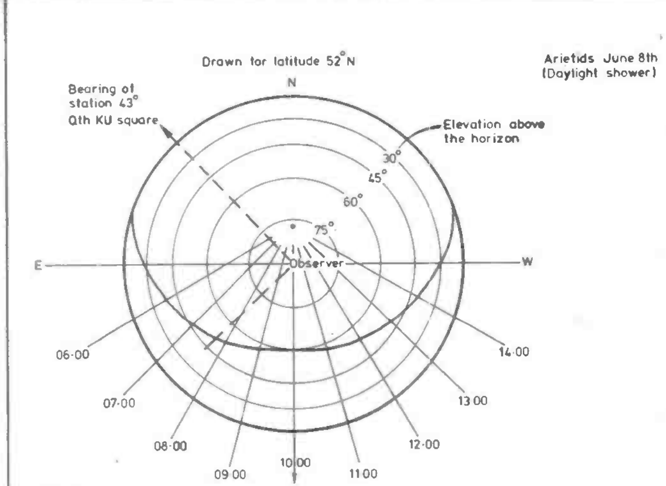


FIG. 8d

TRANSMITTER

As with the receiver, the most important factor is that of stability and the ability to set to a desired transmission frequency. On CW the latter point is easily achieved with the aid of a calibrated frequency meter.

When using a transceiver for SSB operation it is safe to assume that both the RX and TX are on the same frequency. It is then a simple case of zero-beating the VFO onto the chosen frequency using a calitrator. This method should not be used on CW as transmit errors of 800Hz-1kHz may exist due to the inbuilt shift between TX and RX on most commercially manufactured transceivers.

POWER OUTPUT

There is no doubt that the maximum permissible power levels produce the most effective results, but the operator with only 25 watts output power should not be put off as many successful meteor scatter QSO's have been accomplished using only 10-20 watts. Contacts using lower power levels will normally take longer to complete and require additional patience on the part of the operator, but the end results can be very rewarding.

HIGH SPEED CW KEYING

Many people have their own pet requirements for producing the high keying speeds necessary for ms commications. Speeds generally used are between 400 and 1000 letters per minute although 600-800 LPM are the limits generally accepted unless other specific arrangements have been made.

One popular means of producing CW at these speeds, with the ability to alter the message content rapidly is to use one of the many home computers available, interfaced with the TX.

For those without this facility there are numerous designs for digital memory keyers, published, giving a wide range of facilities. One of the better designs which also incorporates an excellent Iambic Keyer with dot and dash store is the *KM4000*, published in the February 1982 edition of *Radio Communication*. This keyer has more than adequate memory but like many other memory keyers suffers from the inability to re-circulate the

TABLE 2 — MINOR SHOWERS

SHOWER & DATE	NORMAL LIMITS	CELESTIAL CO-ORDINATES RA°	DEC°	HOURLY RATE	CULMINATION (LOCAL TIME)
KAPPA CYGNIDS JAN 17		295	+ 53	10	12 Hours
GAMMA LEONIDS FEB 5		152	+ 20	5	01.3 h
ALPHA AURIGIDS FEB 7-8		74	+ 43	10	20 h
ZETA BOOTIDS MARCH 11		218	+ 12	10	03.2 h
URSAE MAJORIDS APRIL 1-2		160	+ 55	10-20	12h
PISCIDS MAY 7		26	+ 25	30	10.7 h
NU PISCIDS MAY 12		17	+ 26	16	09.8 h
54 PERSEIDS JUNE 26	PERIODIC SHOWER	68	+ 34	30	10.3 h
BETA TAURIDS JUNE 29		88	+ 17	25	11.4 h
JUNE DRACONIDS JUNE 29	24 hours	231	+ 54	?	21 h
ALPHA ORIONIDS JULY 12	PERIODIC SHOWER	87	+ 11	50	10.5 h
NU-GEMINIDS JULY 12	PERIODIC SHOWER	98	+ 21	60	11.2 h
LAMBDA-GEMINIDS—JULY 12	PERIODIC SHOWER	111	+ 15	32	12 h
ALPHA CYGNIDS		314	+ 47	15	01.5 h
THETA AURIGIDS JULY 25		86	+ 38	20	09.6 h
DELTA CASSIOPEDS AUG 10		18	+ 63	15	04. h
ALPHA AURIGIDS AUG 28		74	+ 43	12	06.5 h
BETA CASSSIOPEIDS SEPT 7-15		358	+ 60	10	0.6 h
EPSILON PERSEIDS SEPT 7		62	+37	10	05.1 h
50 CASSIOPEIDS OCT 13		29	+ 72	20	0.5 h
EPSILON ARIETIDS OCT 14		40	+ 20	12	01.2 h
PEGASIDS, OCT 19-20		349	+ 27	18	21.4 h
AURIGIDS NOV 2		90	+ 40	10	03.2 h
ZETA TAURIDS DEC 10		83	+ 22	10	0.3 h

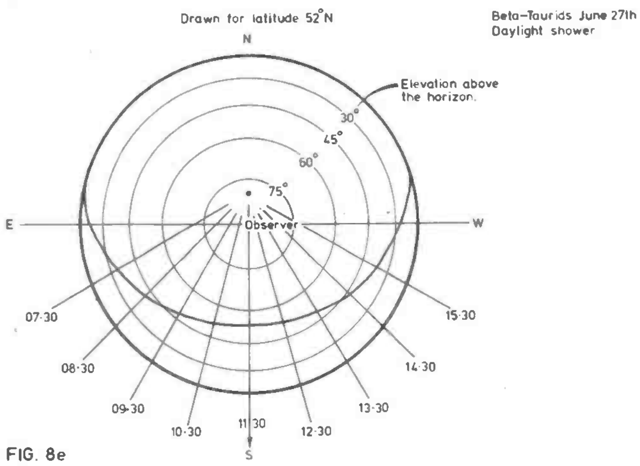


FIG. 8e

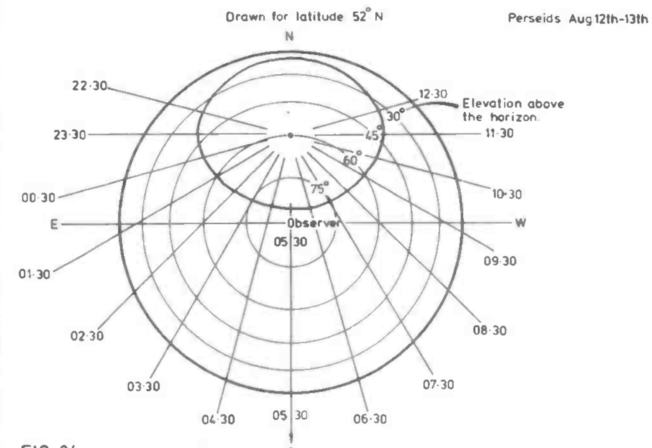


FIG. 8f

wanted information only. This means that long gaps appear on the transmission unless the memory is completely filled.

A modification to the *KM4000* to overcome this problem and allow any length of message, however short to be re-circulated is shown in **Fig. 11**.

CW output from IC11b pin 10 is fed via inverting buffers IC17a, b, to reset the binary counter IC18, whenever CW is being sent. As soon as the CW input stops, a '1' on MR starts the 14 stage binary counter IC18 counting inputs from the address line via buffer IC17c. When stage 06 is reached the positive-going edge triggers mono-stable IC19 producing a negative-going pulse which after buffering/inverting is used to turn off Q1 and reset the *KM4000*. With SW closed normal operation of the keyer occurs.

If shorter or longer breaks in transmission are required before re-circulation of the memory, different stages of the binary counter output (IC 18) may be used. This may necessitate a change in value of the 2.2 uf mono-stable timing capacitor between pins 1 and 2 of IC19.

CW DECODING

Owing to the high speeds necessary to take full advantage of short bursts, some means of decoding is required. The most popular method is to use a 4 speed tape or cassette recorder, modified with continuously variable speed. In this way it is possible to decode bursts received during the previous listening period. It is important to ensure that any recording equipment is not prone to RFI as playback is used during the station's transmit period.

A method of overcoming the difficulties encountered when reducing the speed of recorded information is to use an audio frequency up-converter. Audio from the receiver is up-converted to around 8.5Khz and when reduced on playback by a factor of 8 times produces an easily readable output frequency of 1Khz.

A design of this type is described by LA8AK in the September 1982 issue of *Radio Communication*.

BEAM HEADINGS

For normal forward scatter communication best results will be obtained by directing the antenna towards the other station using great circle bearings. At optimum path times beaming 5 or 6 degrees north during the morning and south by the same amount in the evening im-

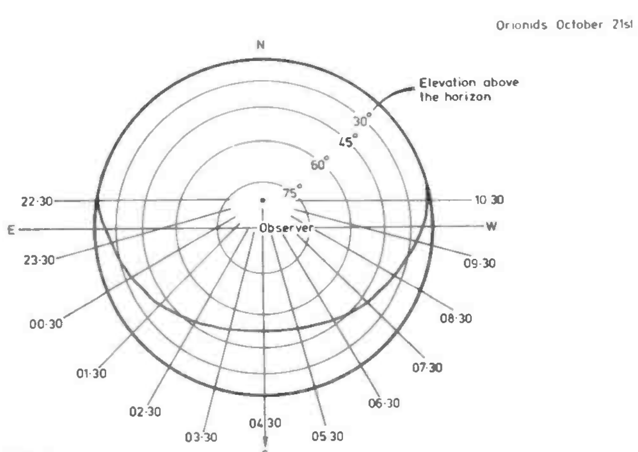


FIG. 8g

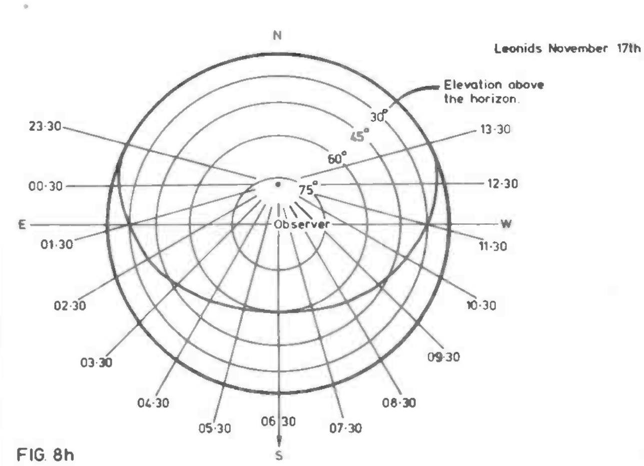


FIG. 8h

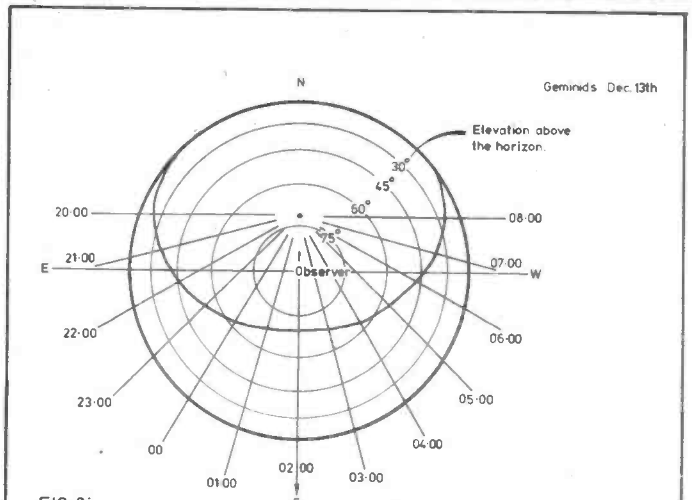


FIG. 8j

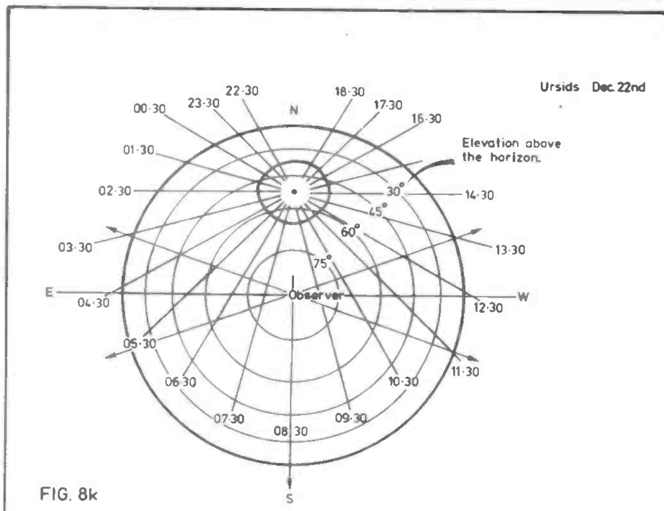


FIG. 8k

prove results, but these small changes make very little practical difference using average single yagi antenna systems. However stations with large arrays and narrow horizontal beamwidth may find improved results by deviating slightly from the great-circle bearing.

Stations wishing to experiment with side scatter or back scatter will of course need to orientate antennae far from the great circle bearing depending upon the position of the radiant point. In this instance both stations need to be aware of the radiant coordinates and adjust the beam headings accordingly.

METEOR SCATTER QSO PROCEDURES

There still appears to be considerable confusion over the correct procedures for conducting ms QSO's and what constitutes a complete QSO.

As with any 2 way contact whatever the mode or frequency, a QSO is only valid when both stations have received both call signs, a signal strength report, and confirmation of the above. When all of this information has been exchanged, and only when, a QSO is valid and complete.

REPORTING SYSTEM

The reporting system used consists of two numbers only, the first for signal duration and the second for signal strength.

First number

2 — Bursts up to 5 seconds
3 — Bursts 5 to 10 seconds
4 — Bursts 20 to 120 seconds
5 — Bursts exceeding 120 seconds

Second number

6 — S2 to S3
7 — S4 to S5
8 — S6 to S7
9 — S8 to S9

The above reporting system is common to SSB and CW contacts.

REPORTING PROCEDURES

A report is sent *only* when there is positive evidence that any information received contains your own call or your QSO partner's, in part or complete.

For SSB schedules 1 minute periods are normally used and 5 minutes for CW. These periods are only reccommendations of course and may be altered to suit individual preferences on pre-arranged schedules.

Normally stations in the UK transmit during the second 5 minute period following the hour (i.e. 22:05 to 22:10) on CW and transmit during the second 1 minute period using SSB. (22:01 to 22:02). The following example assumes that the distant station is transmitting for the first period.

Upon hearing evidence of either call sign during the first listening period your first transmission period would contain calls and a report i.e. SM7AED G3WZT 27 27. If the other station is not positively identified, calls *only* are transmitted.

As soon as *both* call signs and a report from the distant station are received the letter R is introduced in front of the report i.e. SM7AED G3WZT R27 R27. R is never used unless *all* information has been received.

Continue to transmit calls with R reports until you hear confirmation R's being used by the other station. When R's have been heard it is good practice to continue confirmation R's for two periods i.e. SM7AED G3WZT RRR RRR. This procedure is common to both SSB and CW QSO'swith R's pronounced as 'Roger' when using SSB.

When using SSB during major showers it is beneficial to use short breaks in the transmit period i.e. SM7AED G3WZT 27 27 SM7AED G3WZT 27 27 'BREAK'. This enables full advantage to be taken of long bursts and can bring QSO's to a rapid conclusion.

SKED DURATION

Skeds normally run for 1 or 2 hours. Every uninterrupted sked must be considered as a separate trial. It is not possible to break off and recontinue a sked at a latter time or date, using information received during the previous period.

ARRANGING SKEDS

Although it is possible to arrange skeds by letter, it can be rather long-winded and expensive.

The easiest and most effective method is to listen on the 20 metre VHF net. This is a net specifically for those people with an interest in all things VHF and is well populated with meteor scatter enthusiasts, particularly around times of major showers.

The VHF net is to be found

around 14.345MHz and is most active during the weekends although during major meteor showers there are often people on throughout the week.

RANDOM ms

During major showers it is possible to make unscheduled QSO's on the random calling frequencies. At present the official, nominal calling frequencies are 144.100MHz for CW operation and 144.400MHz for SSB.

Although 144.200MHz was officially withdrawn as a random SSB calling channel by the IARU region 1 conference in 1981 it still continues to be used by many operators throughout Europe.

The main difficulty in working random ms on SSB is the high level of QRM. During the major meteor showers, 144.200MHz is bedlam! When a burst occurs, three or four YU stations may be heard. Each of these is then called by one or more G stations. In the next burst, a different YU may be heard, along with two HG stations and an OK. Each of these is then called by one or more G's. People are still trying to work the YU's from the first burst, and through all this other G's are calling CQ. The resulting racket is more spectacular than it is useful.

In an attempt to solve this problem, the IARU Region 1 Conference held in Brighton in July 1981 introduced a new procedure for random calling on SSB. The basis of this scheme is quite simple: CQ calls are spread out across the band according to the last letter in the call-sign of the station calling CQ. To calculate 'your' frequency, you take the last letter of your call-sign. Modifiers are ignored, so G9XYZ/P counts as Z, not P, and PA9ABC/LX count as C, not X. The last letter is then converted to a number, using the rule A=1, B=2, C=3, etc. up to Z=26. You then add this number to 144,000 to give 'your' frequency in KHz. Or, in other words, your number corresponds to the number of KHz above 144.4MHz. In the case of PA9ABC/LX/P the last letter is C; C is the third letter of the alphabet, so his frequency is 144.403MHz. Similarly, for G4DEZ, Z=26, frequency 144.426MHz. All you do now is call CQ on 'your' frequency, and listen for replies on the same frequency.

So far, so good; it's a very simple matter to work out your frequency, call CQ on it, and listen for replies. QRM will be much lower because stations are spread over 26Khz instead of about 2Khz. Why then, does one not hear G4DEZ on 144.426, and why is 144.200 still universally used for random calling? The answer is that the new system does not work. It's fine for sending CQ's BUT NOT FOR HEARING THEM. It just isn't possible to catch a meteor burst while continually tuning up and down a 26Khz range (quite apart from which, if you try it your arm soon tires. *(What about auto scanning? — Ed!)*

A new system has been proposed by G8NGO which overcomes this difficulty. You begin by working out 'your' frequency in exactly the same way as in the IARU scheme. You then call CQ on 144.390MHz but listen for replies on 'your' frequency. As long as you hear no replies, you continue calling CQ on 144.390MHz and listening on your frequency. As soon as you hear a reply to your CQ you start the QSO attempt on your own frequency, and continue both transmitting and receiving on that frequency until the QSO is either completed or abandoned. From the other side, if you wish to listen for a CQ call rather than calling yourself, you simply listen on 144.390MHz. When you hear a station calling CQ, you work out what his frequency is according to the same rules as before. You then call him on his frequency and listen for his reply on his frequency also.

The advantages of this system are obvious: 144.390MHz will be occupied only by stations actually calling CQ. Replies to CQ calls and QSO's themselves take place on the frequency corresponding to the call-sign of the station that originally called CQ.

There is one disadvantage: a station calling CQ must be able to switch rapidly and accurately between two frequencies that are between 11 and 36kHz apart. The philosophical answer to this problem is that amateurs have always decided WHAT they wanted to do, and then bought, borrowed, built or bodged-up the gear to do it. The practical answer is that most operators already have suitable equipment. The latest generation of 2m transceivers mostly have twin VFOs or a memory. On older gear e.g. FT221 you can fit a crystal for 144.390MHz and set the VFO to 'your' frequency (or vice-versa). On some multi-mode rigs you can replace the repeater-shift crystal with one that gives a shift corresponding to the difference between 'your' frequency and 144.390MHz. If all else fails, remember that you only need split-frequency to initiate a CQ: you can use any rig to reply to one.

The system proposed by the IARU in July 1981 was to run for a three year experimental period. Perhaps the system proposed by G8NGO will initiate discussion among meteor scatter operators, that will lead to its successor.

USING THE RADIANT PATH PLOT

The plots shown in **Figs. 8a** to **8k** indicate the path of the radiant point for all major meteor showers and includes several minor and daylight showers.

They are all drawn for latitude 52 degrees N but will provide sufficient accuracy for stations between 42 degrees and 62 degrees N. As stated in the text it is the point midway between the two stations that requires the radiant to be at right angles to them with an elevation of 45-60 degrees.

This means that if the distant station is located due south at latitude 36 degrees N a new plot should be drawn for the mid latitude point of 44 degrees (assuming your latitude is 52 degrees N). Unfortunately this would require many pages of plots for the mid way points north or south of the observer. This point is made to make the reader aware of the minor errors introduced by producing plots for one particular latitude. These errors will be very minor and will not significantly alter results within the latitudes mentioned above.

QUADRANTIDS

Fig. 8a shows an example for the Quadrantids shower. Bearings are always laid off from the observer and in this example the other station is on a bearing of 154 degrees.

A line is drawn on this bearing through the observer with another line at 90 degrees to this passing through the projected path of the radiant point. In the example the lines intersect at M showing an ideal radiant elevation of 50 degrees. The time at this point is just after 03.30 *local time* and as the other station located in Toulon is only 6 degrees east, representing only 24 minutes time difference, (12 minutes at the mid latitude point) no further correction need be made. A one hour sked in this instance would run from 03.00-04.00 local time.

The Quadrantids often produce excellent reflections at their peak on the 3rd or 4th of January but are very sharp, with a maximum life of only 8-10 hours. Accurate timing is therefore important for best results in the chosen direction.

LYRIDS

Although the April Lyrids are not usually an exciting shower for the ms operator they can produce results when correctly used, despite the low meteor count. The example in **Fig. 8b** shows the distant station located in XW QTH square on a bearing of 195 degrees. Once again there is negligible change in the time zone and the optimum time for a 2 hour sked would run from 23.30 until 01.30 local.

It can be seen from the diagram that this direction gives a radiant elevation of 70 degrees which is a little to high and better results would be obtained by selecting a direction giving reduced radiant elevation (i.e. due South or North).

ETA-AQUARIDS

Although the radiant elevation of this shower does not rise above 38 degrees in Southern England the activity produced by Eta-Aquarids should improve over the next few years as Halleys Comet approaches its perihelion in 1986.

The example shown in **Fig. 8c** is for a station located due east in NH QTH locator, a distance of approximately 2000km from the home station in ZK.

Reading from the plot in **Fig. 8c** the radiant elevation is 38 degrees and is the highest possible for this shower at latitude 52 degrees North.

The time indicated is 07.30, but as the time wanted for optimum, is mid way between NH and ZK QTH locators the time difference must be taken into consideration. The difference in longitude between the two stations is 28 degrees and amounts to a time difference of just under 2 hours. The mid way time will therefore be 1 hour earlier as the other station is towards the east.

