APRIL 1984 90p

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Two FRG7700s - plus Trio's R2000 on test by G3OSS

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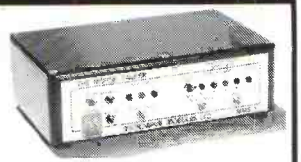
MMS1



Price: £115 inc VAT (p+p £3.00)

THE MORSETALKER
Speech synthesised Morse Tutor. 2-20 wpm, variable group lengths, ideal for amateur, Post Office and Maritime Exams.

MTV435

Price: £159.95 inc VAT (p+p £3.00)

435MHz 20 WATT ATV TRANSMITTER
Two channel, two video inputs, internal aerial changeover switching internal waveform test generator

MML28/100-S

Price: £129.95 inc VAT (p+p £3.50)

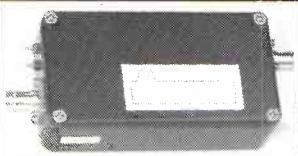
28MHz 100 WATT LINEAR AMP & RECEIVE PREAMP
Suitable for 10 Watt transceivers, RF Vox, switchable PA and preamp

MMC144/28

Price: £29.90 inc VAT (p+p £1.25)

2 METRE CONVERTER
For use with 28-30MHz receivers to allow reception of the ever popular 2 metre band

MMC435/600



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Fully compatible with our MTV435TX.

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144MHz 30 WATT LINEAR AMP & RECEIVE PREAMP
Switchable input, 1 or 3 Watts, suitable for use with rigs such as C58, FT290-R, TR2300 etc

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Suitable for 45.5, 50, 75, 100 baud RTTY 110, 300, 600, 1200 baud ASC with printer output facility.

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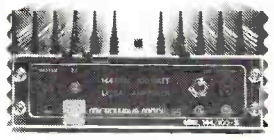
Noise figure: 1.3dB max
100 Watts through power capability
Utilises 3SK88 MOSFET

MML144/100-S



Price: £149.95 inc VAT (p+p £3.50)

144MHz 100 WATT LINEAR AMP & RECEIVE PREAMP
Suitable for 10 Watt transceivers, RF Vox, switchable PA and preamp

MMD050/500

Price: £75 inc VAT (p+p £1.25)

500MHz DIGITAL FREQUENCY METER
Two ranges: 0.45-50MHz, 50-500MHz
6 digit resolution, highly compact, 12v DC operation

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2 METRE LINEAR TRANSVERTER
For use with 10 metre transceiver
10 Watts RF output, low-noise receive converter, 12v DC operation

MML144/100-LS

Price: £169.95 inc VAT (p+p £3.50)

144MHz 100 WATT LINEAR AMP & RECEIVE PREAMP
Switchable input, 1 or 3 Watts, suitable for use with rigs such as C58, FT290-R, TR2300 etc

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Amateur RADIO

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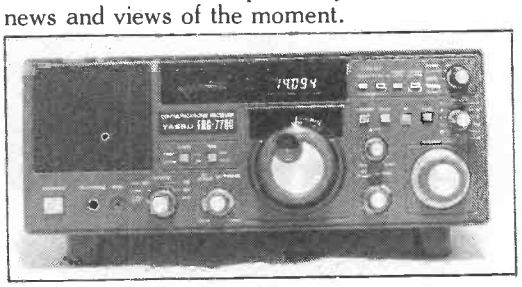
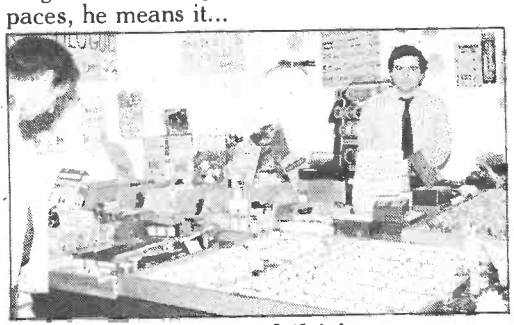
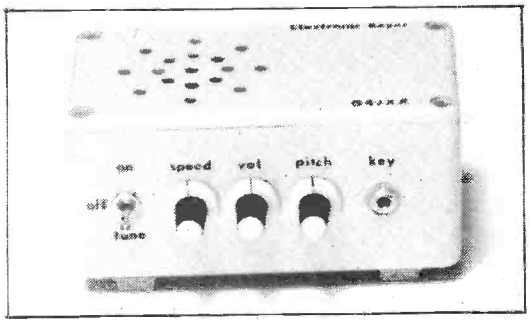
Front cover: The three receivers tested in this month's issue, by Angus McKenzie G3OSS. See pages 16 to 23. Picture by Jay Moss Powell.







We are pleased to announce that the company has recently been appointed U.K. distributors for the TELEREADER range of equipment. Those of you who have seen TELEREADER products will know that outstanding performance allied with ease of operation are the hallmarks of this particular company. The three models in our range are the **TELEREADER CWR685E** combined transmitter and receiver and the **CODE MASTER CWR610E** which not only receives CW and RTTY (Baudot and ASCII) but doubles as a morse tutor.

The **TELEREADER CWR685E** has many outstanding features: CW, Baudot and ASCII receive and transmit: CW at 3-40 wpm. RTTY at 45-300 bauds (six speeds): ASCII transmission/reception of both upper and lower case letters. Built-in 5" green phosphor screen giving a clarity and brightness that I have not seen before.

An external QWERTY keyboard housed in a substantial metal case and supplied with 3 feet of connecting cable. Not a "rubber key or plastic faced touchpad" but a true moving keyboard.
6 Memory channels (63 character capacity each). If required total memory capacity can be allocated to one channel. In addition the 4 standard test transmissions (RY, QBF, Baudot all characters, ASCII all characters) are permanently stored in memory and can be recalled and transmitted in a variety of formats. 480 characters of transmitting buffer memory are also included.
Automatic and manual transmit/receive switching.
Printer output: Centronics compatible parallel interface for hard copy.
The **TELEREADER CWR610E Code Master** is a compact morse and RTTY converter which also includes an audio-visual morse tutor.
Features of the **CWR610E Code Master** are:
★CW, RTTY (Baudot and ASCII reception) ★CW: 3-40 wpm. Baudot/ASCII: 45.45-600 bauds (seven speeds) ★CW morse practice at 2-30 wpm ★Display characters: 612 characters x 2 pages ★Centronics compatible parallel interface for printer output ★UHF/VIDEO display output ★12 volt DC operation
TELEREADER CWR685E £730.94 inc VAT. carr. £6.00
TELEREADER CWR610E £175.00 inc VAT. carr. £6.00

THE POCKE TRA, A NEW DIMENSION IN PORTABLE AMATEUR RADIO

A RIG FOR YOUR TOP POCKET, THEREFORE PERFECT FOR THE ACTIVE RADIO AMATEUR

★The rig you will forget you are carrying ...
With overall dimensions of 140mm high, 69mm wide, 26mm deep and weighing only 260 grams (including aerial and batteries), the LS-20XE fits easily into your pocket giving perfect portable communication.

★Long range communications ...
A newly developed dual gate MOS FET is used in the RF stage of the transceiver which considerably improves receiver performance. The internal 50mm diameter speaker ensures clear audio under difficult portable conditions.

★Full coverage of 2 metre amateur band ...
The transceiver covers 144 to 146 MHz in 5 kHz steps and has repeater shift and automatic tone burst.

★Switchable output power for extended operation ...
In order to extend portable operation, transmission power level is switchable, 1 W, 500 mW and 100 mW, so depending on the terrain and conditions, the most economical level can be selected.

★Simple to operate ...
Simplicity of operation is a special feature of this rig and many optional accessories are available. Of major interest is the matching headset SH-2 having built-in vox. this convenient accessory provides simple and safe operation whilst cycling, walking etc.

LS 20XE

£139.00 inc VAT carriage £2.50

Before I buy, I carefully consider the purchase. If the item is not expensive, then probably consideration will not take long, but if the cost is for example, two or three hundred pounds or more, then there are several questions which I would want answering.

what to buy,

The first is whether to buy ICOM, YAESU or TRIO. Obviously, we are convinced that TRIO equipment is the best. Since we import the equipment, you could accuse us of being biased in this view. However, our conviction is based on many years' experience, and the simple fact that the volume of TRIO sales in the UK is extremely high. **Many amateurs are to be found using TRIO equipment, and we are confident that a TRIO rig is its own best advertisement. Why not ask an owner?**

where to buy it,

The second question is where to buy your rig or accessory. Ever since the company began, some twenty years ago, our policy has been one of service. No matter how careful a manufacturer may be, equipment can go faulty and it would be wrong to say otherwise. Having said this, a high priority on your shopping list must be the quality of after sales service that you can expect from the company that supplied the goods. Service that can be asked for with confidence and result in your favourite piece of gear being rapidly repaired. Service of this calibre can only be given if sufficient money has been invested by the company in the necessary test equipment and spare parts. A point worth remembering is that test equipment by itself is useless: the company must also have technically able staff. How many amateur radio shops do you know that have eight engineers whose sole job is the repair of your equipment? **Who other than LOWE ELECTRONICS have sufficient pride in their facilities and expertise to hold an "OPEN DAY" once a year?**

help,

Informative and helpful service is also of major importance. Both the newcomer and the experienced amateur may want to discuss their requirements before making a purchase. They may be seeking advice. They will certainly want to check that the piece of equipment they have chosen does what they want it to do. What a customer does not want is pressure sales. **At a LOWE ELECTRONICS shop you will receive advice and courtesy: the service on which we and all members of the staff pride ourselves.**

LOWE ELECTRONICS accept the fact that everyone cannot travel to Matlock. To make purchase of equipment easy, we have opened our own shops, all with the same high standards, in Glasgow, Darlington, London and soon in Cardiff - the managers of the shops being hand picked for their abilities. For those who are still too far from a LOWE ELECTRONICS shop, then we have the fastest in mail order. Remember, we are the importers of the majority of the equipment we sell - we don't have to take your order and then obtain the goods. In addition to all these facilities, there are selected approved TRIO dealers who offer the same direct link with the TRIO factory as ourselves. A list of these approved dealers is published regularly by TRIO. Please ring us here at any time for information on your nearest approved dealer.

Lowe Electronics.

Matlock. Lowe Electronics Ltd.,
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Tel: 01-837 6702

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Tel: 041 945 2626

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56 North Road, Darlington, Durham.
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Yes, we don't give discount. Our price is the price, and takes into account the above services which have to be paid for. **But it is much better than getting 5% off "LOWE'S PRICE" and then finding when you have a problem that you may have bought from a rogue.**

Not everyone can afford a new piece of equipment. To cater for this need, we prepare a weekly list of what is available both here in Matlock and also at the LOWE SHOPS. This list is sent out with all correspondence and to those who request it. Regarding the SECOND HAND LIST, please contact Matlock for your copy.

Credit is also available. We have for your convenience, the LOWE CARD which not only makes purchasing easy, but each quarter along with your statement are details of the "SPECIAL OFFERS." **Ring for a LOWE CARD application form.**

So that's it; simple questions which should receive answers before making a purchase, be it an SWR meter or a new HF rig.

TR9130 TWO METRE ALL MODE TRANSCEIVER

This rig is proof, if one needed it, that TRIO do not bring out new models just for the sake of it. The TR9000 is remembered as a classic rig and today people are still asking for second hand ones, even they are a rarity on our S/H shelf. The TR9130 incorporates the improvements that all amateurs asked for: green display, reverse repeater, tune whilst transmitting, higher power, more memories and of course memory scan. TRIO's answer, the TR9130.

TR9130 ..... £442.52 inc. VAT

TS780 DUAL BAND BASE STATION TRANSCEIVER

The TS780 is the perfect base station VHF/UHF transceiver for the enthusiastic operator. The rig has all the necessary control functions essential for operating on both today's busy two metre band and the wide spaces of seventy centimetres. Full repeater facilities plus reverse repeater are included and the transceiver has the usual memory channels (10), two VFO's, up/down frequency shift microphone. IF shift, two priority channels, memory and band scan etc. A superb rig. I have one myself. Ring for a full enthuse!

TS780 ..... £795.00 inc. VAT

TR7930 TWO METRE FM MOBILE TRANSCEIVER

Those who have used or owned a Trio TR7800 will know what I mean when I say that Trio, with the introduction of the TR7930 have improved on the unimprovable. The Trio TR7930 improves on the TR7800 by giving a green floodlight liquid crystal display, extra memory channels, both timed and carrier scan hold, selectable priority frequency and correct mode selection (simplex or repeater). The most significant change is the liquid crystal display, but closely following this must be the ability to omit specific memory channels when scanning and the programmable scan between user designated frequencies.

TR7930 ..... £312.11 inc VAT

R2000 GENERAL COVERAGE RECEIVER

The amateur bands are only a very small part of the radio spectrum, many other transmissions are available for the short wave listener. Broadcast stations provide an alternative source of current information both political and regarding the life style of the country. Fitted with the internal VHF converter the R2000 covers continuously frequencies from 118 to 174MHz giving access to amateur two metre transmissions (am, fm, ssb and cw) plus a lot more. Having 10 memories, memory scan and programmable scan the R2000 provides in one rig the perfect receiver.

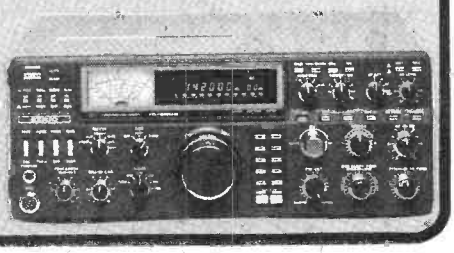
R2000 ..... £421.36 inc VAT

TS930S HF TRANSCEIVER WITH GENERAL COVERAGE RECEIVE FACILITIES

Much has been said about the TS930G transceiver and it now has a place high in the affection of those amateurs fortunate enough to own one. Indeed it has become the "flagship" of the TRIO range. Providing full amateur bands plus a general coverage receiver (150KHz to 30MHz), the TS930S has every conceivable operating feature for today's crowded frequencies.

TS930S ..... £1,150.00 inc. VAT

NEW PRICE



TR2500/TR3500 HANDHELD TRANSCEIVERS

Two first class hand held transceivers, one for two metres and the other for seventy centimetres. Ten memory channels, band and memory scan, repeater shift, reverse repeater and a low power position make the rigs extremely useful for the radio amateur who wishes to keep in touch with his local scene. A comprehensive range of accessories, base station charger, speaker microphone, mobile mount, etc., can be added to enhance operation. Accessories used with one rig being compatible with the other.

TR2500 ..... £237.82 inc VAT
TR3500 ..... £256.45 inc VAT

TS530SP HF AMATEUR BAND TRANSCEIVER

A logical progression from the reliable TS520 series the TS530S was the most popular HF rig in the range. I use the term "was" because TRIO decided to cease production and supplies were no more. However, the demand from radio amateurs worldwide for the transceiver has continued and TRIO have re-introduced the rig. A standard HF valve transceiver without the frills but providing today's amateur with all necessary facilities for reliable world wide communications, the TRIO TS530SP

TS530SP ..... £638.00 inc VAT

TW4000A DUAL BAND FM TRANSCEIVER

I have been waiting for this rig for the last three years. Now it is here and I am using one, words fail me. Send for details.

TW4000A ..... £469.00 inc. VAT

just a part of the range

Send 90p for full catalogue

CURRENT·COMMENT

By the time that this appears in print, hopefully people will be referring to UOSAT-B. Bearing in mind the incredibly short time available to the University of Surrey to build the satellite, I can't help feeling that the chances of something going wrong with it are greater than usual. If I'm wrong, and all goes to plan, that is itself a tribute to the UOSAT team. It's refreshing to see a university department having the courage to shed its protective academic cocoon and risk its reputation by taking on such a complicated, practical job in so short a time. After all, Dr. Martin Sweeting and his colleagues could so easily have chosen the easy option, ie. simply not have bothered.

In the past the UOSAT project has come in for some stick for rejecting the 'amateur' tag. Being realistic, surely the only 'amateur' aspect of this project is the frequencies used by the satellite. Apart from that, how can we radio amateurs have any justification in claiming the UOSAT team's achievements as our own?

It's interesting to speculate on what future *Oscar* might offer. One possibility is to put satellites in geostationery orbit, so that fixed aerials can be used to give 24 hour coverage without the need for any azimuth/elevation tracking. Already, some people have suggested that this makes long-distance amateur communication too easy - the satellite becomes a glorified repeater in the sky.

A geostationary satellite would offer to the amateur 24-hour, reliable, high quality communications paths to distant places. We've never had that before; we've always been at the mercy of the ionosphere. But given such an easy path to the DX, what would we do with it? If we used the thing as a glorified repeater in the sky, rather like a 2m repeater during a lift, surely that would be pretty daft. If, on the other hand, we exploited the new *means* of communication to fulfil some useful new *end*, that would be different. I've argued for third-party traffic in the past, and I'll refrain from boring you by repeating the argument. However, the only thing that limits the potential uses for a geostationary amateur satellite is our imagination.

What do you think the future of amateur satellites should be?

Introducing you to this month's issue

April shower

That is a funny way of introducing this month's contributors. No? Seriously though, they're a good lot; in fact the magazine's single greatest asset.

Angus McKenzie G30SS has been up to his usual tricks: this month with three HF receivers. This review is unusual for two reasons. First, the receivers in question are not exactly new; they have been around for some time. However, until new models come out, plenty of people will continue to buy the Trio R2000 and the Yaesu FRG7700 models, so we feel it is a good idea to give them the G30SS-style grilling.

The other reason why this review is unusual is that the third receiver is a souped-up version of the FRG7700. A small British company - Surrey Electronics - specialises in making equipment for broadcasting stations to very high specifications. Much of the sound that you hear on BBC and IBA radio and television stations comes to you via equipment designed and manufactured by this company. Anyway, they have taken the FRG7700 and made a number of modifications to it for the broadcast market. In doing so, they have produced a machine that could interest a great number of short wave listeners, because of the vastly improved quality of the AM reception. Where nearly all other receivers use a crude diode demodulator with the inevitable distorted output, this machine produces distortion levels well below those produced in the BBC and IBA transmitters. So, if you like listening to medium and short wave AM stations, this receiver could be the one for you. Enough said. See Angus's review!

If you've been following the last two issues of *AmRad*, you can't have failed to notice the series on 24cm amateur TV by Andy Emmerson G8PTH. This month he takes a look at some of the accessories that, in his view, sort out the amateur TV 'sheep' from the amateur TV 'goats'.

Andy has also uncovered some fascinating information about "900MHz before CB". It appears that following World War II, this sort of frequency was neglected by the authorities. It was too high for existing VHF/UHF techniques - in those days microwaves started at 500MHz. Yet it was also too low for 'centimetric' developments such as the magnetron, which proved to be so vital to British wartime radar. Anyway, the 900MHz neck of the spectral woods was used for the Post Offices's first major microwave link, from London to Birmingham, for the extension of the BBC's 405-line TV service outside London. This link was switched from AM to FM shortly before it went into service. Ironically, a generation later, Andy is writing about the same trend happening in amateur television links - just slightly higher up the spectrum.

Another application of 900MHz was an experimental troposcatter link from Devon to the Home Counties. It worked very well. Nowadays troposcatter links are used for commercial communications around the world, including (for example) the 'Ace High' chain for NATO throughout Europe, from Turkey to Scandinavia, including the UK.

Staying with the nostalgia, John D. Heys G3BDQ will soon take a look at some more historical QSL cards from his mammoth collection: this time it's cards to do with Marconi. Quite a few special event stations have been operated to celebrate many aspects of Marconi's incredible achievements in radio. Amongst the most famous are the attempts to cross the Atlantic Ocean from Cornwall to Newfoundland; and the first UK broadcasting station, "Two Emma Tock", at the Marconi factory at Writtle, near Chelmsford, Essex.

Glen Ross G8MWR as well are performing his usual task as writer of "On the beam", has been looking at radio *long before Marconi*. He tells me that he does a lecture to radio clubs entitled "The first 400 years of amateur radio". It appears that one or two people were experimenting with the use of electromagnetic radiation, as a means of communication, long before the likes of Hertz and Marconi arrived on the scene

Aerial leaders

One thing that I forgot to do last month is to thank Amcomm Services of South Harrow for their help with our feature on aerial rotators. They very kindly lent us some rotators for our research for the article; greatly appreciated. I would also like to thank Clive Everley G4PPK for his help with this month's front cover. When it came to the photographic session, our intrepid lens-man Jay Moss-Powell G6XIB found himself one FRG7700 short, because of an editorial oversight, ie cock-up. Clive very obligingly plundered his shack and solved the frog crisis for us.

Finally, a personal note. I am moving on to other publishing activities, unconnected with amateur radio, which means that I shall have to relinquish the editorial chair here at Bicester. However, I hope to continue to contribute to the magazine in the future. But for now I shall join the rest of the magazine's freelance writers. I will now be at the mercy of the new editor! Anyway, I've enjoyed my brief stint in the hot seat. Chris Drake will look after the magazine until the new editor can take over. I wish them both every success.

73 de Richard Lamont

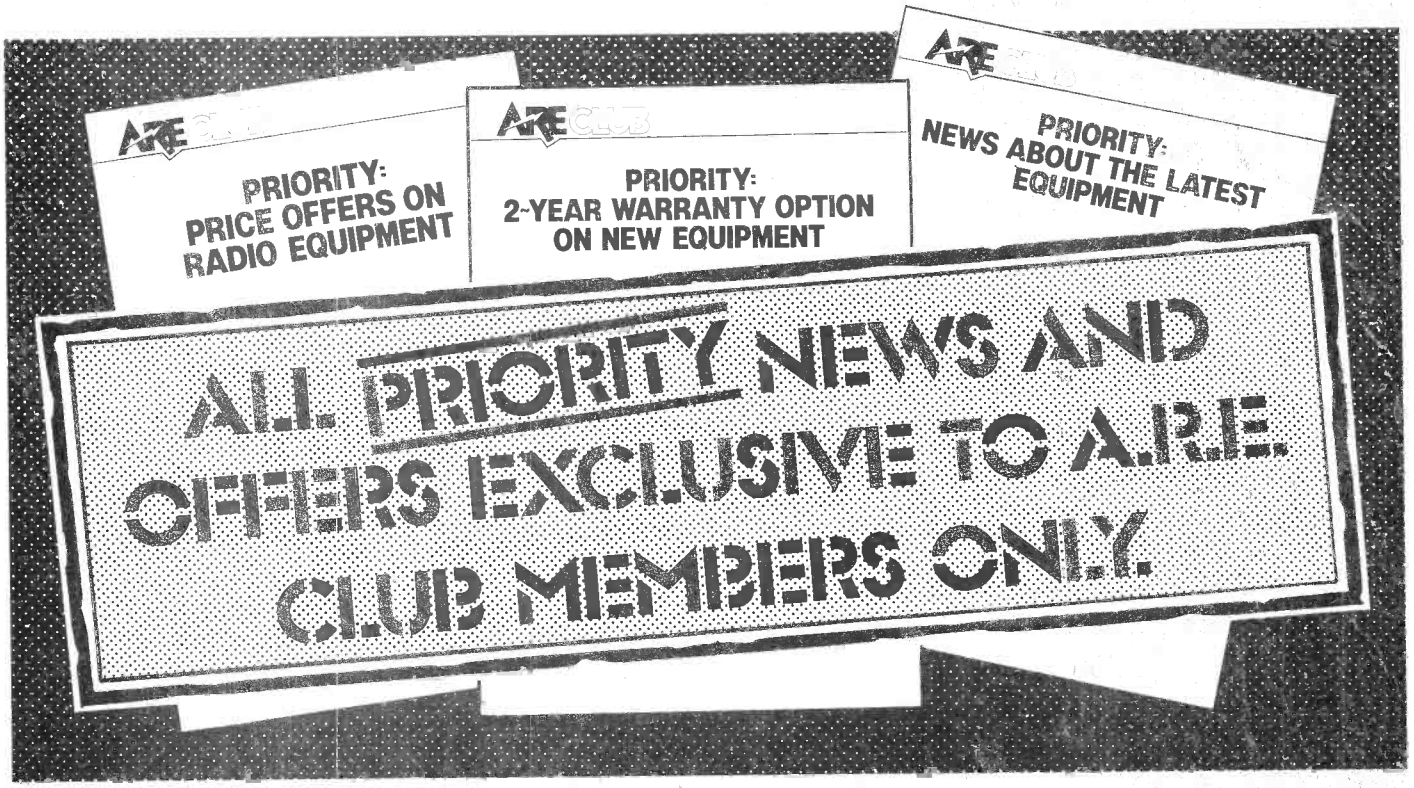
INTRODUCING THE ARE CLUB

Why you'll want to make it your club.

Ever wished you could have first priority on news about the latest radio equipment? First priority to buy at very special prices—or a 2-year Warranty option?

All this kind of exciting news and information is now available—on an exclusive priority basis—to members of the Amateur Radio Exchange Club.

We can also arrange for Radio Clubs affiliation—Club Secretaries, please write.



For details of how to join- come into any of the A.R.E. shops. Or phone.

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ARE *more on your wavelength*

L·E·T·T·E·R·S

Facetious phonetics

I write to take issue with you with regard to your view in "Current Comments" that facetious phonetics should be allowed when making callsign identification.

Anyone using facetious or objectionable language either when identifying their callsign or while in QSO is contravening the conditions of his/her licence and deserves to have his/her licence revoked.

The use of such words lowers our standards as radio amateurs so those of the CBers.

Those new to our ranks, especially from the land of 27MHz, should be encouraged at every opportunity to use standard phonetics and practices, and not bring the rest of the amateur fraternity down to a level which brands all of us as illiterate morons.

R.G. Whittering G3URA, Cheshunt, Herts.

Staple diet

I have been collecting *AmRad* since issue number two. Unfortunately, I did not have the chance to send off for a back issue, and seeing the announcement that number one is out of stock, I am wondering if you will print it again.

Just one small moan; the last two issues I have received have had the top staple missing. This does create problems, particularly if you wish to put them in binders. Also, could you send me some information on how to send you info for your club news spot? Thanks for a great mag anyway. It's the best out of the lot!

Mark Townsend (soon to be licensed, I hope!), Chadwell Heath, Essex.

Apologies for the staple-less issues - it's the first we've heard about the problem, but we'll keep an eye on things in future. Regarding our club news section, simply write out the newsy items on a sheet of paper (preferably headed with the radio club's name, address, telephone number etc.) and send it to the Editor. Deadlines are roughly a month prior to cover date - which means that you'll need to let us have the information for the June issue on May 1st - Ed.

Novice Licence - Part XXXVII

Just what is Ian Abel and his ARNLC after? Blowed if I know! Personally I don't see how the entrance requirements to our hobby can be made much easier - and still retain a reasonable standard.

If you have adequate grey matter - or more important - a keen interest in the subject, then it is easy to learn to read CW at 12wpm as it is to read it at 5wpm. You simply press on that little further. Also, whilst not wishing to go into the pros and cons of the multiple choice RAE, surely no one after reviewing the present situation on the bands would wish to lower the threshold any futher.

In that direction would be a licence on the National Health Service - or in exchange for four soap powder coupons, plus 50p postage and packing! So, come on Ian, you've a lot of drive but it's pointed in the wrong direction.

Leave the "novicing" to the nuns - they've been at it longer!

New Kirk, Rotherham, Yorks.

Upon reflection...

Regarding Mr Gillam's letter on 'Reflections' published in the March issue of *Amateur Radio*, I agree with him that the term **power** is often misused, but with respect would say that he is mistaken in believing that there is not reflected electrical energy on a mismatched transmission line.

Although, as he says, the input impedance of a loss-less line which is either o/c or s/c at its far end is purely reactive (except when the line is an exact number of $^1/_4$-waves long), this is true only *after* the out-going energy of the generator (source of emf) has been reflected from the end of the line and returns to the input.

Initially when first switched on, the generator sees only the characteristics or surge impedance of the line which is purely resistive, ie, the voltage and current being in phase. A line therefore only behaves reactively because of the existence of both a forward (or incident) and reflected wave of energy. Reactive components such as a coil or condenser also return energy to an AC generator, once every $^1/_2$-cycle, the energy being stored temporarily in either the magnetic or electric field as the case may be. Although, as Mr Gillam says, there can be only one voltage and current on a two-wire line, they are not due to the out-going wave of energy alone but result from the presence of both a forward and reflected wave of energy and the way that they interact.

What actually happens to reflected energy when it arrives back at the generator depends on the latter's impedance. If it is the same as that of the line, the generator circuit is able to accommodate the returning energy, but if the impedances are different, some of the returning energy is reflected back to the load. I described this action in detail in the July 1982 issue of *RadCom* and shall be pleased to send a copy of the article to anyone who is interested. The greater losses sometimes associated with mismatched lines, especially those having a solid dielectric, are not as Mr Gillam believes, due to mismatching between line and generator, but to the greater energy flowing in a mismatched line compared to that in a matched one delivering the same power to its load.

However, he is correct about the following important point, which is that a mismatch between line and load does not prevent the maximum power output being obtained from the generator and delivered to the load, providing that the input impedance of the line is matched to the generator. From the point of view of radio communication, the increase in losses resulting from a mismatch betwen line and load, is usually too small to make a detectable difference in the strength of the received signals. The load in the case of reception is of course the receiver's input impedance, not the aerial.

Hoping this will be of interest,

Kenneth E. Parker G3PKR, Hayes, Middlesex.

Going nowhere

I had to laugh at the two 500 resistors going nowhere: Fig 2 page 61 in the February issue.

At the end of any aerial wire there is a node (no damned current) so there is no point in putting a resistor there.

R. Store, Southsea, Hants.

Er, um. Yer. Apologies... Ed.

The lore of hand-helds

I was interested by your article on modifying old Pye radios (February *AmRad*) for 432MHz. I find UHF propagation particularly fascinating, and remember when the police were first issued with Pocketfones. The story was that the Home Office was testing about three VHF portables (a "portable" radio was used by Brighton police in the 1930s) when Pye at last produced an equally reliable 452MHz set, although in separate cases.

The civil servants wanted to wait for a more conventional system, but the then Home Secretary Roy Jenkins, insisted on immediate introduction of the PF1.

I was often tempted to ask passing constables if I could look at their radios and if they knew how revolutionary they were! They made a big

L·E·T·T·E·R·S

thing of them on "Z Cars" and "Softly Softly", the police series of those days, the actors getting out their transmitters with their spring loaded whip aerials (no rubber ducks!). In those pre-scanner days, UHF radio telephone advertisements emphasised their "security." I wonder if their users know about the MOD's plans? I suspect that even public services will have to move up to 900MHz, and how long will that be safe?

I know that the conventional interpretation of the Wireless Telegraphy Act forbids listening to those "interesting transmissions" but I think in Paul v Ministry of Post and Telecommunications (Times Law Reports March 3rd, 1973) the Appeal Court came dangerously close to limiting the legal listening of anyone in Britain not explicitly authorised otherwise to (1) the BBC, IBA stations and (2) amateurs. I challenge their interpretation of the term "authorised broadcasting stations" to mean just (1). I know of no prosecutions since the above (although there were several in London in 1972) for unauthorised listening, and people walked around airports with aircraft receivers quite openly, even then.

On a less Orwellian theme - I am sure I am not the only person who is fascinated by hand portables and their history, particularly above 400MHz, going back to the super regenerative (like direct conversion and pulse counting, a neglected technique, I think) S-phone of 1944.

I suggest an article on this subject would be worth considering. There are thousands of people who have experience in regular, long-term use of these frequencies, apart from amateurs. I am sure there must be many interesting stories about unusual reception (which would not contravene even the widest interpretation of the law).

For example, in May 1978, after several days of hot, very humid weather, the Herefore fire brigade were reported by the Midlands press to have received signals from North Sea oil rigs. I think this must have been confined to a narrow area since I do not remember any reports of lifts on VHF or UHF for that week in the amateur magazines. It is a pity that 934MHz CB has not caught on more.

In my experience most PFI receivers (six out of seven I bought a year ago) have hardly any audio output. The cause of this is misalignment of the IF transformer next to the 10.8MHz second oscillator crystal and is easily remedied; just twiddle it. The first oscillator crystals are very vulnerable to heat. I suggest cutting through the solder and copper track to remove them, instead of desoldering (they are, of course, useful for other things) and fitting part of an IC holder, or best of all, the "cage jacks" supplied by Ambit, for the replacement crystal. They also seem to vary a lot in their minimum supply voltage. That ticking noise the battery saver gives off would have driven me mad.

Perhaps that is why the police became more aggressive in the 60s, and by the time silent ones came along, they could not go back to being bobbies!

R. Saunders, Longbridge, Birmingham.

Stabiliser neons

Ken Williams has devised an excellent CW junk box transmitter. Since he would appear to have a monumentally large 'bits and pieces' box containing a wealth of stabiliser neons, which are not too easily obtainable on the surplus market, might I suggest an alternative.

When building valve power supplies requiring separate bias voltages I have used series connected Zener diodes making up the total as per specification. In this instance, 3.75v and one at 24v; the whole being paralleled with a 0.1uF capacitor of 500v or more

Frank H. Thomas, Hermon, Glogue, Dyfed.

Appalling SX200

I must hasten to comment on a remark included in the review of the AR2001 Scanning Receiver. The author states that he had heard an SX200 recently and was appalled by the synthesiser noise. In fact, I took the unit in question to Angus McKenzie's laboratory to demonstrate some 'bolt-on goodies' (S-meter and frequency range extenders) and specifically told Angus that the set was a reject for excessive noise and was merely a workshop 'galloping test-bed'. We have sold a few thousand SX200s and it is clear that the vast majority of users accept some synthesiser noise in return for all the other benefits.

I would also challenge the assertation that the advent of the AR2001 means that all other scanners can be written off now. Our continuing rate of sale thoroughly belies that statement; it seems that customers prefer the proven reliability and after-sales support which have helped make the SX200 so successful.

It is rather unfortunate that the glowing review of the AR2001 has only served to compound the nightmare of the dealers trying to obtain supplies in the face of the production and quality control difficulties.

P.W. Longhurst G3ZVI, 7 Norvic Road, Marsworth, Tring, Herts HP23 4LS.

More help needed

Thanks once again for a great magazine. I wrote to you a while ago for some information about a GDO, and with your help I received some fantastic results.

I now have another problem; I have just bought an oscilloscope Type 13A Hartley Electromotives Ltd., and it is a dual beam type of scope with a switch for high tension and low tension. My problem is when I switch to the low tension mode - it does not work. It is, however, OK on HT. I know it is difficult to trace faults without a circuit diagram, so if any readers can help, I would be appreciative.

The scope is an old type - possibly ex-forces. Also, do you know where I can get this ic - A5-8100 or a circuit for a digital readout for a shortwave set (ie add on)? Finally, has anyone got a circuit for a low power 28MHz transmitter?

John Vernon, 215 Anglia House, Longsight, Manchester M12 4AF.

Well, can readers help with this man's "other" problem? - Ed.

What's an adult?

Re: the article on page 10, third column on "CB changes". Surely it is illegal not to transmit music and relay broadcasting stations, and as for the age limit, that ought to be 21 at least, judging by what I hear in this area.

How will they be able to enforce "under 14 with adult supervision?" What's an adult? A 15 year old?

Dave Brightman, Milton Keynes, Bucks.

Pye modifications

I much enjoyed reading the article on Pye equipment (February AmRad) in your magazine. I feel sure that you have succeeded in whetting the appetite of many amateurs and suggest a series of follow up features showing step by step (blow by blow?), how modifications can be carried out.

This would be of particular value if the writer could bear in mind that the average amateur has little or no test equipment. With the rally, exhibition and junk sale season almost with us, I feel sure more people would feel happier in knowing that the Cambridge Motofone, or what have you can be

LETTERS

modified since instructions are now on hand.

Whilst Malcolm Pritchard's article was very enjoyable and most useful in many respects, I feel that a series of features as described would be worthwhile. Keep up the good work.

Mike Shread, G6TAN, Milton Keynes, Bucks.

Pirate amateurs

Re: the comments in letters on the shuttle downlink. Well, it just bears out what I have learnt over the last two years so so - the passing of the RAE and Morse test doesn't make you a good operator or a good citizen.

It just proves you've had a certain amount of education. I do wish that radio hams would stop decrying CB; evidently from your letters the behaviour of some so called radio hams leaves a lot to be desired, so let the RSGB clean its own stable before criticising other radio users.

It has not been unknown for licenced amateurs to play havoc on 27MHz FM with equipment that is totally illegal and unlicensed as well - in other words PIRATE. And as for some of the comments on the 80m band I am still wondering where they got their licence, because some of the comments were so stupid, I know boys of 15 who could tell them more about propagation etc, than they know. Mind you, these lads are all illegal but they have talked round the world with a lot less power than most radio amateurs use on bands that, according to G4s on 80m, it is impossible to do it on.

No sir, these are the real radio hams, illegal maybe, but there is a certain satisfaction when a station from the Black Sea coast gives you 5 + 9 on two watts on equipment all home built, five element beam and all. Yes, that's being a radio ham, and that was on 26MHz.

I wonder how many licenced hams could do it. When I hear the local SSB net on 10m on Sunday morning. How I wish I could make them take a lesson from a few illegal CBers. It would do them the world of good; they can't even set on frequency, and I can assure you they are all licenced, and the signals are often so duff that I know blokes with two watts 27MHz hand helds who can do better.

Ah well, I suppose even old men will grow up one day. I suppose that some of the ill will from radio ham operators is due to the CB fraternity winning the right to do things that hams couldn't, or can do. But we stuck our necks out and took the risk of being clobbered, and won. Maybe we were bad boys but at least we got something done which compared with the RSGB's soft hearted way of doing things, is a revelation.

J.H. Halsey, Bishopthorpe Road, York.

P.S. I operate on 80m to 10m, but will go 160m when I've finished building the set.

Wanted: an ATU

Having just set up myself with a general coverage receiver, and erected an antenna, I now need an ATU.

I have friends who are SWLs, and they suggest that I ask whether you can supply us with instructions on how to build our own ATUs. Thanks for a good magazine!

R. Anthony Corbett, Sunnyside, Adwy, Coedpoeth, Wrexham, Clwyd, N. Wales.

With a bit of luck, see this issue. If not, can readers help with the necessary instructions? - Ed.

RALLY CALENDAR

April 1: **White Rose** Rally at the University of Leeds. Opens 11am, talk-in on 2m and 70cm, free parking, entrance 50p children and OAPs free).

April 8: **Buxton** Rally, at the Pavilion Gardens, Buxton. Open 11am to 5.30pm (10.30 am RAIBC). Admission 50p, children under 14 free if accompanied by adult.

April 8: **Swansea** Rally, at Patti Pavilion, Swansea (next to St. Helen's Cricket Ground on A4067 Swansea-Mumbles coast road). Open 10.30am-5pm, talk-in, S22.

April 28/29: **RSGB National Amateur Radio** Convention, National Exhibition Centre Birmingham.

May 6: **Anglo-Scottish** Rally at Kelso. Weekend accommodation available.

May 27: **Plymouth** Rally, at Devonport Secondary School, Park Avenue, Devonport, Plymouth.

June 17: **RNARS** Rally at HMS Mercury near Petersfield in Hampshire. Open 10am-5.30pm, Talk in on 2m and 70cm.

July 21: **Radio and Electronics Fair** organised by the West Kent Amateur Radio Society at the Royal Victoria Hall, Southborough (between Tonbridge and Tunbridge Wells). Open 9.30am-5pm.

September 23: **Lincoln Hamfest,** organised by the Lincoln Short Wave Club, on the Lincolnshire Showground (4 miles north of Lincoln on the A15). Open 11am-5.30pm. Talk-in S22 and SU8, caravan and camping facilities, facilities for the disabled.

DX DIARY

News for HF operators, compiled by Don Field G3XTT.

DXers are often accused of being anti-social blackbox operators whose only interest is to reach the point where they have "ticked off" every country on the current ARRL list.

It is said that they take from the hobby without putting anything back into it. Unfortunately such statements are indeed true of some DXers. But not, I would suggest, of the majority. In some ways I feel it is a pit that DX awards are predominantly geared up to the "traditional" modes of CW and SSB rather than encouraging experimentation with more "efficient" modes of communication (Amtor is an obvious example which comes to mind). Nevertheless, there are many ways in which self-training on the part of the licencee (to use the form of words internationally accepted as describing one of the key reasons for amateur radio) is essential if you are to become a successful DXer.

An awareness of antennas and propagation, a knowledge of geography and culture, a smattering of other languages; all these help in our DXing and are beneficial in their own right. In the January column I discussed split-frequency operation and expedition frequencies. In this month's column I have tried to give you a flavour of some of the other, perhaps more interesting, considerations which can help our DXing.

First, here's the news in detail...

Let's look at what is new. For those with a taste for the exotic, the Venezuelan national society is organising an expedition to the Churum-Vena (Angel Falls) in the Venezuelan jungle, to take place from 30 March to 1 April. The falls are the highest in the world (3212ft) and were discovered in 1935 by an American pilot. The special callsign will be 4M5ARV/6, and a special QSL will be available from the society. The usual DX frequencies will be used, 80-10 metres, both SSB and CW.

Those needing a contact with Vatican City will be interested to know that HV3SJ (located in the Jesuit HQ) is active each weekend, with 40 and 80 metre activity taking place after about 2100 GMT. There are two other stations in the Vatican, HV1CN just inside the Vatican walls and HV2VO at the Vatican Observatory outside Rome. The latter call is held by Father Edmund, an astronomer who travels extensively and is therefore only rarely on the air.

Another "country" located in Rome is the Sovereign Military Order of Malta, an ancient order of knights which enjoys sovereign status. An amateur radio station 1A0KM has been active from time to time, but the station is located in a part of the building which is frequently used for other activities, so operation has been somewhat sporadic. What I am able to tell you is that activity is usually at weekends, and that the group intend to make a special effort on the low bands (particularly 160 and 80) whenever they can be operational.

Rumours have been circulating recently about some activity from Albania. This is the only European country which does not allow amateur radio, but a thaw in the offical attitude may be imminent. A Finnish DX group have already sent some equipment to Albania, and it appears that one or two Albanian nationals may have been putting it through its paces in recent days. Don't expect a flood of ZA stations on the air, but if you hear one I suggest you work it and worry later about whether it was genuine.

By the time you read this the Clipperton Island expedition should be history. The QSL route is the same as that for all of Lloyd and Iris Colvin's operations, ie the YASME Foundation. The address is PO Box 2025, Castro Valley, California 94546, USA.

There is activity again from Franz Josef Lane under the callsign UK1PGO. A good time to look for them is on Tuesday mornings on 7095kHz from 0700 GMT.

The recent troubles in Uganda meant that 0H2BAH, who was in Kampala for several weeks during February, thought it inadvisable to take his transmitter into the country. The last major operation from Uganda was in October 1980 by Carl and Martha Henson, WB4ZNH and WN4FVU, who in subsequent years have operated from both 3CO and TT8. This year they are believed to have travelled to Niger (5U7), but have not been heard on the air. Still on the subject of Uganda, G8GRN has made occasional appearances on 15 metres using the call G8GRN/5X, with his QSL route being G4CTQ. It is understood that G8GRN is living in Uganda, so we can only hope that he will become more active as time goes on.