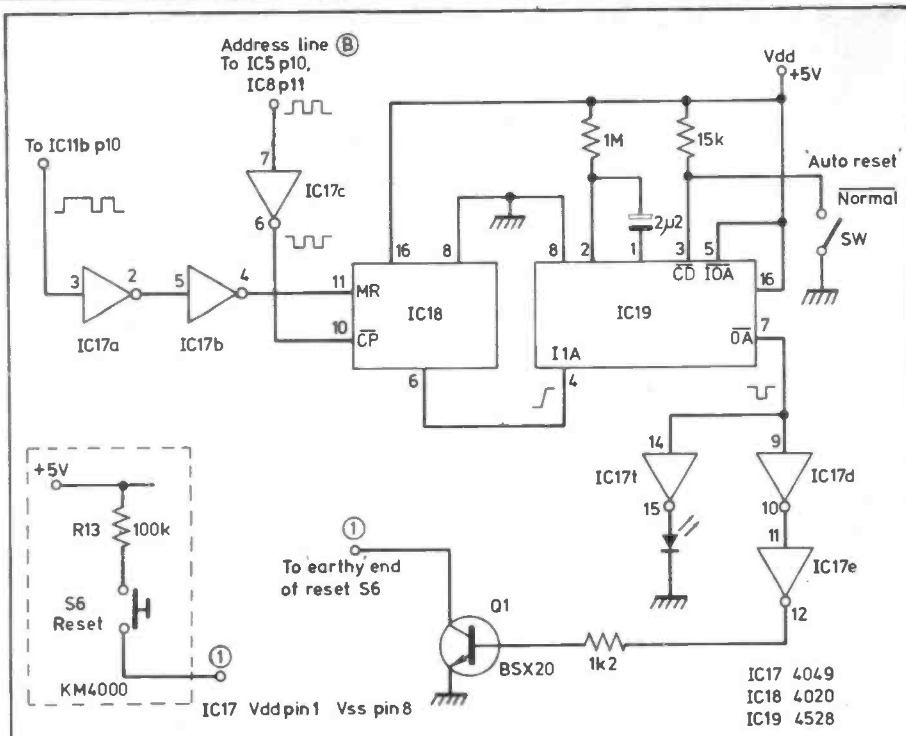


FIG. 11. KM4000 Auto reset mod.

Optimum times for a 2 hour sked would be from 05.30 to 07.30 local time.

Attempting to work stations due North or South in this particular shower would be difficult as the radiant would be very close, or below the horizon at the optimum path time.

ARIETIDS

The final worked example is for the Arietids daylight shower and is shown in **Fig. 8d**. Excellent results can be obtained with high reflection rates during the period 7th and 8th June. The distant station is located in KU QTH locator, bearing 43 degrees from the home station in ZK.

By drawing a line at right angles to the distant bearing through the observer it can be seen that optimum time is around 07.45. KU QTH locator is 20 degrees east of ZK and amounts to a time difference of 1 hour 20 minutes. As we are looking for the mid point time (10 degrees east) this figure is divided by 2 and subtracted from the time shown on the plot. Optimum time is therefore 07.45 minus 40 minutes, this would be rounded to 07.00 and a 2 hour sked run from 06.00 to 08.00 local. If the distant station was located to the West then time difference would be later and added to times given on the plot.

The remaining diagrams, **Figs. 8e-8k** show the radiant paths for most of the remaining major showers and some of the less active ones.

No examples are given for these but they may be used in exactly the same way as shown in the worked examples.

One interesting plot which shows clearly why it is not possible to work some showers in certain directions is the Ursids on December 22nd. It will be seen that the only directions which cross the path at right angles are bearings within the shaded sections of **Fig. 8k**, all other headings miss the radiant path owing to the high declination angle of the shower. Although this shower has a very low hourly rate QSO's can be made if times and directions are correctly calculated. Finally TABLES 1 and 2 give information on most major and minor showers and includes the known daytime occurrences.

Some of the minor showers can be deflected or perturbed and may not give results, however they can return and give rates far above sproadic for those operators willing to experiment.

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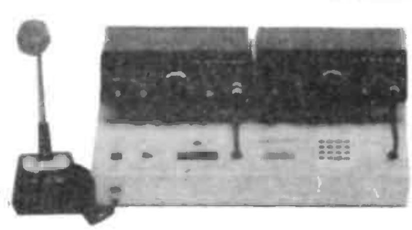

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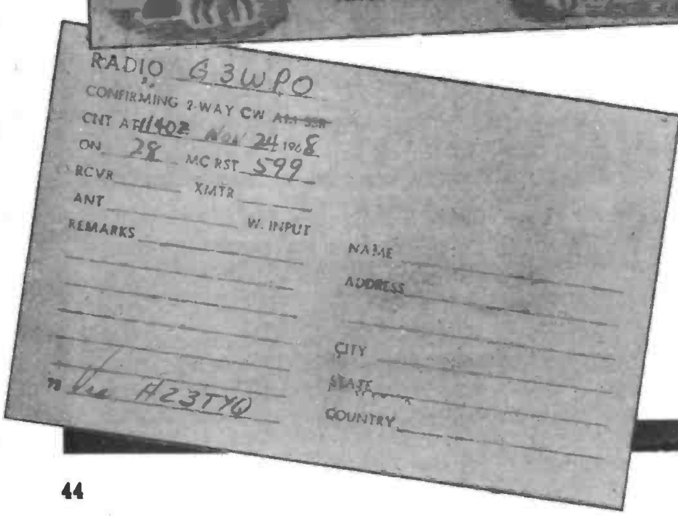
RADIO YESTERDAY

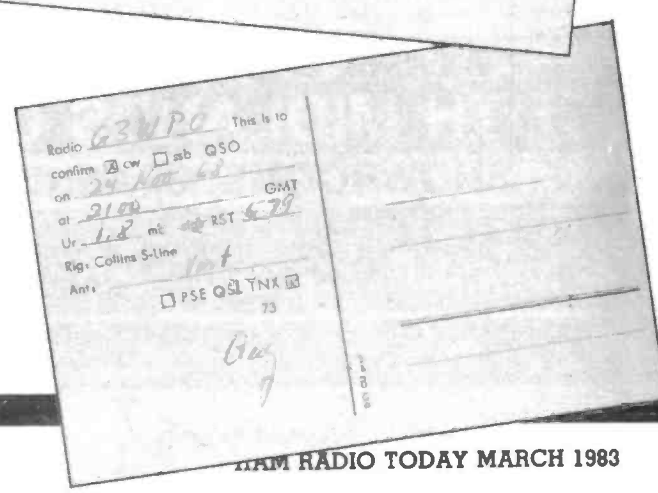
by **Andy Emmerson, G8PTH**

What's in a call sign

A radio callsign can in fact speak for itself, telling you about the class of station it refers to and the date when it was issued. The history and lore of callsigns has fascinated me for some time, particularly since this subject has not attracted a lot of attention in books and magazines. This, then, is a distillation of the facts concerning British callsigns, based on random references found in print and heard on the air.

Right from the earliest days of experimental radio, callsigns appear to have been harmonised by international agreement and took the form of a number followed by two (or three) letters. No differentiation was made, in Britain at any rate, between amateur, industrial and broadcast stations, probably since they were all classed as experimental. Thus 2LO (BBC, London) and 2MT (Marconi's Wireless Telegraph Company, Chelmsford) appear deep in the midst of the list of mainly amateur calls, and it is clear that callsigns were issued 'out of sequence' to anyone who desired a memorable combination of letters. National prefixes were not used and complications started once international DX became possible. For the amateurs this problem was solved in a very practical fashion, and the early DX workers just added a single letter prefix to indicate their country. This was generally written as a small letter on QSL cards and the like, since it was not part of the official callsign. British amateurs used g (for Great Britain), France had f, and Americans used y (Yankee), a (America) and u (United States). In due course the matter was regularised with internationally agreed prefixes issued to amateurs. Some of those letters have since changed — originally Germany was D and the Netherlands EN.





In Britain the original 2, 5, 6 or 11 plus two letter calls were abandoned, and a new series starting G2, G3, G4, G5, G6 and G8 plus two letters were issued down to 1939. There was no correlation between old and new calls, thus 2AA did not become G2AA etc.. The G7 plus two series was used for special purposes: G7AE was an early Arctic expedition and G7FA to G7FH were used for clandestine contacts with Germany during the war.* Before the war an additional type of licence was issued, known as the 'artificial aerial' licence. Known nowadays as suppressed radiation, it is still beloved by the Home Office for test and development work, and the idea is that all transmitter development can be dome with a dummy load and without radiating. The callsigns for 'AA' amateurs comprised G2 plus three letters, and when amateur licences were issued once more after the war in 1946 the G2 plus three calls were re-issued to their original holders, this time with permission to radiate. Other calls held previously were also re-issued, and all new applications for licences received callsigns in a new series starting at G3AAA which continued until it was exhausted in 1971. The year 1954 saw two innovations, a mobile transmitting permit and a special television licence. This ATV-only licence carried standard G3 calls, suffixed /T. From 1964 these were transferred to the G6 plus three/T series to remove the confusion between class A licences and television licences (which permitted transmission on 70 cm and higher only). Existing licence holders kept their letters, thus G3NOX/T became G6NOX/T, but any new ATV licences started at G6AAA/T.

In 1964 the first class B (VHF/UHF only) licences were issued, with callsigns starting at G8AAA. Two years later, in 1966, the G5 plus three series was inaugurated as reciprocal calls for foreign amateurs operating in the UK. G5AAA to G5LZZ were set aside for class A licencees and G5MAA onwards for class Bs. In 1971 G3ZZZ was issued (so they're not all geriatrics!) and new class A calls were issued starting G4AAA, still going strong. The separate licences for mobile and television operation were abolished in 1977: mobile operators had previously used their normal call suffixed /M and this did not change. TV amateurs, however, lost their G6 plus three/T callsigns; if they already held a sound licence then this was the call they were to use, otherwise they were allocated a new G8. If they later graduated to class A they regained their original G3 callsign, minus the /T suffix of course, if they had held one, and this is what Jeremy G3NOX did (just for sake of example!). Complicated, isn't it?

Since then, the only major change has been the exhaustion of G8 plus three calls in 1981 and the consequent start of the G6 plus three series for new class B licences. These are still being issued apace and look like running out in the not too distant future. There is some speculation as to which series will be used next: G1 and G0 are unlikely and G9 is definitely 'out'. The G9 plus three series is in fact allocated to non-amateur test and development licences, mainly for industrial purposes. A notable example was G9AED, issued to the mobile TV transmitter built by Belling and Lee Ltd for service area tests before the start of band III broadcasting in the mid 1950s. Many TV dealers used the G9AED testcard for demonstrating television sets just before ITV started. Quite a few amateur radio dealers use G9 calls for testing rigs on the air, and several G9s have been issued in connection with the new UHF CB radio service, including my own G9BUP. The fact that this was issued on 31st March 1981 shows that the G9 series is likely to last for many months to come.

So far I have mentioned only G as the national prefix: there are in fact several. GD (Isle of Man), GI (Northern Ireland), GJ (Jersey), GM (Scotland), GU (Guernsey) and GW (Wales) are all in use, and until recently GC was used to signify the Channel Islands. The GB prefix is used for beacons, repeaters and special event stations. Suffixes in use include /A (alternative address), /M (mobile) and /P (portable). More exotic are /MM (maritime mobile), /MA (maritime anchored) and /AM (aeronautical mobile). In some countries (for example Belgium) /T (television station) and /F (special event station) are also in use. Within the actual callsigns three letter combinations commencing Q are not used for fear of confusion with international Q-code messages, and British callsigns incorporating the figure 1 are rare (GB1RS news bulletin during the early 1950s and GB11ARU special event station in 1981).

By international agreement British calls can start with not only G but also M or various combinations commencing V and Z, also 2AA-2ZZ, so there is little risk of running out of callsigns. Finally, not all callsigns, heard on the bands are amateur stations of course. Three letter stations include standard frequency transmissions (e.g. GBR and MSF at Rugby), coast stations (e.g. GNF North Foreland) and government departments (e.g. GMP). Calls with four letters are ships and five letters are aircraft. Further details are given in the official Handbook for Radio Operators, published by HMSO. This is a fascinating book and is well worth adding to the shack bookshelf: it contains the full list of Q-codes for instance. ●

**Bitte QRX, Krieg* by Michael Ockendon, G3MHF (Short Wave Magazine, June 1981).

23cm Transverter Kit

USL 2 Linear Amp

Keith Smith G3TLB builds a 23cm transverter kit and describes the heartache in his inimitable style

Good Grief, what the heck have I let myself in for? Not my exact thoughts, but that will suffice.

"At first the three transistors are to be inserted from the backside . . . done as follows:

"Sign the collector connection (chamfered flap) on the transistor cabinet by a white point."

What the hell are they talking about?

"The collector and basis flaps . . . they have to be cut with scissors. . . . "The emitter leads should lie planely on the grounded surface . . . is now slipped on provisionally and then screwed."

Did this really come from Germany, or was it Sweden?

" . . . for guaranteeing a plane resting . . . they will break, if the nuts are screwed!" You wait 'til I see Frank the editor of Ham Radio today. He didn't tell me this was soft porn.

Transistors fitted without too much trouble.

"The small trapezoid capacitors are bushed through the punched out slots . . ." Which slots? There's only one. I see . . . the guy got tired, only cut one and left the other for me to cut. How do I cut a slot 1mm wide by about 5mm long? Drill small holes and join them up. Haven't got a 1mm drill. Tried Jack (6KTS), he hasn't got one. Tried Frank (4LDJ). He has. Slot cut at Frank's. When fitting trapezoid (small leadless) capacitors, make sure it is not shorted out on ground plane side of PCB.

NOTE (added later) — Although not shown on this instruction sheet the following is shown on the UEM2 instructions:

"Note some of the track will have to be removed with a small file to prevent a short across the capacitor."

Don't like fitting the trapezoid caps on the track side. They are coupling caps fitted vertically on the PCB between two pieces of track.

What the hell does Dr1, Dr2, etc mean?

Looks at circuit and circuit notes. Dr1, Dr2, Dr3 = 0.15uH (Neosid).

Ah, they are chokes.

Dr4, Dr5, Dr6 = 1 Wdg 0.8mm ϕ Cu Ag über 3mm Dorn.

Can only assume 'Dorn' means diameter, so shall wind these small coils accordingly. Although the wire is supplied, there is only just enough.

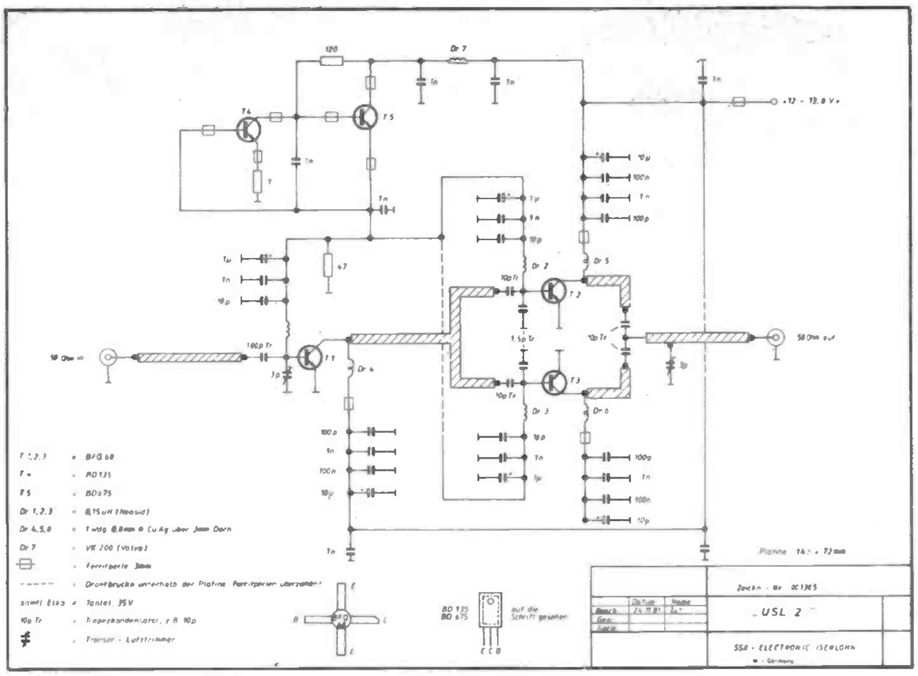
"The RF leading connection of the trimming capacitors is shortened up to the ceramical bead and is soldered then as short as possible with the printed line".

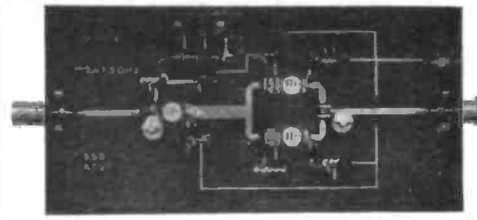
Who did the translation? "the signatures of the transistors are directions to the PCB."

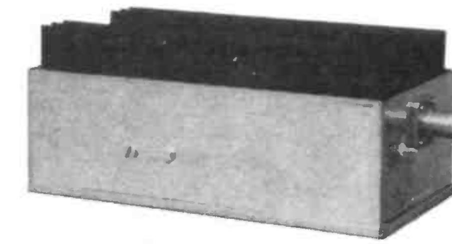
Completed board. Now to solder the two halves of the case together. The BNC input and output sockets must be fitted before soldering case together. Case is made of quite thin tinplate and easy to solder, although you wouldn't think so when reading the instructions.

"Before being inserted into the white iron cabinet."

Fitting PCB into box entails soldering input and output line PC to centre pins of BNC sockets, then soldering the earth plane side of board to the box all around edge. It is a fiddle fitting the two bias supply transistors, T5 and T6. There is a ferrite bead on each lead of the transistor which tended to fall off while trying to feed the leads through the holes in the PCB. The mounting hole in the transistor then lines up with the hole in the mica washer and one in the case side.







Bumf from 23cm power amp module. Keith's interpretation (above).

A small soldering iron bit is a must, particularly when fitting the two 10pF trapezoid caps at junction of the collector lines and output line. These caps are mounted vertically on the PCB between the ends of each line, and very close together, there being only about 2 to 3mm spacing.

Generally, construction is straightforward.

Fitting the trapezoid capacitors for the first time, be it the ones through the board, or the ones mounted vertically on the board, is none too easy. Muriel (Mrs G3TLB) helped when fitting the vertically mounted ones. Pair of long nosed pliers were needed.

Assembly instructions are poor, and obviously translated from the German by a non technical person; that's an understatement!

There are three 1nF and two trapezoid caps spare. (Don't think I've missed any). A small container of heat conducting paste is supplied, more than is needed. Oh yes, instructions read: covered with warm conducting paste."

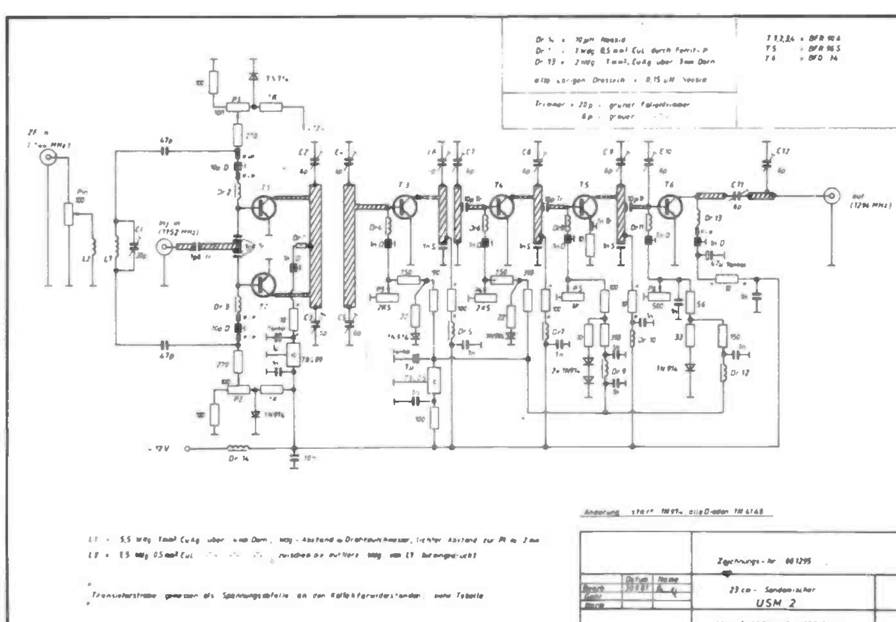
Adjustment instructions are also given but this will be dealt with later.

USM 2 (Universal Transverter).

Here we go again, more German/ English! Oh no, "At first all feed-through capacitors are soldered in..." Good, they are standard solder-in feed thru's. "also all the three disc-type capacitors ..." They go thru' the board but the slots are there. "... and the trapezoid capacitor to the emitter of T5". You've guessed it, no slots cut. Contacted Chris (4HCA) this time, he has small drills. Cut slot round Chris's. Why can't they be consistent?

What are they on about? "Then the capacitors T1-T5 are placed into 4.5mm boreholes." Looked at circuit, T1-T6 are transistors!! "The legends of the transistors T1 and T2 show once upwards and once they show downwards." This may sound like double dutch but is quite easy to understand after consulting the German layout diagram!!

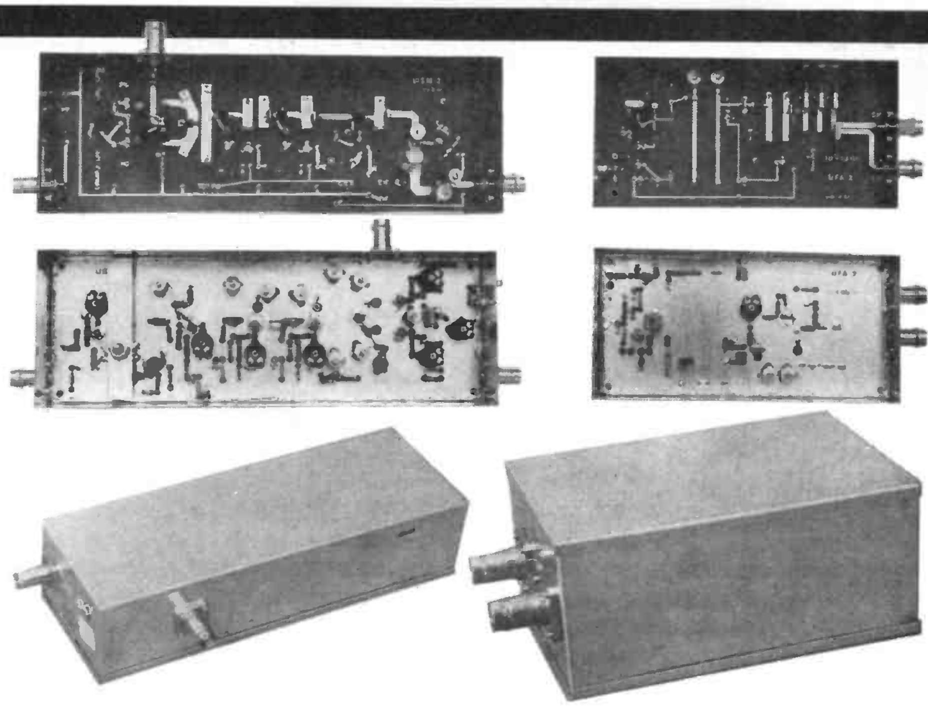
This is a real beauty: "With the rest-sheet of the emitterleads of T6 now the second Filtercircuit after the mixer is contacted through to the ground." Now, if you can understand this, you are a better man than I, Adolf. Some time later, after having worked out what the above means, I now translate for you: When fitting T6, BFQ34, you have to cut off some of each emitter connection (usual flat RF power transistor pad). At the base of T4 there is a printed strip line. At the earthy end of this line there is a slot (actually cut!) through the PCB. The line has to be earthed through to the ground plane side of the board. Yes, you are right, you use the offcut of the emitter to carry out this



technical feat. Note — it is not good enough to use just a piece of wire earthing the lines, a piece of copper foil, or emitter offcut must be used.

No problems for a while and a lot of components have been fitted. Here we go again: "The diodes at T5 and T6 are contacted thermicly (sic) to the transistor for cabinets with heat-conducting paste". What it actually means is that the diodes lie across the top of the transistor in thermal contact with it! Yet another prize one. "The coil L2 of enamel copper wire is pressed between the middle woundings of L1, to reach an as high as possible coupling degree". Shove L2 into the middle of L1 as far as possible!

PCB completed and checked. This is the largest kit, having about 110 components to fit. The BNC sockets must be fitted to the case sections before the two halves are soldered together. PCB is fitted in case and soldered all round.



Construction is straightforward once you understand what they are talking about! It is not at all easy to solder between the two lp8 trapezoid capacitors at the bases of T1 and T2. As with the USL 2 Linear, they are very close together. In the base bias circuit of T5 there are two diodes in series, both of which have to be in thermal contact with T5, and this is not easy to achieve. The series regulator, type 78LO5 which feeds collector volts to T1 and T2 is incorrectly orientated per the German layout diagram but has been shown correctly in biro.

Setting-up procedure is given but has yet to be studied closely — it looks frightening! Good grief, these assembly instructions are actually in English. Obviously translated by a different person. At least these instructions explain that, where the strip lines are earthed thru' the PCB, it should be done using copper foil or offcut of RF power transistor tab and not to use single piece of wire. They state that "this point must be a low inductance."

Great, no slots to be cut, both already done. Board completed without any problems. BNC sockets fitted and case assembled. PCB fitted in case. This would appear to be the easiest unit to construct. Coils, capacitors, and chokes supplied for three alternative IF's — 144MHz, 62.25MHz (obviously a German VHF TV channel,) or 28MHz.

Setting up instructions given but not yet attempted.

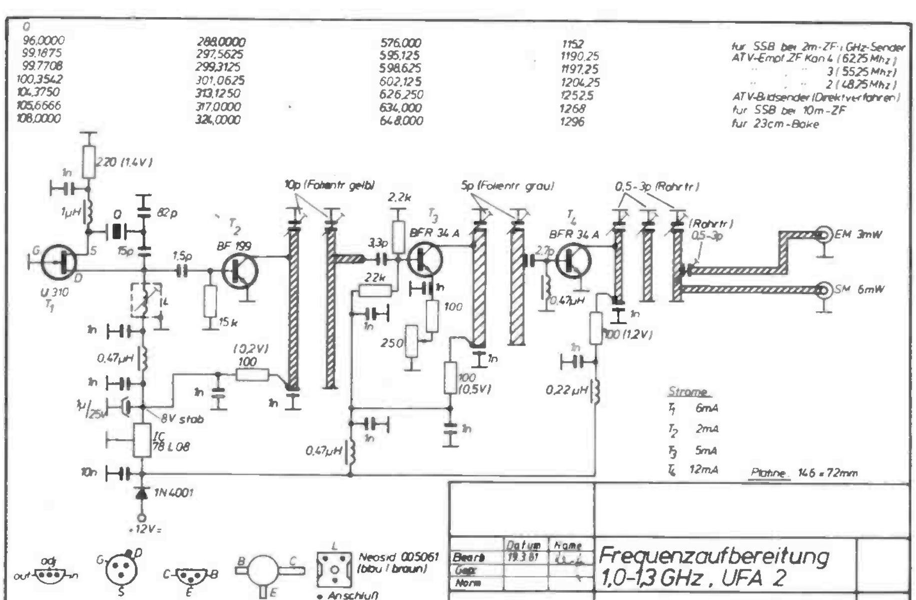
UFA 2 (Oscillator/ Multiplier)

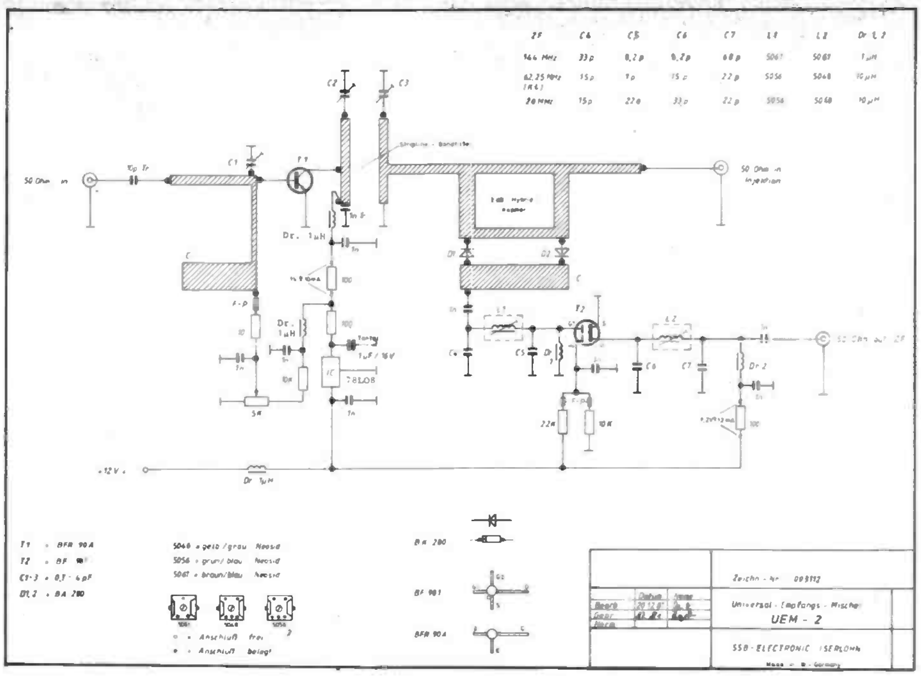
I don't believe it, these instructions are also in English! Ah well, don't talk too soon, more slots to be cut. At least they are consistent with this board: "... should be connected through to the earth plane by forming a thin slot from the two holes in the PCB ... again the end of the stripline must be slotted ..." All eight slots to be cut!

Out to buy two (one spare!) 1mm drills. (one spare!) Thinks, must remember Frank owes me some money for these.

Thank goodness that's the last of the slots to be cut. Will cut back the earth plane later so that the chip capacitors don't short out. First soldering recommended is to earth those striplines which require earthing. Have used the remainder of the offcuts of the RF power transistors on kit USL 2 (just as well I hadn't cleaned the bench off).

What I have just said, out loud, is not reproducible in print. Oh dear, I've broken a 1n chip capacitor! At least now I shall never complain about kits having extra components. There was one spare on the USM 2 — it's difficult to know





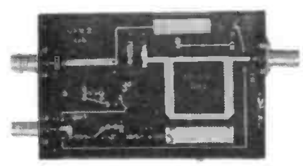
100 ohm resistor and 0.22uH choke in the supply to T4 collector. It's not shown on the layout diagram although the pad is shown. Lovely, the boards finished, but whats this? Two ruddy resistors left over — one 150 Ω and one 68 Ω. Check circuit and they are nowhere to be seen. Looks at original German instructions and there we are — " . . . , den Emitter-Festwiderstand zu variieren. (68,150 Ohm) Der Wert dieses Widerstandes . . ." etc. Must find out what that means! They are not consistent. On the other three units they supplied a solder tag to solder to the outside of the case for the negative supply, on this unit they haven't.

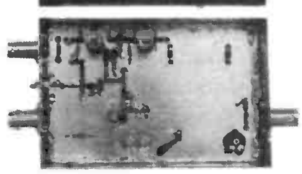
In the pictures of the unit in the German instructions they show the +ve connection feedthru' in the case beside the crystal, not over the +ve pad on the PCB, where in fact it is actually located.

Components left over as previously stated — 2 resistors, 2 capacitors.

whether they are spare or you've left them out! I'm afraid my promise not to complain, about extra components, is short lived — doesn't stop me complaining about other things. As suggested in the assembly instructions, I am reading them in conjunction with the circuit and layout diagrams. The "Bestuckungsplan (Leiterbahnseite, Atzseite)", whatever that might mean, shows a 27pF chip capacitor. I look in one of the little packets and what do I find? One definite 2.7pF, and one which could 2.7, or it could be 27pF. Is it a dot, or is it a piece of dirt. I decide to put in the one which could be 27pF. Fine, so read on in the instructions. "The base lead of T4 is bent up at 90° such that it can make contact with the vertically mounted leadless coupling capacitor (2.7pF)." Yes, you've guessed it, they were both 2.7pF in the packet. The "Bestuckungsplan . . ." is wrong, not 27pF. One 2.7pF to go on the PCB, and one spare. (What did I say about spare capacitors?) The circuit shows a 15pF, the "Bestuckungsplan" shows 15pF, between the Drain of T1 and the crystal, but they supply an 18pF — ah well, lets use it! There's another spare capacitor but no value on it — looks the same as the 1n used.

Commented earlier about consistency on this board — no, not another slot, but one hole to drill for one end of the 1uF Tant. capacitor that's shown as 2uF on the "Bestuckungsplan", and 1uF on the





circuit! Oh no, is this some secret plan to drive G3TLB mad? Just one RF choke left and its a 0.47uH. What do I need? A 0.22uH. Ah well, put it in and see if it works. *Note* — unfortunately I'm not clever like the editor, he would know immediately whether the change in inductance (must find out what that means) would make any difference. Last thing to do, put it all the 1n miniature plate ceramic caps, but have one left over — Checks PCB against "Bestuckungsplan (Volkaschierte Seite)" and have put in all those shown. Checks board and have one spare hole. Checks circuit and yes, thats where the last 1n cap goes — at the junction of the

General comments

When Mr. Ogden, your 'Hon. Ed.', said to me "Here Keith, how do you fancy building some kits?", he didn't mention anything about having to take a crash course in Technical German. At least we have all become used to Japanese/English with the instructions to our 'Black Boxes'.

I can't understand why they have perfectly good, well translated instructions to two units, and poorly translated ones to the others.

The original German literature supplied looks well presented, and good quality components are used.

For all my moans, it was a real pleasure to build these kits and make use of that thing called a 'Soldering Iron'.

Plans are in hand to construct a 'Cavity Wavemeter' and 'Simple forward power indicator' from information given in the Test Equipment section of the RSGB VHF/UHF Handbook. These items are necessary for setting up the units. *(Piper Communicatons, the kits' distributor in the UK, tells us that new instructions — in the Queen's English — have now been prepared. — Ed.)*

The next report in this series covers operational and laboratory test reports.

Getting started in ATV

Learn what it takes to be seen in this growing activity group...

by Andy Emmerson, G8PTH

If you've ever tuned across 144.75 MHz on two metres you may have heard ATVers talking: you may even have been asked to QSY if you thought it was a quiet channel! This is because 144.75 is the international calling and talkback channel of amateur television (ATV) and if you listen in you'll probably hear a strange language of vidicons, monitors and P-points.

Depending on your inclinations you may have dismissed this as the obscure ravings of a fringe activity group or perhaps something mildly interesting, worthy of closer attention some time in the future. Amateur television has not received a great deal of attention in the past (except the occasional 'look at these wierdos' spot on the local TV news) and the legend has grown up that to work ATV you need (a) pots of money, (b) crates of valves and racks full of equipment and (c) a post-doctoral degree in electronic engineering. Contrary to all this, in fact you need just common sense, perhaps some good luck and definitely an oscilloscope.

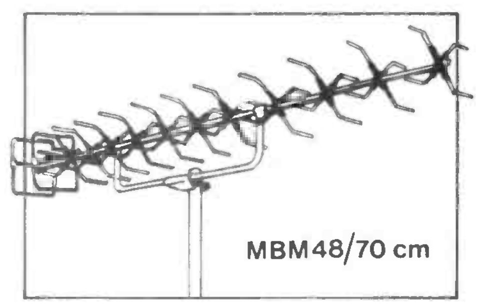
What is the fascination of ATV? It's obvious really, because ATV gives you the ability to make visual contact and see the person you are talking to. Amateur radio is a satisfying hoppy in itself but there is an even greater sense of achievement in making visual communication. You can show circuit diagrams, let people actually see your latest construction project — or your family. You can demonstrate your own video recordings, work TV contests or send test cards to test transmission characteristics at different power levels. Perhaps best of all is the thrill of working a station some 200 miles away in say, Holland, and have someone there read back the small print on your test card, thus providing the DX reception of your few watts of TV signal. For me — and many others — ATV is more satisfying than, say, RTTY, slowscan TV, microcomputers or some other speciality mode, yet you can combine any of these with ATV and retransmit via "cross mode".

How much power?

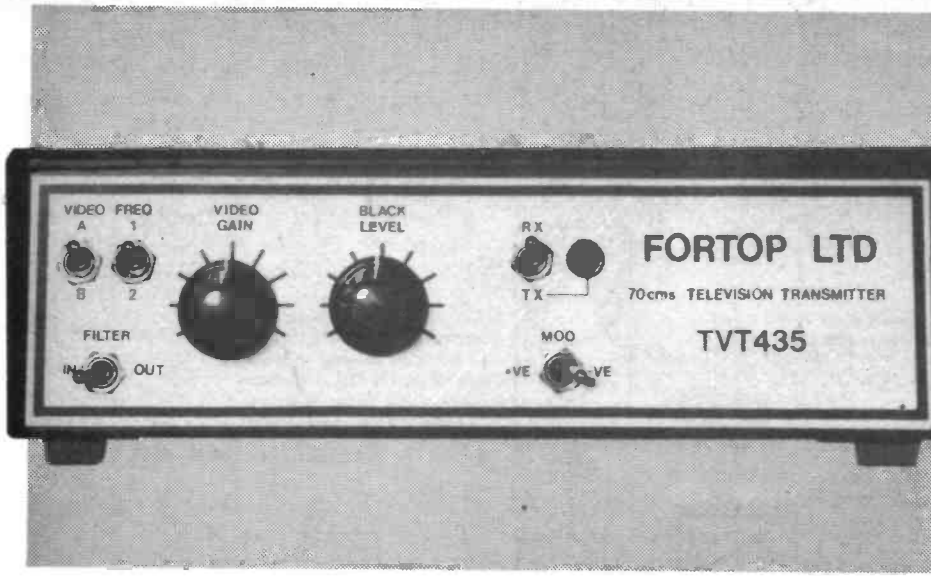
But from now on I shall assume you're hooked (otherwise you wouldn't have read this far) and I'll describe how you can get started in ATV at a reasonable cost and without making the mistakes which might be costly or time consuming. The first thing you must do is join the British Amateur Television Club — BATC for short. The BATC has well over 1500 members now and supports them with an excellent magazine, constructional handbooks, cut-price supplies and the organisation of contests and conventions. What's more the BATC is the only body which supports ATVers in this country. You can join the BATC for £4.50 (address at end of article). Next you want to read as much as you can about television and how it works — you can never know too much! You local public library will have some books on TV theory and even if they are a bit old they will doubtless have some value.

Next you will want to start playing around with TV. There is a great temptation to rush out and get a transmitter but I don't recommend it — take it gently and do things in stages. Get experience by watching other people's transmissions and by producing video in the shack on a close circuit basis. None of the equipment you acquire will be obsolete when you start transmitting, and you can build up valuable experience with only a gradual drain on your wallet.

So what do you need to begin? Well, you must have a reasonable site from a UHF point of view. Buildings, trees and hills absorb RF like a sponge at UHF, so if you live in a deep hole you'll have to move home first. Range on 70cm TV (we'll assume you start with 70cm and not 24cm or the microwave bands) is more or less like simplex FM: 10 watts of TV has about the same range as 2 watts of FM On two metres, around 50 watts of ATV will go as far as 10 watts of two metres. You'll need a good aerial mounted as high as possible, at least above roof and chimney level, and you must use good feeder and connectors. PL-259 plugs are out and so is bootlace co-ax otherwise you'll just be throwing away your signal. UR



The Multibeam design of antenna is a popular choice for amateur television enthusiasts. The 48 element MBM 48/70, made by Jaybeam Ltd., is very satisfactory and costs around £31.



Typical of the seventy-centimetre ATV transmitters on the market is this model from Fortop Ltd.. It delivers 15 watts output and costs £148.50 including VAT.

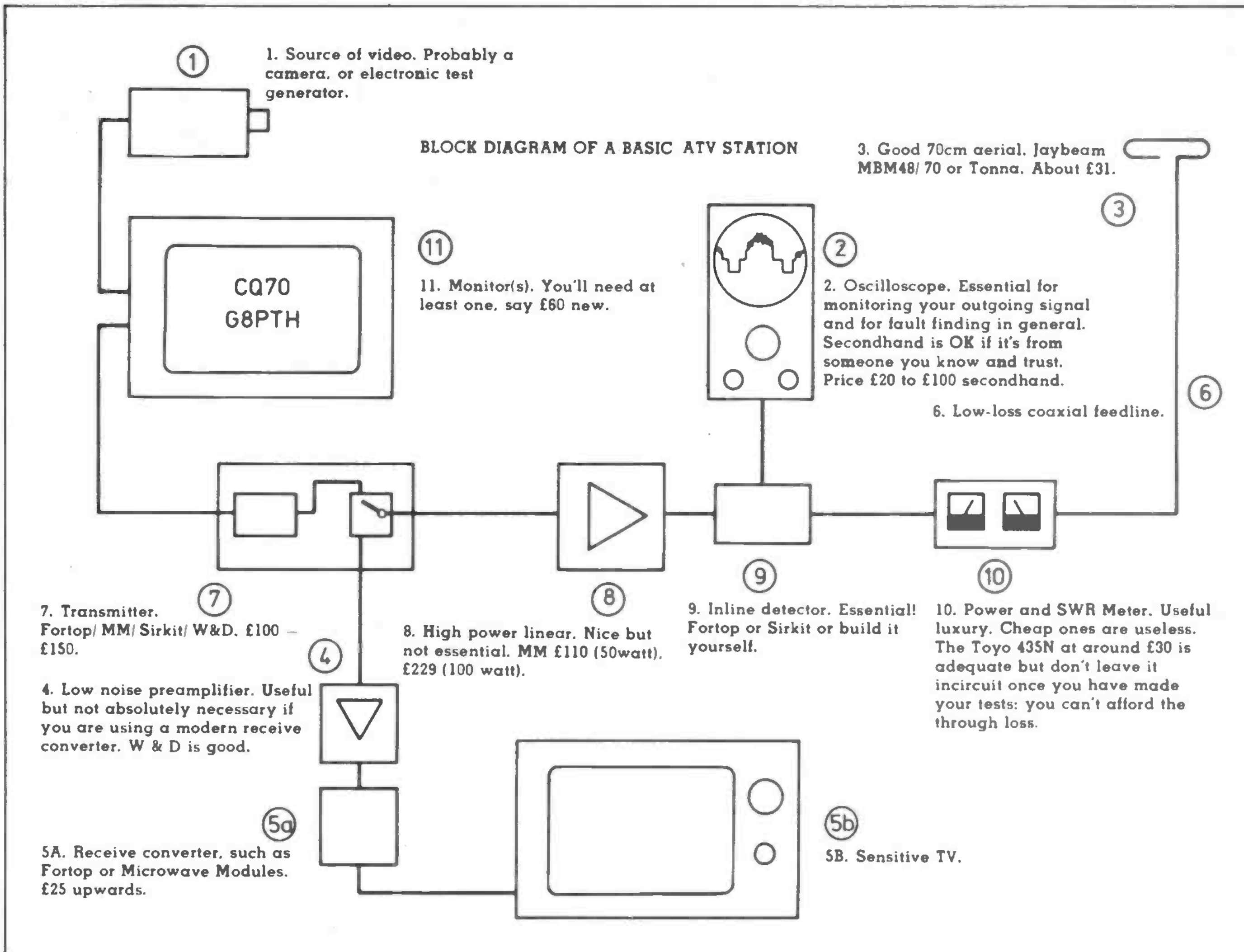
67, RG-8 or RG-213 types of cable are the minimum standard of cable, with BNC or N-type connectors. New prices for these are high, but you will find very good prices at rallies and W.H. Westlake does some excellent bargains in the cable line. A good aerial means something like the Jaybeam MBM48/70 which is used worldwide and is ideal. Alternatives are the Tonna ATV aerial or the Jaybeam 8 over 8 design. Their 88 element design has more gain but this is offset by the larger size, higher price and narrower forward beamwidth; it's not for the beginner. A masthead preamplifier is a great help, but unless you use separate transmit and receive aerials (extravagant) you'll need some kind of relay or RF switching mechanism to put it out of circuit when you are transmitting through the aerial. For watching transmission you will need either a TV which tunes 70cm (a lot of modern ones do, particularly Japanese ones) or else a receive converter which transfers the incoming ATV signals to channel 38 or 40 so you can watch them on a normal TV (ideal if it is rented). Use a decent TV of course, not some old wreck which may be totally insensitive.

For producing video signals you are bound to want a camera. If you are satisfied with monochrome, there are a lot of Japanese home video cameras being dumped at silly prices (£75 or less) or you can pick up secondhand examples for less (see Exchange and Mart). Used surveillance cameras can be picked up at amateur radio rallies for prices of £35 upwards and can be good bargains, though you should m ake sure a lens is supplied otherwise you can end up spending more on the lens than on the camera if you buy new. Cameras and other equipment are often advertised in **CQ-TV**, the magazine of the BATC, another reason for joining. Construction kits for cameras are seldom good value. Colour cameras seem to be coming more common in ATV shacks nowadays and you may find a good bargain in home video shops. Of course, if you are already into home video production you may have this sort of thing to hand anyway.

The right equipment

You will want a monitor for watching and checking your video. One is essential two are nice but more than two may prove to be an embarrassment. If you have more than one source of video a switchable 'preview' monitor is handy. Compact small-screen monitors are pricey, say £50 upwards new, but if space is not a premium you can usually find old valve monitors for £15 or £20. These are an excellent substitute for central heating in the winter as well. But they do take up a lot of room. Test patterns, produced electronically, can be useful and can look very professional if, for instance you build the BATC design of colour testcard. They save using (and getting out) the camera, and the simple designs are cheap to build using TTL chips. The BATC Handbook volume 1 has some excellent designs, and you can get this book from the BATC or the RSGB. A video recorder is also a great advantage in the shack: you can use to capture on tape those rare DX contacts and to prepare demo tapes of a conducted tour of the shack. If you get, say, a Beta or VHS machine, even a cheap secondhand or obsolete model, you will be able to swap tapes with others — and record programmes off normal TV. Buying an old black and white reel to reel recorder may not turn out to be a bargain. Prices start at £50 but spares and tapes may be hard to find, and some are 405 line machines (but the seller doesn't tell you). Try and get a written guarantee if you buy an old machine.

When you start transmitting you will need a transmitter (that's pretty obvious) plus some other gadgets (which are not so obvious). Commercially made transmitters, although a newish phenomenon, are quite easy to pick up nowadays and this has made it possible for a lot of new ATVers to get on the air. There is nothing wrong in using off-the-shelf gear when it comes to transmitting ATV: UHF construction techniques are not easily learned from books, and you can spend a lot of time and/or money building a project which in the end still does not work. (I did.) Ten watt TV transmitters for 70cm are made commercially by Microwave Modules and Fortop Ltd.: both are good and cost around the same price. Their features are slightly differnt so it is worth checking out both. If you want to reduce the initial outlay you might consider the Wood and Douglas 3 watt transmitter, though you will have only local contacts with 3 watts. You can of course add a linear amplifier later to bring up the power to the normal 10 watts. Depending on how ytoui wire up the station you may need a transmit/receive switch to connect either the transmitter or the receive converter to the aerial, but some transmitter designs have this built-in. What you will also need is an in-line video detector and oscilloscope to monitor and adjust your transmit-



ter for maximum power and a clean signal. You can **not** do this by watching your own signal on a TV set: it just overloads and this is the reason for those weak, distorted transmissions you get from more-money-than-brains stations. These inline detectors are sold by Fortop and Sirkit, and there are DIY designs in the RSGB VHF Handbook and the BATC Handbook.