Phil Weaver, VS6CT (and G4JMB), was active from Macau in early February as CR9CT. His QSL route is PO Box 12727, Hong Kong. From March 1st, the prefix for Macau changed to XX9, so you should alter your prefix lists accordingly.

160 metres continues to produce some interesting DX, with all continents being worked. Indeed, VK6HD was worked by several UK stations during the RSGB's February Topband Contest. Amateurs in more and more countries seem to be receiving permission to use the band, the most recent newcomers in Europe being Portugal and the Azores. In fact, Hungary, Belgium, Albania and Rumania now seem to be about the only countries in Europe without 160 metre permission (YP3A was active from Rumania in the CW WPX CW contest last year, but this was a special permit for the contest weekend only).

Lost DX

I am convinced that much DX is lost due to a failure of common sense. The great truism that you can't work them if you can't hear them is all very well, and all the top DX ers will tell you that time is much better spent tuning the bands rather than calling CQ. However, there is no sense tuning a dead band or, come to that, a band which is open to a part of the world where everyone is asleep. Attention to time zones, weekends, holidays and propagation will all reap rewards. As a simple example, most Muslim countries set aside Thursday and Friday as their "weekend", so that amateur radio activity from the Middle East and North Africa tends to be most prolific on these days. But, having said this, countries like Saudi Arabia and Kuwait are several hours ahead of us, so don't expect too many of them to be on the bands at midnight out time, even if propagation is favourable. The conclusion we come to is that early to mid evening on Thursdays

and Fridays is the best time to be looking out for stations in the Middle East. All a matter of common sense, you will agree, but too often overlooked.

Contests, of course, are often occasions when many operators will ignore such undesirable intrusions as the need to eat or sleep, and it is surprising to discover just what can be worked on contest weekends. Very often it isn't propagation which is the limiting factor in our hobby, but rather the basics of life such as having to go to work, sleep, etc.

Amateur linguistics

I mentioned in my introduction that if often helps to know a smattering of other languages. UK amateurs can often be very lazy in this respect, taking advantage of the fact that English has become the international language of the air.

However, as an example, there is much activity in French in the 14100-14150kHz region, mainly from current and former French possessions in Africa and the Pacific. A call to these stations in their native language can often bring a delighted response where a call in English would have been ignored. My one and only 5U7 contact would never have come about had it not been for my (limited) knowledge of German which helped both in recognising who the DX station was in the first place and in persuading him to stay on the air for a few minutes longer to work a mere Englishman.

Having said all this, propagation is of course vital, and it is essential for the would-be DXer to know about MUFs, long and short paths, grey lines and much more. Some of these factors are most applicable to LF propagation and I will deal with them in a future column. For the higher bands (10,15 and 20 metres), the basic data you will need to be aware of is that relating to Maximum Usable Frequency (MUF) on the path you are interested in. Several publications contain propagation forecasts relating to specific routes, but you can go one better if you have access to a computer. The MINIMUF programme, which has been published in *Radio Communication* and also in the American journal *QST*, can be run on many home computers, and enables you to make your own propagation forecasts based on exactly the two end-points you are interested in. The only data which have to be input are the co-ordinates of either end of the path, together with a figure for the sunspot number. This latter is relatively easy to provide: predictions abound, some weekly publications carry recent data, and smack up-to-date figures, together with a forecast for the coming 24-hours, can be obtained by telephoning 0101-030-497-3235, a round-the-clock service operated by the US National Bureau of Standards in Boulder, Colorado. One of the most comprehensive weekly reports is that compiled by KH6BZF. This contains both historical data and forecasts, and is available for an annual subscription of $44. One of the great advantages of being able to plot MUFs according to the time of day is that you can often catch the beginning of an opening to a particular part of the world and work the DX station long before anyone else is aware that he is audible.

A knowledge of where to point your beam (assuming you have one) is also vital. Beam headings are, in fact, one of the outputs of the MINIMUF computer programme which I mentioned above. If you don't own a computer, never fear, the *Amateur Radio Yearbook* does it all for you (p.83). Use this data or great circle maps with caution, however. For the UK, the data is usually based on bearings from London, and for paths to the other side of the globe the bearing from other parts of the UK can be significantly different.

Antarctica

So much for the hints and tips. Now for something completely different. Back in January my friend VP8ANT (whose UK call is G3CWI, a call previously held by his uncle) returned from a two-year tour of duty as the base radio officer on Adelaide Island in the Antarctic. During that time be made a grand total of 40,838 contacts, including the first activity from Antarctica on the new 10,18 and 24MHz bands. The bulk of the contacts were on 15 and 20 metres, though he was able to make 526 contacts on topband much to the delight of the 160 metre enthusiasts. Richard's QSL manager, G3ZAY, handled some 8,000 direct and 2,000 bureau cards during this period, a magnificent effort in itself. In fact, due to the infrequency of the mail service from the Antarctic, most of the confirmations were handled over the air rather than waiting for the logs to arrive in the UK. This necessitated twice weekly schedules, usually on 20 metres, and it is interesting to note that propagation prevented these on only about two occasions over the whole period.

Richard was able to operate briefly from South Georgia en route to Antarctica, and also from Deception Island in the South Shetland Group on the way home. His other claim to fame is by way of some QRP contacts with the UK using a back-pack radio on several occasions while out on field trips in the Antarctic.

After such a prolonged spell in the polar regions Richard now has plans to seek the sun, and by the time you read this will be bicycle mobile (2 metres only!) in Australia.

A few words about amateur radio activity from BAS bases may be of interest at this point. There has been quite a lot of activity over the past year from Signy base in the South Orkney group, and Faraday and Halley bases in Antarctica itself are also frequently on the air. There is no BAS base in either the South Sandwich or the South Shetland Islands. The latter have seen activity of late by UQ2GDW operating from a Russian base as 4K1GDW, though he has now moved to Antarctica itself. South Sandwich has not been on the air

Richard VP8ANT/G3CWI gets down to the outstanding bureau cards on his return to the UK.

DX DIARY

since 1981 when LU3ZY ceased activity. the Grytviken base on South Georgia, so much in the news over last couple of years, is still closed, but the Bird Island base is still operational so there is always a possibility that we will hear some activity from there.

Last month I discussed awards generally, and the DXCC programme in particular. I now have details of a couple of other awards which may be of topical interest. Firstly, the German national society (DARC) is offering an award for contacts with 15 of the special World Communications Year stations, and details can be obtained from the custodian DL9XW.

I4ZSQ, award manager for the RKE awards programme, has sent me details of the programme which may be of interest. The Half-Thousand Countries Award (HTCA) is for confirmed contacts with 500 countries from the ARRL list since 1st January 1983, using the 10,15,20,40 and 80 metre bands. The Thousand Countries Award (TCA) requires confirmed contact with 1,000 countries on the same five bands, but with a starting date of 1st January 1969. Before anyone tells me there are only 315 countries in the world, the idea of course is to total your countries' score on each band!

Finally, I trust you were all busy working the special stations which appear from Sarajevo during the Winter Olympics. There is almost bound to be some kind of award available in due course in connection with this event. Hope to see you at the Birmingham Convention.

March 25/26 CQ WPX SSB Contest

March 30 - April 1 4M5ARV/6 (see text)

April 13-15 Visalia DX Convention (see last month)

April 27-29 Dayton Hamvention (see last month)

April 28 RSGB HF Convention

May 5/6 Late Spring QRP SSB Weekend (see Feb. issue)

May 13 WAB LF Phone Contest

May 26/27 CQ WPX CW Contest

First off then; Cambridge Kits have produced a special offer exclusive to Amateur Radio readers. It is for their new Antenna Tuner Kit, which is now being offered at £4 off retail price. The bandpass tuner is designed to improve reeption from 0.1 to 30MHz, and has switched series or parallel tuning to suit both long and short end fed antennae and receivers having the usual low impedance input. It's particularly effective with indoor antennas, we understand.

J.M. Mann, of Cambridge Kits, told Amateur Radio that: "The kit includes a detector output for a meter to adapt it to a sensitive absorption wavemeter or field strength meter, or with headphones to make a modulation monitor, or a quite remarkable general coverage crystal set (useful in emergencies!). Although primarily designed for receiving, it will handle transmitter powers up to 10 watts."

This easy to build kit contains all the parts, including ready wound inductors and 4 x 7 x 14cm metal case, instructions, calibration chart and is available at the special price of £21.20, including VAT and UK postage if ordered before the end of May this year.

The only other conditions are that you must order it direct from Cambridge Kits (45 Old School Lane, Milton, Cambridge CB4 4BS) and as usual, allow around 28 days for delivery. After the end of May, the price goes back to the original price of £25.20.

On the subject of whether you can listen into a transceiver for short wave transmissions without a licence, we thought you might be interested in a letter sent to Geoff Brown GJ4ICD, who works at SMC (Jersey) in the Channel Islands.

Geoff says he has spent "days" on the telephone with the DOTI asking various questions about the legality of short wave listening and other confusing matters. The reply, from P.G. Le Maistre, Executive Engineer Transmission, Jersey Telecoms, is reprinted below.

Dear Mr Brown

With regard to your letter dated 19th September, 1983, I am now able to clarify the following points:

a) A short wave listener or Class "B" amateur may install a Transceiver used only for the reception of messages sent by Telephony or Telegraphy from licenced amateur stations.

b) A Class "A" licensee may operate a Class "B" licensee's station, below 144MHz, providing he uses his own call sign with suffix/A.

c) Can a Class "B" licensee operate his station using the H.F. bands (if such a facility exists) while under the supervision of a Class "A" amateur? The answer is "yes". In this case it is essential that the "A" amateur's call sign is used.

Please note that this is a Department Of Trade And Industry concession to the strict interpretation of the licence, and can be withdrawn, by them, at any time.

d) For identification purposes the call sign should be sent at the beginning and end of each period of sending. It is necessary to repeat the call sign when the period of transmission exceeds 15 minutes (clause 9 (2) of the Amateur Licence refers).

It is nice to stir up what some people might call "controversies" in our editorial pages! Mind you, Hilary Humphries, whose letter appeared in last month's issue, has developed into a rather intelligent discussion. He's neither a licensed amateur nor a CBer, but he says he would like to "redress the balance" following our photograph last month of the CB Centre in Hastings, which specialised in ladies' clothing.

He says: "Lowe Electronics supplied the JST 100 (reviewed last issue) review sample which was said to look somewhat 'army-fied'. Anyone in the London area wishing to acquaint themselves in person with its rugged good looks might well have to run the gauntlet of an array of equally rugged looking make models since Lowe is situated in the Hepworth's building in Pentonville Road. Who's laughing now?"

A modicum of decorum please.

Mr. Humphries adds that he notes Richard Lamont's comments about variable selectivity on FM costing more money. "Perhaps this is a modification we will see incorporated in the future. Equipment reviewers and writers on basic receiver requirements have pointed out that extras such as memory, timers and digital clocks do not contribute to the quality of the received signal, and are luxuries many can do without." Quite, Mr. Humphries.

Rather than split Mr. Humphries's letter into two, and feature some of it on the letters page, we'll reproduce it here.

"If the IF bandwidth of general coverage receivers is insufficiently narrow for some FM transmissions, it is equally true to say that in the main Rxs do not have a bandwidth that does

justice to medium and long wave broadcasts. Racal offer a choice of IF filters, including 8kHz and 13kHz, and Yaesu are to be complimented on providing a 12kHz position on the FRG7700.

"This resulted in the version modified by Surrey Electronics being reviewed in the February 1982 issue of Hi Fi News, something unheard of for a communications receiver. I look forward to reading Angus McKenzie's review of the FRG7700, both modified and unmodified.

"It would seem that the improvements that Surrey Electronics have introduced are considerable, and point to the unmodified version as having a rather poor performance. For instance, the original third order intercept point of -21dBm has been upped to -2dBm on a par with JRC equipment. Even the remarkable little AR2001 scanner achieves -17dBm. The modified Yaesu receiver is also superior to the Racal series 1770 with respect to detector board distortion and AF bandwidth if the claimed figures are correct, and are compared with Racal's data sheet for the year 1973.

"The letter in last month's issue in power, made interesting reading. As you disagreed somewhat with the writer the matter seems unresolved. Perhaps Angus McKenzie will reply in person, or maybe another of your readers will put the matter into perspective.

"My own view is that the purpose of vocabulary is to convey meaning, and provided we do this it is not always necessary to be word-perfect. However, it does no harm to discuss things from the angle of textbook accuracy. Strictly speaking, a transmitter feeds energy into a transmission line. The word 'power' only needs to be used when the rate at which energy is supplied needs to be quantified. Power is also used as a verb in the sense of a battery powering a set, and in this context it is not necessary to quote the actual power.

"Another common error is to speak of IF frequency, since one is repeating the word frequency. An even clumsier mistake is perpetrated by the press, and, I am sorry to say, the BBC, whenever a spy scandal breaks. Geoffrey Prime from GCHQ and the Krogers from Portland were said to be in possession of high powered short wave receivers, when the term should have been "highly sensitive."

"Fifty years ago, Robert Ripley's popular 'Believe it or Not' cartoon debunked the popular fallacy that a battery stores electricity. A fully charged accumulator consists of two sets of plates composed of lead and lead oxide, plus an electrolyte of suplhuric acid. One cannot point to any part of the battery as "containing electricity.'

"When the circuit is completed, electricity is produced by a chemical reaction and the energy is stored as chemical energy. Strictly speaking, it is a cell, and not a battery that produces electricity. Battery is short for 'battery of cells.'

"I was in agreement with the letter from R. Jenkins concerning sensitivities being quoted in different units and it seems a good idea to stick to just one method. Would it also be possible to ensure that application forms in the magazine do not having something on the back that the reader might wish to keep? If the reverse side consisted of another form, or perhaps next month's items, people would be more willing to cut them out."

Just a small point, for all radio club secretaries, PROs and publicity officers. Please make sure that information gets to us in plenty of time. I'm afraid the press release that explained what was going on in March (arrived here on March 6th) was wasted. And on top of that, the press release revealed that a special junk sale was being held - on March 6th! We won't mention which club it was, but whoever it was, knows all about it...

Our final date for club news is around six weeks before the cover date. In other words, information for our July issue must reach Bicester by May 18th. And so on.

Richard Thurlow G3WW sent us this interesting (who is it?) SSTV print out, and he explains that the lettering (not visible) down the right hand side was keyboarded by himself as "73 G3WW". Also, the small square alongside the person's right eye was where he removed an extra (wrongly placed) letter!

Richard told us: "On 13.2.84 at 1320 to 1405 GMT on 14230 (the SSTV calling frequency plus/minus 5kcs) 13XQW had a new 32 seconds black and white frames SSTV QSO with me and transmitted many excellent pictures which I taped onto my Sony audio cassette recorder, and also fed into the memories of my Volker Wrasse SC-1 SSTV (black and white and colour) and FAX converter, and played back to him from both memory and tape over the air.

"Peter was using the same converter. Mine goes into an Icom 740, into an SB220 linear and then into the 205BA or 40/80m Lazy H at 56ft. Subsequently I have taken delivery from Volker Wrasse Electronics (DL2RZ) of the print out pcb complete for the converter (of the contents of any of the 12 memories), and purchased in Cambridge the required Seikosha GP 250X Printer, and have been learning its uses from previously taped pictures.

"The enclosed is one from that QSO with 13XQW, enhanced (?) from being put under carbon paper while it was being printed out.

GIANT TEST

THREE TOP RECEIVERS

This month Angus McKenzie G30SS compares three important receivers - the Trio R2000 ranged against the Yaesu FRG7700, and the expertly modified version of the FRG7700 from Surrey Electronics.

When I first listened to a Yaesu unmodified FRG7700 I was singularly unimpressed, but around two years ago, Trevor Brook of Surrey Electronics, was looking hard at general coverage receivers under £500 to see if any of them had a potential for being *very good* if some modifications were carried out.

In much the same way as Chris Bartram (Mutek) has designed Mutek front ends for various VHF rigs, which greatly improve their performance. Surrey Electronics have transformed the 7700 into a receiver which can produce a quality on AM which is better than any I have heard. This review then, deals with both the original and the modified FRG7700 and compares the overall performances and ergonomics with that of the Trio R2000.

FRG7 successor

The Yaesu was introduced as the successor to the FRG7 and is qute reasonably priced. It can receive frequencies from around 40kHz to 30MHz, although in fact it does tune below 40kHz. The breakthrough of the local oscillator into the first IF stage is so high that frequencies in the submarine band, eg 16kHz, are virtually unreceivable. The receiver provides wide, medium and narrow AM bandwidths, NBFM, USB and LSB, the latter also being designation for CW. The frequency band switch covers 0 to 30MHz in 30 x 1MHz chunks, but if rotated further, covers the nine amateur bands, jumping from one to the next, with the 10m band splitting into 2 x 1MHz positions. This facility is useful ergonomically, for if you are just using it on amateur bands you won't have to click the switch round so much. Tuning is with a conventional VFO, the first IF being at 48MHz. The tuning knob rotates between around 25kHz and 70kHz per rev, dependent upon the frequency within each MHz band.

Twelve simple memories are provided with memory in and recall buttons, the frequency being stored to the nearest 1kHz point below it. An RIT preset can adjust the received frequency from established memory by up to + or - 1kHz, but unfortunately this RIT control is inoperative in the normal VFO mode. A digital clock is incorporated with the usual presets for setting it accurately and it does keep very good time, second not being displayed. The clock can be used to turn the receiver on and off again. You can also set the receiver to switch off up to 59 minutes after setting which allows you to nod off with the knowledge that you won't be submitted to propaganda in your sleep for too long.

An IEC mains input socket is complemented by a conventional miniature coax socket for 13v DC input on the back panel.

The antenna inputs include an SO239 socket for frequencies above around 1.7MHz, whilst spring clip terminals are provided for LW, MW and SW. This allows a separate antenna to be used for LF, but a jump wire can be inserted allowing the SO239 to cover all frequencies, in which case sensitivity is marginally degraded. A 20dB attenuator switch is also on the back panel but this would have been much more useful on the front.

Another terminal provides a mute function so that when shorted to ground

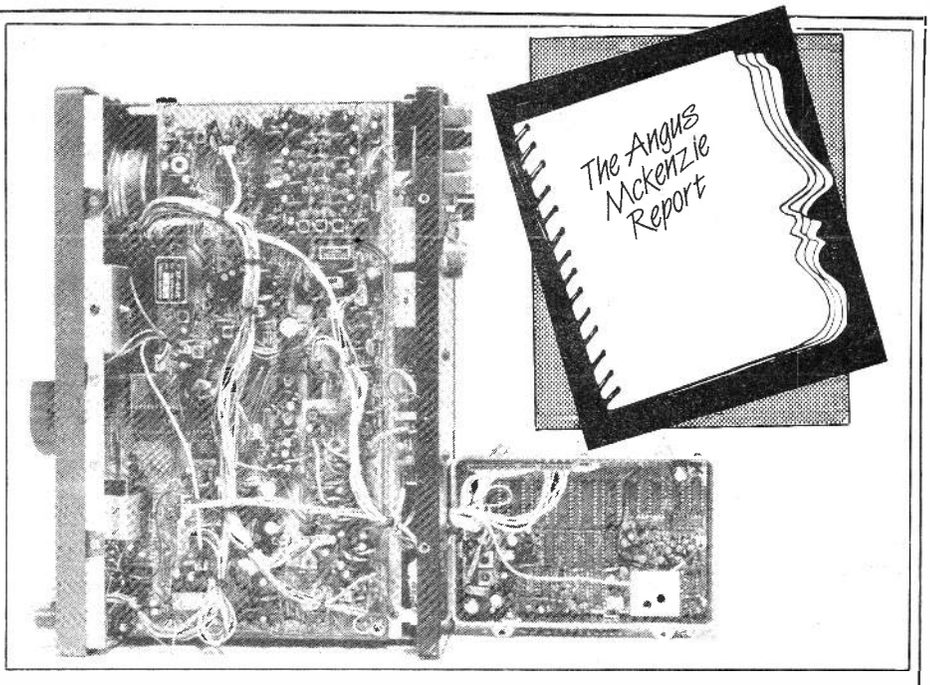
the receiver is muted allowing it to be used with a transmitter. An extension speaker can be interconnected with a 3.5mm jack socket. The set can be used either with normal AC mains or 13v DC, a separate socket being provided for the latter. An accessory socket provides 11v DC, the AGC line, mute output and ground.

Two phono sockets are provided which are driven by the clock timing circuits to give either short or open circuit when receiver is on. This can be used to start and stop a tape recorder, for example, which could be useful indeed. The circuits can short a current of up to 1a at not more than 15v DC, more than enough to operate an external relay which could then switch more current if required. On the underside of the receiver is a bug hutch with cover for inserting three AA size 1.5v batteries for working the clock and holding the memories when the receiver is disconnected from the mains.

The front panel includes a six position mode switch, audio gain mounted concentrically with a tone control, a squelch control operating only on FM, mounted concentrically with the RIT, and an RF preamp variable attenuator. Amongst the clock and memory buttons is one for dimming the display. Two more pushbuttons select fast or slow AGC and noise blanker on/off. A reasonable quality speaker is built in, throwing the sound forward from the front panel. Frequency readout is to the nearest 1kHz, no readout change being apparent when mode is switched.

The frequency readout also can be switched to clock time, AM and PM coming up where appropriate. A headphone jack is a quarter inch type, but an additional 3.5mm jack is provided for feeding a tape recorder at a fixed level of around 100mv max. The receiver is metal encased and is quite well styled, measuring 334 x 129 x 225mm and weighing 6.5kg including memory unit which is optional.

General tuning around on this receiver showed it to have a rather poor RFIM performance, which was particularly annoying on LW and MW, although some problems were noted on 160, 80 and 40m. There seemed to be a lot of spurious carriers around, and I was continually annoyed by slight backlash on the tuning, and the fact that the tuning rate varied from reasonable to very fast indeed, I found it difficult to tune in SSB towards the top end of any of the bands where the rate was fastest, and this was particularly annoying on top band. Sensitivity was fair, but audio quality was definitely worse than that provided by the majority of modern HF transceivers. Reciprocal mixing seemed poor, and the filter shapes not ideal, the response



Left: Three receivers compared, clockwise from the top, the Trio R2000, Surrey Electronics FRG7700 and Yaesu FRG7700. Accessories shown are the Yaesu FRT7700 ATU, and LF filter FF5. Above: Inside the Surrey Electronics version of the 7700, with the rear panel removed.

opening way out on very strong signals, so that selectivity below -40dB was very poor.

When you buy a general coverage receiver, you may be primarily interested in the capability of good AM reception. Unfortunately, the normal unmodified receiver can only be said to be very poor indeed for AM, with response dramatically changing as you tune across a carrier, this being proven in the lab tests. Distortion also seemed poor on AM at high modulation levels. FM reception was reasonably good and the squelch worked well.

On SSB, the received bandwidth was far too wide, and I am surprised that Yaesu did not put in a much better filter for the money, CW reception being extremely difficult because of the wide bandwidth. I was particularly concerned with the high hum level noted on the audio on earlier samples, but Yaesu have now put this right by re-orienting the mains transformer in the same way that Trevor Brook did when he developed his original mods and clearly these mods must have filtered back to Japan.

I gained the impression that the standard model was generally disappointing, and frankly unrecommendable. I could not see any really significant improvements over the earlier model, and at its price it clearly is poor value for money when one considers the price of Yaesu's FT757, which is so much better in every way as a receiver, let alone having an excellent transmit facility, its receiver being in a totally different class.

The RF sensitivities varied from 0.25uV on 10m, to 0.4uV on MW, the measurement being taken with the mode switched to SSB. The FM sensitivity for 12dB sinad was poor at only just under 1uV, and this is deaf indeed. AM sensitivity was generally poor across the board. The RFIM performance was acceptable but certainly not good on SW, but disappointing below 2MHz.

On 10m it measured well though, but this is partly due to there being less overall gain before the mixer at HF. We noted some very bad problems due to intermodulation on MW, including bad cross modulation effects when tuning on LW. If you live within 15 miles or so of powerful MW transmitters, I suggest that it will be essential for you to purchase the Yaesu LW filter and receive ATU which will be described later, which greatly assists the removal of some of the problems.

Close in reciprocal mixing measured rather badly, and the 20kHz measurement was affected as the noise floor was increased, and the 50kHz measurement is more realistic at an appalling 76dB ref noise floor. Local oscillator noise reduced rapidly though so that at 100kHz spacing the ratio was acceptable, and very good at 200kHz spacing.

A tendency to blocking was noted therefore when trying to tune in a fairly weak station close to a strong one, and this problem made it difficult to measure IF selectivity. On SSB, selectivity was much too wide at the top, broadening rapidly down the curve, so the 60dB point was actually 15kHz wide, with double sidebands bringing in the opposite sideband of fairly strong signals. Thus, an appalling shape factor is noted.

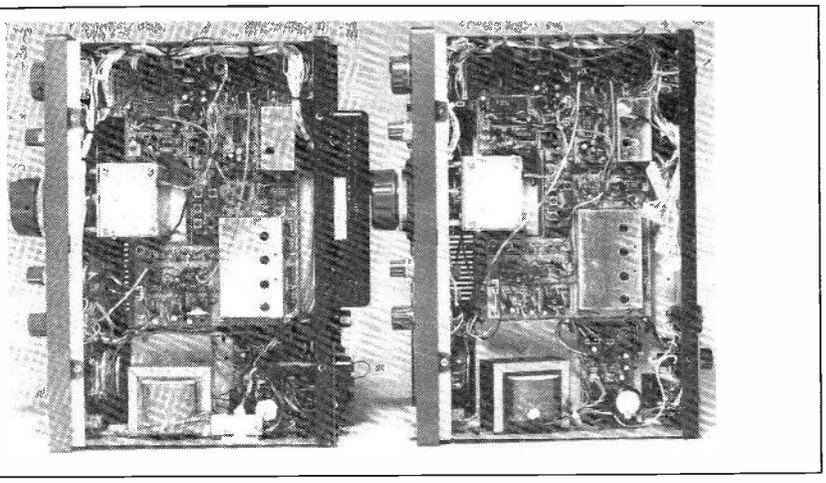
What comment can I make about a 116kHz bandwidth at -80dB caused almost entirely by reciprocal mixing problems? Three selectivities are available for AM. The narrow selectivity position uses the SSB filter, and I cannot think of an appropriate adjective worse than "clothy" other than to say that it is almost useless. The medium selectivity position measured well down to -60dB, although the top was rather pointed. Once again, reciprocal mixing was so bad as to dramatically widen the curve below -60dB. The most impressive selectivity curve was for "AM wide" which is almost ideal for receiving the

total transmitted bandwidth of the odd station that transmits a wider than conventional bandwidth. However, the audio responses were so uneven as to destroy the relatively good selectivity curve here. FM selectivity measurements were very difficult to make, again, because of reciprocal mixing problems, but there did seem to be reasonable rejection of adjacent and alternate channels.

On SSB the S meter gave around 3dB change per S point, 9 + 20 being only slightly pessimistic, the same comment applying to +40 and 60. On FM, the S meter was virtually identical which is unusual, and useful. Fast AGC was giving recovery in well under one second, and seemed quite good, whilst slow AGC was slower than usual which I personally like, almost full recovery taking around 3.5 seconds. Weaker signals though were not really affected by AGC, and S1 required almost 10uV for the onset of AGC, which thus means that weak signals will require you to bring up the audio gain quite a lot. Product detector distortion was reasonable at 1.1% when the receiver was giving 125mW output. AM distortion, with AGC slow, was very poor at nearly 4% for 1kHz, the measurement being the same on AGC fast. At 60Hz, distortion with AGC slow was about the same, but on fast it degraded to 23%!

This shows very clearly that if you want the best quality on AM, you should not use fast AGC. FM distortion for 2.5kHz deviation of 1kHz audio frequency was rather high too, rising to 4.6% for 4kHz deviation. The maximum power output for 10% distortion into eight ohms was 2.4w. The built in speaker is fairly sensitive and so I feel that output power is adequate. The best obtainable signal to noise ratio on AM was 57dB unweighted, which degraded by a few dB when a CCIR filter was switched in, showing that most of the noise was hiss. Earlier models gave a far worse figure because of hum induced by the mains transformer into the VFO and audio circuitry.

We investigated the difference between FM quieting and sinad ratings, and the quieting ratio was 6dB better at the 12dB sinad point, showing that weak FM signals generated considerable distortion and crackling because of the uneven IF selectivity curve and discriminator performance. The capture ratio measured well, inferring that the selectivity was rather too wide for FM spacing on 10m.



Inside the Yaesu and Surrey Electronics FRG7700 receivers, looked at from below. No prizes for noticing the differences!

The unmodified Yaesu FRG7700 is not really suitable for use by those who need good reception on SW. There are some useful facilities incorporated though, which are worth considering but competition is so stiff, that I am bound to say that surely Yaesu will at some time bring out a much better buy which may be worth waiting for.

Major modifications

Surrey Electronics supply many professional clients with high quality circuit boards and accessories for use in studios and in broadcasting. Government establishments spend millions of pounds on extremely expensive receivers, but had a call for a quantity, as did the BBC, of reasonably priced ones which could have a good audio performance.

After studying the market carefully, Brook realised that the 7700 could be made significantly better from a professional point of view. He designed major modifications to the front end and mixer, for example, interposing the mixer's RF input and local oscillator feeds to give improved RFIM performance.

His modifications also gave a much flatter gain characteristic at different RF frequencies. His modification includes a completely new AM detector circuit, and also there are improvements to the product detector. Mains input filtering is incorporated, and a mains circuitry modification can be made which would pass the BEAB approval scheme for safety. A 600 ohms balanced audio output can be provided at a fixed level with maximum output level at around +8dBm (2v) into 600 ohms. The distortion on this output is better than that given by the normal loudspeaker circuit.

Other modifications provide S meter improvements, slight improvements in AGC performance, and a reduction of local oscillator spurii. The normal 7700 RF attenuator varies just the front end gain, but in the modified version the same control alters IF gain which is much more useful. The audio response of the loudspeaker amplifier is greatly extended, particularly on FM, the tone control giving a wide range of adjustment to cut treble if desired. The 600 ohm balanced output is on a standard post office balanced jack socket. Basic facilities of the normal model are retained.

All its niggles...

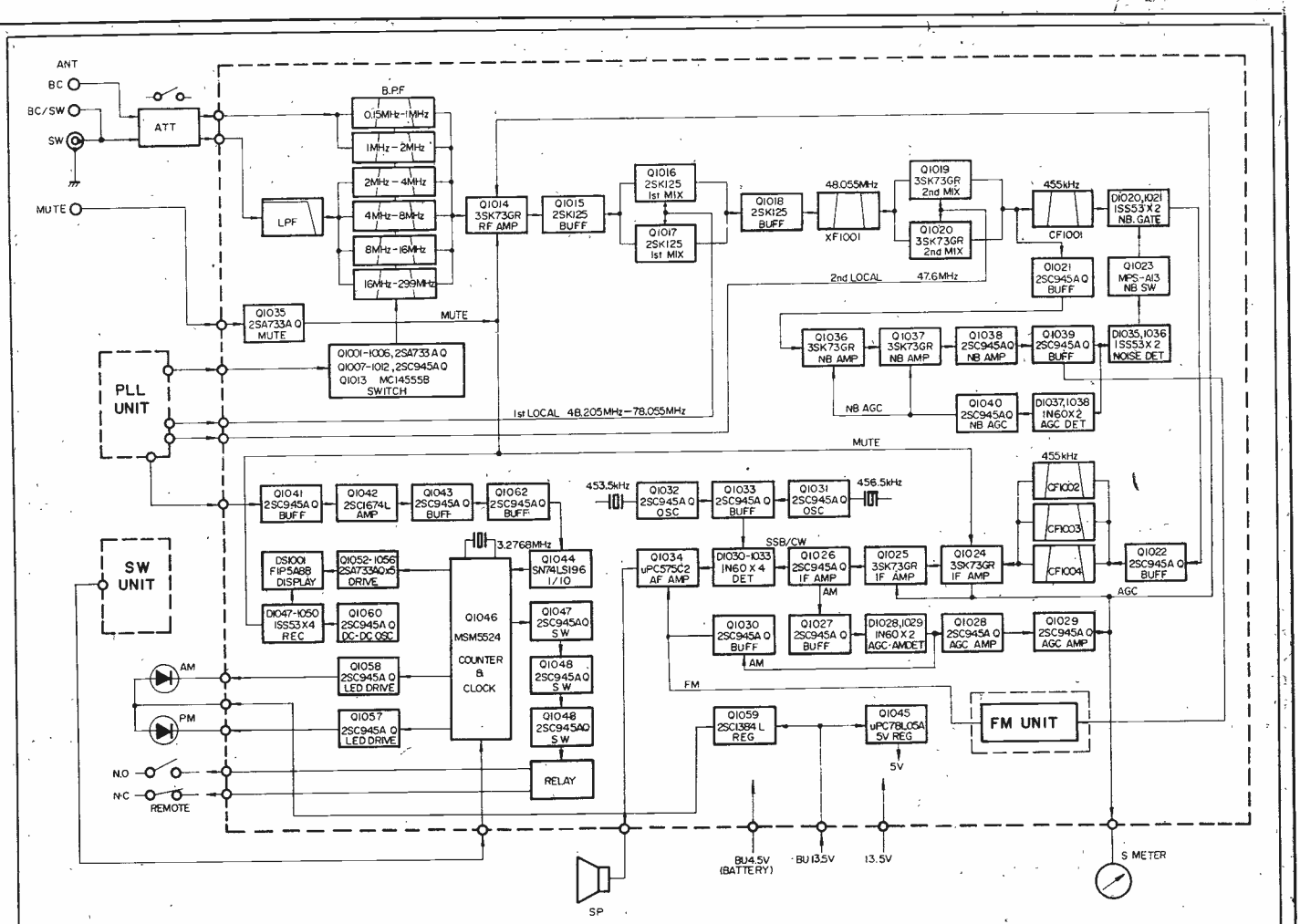
I have been using the Surrey Electronics modified rig as a broadcast reception standard for around two years, and so I have found probably almost all its niggles and good points.

AM reception quality on long and medium wave is superb, and perfectly good enough for transcription purposes when using the 600 ohm balanced audio output interconnected with a professional control desk and monitoring installation. Using a sensitive and fairly high quality external loudspeaker driven directly by the Yaesu, I have found quality again to be very good, although one could not of course achieve normal monitoring levels that would be used for serious monitoring.

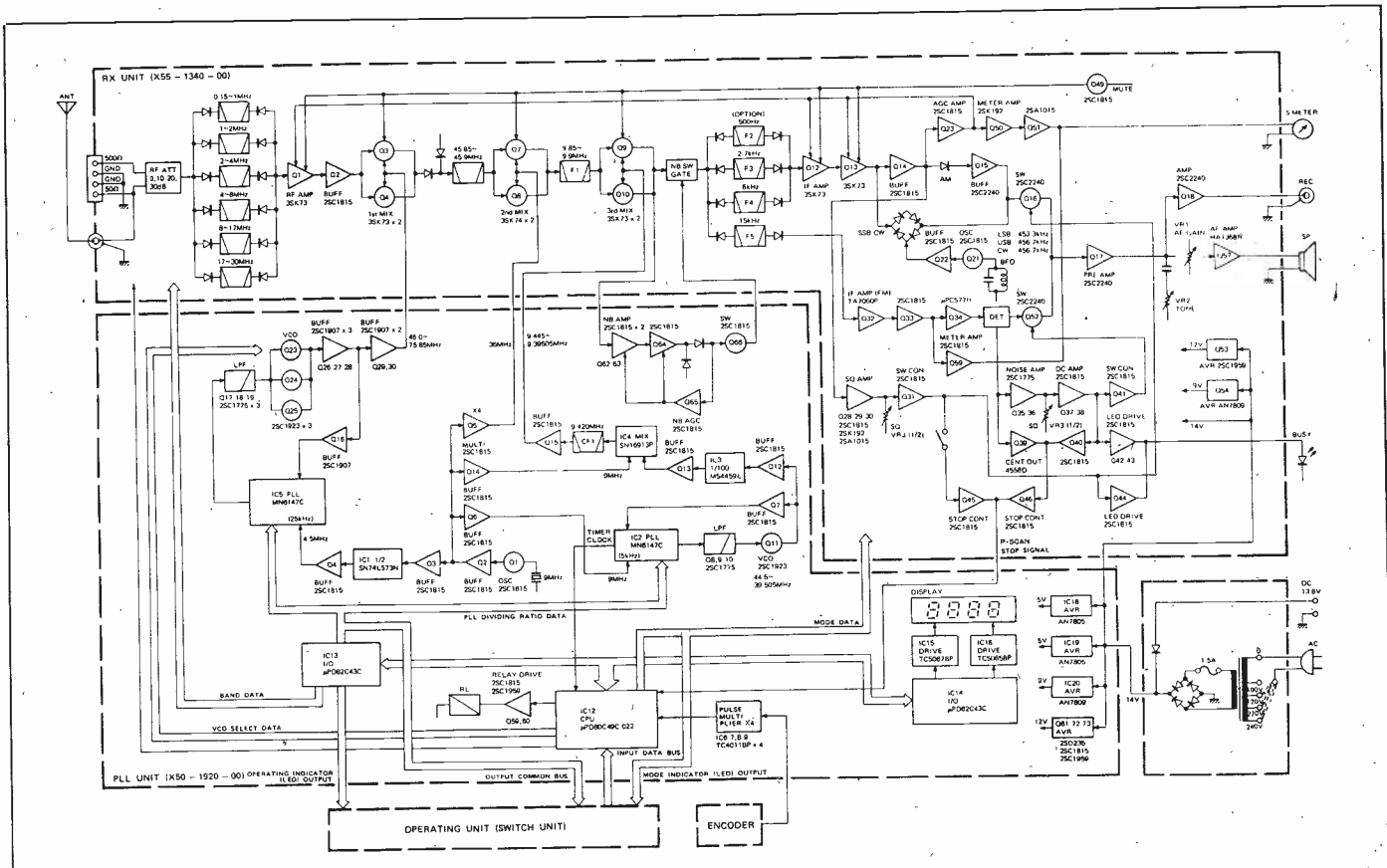
For driving a normal hi-fi system, one cause one side of the balanced output with respect to earth, leaving the other side disconnected, in which case you would get around 1v peak output from a low source impedance. The balanced output is with respect to earth, and if a floating output is desired, you would have to use an external 600 ohm 1:1 transformer, with secondary and primary floated.

I have been surprised to find that many radio stations transmit quite acceptable quality, and the large majority of receivers go nowhere near reproducing the transmitted quality. When tuning across medium wave, the receiver could easily discriminate between the qualities of good and bad transmitters radiating the same programme, and it was fascinating to compare BBC Radio 4 on LW and MW.

The wide filter position did of course bring in slight whistles if the main received station was not very strong, but not too much was lost by going to the medium band width position, with whistles greatly reduced. There was a very marked difference in the quality of LF



Block diagram: Yaesu FRG7700

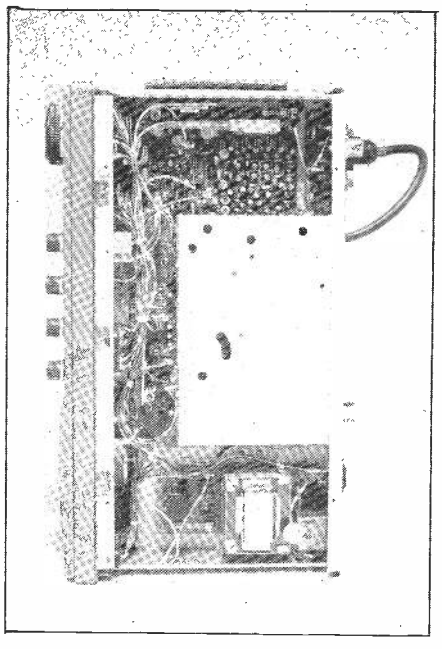


Block diagram: Trio R2000

reproduction between AGC fast and slow, the former being surprisingly poor, but the latter superb.

The FM audio quality was sufficiently good to show dramatic differences in the transmitted quality of modified CB rigs as against multi mode HF transceivers on 10m FM, the average quality of the CB rigs being worse than almost any amateur radio transmitter that I have yet heard on FM. On SSB, bandwidth was definitely much too wide, and because there was some breakthrough from the alternate sideband, it was sometimes difficult to tune SSB very accurately without the two sidebands beating slightly in some cases. Reproduced quality though was surprisingly good, allowing accurate criticisms to be made of transmit quality. For this reason, I have sometimes used the rig for determining transmit quality.

RF sensitivity was not as good as one might expect it to be, for sensitivity has been sacrificed for greatly improved RFIM. One can improve sensitivity by peaking the first mixer output coil, thus achieving higher gain, and improved noise characteristics of the mixer, but this degrades the RF intercept point, which is undesirable for high performance. It would be better to use a switchable bomb proof 10dB gain pre-amp external to the rig for the HF end above 14MHz.



Trio R2000: View of the inside from underneath.

The RFIM peformance, when originally tested, was not particularly good, but we found this was due to a faulty Mosfet, which, when replaced, produced rather better results. The receiver was much better at LF for avoiding RFIM, but again matters were dramatically improved when the accessory LW filter and ATU were used, both of which we consider almost essential for use with most receivers. As with the unmodified version, stability was excellent, but note that the memory only stores the frequency to the nearest 1kHz frequency below the required one.

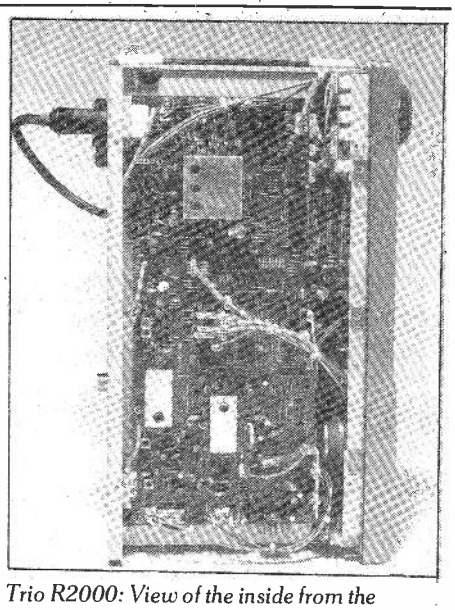
FM quality was definitely better on the modified receiver, and high frequencies were reproduced with a flatter response, allowing one to judge quality most usefully. The maximum audio output capability for some inexplicable reason was slightly lower on the modified version than on the unmodified one.

The SSB filter seemed better matched, the top of the pass band reducing more quickly, but the reciprocal mixing performance unfortunately was again rather poor, causing problems in selectivity measurements well down the skirt. Rather surprisingly though, RM at 50kHz was nearly 20dB better, which must have helped to produce the improvements on subjective quality. Further out, the RM improvement was less marked.

AM selectivity on narrow again used the SSB filter, and I cannot imagine it being used very often in this position, unless one is incredibly desperate! The medium AM selectivity had a much better shape, partly due to the reciprocal mixing being better, but also as a result of the dramatically improved detector giving much better linearity. This position allowed many weak AM stations to be received without whistles etc. On opening up selectivity to the wide position, the curve was again much better controlled and allowed virtually all transmitted modulation to be received without attenuation at HF. Pen chart responses were much more consistent as the VFO was slightly changed in position, showing the detector to be almost infinitely more linear! FM selectivity was similar, but still too wide.

The S meter characteristics show the log law to be virtually identical, but the difference is that S1 is 11dB more sensitive, whilst S9 is 9dB more sensitive, and at a more sensible level of just over 50uV RF input. Above S9 the meter is slightly more linear, with +60 being at about 25mV. FM S meter sensitivity was slightly higher than on SSB.

There seemed to be far fewer spurious carriers around when tuning across the range from LF to HF. I again found backlash to be a little annoying, and the tuning rate was much too fast at the top end of each MHz band. I would have preferred the RIT control to have been in for normal VFO working which would have assisted in the tuning in of SSB signals. It was also a pity that one could not VFO from memory. Ergonomics in general were quite good but nowhere near what they should have been, and the right hand side of the front panel seems a little cluttered to me; some of the controls would, I think, have been better placed on the left side.



Trio R2000: View of the inside from the top.

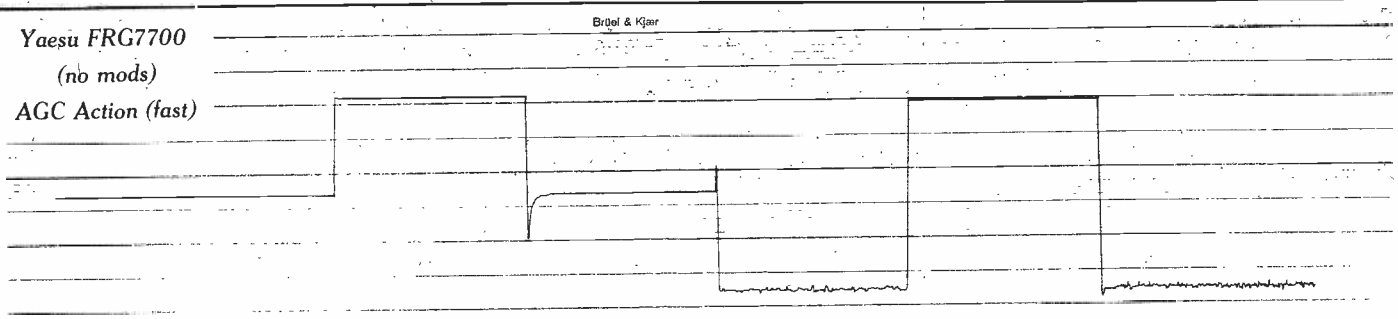
Not a serious disadvantage

RF sensitivity was generally about 5dB inferior on the modified version, although this is not a serious disadvantage for many requirements. Sensitivity can be improved by careful alighment of the mixer output coil as previously explained. FM sensitivity was actually slightly better than on the unmodified version with a deviation above 2.5kHz, reaching a 6dB improvement at 4kHz deviation, whilst measuring sinad at below 2.5kHz gave marginally inferior readings. Quite clearly the IF strip and discriminator was controlling distortion far better, despite the improved (widened) audio passband. Comparing the sinad rating with the quieting measurement shows them to be closer in RF level, and this again proves the FM strip to be better. Of course the noise measured in the quieting test is inferior to that of the unmodified version because the bandwidth is wider in the audio amplifier.

Increased gain at HF

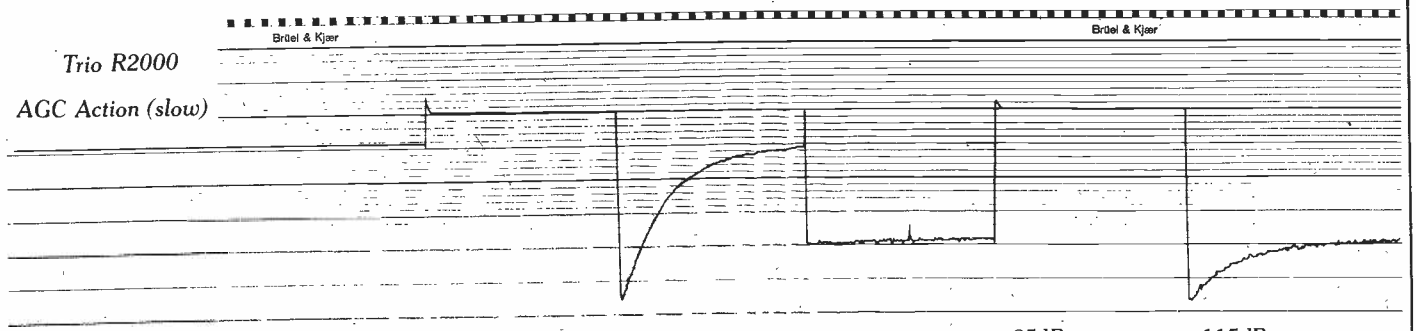
The reciprocal mixing performance was similar, very close in but improved dramatically beyond 20kHz offset, showing that the entire VFO and mixer circuitry seem to work better. RFIM improved by 5.5dB on MW and by 11.5dB on top band, with a similar improvement on 80m. The 10m RFIM performance was already good on the unmodified version, and was virtually the same on the modified one, but with the increased gain at HF, in practice, the subjective feel of the set was so much better. The lab tests of selectivity confirmed all the subjective results, and were clearly improved throughout.

Yaesu FRG7700
(no mods)
AGC Action (fast)



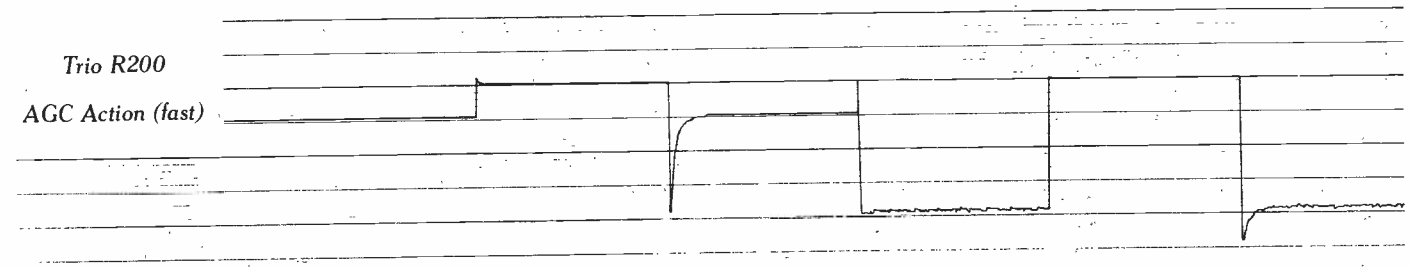
RF input level -100dBm -70dBm -100dBm -115dBm -85dBm -115dBm

Trio R2000
AGC Action (slow)



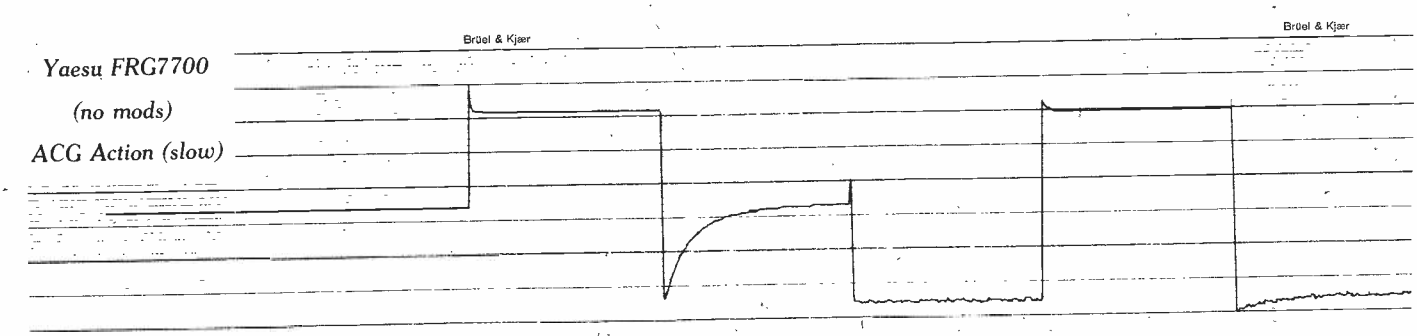
RF input level -100dBm -70dBm -100dBm -115dBm -85dBm -115dBm

Trio R200
AGC Action (fast)



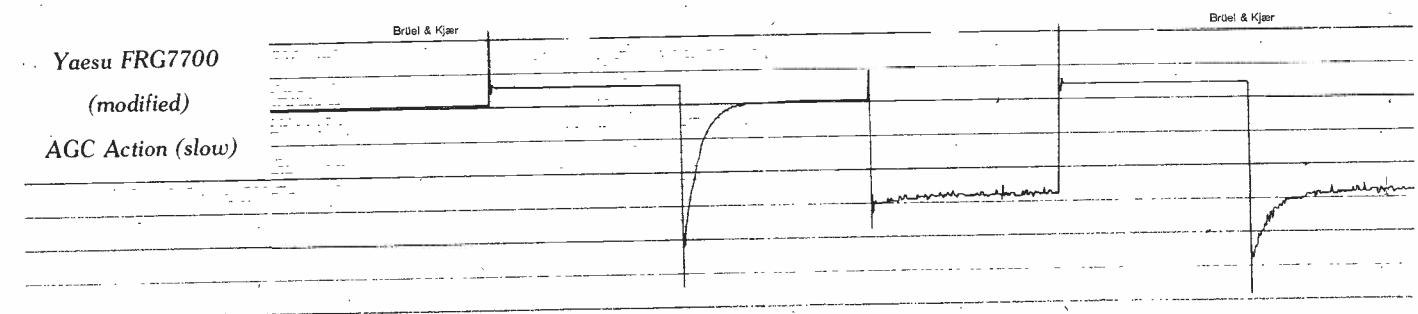
RF level input -100dBm -70dBm -100dBm -115dBm -85dBm -115dBm

Yaesu FRG7700
(no mods)
ACG Action (slow)

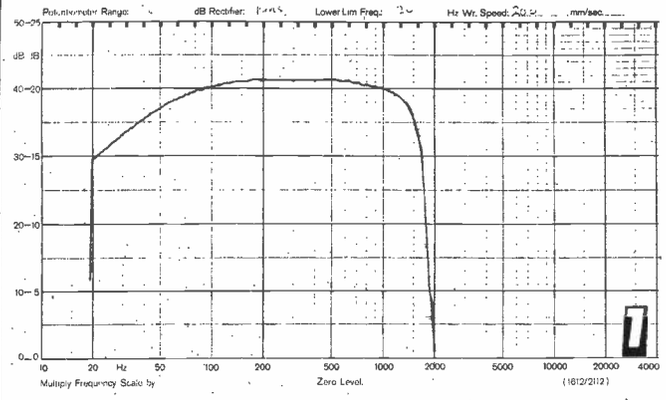


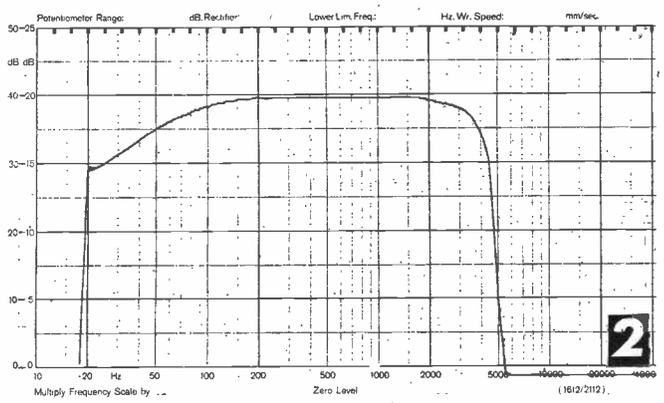
RF input level
-100dBm -70dBm **-100dBm** -115dBm -85dBm -115dBm

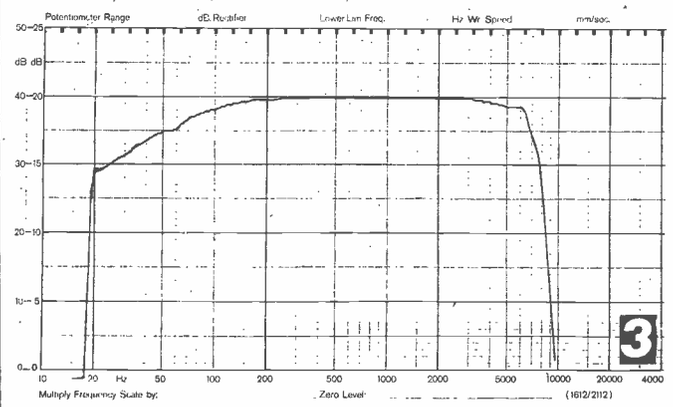
Yaesu FRG7700
(modified)
AGC Action (slow)

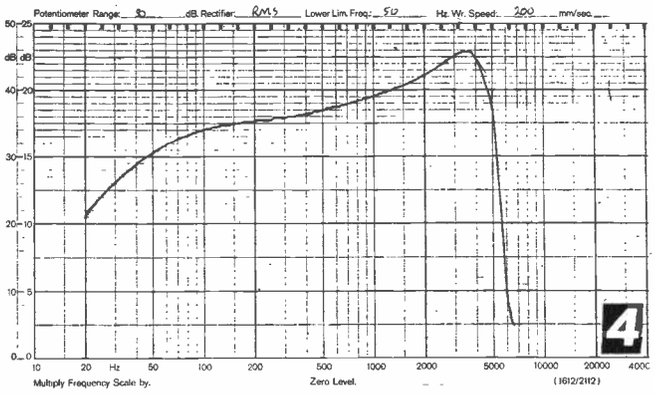


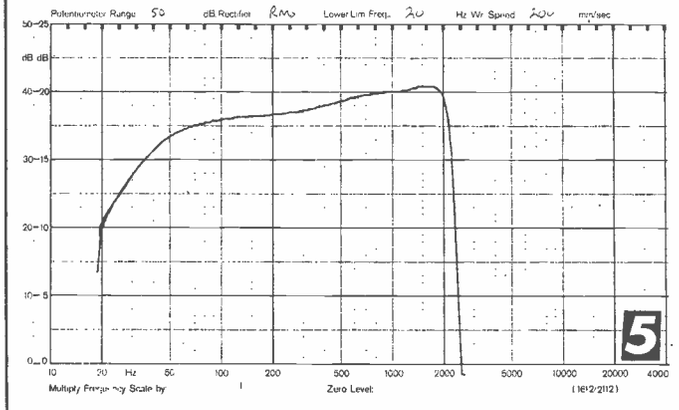
RF input level -100dBm -70dBm 100dBm -115dBm -85dBm -115dBm

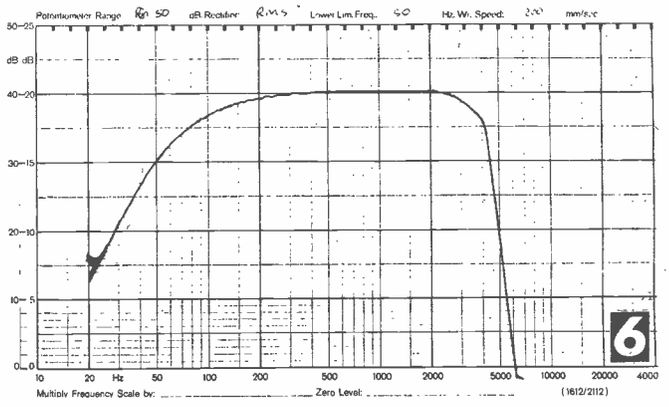


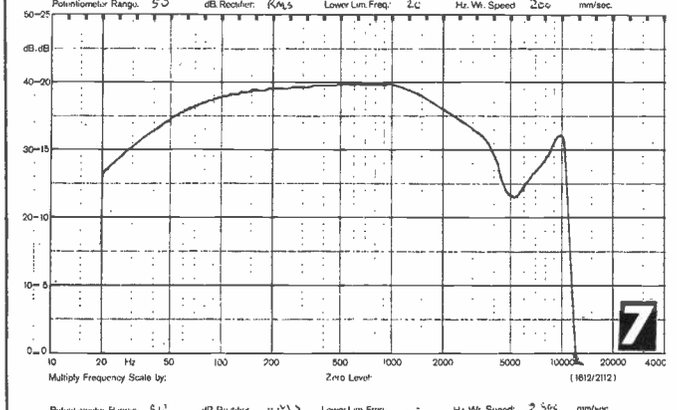


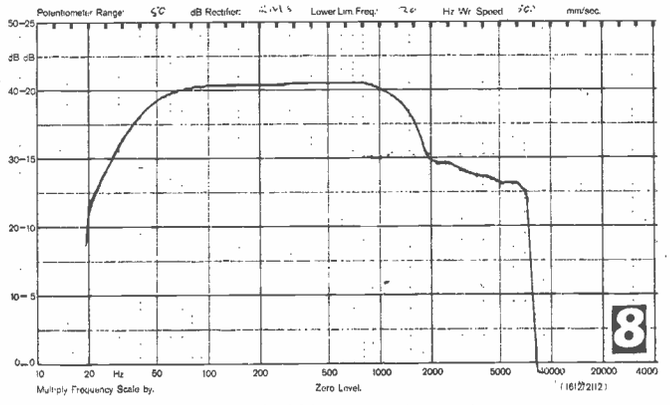


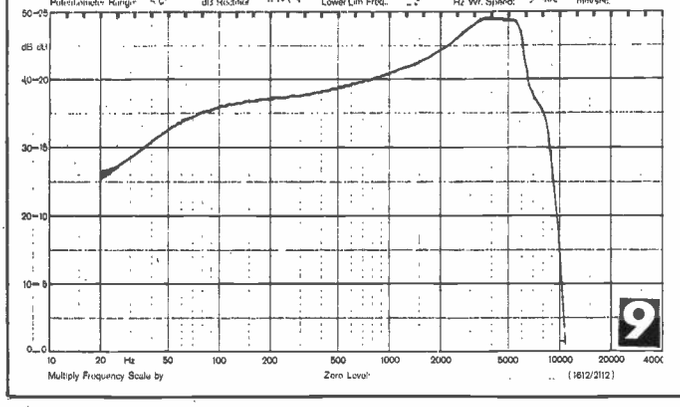












1. Yaesu FRG7700 (modified) AM response (narrow)
2. Yaesu FRG7700 (modified) AM response (medium)
3. Yaesu FRG7700 (modified) AM response (wide)
4. Yaesu FRG7700 (unmodified) AM response (medium)
5. Yaesu FRG7700 (unmodified) AM response (narrow)
6. Trio R2000 AM response
7. Yaesu FRG7700 (unmodified) AM response (wide) first attempt
8. Yaesu FRG7700 (unmodified) AM response (wide) second attempt
9. Yaesu FRG7700 (unmodified) AM, response (wide) third attempt.

It is when we come to AM distortion measurements that we can see the dramatic improvements, for with AGC at slow or fast, 1kHz distortion for 90% modulation was 0.5 to 0.7%, including the distortion of the generator which is around 0.4%

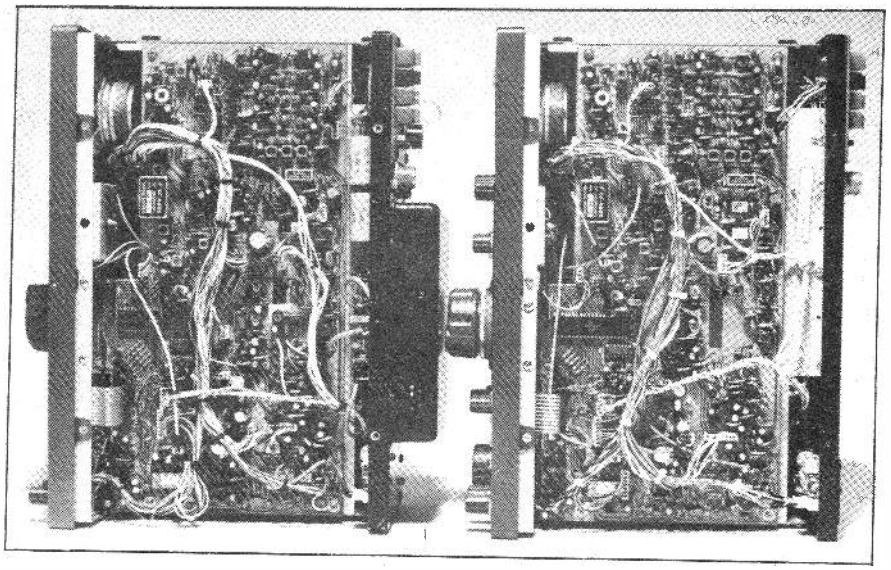
This really is quite astonishing for AM at such a high modulation level. We carried out a long investigation of distortion at lower frequencies on AGC slow and fast to find out why the receiver sounded so good, and to my amazement 60Hz distortion with AGC slow was a mere 2.3%, rising to 23% on 'fast'. At 40Hz, the figures were 3.8% rising to 48% (slow/fast). This really did bring home the fact that a fast AGC line introduces serious ripple in the AGC from highly modulated LF levels coming from the detector, and this ripple obviously tries to counteract LF variations by fighting the carrier, thus introducing serious distortion to the envelope peaks. One wonders how many MW tuners and tranny radios which have bad bass distortion achieve such bad results because the AGC is too fast. It strengthens the importance of having switchable AGC speeds for serious AM listening.

Superiority of the new circuits

FM distortion was around half that of the unmodified version at higher deviations. Despite the increased audio bandwidth, signal to noise ratio on strong signals was 7dB better on the Surrey Electronics version unweighted, the 3dB better with CCIR weighting. This shows once again the superiority of the new detector circuits. On SSB, product detector distortion was substantially better, explaining the audible improvements. Capture ratio on FM was virtually identical, as the discriminator itself was not modified.

AM sensitivity incidentally was just 3dB worse on average on the modified set, but this could be improved if required. The AGC pen chart for AGC slow shows it to act on rather lower RF input signals, and higher levels showed a slightly faster recovery at about two seconds which is perhaps a little too fast for some users.

If we look at the responses, we can see that across the board they are far superior, the AM pen charts being superb and almost "textbook". On examining the FM response charts, it can be seen that the unmodified receiver appeared to have an unwelcome LF lift around 250Hz which was flattened on the modified model, thus improving the clarity of received signals. The modified rig shows a reasonable 6dB per octave roll off which is ideal for practical use, as most FM type transmissions are in effect more equivalent to phase modulated ones in characteristics.



Inside, as viewed from the top, of the Surrey Electronics FRG7700 (left) and the Yaesu FRG7700.

Vastly superior

The modified version is vastle superior in virtually all areas of performance, other than front end sensitivity, and if you want an extremely high quality audio reproduction from a general coverage receiver, than this version can be strongly recommended, although it is much more expensive than the unmodified version. If you do want higher sensitivity, then at least this can be obtained by tweaking the mixer. If you are not primarily concerned with the highest quality standard, then you should either be more than content with the most recent general coverage transceivers, or with the alternative Trio model which is far better ergonomically.

Ergonomics

The Trio R2000 is a far more recent design and has far better ergonomics than the Yaesu rigs. Tuning is in synthesiser steps with three tuning rates, 50 and 500Hz, or 5kHz steps. When the VFO knob is rotated you can thus choose 10, 100kHz or 1MHz per revolution. Three pushbuttons select the tuning rate whilst a fourth one locks the frequency. Ten pushbutton entry memories not only accept frequency, but also band and made, and once a memory has been accessed, you can VFO away from the frequency as well as changing mode, which is a very strong plus point.

AM, FM, USB, LSB and CW modes are provided, with light touch pushbutton changing. The CW RF bandwidth is very similar to that of SSB, although there is a frequency offset on SSB relative to CW. Two AM bandwidths are provided, narrow and wide, but again I cannot see anyone seriously using the narrow position, because as with the Yaesu it is unbelievably muffled, and gives reproduction very low in entertainment value. The loudspeaker is again forward throwing and mounted on the front panel.

A digital timing clock is provided, the internal clock displaying, if required, two different time zones so that each can be set independently, but it does not display seconds.

Almost everything is operated by pushbuttons with microprocessor control. The only rotaries control audio gain, tone, squelch opeating on all modes, and front end RF attenuation of -10, 20 or 30dB. Band changing is achieved with up and down buttons which continue to change if held down at about 4MHz per second, a pip sound emanating for each 1MHz change (pip tone level is adjustable). The band changing sjtops at the lowest or highest band so that if you are blind you can find your way by going to the extremeties and counting 1MHz pips for the required band. Large push-buttons select AGC fast/slow, noise blanker on/off and display intensity shilst lighter touch controls select memory in, memory recall, memory scan, programme scan between memories 9 and 0, hold from memory scan and auto memory. Various clock setting and control functions are of course provided for easy access.

The auto memory facility allows very rapid entry of several memories one after the other more quickly than the normal method. The frequency is displayed digitally to 100Hz, and this display can be switched to clock time one or two. The timer can be set to switch the receiver on or off. A 3.5mm tape recorder feed jack provides a fixed leel of around 300mV max. for feeding a tape recorder. A quarter inch jack gives ample level to average headphones. Although the receiver covers frequencies from 100kHz to 30MHz, the review sample was supplied with the optional VHF adaptor which allows frequencies from 118 to 174MHz to be tuned in, the VHF frequency being displayed correctly on the front and all controls operating in the same way as for short wave.

On the back panel the normal aerial input is an SO239 in parallel with a 50 ohm antenna spring loaded input with eath, also with a 500 ohm input and earth

for long wires at LF. A socket on the back provides data interface and juice to operate the BHF adaptor which slides into the back panel. This adaptor is fitted with an SO239 RF socket having a 10dB switched attenuator by the side of it. Eight ohm extension loudspeakers can be plugged into a 3.5mm jack, and the mains input is an IEC type, a 13v DC input also being provided. A remote control socket provides the same muting interfacing as the Yaesu, allowing it to be used with a separate transmitter. Unfortunately, the Trio excludes external relay switching of tape recorders etc.

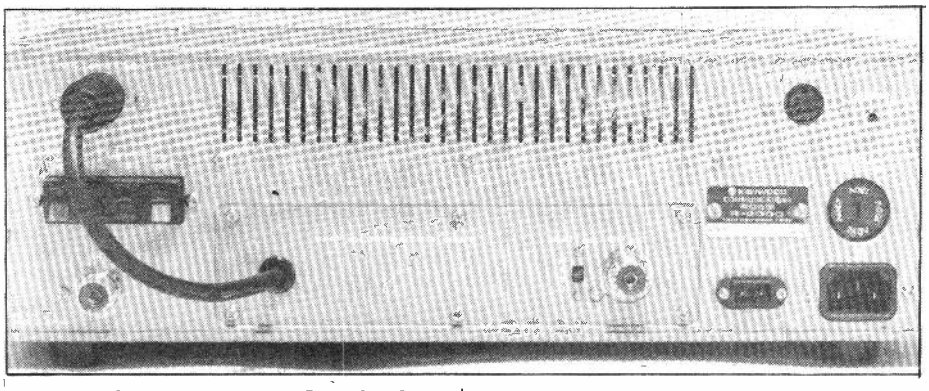
The entire receiver is metal encased, but has a plastic front. Rather unconventionally, the tuning knob is on the extreme right hand side, and this rotates freely and requires a very light rotation movement although I found the finger hole too small for my fat stubby fingers. The layout is much better than on the Yaesu, and ergonomically I cannot offer criticism, which means that Trio have obviously paid a lot of attention to this increasingly important matter.

The front end circuit consists of a 3SK73 dual gate Mosfet feeding two more 3SK73s in a balanced mixer circuit having very high gain which unfortunately contributes to the poor RFIM. The local oscillator runs between 46 and 75.85MHz, the first IF filter passing 45.85 to 45.9MHz. The second IF is at 9.875MHz, and the third IF at 455kHz incorporates various IF filters. AGC is derived from the AM/SSB strip. AGC acts on the RF and 455kHz IF stages. There are no IF amplifiers apparently in between the first mixer output and the third mixer, and if there had been, less first mixer gain would be required, and hence a better RFIM performance. The Trio measures 375 x 115 x 210mm and weighs 5.5kg without the VHF adaptor.

Stability impressive

I have used this rig for receiving signals from long wave right up to VHF and at its best the audio quality is good. I was most impressed by the triple tuning rate facility and the stability. SSB was so much easier to tune in although you could be a maximum of 25Hz off (no RIT). The front end sensitivity was acceptable across the board, and quite good at HF.

I very much like the RF attenuator which allowed quick control on LW and MW, but I have to report that RFIM on the lower frequency bands was bad unless you switched in the attenuator which was



Trio R2000: View from the rear.

virtually always necessary. Over-loading problems at LF were worse than on the Yaesu but using the Yaesu ATU and LW filter improved matters a lot. I felt it a pity that the receiver would not tune down to 50kHz, and thus it was not possible to pick up Rugby at 60kHz for example. Reciprocal mixing seemed on the poor side, although not quite as bad as the unmodified Yaesu, but selectivity seemed reasonable on SSB. But the flexibility on AM in selectivity switching was missed and FM selectivity was far too wide.

More sensitive

The VHF adaptor provided a real fun facility, and everything from aircraft to various mobiles could be received surprisingly well although 12.5kHz channelling produced some interference from either side on some of the stranger frequencies! The WTA does not allow me to describe details of the fun frequencies that can be monitored, but there is much of entertainment value that can be received. VHF sensitivity was poor, and a Mutek or Datong preamp works wonders here, although RFIM performance goes from very poor to bad! Why on earth can't the Japanese designers learn how to fix this parameter as Mutek have done so excellently?

The S meter was no better than that of the Yaesu, other than the fact that it was more sensitive than the unmodified Yaesu was. On FM, the difference between S1 and S9 seemed surprisingly small, which is unfortunate. FM distortion seemed low and reproduced quality clean, whilst AM sound quality was quite reasonable, but a long way short of the magnificent quality of the modified Yaesu. LF was not so clean with AGC slow, although the loudspeaker seemed of quite good quality.

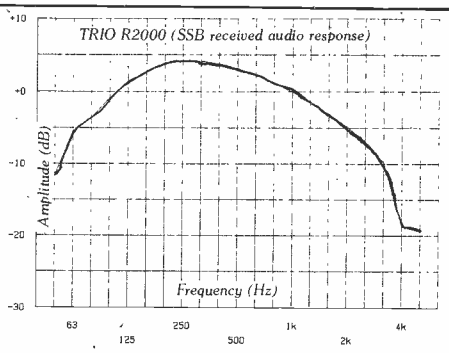
I much preferred scanning a few MHz at a time on the R2000 on VHF than on the recently reviewed AR2001, since short transmissions were not missed so easily. This allowed me to find much more spasmodic activity, especially in the 5kHz step position.

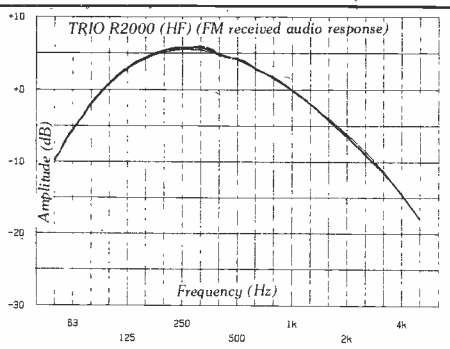
RF sensitivity was quite good throughout the short wavebands, but it did not measure at all well on VHF. I reckon that the noise figure here was around 11dB, interpolating from the measured bandwidth and the sinad measurements, and surely this could have been better. To put this in perspective, the AR2001 is better, which is interesting. The RF intercept points were measured in several different ways, but whatever we did the calculated results were very poor for a modern receiver.

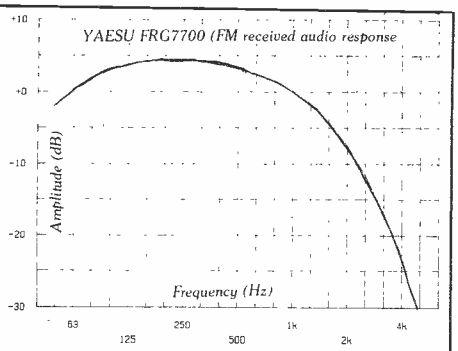
To put this into perspective, two fixed level signals which caused a product to be, say 60dB down on the modified Yaesu would give a product around 40 to 45dB stronger on the Trio. This is because the calculated intercept points are between 20 and 25dB worse. The reciprocal mixing measurements were poor at 20kHz spacing, fair at 50kHz, but not enough improvement was shown at wider spacings, showing the presence of some digital noise on the synthesiser. SSB selectivity, whilst being quite good at the top of the skirt to say -40dB, was degraded badly at the bottom of the skirt by the RM problems. The wide AM curve was extremely well shaped for good communication AM quality down to -40dB, but opened up dramatically at -60dB.

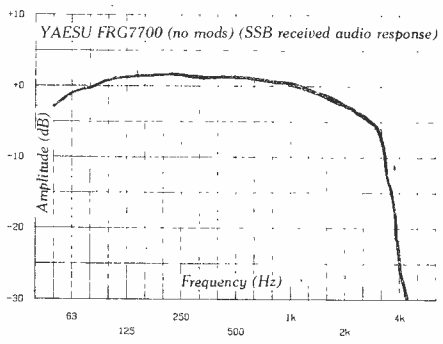
Again, to put this into perspective, the IC751 and the FT757 are so much better here. FM selectivity was clearly too wide. SSB product detector distortion was very much on the high side, although signals were not too seriously affected. AM distortion at 1kHz modulation, 90%, was rather high at 3.5%, on both AGC fast and slow, whilst for 60Hz modulation, with AGC slow, distortion was 9.8% which is high, degrading to 12.7% on fast much less degradation than expected. FM distortion measured very well indeed, clearly due to the wide bandwidth throughout. The maximum signal to noise ratio on AM was good unweighted, but quite a lot of hiss was present, which caused the weighted figure to be fairly poor in terms of maximum achievable results.

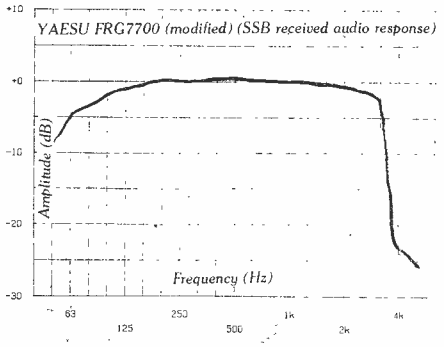
Very slight clock and synthesiser breakthrough presumably was responsible for much of the HF noise. A useful 3.7w was given into an external eight ohm load for 10% distortion, and thus this set can sound quite loud if required! The AGC pen charts show the slow speed to be very slow indeed, which helped strong SSB signals to be reproduced with much less pumping than usual. You will have to use fast though if you are listening to quick tos and fros between stations of widely differing

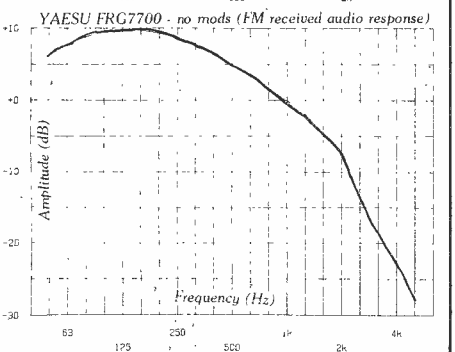












At a glance comparison of the various rigs' performance in terms of FM, SSB received audio response. All tests carried out in January and February this year, and on new equipment.

strengths, fast AGC being slightly faster than the Yaesu.

The variation between speed is thus considerable, but probably quite a wise choice. The S meter was much more sensitive for S1 than the Yaesu, but insufficient range was displayed. On FM, the S meter was useful for detecting the presence of a signal, for on almost all signals it was either at the bottom or near the top, or waving violently in between. I really do feel that 8dB difference between S1 and S9 is laughable at one dog biscuit per S point! How about S9 + 40 being only 19dB higher than S9? There is no calibration beyond S9+40 on the meter.

The difference between the 12dB sinad point measurement on FM, and the quieting (signal noise ratio) at the same RF level was just 4.5dB, showing that the IF passband was indeed wide, and the discriminator distortion was not rising too much at very low levels, for if it had been, the difference between the two measurements would have been much greater. Capture ratio was very good, but again showed the wide selectivity. Frequency accuracy was extremely good, only 30Hz out for the point at which the 100Hz steps changed. On VHF, the indication was around 900Hz out which I consider quite good.

AM sensitivity throughout was rather poor, and should have been better. AM frequency responses were very flat from 200Hz to 3kHz rolling off either end quite reasonably, thus eminently suitable for communication, although music was rather dull. The FM overall response was better controlled at LF than the unmodified Yaesu but there was too much HF cut even with tone control flat out.

From an ergonomical point of view the R2000 is superbly designed and a joy to use. The worst technical feature is the poor RFIM performance, which can only be partly overcome by continually resetting the RF input attenuator, both on the LF/SW and VHF bands. The receiver severely lacks dynamic range at RF and this is such a shame, for if this had been substantially better I might well have raved about this model.

The VHF adaptor is most strongly recommended if you decide to purchase the R2000. As far as LW and MW performance is concerned, you will undoubtedly have a problem with RFIM if you are anywhere near strong LF transmitters, and during evenings or night time you will find it very difficult to receive weak stations reliably at LF without an ATU etc. Just one very strong MW station can cause you trouble, but if you're really out in the sticks, then you could find that you have almost no problem at all, with careful adjustments.

Overall comparison

The tuning and memory functions are outstandingly good, and this is the main reason why I suggest that you should at least consider this receiver, especially if you want the VHF facility. As with the Yaesu though, I cannot but help feel that an improved model may be around the corner, as Japanese companies all seem to be swamping the market with new models far too frequently. If they could only spend more time on the critical design points of mixer performance and synthesiser noise, could they not leave a model in the catalogue for far longer and thus keep the price down over a period? Competition is so fierce, and marketing decisions are not necessarily always right.

It has to be said that all the models reviewed leave a lot to be desired in one way or another, and fall far short of the RF performance achieved on modern transceivers. If you are licenced, then think very seriously about finding the extra money to buy a transceiver with general coverage RX, and a multimode facility.

If you must have VHF coverage, but you only require 2m receive capability, then it is so much cheaper to buy a Microwave Modules converter. My colleagues and I very much like the Trio as our personal favourite, but the modified Yaesu does after all have a far better overall audio and RF performance, other than sensitivity, so it is very difficult to recommend one against the other.

Choosing between the unmodified Yaesu and the Trio is again swings and roundabouts, particularly price versus ergonomics, and this choice is simpler, for I am around 80% towards the Trio as a recommendation. What I feel does come out of this comparison is the fact that if you are not going to spend money on the Trio, then you will probably do far better to consider a secondhand receiver with the facilities you require, although many beloved old steam valve models are in fact, by today's standards, far worse in performance than many of us like to remember, for in the old days we were fairly happy with them!

If you want to do serious short wave listening, on today's crowded bands, and particularly if you want to receive CW or RTTY, then I cannot recommend these receivers. I must admit to being rather shocked by many of the pitfalls, but it does make me appreciate rigs such as the IC751 that much more. I will always keep my modified Yaesu 7700 though, for its magnificent audio quality on AM, if for no other reason.

The Trio manual in four languages is good with much detail, including circuit diagrams. There is even a section on enjoying SW listening with band allocations etc listed. The Yaesu book is also very helpful, in English only containing very full details of circuitry etc.

It also contains helpful details concerning SW listening. There is not much to choose between instruction books.

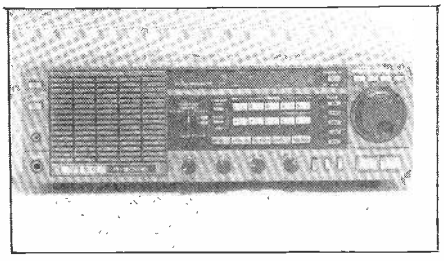
Useful accessories

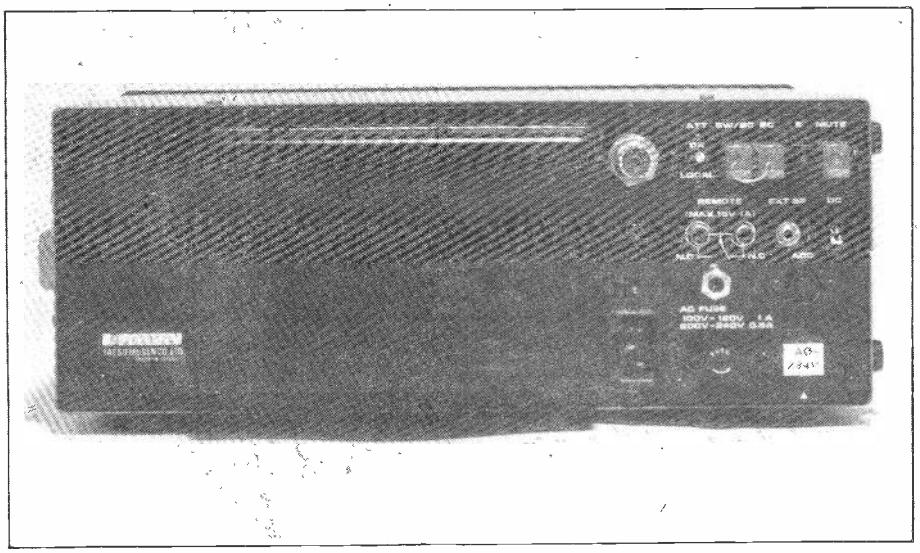
Three different accessories are all useful in conjunction with general coverage receivers, and all of them are for receive only. Lowe Electronics loaned a Mizuho KX3 skycoupler ATU which is well presented in a metal case having diabolical Japanese/English instructions to which Lowe have added adequate and brief notes, including a circuit diagram. The ski coupler is basically a pi network with variable input and output capacitors tuning to deck with an inductance in series having many taps, operated by a band switch. A low pass filter is also included which can replace the complete pi network between input and output, this filter cutting very steeply above 500kHz, thus usefully very considerably attenuating the strong MW signals.

SO239s are provided for antenna and receiver interfacing, with spring loaded connections in parallel with them for use with wire antennas etc. Two more terminals are provided for connection to a 10 turn equalateral triangle loop antenna with sides of half a metre, and when loop function is switched on, the input capacitor then tunes the loop. The loop is not supplied, but ample instrutions are included to make it, and the take off from the loop is a single turn which can coaxially feed from its ends into the receiver. When using the loop function the KX3 only tunes the loop and should not be connected to the receiver. I found this unit matched quite a variety of impedances to various receivers, although the first capacitor did not really have enough capacity to tune some antenna configurations to resonance.