Later on you can extend the station — there's always something to do (or buy!) You can inlay your callsign and the time into transmissions electronically, and some amateurs have gone to town on special effects. A TV typewriter (or a home computer) is also handy. You may wish to increase power:. most people do. Unfortunately the cost is high if you use a linear amplifier and raising the output power from, say, 10W to 100W does not result in a tenfold improvement in range or picture quality. Valves give better linearity than transistors, and the EDL 432 linear amplifer, equipped with a 2C39, was ideal but it is now off the market. The Microwave Modules power amplifiers are not bad but beware of overdriving them, otherwise you will have very non-linear results.

By now you will hopefully be convinced that ATV is the mode for you and I guarantee you'll get a lot of fun out of the hobby. Even when there's no RF activity you will always haye construction projects for the shack, with a constant technical challenge. On local nets you will get to know kindred spirits and learn to improve your operating techniques, so that when the tropo lifts occur in spring and autumn you can work the real DX like a professional. Distances of 200 miles or more and contacts to france, Holland, Belgium and Germany are possible from most parts of the UK under lift conditions. Ten watts is quite adequate on 70cm, though a linear is always an advantage. So if you're not already into amateur television get started! See you on the air . . . ●

NAMES AND ADDRESS (Enclose an SAE when writing; nobody likes giving away stamps)

BATC
Brian Summers G8GQS, 13 Church Street, Gainsborough, Lincs...

FORTOP LTD.
13 Cotehill Road, Werrington, Stoke on Trent, Stafs...

MICROWAVE MODULES LTD.
Brookfield Drive, Aintree, Liverpool L9 7AN...

SIRKIT PROJECTS
'Benbow', Widecroft Road, Iver, Slough, Bucks...

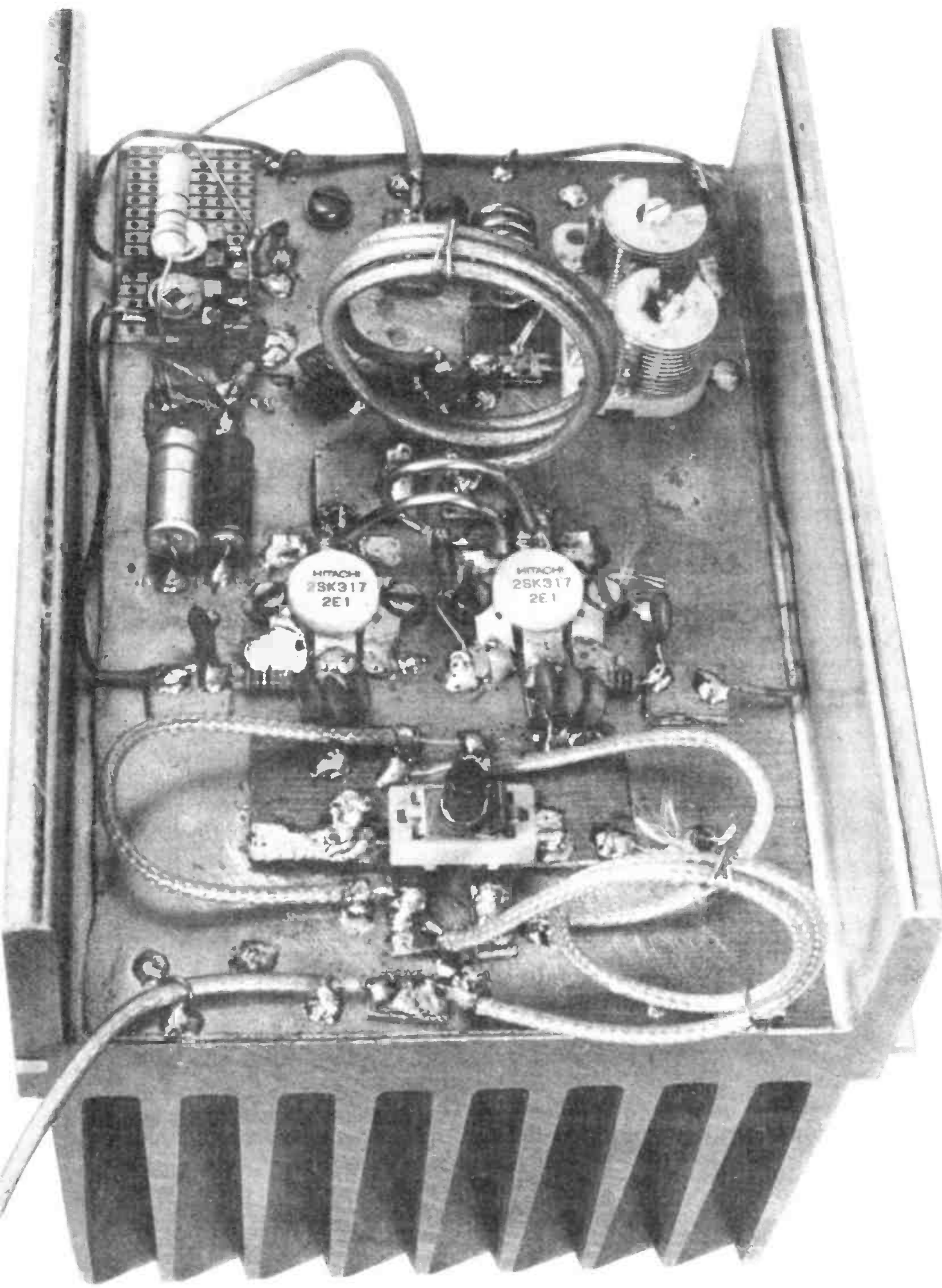
W.H. WESTLAKE
Clawton, Holsworthy, Devon...

WOOD & DOUGLAS
9 Hillcrest, Tadley, Basingstoke, Hants., RG26 6JB.

Technicalities

Getting rid of unwanted RF — Compact Top Band aerial — 250W MOSFET linear — 23cm test source

By Frank Ogden G4JST



This month we've got something rather special in our technicalities column, perhaps even a world first. We offer you a look at the continuing development of a 250W MOSFET linear amplifier for two metres. Yes. Big 2SK317 VHF MOSFET transistors running push-pull for the ultimate in 2m linear QRO. But first to the pedestrian: hot HF gear.

Hot gear

By 'hot' I don't mean stolen. Neither do I mean high performance. I mean when everything in the shack is crawling with finger burning RF, enough to leave those little white scorch marks and the nasty smell of burning human flesh.

VHF people with their neat feeders and compact aerials with built in baluns don't suffer the problem. Neither do HF operators who have about £10 million to spend on the latest thing in ready made tri-band Yagi arrays. It's simple backwoodsmen like myself who get along on most of the HF bands with a length of wire strung down the garden. The trouble is that the current flowing in the aerial is reflected in the earth return with such a simple unbalanced system. If you operate with three 4CX250B bottles in parallel as I do, then the return current may amount to several amps.

The typical arrangement is shown in **Fig. 1.** The TX is coupled to the ATU from which sprouts the now tuned aerial wire and the earth return. Unless it is very short, the earth return will have appreciable inductance and RF current flowing in it will cause an EMF to be developed across it. At a significant fraction of the operating wavelength, the earth wire may well have upwards of 100V of RF developed across it. This potential is reflected back to the equipment which is now live enough to produce quite serious RF burns.

I have actually watched a desk lamp, placed on top of the ATU, start glowing without being plugged in. That is how serious the problem can become.

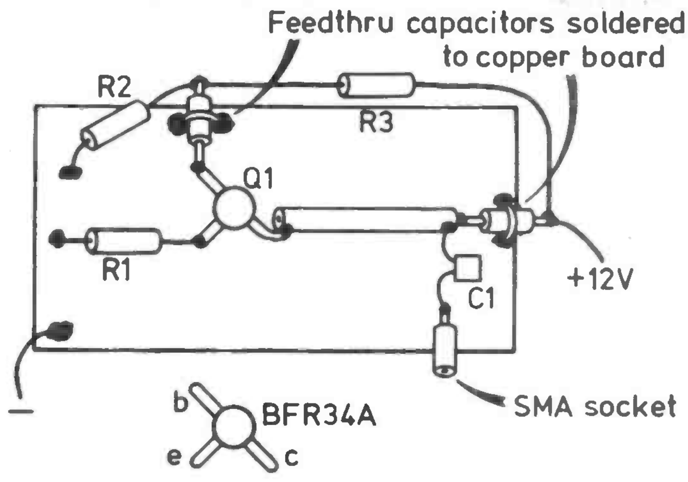
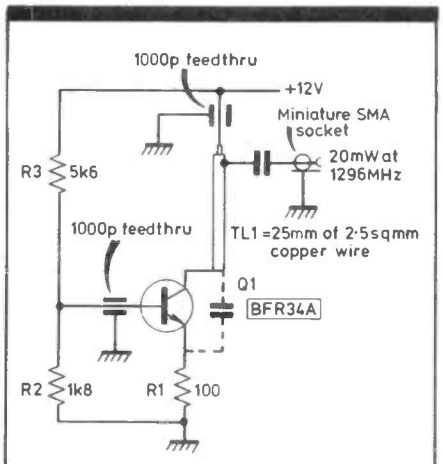


Fig. 6 23cm test source, actual size.

A cure can often be effected by the set-up shown in **Fig. 2.** By including a series capacitor in the earth return, the inductance of the wire can be tuned out. Electrically it forms a series resonant circuit which, of course, represents a short circuit across its ends. When used as the earth return, it has the effect of bringing the waterpipe, earth spike or whatever right up to your equipment.

It makes adjustment of the aerial a little bit tricker. You must resonate the earth return with a neon or similar device before you can tune the aerial for optimum efficiency. However, the sparing of third degree burns is well worth the extra aggravation.

It should be pointed out that the series C tuning system is limited to earth returns which are no longer than about one eigth of a wave length at the operating frequency.



23cm test source. Schematic diagram.

Top band aerial

It's a shame that more people have not yet discovered the delights of Top Band working. And it is a delight. No titanic power struggles, very few contests, just a handful Germans around 1830kHz and virtually no Russians. Marvellous. Furthermore, you can always get a report from the WAB net on 1930kHz. Very gentlemenly. I suspect that a lot of people are put off by the daunting lengths of wire called for by the classic aerial references.

Well, yes. The best signals on Top Band are those coming from hundreds of feet of wire set at hundreds of feet above ground. However, it is possible to put out a respectable local working (inter G) high angle signal with a fairly modest arrangement. I offer the following design from G4B something or other . . . apologies, I can't remember the rest of his callsign. I have tried the following arrangement and can report that it does work.

Fig. 3 gives the salient details. A wire from the TX ATU goes upwards to the eves or, better still, a mast attached to the chimney stack of the house where it passes through an attached insulator. It continues on horizontally down the length of the garden to a guyed aluminium mast at the far end. The top horizontal makes an electrical connection to the mast, the bottom of which is connected to a buried earthing mass such as an old water tank.

At the house end, the TX ATU is earthed to a buried metallic waterpipe or some other earthed object.

In reality, the system is a tuned loop with the ground making up the missing side. Certainly my own experience suggest that the system is about as efficient as it is possible to get within the confines of an eighth wavelength rear garden.

VHF MOSFET linear

About a year ago, Hitachi announced the development of a new RF power MOSFET family, the biggest of which could deliver a claimed 180W of CW at 100MHz reducing to at least 120W at 175MHz. Annotated the 2SK317, the World had not seen anything like this performance before. Companies such as Siliconix and Motorola have produced smaller devices but, apart from the sheer power capability of the Japanese device, there are two other aspects which set the Hitachi technology apart from the competition.

It is high voltage. The drain source breakdown voltage is greater then 180V. The other major parameter, perhaps even more important, is the reverse transfer capacity — the residual capacity between the drain and gate terminals. This is just half a pF, orders of magnitude better than anything else sold as an RF power MOSFET.

These two parameters alone are enough cause for interest. For instance, the high voltage capability means relatively high operational impedances for a given power level. This translates to high efficiency and high power gain — both of which our own development project has realised in practice. The optimal load impednace is around 20 ohms, an order of magnitude higher than

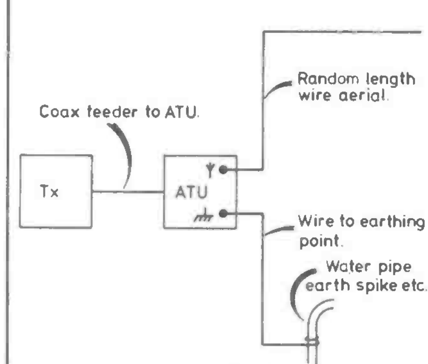


FIG. 1. Typical installation live with RF.

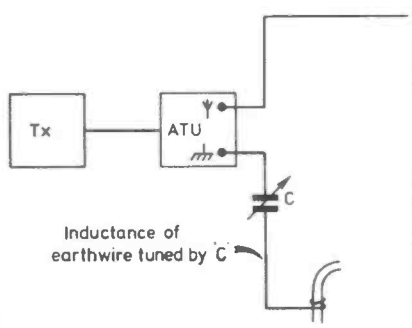


FIG. 2. Inductance of earth return tuned out with series capacitance.

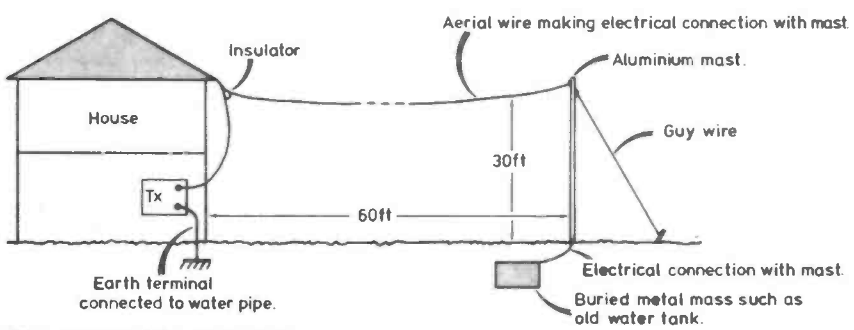


FIG.3. Compact 160m aerial system.

most of the equivalent devices in the bipolar camp.

The low feedback capacity results astonishingly simple circuitry. The technology reduces this design consideration from dominance to that of negligible proportions. The most dominant feature is the common source lead inductance, even more important becuase of the high gain present in the devices. In conventional terms the 2SK317 exhibits 16dB of gain at 144MHz.

Electrically, the device looks just like a very low impedance tetrode; it is even possible to resonate gate and drain circuitry 'cold' just as you would with a valve amp. However the transconductance measures in the region of 1A/V (one Siemens) while the input capacity weighs in at around 600pF. Output capacity is 90pF.

Although the gate insulation has a value of 100's of Mohms, the VHF input resistance is low. The input signal has to charge and discharge the 600pF input capacity through a real resistance of about one ohm — the gate metalisation resistance, substrate resistance, etc. In fact the MOSFET input approximates fairly well to a big bipolar device at (we estimate) 1R-2j. The ouput looks like a smaller bipolar collector circuit.

Fig. 4 shows Hitachi's own test circuit. The simplicity and similarity to a bipolar circuit cannot be denied. However, all you need to bias the device into linear operation is a small positive voltage applied to the gate through an ordinary resistor. There is no DC bias current with a MOSFET.

Furthermore, (according to the literature) the new technology has all the virtues associated with power MOSFETS: no thermal runaway, no second breakdown and all the rest.

As a promotional exercise for our magazine I persuaded my management to buy a couple of devices — and at £100 a time it took a bit of persuading. We have built a linear with what we believe will become the dominant RF power technology of the next decade. Having virtually no information to draw from, I went right back to first principles.

The design had to be push-pull to increase the impedance presented by a pair of devices rather than halving it which would have been the case with two transistors paralleled up. Why two devices? Because 250W is considerably more spectacular than 125W.

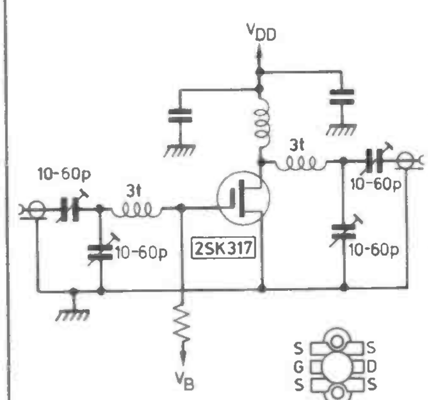


FIG.4. Hitachi's own test circuit.

The circuit given here is preliminary only and it may be modified as development proceeds. To date I have run the circuit up to the 80W level, 80V supply with just 2W presented at the input. When I have tested the design up to full power level (something undertaken very carefully in small steps; at £100 a time, I can't afford to bust anything) I will present it as a full project in HRT.

Circuit description

The development circuit schematic is shown in **Fig. 5. TL1** is the input balun with its far end connected to the inners of the 2:1 input transformer, TL2, TL3. The characteristic impedance of TL1 should be 50 ohms while TL2, TL3 combination should have a characteristic impedance of 25 ohms each. I didn't have any 25 ohm Teflon cable so I used 50 ohm cable for all three transmission lines. It seems to work OK . . .

The 2:1 transformer places an impedance of 12 ohms across the far ends of L2, L3 providing antiphase driving signals for Q1, Q2. VC1, L2, L3 together with the gate lead inductances of Q1 and Q2 match the 12 ohms of the 2:1 transformer to the 2 ohms series resistance presented by both transistors. L1, a variable light guage hairpin wire loop, provides fine adjustment of input VSWR after VC1 has been resonated for maximum power transfer. In theory L1 should not be needed.

Gate bias is provided via R1 and R2. Idling current should be adjusted for 200mA. Eventually, this will rise to around 6A on speech peaks when using an 80V rail.

L4 tunes out the drain-source capacitance of the devices while L5 slugs common mode parasitics. TL4, TL5 is a symmetrical output balun driving into the single ended Pi coupler, VC2, VC3 and L6. Not only does the coupler provide attenuation of any harmonic products (and there aren't many) but it also allows fine adjustment of the working impedance presented to Q1 and Q2. In theory, the circuit should operate satisfactorily without the coupler in circuit. Anyway, it makes valve people feel at home!

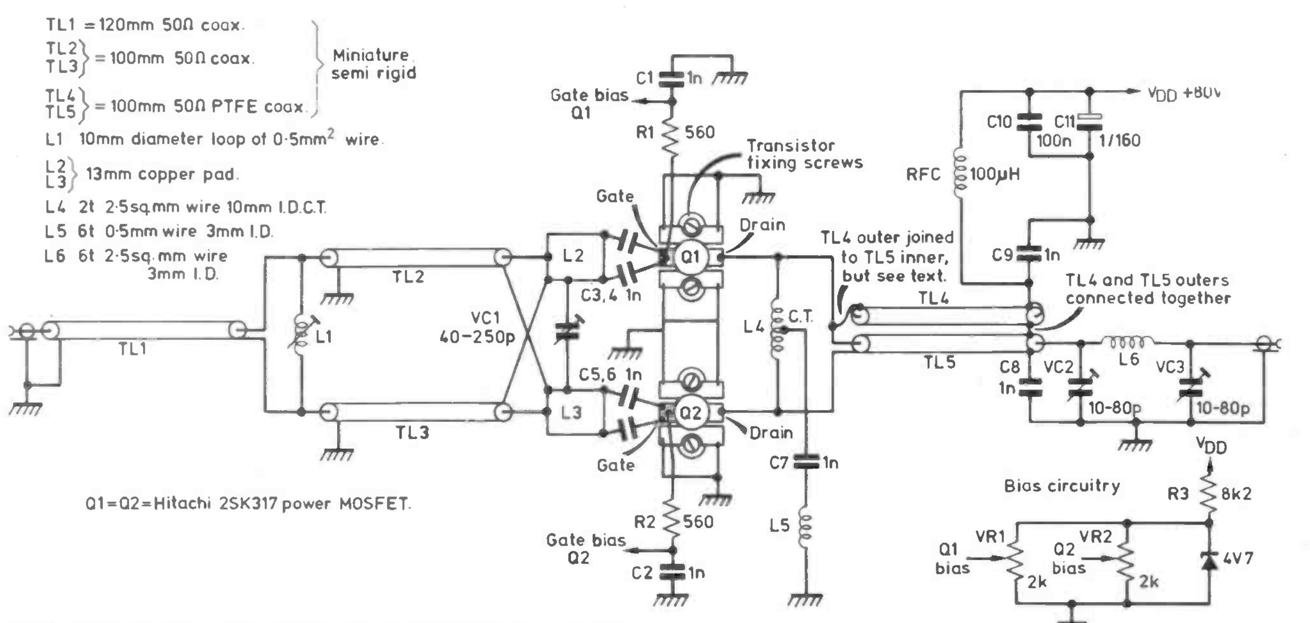
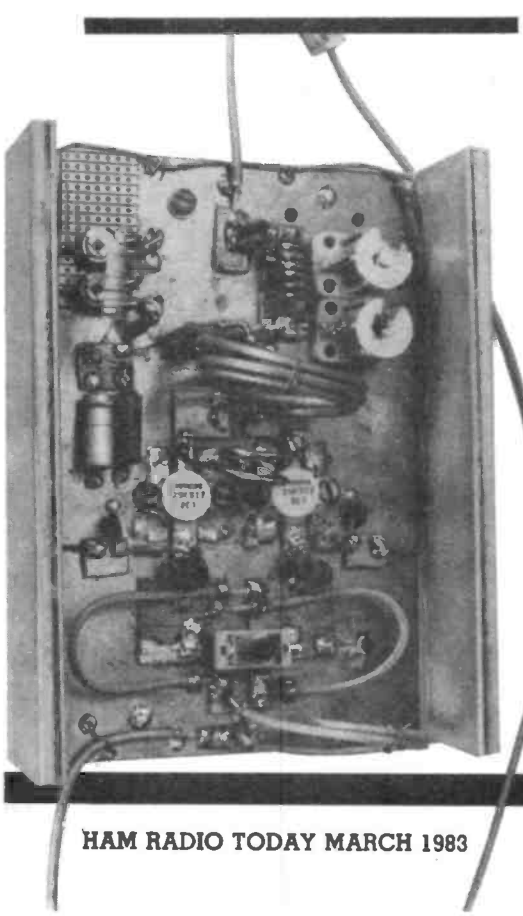


FIG. 5. G4JST development circuit for 250W MOSFET 2m linear amplifier.

The great virtue of the push-pull arrangement is that it virtually eliminates the need for incredibly expensive chip capacitors. The RF currents are all there but they tend to be self cancelling. There are no high circulating currents which require shortcircuiting to ground.

In honesty, it would be a good idea to replace the disc capacitors used to couple Q1 and Q2 to the input circuit with decent Unelco uncased mica caps. The circulating currents at this point are very high. Similarly, VC1 should have been a decidedly better component than I used in my prototype.