I can certainly recommend this unit, the long wave filter being absolutely essential at my location on almost all receivers, allowing me to receive Rugby at 60kHz with no traces of aggro.

Trio R2000





Rear view of the Surrey Electronics FRG7700.

Yaesu can supply two very useful little boxes, designed for use with the FRG7700, but also suitable for virtually any other receiver. The FF5 is a small box having two screened outputs, one for connection to the BC input (LW and MW) of the 7700, and one for connection to the SW input. Three input terminals are fitted again for BC, SW and earth. A three position switch selects either a LW 500kHz low pass filter in or out in series with the BC line, or switches through input to output of the SW line, open circuiting the BC line. It is essentially provided to allow separate antennas for LW/MW and SW. The low pass filter has a rather variable attenuation between around 4 and 12dB from LF to 500kHz above which it attenuates extremely rapidly. There is virtually no attenuation in the other two positions for HF etc.

I consider this unit an essential accessory for LW reception if you are using an effective antenna for LW. I have modified my own unit so that it has just one input and one output which is less confusing, and the photograph shows a BNC and flying lead interconnections which replaced the original terminals and flimsy screened wire!

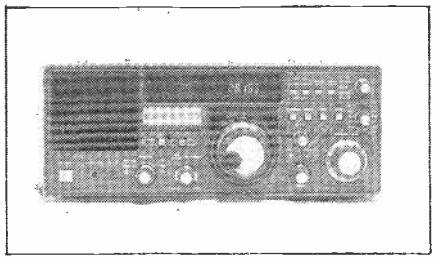
The Yaesu FRT7700 is a wonderful little box which is actually quite complicated. Terminals are provided for connecting earth, antenna one and antenna two, with antenna two duplicated on an SO239 input socket. Two outputs on flimsy screened wires are provided either for direct connection to the two antenna inputs of the FRG7700, or for the FF5 in line. Switches on the front panel select ATU in or out, antenna one or two, and RF out to LW/MW or SW lines. An attenuator switch is provided to give 0,10,20,40 or 60dB attenuation, the attenuation being fairly crude but useful, and not particularly accurate. There is some leakage across the attenuator.

A band switch selects 0.1 to 0.5, 0.5 to 2.0, 2 to 4, 4 to 8, 8 to 16 and 16 to 30MHz. Four taps on the coil can be selected to give an optimum match, and a variable capacitor tunes the band selected inductor. Although this unit did not give such a good match at HF as did the sky coupler, it was much more flexible at LF, although it was, frankly, fairly lossy. On the LW position, it can actually usefully tune down to 60kHz or so, and greatly improve long and medium wave reception as well as usefully tuning various lengths of wire across its range.

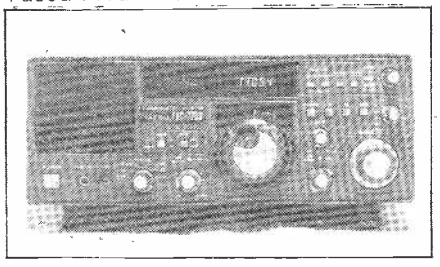
I strongly recommend this little ATU, which may well get you out of trouble, but I wish it could have been a little bit more esoteric.

I feel there is a market for a better designed ATU covering, say, 10kHz to 30MHz with optimised capacitance and inductance values to give the best possible matches at any frequency. The main problem of course is the large capacitor values necessary at LF, but one can always use fixed switched capacitors in parallel with a high value rotary with appropriate instructions for use. I do not know of any product better than the above mentioned ones designed specifically for high quality SW listening at a reasonable cost, so if anyone knows of one, perhaps they could let me know.

Surrey Electronics FRG7700



Yaesu FRG7700



YAESU and TRIO RECEIVERS

LABORATORY RESULTS

Sensitivities for 12dB sinad, USB 1kHz beat

	Yaesu 7700 (unmodified)	Yaesu 7700 (modified)	Trio R2000
1.0MHz	-115.5dBm	-108.5dBm	-107dBm
1.9MHz	-115.0dBm	-110.0dBm	-110dBm
3.8MHz	-121.0dBm	-116.0dBm	-118dBm
7.1MHz	-121.5dBm	-115.0dBm	-119.5dBm
10.1MHz	-121.0dBm	-113.5dBm	-121.0dBm
14.1MHz	-120.5dBm	-114.0dBm	-121.0dBm
21.3MHz	-119.0dBm	-112.5dBm	-121.0dBm
28.4MHz	-119.0dBm	-113.5dBm	-120.5dBm

Sensitivities for 12dB sinad, FM at 29.6MHz 1kHz modulation, 2.5kHz deviation.

-108dBm	-107.5dBm*	-114.0dBm

*(*Varies with FM deviation, best measured value, -114dBm)*

Selectivities, USB

3dB Bandwidth	2.5kHz	2.0kHz	2.6kHz
6dB Bandwidth	4.kHz	2.5kHz	3.0kHz
40dB Bandwidth	6kHz	4.0kHz	4.8kHz
60dB Bandwidth	15kHz	20.0kHz	22.2kHz
80dB Bandwidth	116kHz	32.0kHz	52.5kHz

Selectivities, AM (wide)

3dB Bandwidth	14kHz	11kHz	7.5kHz
6dB Bandwidth	15kHz	14kHz	8.4kHz
40dB Bandwidth	20kHz	19kHz	13.2kHz
60dB Bandwidth	27kHz	22kHz	29.2kHz
80dB Bandwidth	116kHz	53kHz	55.0kHz

Selectivities, AM (medium)

3dB Bandwidth	5.5kHz	6.0kHz	2.4kHz
6dB Bandwidth	9kHz	8kHz	2.9kHz
40dB Bandwidth	12kHz	11kHz	4.8kHz
60dB Bandwidth	15kHz	13kHz	17.2kHz
80dB Bandwidth	69kHz	34kHz	59.1kHz

Reciprocal mixing performance (ref. noise floor) SSB (RF level required off channel to degrade sinad by 3dB)

20kHz spacing	86.5dB	85dB	81dB
50kHz spacing	76.5dB	93dB	90dB
100kHz spacing	96.5dB	103dB	97dB
200kHz spacing	110.5dB	113dB	104dB

Sensitivities, AM (wide) for 10dB signal/noise

-106dBm	-103dBm	-101dBm

Sensitivities, AM (medium) for 10dB signal/noise

-109dBm	-106dBm	-104dBm

RFIM performance at 28.4MHz, SSB
(Carriers at +100/+200kHz spacings for 12 sinad product)

Ratio	78.5dB	75dB	66dB
Intercept point	+1dBm	-1.5dBm	-16.5dBm

RFIM performance at 3.6MHz, SSB
(Carriers at +100/+200kHz spacings for S2 product)

Ratio	57.5dB	61dB	51dB
Intercept point	-9.5dBm	+1.5dB	-17dB

RFIM performance at 1.9MHz, SSB
(Carriers at +100/+200kHz spacings for S2 product)

Ratio	59dB	62dB	48dB
Intercept point	-7dBm	+4.5dBm	-11.5dBm

RFIM performance at 1MHz, SSB
(Carriers at +100/+200kHz spacings for S2 product)

Ratio	72dB	55.5dB	51.5dB
Intercept point	-3.5dBm	+2dBm	-7dBm

S meter: RF levels required to give the following S points: FM

S1	-88dBm	-101dBm	-102dBm
S3	-80dBm	-91dBm	-99dBm
S5	-75dBm	-84dBm	-96dBm
S7	-68dBm	-78dBm	-94dBm
S9	-63dBm	-73dBm	-93dBm
S9+20	-45dBm	-55dBm	-89dBm
S9+40	-30dBm	-37dBm	-75dBm
S9+60	-12dBm	-17dBm	Not calibrated

S meter: RF levels required to give the following S points: SSB

S1	-87dBm	-98dBm	-95dBm
S3	-80dBm	-90dBm	-91dBm
S5	-74dBm	-83dBm	-79dBm
S7	-68dBm	-77dBm	-79dBm
S9	-63dBm	-72dBm	-70dBm
S9+20	-46dBm	-54dBm	-47dBm
S9+40	-30dBm	-38dBm	-21dBm
S9+60	-12dBm	-19dBm	Not calibrated

Selectivity, FM
(RF levels off channel to degrade sinad by 3dB ref: 12dB sinad point)

-/+ 12.5kHz	50/36dB	30/22dB	28/43dB
-/+ 25.0kHz	66/65dB	64/61dB	58/59dB

Capture Radio, FM

5.4dB	5.6dB	5.6dB

Audio Quieting, FM (at 12dB sinad point)

+18dB	+16.7dB	+16.4dB

3dB limiting point, FM

-114dBm	-120dBm	-115.5dBm

Audio output power into 8ohms for 10% THD

2.4w	2.0w	3.7w

Distortion, FM at 125mW output (8 ohms)

1kHz deviation	0.7%	0.6%	1.3%
2.5kHz deviation	2.7%	1.6%	1.0%
4kHz deviation	4.6%	2.9%	1.5%

Distortion, AM (wide) at 125mW output (8ohms)

Minimum	3.9%	0.7%	3.5%

Distortion, AM (medium) at 125mW output (8ohms)

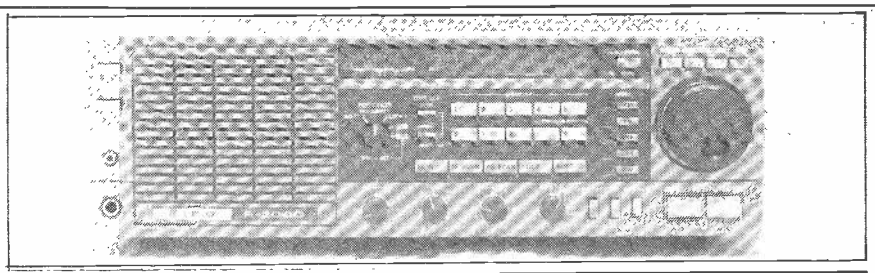
Minimum	2.7%	0.5%	1.5%

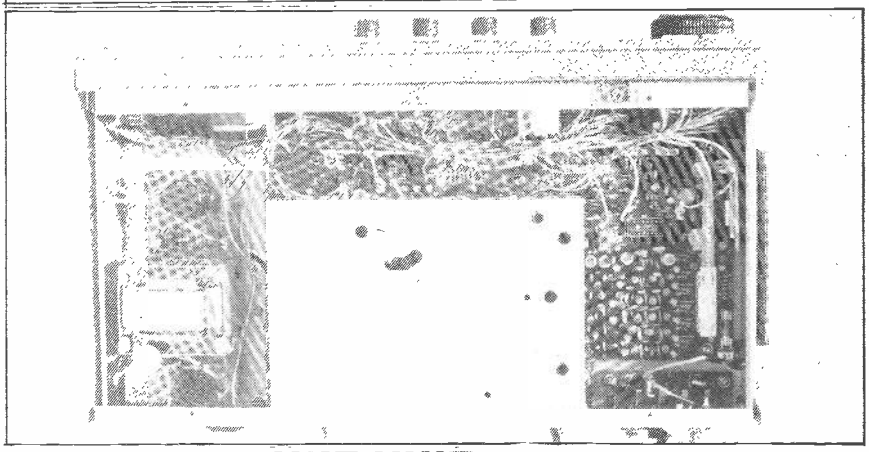
Best obtainable signal/noise ratio, AM

57dB	64dB	58dB

Signal/noise ratio CCIR/ARM weighted, AM

53dB	56dB	49dB





TRIO R2000 VHF UNIT LABORATORY RESULTS

Sensitivity for 12dB sinad, FM (1kHz modulation, 2.5kHz deviation)

144.025MHz	*-111.5dBm*
144.950MHz	*-111.5dBm*
145.975MHz	
145.975MHz	*-112.5dBm*

Sensitivity for 12dB sinad, USB (1kHz beat note) -116.7dBm

Selectivity, FM
RF levels off channel to degrade sinad by 3dB (ref. 12dB sinad point)

-/+ 12.5kHz	*26/39.5dB*
-/+ 24kHz	*55/57dB*

Selectivity, USB

3dB Bandwidth	*2.7kHz*
6dB Bandwidth	*2.9kHz*
40dB Bandwidth	*6.4kHz*
60dB Bandwidth	*26.4kHz*

RFIM performance at 144.55MHz, USB
Carriers at +100/+200kHz spacings for 12dB sinad IM product

Ratio	*66dB*
Calculated RF intercept point	*-17dB*

Reciprocal mixing performance at 144.05MHz, USB
RF level required off channel to degrade sinad by 3dB (ref. noise floor)

20kHz spacing	*75dB*
50kHz spacing	*84dB*
100kHz spacing	*91dB*
200kHz spacing	*101dB*

S Meter: RF levels required to give the following readings

	USB	*FM*
S1	*-95d3dBm*	
S3	*-92dBm*	*-98dBm*
S5	*-88dBm*	*-96dBm*
S7	*-82dBm*	*-94dBm*
S9	*-74dBm*	*-93dBm*
S9+20	*-53dBm*	*-89dBm*
S9+40	*-28dBm*	*-76dBm*
S9+60	*Not calibrated*	*Not calibrated*

Capture ratio, FM	*4.1dB*
Audio Quieting (at 12dB sinad point)	*18.6dB*
3dB limiting point	*-114dBm*
Product detector distortion (-80dBm)	*2.7%*
Audio distortion, FM (2.5kHz deviation, 125mW/8ohms output)	*1.4%*

EXH

Planning to visit the RSGB's annual exhibition at Birmingham?

1983 was the first year that *Amateur Radio* attended the biggest happening on the radio amateur's calendar - the Radio Society of Great Britain's National Amateur Radio Convention.

This year - 1984 - the venue is the same, at the National Exhibition Centre, Birmingham, and the opening times are as follows:

Saturday, April 28th - 10am to 6pm

Sunday, April 29th - 10am to 5pm.

It appears that anyone who is *anyone* will be there, not least of whom will be the Radio Society themselves, including their new President, Bob Barrett GW8HEZ, who was installed on January 14th. Other RSGB luminaries will include David Evans G3OUF, General Manager and Secretary of the organisation, and his deputy John Nelson.

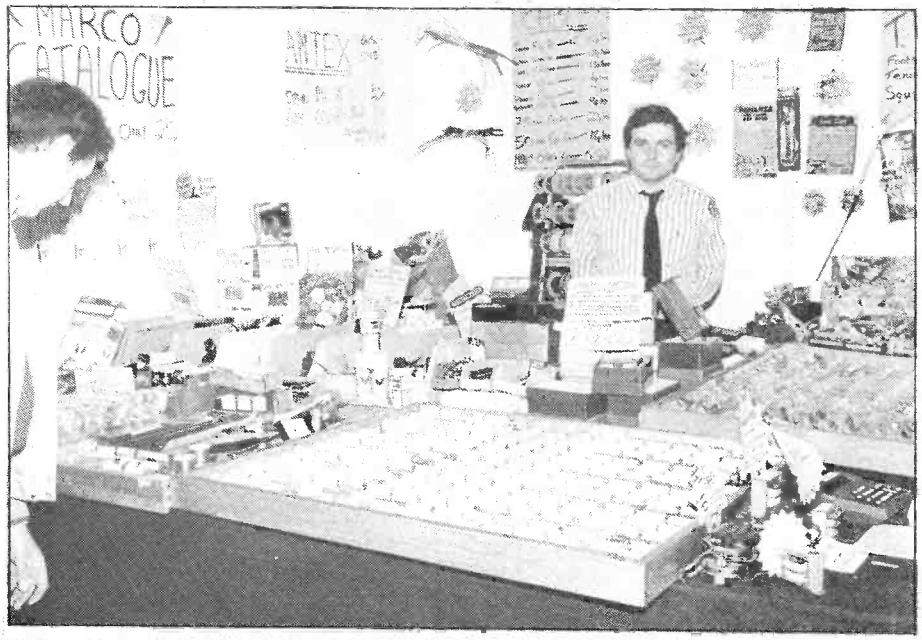
Amateur Radio will be there, of course, and we look forward to meeting our friends (and others) at their stands, in the bar, or in the mile-long queue outside the front doors!

Many new items of equipment will be on show, naturally enough, and we expect to carry a full preview in next month's issue - on sale on April 26th, just two days before the exhibition opens! So keep your eyes open for the mag, or even better, take out an order at your newsagents.

As before, the exhibition will include its successful programme of side events, including various lectures on subjects like propagation, VHF and Microwaves, while elsewhere there will be a special visitor's forum for VHF and repeater enthusiasts.

Last year, the so-called flea market went very successfully, and for 1984 the bits and pieces/ secondhand market will be even bigger, with more exhibitors than ever before. The main picture on these pages shows one of the excellent and absorbing stands in the treasure corner. You could spend hours simple flitting from one stand to another - forget all that new stuff. There's too much going on here!

IBIT ONE



Seriously, the big news has got to be in the major exhibition where all the important dealers and manufacturers will be showing their equipment, accessories and radios. Amateur Radio Exchange, Lowe Electronics, South Midlands Communications, Thanet, and many more will be there, all with a vast selection of their most popular and useful equipment. At the time of going to press, we do not have information on exactly what will be on show, but as we said before, watch out for the next issue of *Amateur Radio*.

One special station at the NEC will be GB4NEC, run by Solihull Amateur Radio Society; this HF exhibition station will operate from 0900 to 1700 on both Saturday and Sunday and be on all HF bands, the right conditions permitting. We understand that emphasis will be laid on 3.5MHz phone, while the rest of the bands will carry CW mainly. Watch out for the special QSL card.

Entrance fee is £2 (children half price), and car parking is free.

South Midlands

* FREE FINANCE • 2 YEAR GUARANTEE

BRANCHES AT SOUTHAMPTON, LEEDS, CHESTERFIELD,

TIRED OF THE QRM AND LACK OPERATING SPACE ON 2M?

Then Q.S.Y. to 70cm and begin to enjoy your hobby again, after all 70cm is 10MHz wide in most of the U.K. - That's plenty of room for all to enjoy their favourite MODE.

In order to help promote further activity on 70cm we have been able to reduce prices of many of Yaesu's UHF transceivers. This has been possible due to S.M.C.'s bulk purchasing from Yaesu together with reduced production costs at the factory due to increasing demand on the Japanese home market since the introduction of UHF repeaters in Japan.

Check out the prices of Yaesu's UHF Transceivers against other manufacturers models and you will probably agree Yaesu leads the way to 70cm.

Just consider with lower equipment costs than equivalent 2M transceivers, a larger number of UHF repeaters in the UK per amateur population than anywhere alse worldwide and remember 70 cm antennas because of their smaller size and similarity to T.V. antennas make them far more environmentally acceptable than 2m long Yagis.

'Need we say more except see you on 70 cms'

New prices effective 1st March, 1984.

FT708R
Now Only
£179.00 inc

FT790R
Now Only
£249.00 inc

Shown with FL7010 optional amplifier

FT730R
Now Only
£229.00 inc

COAXIAL FEEDERS

Don't throw away those valuable watts by using poor quality feeder. Remember approximately 20M of UR67 will have an approximate attenuation of 3dB at 432 MHz. This means if you invest around £250 for a 100W P.A. you will only end up with about 50W at the antenna.

UR67	att 3.9dB per 25M app	**£0.69 p/m**
Pope H100	att 2.25dB per 25M app	**£0.79 p/m**
*Eupen 5121	att 1.4dB per 25M app *NEW*	**£2.93 p/m**
*Andrews LDF2.50	att 1.9dB per 25M app	**£3.00 p/m**
*Andrews LDF4.50	att 1.3dB per 25M app	**£3.58 p/m**

*Helical Foam-Dieletric cables

Carriage on cables £2.40 up to 20M, over 20M £3.20

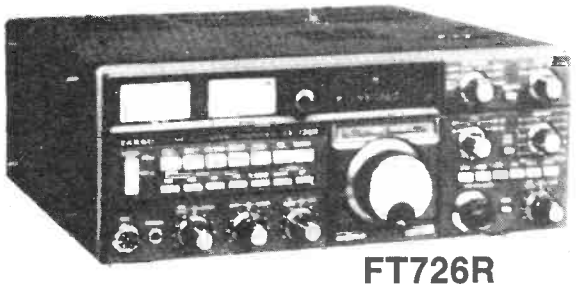
70cm ANTENNAS

D8/70	8 over 8 Yagi	**£25.87**
PBM18/70	18 ele Parabeam	**£32.20**
PBM24/70	24 ele Parabeam	**£44.55**
LW24/70	24 ele Yagi	**£27.02**
MBM28/70	28 ele Multibeam	**£21.27**
MDM48/70	48 ele Multibeam	**£35.65**
MBM88/70	88 ele Multibeam	**£48.87**
8XY/70	8 ele crossed Yagi	**£42.55**
12XY/70	12 ele crossed Yagi	**£52.90**
SMCGP432X	3 x 5/8 wave colinear	**£32.20**
SMCGP714	14 step coaxial colinear 10DB1	*NEW* **£78.60**
SMC70N2V	2/70 cm Colinear	**£32.20**

Carriage on antennas £2.65

LOOKING FOR A SATELLITE TRANSCEIVER SYSTEM?

Those clever men at Yaesu have put together your total satellite transceiver requirements in one package. If you are interested in the RS satellite with 2M to 10M transponders, the answer is FT726R + HF module and satellite unit, or if you want to use Oscar 10 with 70 cms to 2M transponder, the answer is FT726R + 70 cms module and satellite unit. You can even use the FT726R with the mode L transponder on Oscar 10. However, in this case the FT726R does require a little help from Microwave Modules and their MMX1268/144. For mode L the answer is FT726R + 70 cms module, satellite unit and MMX1268/144 on all the above combinations, full duplex is possible when the satellite unit is fitted to the FT726R. So look no further, Yaesu have the answer, the FT726R!!



FT726R

FT726R(2) Transceiver c/w 2M	**£739.00 inc**
FT726R Trnsceiver Main frame	**£589.00 inc**
21/24/28 HF module	**£200.00 inc**
50/726 6M module	**£185.00 inc**
144/726 2M module	**£155.00 inc**
430/726 70 cms module	**£250.00 inc**
SAT726 Ful dupllex module	**£95.00 inc**
XF455MC 600 Hz CW filter	**£39.85 inc**
MMX1268/144 Satellite transmit transverte	**£149.00 inc**

SMC SERVICE
Free Securicor delivery on major equipment.
Access and Barclaycard over the phone.
Biggest branch agent and dealer network.
Securicor 'B' Service contract at £5.00
Biggest stockist of amateur equipment.
Same day despatch whenever possible.

*** FREE FINANCE**
On many regular priced items SMC offers.
Free Finance (on invoice balance over £120)
20% down and the balance over 6 months or
50% down and the balance over a year.
You pay no more than the cash price!
Details and eligible items available on request.

GUARANTEE
Importer warranty on Yaesu Musen products.
Ably staffed and equipped Service Department.
Daily contact with the Yaesu Musen factory.
Tens of thousands of spares and test equipment.
Twenty-five years of professional experience.
● 2 year warranty on regular priced Yaesu products

SMC STOCK CARRYING AGENTS WITH DEMONSTRATION FACILITIES

Neath	John	GW4FOI	(0639) 52374 Day (0639) 2942 Eve	Bangor Tandragee	John Mervyn	G13KDR G13WWY	(0247) 55162 (0762) 840656	Stourbridge	Andrew	G4BJY	(03843) 72632

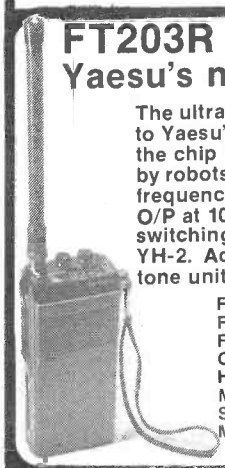
Communications Ltd

AUTHORISED YAESU

MAIN DISTRIBUTOR FACTORY BACKED
BUCKLEY, STOKE, GRIMSBY, JERSEY, EDINBURGH.

FACILITIES + UNEQUALLED PERFORMANCE BY YAESU

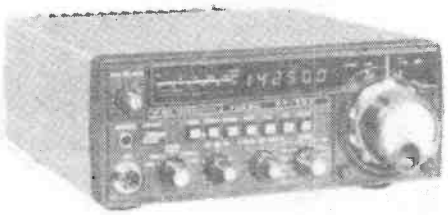
FT203R
Yaesu's new compact 2M handle



The ultra compactness of the FT203R is due mainly to Yaesu's chip component circuit board assembly, the chip components being installed automatically by robots. The 203's features include thumblewheel frequency selection, built in S/PO meter, 2.5W RF O/P at 10.8V, (3.5W O/P with FNB4). Vox activated switching is possible when used in conjunction with YH-2. Accessories supplied include FNB3, FTE-2 tone unit, CSC6 case and YHA-14A antenna.

FT203R 2.5W transceiver	**£169.00 inc.**
FBA5 Case for 6AA cells	**£6.50 inc.**
FNB4 12V Nicad pack	**£36.40 inc.**
CSC7 Soft case (when FNB4 is used)	**£6.50 inc.**
HY-2 Headset/Mic	**£13.80 inc.**
MH-12A2b Speaker Mic	**£16.85 inc.**
SMC8.9AA Charger (13A style)	**£8.05 inc.**
MMB21 Mobile mounting bracket	**£7.65 inc.**

THE BUY OF THE YEAR
FT707
8 BAND HF TRANSCEIVER



~~£499.00~~

now only

£425 inc

FP707 matching AC PSU	**£125.00 inc.**
FV707DM Digital VFO	**£149.00 inc.**

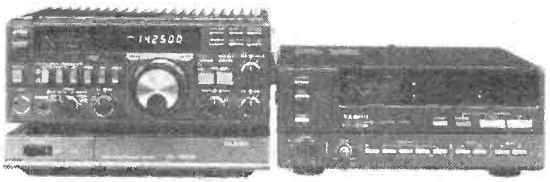
FT980

FT980 Transceiver with general coverage RX	**£1,265.00 inc.**
SP980 External L/S with audio fitter	**£58.65 inc.**
SP980P External L/S with phone patch	**£74.85 inc.**
F1F80 Computer interface for NECPC8001	**£99.65 inc.**
F1F65 Computer interface for Apple II	**£51.35 inc.**
F1F232C Computer interface RS232	**£54.80 inc.**

FT77

FT77 8 Band RX/TX 100W output	**£459.00 inc.**
FT77S 8 Band RX/TX 10W output	**£425.00 inc.**
FP700 Matching AC PSU	**£135.00 inc.**
FC700 Matching Antenna Tuner	**£98.90 inc.**
FV700DM Digital VFO Unit	**£200.00 inc.**
MKT77 Marker Unit	**£10.35 inc.**
FMUT77 FM Unit	**£27.20 inc.**

YAESU'S LINE UP FOR '84
THE FT757 SYSTEM



FT757GX All Modes and Filters fitted	**£685.00 inc.**
FP757GX Switched Mode PSU 50% Duty	**£149.50 inc.**
FP757HD Heavy Duty PSU 100% Duty	**£162.50 inc**
FC757AT Automatic Antenna Tuner .	**£231.50 inc**

Frequency range 160-10m Tx general coverage RX,10HzVFO steps and 500KHz band steps Modes, USB, LSB, CW, AM, FM all as standard.

Power output 100W SSB, CW, FM 25W carrier AM, 3rd order products-40dB at 100W on 14MHz.

Dynamic range better than 100dB CW(N) at 14MHz.

Frequency stability better than ±10ppm after warm up.

Dual VFO's and 8 memories with VFO/memory transfer feature allowing more flexible split frequency operation.

Programmable memory scanning with scanstop threshold adjustable with the RF Gain control. All accessories installed including AM, FM, Marker, Speach processor, shift filters, 600Hz CW. filter and keyer.

New heatsink design and ducted cooling system allow 100W o/p at 100% transmitter duty cycle. ★

Selectable semi break-in or full break-in and built in iambic keyer with dot-dash memory. Three microprocessors control most of the switching and adjusting functions normally done by hand and on optional CAT interface unit allow further operating flexibility with an external computer.

★ 100% Duty only with FP757HD

SOUTHAMPTON	GRIMSBY	STOKE	LEEDS	CHESTERFIELD	BUCKLEY	JERSEY	EDINBURGH
SMC Ltd	SMC (Humberside)	SMC (Stoke)	SMC (Leeds)	SMC (Jack Tweedy) Ltd.	SMC (TMP)	SMC (Jersey)	SMC Scotcomm
36/38 Rumbridge St.,	247A Freeman Street	76 High Street	257 Otley Road	102 High Street	Unit 27, Pinfold Lane	1 Belmont Gardens	23 Morton Street
Totton, Southampton,	Grimsby, Lincs	Talke Pits, Stoke	Leeds 16, Yorkshire	New Whittington, Chesterfield	Buckley, Clywd	St. Helier, Jersey	Edinburgh EH15 2HN
Southampton (0703) 867333	Grimsby (0472) 59388	Kidsgrove (07816) 72644	Leeds (0532) 782326	Chesterfield (0246) 453340	Buckley (0244) 549563	Jersey (0534) 77067	Tel: 031-657 2430
9-5.30 Mon-Sat	9.30-5.30 Mon-Sat	9-5.30 Tues-Sat	9-5.30 Mon-Sat	9-5.00 Tues-Sat	9.30-5.30 Tues-Sat	9-6.00 Mon-Sat	10-5 Tues-Fri 9-4 Sat

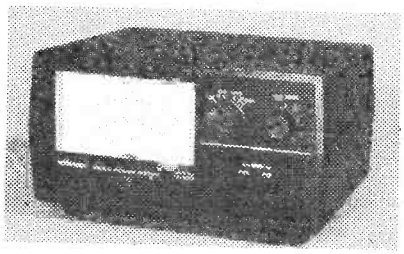
REMEMBER

Only authorised Yaesu dealers have direct contact with the factory in Japan, and only if you buy your radio from an authorised dealer can you be assured of spares and service back up. So BEWARE of grey importers who offer sets a few pounds cheaper, they may not be around if your set goes wrong!

POWER METERS

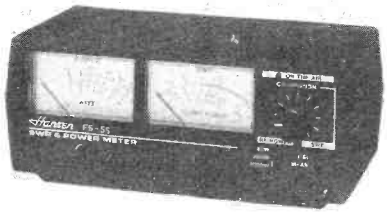
IN LINE POWER/SWR BRIDGES P.E.P., R.M.S. 1 · 8-440 MHz

The Hansen range covers 30 quality models with top-of-the-line the FS710. This is a flat frequency response peak envelope power and average in-line wattmeter with many novel features. Notable being the 'power independent' SWR scale — no forward power calibration knob, just direct reading SWR.



HANSEN FS 300H

HANSEN		
FS710H	1.8-60MHz 15/150/1500W pep	£97.75
FS710V	50-150MHz 15/150W pep	£97.75
FS50HP	1.8-80MHz 20/200/2000W pep	£96.60
FS50VP	50-150MHz 20/200W pep	£96.60
FS500H	1.8-80MHz 20/200/2000W pep	£77.80
FS50OV	50-150MHz 20/200W pep	£77.80
FS300H	1.8-80MHz 20/200/1000	£50.60
FS300V	50-150MHz 20/200	£50.60
FS200	1.8-150MHz 20/200 pep	£55.96
FS601M	1.8-30MHz 20/200W pep	£57.50
FS601MH	1.8-30MHz 20/2000W pep	£57.50
FS602M	50-150MHz 20/200W pep	£57.60
FS603M	430-440MHz 5/20W pep	£56.75
FS210	1.8-150MHz 20/200W Auto SWR	£59.80
FS301M	2-30MHz 20/200W	£39.50
FS301MH	2-30MHz 20/200W	£39.50
FS302M	50-150MHz 20/200W	£39.50
FS711H	2-30MHz 20/200W Head	£41.00
FS711V	50-150MHz 20/200W Head	£41.00
FS711U	430-440MHz 5/20W Head	£41.00
HB1	FS711H Coupler	£23.00
VB1	FS711V Coupler	£23.00
UB1	FS711U Coupler	£23.00
FS5E	3.5-150MHz 20/200/1000W HF	£41.00
FS5S	1.8-150MHz 20/200/1000W HF	£41.00
FS7	145&(432MHz) 5/20/200 144	£41.00
SWR3E	3.5-150MHz 20/200/1000W HF	£44.85
SWR3S	3.5-150MHz F/S Meter ant.	£26.85
SWR508	3.5-150MHz Twin Meter	£28.35
FS20D	3-150MHz 5/20W	£26.87
FS800	1.8-150MHz 6/30/150W	£29.85
		£115.00
JD		
JD110	1.5-150MHz 10/100W	£13.80
MIRAGE		
MP2	50-150MHz 50/500/1500W pep	P.O.A.
SMC		
S3-3OL	Mini CB	£8.80
T3-170L	3.5-170MHz Relative	£16.50

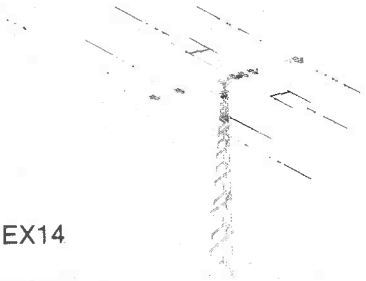


FS 5S

NB: PRICES INCLUDE VAT AT 15%
Carriage free by post

HF ANTENNAS

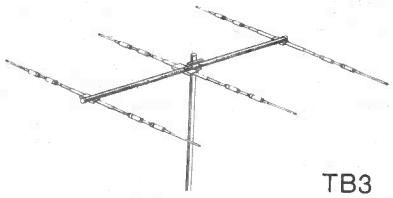
S.M.C. have the greatest range of H.F. antennas eg., Multi Beams/Quads, over 20 models. Shown below is the sensational new Explorer 14 — contact us for full details.



EX14

MULTIBAND BEAMS

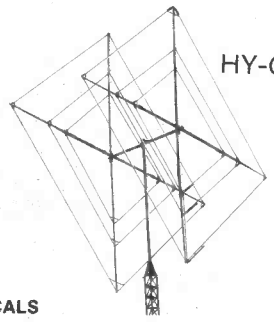
		Inc VAT	P & P
EX14	Explorer 10-20	£325.00	£5.95
TH3JN	3 Ele 10-20	£199.00	£3.50
TH2MK3	2 Ele 10-20	£169.00	£3.50
TH3MK3	3 Ele 10-20	£275.00	£5.30
TH5DXX	5 Ele 10-20	£419.00	£6.70
TH7DXX	7 Ele 10-20	£520.00	£8.75
TB3	3 Ele 10-20 Jaybeam	£189.75	£5.90
HQ1	Mini Quad 10.20	£169.00	£4.00
G4MH	Mini Beam 1-20	£88.50	£4.50
TA33JNR	3 Ele 10-20 Moseley	£177.10	£6.00
Mustang 2	2 Ele 10-20 Moseley	£177.10	£6.90
Mustang 3	3 Ele 10-20	£220.80	£6.90
GQ2E	2 Ele 10-20 Quad	£270.25	£5.90
GQ3E	3 Ele 10-20 Quad	£435.00	£9.20
GQ4E	4 Ele 10-20 Quad	£399.00	£10.00
Hyquad	2 Ele 10-20	£325.00	£6.70
LP1007	Log Periodic 13-20 MHz	£1707.75	DIST
3Y1015D20	3 Ele 10-20m	£158.70	£5.95
DB10/15A	3 Ele 10-15m	£199.00	£4.80



TB3

MONO BAND BEAMS

103BA	3 Ele Yagi 10M	£69.00	£3.50
105BA	5 Ele Yagi 10M	£155.00	£3.75
153BA	3 Ele Yagi 15M	£95.00	£3.50
155BA	5 Ele Yagi 15M	£239.00	£5.90
203BA	3 Ele Yagi 20M	£179.00	£4.90
204BA	4 Ele Yagi 20M	£289.00	£7.30
205BA	5 Ele Yagi 20M	£399.00	£9.40
402BA	2 Ele Yagi 40M	£249.00	£6.50
18TD	Dipole Tape 10-80M	£121.90	£2.80



HY-QUAD

VERTICALS

12AVQ	Vertical 10.20M	£52.90	£2.75
14AVQ	Vertical 10.40M	£66.70	£2.75
18AVQ/WB	Vertical 10.80M	£113.85	£2.75
18V	Vertical 10.80M taped	£36.22	£2.75
C4	Vertical 10.20	£59.00	£2.50
SMCHF5V	Vertical 10.80	59.00	£2.65
SMCHF5R	Radial Kit for above	£38.35	£2.50

TRAP DIPOLE

SMCTD/HP	High Power 10.80M	£45.00	£2.65
SMCTP/P	Portable inc coax	£65.55	£2.65

MOBILE

Tribander	10-20M Slide sw.	£27.37	£1.65
Multiband	10-20M	£32.20	£1.50
Flexiwhip	10M only	£19.21	£1.85
Extra coils	for above to 160m	£6.90	£1.00
Flexiten	2, 10, 12, 17, 15.20. 30, 40, 80M	£49.00	£2.35
Bases	For above	£5.75	£1.00

N.B. PRICES INCLUDE VAT AT 15%
Carriage extra. Mainland rate shown

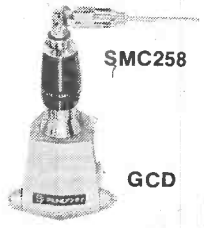
SMC-HS

HF, VHF, UHF ANTENNAS MOBILE VERTICALS

SMC-HS Mobile Elements, tabulated below, feature an inbuilt PL259M connector, which mates with the SO239M on any of the four standard mounts. This arrangement is ideal for easy removal — band changes, comparative test, car wash, and anti-vandal, system checks from the feed point, portable operation and for ease of garaging, etc. All models have fold over bases (either lift and lay or locking collar) except the 78B which has an inbuilt ball in case the mount must be fitted askew.

SMC OSCAR 10SE

GCD



SMC258

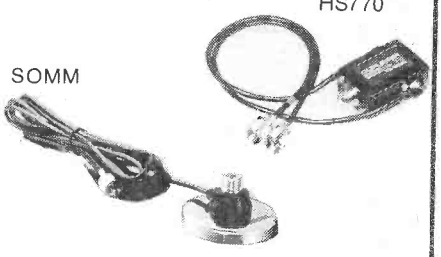
GCD

SMC-HS MOBILE ANTENNA

SMC6P 2T/PL	Telescopic 2M PL259 fitting OdB¼	£5.75	£0.85
SMCT144h	Telescopic 2M½ wave BNC	£9.20	£0.85
SMC6P2T/ BNC	Telescopic 2M BNC fitting OdB¼	£5.75	£0.85
SMC2H/PL	Helical 2M PL 259 fitting	£5.67	£0.85
SMC2H/ BNC	Helical 2M BNC fitting	£5.75	£0.85
SMCHS430	70cm ½ wave BNC fitting 2.5dB¼	£7.30	£0.65
SMC2QW	2M ¼ wave OdB¼ 1.6'	£2.53	£1.80
SMC2NE	2M ⅝ wave fold 3.0dB¼ 4.3'	£7.30	£2.00
SMC2VF	2M ½ wave fold 3.0dB¼ 3.5'	£12.65	£2.00
SMC78F	2M ⅞ wave fold 4.5dB¼ 5.7'	£14.95	£2.50
SMC78e SMBC78B	2M ⅞ wave ball 4.5dB¼ 5.6'	£14.95	£2.50
SMC78SF	2M ⅞ wave short 4.7'	£14.95	£2.50
SMC88F	2M 8/8 wave 5.2dB¼ 6.5'	£20.70	£2.50
SMC118M	Colinear 2M 11/8 wave fold 7dB¼ 9.7'	£33.35	£2.65
SMC258	70cm 2 × ⅝ fold 5.5dB¼ 3.1'	£13.80	£2.00
SMC358	70cm 3 × ⅝ 6.3dB¼ 4.7'	£18.40	£2.00
SMC70N2M	Dual band 2M 2.7dB¼ 70cm 5.1dB¼	£18.40	£2.00
SMCHS770	144/432 Duplexer 50W	£16.50	£1.85
SMC20SE	20M 1.72M 'fold over' 100W PEP	£19.15	£2.00
SMC15SE	15M 1.72M 'fold over' 130W PEP	£15.70	£2.00
SMC10SE	10M 1.72M 'fold over' 200W PEP	£14.95	£2.00
SMC17SE	17M 1.915M 'fold over' 200W PEP	£17.25	£2.00
SMC12SE	12M 1.915M 'fold over' 200W PEP	£15.35	£2.00
RSL-286	Yaesu 10m mobile whip	£10.65	£2.00
SMCGCCA	Gutter clip 4 mtrs cable	£10.35	£2.00
SMCSOCA	Cable assembly 4M	£5.35	£1.50
SMCSOCAL	Cable assembly 6M	£5.75	£1.50
SMCT MCAS	Trunk mount c/w 6M cbl	£9.20	£2.00
SMCSOMM	Magnetic base c/w 4M cbl	£10.75	£2.00
SMCSOWM	Adjustable wg mnt base	£4.60	£0.90
SMCCGCD	Gutter clip deluxe	£5.00	£1.50
SMCBSD	Bumper strap deluxe	£9.60	£1.50
HS888K	Bumper mounted extension for 144 MHz ant.	£20.30	£2.00

HS770

SOMM



NB: PRICES INCLUDE VAT AT 15%

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144 MHz, 12VDC Transceiver. 25W/5W Hi/Lo (both adjustable). Compact $2\frac{2}{16}$" x $6\frac{3}{8}$" x $7\frac{3}{16}$". $12\frac{1}{2}$KHz steps (100KHz fast QSY). Amber LCD 'Sunlight View', Side Lit. Display; 100's of Hz or channel number. Sensitivity 0.2 V for 12 dB SINAD. Single knob frequency control "Dial". Endless or non-endless dial options. RIT; 1 KHz steps, V.F.O. + memory. Two 5 slot memories A, B, A+B, AxB. 11th memory instant "call" channel. Memories simplex or duplex channels. Band scanning, programmable limits. Scan halts on squelch + centre zero. Pause on scan halt for 3 seconds. Scan/tune/RIT from microphone ± 600KHz split, plus cross memory. Repeater input listen by pressing "dial". Setable; steps, tone, splits, limits. Simple controls for safe mobile operation. C/W mobile mount, mic and handbook.

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C5/2M	Colinear omnivert 4.8dBd	**£54.62**	£2.65
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LW8/2M	Yagi 8element 9.5dBd	**£17.82**	£2.65
LW10/2M	Yagi 10element 10.5dBd	**£24.15**	£2.65
LW16/2M	Yagi 16element 13.4dBd	**£35.07**	£3.20
14Y/2m	Yagi 14element 12.8dBd	**£36.23**	£3.20
PBM10/2m	10ele Parabeam 11.7dBd	**£44.85**	£3.20
PBM14/2M	14ele Parabeam 13.7dBd	**£55.77**	£3.20
Q4/2M	Quad 4element 9.4dBd	**£29.32**	£2.65
Q6/2M	Quad 6element 10.9dBd	**£39.10**	£2.65
Q8/2M	Quad 8element 11.9dBd	**£44.85**	£2.65
D5/2M	Yagi 5over 5slot 10dBd	**£25.30**	£2.65
D8/2M	Yagi 8over 8slot 11.1dBd	**£34.50**	£2.65
5XY/2M	Yagi 5ele crossed 7.8dBd	**£28.17**	£2.65
8XY/2M	Yagi 8ele crossed 9.5dBd	**£35.65**	£2.65
10XY/2M	Yagi 10ele crossed 10.8dBd	**£46.00**	£2.65
PMH2/C	Harness cir polarisation	**£9.77**	£1.65
PMH2/2M	harness 2-way 144MHz	**£12.65**	£1.65
PMH4/2M	Harness 4-way 144MHz	**£28.75**	£1.65
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D8/70	Yagi 8over 8slot 12.3dBd	**£25.87**	£2.65
PBM18/70	18ele Parabeam 13.5dBd	**£32.20**	£2.65
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MBM28/70	28ele Multibeam 11.5dBd	**£21.27**	£2.65
MBM40/70	48ele Multibeam 14.0dBd	**£35.65**	£2.65
MBM88/70	88 ele Multibeam 16.3dBd	**£48.87**	£2.65
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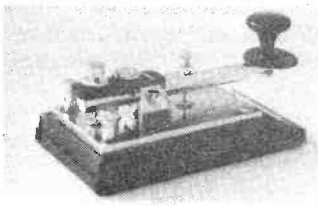
PMH2/70	Harness 2-Way	**£10.35**	£2.65
PMH4/70	Harness 4-way	**£22.42**	1.85
1296 MHz			
CR2/23CM	Corner reflector 13.5dBd	**£40.25**	£2.65
PMH2/23CM	harness 2-way	**£31.05**	£1.65

NB: PRICES INCLUDE VAT AT 15%
Carriage extra, mainland rate shown

MORSE EQUIPMENT



Morse Keys

HK703	Straight Key	**£28.00**	£1.20
HK704	Straight Key	**£19.25**	£1.20
HK706	Straight Key	**£15.90**	£1.00
HK707	Straight Key	**£15.00**	£1.00
HK710	Straight Key	**£39.70**	£1.75
HK808	Straight Key	**£49.70**	£1.75
HK711	Key Mounting	**£32.15**	£1.50
BK100	Mechanical Bug	**£24.25**	£1.75
MK701	Single Lever Paddle	**£27.50**	£1.60
MK702	Single Lever Paddle	**£28.85**	£1.60
MK703	Squeeze Key	**£28.30**	£1.75
MK705	Squeeze Key	**£24.65**	£1.75
MK706	Squeeze Key	**£21.25**	£1.75
IKP60	Iambic	**£9.95**	FOC
HK802	Deluxe Brass Key	**£85.85**	£2.00

Morse Equipment

KP100	Squeeze CMOS 230/13.8V	**£77.05**	£2.00
KP200	Memory 4096 Multi Ch Mem Back Up 230/13.8V	**£165.62**	£2.50
D70	Morse Tudor (Datong)	**£56.35**	FOC
MMS1	Morse Tudor (M/M)	**£115.00**	FOC
MMS2	Morse Tudor Advanced	**£155.00**	FOC

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MM2001	RTTY to Demod./Convertor	**£189.00**	FOC
MM4001KB	RTTY Transceiver c/w keybd	**£299.00**	FOC
MM1000KB	ASCII - CW conv c/w keybd	**£135.00**	FOC

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SCANNING RECEIVER

MS-8400

New from SMC the MS-8400 VHF/UHF microprocessor controlled scanning receiver with 40 programmable memory channels, keyboard entry of frequency or command, automatic band search, AM and FM selectable 4 selectable scanning steps, priority channel, connections for external antenna and loudspeaker, speaker supplied c/w telescopic antenna mounting bracket, etc:

Frequency Range:
Low VHF 68,000MHz - 88.000Mhz
Air Band 108,000MHz-136,000MHz (Auto AM)
High VHF 136,000MHz-174,000MHz
UHF 360,000MHz-512,000MHz

Scanning Steps: 5, 10, 125 and 25KHz VHF (10, 125 and 25KHz UHF)
Channels: 40 programmable memories
Modes: AM or FM selectable
Scan rate: Approximately 18 channels per second
Scan delay: 2 second
Priority sampling: 4 second
Audio output: 1.2 Watts
Selectivity: Better than - 60dB at ±25KHz
Power supply: DC 12V - 16V/0.6A max
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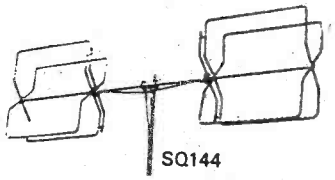
Antenna: Telescopic antenna or External
Loudspeaker: 25" x 4" oval speaker
Size: 190 (W) x 250(D) x 85(H) mm
Weight: 1.7kgs

£249.00 inc
price includes free carriage

SMC-HS

HF, VHF, UHF, BASE STATION ANTENNAS

SMC HS range of base station antennas covers from 80M through to 70cm. All have SO239M connectors and are supplied complete with all required mounting hardware.



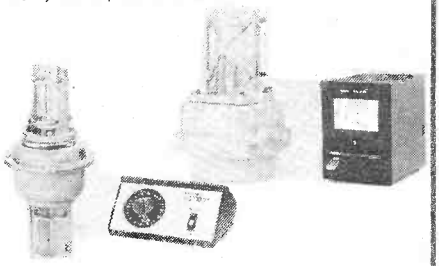
SQ144

SQ144	2M Swiss Quad Vertical Mounting	**£63.25**	£2.65
GP2M	2M $\frac{5}{8}$ c/w ground plane 3.4dB $\frac{1}{4}$	**£20.70**	£2.65
GP144W	2M 2 x $\frac{5}{8}$ colinear 6.5dB $\frac{1}{4}$	**£29.90**	£2.65
GP23	2M 3 x $\frac{5}{8}$ colinear 7.8dB $\frac{1}{4}$	**£43.70**	£2.65
GP432	70cm 3 x $\frac{5}{8}$ colinear 6.8dB $\frac{1}{4}$	**£32.20**	£2-65
70N2V	2M/70cm colinear 2.8dB $\frac{1}{4}$/5 7dB $\frac{1}{4}$	**£32.20**	£2.65
HS770	2M/70cm Duplexer 50W 30dB isolation	**£15.35**	£1.85
VHFL	65-520 MHz Discone Rx only	**£16.95**	£2.65
GDX1	80-480 MHz Discone 3dB $\frac{1}{4}$	**£43.65**	£2.65
GDX2	50-480 MHz Discone 3dB $\frac{1}{4}$	**£55.20**	£2.65
GDXA	100-480 MHz Discone 3dB $\frac{1}{4}$	**£36.80**	£2.65
LT606	50-500 MHz Log Periodic 7-8dB	**£115.00**	£2.65
HF5V	Trapped Vertical 10-80M 5 bands	**£59.00**	£2.65
HF5R	Loaded Radial Kit	**£38.35**	£2.65
3Y1015D	20 3 ele, 10, 15M Dipole 20M	**£158.70**	£5.96

NB: PRICES INCLUDE VAT AT 15%
Carriage extra, mainland rate shown

ROTATORS

The finest range be it Kenpro, C.D.E., Channel Master, S.M.C. has over 19 models to choose from. Ask the experts for the right model to suit your requirements - it should save you money. Write, phone or call.



KP250	Bell 6 Core	Lighter Duty		**£54.91**
9502B	Offset 3 Core	Lighter Duty		**£57.50**
FU200	Thro 3 Core	Light Duty		**£49.95**
AR40	Bell 5 Core	Medium Duty		**£98.90**
KR400	Bell 6 Core	Matches KR500		**£99.95**
KR500	Thro 6 Core	Elevation		**£126.50**
AR50	Bell 5 Core	5 Position Medium		**£113.85**
KR400RC	Bell 6 Core	Medium Duty		**£118.45**
CD45	Bell 8 Core	Heavy Duty		**£149.50**
KR600RC	Bell 8 Core	Heavy Duty		**£167.90**
HAM iV	Bell 8 Core	Heavier Duty		**£264.50**
KR2000RC	Bell 8 Core	Heavier Duty		**£333.50**
T2X	Bell 8 Core	Very Heavy Duty		**£332.35**
H300	Bell 8 Core	Digital Readout		**£546.25**

Control Cable

RC5W	5 Way	**40p metre**	carriage £1.90
RC6W	6 Way	**55p metre**	carriage £1.90
RC8W	8 Way	**59p metre**	carriage £1.90
KCO38	Lower Mast Clamp KR400 600	**£12.65**	carriage £2.50
9523	Support Bearing 9502	**£15.85**	carriage £2.50

Prices including VAT and carriage, but accessories are extra unless ent with rotators.

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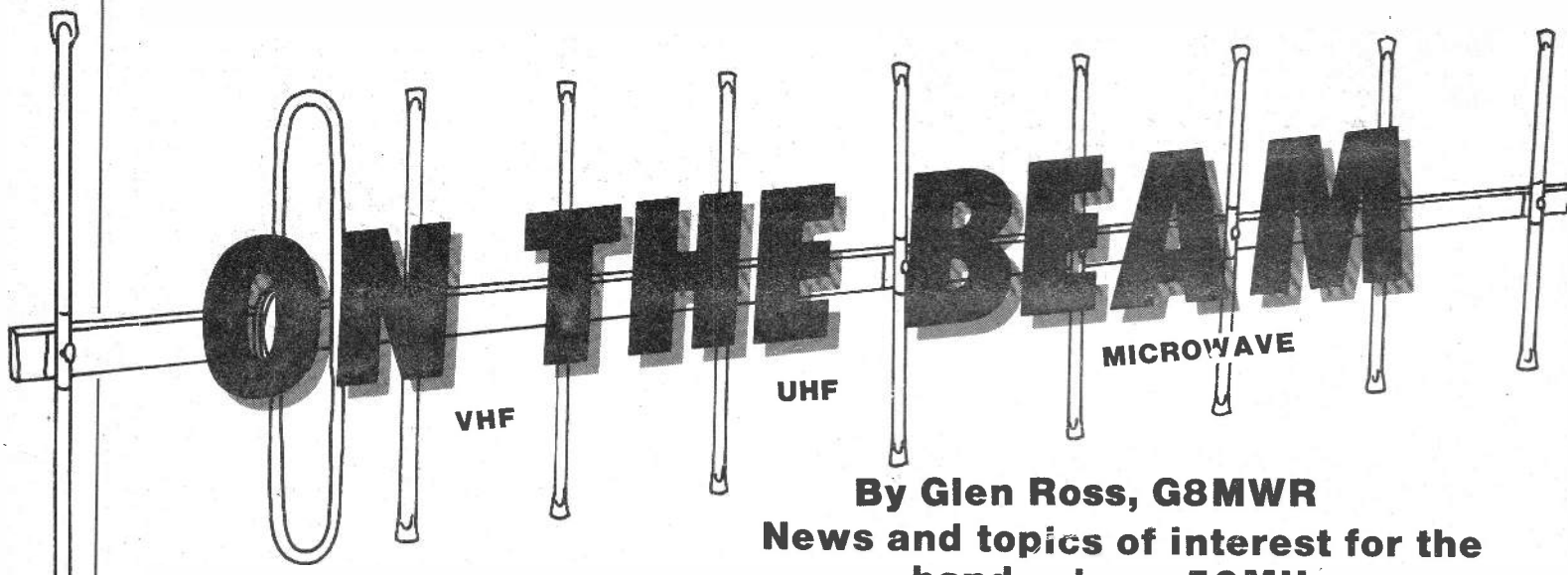


By Glen Ross, G8MWR

News and topics of interest for the bands above 50MHz

UOSATB

If all has gone well the new University of Surrey satellite should be in orbit by the time you read this. The launch was due to take place at 1800 hours GMT on 1st March using a Delta 3920 rocket. The planned orbit is at a height of 700Kms (435 miles) compared with UoSat 1 which was at 530Kms (330 miles). Two advantages will be gained by this extra height: first, the satellite will be available for a longer period on each orbit and, secondly, the satellite's 'footprint' (meaning the area of the Earth's surface that it can see) will be greatly increased

The orbit is polar and sun-synchronous and will therefore be overhead at the same time each day. A problem with the original unit was the limited number of passes per day and the fact that these were at around 1500 and 0300 GMT, times when most people are not available to make use of the facilities. The higher orbit of the new unit means that there will be more passes available and the timing now centres around 0900 and 2100 GMT. The first of these will be useful for the educational establishments making use of the machine, and the evening passes are at an ideal time for most people. The maximum amount of time on any pass will be 14 minutes, and the time for a complete orbit is nearly 99 minutes.

The satellite is described as being "about the size of a domestic swing bin" and weighs in a about 132lbs. The telemetry and general housekeepin systems are based on those used in UoSat 1 but they have been substantially redesigned to include experience gained on the 1st unit. The knowledge gained has been so great that of the 36 PCBs included in the unit, 35 are completely new designs. The working life of the satellite is reckoned to be about three years. As before, the control of the unit will be from the command station at Surrey University, with a back-up control station in the USA operated by AMSAT-USA.

On board

UoSat 1 was the first satellite to use a speech synthesiser, usually known as the "Digitalker". The original intention of this unit was to enable users to receive data about the system using nothing more complex, or expensive, than a small handheld. It has proved to be one of the most popular experiments on the satellite, even though it was limited to a vocabulary of only 150 words. UoSat B will carry a more ambitious system. The vocabulary is larger than the original and it will now be possible to transmit telemetry data and news broadcasts as extensive as those which, up till now, have only been available to users with much more elaborate equipment.

Images

What is known to the builders as "The Earth imaging experiment", and to the rest of us as the "TV Camera", will once again be on board. For some reason the unit on UoSat 1 became "degraded after launch" and satisfactory pictures were not available. The main electronics of the system which are used for storing the picture and then transmitting it were proved to be very successful. An improved system will be used on the new unit, the camera will be able to "see" an area about 1000 miles square and will have a resolution of about 2 Kms. In practice this means that a small village can be easily seen. The picture is sent down as a data stream which then has to be decoded and stores before you can display it on a standard TV receiver. This is supposed to provide a low cost system but it seems a pity that there is not a SSTV system on board which could be made use of by the large number of people who are already on this mode. The camera will also be used as part of an investigation into aurora displays, which will also use the three Geiger counters and an electron spectrometer (shades of Cmdr Henry Hatfield!) being carried as part of a particle wave experiment.

Mailbox

A new unit being carried is the "Digital communication experiment". This is a facility normally called an electronic mailbox. The unit will use 96k-byte of random access memory, under computer control, and will enable you to load a message or date 'addressed' to another station. This will then be held in memory until the other station collects it. This idea has been well proved by the 'Packet' radio systems already in use. The main problem to be overcome is the reliability of solid state memory devices under space conditions. Several different types of devices will be included and the whole thing will be driven by a NSC800 processor.

Full details of how to use this system are not yet available, it is known that an uplink frequency will be made available soon after launch, if all goes well. We suggest you listen for the Digitalker for up to data news.

Problems

UoSat 1 was plagued with problems right from the start, the most serious one being a complete loss of control that involved prodigious amounts of power to correct. The gravity gradient boom which should have kept the base of the unit always pointing to the EARTH, failed to operate correctly. This, coupled with the fact that the space craft carried only a single axis magnetorquer, gave a lot of problems in controlling the attitude of the satellite. UoSat B will carry three magnetorquers for spin axis and spin plane control. There will also be Sun angle and Earth horizon sensors and an improved magnetometer. The effect of all this technology will be to make control of the unit much simpler, quicker and much more accurate. To complete the job a gravity gradient boom will also be fitted.

The simple transmission systems carried on UoSat 1 were found to have some limitations at low signal levels and in noisy reception conditions. UoSat B will be used to experiment with various error-resilient coding techniques to overcome these problems.

Beacons

Full details of the various beacons which may be carried are not yet available. It is known that the 2.4GHz beacon will be carried and that it will be used to carry telemetry and data as a prime downlink.

Effort

The amazing thing about this unit is that the team which built it had just five months to do so, a feat which is probably without equal in the field (or space) of satellite construction. Congratulations must go to Dr Martin Sweeting and his team at the University of Surrey plus all the other people, both in the academic world and in the electronics industry, without whose tremendous efforts the satellite would not have been completed in time for the launch. Keep an ear on 145.825 for the latest developments.

Down to Earth

A new idea in providing club talks has been tried in South Africa. At 1900 hours on February 26th most of the South African repeater network was linked to a single input and carried a talk on aerial systems given by Brian Austin ZS6BKW. As far as is known this is the first time that a repeater network has been used for this purpose.

A variation of this idea is used in the USA where a lot of the repeaters are owned and operated by local clubs. It is common practice over there for the repeater to be closed down for normal use for about an hour on one night of the week while a club broadcast is made. This usually consists of engineering information on the repeaters run by the group, information on the club activities for the following week and even a "For Sale" and "Wanted" spot. These broadcasts are very popular and do not seem to suffer the same mindless vandalism that affects our repeaters. They also make a suitable occasion for visitors to the area to make themselves known to the local inhabitants. It really is an excellent system and it seems a pity that the restrictions on our repeaters do not allow a similar facility. Probably the yobbos would kill it anyway.

Contests

The 8th April sees the RSGB 432MHz CW contest. This is a four hour event and takes place between 1300 and 1700 GMT. On the weekend of the 14/15th the BARTG VHF/UHF RTTY contest takes place. This is an opportunity to collect some of those missing counties. The 15th of April also is the date for the Stevenage 144MHz FM contest. Looking forward into May the various SHF and Microwave cumulative contests start.

The weather

A surprising number of people are equipped to take information from the various weather satellites. To keep interested people in touch and also to provide for an exchange of information a new "Weather Group" has been formed. If you need more information on this club please contact G3REH.

Novice licence

The RSGB are looking into the whole issue of novice licences once again. They have asked that anyone who has some constructive ideas to offer should contact them. They are particularly interested to hear from any listeners who are thinking of coming into the hobby. It may not be of any great interest to someone who already holds a licence as to wether a new novice licence is issued, so the thoughts of listeners would be most welcome. This is your opportunity to make your thoughts on the subject known.

50MHz permits

The deadline for the return of completed applications for the 50MHz permits has been extended to the 30th of April. If you have already applied for a permit in phase I then simply confirm your interest; if not apply for that ticket right away to the RSGB. Please remember that the RSGB do not issue the permits, they are simply getting the paper work organised. There has been a great deal of effort put in by some people to get the authorities to extend the permits to include class B operators and it seems that this will eventually succeed.

Cable TVI

There has always been some concern at the possible problems that cable TV might bring with it. These are mainly concerned with the frequencies used to distribute the programmes and the specification of the cable used to carry them. It seems that perhaps not enough thought had been put into these areas.

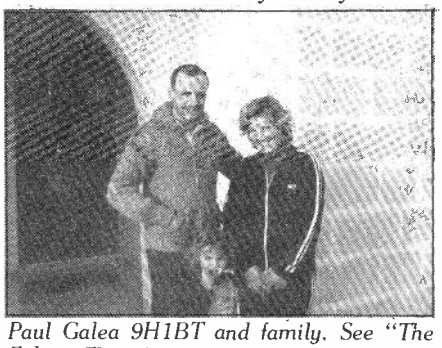
The probl m has come to light in the Milton Keynes area and is causing considerable havoc on 144MHz. Not enough information is known about this problem and anyone experiencing interference is asked to let us know, with as much detail as possible, so that a more complete picture can be built up. This is something that needs to be dealt with quickly because, once the network is well established, it will be too late to do anything about it.

NASA rules OK?

The word is that after the recent space flight by Owen Garriott, NASA are very pleased with the results and that they are prepared to look at requests for similar activity with an OK! The real point is, are the amateurs prepared to do the same? It transpires that, after all the yelling and screaming died down, a matter of five calls were heard from the UK. Note heard, not worked. Was it worth the effort?

The Falcon flies

Many people managed to work into Malta GC during the sporadic E season last year and may be wondering when they are going to receive QSL cards for the contact. A letter from Paul, 9H1BT reveals all. Due to the fact that the rules governing the Falcon Award were being changed it was decided not to send out the QSL cards until the new rules were known and could be printed on the reverse side of the cards. Paul tells me that this has now been done and that the cards will be on the way shortly.



Paul Galea 9H1BT and family. See "The Falcon Flies." Photo: E. Jarrett.

Gasfets

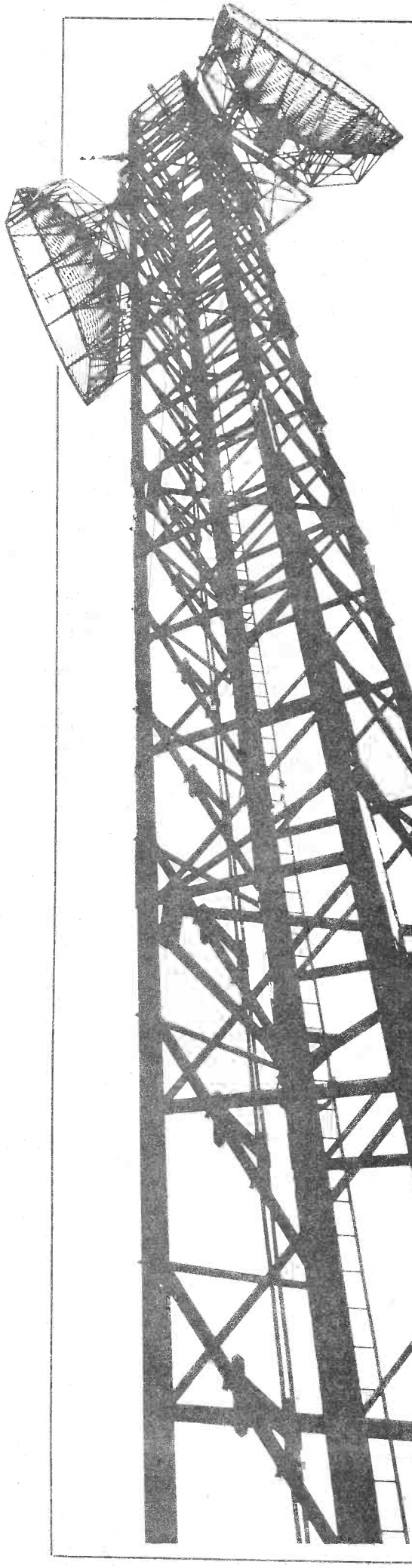
Ever wondered why Gasfets were so much better than ordinary transistors? It has taken no less an authority than the *Financial Times* to explain it. Quote: "In Gallium Arsenide, ELECTRICIANS can move about more easily and reach higher velocities...". Presumably amateurs can do the same thing?.

Microwave awards

A new series of awards for microwave operators is being offered by the Microwave Society. There are several classes of award available and they will only be issued in recognition of contacts made since 1st January 1984 so that the many newcomers to these bands are in with an equal chance. Full details from the society at 81 Ringwood Highway, Coventry.

Closedown

Thanks to all those people who have written with news and comments, please keep in touch with news of you, your club or anything else to do with the higher frequencies.



900 MEGACYCLES

What happened ⋆BCB?

Andrew Emmerson G8PTH delves into the records and asks the question: with the current interest in the 900MHz band (cellular radio, CB and phase 2 cordless telephones) why has this band remained "green field" territory up to now? In other words - what was there before CB and why did nobody lay claim to this band?

⋆This stands for Before Citizens' Band...

To answer these questions we must look back to the olden days but I had better first define what I mean by the olden days.

It was not so long ago when 56 megacycles per second was ultra shortwave, and a connector designed to work in this region was legitimately called a UHF plug! Microwaves started at 500 megacylces (or 60 centimetres) in those days - I have a copy of the RSGB's 1947 *Microwave Technique* to prove it. Since then we have had inflation, everything has been devalued, and even microwaves have been forced to start on a higher footing.

View of the 130ft mast and dish aerials at the Dunstable intermediate repeater station on the GPO London - Birmingham TV link, taken in 1950. Photo: British Telecom.

Those days can be likened to the dark ages of the 0.5 to 3.0GHz spectrum because nothing seemed to happen there. Apart from the pre-war experiments with an 18cm commercial speech link across the English Channel little experimentation had been made in this part of the spectrum, in marked comparison to the 10cm and 3cm radar bands of the second world war. There was a simple reason and I can do no better than to quote that RSGB book of 1947.

> *"Between 500 - 1000Mc/s very little work is done as it is the Cinderella of the microwaves, being too high for ordinary techniques and a little too low for special microwave methods."*

The only power devices were 'lighthouse' tubes of the 2C43 variety, which had a job to poke out more than four or five watts. Losses in coaxial cable were fearful. Waveguide was out of the question as it would be far too big at those frequencies. We move on therefore, somewhat hurriedly, to what I shall call the mediaeval period of microwaves: the very late 1940s and the 1950s.

Following the post-war reopening of the BBC's television service there was an early demand to extend this from London to Birmingham and other centres of population. The intensive work into radar carried out during the war had provided a range of UHF techniques which were looking for peacetime applications and it was only natural that for the London to Birmingham link a radio relay should be considered. Such links were the natural province of the GPO, it being the country's monopoly public communications carrier, and planning work commenced.

The specification set out requirements considered remarkable at the time. The link should be able to carry simultaneous two-way transmission of standard 405 line TV signals, and the range of the system should be capable of extension up to 400 miles without apparent deterioration of the received picture. A further requirement was that all stations in the system should be unattended and remotely controlled.

Construction of the link was entrusted to GEC Ltd, and it was to be ready in time for the opening of the BBC TV transmitter at Sutton Coldfield. Naturally all of the was achieved and the link first saw service on the 17th December, 1949, which is more than can be said for the BBC's 405-line Band I transmitter. This blew its output valve during the opening ceremony, causing a three-hour shutdown and acute embarrassment all round. In those days there was no standby!

The design of the link system relied on the availability of a series of disc-seal triodes which would work at frequencies up to 1000MHz. The frequency band of 610-950MHz had been suggested by the authorities as it was believed that fading effects would be less severe in this region than at higher frequencies. Originally 700MHz was proposed for the link, but this was later increased to 900MHz.

The link ran the 115 miles from Museum telephone exchange in London (where the Telecom Tower is now) to Telephone House in Birmingham: intermediate repeaters were at Harrow Weald, Dunstable, Charwelton and Turner's Hill. There was also a spur to Harrow from the GEC laboratories at Wembley to begin with: this was to allow testing without routing transmissions via the terminal station in London.

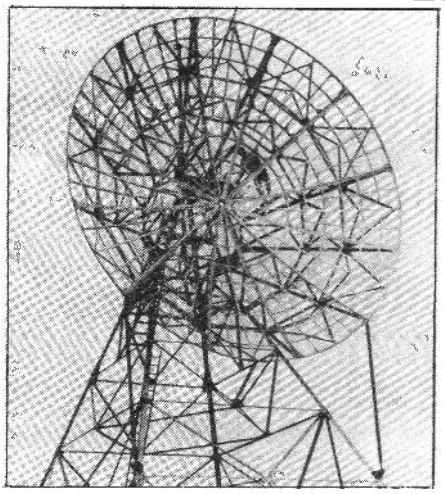
Aerials used 14ft paraboloid reflectors and were mounted with the radio equipment at the top of the towers. Frequencies used in the down (London-Birmingham) direction were 917 and 937MHz, while 870 and 890MHz were used in the up direction. The actual power output device was a CV436 valve, equivalent to an ACT25 (MO Valve Company) and was a modified version of an early military radar disc-seal triode. The output stage, which delivered between 6 and 7.5 watts to the antenna, used a forced air-cooled triode in a frequency changer circuit. Anode power was 250 watts, with 60 watts RF drive and a few watts of IF signal. Much of the RF circuitry used metal castings ('plumbing') and even the aerial changeover relays looked more like piston engines than switches. RF cables, incidentally, were of 62 ohm impedance.

To obtain adequate linearity the system was changed from AM to FM just eight months before the in-service date and the link remained in service for some ten more years until the 900MHz band was reallocated to other services. Later Post Office microwave links used first the 2GHz and then the 6GHz bands.

Our tale now moves ten years forward, still in a time when cycles were cycles, not Hertz. The Marconi company, among others, was investigating radio propagation beyond the horizon using forward scatter from the troposphere. There was no shortage of information but little had been done to harness the technique for commercial communications. Marconi therefore determined to set up an experimental link to demonstrate the practicability of carrying multi-channel telephony and telegraphy over such a link.

In the event the link was most successful, operating in just one direction with spaced diversity aerials at the receiving station. Several modes of modulation were investigated, and finally a television picture was transmitted over the link. To produce the high power levels necessary a klystron power amplifier was used, and as tubes capable of producing 10kW at around 1000MHz were available, a frequency in this region was sought. In the event the frequency 858MHz (and the callsign G9AHR) were allocated, and the link was in operation from March 1958 to May 1959.

The choice of route demanded some care since path attenuation increases rapidly as the angle of elevation of the aerial beam is increased. Equally, a reduction in path attenuation is achieved if the beam can be depressed below the horizontal, as is the case where the antenna is on high ground overlooking the sea. Finding a suitable route in England was not easy. Where troposcatter links are normally used, over sea paths and in sparsely populated areas, this is not always so difficult.



Construction work on the troposcatter dish at Mount Misery, Barbados. Similar aerials of 30ft diameter were used on the Start Point - Galleywood link. Photo: Marconi Communication Systems Ltd.

The eventual route selected ran 206 miles from the transmitter site at Start Point in Devon to the receive site at Galleywood, near Chelmsford. The first 55 miles were over sea, from a 400ft takeoff, which allowed the beam to be depressed 0.4 degrees below the horizontal. The aerials employed had 30ft diameter parabolic dish reflectors and a focal length of 10ft. Transmitter power from the four cavity power klystron was 10kW: this was the limit of linearity, which was required for the single sideband tests.

Transmissions made were:

(a) 24 channel telephony/telegraphy/music (FM).

(b) Wideband (4mc/s) FM TV.

(c) Pulse amplitude modulation.

(d) Crystal controlled carrier for high stability.

(e) 24 channel telephony (SSB).

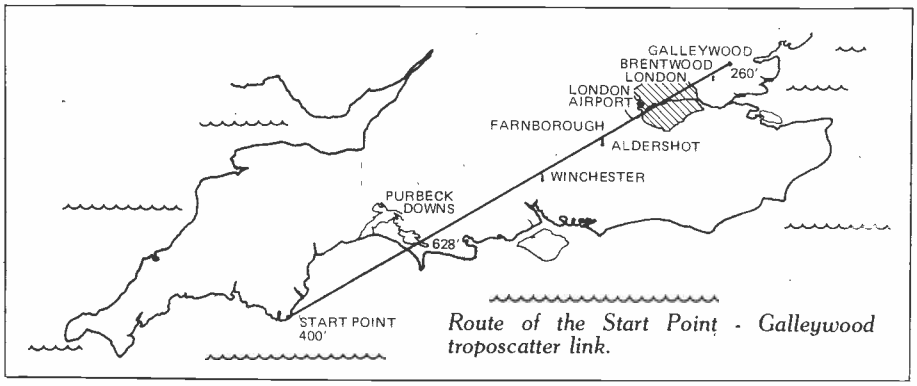
The wideband FM used a TV signal generated from a monoscope camera. TV DXers will be interested to learn that the pattern was Test Card C with Aarhus identification - obviously a maintenance spare!

Propagation was carefully monitored and revealed considerable disturbance due to aircraft flutter, which was not surprising considering that the route passed through London Airport. Diversity reception ensured that performance on telephony was not unduly affected. In fact propagation was such that speech quality was consistently good. Even on a TV picture quality was better than expected, with occasional momentary fade-outs.

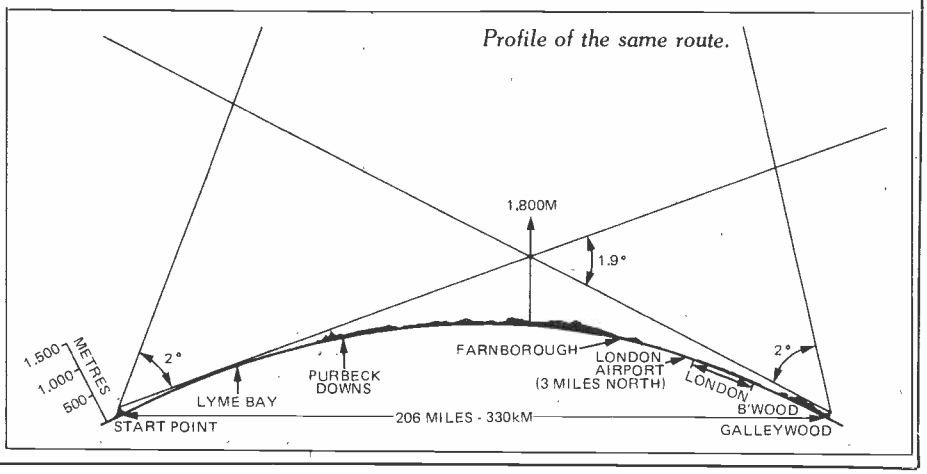
The experience gained from the experimental link was of considerable value and enabled Marconi to construct a large number of troposcatter links overseas. Subsequent use of the 900MHz band is mainly recent history, and perhaps in twenty years time someone will take up the story of the pioneers of CB (whatever happened to 928MHz?).

Acknowledgements are due to GEC Ltd., Marconi Communication Systems Ltd. and British Telecom for assistance with the compilation of this article.

1. "Microwave Technique" by J.H. Shankland G8FM and E.D. Hart.



Route of the Start Point - Galleywood troposcatter link.



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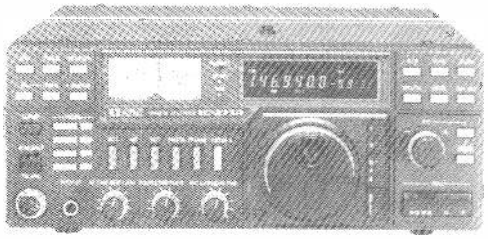

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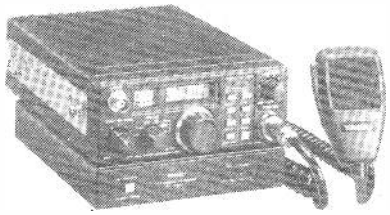

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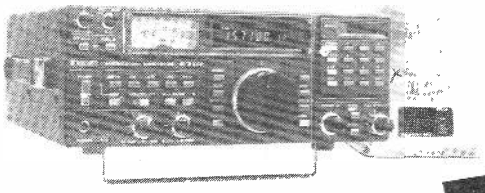

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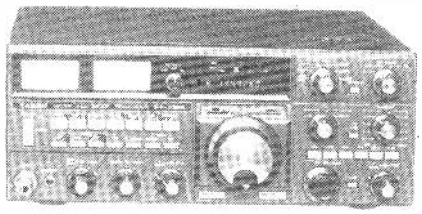

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IF Width	yes	no
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X-band Full Duplex	option	no
Squelch	all modes	FM only
Memory Channels	11	10

FEATURES	FT 726R	TS780
Limited Band Scan	yes	yes
Mode Memory	yes	no
Memory Backup	lithium	AA cell
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Speech Processor	AF	none
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STAND B35/36

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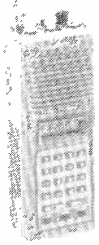

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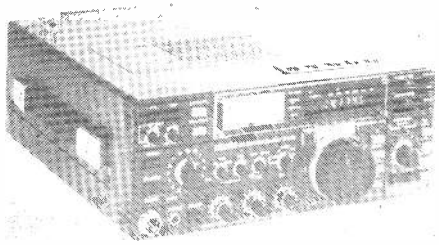

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STAND B35/36

S·W·L

By Trevor Morgan GW4OXB

Well, another column. Thanks to all who wrote either direct to me or via the Editor. It's nice to hear from listeners and I will certainly help with readers' problems if my experience allows. If there are any problems that I have had no experience to fall back on I will find out the solutions from others. Either way, we'll help if we can.

To quote from a couple of our listeners we turn first to Jack Shail who asks for the address of the **International Short Wave League.** Those interested can write to: c/o H. Drinkwater, 88 The Barley Lea, Coventry, CV3 1DY, who will be pleased to pass on the necessary information, but please enclose a stamped addressed envelope (foolscap size).

Back to Jack Shail who hails from Bristol and uses a Sony ICF 7600D receiver, Jack says he finds this particular model very stable and, using an end fed random wire at about 30 feet, he listens worldwide. His earth system, consisting of copper plates buried five feet under the ground, must certainly help!

Considerable time to get cards from some stations

Next we hear from Paignton in beautiful Devon where Eric Franks puts pen to paper to respond to my comments on unverified reports. Eric is a keen award worker and finds it a bit upsetting when, after struggling to hear a distant station under adverse conditions, his report meets a blank. I entirely agree, but must add in all fairness that it can take a considerable time to get cards from some stations and it's not all their fault, just an intrinsic part of bureau operation. I recently had a batch of cards from the bureau that included some cards from contacts made 18 months and two years ago. I have heard of cards being received *four years* after the contact. Not much help to the poor chap who started listening and gave up after not having had a card during his first year!

However, to nicer things, with a letter asking about the use of computers for the reception of Morse and RTTY. As you remember, I went into Morse last month and suggested that listeners learn the code. A great help are the various stations transmitting slow Morse practice transmissions on various wavebands. Some of the British stations are listed on this page.

SUNDAYS	1200	G3GNS	LOCKING, AVON	A1A	1.910, 3.550, 144.250
	2030	G3ORP G4UAQ	MAIDSTONE	A1A/ J3E	144.250
MONDAYS to FRIDAYS	1830	G3GNS	LOCKING, AVON	A1A	1.910, 3.550, 144.250
	2030	G4BFJ	BANSTEAD, SURREY	A1A/ J3E	1.950, 144.625

Many two metre stations are operative with Morse practice transmissions but some of these are unknowingly operating outside the terms of their licences. The permission for the transmission of Morse practice is *only* obtained via G3KGU (QTHR) as the licence for these transmissions is granted by the authorities to the RSGB as a concession. The authorities lay down regulations regarding the way these transmissions are made which is why prior permission must be obtained.

There are also transmissions from other stations abroad and the most well known is the Dutch Radio Club 'VERON', using their club callsign PAøAA. They transmit in English and Dutch and at the speeds from 8wpm up to 24wpm. A letter to the club with a couple of IRCs will bring full details of the transmissions and a handbook. The difference between them and British stations is that we cannot send random letter groups (summat to do with codes and things???) The address is PO Box 1166, Arnhem 6001, Nederland.

Regarding the reception of Morse by computer (sorry! got carried away there!), there are many programmes available for Morse and RTTY for a variety of computers ranging from the ZX81 up to the BBC computers. However, don't think that you just need the programme as there are other components necessary and these are available from many software specialists in ready assembled or kit form. There are also units available purely for the reception of code. These tend to be a bit pricey but are an excellent way of copying RTTY and other codes using either a normal television set or having a built in screen. You can reckon on spending about £160 on one of these but a computer and the necessary extras could cost that much especially if you don't use the computer for anything else. It makes a change from space monsters anyway!

Talking about gadgets, I must have one of the cheapest six zone timepieces possible at a cost of £7.50! If you would like one, don't write to me! Keep a look out in the local market. I was fortunate to spot some Hong Kongese gents' digital watches for sale locally for the princely sum of 99p each. Quickly snapping these up, I installed six of 'em in a nice plastic project box (cost £1.50), painted a world map on the front and neatly labelled the areas required. Result is a shack clock giving me the times in S. Africa, Delhi, Sydney, Los Angeles, New York and Swansea. All instantly visible without pressing buttons. It pays to keep your eyes open. Psssst! Anyone wanna buy six watch cases with straps... only 99p each!

Right, then, now to this month's scan round the bands. Last month we covered the 160 and 80 metre bands without going too technical so this time we'll cover the 40 and 20 metre bands in similar vein.

Forty metres has a number of features it could well do without! For starters it is a very narrow band only covering 7.0-7.1 MHz and as a result has little enough space for amateurs especially as it's slap up against the 41 metre broadcast band carrying some of the big boys on this mode. Tirana, Moscow, Prague, Sofia etc.

Part of the problem lies in the fact that these high power broadcast stations, although outside the IF passband of your receiver, are almost certainly within the RF passband of the same receiver so causing cross modulation due to overloading of the RF stage. You can improve matters here by using an external bandpass filter between the aerial and the receiver. This will increase the selectivity of the system and make the amateur signals stronger in comparison to the stray broadcast signals.

...using the RF control to bring in the signal

When receiving on busy bands like this it is good procedure to back off the RF gain control and peak the AF gain, using the RF control to bring in the signal. This will help reduce any cross modulation effects. Forty is capable of producing some really choice DX when it's on form as it can reveal better propagation than eighty during the day and night. It's certainly worth a scan despite the noise present.

Now to twenty. This is not only the most used band but also the most abused! This band is probably the one where the average new licencee cuts his teeth as there is more 'action' here for more hours than on any other band.

But it's not the beginners who cause the problems. The newcomer is usually eager to make his first calls as clean and correct as possible. After all, he worked hard for the privilege of using the airwaves.

The abuse is a result of poor operating procedure for which there is no excuse especially when the operators concerned are 'old hands'.

You'll hear the sort of thing when there's a DX station on with a bit of a pile up. He may ask for calls from, say, North America only. He's obviously trimmed his beam for that direction. The poor bloke's ears are immediately bombarded by a bunch of idiots (here come the letters!!) screaming callsigns at the tops of their voices, completely oblivious of the fact that they are not in North America. Lord only knows what powers these people use but they are invariably end stopping! Then a funny thing happens. A quiet, restrained voice will come up immediately the loonies have had a go, give his callsign clearly in phonetics once and wait. He'll get an immediate response and he'll pop off to get another one. Just listen for a QRPer sneaking in behind a pile up and you'll see how it's done!

Anyway; to listening. Top band, eighty and forty are similar as far as propagation goes and ground wave propagation provides fairly short distance communication any time of day and night skywave propagation over greater distances. However, on twenty, ground waves tend to be absorbed by the earth so the range is short. Also, during the dark hours, the sky waves are almost non-existent and the band can go dead during these hours.

Signals at these frequencies are reflected by the F2 layer of the ionosphere and, as one would expect, as this zone is higher than the E layer the angle of reflection is greater so the distances covered by the reflected signals are much greater. As a result these signals cannot be received by the nearer stations.

Long distance reception on the frequencies in the twenty metre band needs a path of daylight whereas the lower bands require a path of darkness. So, on the low bands the best distances are usually worked to the east at dusk and to the west at dawn. With the higher bands we have virtually the opposite, with the best distances worked to the east from dawn and to the west just before dusk.

Early risers can be pretty certain to get excellent reception from Australasia and as the day goes by the Japanese, Indian and Asiatic stations come to life. In the summer months, twenty metres is often active for twenty fours hours a day but some areas, obviously, lose a bit of strength. Nevertheless, twenty is rarely lacking in something worth a few hours listening, although during the winter months there's not much doing after dark, if the sunspot activity is high there can be workable stations around for quite a while after dusk.