So far the transistors and the technology which they represent has lived up to the manufacturer's claims. I have run into one or two problems though. The output balun runs at a fairly high temperature, even at the 80W level. At present I have only a very limited supply of rather thin 50 ohm PTFE or Teflon cable. If anybody out there reading this has anything more substantial to offer me — just a couple of feet would be a great help — please send it to me, Frank Ogden G4JST c/o 2 Mallory Road, Hove BN3 6TB. Likewise, I would appreciate a similar length of 25 ohm PTFE coax to improve the matching on the input baluns. I have no 25 ohm cable whatsoever.

23cm test source

When I am not editing this magazine, playing about with MOSFETs or just simply out boozing, I look towards 23cm as an interesting band. In building some gear for this frequency, I had need for a simple, medium power test source to carry out a bit of 'cold tuning' (tuning circuits for approximate resonance before turning on the supply volts.)

Fig. 6 is the schematic of the oscillator circuit which produces about 20mW of RF in the 23cm band. Stability is surprisingly good although not anywhere near good enough for a precision signal source, for instance as a carrier for narrow band FM. However it is perfectly acceptable for active wavemeter applications. With the base terminal of the BFR34A transistor connecting directly to a feedthrough soldered onto a piece of laminate, the collector of the transistor connects to about an inch of 2.5 sq mm copper wire. The end of this is soldered to another feedthrough at the far end of the piece of board. See **Fig. 6** for the layout. A single 100 ohm resistor is soldered from the emitter of the transistor directly onto the copper laminate. The bias and supply components fit to the other side of the feedthru's.

By trimming the length of the copper line, stable oscillations can be obtained anywhere from about 1200 to 2000MHz. Power is extracted from the earthy end of the line via a small capacitor to SMA socket soldered to the card. The frequency should be checked by running a knife edge down a Lecher wire coupled up with a simple diode detector. The halfwave nodes show very clearly making it possible to work out the frequency within a few percent.

If you don't know about Lecher lines, I will keep the topic for a Technicalities column on another occasion. **G4JST**

Metrewave

Our regular VHF column

By Jack Hum G5UM

It is no bad thing to start this series straight away with an attempt at a definition: What do we mean by metre-wave? The answer put in the simplest of terms reads like this: from 10m and upwards in terms of wavelength is HF. From 10m downwards is metre-wave. In amateur radio terms the 28MHz band ('Ten') is a HF one, but the 70MHz band ('Four') is a VHF one. So is 144MHz ('Two'). Higher than that you move into the UHF region (officially as from 300MHz). So the ham band at 433MHz is UHF. So is 1.3GHz. Higher still, beyond the 3GHz benchmark, it becomes microwave.

Metre-waves, then, will be the business of this continuing feature in *HAM RADIO TODAY*. It will talk about the frequency spectra delineated above. But *how* will it do its talking? Your editor and your columnist exchanged some earnest correspondence about the 'how' of METRE WAVE and this is what emerged from it:

Both of them agreed there was little point in making this feature an account of the latest feats of derring-do on the VHF and UHF bands. A score of magazines around the world (three in the United Kingdom alone) follow this procedure. There is much to be said for their approach. By presenting a conspectus of what was worked and when, under what conditions and with what modes, they built up a body of knowledge over the months and years about the peculiarities of metre-wave propagation — and whatever the professionals may suggest, there is still much to be learned about it. A corps of diligent, dedicated observers like the amateur radio movement can add to this body of knowledge although not perhaps in so dramatic a form as sixty years ago, when all was young, little was known about how transmitted signals got where they did, and it 'hadn't all been done before'.

'Thousands of newcomers...'

Yet how many of today's metre-wave operators are dedicated in this way? Perhaps a thousand or two. Contrast their number with the total of Class B licensees who choose to pursue their VHF/UHF activities along rather different avenues. How many are there? Let's take a look:

The 1983 edition *The RSGB Callbook*, that indispensable adjunct to every metre-wave person's station, lists 80 pages of them, more than a third of the content of that publication. Add to them another half-dozen callsign blocks issued since *The Callbook* went to press last August and you conclude that some 4,000 new Class B callsigns have come onto the air in the last four or five months. Granted that a sizeable number of their holders will take an interest in the DX capabilities and propagation quirks of the metre-waves, an even more sizeable number probably won't.

It is to this enormous aggregate of VHF and UHF operators, who wish to pursue the ham radio pastime in less dramatic ways than those normally publicised, that this column will address itself.

At any time, thousands of newcomers to the metre-waves, Class A as well as Class B, are in search of information about them. It is hoped this column will be able to help. It won't set out to be a textbook on this or that; what it *will* attempt to do is to discuss some of the subjects daily aired on the bands, like antennae (on which probably more has been said and written than anything else in ham radio), on the 'how' of operating, on 'Morse' or not?' and much else.

Saying your piece

Your METRE WAVE feature will also encourage its readers to 'do their own thing' by turning in subjects for discussion, by writing in to agree or disagree with what is said here, by generally helping to stir things up — the unfailing sign that a column is being read and noticed. Could be that some reader somewhere might feel strongly enough or enthusiastic enough about a metre-wave matter to occupy the whole of this page one month!

Enough of preliminaries. Now, getting right down to basics, let's go straight to one of the most interesting bands of all, 70cm.

Even to say that a band is 'the most interesting' is apt to bring the protagonists of other bands rushing to the ramparts declaiming 'Wait! Why 70cm? Why not 70MHz (or whatever)?'. And of course they would have a case. So would the adventurers on the microwave scene

TABLE 1

432 to 432.15MHz	telegraphy
432.15 to 432.5MHz	telegraphy and single sideband
432.5 to 432.8MHz	all modes
432.8 to 433MHz	beacons
433.0 to 433.375MHz	fm repeater output channels in 25kHz steps; although RB8 is listed as a repeater output channel it is widely used as a popular simplex channel (433.2MHz).
433.4 to 433.5MHz	fm simplex channels in 25kHz steps; national fm calling spot is 433.5MHz
434.6 to 434.975MHz	fm repeater input channels in 25kHz steps
435 to 438MHz	reserved for satellite communication
434 to 440MHz	amateur television in frequency areas not employed by other users.

where every QSO is an event, where an enormous amount of latter-day expertise is put into equipment designing and building, where indeed the appellation 'most interesting' may truly be applied.

Let's stick to 70cm. Don't lament the restrictions which were placed on the use of a couple of megs at the bottom of the band last year. Realists know that the space was little used. The space on 'Seventy' which *is* used (and intensively at that) is the bit in the middle, meaning from 433 to 435MHz.

***Excluding 50MHz, not yet in general allocation.**

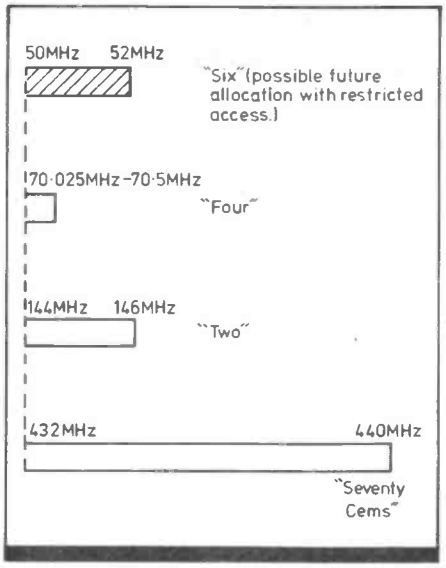
The ordered logic of the bandplan

Here lies a profusion of simplex channels plus repeater inputs and outputs in the ordered logic of VHF/UHF bandplans. It might be rash to say that more repeater stations are provided on '70cm' than on 'Two' for the number is changing all the time as new ones are commissioned. But it would not be at all rash to say that a ham-mobile driving from Thames to Tyne would rarely if ever be out of range of one or other repeater station along his route, with the ever present possibility that many 432MHz simplex contacts might be initiated following a through-repeater one.

No excuse at all is made for talking about repeaters first in a survey of 'Seventy': thousands of operators use them in the course of a year, noting them to be less congested than repeaters on 'Two' than is sometimes the case on 'the next band down'.

'But isn't this because there are fewer people on 70cm?'. Regularly the question is thrown at your columnist half a dozen times a week. And the answer to it is 'Yes, it *is* less congested', and this is for two reasons: first, that a lot of newcomers who can't afford more than one transceiver to start with, will plump for a 2m...but secondly one *must* demolish the legend that there's nobody but nobody on 70cm. It just isn't true.

You could say that 70cm is 'three times the frequency of 2m and gives three times less range'. You could add what many of its users think: that it is three times as interesting! All very off the cuff, especially that bit about 'three times less



range', because QRB (look it up) turns very much on what kind of equipment and particularly what kind of antenna is in use.

We are back to antennae again, you will notice ('that most discussed of subjects'). Look at a half wave rod for 70cm — just a foot of metal — and you will rightly remark 'This can't possibly get me any place'. You would be right. Make it up into a beam (for your home station, anyway) and you will be in for a big surprise — but more about antennae in depth (or height) in a later METRE WAVE column.

If repeaters and FM simplex are regarded as the major part of the traffic carried by 70cm one should not fail to invite attention to at least three further activities offered by the band. One is the 24-hours-a-day beacon service (yet another subject for later discussion in METRE WAVE). Another is DX at the lower end (telegraphy and single sideband) and a third is television at the upper end.

All these modes of emission find their place in the bandplan shown at **Table 1.**

Higher still

Officially, the ultra-high-frequency spectrum extends from 300 to 3000MHz. It therefore embraces 70cm. But it also includes 23cm which to many operators is a microwave area regarded as esoteric today as 70cm was a dozen years ago (but not by its devotees). The microwave region is one that calls for separate discussion here (like antennas and beacons already mentioned — and apologies for putting a few subjects into the pending tray. Be assured they will reach the action tray before many months have passed).

Popular 'Two'

The enormous increase in activity in the 144-146MHz area during the last two years and the spread of the repeater service in the last twelve, means that 'Two' is on the go virtually for all of the day and much of the night as well. It was very different in the old valve era: customarily one 'tuned the entire band for any possible call'. Some wags were wont to say Any impossible call! Today on 2m there is always somebody to talk to; *where* you can talk to them and on what modes is made clear from the bandplan shown at Table 2.

It must be admitted that 'Two' has its detractors, those who deplore the perceived penetration of what they call 'the CB mentality' into it. What needs to be emphasised is that former Citizen's Band operators who come to true amateur radio do so with some experience of microphone useage plus the determination to pay for and take (and pass) the Radio Amateurs' Examination. Most of them as they become observant of ham radio procedures quickly rid themselves of inane phrases like 'the handle' and 'break, break', recognising that the most ef-

Continued on page 79

TABLE 2

144.0 to 144.15MHz	telegraphy (calling frequency 144.05MHz)
144.15 to 144.50MHz	single sideband (calling frequency 144.3MHz)
144.5 to 144.845MHz	any mode
144.845 to 145.000MHz	beacon area
145.0 to 145.175MHz	repeater inputs in 25kHz steps
145.2 to 145.6MHz	fm simplex channels in 25kHz steps; national fm calling spot is 145.5MHz (S20)
145.6 to 145.775MHz	repeater output channels in 25kHz steps
145.8 to 146.00MHz	satellite service, never to be used for local fm conversations.

A PLAIN MAN'S GUIDE TO MASTS & TOWERS

Part 2

Selecting the correct feeder for the job. A look at rotators.

By Alan Barraclough G3UDO*

In last month's issue we said that the length of coaxial cable needed was an important factor to be considered when deciding on the most practical height for the aerial.

Like any electrical conductor, the amount of current flowing through a coaxial cable can be effected by the length of the cable. That is to say, not all the current entering at one end of the cable finally reaches the other end. Some of the current is lost or attenuated along the way, the amount of the attenuation depending upon the length of the cable and the frequency of the current passing through it.

The loss or attenuation that occurs in coaxial feeders .is not directly proportional to the length of the feeder but varies as a logarithmic proportion that is usually expressed as a value of dB (decibels) loss per 100 foot length of cable. Depending on the frequency of the current passing, the amount of attenuation varies so that at high frequencies such as VHF or UHF the losses can be quite high.

The values given in **Table 1** are approximate and based on straight lengths of cable that are operated under perfect conditions. When planning your aerial layout, it should be remembered that the routing of the cable and number joints can also impair system performance and increase losses.

At the lower end of the HF frequency range, the losses in coaxial feeder can be tolerated and to some extent made up by an increase in transmitter power up to the legal limit. As the frequency gets higher toward UHF, the losses in the coaxial cable can be high enough to cause difficulties. Losses to the transmitted signal can be made up by increasing the transmitter power but incoming or received signals are equally attenuated and cannot be so easily made up, so that performance is seriously impaired.

Before finally deciding on the best practical height for an aerial it is well worth taking into account the losses that can occur in the coax feeder and balance these against the gain in aerial performance that results from the height of the aerial. As long as the gain from the extra increase in aerial height is much more than the losses of signal or power in the coaxial cable needed to feed it, then increases in height are worthwhile.

Although there are a number of different types of aerial feeder which can be used coaxial cable is probably the most popular. Generally, coaxial cable is easier to instal, is more tolerant of other cables or metallic objects in close proximity and its characteristics remain fairly constant. **Fig 1** shows some typical feeders. The first two consist of twin stranded wire conductors encased in a polythene insulation. These are generally of flat or oval form in construction, with the conductors running parallel to one another.

Coaxial cable, where the conductors are placed one inside the other is generally manufa... sizes from about 3/16" diameter up to 1" in diameter in two principal impedences, 72 Ohms and 50 Ohms (there are some small variations). Although there are no real differences in effectiveness of one cable over another, the most commonly used is of 50 Ohm impedence. This is because most test and transmiting equipment is designed to work into a 50 Ohm load. To identify the two impedences, 72 Ohm cables are generally coloured brown and 50 Ohm black.

Referring to Fig. 1, the construction of coaxial cable shows the inner conductor 1, polythene insulation 2, braided (WOVEN) outer conductor 3 and the final

TABLE ONE

	Nominal Impedence	Attenuation in dB/100 ft frequency MHz						
RF58/A SOLID	53	3.5	7	14	21	28	144	420
UR47	53	0.68	1.00	1.50	1.90	2.20	5.70	10.4
RG58/FOAMED	50	0.52	0.80	1.10	1.40	1.70	4.10	7.1
RG59/SOLID	73	0.64	0.90	1.30	1.60	1.80	4.20	7.2
RG59/FOAMED	75	0.48	0.70	1.00	1.20	1.40	3.40	6.1
RG8/A UR67 SOLID	52	0.30	0.45	0.66	0.83	0.98	2.50	4.8
NEW RG213 RG8 FOAMED	50	0.27	0.44	0.62	0.76	0.90	2.20	3.9

*Allweld Engineering Ltd

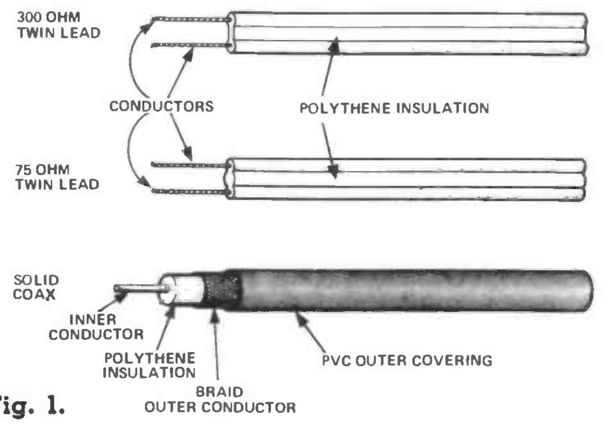


Fig. 1.

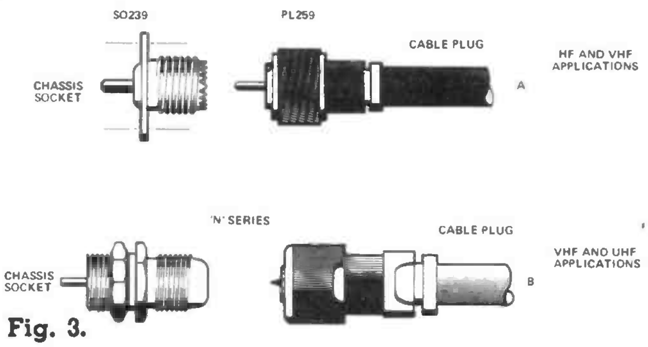


Fig. 3.

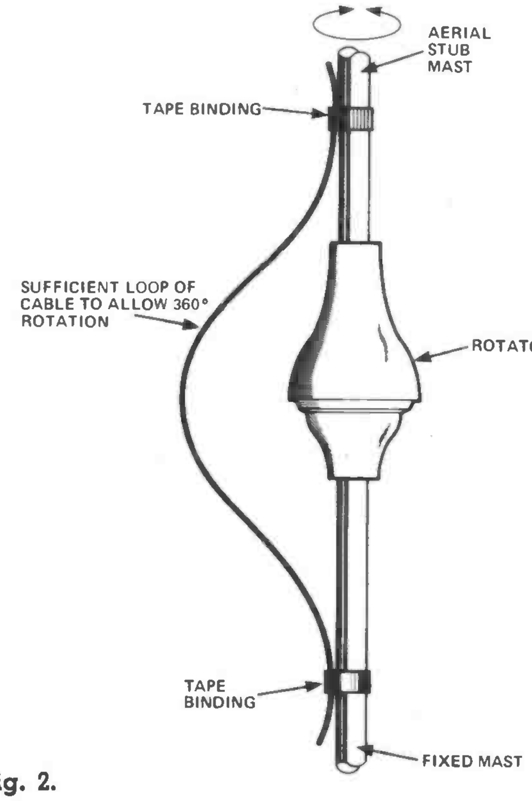


Fig. 2.

weatherproof, insulating PVC covering. On some coax, the polythene insulation may be of a cellular construction with air bubbles. This is called a foamed dielectric and has lower RF loss in the cable.

Hints on choosing and using coax cables.

1. Always choose a cable that has a capacity sufficient to carry all the power from your transmitter.
2. Avoid cheap cable: its characteristics are likely to be poor and losses may be higher than specified.
3. Seal the ends of coax cables with a good SEALING COMPOUND or tape to prevent water getting under the outer covering.
4. Smaller diameter coax with thin conductors have higher losses.
5. The FOAMED type dielectric has a lower loss value and should be better for VHF and UHF.
6. Use good quality connectors, such as the PL259 plug, SO239 chassis socket or the 'N' series fittings specialy designed for UHF applications. See **Fig 3.**
7. Avoid sharp bends in the coax on the run from the transmitter to aerial, and support long lengths to prevent stretching.
8. When using a rotator, make sure you leave a loop of cable slack between the rotating section of mast and the fixed section sufficient to allow 360° of rotation. See **Fig 2.**

Rotators

A rotator turns the aerial into the required direction. There are a large number of different rotators available and it is beyond the scope of this article to discuss all of these. However the first thing to remember is to choose a rotator suited to your application and not one that is either too small or far too big for the job in hand. There are three basic types of aerial rotator that one can use and these are shown in **Fig 4. A-D.** You will notice that Fig 4A is a typical rotator for mounting directly onto a mast or support tube. Fig 4B and D shows essentially the same rotator but with the bottom clamp removed so that it can be mounted directly on to a flat plate as in Fig 4D, into a rotator head unit of the type generally used on lattice towers. Fig 4C shows another type of rotator where the rotating stub mast passes through the motor. A support bearing can be mounted below the rotator on the support mast and serves to steady the stub mast.

Wind load

When choosing your rotator, it is essential to have some idea of what sort of loads your aerial will put on the rotator. Most rotators have internal ball or roller bearings in them capable of taking all the loading that the manufacturers state. These are chiefly the weight of the array and the loads due to the wind resistance of the aerial.

Refering to **Fig 5.** There are two loads due to the wind resistance of an aerial. These are the side load on the rotator bearing and the other is the turning load on the drive or brake mechanism due to the "weather locking" effect of the aerial. On large aerials these can become quite considerable and, if not allowed for, soon put paid to the rotator.

Additional supports to the stub mast above, or below the rotator can reduce the SIDE LOADS considerably and these can be a simple support sleeve or an additional support bearing mounted onto the mast or rotator head, Fig 5, **C** and **D.** However, the turning load due to weather locking is another matter and has to be watched closely. Read the manufacturers specification carefully and ensure that their figures are sufficient to cater for your needs.

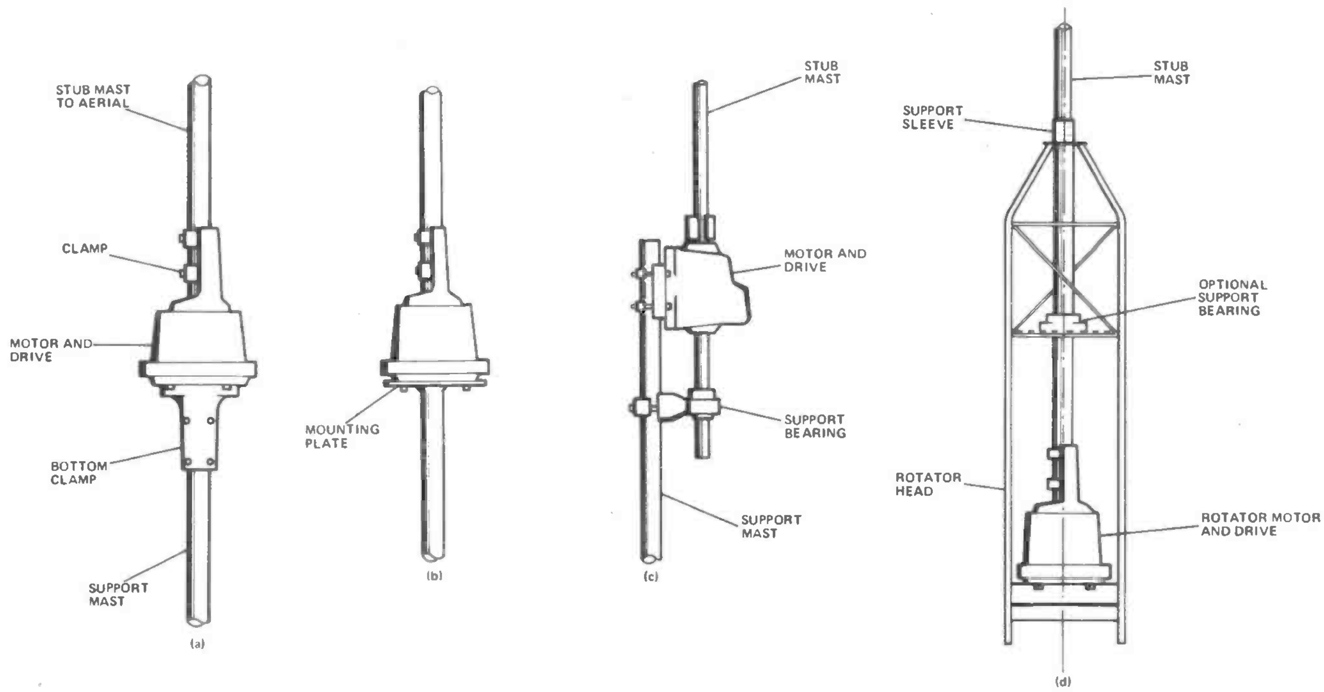


Fig. 4.