The technique of backing off the RF gain

Twenty is the most popular band for long distance working and as a result there is often a lot of noise to listen through. This is where the technique of backing off the RF gain pays dividends. Good listening also needs headphones. However, the high quality headphones used for hi-fi or stereo systems are not really suitable for radio listening. The reason is that high quality stereo headphones are designed to reproduce as high and as low frequencies as possible. Typically 15Hz to 25kHz in a good pair.

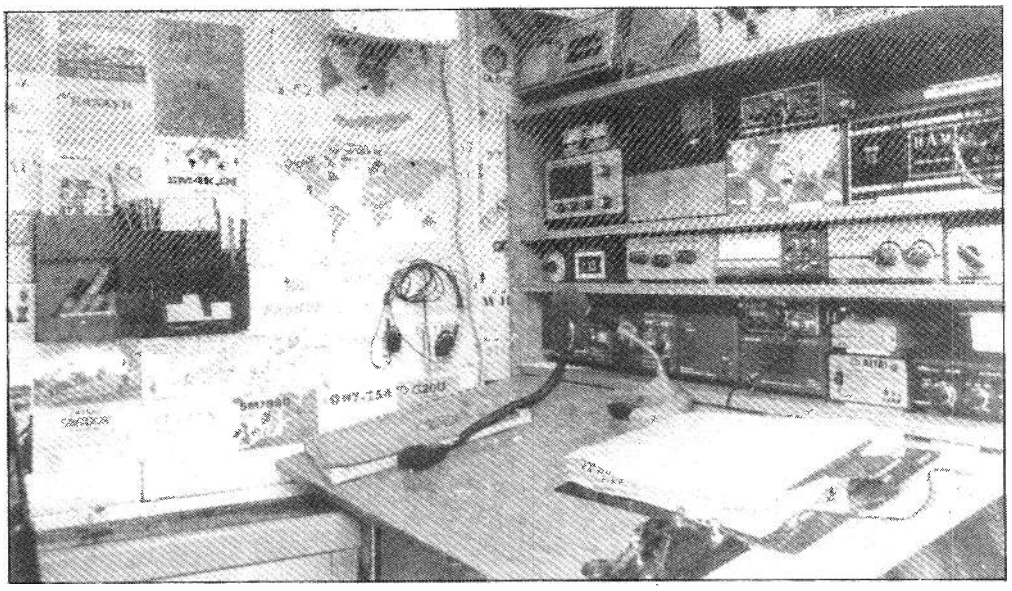
With short wave listening we are not interested in excellent bass response or high frequency reproduction. Our interests lie in the human voice which has a much smaller range so the frequency coverage is not so great. I have found that some of the cheaper headphones fill the bill admirably but don't get a pair with totally enclosed earpieces unless you want roasted ears. Listening for any extended period of time is fatiguing and I find that a lightweight headset with small enough earpieces that can be slid forward of the ears are a boon. You can also hear the missus if she calls to tell you that the junior op has set fire to the cat.

Now to fifteen. This band is not as popular as twenty and certainly not used to anything like the amount. However, this band is capable of outrunning twenty on the DX potential when the sunspot activity is high. Even with this activity in the lows fifteen is good for some choice distance working and as the band is relatively quiet the stations that do come up are copied much more easily. As we are getting high on the frequency scale, fifteen relies much more on daylight conditions and tends to fade quite quickly after dusk and doesn't really liven up until well after dawn under average conditions.

Normal distances that can be worked on this band can be from 800 to 4000 miles with openings to 8000 miles or more especially during peak summer months. That brings us to the end of another tour of the bands. Next month we'll take a look at the ten metre band and the 'new' bands which are not fully in use yet but worth a gander. If there is any particular aspect of listening you would like covered in more detail please let me know.

I hope to cover construction of some useful station accessories shortly so any of you with soldering irons, get the bits sharpened and stock up with solder. The projects will be quite simple and easily constructed by the newcomer to home construction. Keep the letters coming. Have a good month's listening!

73 Trevor



A view of the shack of GW40XB, showing, among other things, a 5" TV & cassette recorder; Trio world clock, Speech processor, AT5 transmitter (top band and 80m), Sony ICF7600A broadcast Rx, HF antenna tuner, Trio SWR/PWR meter, 2m antenna tuner, Crystal calibrator, TS130V HF transceiver (80-10m), PS120 power supply, TR2300 2m transceiver PS10 psu, Alinco 2m linear amplifier (10w output), and HF linear amplifier 200w pep.

The GO-BETWEEN

The ATU (Antenna Tuning Unit), is a device commonly used by radio amateurs as an interface between their antenna system, and the transmitter output of the rig. This article describes why such a unit is sometimes needed, and discusses the various types. Readers contemplating such a purchase (?), or construction of such a device will find the article of use in assessing both the need, and design suitable for their station's requirement. G. W. Goodrich G4NLA refers to these devices as AMUs (Antenna Matching Units), as this describes their function more accurately, he maintains.

First of all, let's discuss the need to match the antenna to the transmitter. A power amplifier is designed to deliver power at a designed rating, into a range of specified impedance. (called the load impedance Zl. A deviation from this range may cause the amplifier to depart from its desired characteristics. One effect of this is that the power amplifier would be unable to develop its full rated power into the load.

The output stage of an amateur transmitter is a power amplifier. Just like any other power amplifier, it has a specific, and often narrow, range of impedances into which it can work properly. In this respect, valve power amplifiers have a distinct advantage over the more modern semiconductor broadband PA. This is because (a) valves are rather more robust (electrically) than semiconductors, and (b) the design of the majority of valve PA have adjustable coupling networks in the anode circuit, (Fig. 1).

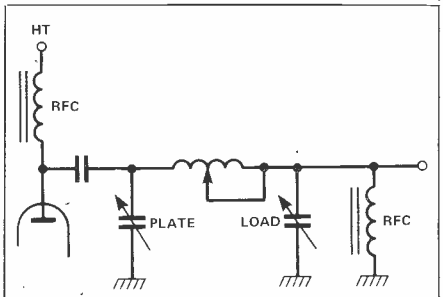


Fig. 1.

The problem with solid state PAs lies in the current driven nature of the transistor. The implication is that they can only deliver maximum power to the load circuit, if ZL is very close to the designed load impedance. A departure from this design impedance may cause the transistor to draw excessive current, get hot and fail. To get over this problem, designers of transmitter PAs protect the PA devices by reducing the drive to the device if a mismatch is seen at the transmitter output. This is where the aerial matching unit comes in. The AMU can be used to "match" the output impedance of the power amplifier, to the input impedance of the antenna system.

I am not going to explain the principle of standing waves on transmission lines. For those unfamiliar with the phenomena I suggest reading one of the standard texts available to radio amateurs.

The only VSWR that the average radio amateur needs worry about is the one present on the transmission line leaving the transmitter output. This is not so we can assess losses due to the VSWR in the line (which will be negligible even at high values of VSWR), but in order to assess the load seen by the transmitter.

Knowing the VSWR on this transmission line means that we can assess the load the transmitter is seing, and thus ascertain likely loss of transmitter power due to an excessive mismatch.

Most amateur transmitters have an output impedance of 50R. The manual supplied with the rig will specify either the range of impedance, or VSWR that the transmitter can develop full power into without damage to the PA devices. If the range of VSWR is know, then the range of acceptable impedances can be found.

$$\text{Since VSWR} = \frac{Zo}{Zl} \text{ or } \frac{Zl}{Zo} \begin{matrix}\text{(which ever}\\\text{(is the}\\\text{(greater}\end{matrix}$$

where Zo = output impedance of transmitter
Zl = load impedance.

$$\text{Then } Zl\ (max) = VSWR \times Zo$$
$$= 3 \times 50$$
$$= 150R$$

$$\text{and } Zl\ (min) = \frac{Zo}{VSWR} = \frac{50}{3} = 16R$$

(Assuming that the maximum VSWR is 3:1)

So the expected range of impedance that this power amplifier can handle is:

$$16 - 150R$$

Check the maximum VSWR allowable for your rig before using these figures.

Another point to note (before moving on) is that although the PA is maybe capable of driving an impedance of this range without damage, maximum power output will only be realised over a much smaller range. In my experience most HF rigs are still delivering 80% of their maximum rated power at a VSWR of 2:1, and this figure is somewhat pessimistic.

So far so good. We have established that the transmitter power amplifier needs to see a "reasonable" load. The implication of this is that some antennas can be plugged straight into the transmitter with no AMV at all. For example, you could expect a $^1/_2$ X dipole, fed with a 50 tansmission line to exhibit a VSWR of <2:1. In the majority of cases it would be a complete waste of time and effort to connect an AMU in line with the transmitter to get the VSWR down to 1.5:1.

However, not all antennas exhibit characteristic impedances within the acceptable range of the transmitter PA and under these circumstances some form of matching does become necessary. If we are going to match the output impedance of the antenna system, it is important that we understand the nature of the impedance presented by the antenna.

Impedance cannot be regarded as a pure resistance. In fact an impedance is made up of two components - that is a resistive component, and a reactive component. The reactive component is the part played by capacitance and inductance in any circuit. So there are two types of reactance, capacitive reactance (Xc), and inductive reactance (XL). We can calculate the value of either using the following equations.

For inductive reactance:

$$Xl = 2piFL$$

where Xl is in Ohms
F is in Hertz
L is in Henries.

and capacitive reactance

$$Xc = \frac{1}{2piFC}$$

where Xc is in Ohms
F is in Hertz
C is in Farads

As you can see, both types of reactance are dependent on frequency.

Now, if a circuit contains both a resistive component and a reactive component, (of either type or both), we can say that the circuit has an impedance of Z (the symbol for impedance) ohms.

So what has all this got to do with antennas? A great deal in fact! Most antennas have some form of reactive component present in the antennas impedance. The way that we match the antenna to the transmitter is very dependent on the magnitude of the resistive and reactive components present at the antennas input.

In theory, a resonant antenna has a purely resistive input impedance. A ½ wave dipole has 72 ohms impedance. Other types of resonant antenna have impedances which are higher or lower than this.
Before looking into this, let's consider the resonant "folded dipole", and see how this can be matched to 50ohms.

The "folded dipole" (Fig. 2), has a radiation resistance (Rr) of about 300 ohms and does not look like a "reasonable match" to the transmitter. In fact, provided that the transmitter could be persuaded to drive this load we would see a VSWR of about 6:1.

$$EG\ VSWR = \frac{Zl}{Zo} = \frac{300}{50} = 6$$

So how do we improve the situation? The easiest method is to use a transformer to match the impedances. With a little transformer theory we can derive a turns ratio:

$$\frac{NS}{Np} = \sqrt{\frac{Zs}{Zp}}$$

where $\frac{Ns}{Np}$ *is the turns ratio*

Zs is the secondary impedance
Zp is the primary impedance

$Zp = 50R$, $Zs = 300R$

$$\frac{Ns}{Np} = \sqrt{\frac{300}{50}}$$

$= 2.44$

It's not easy to wind a transformer with a turns ratio of 1:2.44, but by making the turns ratio 2:5 we find

$Zp = Zs/(Ns/Np)^2$

since $Zs = 300R$, *and* $Ns/Np = 2.5$ *then* $Zp = 48R$

- which is a much more "reasonable match". In fact an AMU for this antenna at its resonant frequency could consist of a simple transformer (Fig. 3).

Constructing: The joy of constructing an AMU is the considerable ingenuity employed to build the thing, particularly if there are mechanical, as well as electrical, requirements. Until recently all my AMUs, putting it politely, have been "open plan", and though far from ideal have always seemed to work. Another bonus is that they are passive devices, so there is no PSU to build. In fact the construction of an AMU is a good place for the first time homebrewer to begin. Plenty of chassis bashing, and lots of lovely big soldering jobs!

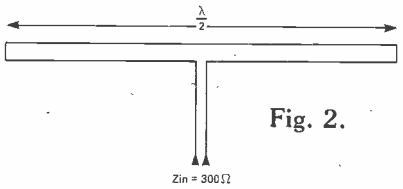


Fig. 2.

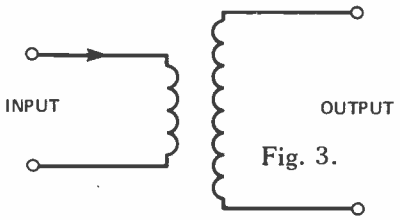


Fig. 3.

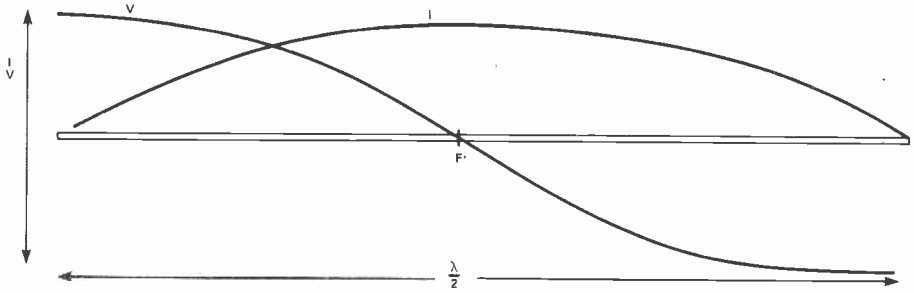


Fig. 4

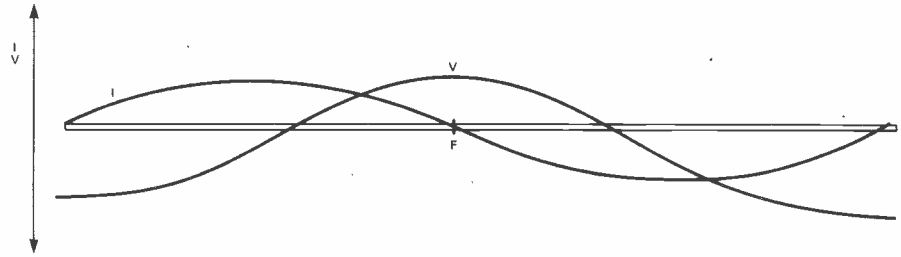


Fig. 5

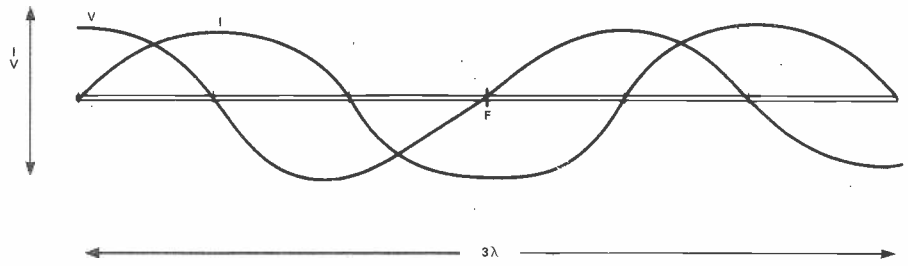


Fig. 6

The main problem, of course, is getting hold of the bits; however the following points may prove useful.

Capacitors: Provided that the maximum power you intend to use is not more than 100 watts pep, the air spaced capacitors in old radios are ideal. However, prior to breaking up Great Aunt's steam radio, do check that it's not a collectors item - you could break a collector's heart apart from just a tatty old radio! For higher powers it becomes necessary to use wide spaced air capacitors, of suitable value. Finding such capacitors is by no means easy as everyone else is looking fo them as well. In general, it takes longer to locate these components than it does to build the AMU. I really don't know where you would buy such devices new, but I am determined to buy a complete set one of these days!

Tapped inductors: It's convenient to be able to use a "roller coaster" when the circuit is of the pi-network or T match variety, as you can get to just the right tap on the inductor. Unfortunately, air-spaced capacitors and roller coasters are becoming increasingly difficult to get hold of. If you do manage to lay your hands on one check the component carefully for worn contacts etc. A roller coaster in poor condition should not be used until fully overhauled because the contacts maybe somewhat "intermittent".

If you do not possess a roller coaster, dont despair! Necessity is the mother of invention and tapped inductors can be made in a variety of ways.

My favourite method is shown in Fig. 20. The coil former is a length of $1\frac{1}{4}$ in grey plastic drainpipe (wonderful stuff). The coil is wound around the pipe using 16swg tinned copper wire. A multitude of tapping points can now be accessed with either a crocodile clip, which will fall off at a crucial moment or the G4NLA "wonder slider". This consists of a short length of $1\frac{1}{4}$ plastic drainpipe, split on one side.

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The tapping point is made out of a nut and bolt through the slider. The whole unit is then clipped over the coil, and can be slid around until the correct tapping point is found. NB: Only slide it around on receive! This unit is a prime candidate for the CUE award (Crude But Effective), even if it does force the user to adopt an "open plan" AMU.

To those poor individuals who are required to have a "presentable shack", the open plan scheme may not be acceptable. In this case the inductor can be made in the same way, but taps will have to be soldered into place. There are some important points to note here; do not try and tap every turn. Rather select the taps that work best for each band. The taps can either be selected by a good quality ceramic rotary switch (if you can get one), or a patch panel on the front of the AMU. The leads used as tapping points must be as short as possible in order to avoid RF being radiated around the shack.

Antenna matching hints and tips

Hopefully, this article will have given you a few useful pointers as far as antenna matching is considered. The principle "Kiss, (Keep It Simple Stupid) applies to AMU as much as it does anywhere else.

In general, it is a lot easier to select and design a matching unit for a monoband antenna where the parameters involved are easily assessed; in fact, don't use one at all unless necessary. And always choose the simplest one capable of meeting your matching requirement.

Most radio amateurs use one of two types of transmission line or feeder.

1. Coaxial feeders (unbalanced).
2. Open wire feeders (balanced).

Some antennas are inherently balanced, ie, yagis, quads, dipoles etc, so should be fed with a balanced feeder (oh gawd I've done it now!) To convert the unbalanced output of the rig to the balanced input of these antennas, we use a balun. You can position this in one of two places.

1. A loft with the antenna (Fig. 17).

In this case the balun is mounted at the feedpoint of the antenna elements, so the balun must be made weather proof. The antenna can now be fed with metres of coaxial cable (very expensive).

2. After the AMU, or even in the AMU (Fig. 18). Here the unbalanced output of the transmitter is converted to a balanced line, via a balun. In this case the balun is generally indoors so doesn't need water proofing. You can use metres upon metres of homebrew balanced feeder. Dirt cheap.

Of the two, guess which I prefer...

The problem with balun transformers is their inability to function in the presence of highly reactive loads. This implies that while it is perfectly feasible to use a balun between the antenna and AMU if the antenna is resonant, it is not possible to use one on most multiband single element antenna due to the reactive impedance on some bands. In this case a rather more sophisticated AMU is required. Such a unit must be capable of:

1. Compensating for any reactive component present in the antenna;
2. Perform an impedance transformation of high values of radiation resistance;
3. Convert the unbalanced output of the transmitter to the balanced feeder used to feed the antenna.

This little brute uses the "swinging link"

In order to achieve these requirements the circuit in Fig. 19 is used. This little brute uses a "swinging link" to perform the matching requirement. The circuit has been described by Louis Varney (G5RV) in ref. 3.

1. SWR FACTS AND FALLACIES. A GUIDE TO AMATEUR RADIO. 18th EDITION. RSGB: PAT HAWKER G3VA pp 76-78

3. ATU OR ASTU? LOUIS VARNEY GSRV *RADIO COMMUNICATION* AUGUST 1983, RSGB.

Radio amateurs have a definite problem, apart from the usual ones. This problem manifests itself in our antennas by making the input impedance to the antenna "complex", ie, it has some antenna is too long (not a multiple of the basic $\frac{1}{4}$ wave then it will appear inductive at its input. While if an antenna is too short then it tends to appear capacitive. This means that a complex impedance is present at the antenna terminals the magnitude being given by

$$Za = Rr^2 + Xc^2$$

where Za is the impedance of the antenna
Rr is the radiation resistance
and X is the reactive component.

Unfortunately a reactive component cannot absorb all the power from a circuit, so any such component represents a power loss. We cannot employ an antenna with a reactive impedance with a simple transformer and expect to gain maximum efficiency from it. Instead we have to find a way of reducing the reactive component.

Fortunately, inductive reactance and capacitive reactance are electrical opposites, and can be used to compensate for one another, thereby reducing a reactive component to zero. If we succeed in doing this, we need only worry about the resistive component.

Since $Z = Rr^2 + X^2$

also $Z = Rr^2 + (Xc \quad Xl)^2$

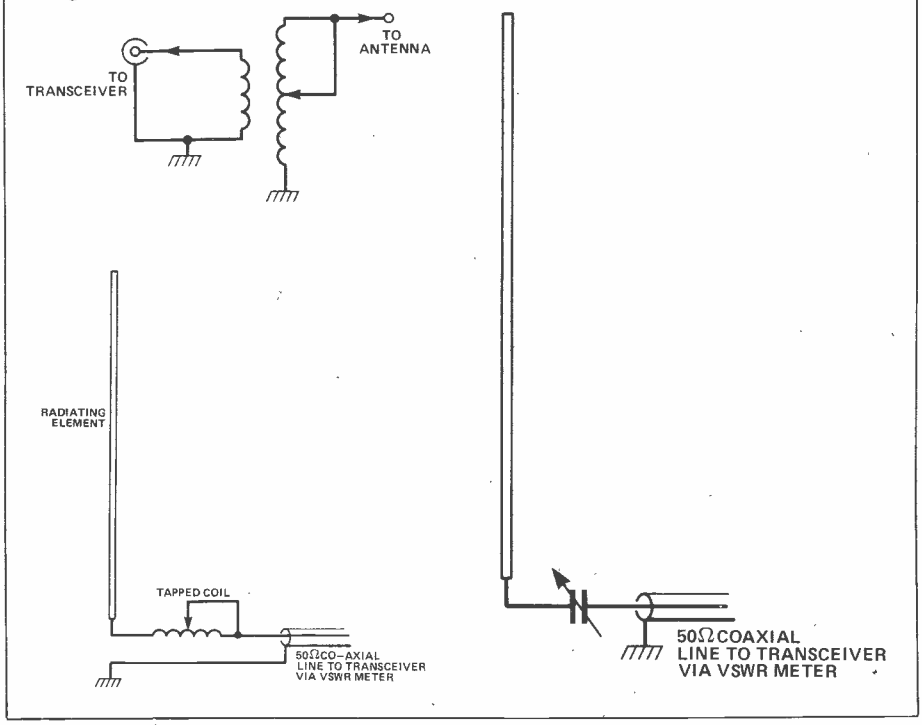
Where is taken to mean the +ve difference the two co-efficients Xc and Xl

So, if $Xc = Xc$, *then*

$Z = Rr^2$

$Z = Rr$

Fig. 8



Probably the best way of examining this principle, is by a simple example. Imaging that you have been offered a rather nice metal rod, which is about 15 feet long. If you are anything like me you accept it without further thought, believing that anything and everything is likely to come in useful someday. Pondering upon your latest acquisition you realise that it might be useful as a 20 metre vertical, except that it is about a foot too short for a conventional $^1/_4$ wave. After a few seconds deliberation, and to your friend's absolute amazement you announce: "This will have an approximate impedance of 50 ohms, and will have a capacitive reactance. I shall try a loading coil!"

Proceed to select a tap for minimum VSWR

You wind a tapped loading coil, and connect this in series with the new element (Fig. 8). Having mounted the antenna in its chosen site you proceed to select a tap that gives the minimum VSWR on the frequency on which you wish to work. Having done this, the whole lot comes back indoors; the tap is soldered into place - the lot weatherproofed - and put back on its outdoor site. You now have a loaded vertical for 20 metres.

As I pointed out earlier, a radiating element that is too short will be capacitive in terms of the reactive component present at the antenna terminals. The loading coil in this example compensates for the capacitive reactance, and leaves us with the radiation resistance of the antenna.

Principles for antennas that are too long

The same principle can be applied for antennas that are too long. In this case the antenna has an inductive reactance at its terminals, which must be compensated for with a variable capacitor. (Fig. 9).

We have come to a point where we can guestimate both:

1. The likely magnitude of the impedance of the antenna system.

2. The presence and likely nature of a reactive component at the input to the antenna system.

So we can now assess whether any matching is necessary and what type to use. This is FB OM if the antenna is to be used on a single band, but is not terribly helpful if you use a multiband antenna where the impedance varies over a wide range, and the reactive component is a lot less predictable in terms of magnitude and type.

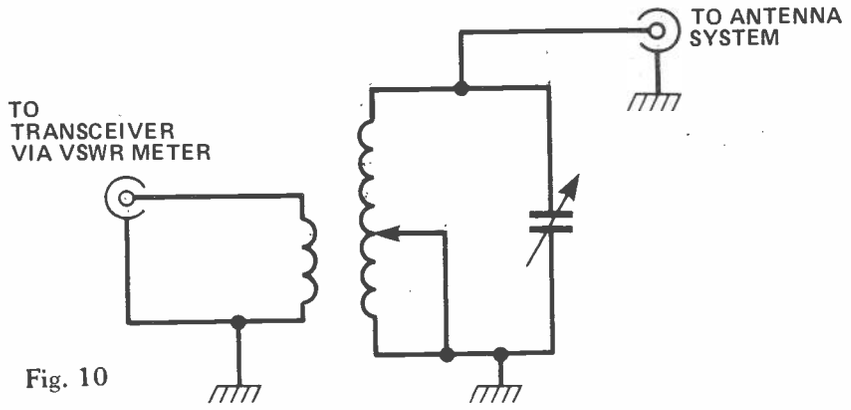


Fig. 10

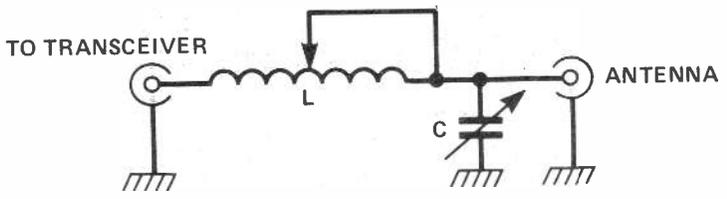


Fig. 11

Many radio amateurs rely on multiband antenna systems due to lack of space or other restrictions and require much more versatile AMUs to obtain a reasonable match on all bands of interest.

Such a unit must posses the following characteristics:

1. The ability to match a wide range of impedances.

2. Adequate provision for varying magnitudes of both capacitive and inductive reactances.

We can develop such a unit from the circuits investigated earlier. The one illustrated (Fig. 10) has both a variable capacitor, and a tapped inductor. Each of these can be used to compensate for reactive components in the antenna's input impedance. The transmitter is connected to the system via a primary winding to match the radiation resistance of the antenna.

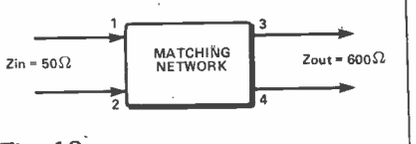


Fig. 12

In practice, I found that this unit is more suitable for use on the LF bands. (eg. 80 and 40 metres) where the antenna has a high radiation resistance. On the HF bands (15 and 10 metres) the number of turns on the secondary coil may make it difficult to perform an adequate impedance transfer to the primary windings. In the case of a high impedance antenna the unit also functions as a high Q tuned circuit, and can thus aid the selectivity of the receiver.

There are two main circuits used to meet the requirements of most multiband antenna systems. These are the "PI" and "T" newworks. I am not going to delve into the mathematics of circuits.

Consider the diagram in Fig. 12. The "box" shown can either be a PI or T network. (Figs. 13 and 14 respectively). Both of these circuits can be designed to fulfil the matching requirement shown in Fig. 12.

Values are a "whole lot" bigger

If you were to actually design these circuits you would find that the values of VC1, VC2 and L in the pi-network are a whole lot bigger than those for the equivalent T network. The implication of this is that the T network can match a much larger range of impedances than a pi-network using the same components. So do we use a T network, you may ask? The answer is yes, but with two important riders.

1. From a constructional point of view the pi-network is generally simpler to build, since the capacitors do not need to be insulated. If you look at the T network carefully you can appreciate that both sets of capacitor plates are hot.

2. The pi-network can also function as a low pass filter, this is useful since it will attenuate harmonics generated by the transmitter. The T network is a high pass filter, and offers negligible attenuation of harmonics, apart from its insertion loss.

Fig. 16 shows an extension of the basic T match circuit, which offers an improved low pass response, yet retaining the flexibility of the T network. Of all the

The GO-BETWEEN

circuits I have tried this one has been the most easily constructed. I have loaded all sorts of things up with this brute; my filing cabinet, curtain rail, a sheet of aluminium. It also effects amazing impedance transfers with the ½ size G5RV and the 70ft long wire in the garden.

It is well known that a dipole resonant on 40 metres is also resonant, and can be used with a reasonable match on 15 metres. But is this the only other frequency that the antenna can be said to be resonant on? No, this is certainly not the case; the 40m dipole will also be resonant in the 20 and 10 metre bands. However it is the value of the impedance on 20 and 10 metres that prevents the antenna being loaded up. In fact we could load the antenna up if a match to 50 ohms can be found in some way.

We must be able to assess the impedance of an antenna in order that we can determine an AMU design. To be able to predict Rr in an antenna we need to know how voltage and current are distributed in the antenna.

Looking at these distributions in a ½ wave dipole (Fig.4) can give us a starting point. The dipole is fed in the middle at point F. At this point the current is high, and the voltage low, indicating that the impedance of the antenna at this point will be low. Now look at Fig. 5. This shows the voltage and current distribution in a full wave dipole. In this case the voltage and current distributions indicate that the impedance will be high.

So why does a 40 metre dipole work on 21MHz? In this case Fig. 6 shows the current and voltage distributions indicating a low impedance. You can repeat the exercise yourself by drawing the current and voltage distributions for 10 metres on a 40 metre dipole, asking whether this will present a "reasonable match" to the transmitter.

So far, we have only investigated the impedance of dipole antennas. A lot of radio amateurs use vertical antennas and the impedance of these antennas can be estimated in the same way if you consider the feedpoint as the centre of an equivalent dipole. The same basic principles also apply to random and long wires.

Having reviewed the likely impedance of these antennas, we can now begin to think of ways of matching them to the rig. A method that springs to mind is the "variable transformer", illustrated in Fig. 7. The position of the tap in the secondary winding changes the

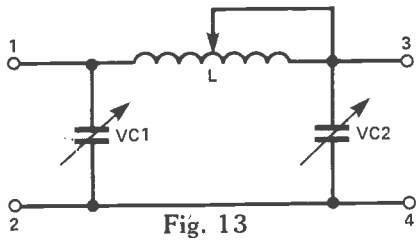


Fig. 13

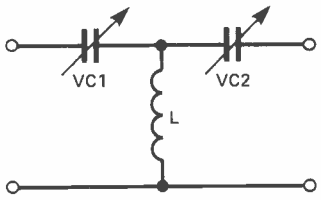


Fig. 14

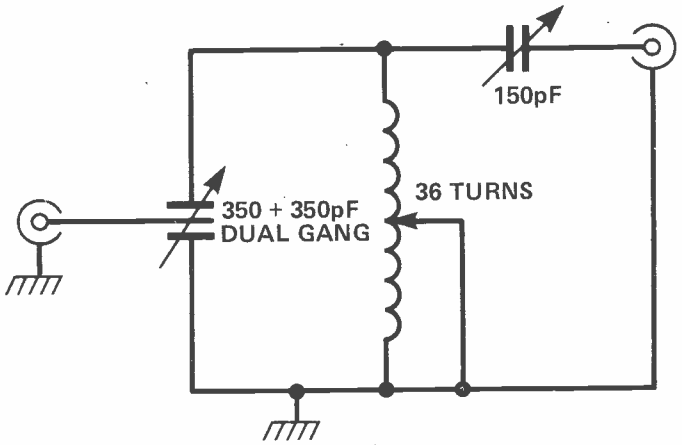


Fig. 7

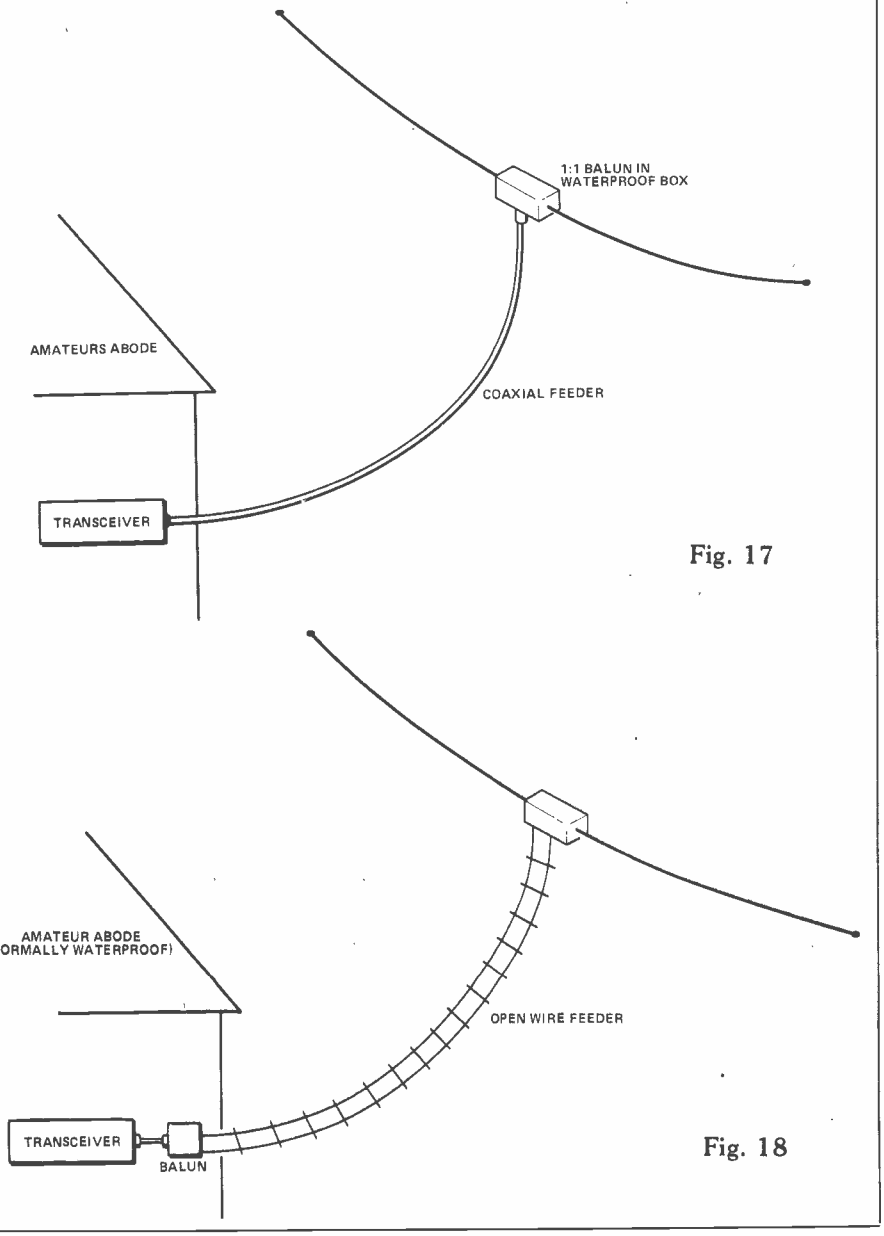
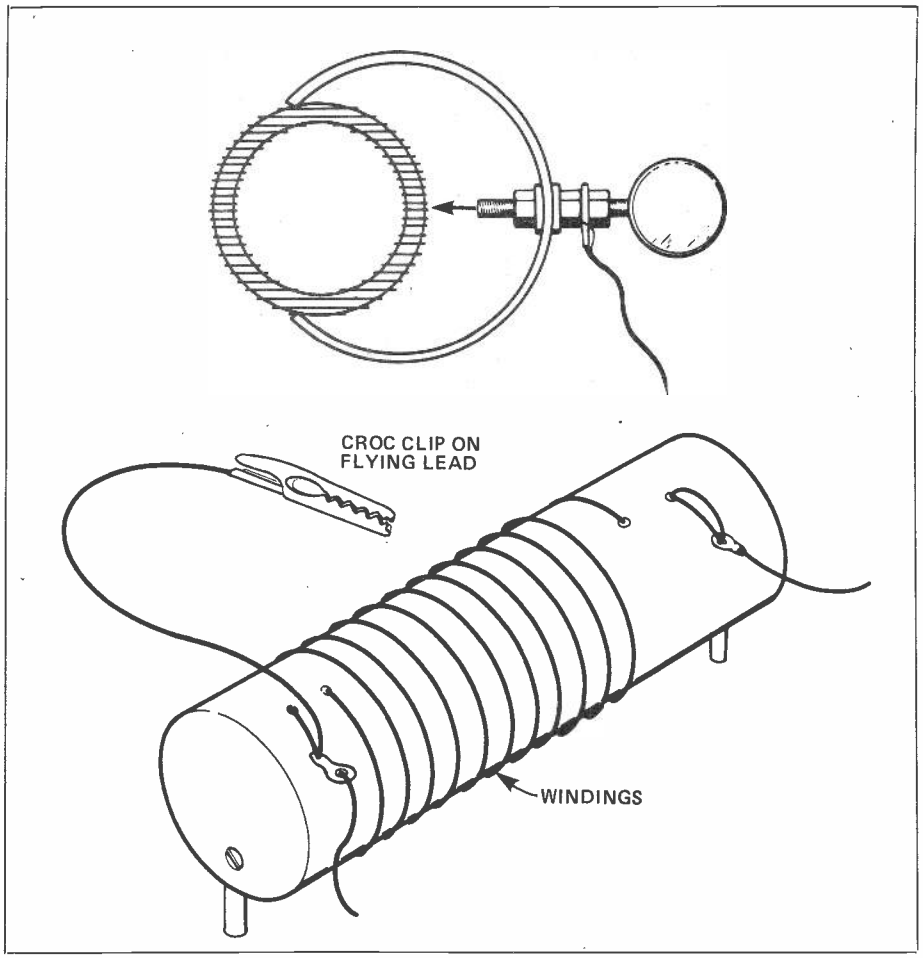


Fig. 17

Fig. 18



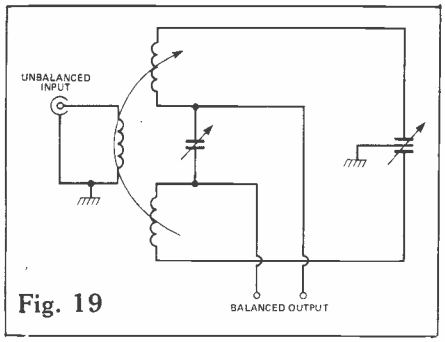


Fig. 19

effective turns ratio, and hence the impedance transformation.

A word of warning! While this simple system can be used to match the impedance of the antenna to the transmitter source impedance, it cannot cope with any reactive components in the antenna's impedance.

Prior to building a "transmitting AMU", I used such a transformer as a "desparate-to-get-on-the-air new G4", to obtain some kind of match to a 80ft random wire on 80 and 40 metres. On the 80 metre band the minimum VSWR obtained was 1.5:1 and the maximum 4:1. On 40 metres the minimum was 2:1 and the maximum 3:1.

Without the transformer in circuit, the VSWR on both bands exceeded 10:1. Not too good for my nice new homebrew transceiver!

TECHNICAL TOPICS

The first of what could become a regular series of sections on things topical and technical. Written by Tony Bailey G3WPO

Out there in the big wide world of amateur radio, there must be some of you with ideas, circuits or hints and tips that you would dearly love to pass on to the rest of us! The Editor felt that he couldn't ignore you any longer and asked me to try to persuade pens to paper for a new column. We will be happy to accept any ideas, useful circuits with radio in mind, constructional tips you have picked up through the years, or questions you want the answers to.

Before it occurs to you, we are NOT trying to copy other magazines' efforts. There are bound to be some similarities; however, there is room for such a column in this magazine, and I hope you will be forthcoming with the necessary contributions. Send your letters to this magazine.

Tune up

A large proportion of you are probably relatively newly licenced, and many of you will be using SSB, on VHF or HF. How many of you have come across (or even been guilty of using) the dreaded 'AHHHHHHHLO' method of tuning up the rig for maximum output. It is more than slightly anti-social and anyway, you should be using a dummy load for high power tune up, then lowish power to set up the Matching Unit (if you have one). There is another angle to all this and that is the life of the output devices in your Tx. The problem isn't so bad with solid state PAs, but with valve types, they are often not adequately rated for the near 100% duty cycle that is forced on them during tuning up. Result — the life expectancy drops quickly. Its not a bad idea to look after solid state PAs too.

There have been several gadgets published with low duty cycle outputs that can be fed into the mic socket for such tuning up operations. Unfortunately, most of them sound worse than the 'AHHH...' method.

If you have an electronic keyer, then the problem is solved. Simply wind up the dot speed as high as possible, and then transmit (into a dummy load) using the key on dots only to reduce the duty cycle down to 50%. Down goes the power dissipation in the output stage, and hopefully, longer life for the rig results.

PCBs

Any constructors amongst you will probably have come across the problem of mounting a pcb away from the chassis. You can use metal spacers, or nuts and several bolts. Or, if you have a few dead Biros around the place, why not cut the body (remove the middle first!) into suitable lengths and use these as spacers? Also useful for stacking pcbs on top of each other.

TS820 sidetones

A couple of friends have TS820s, both with the annoying habit of generating a loud click when the sidetone circuit is being used for CW. If you have this problem, then the cure is to increase the value of C38 from its existing value of 22n (.022nuF) up to 220n (0.22uF). The replacement capacitor should be a monolithic (multilayer) ceramic type, as otherwise you will have trouble getting it onto the board.

C38 is located on the 'FIX-VOX' pcb, and the new one will replace the old one fairly easily. Don't attempt this if the rig is still under Warranty of course.

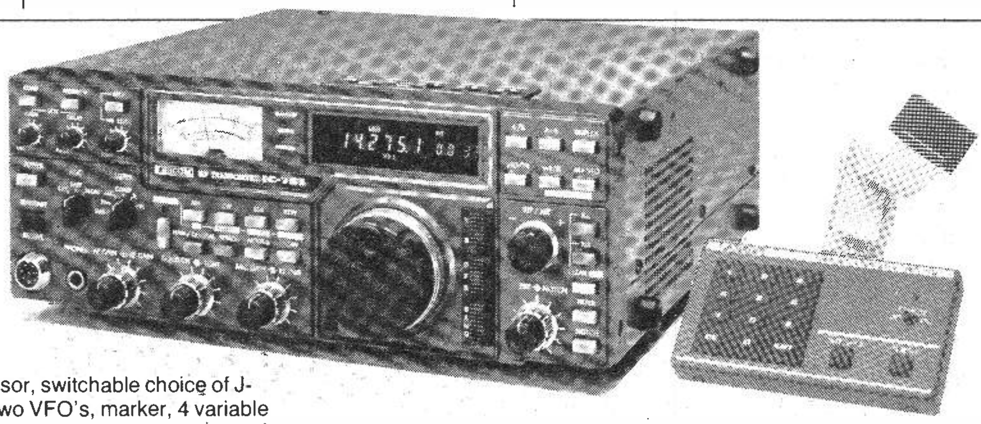
This does illustrate that not all commercial rigs are infallible. If you can steel yourself to open the cabinet, many similar improvements are generally possible if you know what you are doing. After all, *the manufacturer is selling you what he thinks you want to buy.* If it doesn't suit you, then you could alter it in some cases. The only problem with such modifications is that the eventual buyer of your equipment might not be overcome with admiration when you tell him you have modified the rig!