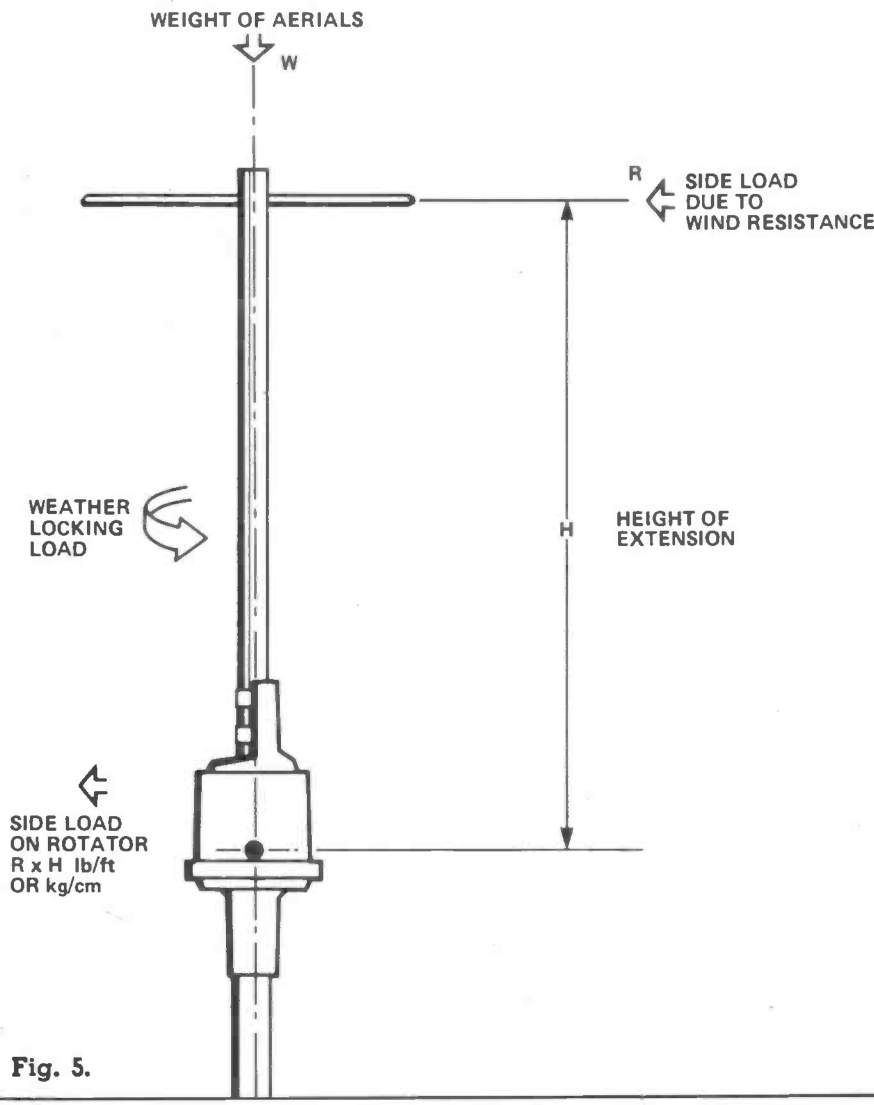


Fig. 5.

The installation of a rotator is a relatively simple job and the manufacturers instructions should be followed. Where coax cables are concerned, leave enough slack to allow for 360° of rotation, without the cable being stretched. Most rotators have a stop of some kind which prevents them from doing more than one revolution. Generally, the stub mast above the rotator should be of a lesser diameter than the support mast to which the rotator is clamped. Avoid using steel tube above the rotator as this adds unnecessary loads on the rotator, especially when the mast or tower is being cranked up from the horizontal.

Before clamping the stub mast onto the rotator, align the aerial with the heading indicated by the position of the rotator. This should be done with a compass but remember that magnetic North is not the same as true North. Any ordinance survey map should give you the correct magnetic variation. Although in practice it is simpler to align the aerial from magnetic North and make any allowance required when selecting the required heading.

A rotator that is *NOT* overloaded and regularly serviced should have years of trouble free service.

Next month: selecting the most suitable type of tower.

A general coverage synthesised HF transceiver Part 3

By Frank Ogden G4JST
Editor Ham Radio Today

It goes almost without saying that the transmit process is the reverse of receive. The IF board produces a fixed frequency SSB signal which is mixed with the output from the synthesised local oscillator module described in the first part of this series (January issue).

The signal, shifted to its working frequency together with an IF image, is passed through the preselector circuit where the image signal is stripped off. This leaves a low level SSB drive signal (below -10 dBm, 70mV) to drive the broadband PA strip.

I claim no originality what so ever for the PA strip used in this design. The first pass at the circuit used a couple of VN66AJ power MOSFETs in push-pull running with Class A bias driving a further pair of the same devices running Class AB in the output. The transmit pre-amp was as described here. The MOSFET design was interesting in that it used transmission line transformers throughout, and that it delivered a very low distortion output at the 10W PEP level. However, these devices weren't particularly happy at the 20W level. I therefore reverted to standard bipolar design.

Having scrapped the first attempt, I confess to making up the bipolar version with whatever components were to hand. Most of these were originally obtained at junk sales and rallies and are therefore of uncertain parentage. I suggest that it would be nearly impossible for anyone reading this to duplicate exactly what I've done myself. I could not tell you about the precise characteristics of the ferrite cores, or precise, readily available substitute devices for the BLX39 transistors used so successfully in the output stage.

What I can tell you however is that parameters such as permeability, core area, Gauss/unit core area are only important if you happen to have the data to hand. Likewise, it is almost certain that any half decent RF power transistor would perform satisfactorily in the output stage. My best advise is to suck it and see using just a few basic guidelines. More about these later.

Transmit pre-amp

This three transistor strip has two principal functions: to provide most of the voltage amplification required by the transmitter section; to provide frequency compensation (make good the fall-off in gain of successive stages towards the HF end of the spectrum). It also provides manual drive control and a CW keying facility.

Fig. 13 shows the pre-amp schematic. The dual gate MOSFET has more to do with providing gain control via the DRIVE pot connected

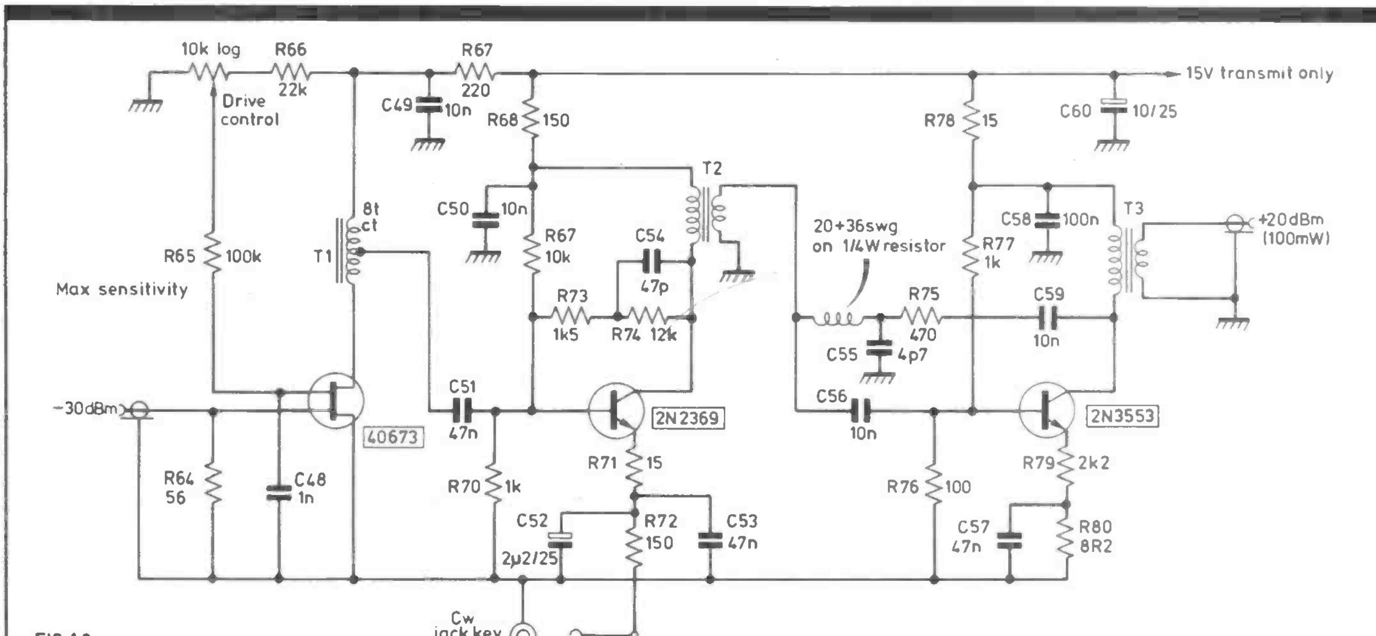


FIG. 13.

through to G2, than with offering any amplification. The input resistor, R64, provides correct matching to the preselector with which it connects in transmit via a C/O relay. As arranged the transistor provides a low distortion, DC controlled attenuator. With a piece of equipment such as this transceiver, it is a very good idea to keep signal lead connections to the front panel at an absolute minimum. The transformer in the drain circuit comprises eight turns of fine guage wire, centre-tapped, wound on a readily available ferrite choke bead which looks like a tiny transformer.

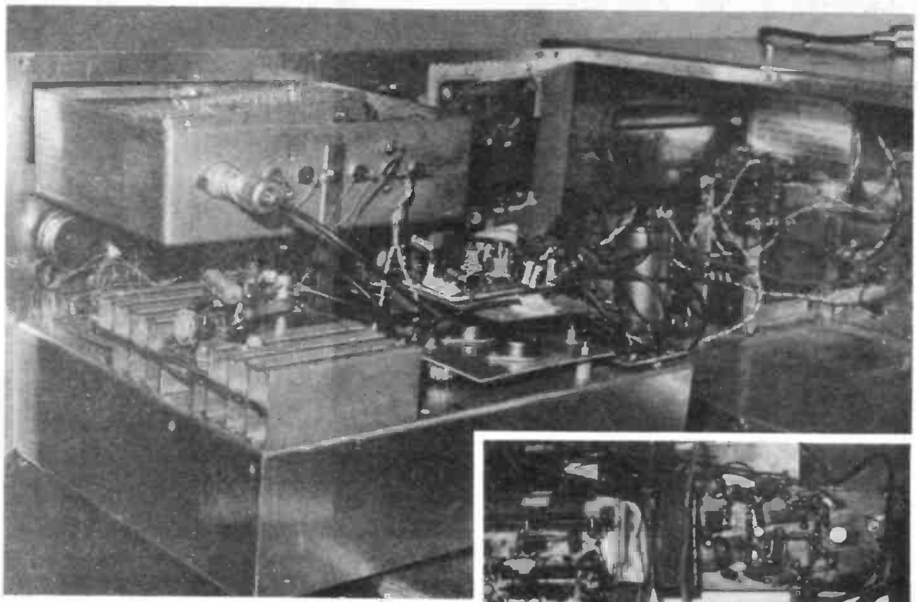
Assessing cores

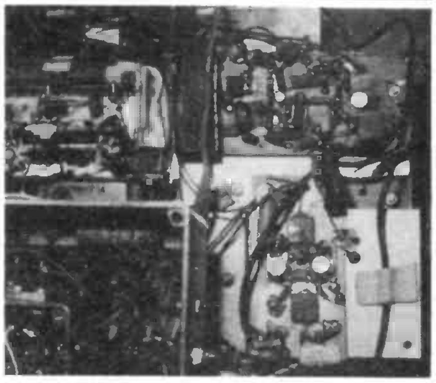
This leads nicely to a general point about assessing the suitability of a ferrite core or bead for a particular task. My method is to connect up an HF receiver to a signal generator through a Pi type arrangement. This comprises two 47 ohm resistors and one turn of wire passing through the bead under test.

The one turn choke wound on the core under test occupies the top section of the Pi arrangement, the two resistors being placed in parallel with the receiver and generator respectively.

The output from the signal generator is adjusted to the minimum frequency of interest — in this design it would be just under two Megs — and at a level which produces an S3 output on the receiver S meter. The bead is simply shorted out and the new level noted. If the signal level indicated by the S meter goes up by one point, you could make a very rough guess that a single turn on the core has an impedance in the order of 50 ohms. Therefore, two turns will show an impedance of 200 ohms and four turns, 800 ohms, etc. As a rule of thumb, broadband ferrite based circuits require an inductive reactance of at least twice the operational impedance of the cirucit at the lowest operating frequency.

The remainder of the transmit pre-amp circuitry is conventional bipolar with no surprises. T2 is a 2:1 transformer comprising four turns on the primary, two on the secondary (28SWG wire). The core type used was of the square 'slab' type with two parallel holes. The core measured roughly a cm square. T3, the output transformer, is made the same way as T2. Most of the frequency conpensation is carried out by selective feedback from the collector of the 2N3553 output transistor to its base circuit. The precise response can be tailored by alteration to R75, C55 and the 20 turn inductor wound on a small resistor. CW keying is achieved by turning off the second transistor, a 2N2369 by disconnecting the emitter return. C52 provides protection against key clicks.





Inside of the transreceiver (above). The bird's nest. PA stage can be seen in the front of the picture.
Right: detail of PA driver.

Driver stage

The transmit driver circuitry, **Fig. 14** is equally conventional. For lowest second harmonic distortion, the 2N3866 transistors should be matched for DC hfe — just as would be the case with a push-pull audio amp. C62 and the small inductor in series with it provides a bit of peaking towards the 10 metre band. The amount of peaking can be controlled by adjusting the turns on the inductor. The ubquitous square ferrite cores are used once again.

As shown the diriver circuit runs at about 20mA quiescent rising to 200mA or so on speech peaks. So far, heat sinking for the devices has not proven necessary although it might be prudent if a great deal of RTTY operation was being considered. The Fig. 14 driver stage operates from the 24V rail, not the 15V rail shown. There is quite a lot of voltage gain available so that passive frequency conpensation networks could be considered as part of the input circuitry to the stage.

PA circuit

Once again, it's completely conventional (see **Fig. 15**). The diode bias chain should be in contact with the output transistors' heatsink, a dollop of silicone grease between diodes and heatsink ensuring good thermal coupling. The bias transistor is a TIP41 power audio device. It has to dissipate a couple of Watts and pass a couple of hundred milliamps when the transmitter is at full chat. It should therfore be mounted on a heatsink.

The one ohm resistors in series with the output transistor bases offer protection against parasitics and should never be left out of circuit, particularly when using transistors a long way below their transition frequency. It goes without saying that the resistors should be carbon composition, low inductance types. It is better to use four 4.7 ohm resistors in parallel if high frequency drive is not to suffer.

The input transformer is a single

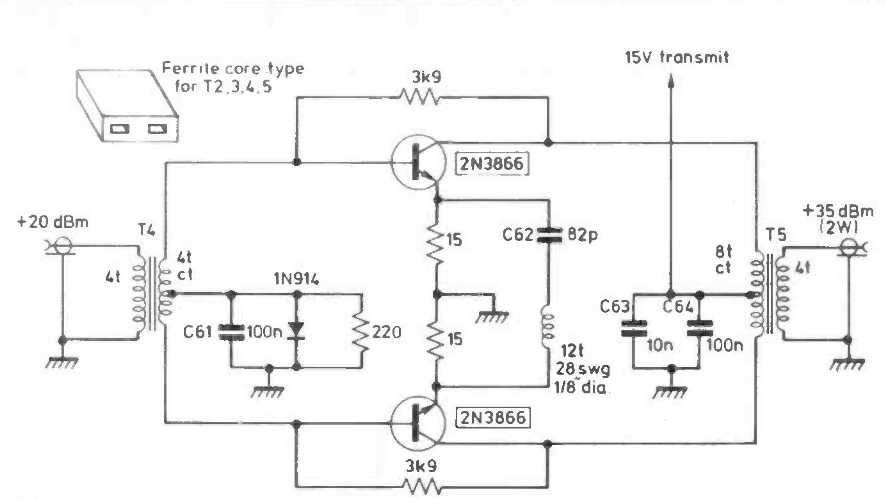


FIG. 14. Transmit driver

square type core wound with five turns of 28SWG on the primary and a single turn of 22SWG on the secondary. The middle of the secondary loop connects with the grounding and biasing components. The output transformer comprises of a pair of balun cores, each core appearing to have the physical and magnetic properties of a pair of stacked T68-2 cores. The original was wound with four turns (CT) of 18SWG wire while the secondary comprised a single winding of six turns. A further one turn winding on the output transformer core provides an output for the meter circuit: measurement must be right at the collector circuitry to know whether the output transistors are clipping. It is no use trying to look at output swing after the signal has passed through a filter. Thus the extra winding.

Ground loops

Construction of the output stage was virtually 'bird-nested'. Because it was a bit of a lash-up (that has worked perfectly ever since) I always promised myself that I would lay the circuit neatly out on a PCB . . . one day. That day has yet to come. When producing your own version just keep an eye on where the current loops are for a nice, stable outcome. The major one runs through C69 from the centre tap of the output transformer primary, splits, and passes to the emitters of the transistors. Passing through the transistors, the split loop joins once more at the primary centre tap. Let no part of the input circuit current loops traverse the same piece of conductor forming part of the output loop. There should be just one point, centrally positioned between the emitters for an RF null, used as the common return for C69 and C67. Every other design consideration is secondary to this. Next on the list is to keep connection inductances low and symmetrical. None of this business of neatly squaring off PCB conductors, etc. The shortest, thickest equidistance between two points must be the rule.

I doubt whether BLX39 transistors are readily available. However almost any 20W+ rating RF transistor will do though. The only thing that you must watch out for is the supply voltage. The prototype was designed to run from a 24V supply although conversion to 12V would present few difficulties. However a 24V rail rules out quite a few of the popular 12V FM transistors such as the 2N6083/4. 12V AM transistors would be entirely suitable though, as are the 587BLY surplus transistors which are occasionally advertised in *RadCom*.

As a general point when assembling the transceiver as a whole, look out for the posibility of RF getting into places it shouldn't. For instance, microphone inputs, key inputs — even headphone outputs — should be carefully decoupled at their point of entry or exit to the cabinet in respect of RF. 10nF disc caps, ferrite beads, more 10nF caps will almost certainly be necessary, especially when using linear amplifiers and particularly on 10 metres. I am assuming that the synthesiser and IF modules have already been self contained and screened from the RF strip.

One of the things that I haven't shown is an output filter arrangement for the PA stage. Ideally, there should be a separate filter for each band to keep harmonic radiation to a minimum. However, providing the PA strip is not overdriven, harmonic production is pretty low and a typical six pole 30MHz lowpass filter on the output will suffice, especially as the basic rig is not particularly QRO and it is nearly always used with some sort of ATU. I haven't bothered with separate band filters and have yet to receive a flying visit from Buzby. ●

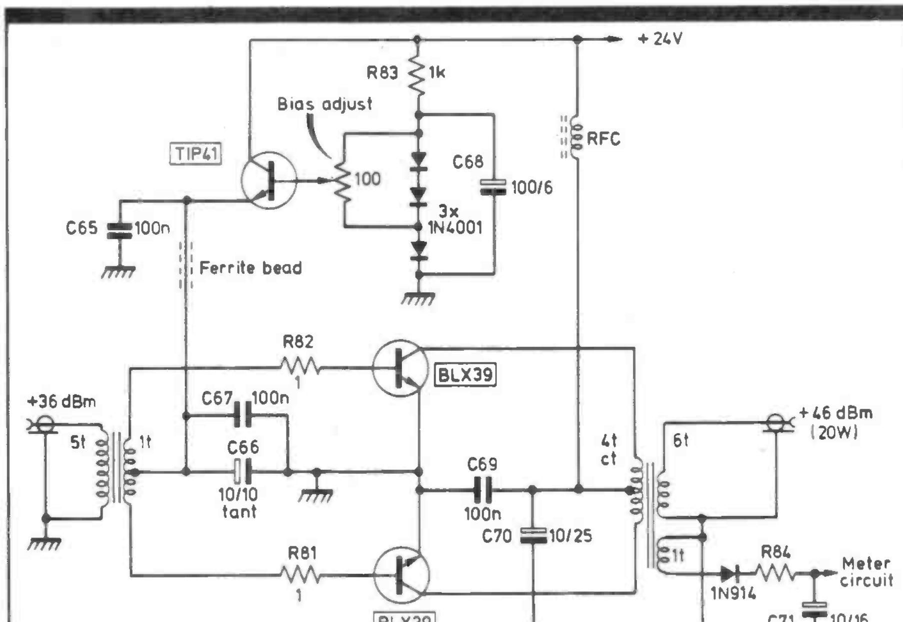


FIG. 15. Transmit PA

RIG REVIEWS

ICOM's 2m and 70cm FM mobiles under test

By Tony Bailey G3WPO

The IC25-E has been around for some time, while the IC45-E version is new. Both are Icom's contribution to the up-market FM only mobile transceiver market, the two metre version running 25W output, while the 70cm delivers 10W. Icom first introduced an FM rig to the UK market in 1970 — the IC2F (which was the first ever FM black box seen in this country), which retailed at £80, although I seem to remember Bill Lowe flogging them for £50 to Clubs. Maybe he knew what he was starting?

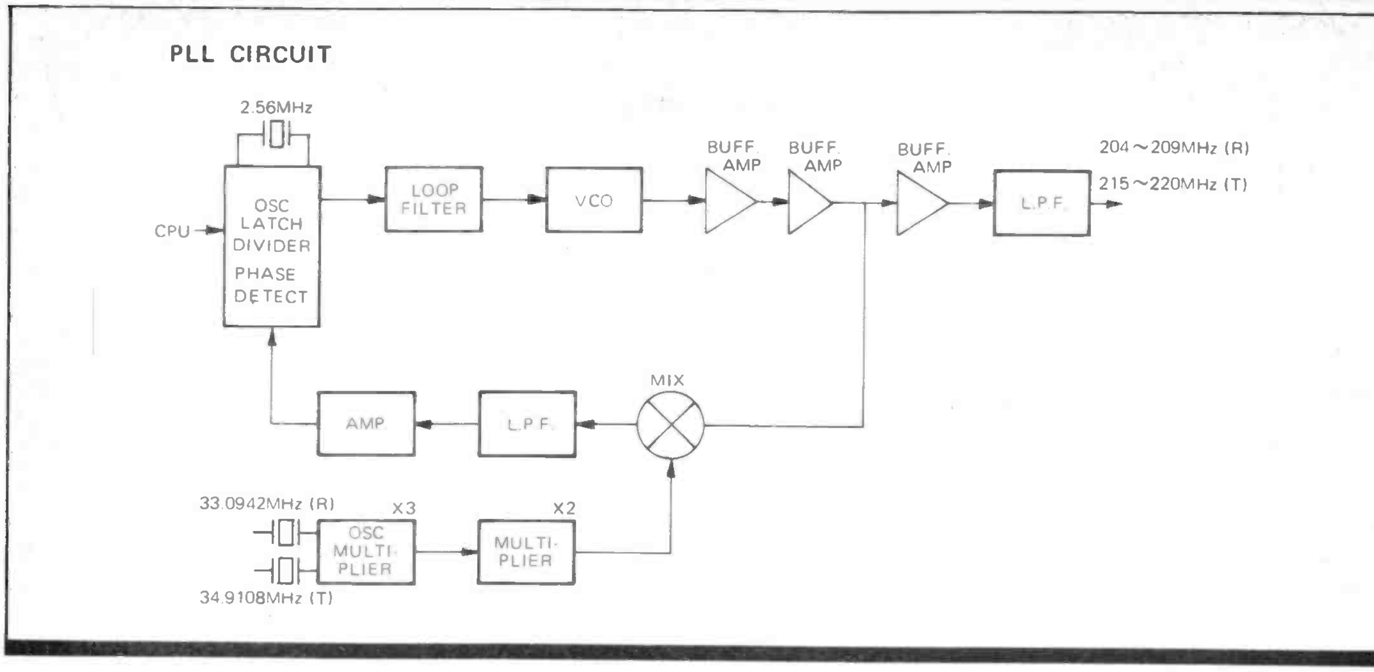
Since then they have had great success with the IC22/IC22A/IC240 series, the latter possibly the most successful of mobile rigs judging by the numbers still in use.