What price

HF Equipment

IC–751	All band AM.FM.SSB.CW + Gen Cov Rx. 32 Memories	1049.00
PS35	Internal switched mode power supply	149 00
SM6	Desk microphone	34.50
HM12	Hand microphone with up/down scanning	16.50
EX310	Voice synthesizer module	39 00
RC10	Frequency controller unit	29.95
CR64	High stability xtal unit	49.95
FL32	9MHz CW/RTTY filter – 500Hz	39.00
FL63	9MHz CW/RTTY narrow filter – 250Hz	39 00
FL33	9MHz AM filter – 6KHz	32 50
FL70	9MHz SSB wide filter – 2.8KHz	35.50
FL52a	455KHz CW/RTTY filter – 500Hz	79.00
FL53a	455KHz CW/RTTY narrow filter – 250Hz	79.00
IC–745	All band SSB.CW.AM(Rx only) Gen Cov Rx 16 mems.	839.00
PS35	Internal switched mode power supply	149.00
SM6	Desk microphone	34.50
HM12	Hand microphone with up/down scanning	16.50
EX310	Voice synthesizer unit	39.00
EX242	FM unit Tx & Rx	32.50
EX241	Marker unit	15.95
EX243	Curtis keyer unit	39.00
FL45	9MHz CW filter – 500Hz	45.00
FL44a	455KHz SSB narrow filter – 2.4KHz	79.00
FL52a	455KHz CW/RTTY filter – 500Hz	79.00
FL53a	455KHz CW/RTTY narrow filter – 250Hz	79.00
FL54	9MHz CW/RTTY narrow filter – 270Hz	39.00
IC–740	No longer available. Accs still in stock.	
PS740	Internal switched mode power supply	149.00
SM5	Desk microphone	34 50
EX241	Marker unit	15.95
EX242	FM unit	32.50
EX243	Curtis keyer	39.00
FL44	455KHz SSB filter – 2 4KHz	79.00
FL45	9MHz filter – 500Hz	45.00
FL52	455KHz CW/RTTY filter – 500Hz	79.00
FL53	455KHz CW/RTTY narrow filter – 250Hz	79.00
FL54	9MHz CW/RTTY narrow filter – 270Hz	39.00
IC–730	10–80 Mtrs compact transceiver	659 00
PS15	External power supply – 20amps	119.00
PS20	External power supply with speaker – 20 amps	176.00
SM5	Desk microphone	34.50
HM7	Hand microphone with pre amp	14.95
EX202	LDA unit for use with AT100/500	13.50
EX203	CW audio filter	14.50
EX205	Transvertor unit	14.00
EX195	Marker unit	17 00
FL44	455KHz SSB filter – 2.4KHz	79.00
FL45	9MHz CW filter – 500Hz	45.00
FM04	FM unit Tx & Rx	49.00
IC–720A	No longer available. Accs still available.	
PS15	External power supply – 20 amps	119.00
PS20	External power supply with speaker 20 amp	176.00
CF1	Cooling fan for PS20	24.00
SM5	Desk microphone	34.50
FL32	CW narrow filter	39.00
FL34	AM xtal filter	34.00
BC10	Memory back up unit	5.95
FM03	FM unit Tx & Rx	89 00
IC–R70	General Coverage Receiver 0.1–30MHz	549 00
EX257	FM unit	32.50
FL63	CW narrow filter	39.00
FL44a	455KHz SSB filter	79 00
CK70	DC cable kit	5.75
7072	interface unit to transceive with IC720A	97 50
IC–R71	All mode Gen Cov Rx, k'pad entry. 32 memories	649.00
RC11	Remote control unit for above	T.B.A.
IC–2KL	1KW PEP Linear, auto band switching, complete with –	
2KLPS	Power supply to run 2KL linear	1303.33
IC–AT100	100Watt Automatic antenna tuner	269.00
IC–AT500	500Watt Automatic antenna tuner	369.00
IC–PS30	Systems power supply, 25 amps continuous	229.00
IC–AH1	Mobile antenna. 3 5MHz–30MHz	199.00
VHF Equipment		
IC–271E	Multimode base station, 25w, 32 memories	629.00
IC–271H/E	High power version of above, 100w	T.B.A.
PS25	Internal switched mode power supply	89.00
EX310	Speech synthesizer unit	39.00
AG20	Internal receive pre-amp	49.00
SM6	Desk microphone	34.50
IC–290D	25W Multimode mobile, 5 memories, scanning mic	469.00

IC-751, £1049.



The IC-751 now has an interesting and useful addition, a remote push-button frequency selector pad, so you can either twiddle knobs or press buttons.

The IC-751 could be called the flagship of the ICOM range as it features 32 memory channels, full HF receive capability, digital speech synthesizer, computer control and power-supply options. The 751 is fully compatible with ICOM auto units such as the AT- 500 and IC-2KL.

Standard features include: a speech processor, switchable choice of J-FET pre-amp or 20dB pin diode attenuator and two VFO's, marker, 4 variable tuning rates, pass band tuning, notch, variable noise blanker, monitor switch, direct feed mixer in the front end, full break-in on CW and AMTOR compatibility.

For more detailed information on this excellent set, please get in touch with us.

IC-R71E, £649.

The best has just been made better! The ICOM IC-R70 receiver has had some important additions made to its specifications and this model is named the IC- R71E. Here are some details:–

100 KHz – 30 MHz all mode (with FM option). Quadruple conversion superhet. IF frequencies 70 MHz 9 MHz and 455 KHz with continuous bandpass tuning and notch filter. Virtually immune from adjacent channel interference with 100 db dynamic range. Adjustable AGC, noise blanker and switchable pre-amplifier. Direct entry keyboard into twin VFO's with 32 programmable memories: Auto squelch tape record function.

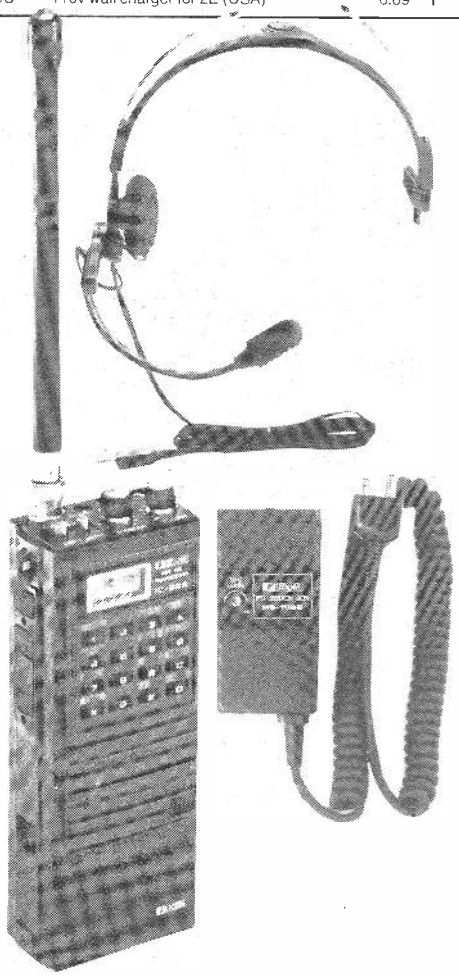
Options:– Synthesized voice readout, infra-red remote controller, 12V DC kit, mobile mounting bracket, two CW filters 500 and 250 Hz, FM unit, computer interface, headphones.

The IC-R70 will still be available at £549.00. Ask for a leaflet giving the full details of these two fine receivers.

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

perfection?

IC-27E	25W FM mobile. 9 memories. multi function display	299.00
U216	Voice synthesizer unit	T.B A.
IC-25H	45W FM mobile. high power version of old IC25E	359.00
BU1	Memory back up unit for mobiles	24.50
	DC leads (flat pin or square 6 pin)	4.50
	DC Plugs (flat 4 pin)	.30
	DC Sockets (flat 4 pin)	.30
IC-2E	Synthesized hand portable. 1.5 watts	169.00
IC-O2E	Synthesized hand held. keypad entry. LCD display	229.00
ML1	10 watt booster unit for 2E	69.00
BP3	Standard battery pack	25.00
BP2	Low volts high capacity (long life)	38.00
VP4	Empty battery pack. takes 6 x AA size cells	7.95
BP5	High volts high capacity (high power)	48.00
BP7	High volts high capacity (for use with O2E ONLY	59.00
BP8	Low volts high capacity	49.00
DC1	12v regulator pack (2E ONLY)	12.50
CP1	12v charger lead for cigar lighter	4.95
FA2	Helical antenna	7.50
LC1	Leatherette case (BP5)	5.00
LC2	Leatherette case (BP4)	5.00
LC3	Leatherette case (BP3)	5.00
LC11	Case for O2E (BP3)	5.00
T/L1	Heavy duty leather case (all batt packs)	21.27
BC25E	240v wall charger for 2E	6.69
BC25U	110v wall charger for 2E (USA)	6.69
BC16E	240v wall charger for O2E (BP8 BP7)	9.95
BC30	Desk top drop in charger (fast and slow) old packs	56.35
BC35E	Desk charger all packs new & old (fast slow)	56.35
HM9	Speaker microphone	16.50
IC-202S	SSB Portable - CW 3 watt output	199.00
BC15E	AC Charger 240v	41.80
BC20	DC Charger 13.8v	41.80
	DC lead	1.75
	Telescopic antenna	1.50
LC25	Leatherette carrying case	8.25
FA1	Helical screw in antenna	7.50
UHF Equipment		
IC-471E	Multimode base station 25watts. 32 memories	699.00
PS25	Internal switched mode power supply	89.00
EX310	Voice synthesizer unit	39.00
SM6	Desk microphone	34.50
IC-490E	Multimode mobile. 10 watts. 5 memories	495.00
IC-45E	FM mobile. 10 watts. 5 memories	329.00
BU1	Memory back up unit for mobiles	24.50
	Spare DC leads (flat 4 pin or square 6 pin)	4.50
	DC plugs & sockets (flat 4 pin)	.30
AG1	Mast head pre-amp for 471/451/490	49.00
IC-4E	Synthesized hand portable. 1.5 watts	219.00
IC-O4E	Synthesized hand held. k pad entry. LCD display	T.B A.
FA3	Flexi 1/4 wave antenna	7.50
	Accessories same as IC2E/O2E	
IC-402	SSB portable - CW. 3 watts output	257.00
BC15E	AC charger 240v	41.80
BC20	DC charger 13.8v	41.80
	DC lead	1.75
LC25	Carrying case	8.25
1.2 GHz Equipment		
IC-120	FM mobile. 1 watt output. 40MHz coverage mems	439.00
BT23E	Bit Zero 23e. 1296MHz linear. lw in - 7.8w out	179.00
50 MHz Equipment		
IC-551	Multimode base station. supplied SSB CW only	379.00
EX106	FM unit	112.00
EX107	VOX unit	49.00
EX108	Pass band tune unit	97.50
IC-505	Multimode portable. 3/10watt. supplied SSB only	382.00
EX282	FM unit	28.50
BP10	Nicad pack	59.00
BC15	Charger unit	6.50
LC10	Carrying case	22.50
Mobile Mounting Brackets		
MMB5	Mount for 251E. 451E. 720A. 730	12.50
MMB6	Mount for 240.	12.50
MMB7	Mount for 245E	12.50
MMB8	Mount for 255E. 260E	12.50
MMB9	Mount for 290E. 490E	12.50
MMB10	Mount for 25E. 45E. 120	12.50
MMB11	Mount for 22U. 24G	12.50



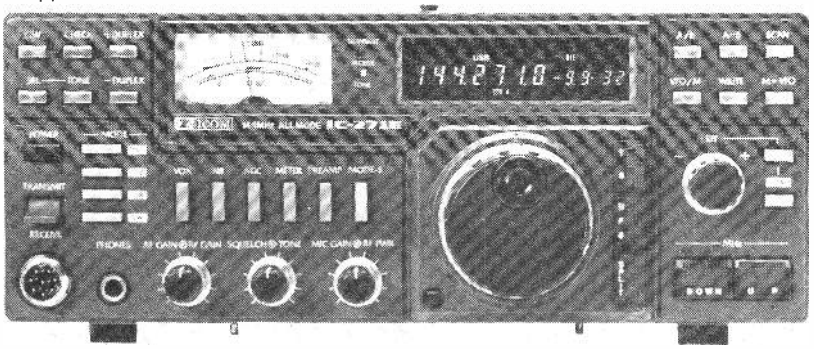
IC-02E, £229.

ICOM introduces the new top-of-the-line IC-02E to compliment its existing line of popular handheld transceivers and accessories. The new direct entry microprocessor controlled IC-02E is a 2 meter handheld jam packed with excellent features.

Some of these features include: scanning, 10 memories, duplex offset storage in memory & odd offsets also stored in memory. Internal Lithium battery backup and repeater tone are of course included. Keyboard entry is made through the 16 button pad allowing easy access to frequencies, duplex, memories, memory scan and priority. The IC-02E has an LCD readout indicating frequency, memory channel, signal strength, transmitter output and scanning functions. New HS-10 Headset, with earphone and boom microphone, which operates with either of the following:- HS10-SB Switch box with pre-amplifier giving biased toggle on, off and continuous transmit. HS10-SA Voice operated switch box, with pre-amplifier, mic gain, vox gain and delay.

IC-271E, £629.

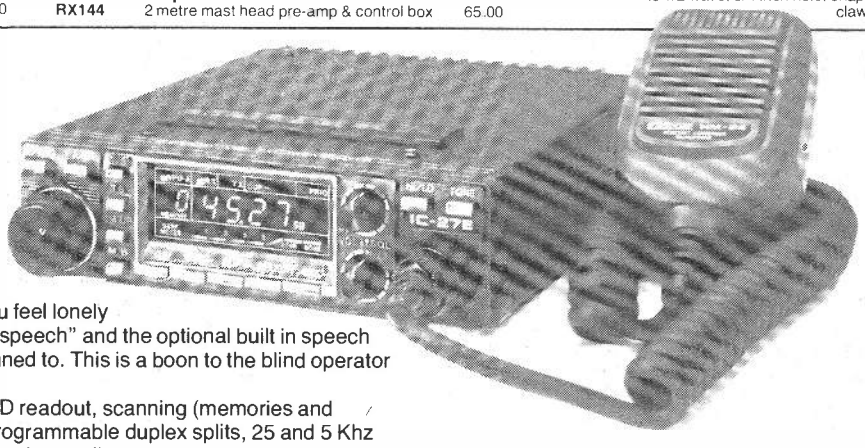
The IC-271E,2 meter VHF and IC-471E,430-450 MHz are the 'terrific twins' in Base multimodes at the moment. The design is based upon a new CPU chip that is easy to operate and offers the maximum number of functions available. Power can be adjusted up to 25W on all modes, squelch works on all modes and a listen-input facility has been added for repeater work. RIT shift is shown on the multicolour fluorescent display. 10Hz tuning facilities are included on both machines. Options for the 271E and 471E include - switchable front-end pre-amp, SM6 desk microphone, speech synthesizer announcing displayed frequency, 22 channel memory extension with scan facilities and an internal chopper PSU.



MMB12	Mount for R70, 740, 271E, 471E	12.50
MMB16	Mount for 2E, 4E, O2E, O4E	6.95
MMB18	Mount for 751	T.B.A.
SS1	Shoulder strap for handhelds	7.50
Microphones		
HM3	4 Pin hand microphone (IC240)	12.50
HM5	4 Pin hand microphone noise cancelling	20 00
HM7	8 Pin hand microphone (IC–24G, 730, 720A)	14.95
HM9	Speaker microphone for hand helds	16.50
HM10	8 Pin microphone with up/down scanning	29.00
HM11E	8 Pin microphone with up/down scanning + tone call	22.50
HM12	Up/down scanning mic for new sets (271/471/751/745)	16.50
SM2	4 Pin base microphone	34.50
SM5	8 Pin base microphone	34.50
SM6	Base microphone for new sets (271/471/751/745)	34.50
Ext Speaker/Headphones/Headsets		
SP3	Matching speaker for ICOM sets	45.00
SP4	Mobile speaker with magnetic mount	19.55
HP1	Good quality headphones	28.50
HS10	Headset and boom mic for ICOM hand helds	18.40
HS10SB	PTT switch box for HS10	18.40
HS10SA	VOX unit for HS10	20.70
ICOM Global digital clock		
Attractive gold colour, gives time in cities all over the world. Pulsating red LED's. LCD readout with alarm. 195mm		59.00

TONO CW/RTTY/ASCII Terminals		
9000E	Communications computer, RTTY, CW, ASCII, TX/RX	669.00
550	CW/RTTY decoder, inc CW practice, and CW transmit	299.00
5000E	Comunications terminal & k'board, inc AMTOR, VDU.	799.00
9100E	As 9000E with amtor	699.00
CRT1200G	High quality video monitor with green display	136.00
TONO Linears		
MR250W	144–146MHz, 10–15W drive, 180–200W out, RX pre-amp	325.00
MR150W	144–146MHz, 10–15W drive, 120–140W out, RX pre-amp	169.00
MR100W	144–146MHz, 10–15W drive, 80–90W out, RX pre-amp	99.00
2M50W	144–146MHz, 1–3W drive, 30–45W out, no pre-amp	59.00
NEW "G" Series		
2M40G	144–146MHz, 1–3W drive, 20–35W out, RX pre-amp	79 00
2M90G	144–146MHz, 10–15W drive, 70–90W out, RX pre-amp	115.00
2M130G	144–146MHz, 10–15W drive, 110–130W out, RX pre-amp	160.00
4M60G	430MHZ, 3–15W drive, 40–60W out, RX pre-amp	159.00
TONO Pre-amps		
RX144	2 metre mast head pre-amp & control box	65.00
RX430	70 cm mast head pre-amp & control box	70.00
TELEREADER Equipment		
CWR685E	CW/RTTY/ASCII terminal & k'board, with VDU, TX/RX	730.99
CWR675E	RX only version of 685E, with inbuilt printer/VDU	599.00
CWR670E	CW/RTTY/ASCII RX only, use with TV or VDU	349.00
	12 pin plug for 670/675/685	6.00
CWR610	CW/RTTY decoder, slow morse practice	159.00
CWR610E	As 610 with adjs baud rate from front panel (45–600)	175.00
	13 pin plug for 610/610E	4.75
CM40PS	40 character dot matrix printer, 11.5cm paper roll	199.00
ZENITH Monitors		
123E	12 inch with green display, good quality	109.25
122E	12 inch with amber display, good quality	125.00
TAL, ASP Series System 6 antennas		
ASP2016	138–512MHz 1/4 wave whip with threaded adaptor	2.56
ASP3976	66–138MHz 1/4 wave whip with threaded adaptor	5.21
ASP3936	130–174MHz 1/2 wave whip with barrel/spring, 3dB	18.63
Mounts for above		
K57	Fits 1/2 wave, 3/8 inch hole, snap-in type	3.10
K440	Fits 1/4 wave, 3/8 inch hole, snap-in type	1.55
K145	Fits 1/2 wave, 3/4 inch hole, snap-in with claw mount	5.43

IC-27E, £299.



This must be the smallest, 2M, FM mobile available today, measuring only 38mm H × 144mm W × 177mm D. IT has all the features that you probably require included in this microprocessor controlled unit. In addition, if you feel lonely and can't find anybody on the band, just press "speech" and the optional built in speech synthesizer will tell you the frequency you are tuned to. This is a boon to the blind operator or to those that tuck their rigs out of sight.

Brief features:– 25/1 Watt output, green LED readout, scanning (memories and programmable limit band scan), priority scan, programmable duplex splits, 25 and 5 Khz tuning steps, 10 memory channels with lithium back up cell, normal and reverse repeater switch, dual VFO, internal speaker and optional speech synthesizer. Just ask for a leaflet and we'll be glad to send you one. Price 299.00 and 39.00 for the optional speech synthesizer.

IC-120, £439.

What can we tell you about the IC-120? It is a comparatively new mobile using the 1296MHz, FM frequency. 1296 is now becoming increasingly popular in the U.K., mainly for the person who would like to avoid all the QRM sometimes found on the more widely used 2M waveband.

Later options, soon to be available for the IC-120 will include a linear amplifier and a power supply.

Some of the 120's features include: frequency coverage 1260 to 1300MHz, adjustable repeater shift, 6 memories with scanning facility, spurious emissions are 40dB or better, output power is 1W or more. Mode FM, 2 VFO's, deviation +5KHz and RIT.

More detailed information is easily available from Thanet Electronics Ltd. Break new ground with the IC-120.

K65	Fits 1/4 wave, 3/4 inch hole, deep claw with 17ft cable	9.31
K47	Fits 1/2 wave, 3/4 inch hole, wing mount	7 17
KR47	Fits 1/2 wave, 3/4 inch hole, narrow wing mount	12.42
K220	Fits 1/2 wave, magnetic mount with 17ft cable	12.10
K220A	Fits 1/4 wave, magnetic mount with 17ft cable	12.10
M161	Fits 1/2 wave, boot lip mount, needs K57	3.88
M161	Fits 1/4 wave, boot lip mount, needs K440	3.88
KR193	Fits 1/2 wave, swivel ball mount	4.03
K67	Ground plane kit for all whips	16.30
3000 Series System 6 antennas		
TAP3006	60–110MHz, 1/4 wave whip with threaded hinge	7 76
TAP3016	110–512MHz, 1/4 wave whip with threaded hinge	7.76
TAP3026	144–174MHz, VHF 1/2 wave, 3dB gain, threaded hinge	10 86
TAP3676	144–174MHz, VHF 1/2 wave, 3dB gain, with spring	12.42
TAP3456	420–440MHz, UHF 3dB gain, with threaded adaptor	14.74
TAP3466	450–470MHz, UHF 3dB gain, with threaded adaptor	14.74
TAP3696	420–440MHz, UHF 5dB gain, with shock spring	18.63
TAP3666	450–470MHz, UHF 5dB gain, with shock spring	18.63

Mounts for above		
K68	Snap in adaptor for 3/8 inch hole	2 32
K145	Snap in adaptor with claw fits 3/4 inch hole	5 43
K72	Wing mount with 17ft of cable, fits 3/4 inch hole	11.64
K66	Claw mount with 17ft of cable, fits 3/4 inch hole	7.76
K65	1/2 inch deep claw mount with 17ft cable. 3/4" hole	9 31
K220	Magnetic mount with 17ft of cable	12.10
ASPR332E	Gutter clip with 10ft of cable	11.79
M161	Boot lip mount needs K68	3.88
KR223	Duraflex noiseless spring	10 86
K67	Ground plane kit	16 30
Base station antennas		
ASP655	130–174MHz economy base, 1/2 wave with g-plane	27.94
TAP4009	156–174MHz Colinear, 3dB gain	50 45
ASPD682	160–166MHz Colinear, 4.5dB gain	194.00
ASPE682UK	164–172MHz Colinear, 4.5dB gain	194.00
ASPD700	450–460MHz Colinear, 7dB gain	163 00
ASP2006	156-174MHz Unity gain	47.44
Low profile/Heavy-duty antennas		
ASP2001	66–88MHz dome shape, –12db	55.89
ASP2000	105–108MHz TX – 138–141MHz RX dome shape, –4.5dB	73.74
ASP2002	162–174MHz dome shape, –3.5dB	55.89
ASP2021	162–173MHz fin shape, –1dB	55.89
ASP4005	450–470MHz dome shape, –0.5dB	31.05
Marine antennas 156–162MHz		

ASM37E	1/2 wave unity gain, deck mount, with 20ft cable	26 90
ASM38E	Colinear 3dB gain, deck mount, with 20ft cable	39 32
ASM77E	1/2 wave unity gain, mast mount, with 3ft cable	19.67
ASM88E	As above with 60ft of cable	27.83
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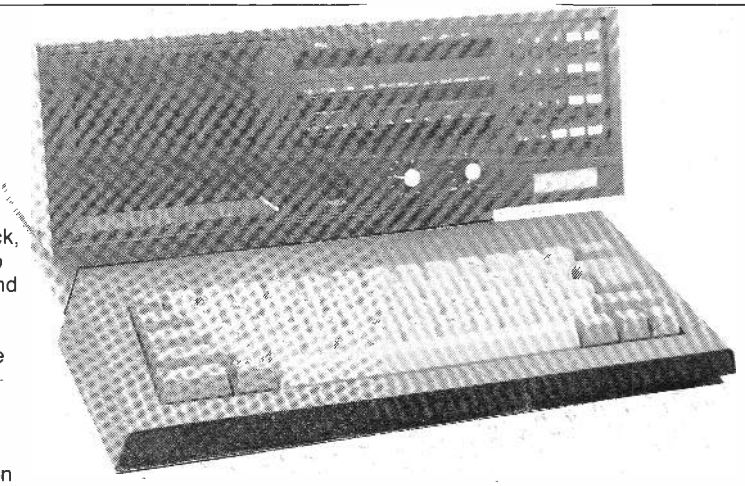

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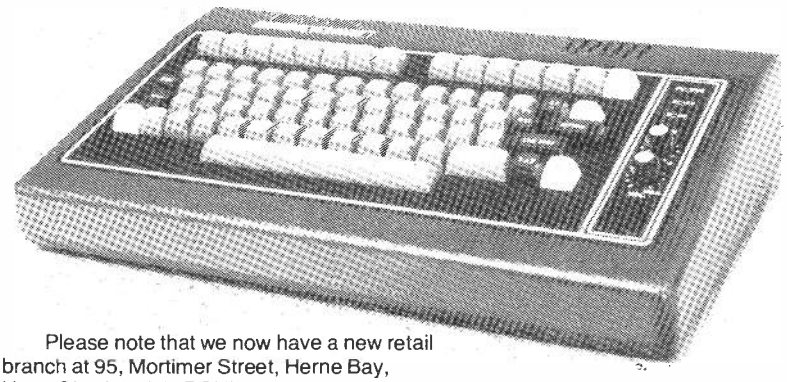

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Underground Aerials

The practical uses and advantages of this alternative type of antenna in dense media. John D. Heys G3BDQ continues his dissertation on the various techniques of aerial design and use.

In recent years there has been a revival of interest in the remarkable properties of certain undergound antennas. The original 'Rogers antenna' which was developed in the USA in the early 1920s was essentially a well insulated end-fed wire buried a foot or so below the soil surface, or supported at a similar height above ground on short vertical sticks. This latter version was later refined and its derivatives are now known as 'Beverage' aerials, and are used by commercial point-to-point stations and also amateurs with extensive real estate; for they are always at least 500 to 1000 feet long! The Rogers antenna was normally tuned against an earth connection. Sixty years ago it was considered to be excellent for low noise reception, and to have striking directivity. Static and man-made noises were well down on such antennas and they only received signals from stations located at a distance in the line of the wire. This 'disadvantage' was overcome by some experimenters who ran as many as eight wires out radially from the receiving position; each wire being switched into circuit as required. One point which was stressed in the design data for the original 'Rogers' was that the far end of the wire had to be really well insulated from the surrounding soil.

QSL card sent to G2CX by Peter Kondratieff EU3AN in 1930. Kondratieff was then still in his 'teens', and was using an inverted 'L' antenna on 20 metres.

Many experimenters in the 1920s used similar buried wires for both transmitting and receiving and they had quite good results, even when using low power. I have a QSL card which was sent to G2BJP by G6PG of Dartford, dated February 1926, which mentions that his 6 watts on 90.5 metres had given him a QSO with the Swedish station SMWS when using his underground aerial which was 70 feet long and 18 inches deep. Incidentally, Cyril Targett G6PG was a well respected RSGB Area Manager of the Society in London.

Underground antenna research faded when the 'Hertzian' types of aerial were introduced around 1928, but during the past twenty years military requirements for a virtually indestructable antenna system which would survive even a nuclear attack has once again drawn attention to the forgotten 'ground hooks'. British and American work continued in the footsteps of the Soviet 'antenna wizard', P. Kondratieff (formerly EU3AN) who is now recognised as the discovered of what is known as the 'Kondratieff Anomaly'. His most interesting findings show that the attenuation of signals which always occurs with any buried antenna system is dramatically reduced within a narrow frequency band which centres on 6.8MHz. This means that amateur operation on 7MHz becomes a practical proposition when using underground antennas, and it opens the door to further experiment.

Peter Kondratieff was led into his research on underground antennas by progress in work with proton magnetometers. These devices use the property called 'nuclear magnetic resonance' and discrete radio frequencies to stimulate the atoms of different elements found in the earth. They are a useful tool for survey work, mining and mineral exploration and also archaeology. Such work showed that certain non-metallic elements, particularly silicon, which as silica, (silicon dioxide) makes up most of the Earth's rocks and soils, have little effect upon the passage of radio frequency energy at a frequency roughly between 6 and 7MHz. Glass is a familiar and well known variety of silica and it is almost (the non-leaded varieties) completely transparent to most HF and VHF radiation. You are able to transmit easily through your picture window! Many soils are silica rich and contain few of the heavier metallic elements which stop signals at HF and VHF. Military experiments at Blandford, Catterick and Portland have shown that by using buried antennas and with power levels between

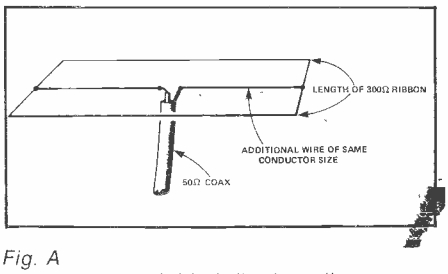


Fig. A
The three wire folded dipole radiator suitable for an underground antenna. This will match into 50 ohm coax. For really low (3 ohm) feed impedances a four wire folded dipole may be used (see text).

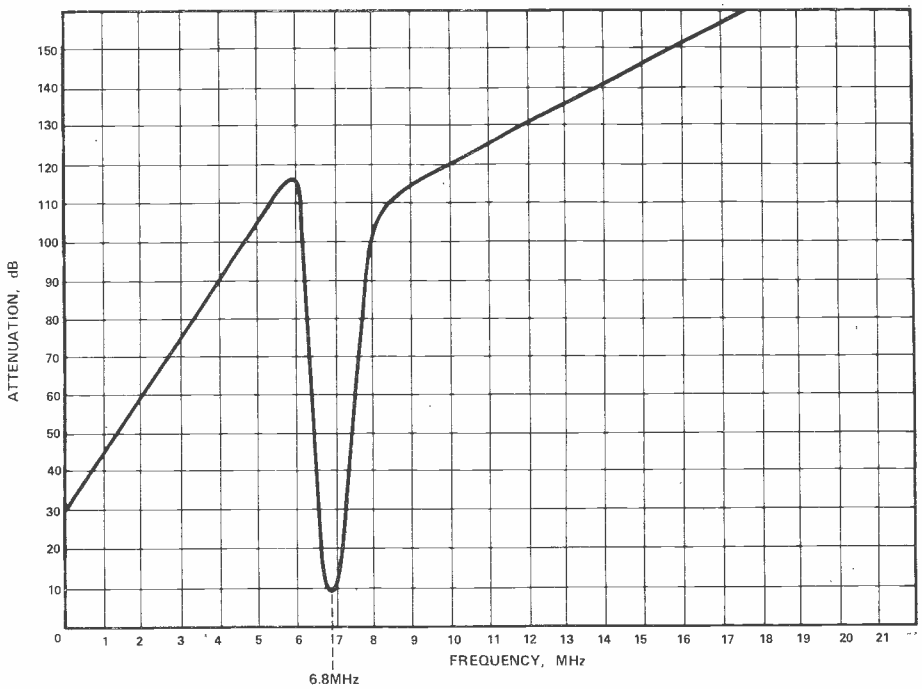


Fig. B
Graph showing the attenuation at different frequencies for an antenna buried one metre in silver sand. The Kondratieff Anomaly is clearly shown centring on 6.8MHz.

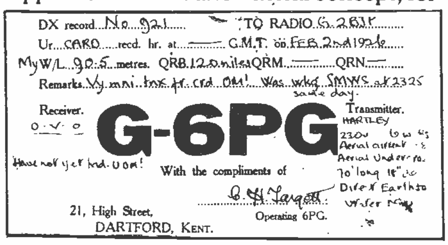
25 and 100 watts, excellent communication can be maintained between stations 100 to 300 miles apart; so long as the frequencies used lie within the 'Kondratieff Anomaly' band (about 6.5 to 7.1MHz).

Early workers with underground antennas soon learned that they greatly reduced the pick up of man-made interference. This was because a horizontally laid buried wire picks up or transmits almost no vertically polarised signal. The radiation is all skywards at high angles and there is virtually no low angle radiation of the kind so favoured by DX hunters! The ground wave signal is also at a low level so the buried antenna is of little use for local working. The antenna really comes into its own for 'short skip' devotees, and is fine for inter-G and near continental working. It appears to be ideal for people who like reliable communication on the many SSB 'nets' which abound on 7MHz, and very strong signals are assured when the 'skip' is short.

The actual range will vary between night and day depending upon propagation conditions, but really long distance working will always be inhibited. The underground antenna certainly will cut out interference from both local and 'second hop' stations and this is a useful feature.

We are fortunate that the 'Kondratieff Anomaly' includes amateur band (it also goes some way to explain why many governments are so tetchy regarding piracy around 6.8MHz!) and it allows the construction of a cheap and effective antenna for 7MHz. Research shows that dry sandy soils, gravel, chalk and certain limestones are the most suitable media to surround the dipole. (See Fig. B) The lighter the colour of the sand or gravel (including flint which is almost pure silica) the smaller will be proportion of iron oxide within it, and consequently the smaller will be the attenuation of signals.

It is best to dig out a straight trench some two or three feet deep and about 2 feet wide. This trench should be about 70 feet long and half filled with white sand, flint gravel (beach) or chalk chippings. The antenna is then laid out on this bed inside a protective PVC tube. Standard plumbers' plastic water pipe is ideal for this purpose and is not expensive. The early experimenters used rubber hose or even three inch diameter ceramic drainage pipes! When the antenna is tuned up and cut for a good match, the trench may then be filled up to ground level (or higher) using the same material that was used for the initial half-filling. Another method of construction is to lay the antenna along a raised bed of suitable rubble and cover it with about 18 inches of the same material. This technique involves no digging, but leaves a long ridge down the garden! The end-fed wires so favoured in the early days are not the best approach to the buried aerial concept, for feeding such wires is difficult. Any lead-in wire above ground would destroy the unique properties of the antenna. A more elegant solution is to use a centre fed dipole with coaxial feeder, which may itself be buried on the run to the shack.



QSL card sent by G6PG in 1926 giving details of his underground antenna.

Text books on aerial theory explain how the radiation resistance of a half-wave dipole drops rapidly as the aerial nears the ground. Such a dipole if laid directly on to a sheet of metal will have a radiation resistance approaching zero, (zero is actually impossible!) but the earth is far from being a perfect conducting plane and this means that although low, the impedance of a buried dipole can be matched to a coaxial feeder. With a feed impedance of around 5 to 10 ohms (check yours first with an antenna noise bridge) matching becomes easy if the antenna has been designed as a triple wire folded dipole. Then its centre impedance is raised to a factor of nine times that of a simple single wire dipole, and it will allow a fair match to be made to a standard 50 ohm coax. (See Fig. A) Purists may wish to include a balun at the feed point but this is not necessary. An ATU between the shack end of the feeder and the rig is recommended. A suitable three wire folded dipole is made from a length of standard 300 ohm ribbon feeder together with another wire which has a conductor diameter equal to that of each of the wires in the ribbon. The three wires are joined at each end of the dipole. A four wire folded dipole will have a 'step up' factor of 16 and it would raise an extremely low feed impedance of say 3 ohms up to almost 50 ohms! The PVC weatherproofing tube must be sealed against moisture ingress at each end and also where the coax leaves midway along its length.

Being in the ground (the dielectric constants of most silica derivatives lie between 5 and 8) the 'end effect' is enhanced and the dipole length will be considerably shorter than that of a normal elevated half-wave antenna. On 7MHz it may be in the region of 50ft in length or even shorter. Before the feeder is connected (and before the antenna is buried!) the dipole length must be adjusted to resonance on the band by using a dip meter coupled to a single turn of wire joining the two wire ends at the actual feed point. Each site will present a different dielectric constant so I do not offer definite dipole lengths. Being a shortened half-wave, the buried antenna will of course have a narrower bandwidth than a standard dipole and it will operate satisfactorily only some 15kHz from the design centre frequency on the 7MHz band. This should be adequate for most SSB or CW work, bearing in mind the fierce broadcast interference above 7050kHz. The radiated power will be down of course (see Fig. C) when compared with a normal well-elevated half-waver, but it compares favourably with some of the bottom loaded verticals that are often used; its efficiency will be between 5 and 10 per cent. All the radiation and all incoming signals will show horizontal polarisation. This does not mean that stations using vertical polarisation will not be heard; once the RF leaves an antenna and travels beyond ground wave distance it can exhibit all kinds of polarisation.

The figures which accompany this article will help in the design and construction of buried dipoles for the 7MHz band. Get out that spade, roll up your sleeves and get digging! Nosy neighbours will *never* dream that you are actually antenna farming!

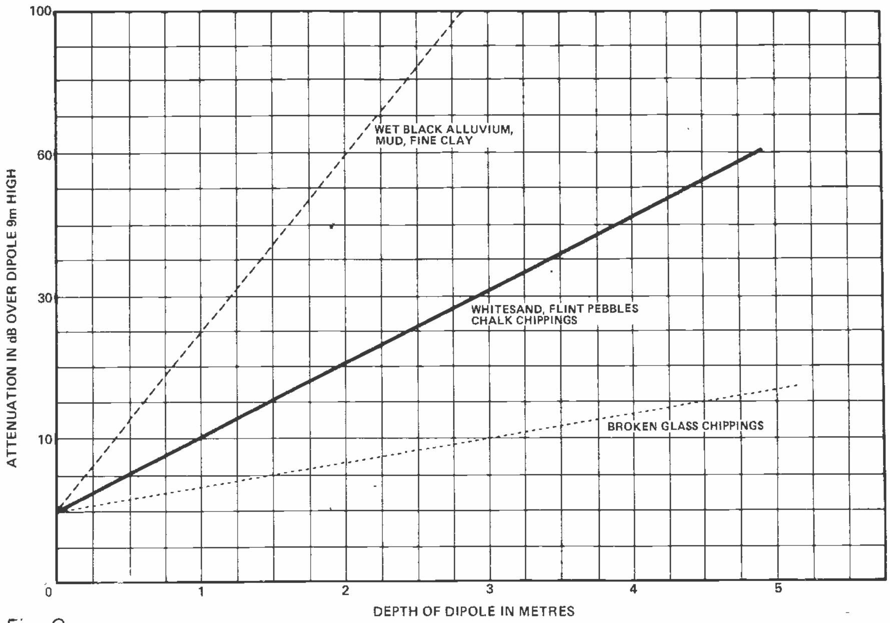
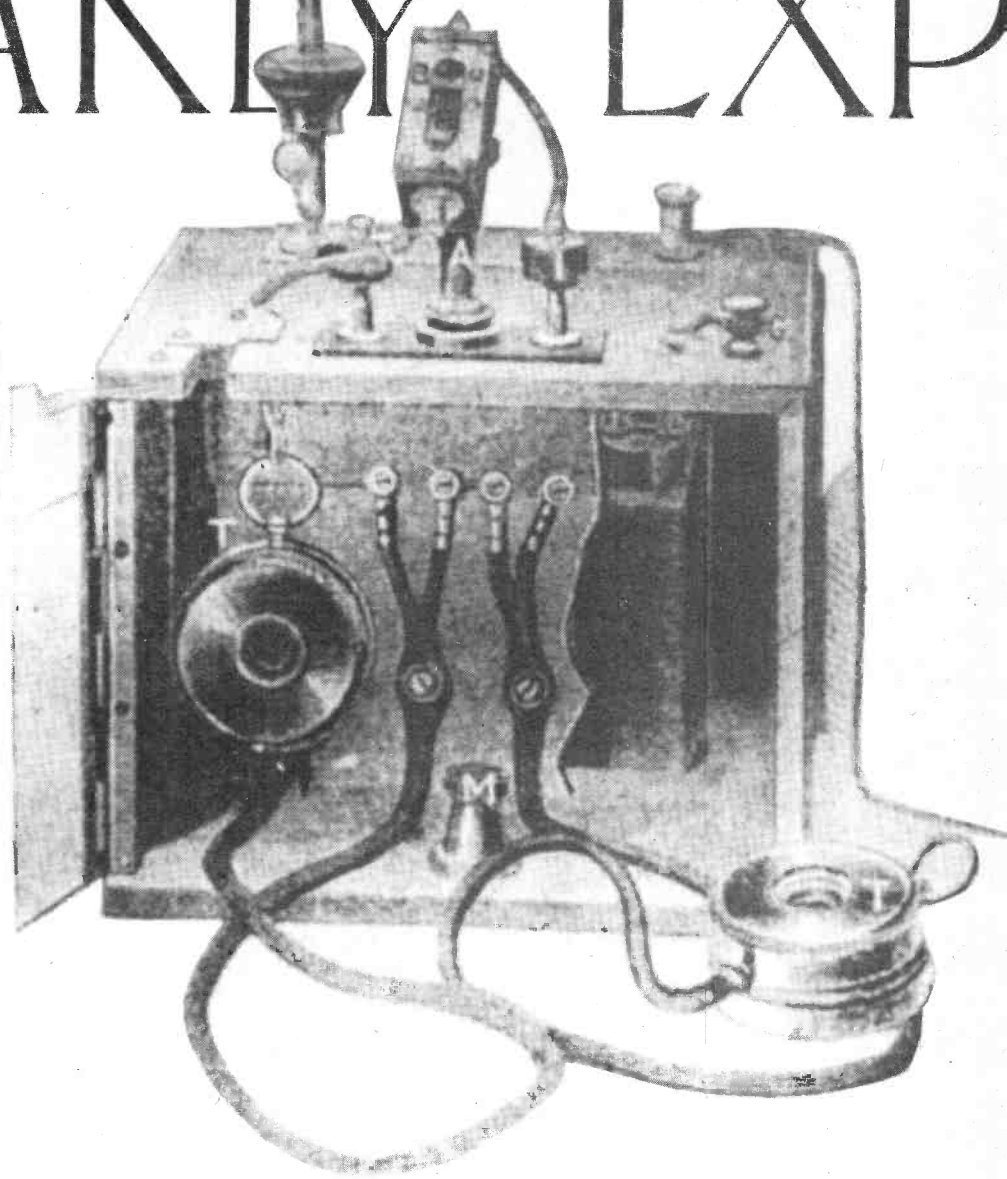


Fig. C
Graph displaying the attenuation at different depths and in different surrounding media. It will be noticed that even at ground level there will be attenuation.