This review will concentrate on the IC25-E, with differences noted for the IC45-E. In compiling the review, the approach has been taken that most potential buyers will want to know what the rig offers, and how it performs in terms of facilities and on-the-air results, rather than pages of intricate circuit analysis, which will probably not be read anyway, so the latter has been limited to a quick run through plus the odd comment. What really matters are the actual lab figures which you can digest at leisure and compare with other rigs. After all, Icom should know how to electrically design a transceiver by now — whether it designs if for the user is another matter!

General appearance

The first thing you will notice is the diminutive size of both rigs, which are virtually identical in appearance, at 50mm high × 140 wide × 170 deep, weighing 1.5Kg. They come with mobile mounting brackets, which won't scratch the rig, can also be locked, and aren't of

IC45E: 70cm 10W



the infuriating slide-into-a-channel-in-the-side-of-the-rig type (they swing round the rig in two U-sections) and the usual range of plugs etc. A very long (nearly three metres) DC power lead is supplied, unusually fitted with a fuse in both leads. Connection to the rig is by Icom's standard plug, mating with a socket, which for some reason is on the end of a flying lead projecting some 20cm from the rear apron.

Transmit current consumption is stated as 4.8A on the IC25-E and 3.5A on the IC45-E, both at the high power setting. Microphones are supplied, the IC25-E using a 1.3k dynamic with 5 control switches/buttons, while the IC45-E uses a smaller Electret 600 ohm type with 3 control buttons.

Manuals

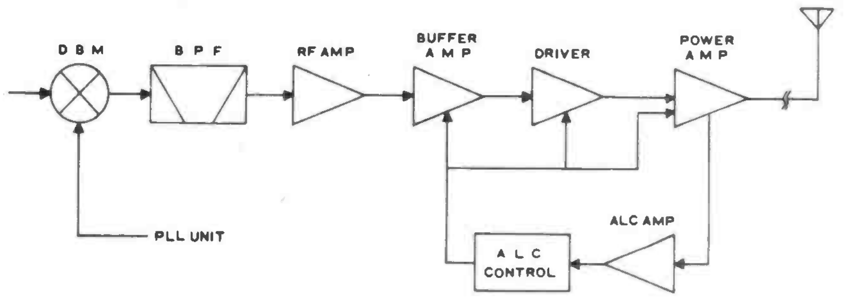
Both rigs were extremely well packed for transport, with only DC power and an antenna needed to get on the air. A reasonably comprehensive manual is supplied, although this tends to tie itself in Japanese/English knots in places, especially when trying to explain the operation of the VFO's, memories and scan functions. A separate circuit diagram is supplied for both rigs.

One of the Japanese practices which make circuit diagrams difficult to follow is that they tend to have a dozen or more lines running parallel to each other round a very small diagram, which can be a nightmare to follow. With both of these, Icom has merged a number of lines together as they pass, so that you only have to follow one line, until it branches with the correct function you are looking for.

The manual doesn't quite come up to Yaesu standards from the Japanese — English translation aspect. However, in the case of these rigs, the statement 'When all else fails, read the instructions' was never truer! It is strongly suggested that this is done, rather than press buttons in an effort to find out what happens, even though you may be even more confused after reading

IC25E: 2m 25W

RF POWER AMP CIRCUIT



the manual. We will leave you to ponder on this definition of the squelch circuit (or is it the 'anti-signal' circuit?):-

> *"This is a noise circuit that suppresses noise when signals enter the set."*

One worrying factor was the inclusion of a slip-in warning notice with the IC25-E, cautioning against incorrect initialisation of the micro-compressor controlled functions. Icom has obviously had problems in this respect, as it points out that this is not an equipment malfunction, and tell you to switch the rig off and then on again after a short period to overcome this. During the review period, none of the described symptoms materialised, although one other owner reported occasional lack of a display on power up.

Facilities

The IC25-E uses a red seven segment led display, showing the unit MHz + kHz. For some reason best known to themself, Icom chose to have the unit kHz indicator much smaller (1/4 the area) than the others, and reading '5' or blank. This looks odd, and would have been better at full size. As usual with all led displays, the readability is poor under bright light when mobile — a green fluorescent type would have been a marked improvement.

Under the frequency display is the main frequency control knob — this is very smooth but easily knocked, whereupon you will find yourself on another channel during transmission as there is no control lockout — the button provided on the mic for this purpose can unfortunately be overridden by the front panel knob. Unlike some optical encoder controls, this one showed no tendency whatsoever to jump channels, despite attempts in this direction. Nominal frequency coverage is 144-145.995MHz (power up at 145.0MHz) but you can cover 140-150MHz both transmit and receive (see later — not in handbook!).

S-Meter indication is by led bargraph (lemons and cherries type), with somewhat pessimistic indication as supplied — a fairly strong fully quietened signal does not give a reading on the meter (internal adjustment is possible to suit your own S-Meter interpretations).

VFO's

The transceiver has two VFO's (designated A & B controlled by a latching pushbutton, VFO A gives 5kHz increments, while VFO B gives 25kHz, both being usable independently for frequency selection. A separate 6 position switch selects either VFO, or one of 5 memory channels. Both the VFO's and the memory frequencies are retained on switch off, providing power is still present on the connector. No internal memory back up is possible, but the handbook mentions a memory back up supply. No further details are given, but there is a third pin on the power connector which may be for this purpose. A bit of digging around in American journals showed that there is memory back up supply available at around $38.

Repeaters, hidden MHz

Repeater operation is catered for with two of three pushbuttons to the right of the display. The centre button controls *simplex* or *duplex* modes, and the right, *normal* or *reverse* operation. As you might guess, depressing both buttons puts you into reverse repeater mode, but it also has another effect — the microprocessor loses control and you have a rig tuneable from 140-150MHz, both transmit and receive! However, you cannot program the memories like this, but you can use the scan facilities. Also, depending on what you try when 'out-of-band', you may find the repeater offset has changed when you return in band. We should add that you will find these facilities of no benefit unless you have the correct licence, but if you are visiting the States it will be of help.

Scanning

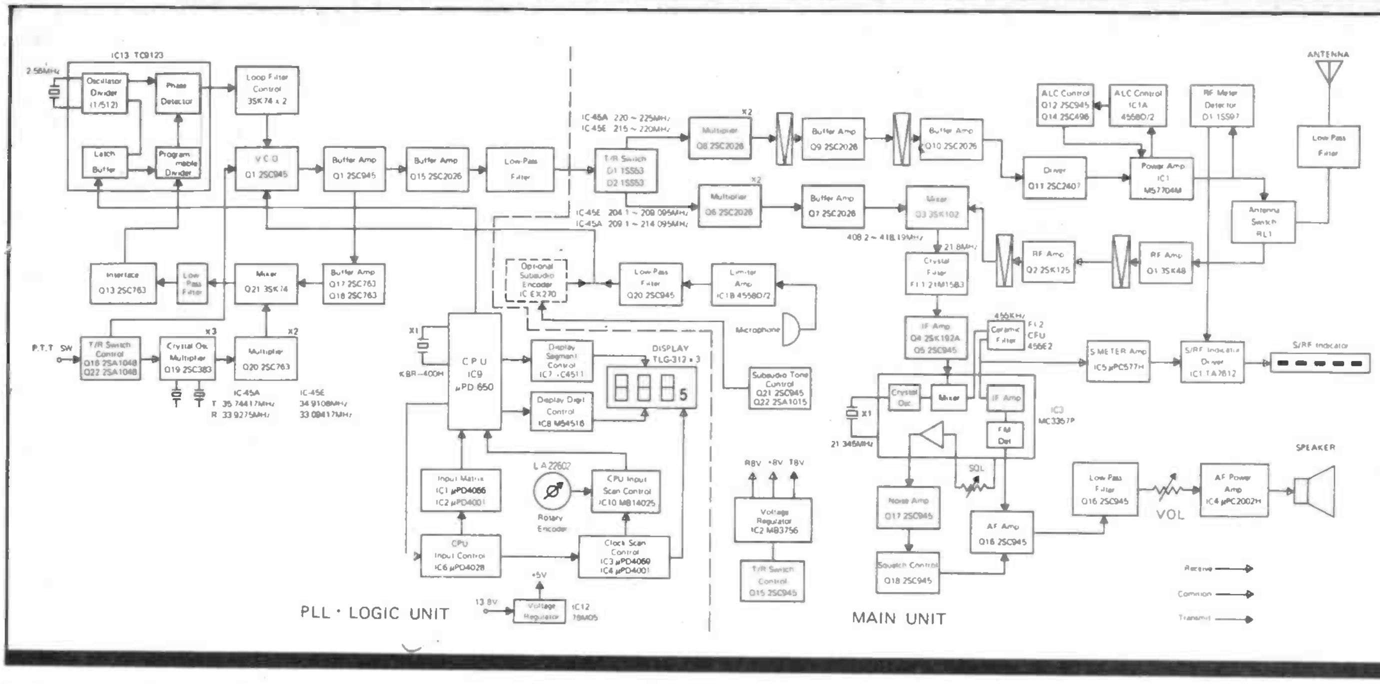
Very comprehensive scanning facilities are provided, by front panel control, or from the microphone, although the mic control gives different facilities to the panel. Selectable stop-on-busy or clear channels, together with scan speed and stop delay adjustments are provided, these controls being under the top lid, Icom assuming that they would not be used often.

The left pushbutton of the three already mentioned controls either full (2MHz) or a 'programmed scan', with the lower limit set in Memory 1 and the upper in Memory 2. This is very useful both as a base station, and when mobile, and most of the time was spent scanning 145.5-145.775MHz, which encompasses most activity.

Not quite as the book says...

While the handbook states that the scan will proceed from the lower limit specified in Memory 1, this was not the case — the scan in fact starts one channel above (either 5 or 25kHz, depending on which VFO is setting the step rate). The IC45-E did the same, and it is necessary to set Memory channel 1 one notch lower than actually required ie, if you want to start at 145.50MHz, using 25kHz steps, then Memory 1 has to be programmed with 145.475MHz.

A 'memory scan' is also possible where the scan is of each memory channel, plus each of the VFO frequencies — again useful for a specific set of channels over the band without looking at all intermediate ones. A momentary push

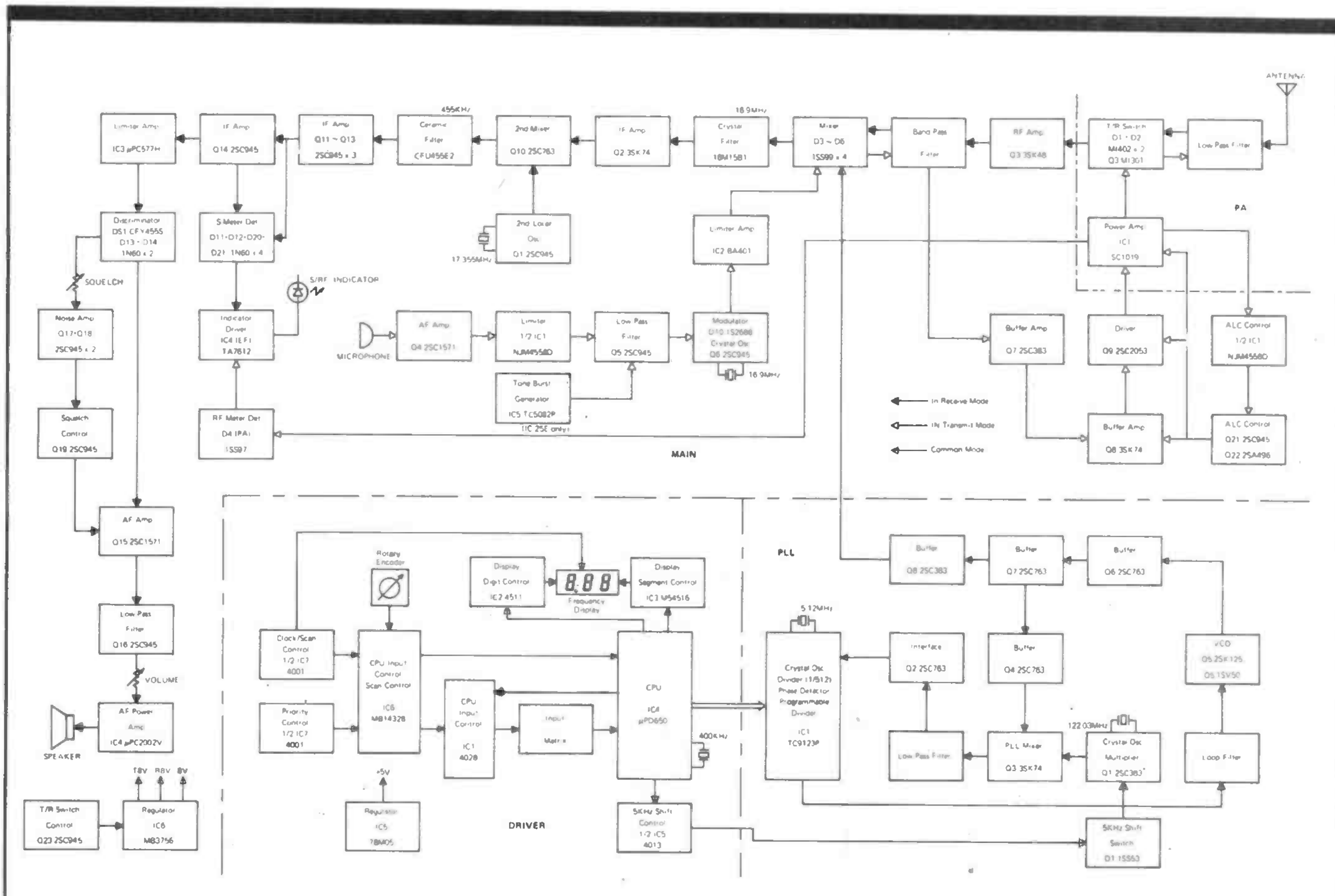


Block diagram IC45E

button on the front panel controls the programmed and memory scans, with write-to-memory controlled by another similar button. This latter button may also be used to transfer one VFO's frequency to the other if required. Note that VFO A must be selected when setting up memory frequencies. All this takes some getting used to, and isn't helped by the handbook explanations.

In all these scan modes, the scan rate is adjustable from fairly slow to extremely fast (about 10 steps/sec), although in memory scan the speed is a little slower than the other modes. At the fastest scan rate, the rig did have a tendency to ignore channels with very strong signals on them. The stop-on-busy

Block diagram IC25E



(or stop-on-clear if you adjust the internal switch) delay is adjustable from about 4 to 20 seconds. In all scan modes, the display decimal point flashes at the scan rate.

Microphone controls

The microphone supplied is not that referred to in the handbook, nor is the supplied one mentioned. Some of the adverts for these rigs state that comprehensive scan facilities are available both from the panel or the mic. This is not quite the case as the mic does not duplicate the front panel scan modes, so no programmed or memory scan is available using this.

By various combinations of the two slide switches and three pushbuttons it is possible to single step up or down, rapid step — either continuously or stop-on-busy but nothing else. This is a shame as it means reaching for the rig while driving, if the other modes, such as memory scan, are required but you could probably change the connections around if wanted (if you don't mind invalidating your warranty).

Priority

Another pushbutton function is that for the priority channel, where one of the memory channels is checked every five seconds for activity, when nominally receiving on one of the VFO frequencies. This is normally a useful function, but spoint here by too long a dwell on the priority channel (1s), instead of the fraction of a second taken by most rigs. One second is too long while listening to another conversation, and upsets the flow of the main QSO.

The button can also be used to display the repeater offset, and reprogram it in 100kHz increments, useful if you were using the rig to drive a 70cm transceiver for repeater use and wanted to get the 1.6MHz offset required.

The remaining controls are two small knobs for volume/on-off and squelch/high-low power, sensibly separate as they should be on a mobile rig, together with led indicators for receive/transmit, priority, and VFO A 'in-use'. That just leaves one pushbutton — and why put it on the front panel! This is the toneburst which should really be on the microphone for mobile use. The mic has plenty of room for another button, and the scan-stop control is redundant anyway (a quick press of PTT stops the scan) so this could be rewired.

Differences with the IC45-E

Frequency coverage is 430-439.995MHz, with power-up at 431.0MHz. A similar led display is used, but green, and still not very good in bright light. Most of the controls perform the same functions except for the following.

The memory-write button performs a dual function as it is also a temporary listen-on-input control for repeater operation. No reverse-repeater operation exists as such, as the corresponding switch on the IC45-E only determines whether the transmit shift is + or − relative to the receive frequency. It is possible to have a pseudo reverse repeater facility by programming the memories for specific repeaters.

While programmed scan is still available, the select switch is now inside the case, with the front panel control instead incrementing the frequency in 1MHz steps — useful in getting round the band, an otherwise slow operation.

And to our delight, the toneburst control is now on the back of the microphone. Someone must have been listening at Icom! The actual toneburst is inside the microphone. The previously allocated button now gives instant access to Memory channel 5, with priority over all other VFO's and memories when selected. Once again you have to reach for the button when mobile though. Incidentally, if you depress this button and then press the front panel scan button, the memory scan feature is duplicated.

The simpler microphone supplied now has only up-down step controls, and so less mic controlled scan facilities with the same constraints on panel versus mic control. It is now only possible to single step or rapid step, with the button held down continuously. With both rigs, it is fairly easy to inadvertantly step a channel while handling the microphone, both in transmit and receive, although the IC25-E can be locked to prevent this.

Rear Apron

Both rigs have the same line up — antenna socket (S0239 for 2M, N-type for 70cm), and external speaker socket (3.5mm jack), and

the flying power socket. There is no antenna plug supplied with either rig so check that you have an N-type for the IC45-E before leaving your local emporium.

Circuitry

IC-25E. The circuitry of the 25E, apart from the micro-controlled functions is fairly standard, possibly with more discrete devices that would be expected. Signal frequency passes through the PA low pass filter, RF amplification (MOSFET), and the now obligatory four stage helical filter, before being applied to a Schottky double-balanced mixer. The mixer is also fed with 127MHz from the PLL unit, to convert to the first i.f. of 16.9MHz, followed by a 2-pole monolithic crystal roofing filter, and some more amplification. Another conversion down to the second i.f. of 455kHz follows (MOSFET mixer), the conversion signal coming from a crystal controlled oscillator at 17.355MHz.

The main selectivity follows, using a CFU455E ceramic filter — in a rig at this price something with a tighter specification might have been expected as on the air results at normal 25kHz channel spacing did give some adjacent channel interference with local stations up to several miles away (although this is unlikely to be a problem when mobile).

A straight IC limiter follows, then a ceramic discriminator. This is a little unusual, as most FM transceivers tend to use multifunction IC's such as the MC3357/3359. The present arrangement pulls adequate audio from very noisy signals. Part of the output is used for the noise squelch, operating at around 25kHz, and the remainder, after de-emphasis is amplified up to around 2W output.

Transmit

"16.9MHz signals are oscillated by Q6..." — maybe we ought to stick to our own version?

FM signals are generated by applying the shaped audio to a varactor diode, in series with a 16.9MHz crystal, before passing to the same mixer as is used for receive (compare this with the 45-E method of modulation). Adding the 127MHz PLL frequency, takes it up to

144MHz, with the other response removed by the receive helical filter. Three stages of driver amplification follow, thence to a hybrid PA stage, delivering a stated 25W to the antenna via diode TR switch and low pass filter. While a hybrid stage is convenient for the manufacturers, it may not be such a good idea in the event of it needing replacement.

An ALC circuit is used to keep the output power reasonably constant with fluctuating load or voltage, and the same circuit also controls the high/low power output funtion. if needed to drive a high power amplifier, the high power output could be re-adjusted to say 10W if required.

PLL Unit

A 40.677MHz crystal controlled signal, tripled up to 122.03MHz forms one signal for a FET mixer, the other input coming from the VCO running at around 127MHz. After low pass filtering, the resultant signal around 5.1MHz is applied to a programmable divider, controlled by the four bit CPU. A separate (but on the same chip) 5.12MHz oscillator is divided by 512 to give a 10kHz frequency, which in turn is fed to a phase detector, and any resulting phase differences used to generate a dc control voltage for to VCO to lock.

The CPU uses a scanned matrix to increase the number of functions available — anyone interested in how it works is not advised to consult the description in the handbook!

IC45E

Starting at the receive input, signals from the antenna are routed via the PA low pass filter through a cascode MOSFET/FET amplifier pair, then via a bandpass filter (not helical) to the first MOSFET mixer. The first IF is 21.8MHz, with roofing selectivity supplied by a pair of crystal filters. After IF amplification, an MC3357 sees to the second local oscillator, for the 2nd IF of 455kHz, and to the second mixer, limiter, quadrature detector, and active filter functions. The internal 3357 squelch function is used, running at 20kHz for noise detection. Main selectivity is once again provided by a CFU455E ceramic filter. Audio output is via the same process as for the 25E.

On transmit, frequency modulation, unlike the 25E, is derived by modulation of the VCO itself, on the face of it not a very satisfactory process. The result, among other things, is likely to be a variation in the deviation over the 8MHz of 70cm, and this was confirmed with another station — audio quality being markedly worse at the top end of the band, presumably due to over-deviation. *I would be surprised if this were the cause — Ed.* Both transceivers use a shaped, limited, filtered audio circuit after the microphone.

The VCO runs at half the transmit frequency, and after doubling is first amplified to 200mW, then to 10W by a hybrid IC, with low pass filtering interspersed. A similar

ALC circuit to the 25E is used, and again the power outputs can be reset if needed.

IC45-E PLL Circuit

The PLL unit is basically similar to the 25-E, but with naturally different frequencies. The local oscillator is slightly different in that it needs to generate two different frequencies, either 33.0942 for receive, or 34.9109MHz for transmit, both doubled, then tripled to around 200MHz for mixer injection. With both the 25 and 45E, the odd 5kHz shift at signal frequency is achieved by diode switching a capacitor in series with the LO crystal (at 70cm the shift is only 2.5kHz as the final signal is doubled).

Similarly, the VCO runs at 204.1/215MHz (receive/transmit), and is controlled as for the 25-E but using a 5kHz reference frequency. The CPU unit is as the 25-E.

The rig in use

To the reviewer, a transceiver specifically designed for mobile operation should also be designed to allow operation while driving a potentially lethal piece of machinery at speed. In modern cars, there is less and less opportunity to mount the rig in an optimum position ie, near eye level, where you can keep your eyes on the road. Thus the location tends to be on or under a shelf around knee level, or in the central console. Also bear in mind that the more visible the rig, the more likely you are to be parted company with it.

While both transceivers offer many facilities, and make excellent base stations, their use under mobile conditions is less than optimum. Being small, the controls are necessarily grouped closely together, and some thought is necessary to select the correct controls when actually driving. Both the volume and squelch controls are very small and fiddly to use, and the visibility of the displays has already been commented upon.

The most annoying feature of both rigs is that you are likely to be continuously adjusting the squelch control due to a lack of hysterysis. Neither rig has any tail to 'the squelch, or put another way, there is no delay between the signal going and the squelch switching off. The result is continual chattering if any signals near the threshold setting are encountered — this of course happens all the time and actually prevents copy of otherwise readable weaker signals, forcing you to back the squelch control right off to get a readable signal. Again, diving into the circuit could eliminate this problem. Icom squelch is usually 'soft' with a slowly decaying time constant present, so why the departure?

An overdone rig?

The microphone step controls get over the visibility problem to some extent, but can you avoid the temptation to look at the display to check that you are actually where you think? One school of though says that a mobile rig should be as simple as possible, and that these transceivers are overdoing the facilities (witness the huge popularity of the IC240 — which had a minimum of controls but most of the needed facilities — there has to be a reason for its reappearance as the IC24-G, although no comments at present on the thumbwheel switches when mobile...). Some of the proliferation of facilities must be due to competitive action between the manufacturers, vying for a new market position. At least the thing didn't beep at you everytime a button was pushed.

If you are willing to ignore these

points and can handle and remember the facilities when mobile, there is no doubt that both rigs are usable and useful for their purpose. The power output of the IC25-E is helpful when mobile, and for a change, the sensitivity of both rigs matches the respective power outputs. The quoted sensitivity of the 25-E seemed somewhat pessimistic at *"0.6uV for 20dB quieting"*.

One gripe is that the heat sink on the IC25-E is too small. Even after a short period of operation, it is too hot to handle comfortably, and on a long over, does get extremely hot. The IC45-E stayed quite cool at the lower 10W output (this overheating was not limited to the review sample, judging by comments from other owners). Although no adverse consequences were immediately apparent, it can only reduce the life of the output amplifier. Some care in choosing the mounting position with the car to get maximum ventilation would be advisable.

The ability to change channels from the mic was useful, especially when migrating up and down from S20, and the programmed scan a boom on both 2 and 70 for watching the usual simplex and duplex channels. The only drawback was the necessity to reprogram the memories each time the rig was removed from the car as, common with many people, the rig is never left unattended. The ease of inadvertantly changing channels while transmitting caused slight problems at times, starting a QSO with one station, and finding yourself branded as an intruder later on.

Audio output direct from the internal speakers was adequate, although a little too bassy to copy easily at speed with in-car noise. A special external communications speaker was normally used which gives excellent copy with high road noise present. Received reports were always complimentary, stations often recognised the rig as an Icom, as its rigs seem to have a reputation for clean, crisp audio qualities.

Mind you, there is always the exception to the rule, and, on receiving a report that the audio was toppier than is usually the case, the very next station commented that the audio was bassier than normal!

The external appearance of either cannot be faulted, or the standard of workmanship, both internally and externally, given the constraints dictated by the small size. Accessability to the internals is reasonably easy, after removing four small screws from either the top or bottom covers. Due to the small size, it may be possible to fit the rig into the space occupied by a car radio or cassette, although you could be a target for thieves as a result.

Conclusions

It all depends on whether you want a lot of facilities when mobile and, personally, the reviewer found both rigs over the top in this respect. If you do want these facilities then there is little to be really put off by, apart from annoying traits such as the squelch, and the front panel toneburst on the 2m version. Either rig makes an excellent base station with just about every facility available so far, although you might feel that the additional expenditure for a multimode transceiver could be worthwhile if you were using it primarily as a base station.

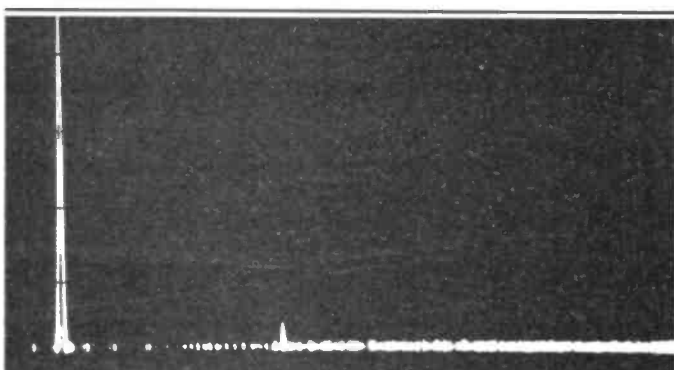
Our technical assessment appears on the following pages.

LABORATORY TEST RESULTS

Test: RX mode	Icom IC-25E (2m)
1) 12dB SINAD sensitivity (measured as PD) using 1kHz modulation frequency at 3kHz deviation (IC-25E) and 4kHz deviation (IC-45E) at band centre and band edges: 145, 144, 145.975MHz; 435, 432, 439.975MHz	0.15uV, 0.16uV. 0.15uV
2) Re-tune signal generator for best SINAD performance and note frequency offset	13.5dB at —1.1kHz
3) Test for RF intermodulation performance using two carriers offset from receive frequency by 25kHz and 50kHz. Adjust levels of both generators until a 12dB SINAD spurious signal is noted	1.1/1.3mV at 25 and 50kHz spacing; 1.05/1.1mV at 50 and 100kHz spacing
4) Test for selectivity. Couple two generators with a specified frequency difference and note the ratio of the levels between them for a degradation in SINAD of wanted signal at 15dB and 12dB deterioration	44 and 38dB noted at 12.5kHz separation; 76 and 59dB noted at 25kHz spacing; 81 and 81dB noted at 50kHz spacing
5) Measure audio distortion with a fairly strong signal modulated at 3kHz (IC-25E) and 4kHz (IC-45E). Test output level 125mW.	2.9% total harmonic distortion
6) Measure maximum AF output for 10% distortion	1.9W for 10% distortion
7) Test S meter calibration: note RF signal generator levels for S1, S5, S9 and S9 + 20dB	1.25uV, 3.2uV, 4.5uV, 6.5uV
8) Measure receive mode current consumption at squelched state, and at 125mW audio output level	370mA, 490mA
9) Check for speaker rattles at high volume settings	Substantial levels of speaker rattle and distortion using test tones in the range 180 to 700Hz; audible with normal speech

TX mode

10) Measure actual transmit frequency against dial calibration at 145MHz or 435MHz. Check the effect on frequency stability of raising supply voltage from 12V to 13.8V	+50Hz maximum error
11) Check repeater shift accuracy	Within 50Hz of repeater shift frequency
12) Measure power output with 12V supply at band centre and band edges; frequency test points as per test 1	19.6W, 19.3W, 19.6W
13 As per test 12 but with supply voltage raised to 13.8V	28W, 27W, 28.5W
14) Measure power output with equipment switched to low power setting	600mW
15) Measure DC current consumption	5A
16) Check TX midband for for spurious and harmonic outputs to at least the 3rd harmonic; note any substantial emissions	2nd harmonic —65dB, 3rd harmonic below 70dB; no spurii detected at noise floor
17) Check carrier at high resolution for close in spectral purity	Nothing untoward detected down to —75dB
18) Check for satisfactory operation into a 3:1 capacitative VSWR: note any spurious products encountered during this test	2nd and 3rd harmonics below 60dB during this test
19) Check maximum instantaneous deviation of TX with high level AF burst	5kHz maximum deviation
20) Check accuracy of tone burst; note excessive deviation on tone	Accurate to within 1Hz!
21) Check for satisfactory TX operation after running with short and open circuit on antenna socket for five seconds duration, each condition (occurring consecutively)	Satisfactory



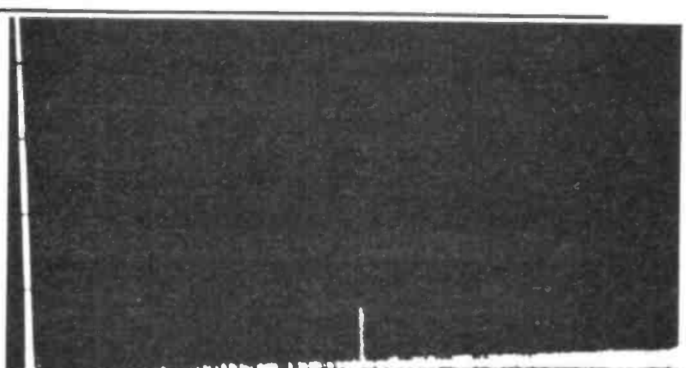
Output spectrum IC-25E
2nd harmonic —65dB
3rd harmonic below 70dB

Output spectrum IC-45E
2nd harmonic —63dB
3rd harmonic —70dB

EQUIPMENT USED

Two Marconi 2019 signal generators. Nada and Greenpar attenuators. Racal power meter type 9303. Elcom hybrid transformer. H-P 8903 audio analyser. Fluke and AVO multimeters. Rhode and Schwartz 30dB attenuator. Bird thruline wattmeter. Marconi 2300B deviation meter. Takeda Riken frequency counter. H-P 8558B spectrum analyser

Icom IC-45E (70cm)	OUR OBSERVATIONS
0.16uV across the entire band	This the basic measure of sensitivity. Both sets are satisfactory when compared against other products in the same category although neither is particularly outstanding
13dB at +1.3kHz	These figures show that the receiver section is happiest operating just over 1kHz off frequency in each case.It's not too important but both sets could do with a slight tweak
0.55mV/0.6mV at 25 and 50kHz spacing	These figures indicate an intermodulation performance (one measure of dynamic range) of just over 77dB for the IC-25E and 71dB for the IC-45E. Once again they are just about satisfactory although several mobiles operating from the same hilltop would almost certainly cause some problems when trying to copy weak signals. For instance, if you were listening on S20 and other stations within a few hundred yards were transmitting simultaneously on S21 and S22, there would be problems
66 and 68dB noted at 25kHz separation; 74 and 75dB noted at 50kHz separation	Satisfactory
2.3% total harmonic distortion	Satisfactory... perhaps a little more distortion than one might expect
1.6W for 10% distortion measured into 8 ohms	Satisfactory
0.45uV, 2.0uV, 3.0uV, 4.2uV	The S meter characteristic on both the 2m and 70cm sets is very poor. Ideally S meter response should require a 6dB signal increase per division. The meters in the review sets cramp everything into the first few microvolts and, as the testing lab says, are good only for signal detection
440mA, 530mA	OK
No problems were experienced with this set	We think that the problem of speaker rattle in the IC-25E was a one off problem associated with the review sample
Initially 200Hz error (not influenced by supply voltage) which drifted to —600Hz by the end of this test	These frequency errors are insignificant in the FM mode. Overall frequency accuracy excellent
Within 50Hz of repeater shift frequency	Comments as above
11.6W, 11.7W, 11.4W	Completely satisfactory
11,9W, 12.1W, 11.6W	Comments as above
2W	All aspects of TX operation were faultless. The output spectrum is exceptionally clean and the deviation control would meet a PMR specification. Very good
3A	
2nd harmonic —63dB, 3rd harmonic —75 dB; no spuril detected at —75dB noise floor	
Satisfactory	
2nd and 3rd harmonics improved to —70 dB and —75dB respectively	
5kHz maximum deviation	
Accurate within 1Hz	
Satisfactory	



OUR CONCLUSIONS

These two sets from Icom certainly fulfil their intended application. Frankly we have not yet put enough sets through our testing procedure to make extended cost performance comparisions. With one or two reservations about receiver performance, we can otherwise say that they meet the manufacturer's specifications and should prove entirely satisfactory in service as a car mounted mobile rig.

They are compact, fairly easy to use and have enough facilities to function as a base station and the slight RX performance criticisms would be mostly un-noticeable in practice. Reasonable value for money. G4JST

The review sets were provided by Thanet Electronics Ltd.

Prices are not available at the time of writing due to a downward fluctuation in the value of the pound. Check with Thanet for details.

MAGAZINE REVIEW

By Tony Bailey G3WPO

Shortwave Magazine

The first off the pile this month is Short Wave Magazine, the only other independent publication aimed entirely at Amateur Radio, to the exclusion of other electronic pastimes. It has a regular following and seems to be back in gear after a few problems in the last couple of years.

Regular features are columns of VHF and HF activities, where operators can write in with their DX worked and views etc., and a Clubs section, similar to our own.

The December issue contains a series of articles by the Rev. G C Dobbs (G3RJV) on constructional practices, an excellent writer and one who would be very welcome at a club lecture, if he does such things. A 10MHz antenna, and the start of a Microprocessor controlled morse decoder, together with a review of the Datong FL3 (we reviewed it last month) and a theoretical article on Line Termination in Aerial design (W5JJ), completes the main offerings. If you like to read general chit-chat on what other people have worked, then you will find the two regular columns covering HF and VHF essential reading.

R & EW

January R&EW gives the basics of a 10 metre transverter based on the previous 6M design, together with a simple CMOS keyer, with integral paddle. A review of the IC730 is one of the main features, but sadly tells you little of what the rig is like to use, just giving 5 pages of detailed circuit analysis. The overall opinion is very favourable in this respect.

Practical Wireless

Practical Wireless for January concludes the RFI series with a useful diagnostic chart for hi-fi amplifiers, plus all the details of the cures normally adopted for this type of interference. An "Active ATU", a guide to QRP operation and the start of a series on RF dummy loads completes the main line-up. The latter gives details of a syrup tin type dummy load using silver sand as the heat exchanger — a different approach to the more normal transformer oil.

Ham Radio

Ham Radio, (the US one that is) contains an extremely interesting article on low-cost linear design for HF. Some excellent advice is given on selecting valves for this purpose, with details of sweep tubes and calculation of dissipations for the various modes of transmission. The preference is for 813's, and the use of three is recommended for a full-kilowatt amplifier. The article runs to 11 pages, and is well worth reading.

A rather different rotary dial and encoder project, using microprocessor control, and capable of looking after 4 dials at once, say for frequency, band-spread, filter frequency, and keyer send speed control looks interesting if you want to keep your station up-to-the-minute. Together with a 40M Tx/Rx, Battery Charge sensor (for Ni-cads), the theory behind receiver dynamic range calculations, and a cautionary article on inadvertently handling a stolen rig, this issue is above average. Although it hit a bad patch a year or so ago, Ham Radio is well worth reading if you don't already subscribe (via the RSGB).

Rad Com

December Radio Communication gives some more detail of the new HQ move to Potters Bar (see last months HRT for address etc). The RSGB moved to the old Doughty Street premises in 1968, and had hoped that that move would last for the foreseeable future. The rapid increase in licencees and the support required as a result must have been a contributory factor to the new move.

On the article side, RadCom has an interesting contribution on Lighting and EMP protection methods for ham gear. The article doesn't actually mention anything about EMP (ElectroMagnetic Pulse), but then you may feel it not worthwhile to protect against this considering the chances of you being around after the source of the EMP has exploded are minimal. However, it is well worthwhile reading and acting on, rather than waiting for the event to happen and losing a few front ends at the least.

A ZX81 computer program for calculating attenuator resistor values, both T- and Pi-types, together with a good non-mathematical approach to explaining the "third method" of SSB generation, plus one stations work on the assessment of his VHF site completing the line-up. The latter represents an interesting insight into how poor a location can actually be from the radio aspect, when detailed examination of large scale maps is undertaken, and the obstructions plotted.

The mention of ZX81's prompts a mention that we forgot to say that December Practical Wireless contained a pull-out supplement on using the ZX80/81/Spectrum series in amateur radio, with some very worthwhile programs listed.

QUA

Although not strictly a magazine, the quarterly newsletter/-Magazine of the Ipswich Radio Club, covering most of the clubs in the East Anglia area, and called "QUA", is worth a read and runs to around 40 pages. Further info from G4IFF, if required, and it looks as though it will set you back 25p a copy. Supported by dealer advertising, there is an article on copying morse code via a computer (for the PET, but the BASIC used is transportable and only needs a PEEK address changed for others) which is worth a try out, together with a suitable interface. Also part 1 of an introductory piece on ATV, details of MF beacons and Coast Station frequencies, and some intriguing results of a Swedish antenna testing exercise.

Continued from page 59

fective method to make contact or to access a repeater is simply to announce one's callsign — nothing more.

What will be evident from the above table showing the UK bandplan for 2m is that, like 70cm, it places DX modes at the bottom end and local communication at the top. An important difference which will be observed is that while on 'Seventy' repeater inputs are high and outputs low, on 'Two' the reverse is the case. To talk through (say) GB3CF you need to offer it a signal at 145.0MHz to persuade it to talk with you on 145.6MHz, its output channel. If you wished to talk through its companion repeater GB3LE you would need to offer it 437.7MHz (RB4) to enable it to answer back on 433.1MHz. Other repeaters pro rata.

Let's take a look at that phrase 'DX modes at the bottom end'. What kind of DX? Many kinds indeed but not for all of the time. In fact for most of the time the DX really needs to be *worked for* becacuse normal conditions prevail. It is then that success on 'Two' is governed by the goodness of your site and the size of your antenna — no, not on how much power you use. A gainy antenna is as good as a power amplifier stage at the end of your transmitter and a pre-amplifier ahead of your receiver. (There we go again, pre-empting the eventual article about antennae. But then, the subject is inescapably all-pervading).

But what when conditions are not normal? These are the times when 'Two' becomes really exciting, when the 'warm weather effect' opens up the band to great distances, when elusive sporadic-E pops up, when (even more rarely) aurora manifests itself to apply that characteristic ghostly rasp to distant signals — and sometimes to not so distant signals. All these 'whens' open up 144MHz to ranges of commonly many hundreds of miles and exceptionally to the thousand mile mark.

The astute observer of the metre-wave scene soon comes to recognise when these various lift conditions are likely to occur. He will also recognise that many of them apply not only to 2m but also to 70cm, which at such times can be a refuge from the heavy occupancy of 2m, but also a greater challenge to the operating skills ('Three times as difficult, three times as interesting', remember?).

There now remain the two lowest frequency bands of the vhf spectrum to discuss. One of them, 50MHz, is barely 'an allocation' at the present time, with restrictions placed on its use, and few allowed to occupy it anyway in view of its incidence with television services. But what of 'Four'? Here is a strange band indeed deserving of more attention by the amateur fraternity than if has so far enjoyed.

TABLE 3

70.025 to 70.075MHz	beacons
70.075 to 70.150MHz	telegraphy
70.15 to 70.260MHz	telegraphy and single sideband
70.26 to 70.400MHz	all modes (70.26MHz a popular fm calling frequency)
70.40 to 70.50MHz	fm simplex (70.45MHz also a calling frequency)

A look at 'Four'

'Four' has always been confined to full ticket operators, meaning Class A licensees, and this for one inescapable reason: international agreement requires the morse code qualification to be held by operators who wish to work below 144Mhz. Hence the non-availability of 70MHz to the Class B folk ('More's the pity...they'd have galvanised it' is a comment occasionally heard).

A look at the bandplan for 70MHz reveals two major differences from those for 144MHz and 433MHz: there are no repeaters, for one thing, and for another, the beacons are placed low rather than in the middle, as they are on the next two bands up.

Habit and custom have caused 70.26MHz, once the centre of amplitude modulated transmissions, to become the FM calling frequency now that dear old AM is a thing of the past (and with its demise a lessening of TVI-proneness). Gradually, the recommended frequency of 70.45MHz is becoming established as the fm calling channel, although many users of 'Four' have ex-commercial mobile transceivers equipped for the one channel of 70.26MHz.

Another habit and custom is the use of cw in the ssb segment of the band, perfectly legitimately: every user of 'Four' being a Class A operator should be capable of accepting a call on the key and of setting up a cross-mode ssb-to-cw contact. Many do: it has become an accepted part of the Seventy Meg scene.

The 'Twice' and 'Half' factor

Those metre-wave persons who have been 'at the game' rather longer may feel inclined to challenge the suggestions made earlier that '...70cm being three times the frequency of 2m may be expected to give *one-third* the coverage' and that 4m being half the frequency of 2m (give or take a couple of megahertz) might be expected to yield *twice* its coverage.

It therefore needs to be explained that these are only rough and ready appromixations that become precise only if the transmitting station's parameters are virtually identical on all three bands. it is imperative to compare like with like: in other words, if you are considering an effective radiated power (erp) of 10W on 144MHz then you must do the same on 433MHz and on 70MHz. And because the antenna is an important part of the equation here again you must compare like with like. If you envisage a 10-element Yagi at 144MHz then you must do likewise on 'Four' — and a 'ten elly' there would be a big beast indeed.

Given that the amateur operator's station parameters are comparable on all the bands used then the results obtained in QRBs covered (look up QRB again if you haven't remembered) will be comparable, too, and such things as path loss as the frequency goes higher will become evident, as will much else (eg, topography).

The next installment is to follow in a couple of months' time. Its title: 'Putting the signal where you want it to go'... yes, antennae! But it could be that the feedback from you, the reader, might be so emphatic that *you* take over this page next time. And 'Antennae' back into the pending tray again!

Northern Amateur Radio Societies Association

The Society is holding its 21st Exhibition at Pontins Holiday Village, Soutport, on Saturday, 19th March and Sunday, 20th March 1983. This was formerly the Belle Vue Exhibition. The Exhibition will open at 11am each day.

It will include an inter-club quiz, construction contest, grand raffle, R.S.G.B. bookstall, amateur computers, N.A.R.S.A. stands and trophy, Trade Stands featuring all types of Radio/Electronic equipment. Desmonstration Station.

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J. Birkett; Radiotronics; Amateur Radio Exchange; John's Radio; New Cross Radio; Wilson Valves; C.B. Electronics; S.O.T.A.; The Computer Junk Shop; W. H. Westlake; D.S. Electronics; Arrow Electronics Ltd; Green's Telecom; Royd Electronics; Newton Engravers; Leeds Amateur Radio; Macro Trading; R.A.I.B.C.; Micro Print Ltd; 2J Sound; Gemini Communications; Radio Surplus; B.N.O.S. Electronics; D. Currie (Printer); G. Jackson; W. E. Griffiths; Waters & Stanton; Ham Radio Today; Garex Electronics; P.L.M. Communication Supplies; Tricon Supply Co; Electro Supplies.

Admission to the Exhibition will be 60p per day or £1 for the two days.

Lots of 20 tickets or more booked in advance from Mike Bainbridge, GAGS7, 7 Rothbury Close, Burg, BL8 2TT, Lancs, can be obtained at a 20% discount by sending the appropriate cash and s.a.e.

Chalets are available if booked direct from Pontins (Tel: 0704 77165) and can be equipped for self catering if you so wihs. Charges vary from £10 + VAT (for 2 person chalet) to £26 + VAT (for six person chalet) — Larger family chalets are available.

Family entertainment will be available during the day while 'Residents' will be able to enjoy evening entertainment.

Talk-in will be on S22 and other available Simplex Channels.

Car parking is free, but please follow the parking attendants instructions and the notices to prevent congestion.

Enjoy yourself at this family weekend exhibition.

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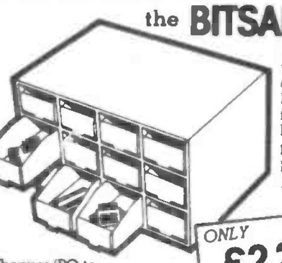

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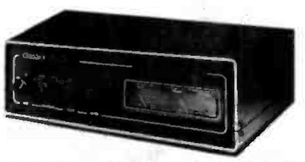

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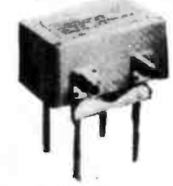

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