EARLY EXP



Marconi wasn't the first amateur, although he referred to himself as such. Here, Glen Ross G8MWR delves back in time to discover when some of the very first experiments in radio were conducted. Did you know, for instance, that somebody called Gilbert was able to transmit "something" in the year 1580? Read on for more information ...

Trying to trace the efforts of early experimenters is a very difficult proposition, mainly due to the fact that very few of them ever wrote about their work, and what was written up tends to be in what are now very difficult to obtain publications.

In the sense that at that time there were no professional radio engineers, all of those working in this area can be described as amateurs. Indeed, Marconi always referred to himself as such. The common belief is that the whole concept of "talking without wires" was pioneered by Marconi but, in fact, many people were involved long before him.

First let us define exactly what *we* are attempting to trace, and what *they* were trying to achieve. It is the ability to cause something to happen at a remote point without the two points being connected by wires. These points could be inches apart, or many miles, depending on the state of the art at the time. Once you have the ability to make something happen at the distant end it is a simple matter to invent a code of some sort to convey information. At its simplest, one click could indicate NO and two clicks YES. (Modern logic circuits work in this way using an ON/OFF code).

Movement at short distances from a transmitter

The earliest documented record that I can find is of experiments done by Gilbert in 1580. No details are available but it is known that he was able to cause movement at short distances from what we would now call the transmitter. 150 years later there are references to some work done by Kleist and Muschenbroeck on inductive radiation but the first work that is complete with any real documentation was that done in 1780 by Adams. In his "Essay on Electricity" he describes his work on propogation and gives the physical layout of the experiment, Fig. 1.

The Leyden jar was in effect a capacitor made by coating the inner and outer surfaces of a glass jar with a metalic substance, which could then be charged up to a high voltage. The unit of capacitance was for many years the JAR, this unit being used in the Admiralty Handbook right up until the last war. It was a crucial piece of equipment for the early experimenters because, although they could generate high voltages very easily this was the only way in which they could store them. In Adams's experiment the jar was discharged close to a series of metal rods, which were supported on insulators, except the last one which was earthed. The charge was coupled from one rod to the next and finally caused a small spark to appear at the last rod. Is this the first example of a repeater?

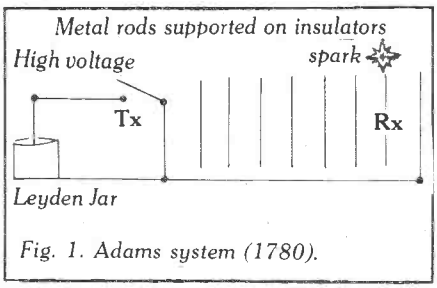


Fig. 1. Adams system (1780).

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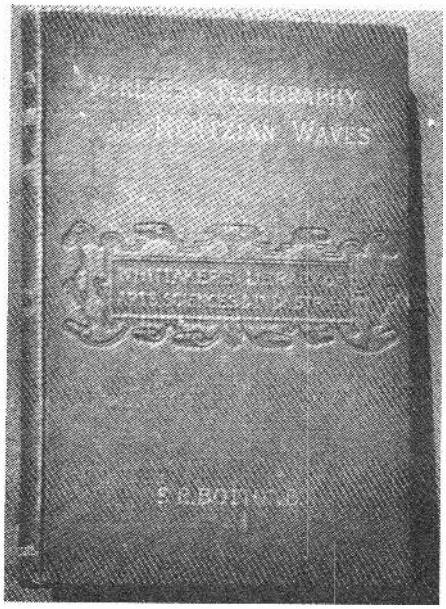


Left: Illustration from S.R. Bottone's book of 1901, showing Popoff's original Wireless Telephone system, circa 1888. Above: Front cover of the same book, now a collector's item.

Shocking

About 1800 a method of alerting the operator to the fact that a message was arriving was devised by Matteuci. His system is shown in Fig. 2. The Leyden jar was discharged into a spiral coil of a few turns of wire. At some distance from this was placed a similar coil, but this time with many turns, thus acting as a step up transformer. Electrodes were connected to this coil and were held by the operator. Every time the jar was discharged the unfortunate person received an electric shock!

Henry, who is remembered for his work on inductance, made some experiments in 1840 and managed to transmit from the attic to the basement of his house. The signals having to travel through two floors that were 14 inches thick.

The period from 1850 to 1880 was a very busy one. Morse, Lyndsay, Cook and Wheatstone all managed to transmit over distances of up to two miles. Lyndsay patented his method of doing this in 1854, 42 years before Marconi. Probably the best results were obtained by Hughes around 1879. At this time he demonstrated wireless communication over distances of several miles. The transmitter consisted of a battery, key, induction coil and an unspecified aerial. The receiver used a loop aerial which was connected to an earphone via a deliberate "dry" joint to act as a detector. He also has the distinction of being the first Mobile operator. He fitted the gear into a carriage and, whilst driving around in Regents Park, was able to communicate to Great Portland Street over distances of more than one mile. He also noted that the signals appeared to be reflected from buildings.

They say that "there is nothing new under the sun" and that is very true of the wireless. In retrospect it is easy to see these germs of ideas. In 1884 Preece achieved signals over several miles using the equipment shown in Fig. 3. This is about as simple a system as one could imagine and is based on what we would now think of as rudimentary Delta loops. There was a proposal to try this system between Britain and France but Preece calculated that the length of each aerial would need to be about twenty miles to achieve the range and the idea was abandoned. It seems certain that the range could have been achieved with much smaller aerials, so Preece denied himself the change to be the first man to communicate between different countries.

At about the same time several experiments were being carried out in the field of wireless control. Chunder Bose managed to ring bells from a distance, but his most spectacular experiment was the remote firing of a cannon! The system is shown in Fig. 4. The transmitter consists of a battery and key connected to the primary winding of an induction coil (this is very similar to a car ignition coil). The high voltage output was connected to two large metal plates, which were suspended on insulators, with a spark gap between the edges of the plates, which acted as radiators. The whole contraption giving an effect very similar to that received from an unsuppressed motor cycle. The receiver used a large frame aerials and the recently invented Coherer type detector. The rectified signal then closed the relay connecting the local battery to the firing mechanism.

Brought into sympathy with the transmitter

It was realised that the range of all transmissions could be extended if the receiver could be brought into "sympathy" with the transmitter. Many systems had been tried to achieve this, with little success. On 10th November 1887 Hertz published his work on tuning circuits and later showed how to adjust an aerial to resonance by using series capacitors or inductors (shades of the RAE). He even went so far as to describe what we would now call High Q coils to reduce the losses in the system. The following year he went on to describe the different losses involved over light and dark paths.

Fig. 3 Preece (1884).

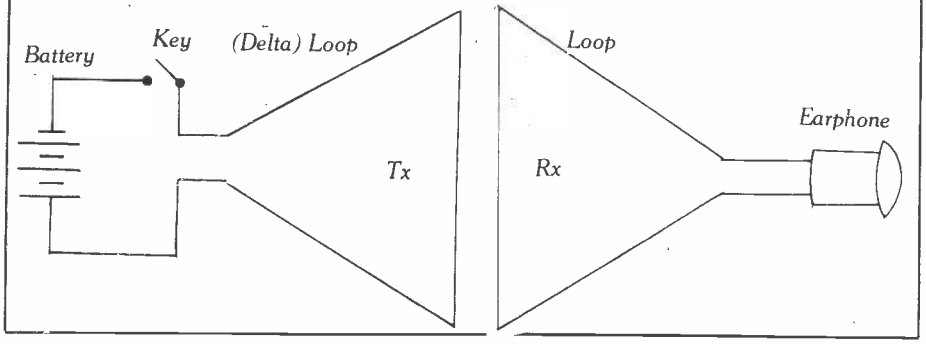
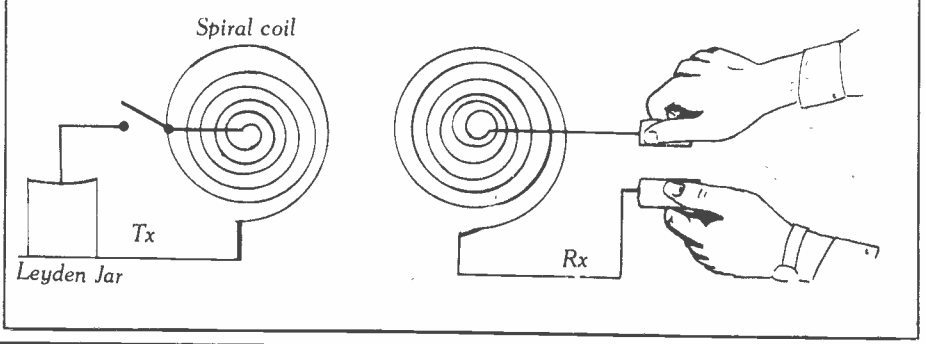


Fig. 2 Matteuci (1880)



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The dipole aerial was first described by Lodge in 1890 and he followed that in 1891 with a description of a parabolic aerial. This was most useful as around this time Bottone calculated that most experimenters were working around 235MHz. One very interesting piece of work done at this time by Robinson was the development of the "Self Tuning" aerial. This resembled a large harp, the idea being, that no matter what the incoming wavelength, one of the wires would be resonant.

About this time marconi comes on to the scene. The circuit diagrams of his original transmitter and receiver are shown in Fig. 5. One of his first achievements was on Salisbury Plain in 1897 when he covered a distance of nearly nine miles. This was easily exceeded the following year, when signals were sent from Chelmsford to France, a distance of 85 miles. Not content with that he went on to set up in 1900 a permanent link from the Isle of Wight to the Lizard Point in Cornwall, over a distance of 186 miles. He then crowned the whole achievement, on December 12th 1901, by communicating from Newfoundland to Cornwall, a distance of 2200 miles.

A lot of thought had gone into the idea of increasing the range of a transmitter by using relay stations similar to those used on the normal 'wire telegraph'. These involved a person taking down the message and the retransmitting it to the next station. In 1899 Guarini described a method of using unmanned repeaters, in exactly the same way as we use them now. The remote control world was bristling with ideas. Bettone described his ideas for a remote control camera shutter and Tesla put forward full design information for a large wireless controlled gun boat for the Navy. The degree of sophistication had improved to the point where the boat was equipped with a system which would transmit its heading back to the shore, so that it was still under full control at night time. A later project was a remote control torpedo to go with it. A quote from a publication of the time has a very familiar ring to it. *"Whether, as Mr. Tesla claims, his apparatus, by reason of its certain and unlimited destructiveness, will tend to bring about and maintain permanent peace, is a question to be discussed"*. But we know the answer to that one!

Although, as we said earlier all these experiments were carried out by 'amateurs', 1898 is the year when we have evidence of the first operation by an amateur in the present sense of the word. The person who, years later when licences were issued, held the call E12B managed to transmit over a distance of 70 yards using a few inch spark coil which is still in existence. In the same year the first use was made of an SOS call (or

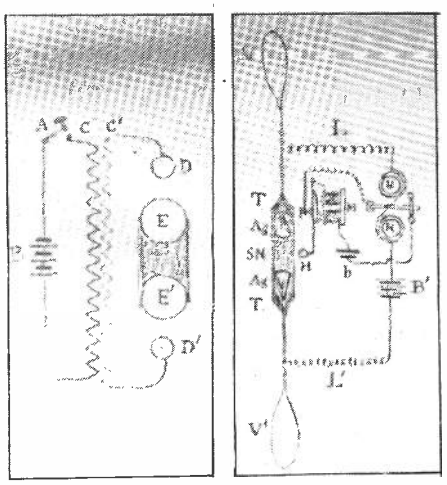
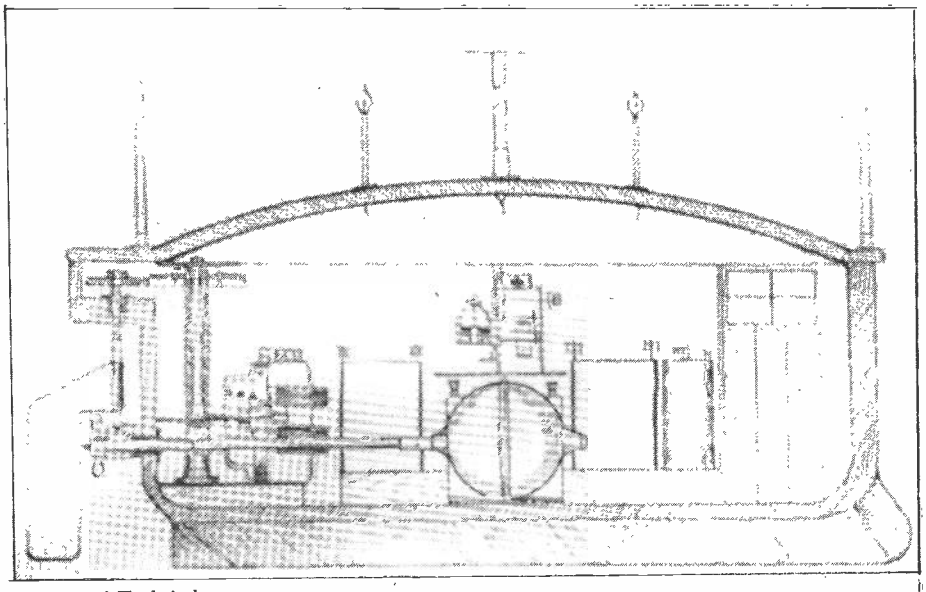


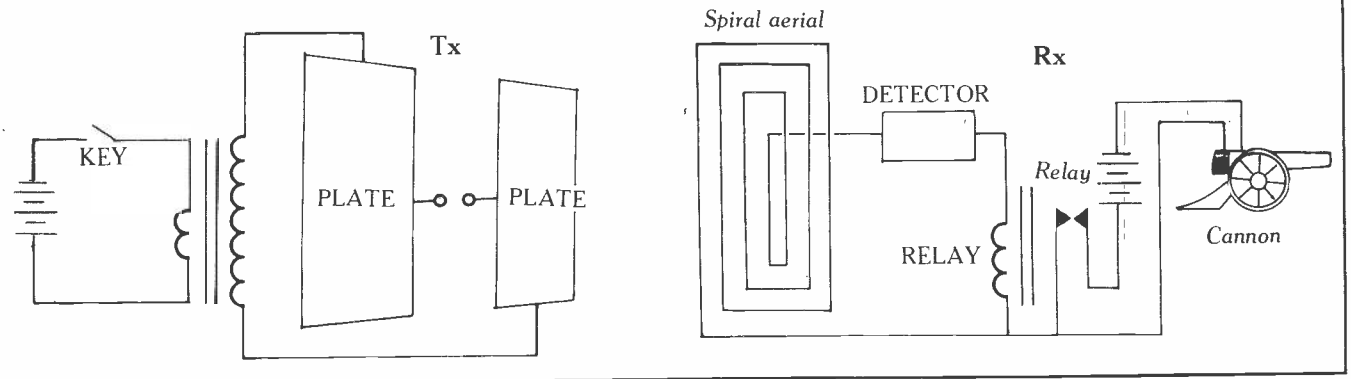
Fig. 5. Marconi's original arrangement.

These illustrations are from Bottone's book "Wireless Telegraphy and Hertzian Waves."



Section of Tesla's boat.

Fig. 4 Bhose (circa 1884).



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CQD as it was then), when the steamship *R F Mathews* rammed the East Goodwin lightship. The result of the call is not known and we had to wait until 28th April 1901 when the "Medora" put out a call and help arrived. In February 1902 Marconi carried out tests from Cornwall to the liner 'Philadelphia' over distances exceeding 2000 miles. In December 1902 he started the first regular service between England and Canada. Wirelss had arrived!

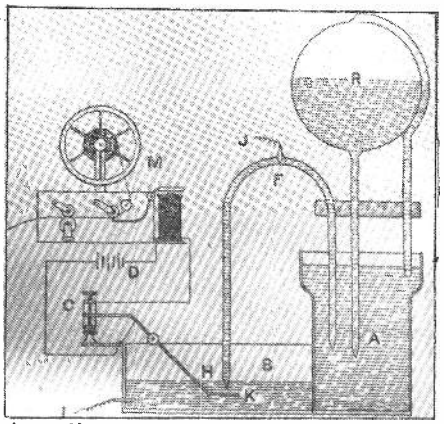
The start of official amateur wireless can be traced to a Bill introduced to parliament by Lord Derby in 1903, following the International Telegraph Conference held in London earlier that year. The Wireless Telegraphy Act became law on August 15th 1904 and remained in force until a new Act was passed in 1924. It was the first legislation of its type in the world, (the USA did not follow suit until 1912). During discussion on the Bill Lord Derby stated: "The class for who we have the greatest sympathy are the experimenters. The bill contains a clause which will give them *complete* freedom, merely requiring them to register. The licence will not be subject ot rent or royalty".

There were in fact three forms of licence and the first was issued in 1905 to Mr. H. Burbury of Wakefield. No callsigns were issued. Prof. Flemming, who invented the diode in 1904, is in the first list as is Prof. Thompson of the City and Guilds Institute (did he pass the RAE?).

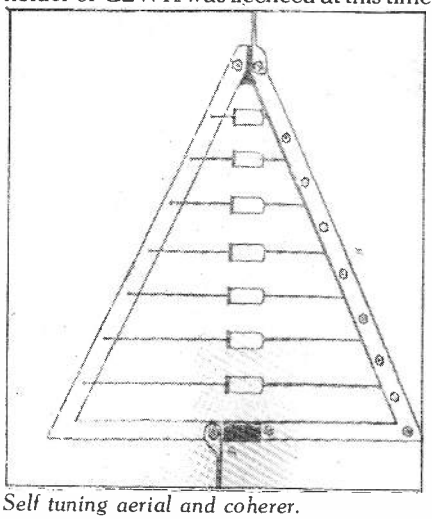
By 1908 three letter callsigns (NXC etc,) were being issued. The present holder of G2WK was licenced at this time and has been licenced ever since, making him, perhaps, the "longest" continual holder of an amateur permit. In 1911 the Derby Wireless society was formed, and the London Wireless Club (now the RSGB) was formed in 1913 with five members. The first 'Club' call was issued to them on the 19th November 1913.

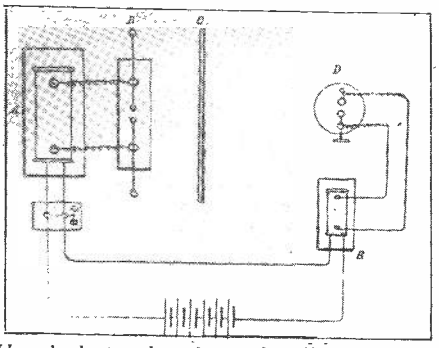
On August 1st 1914 operators received the following telegram from the PMG, "In accordance with your licence, the PMG requires you to remove at once your aerial wires and to dismantle your apparatus".

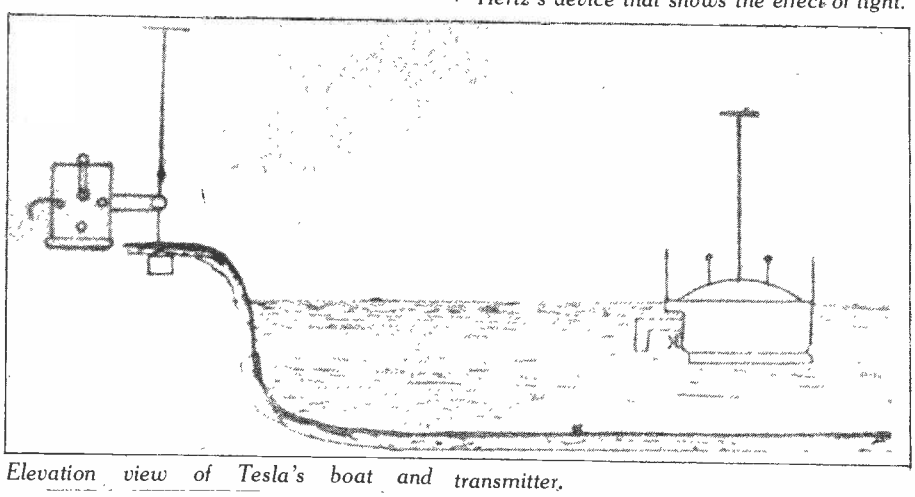
Confusion was caused because the telegram was only sent to stations who were licenced to use 50 watts or more. This was finally clarified in July 1915. Before then several Court Martials had been held to deal with offenders. One, held on December 6th 1914, sentenced George Cocks of Filey to six months for having a transmitter with a range, according to a Post Office witness, of less than one mile. The big QRT was to last until 1920.



Armorl's amazing electro-capillary relay!


Self tuning aerial and coherer.


Hertz's device that shows the effect of light.

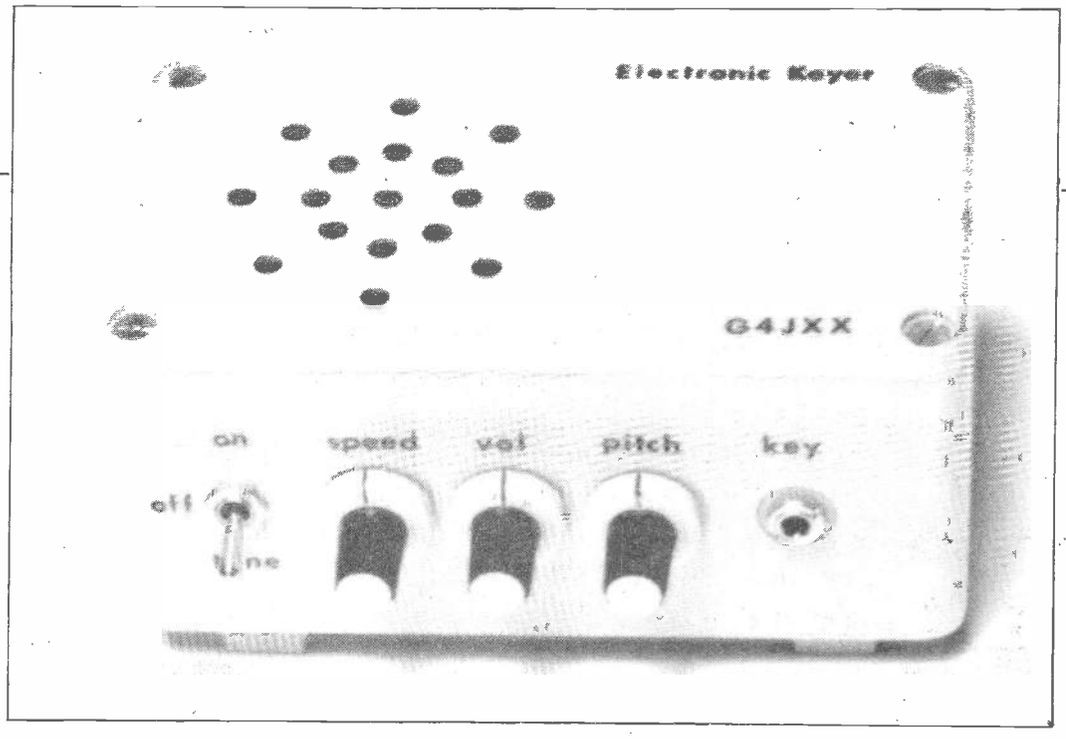

Elevation view of Tesla's boat and transmitter.

Marconi description

Possibly the best description of Marconi's original equipment is in the book *Wireless Telegraphy and Hertzian Waves*, written by S.R. Bottone and published in 1901. This contains the circuit diagrams and a full description, which we quote. (Refer to Fig. 5).

"Consider the sender, at A we have an ordinary tapping key connected to the primary of a coil C, through the battery B. The secondary C1 of this coil is connected to two brass balls, D, D1, which are placed at the opposite diameters of two larger balls E, E1, that are half inserted in a glass filled with vaseline. The distances between D, E and D1, E1 admit of adjustment to suit the length of spark employed.

"The receiver consists in a Coherer T,.... This is connected to the Wings or Resonators V, V1. These are then connected through the Self Induction coils L, L1.... through the battery B and a delicate Morse Telegraph instrument R. The lever is arranged to also close the circuit of the little battery B, through the Electromagnet M, thus causing the hammer H to stoke the decoherer and in this manner restore its capacity for taking up a fresh impression"



BUILD AN ELECTRONIC KEYER

And one that measures up to the quality and facilities of some that are commercially available! Project by Mike Hadley G4JXX

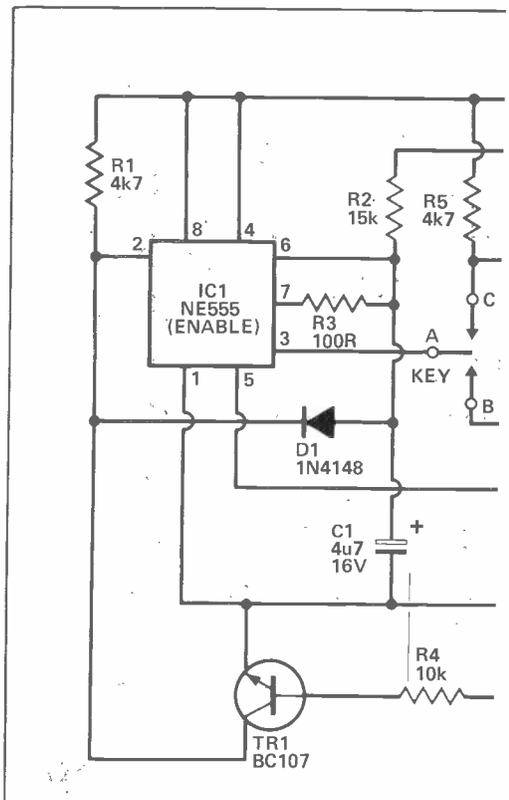
One of the most important and treasured items in an amateur's shack apart from his transmitter is his Morse key. Prized possessions, which are still in use today,may include keys that may have been used in world war one. Solid brass devices on marble or slate bases really look the part and are a pleasure to use.

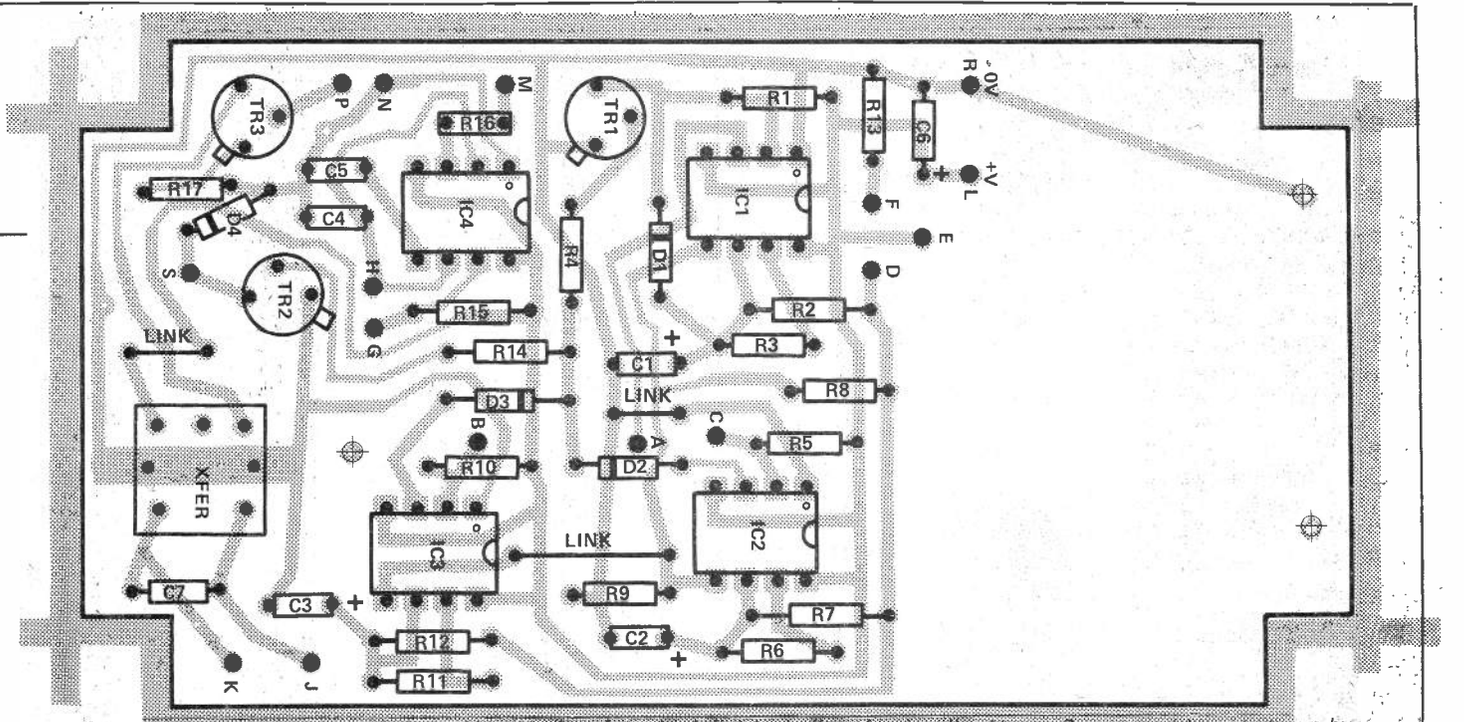
However, leaving nostalgia aside, the modern amateur may wish for something better, and go for a more up-to-date paddle key. Unfortunately a paddle key is no direct substitute for the original up down or straight key and needs the associated electronics to operate the transmitter.

Described here is an easily-built electronic keyer which features many of the facilities offered on commercially available keyers. It has adjustable speed from 10wpm to 40wpm, built in sidetone with variable pitch and volume. An on/off/tune switch is included to allow transmitter tuning.

The keyer simply connects between the paddle and the transmitter and may be run from its internal 9 volt battery or an external 7-15 volt DC supply.

Fig. 1 shows the complete circuit diagram. This circuit has certain advantages over many others, one is that





Opposite page: The keyer as built by Mike Hadley. A neat job finished off professionally. Above: Component layout, drawn by draughtsman Paul Edwards. Below: Circuit diagram with references for easy recognition of parts.

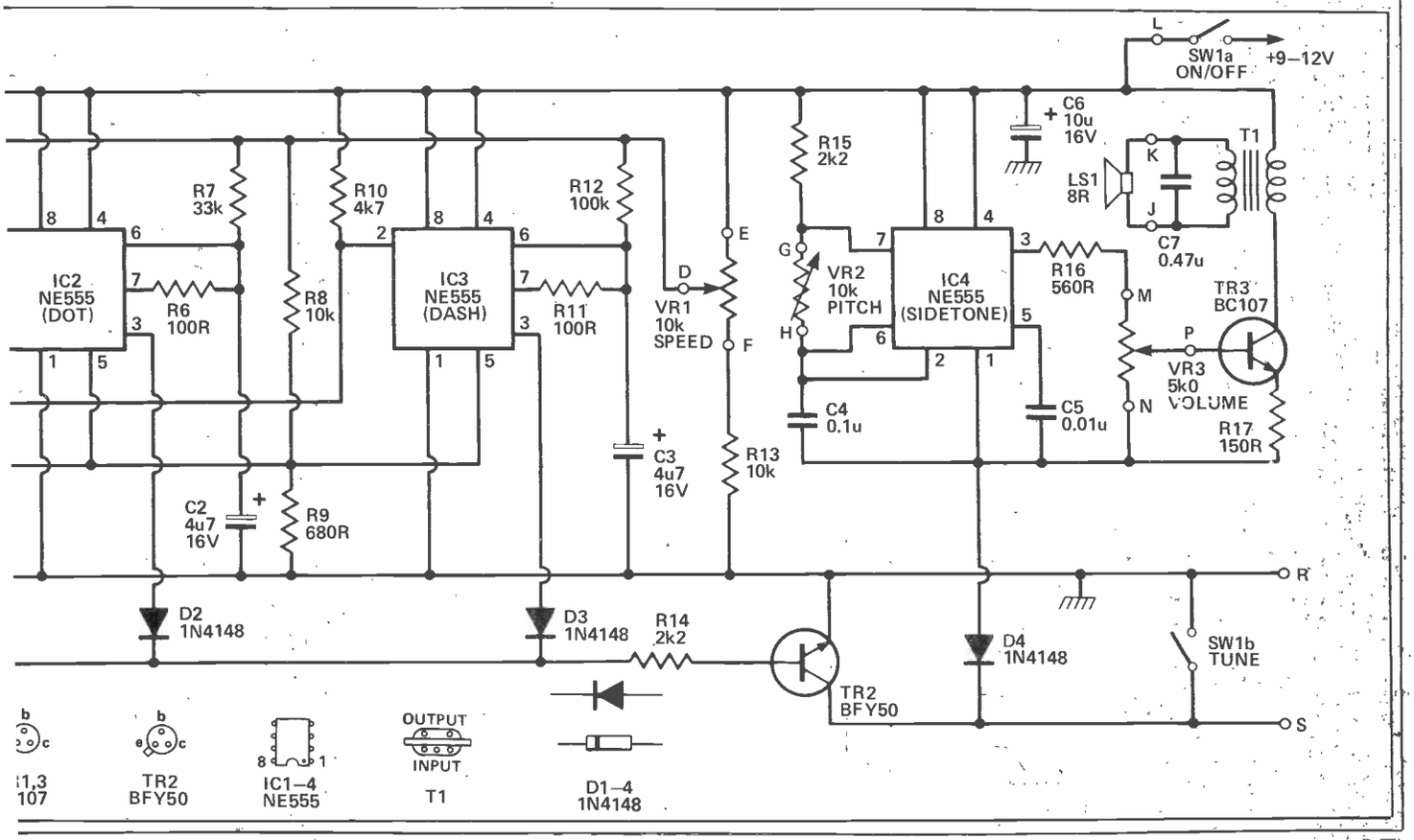
when a dot or dash is started no other information can be entered into the circuit until the end of the following space. This means that another character cannot be generated until the dot or dash entered is complete. Another advantage of this circuit is that because the capacitors are not discharged through the paddle key the possibility of timing errors is virtually eliminated.

The values of timing resistors R2, 7 and 12 or capacitors C1, 2 and 3 may be adjusted on test. Increasing the values of either lengthens the space, dot or dash respectively.

IC1 is an enable (or space) generator which has its output connected to IC2 or IC3 through the paddle enabling a dot or dash to be generated. VR1 (speed control sets the maximum voltage at which C1, 2 and 3 can be charged up to, and hence the speed of operation. The output of IC2 and 3 both connect to the bases of TR1 and 2. TR1 has an inhibiting effect on IC1 until a dot or dash is complete, eliminating the possibility of wrong timing.

TR2 is the output transistor which switches on during dots or dashes, effectively connecting point S to R or ground. At the same time D4 conducts and allows IC4 to perform as a side tone oscillator. The pitch is controlled by VR2. The output of IC4 is taken through to VR3 the volume control. TR3 amplifies the side tone signal and the output is fed to the loudspeaker through T1.

S1 is a three position on/off/tune switch, and tune position allowing the transmitter to be tested or loaded up without the paddle being operated. An integral 9 volt battery is used which is automatically disconnected when an external supply is used.



BUILD AN ELECTRONIC KEYER

Figs. 2 and 3 show the PC board artwork and component layout. Start assembly of the board by first inserting solder pins A to S, 16 altogether. The resistors are next, R1 to 17. Capacitors C1 to 7 should be fitted next. Observe the correct polarity of C1, 2, 3 and 6. The semiconductors are now assembled onto the board. ICs can be soldered directly to the board or mounted in 8-pin DIL sockets. Ensure that the IC pins are not bent over after being pushed into sockets. Diodes D1 to 4 have their cathodes marked by a broad yellow band. TR1, 2 and 3 should be mounted close to the PCB. Finally mount T1, and insert the two wire links which can be offcuts from resistors.

Before continuing, examine the board for missed solder joints and solder bridges. Check that all components are correctly positioned, especially diodes and capacitors.

Drill the box as shown in Fig. 4. The lid can also be drilled as in Fig. 5 and the loudspeaker glued onto the underside with contact adhesive. The potentiometers and sockets can now be fitted to the box. SKT1 (key must be insulated from the box.

Reasonable length of wire

Fig. 6 shows the wire connections from the PCB to the controls and sockets. Allow a reasonable length of wire for the battery clip and speaker. The battery is fixed into the space provided on the PCB and held in place with double-sided adhesive foam strip.

Make up a connection lead with a 3.5mm 3-pole jack plug and after identifying the common, dot and dash wires connect up to your paddle key. Set all three controls to about mid-position and switch on. Operate the paddle and adjust the speed, volume and pitch controls to your own taste. If everything is working then make up another connecting lead to connect from the phono output socket SKT3 to the key input of your transmitter. Switch the transmitter on, switch SW1 to the TUNE position. The transmitter should now be operating with a continuous carrier. Switch SW1 to ON: the keyer is now ready to use. Note that if an external DC supply is used the speed will vary depending upon the voltage.

Keyer with the top off

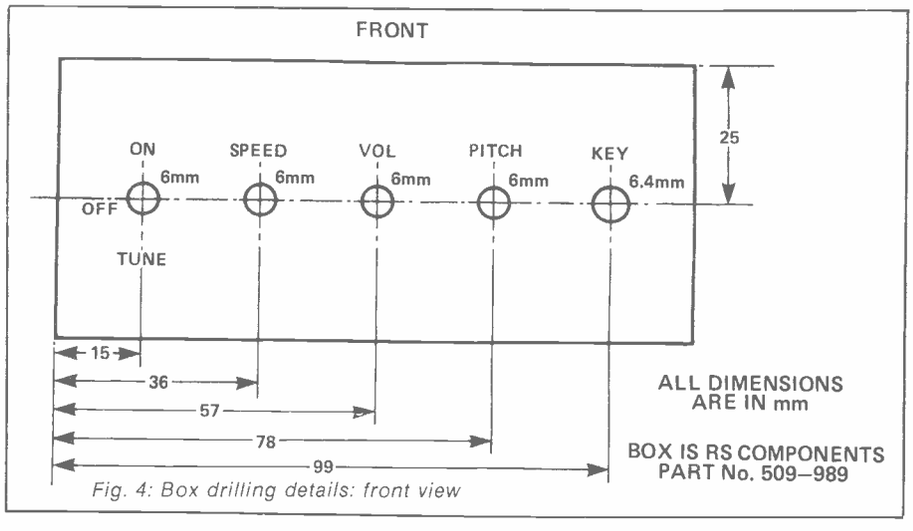


Fig. 4: Box drilling details: front view

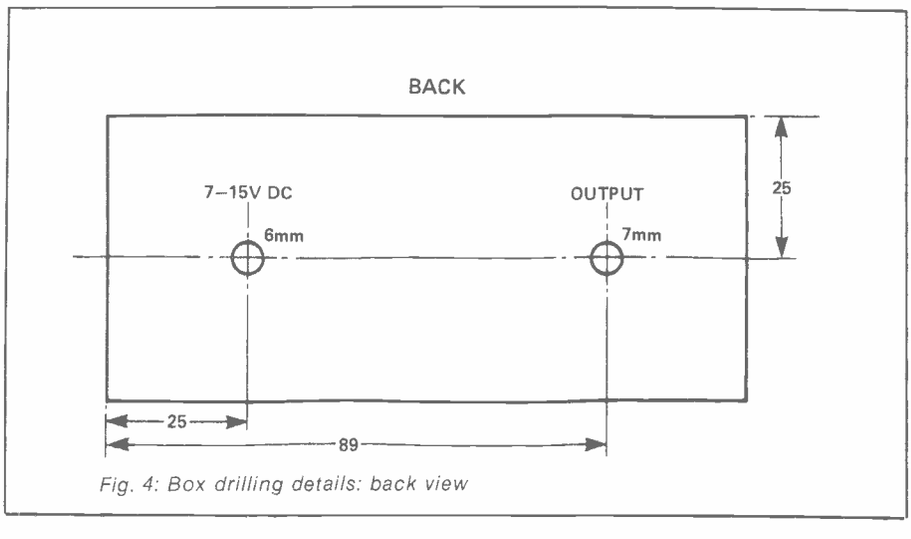


Fig. 4: Box drilling details: back view

"Before continuing, make sure you don't have any solder bridges - and for that matter, that you haven't missed any joints!"

Failure of the keyer to operate can be checked by disconnecting the output lead and operating the paddle. If sidetone can be heard but there is not output suspect TR2. If there is no sidetone or output switching, then try shorting SKT3 to ground. If the sidetone then operates the fault lies in the keying circuit before IC4. A careful check should then be made for circuit errors.

By connecting a straight up/down key to socket SKt3 the keyer can be used as a normal practice oscillator; useful if there is an up and coming Class A trainee around.

Semiconductor Design For the Radio Amateur. ARRL. The Radio Amateur's Handbook. RSGB. Amateur Radio Techniques. RSGB.

"Failure of the key to operate can be checked by disconnecting the output lead and working the paddle"

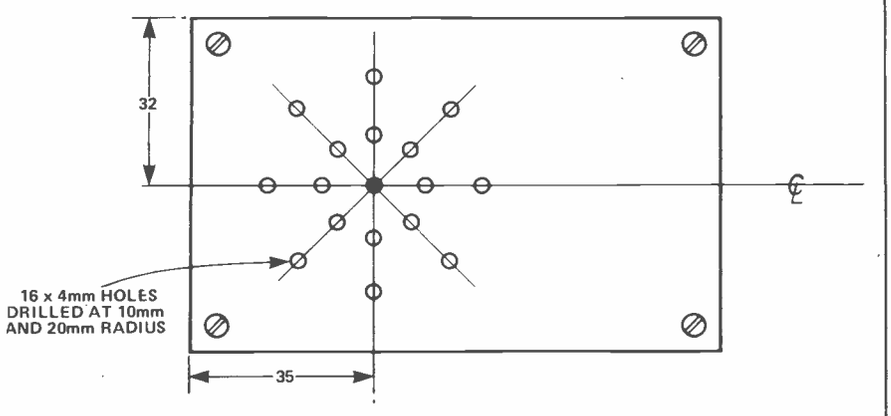


Fig. 5: Lid drilling details

components list

R1,5,10. 4k7
R2 15k
R3,6,11 100R
R4,8,13 10k
R7 33k
R9 680R
R12 100k
R14,15 2k2
R16 560R
R17 150R
VR1,2 10k lin pot. miniature
VR3 5k lin pot. miniature

C1, 2, 3. 4.7uF 16V tantalum
C4 100nF disc ceramic
C5 10nF disc ceramic
C6 10uF 16V tantalum
C7 470nF monolithic ceramic

IC1-4 NE555 timer IC
TR1, 3 BC107 transistor
TR2 BFY50 transistor
D1-4 1N4148 diode

T1 Miniature output transformer 8ohm 2 inch loudspeaker
S1 DPDT min. toggle switch, centre off
1mm dai. solder pins 16 off
Control knobs 3 off
Diecast aluminium box RS type 509-989
PP3 battery connector
SKT1 3.5mm 3 pole jack socket
SKT2 3.5mm 2 pole jack socket
SKT3 phono socket
M3x10 screws 3 off
M3 nuts and washers 3 off each
double sided adhesive foam
Wire solder etc

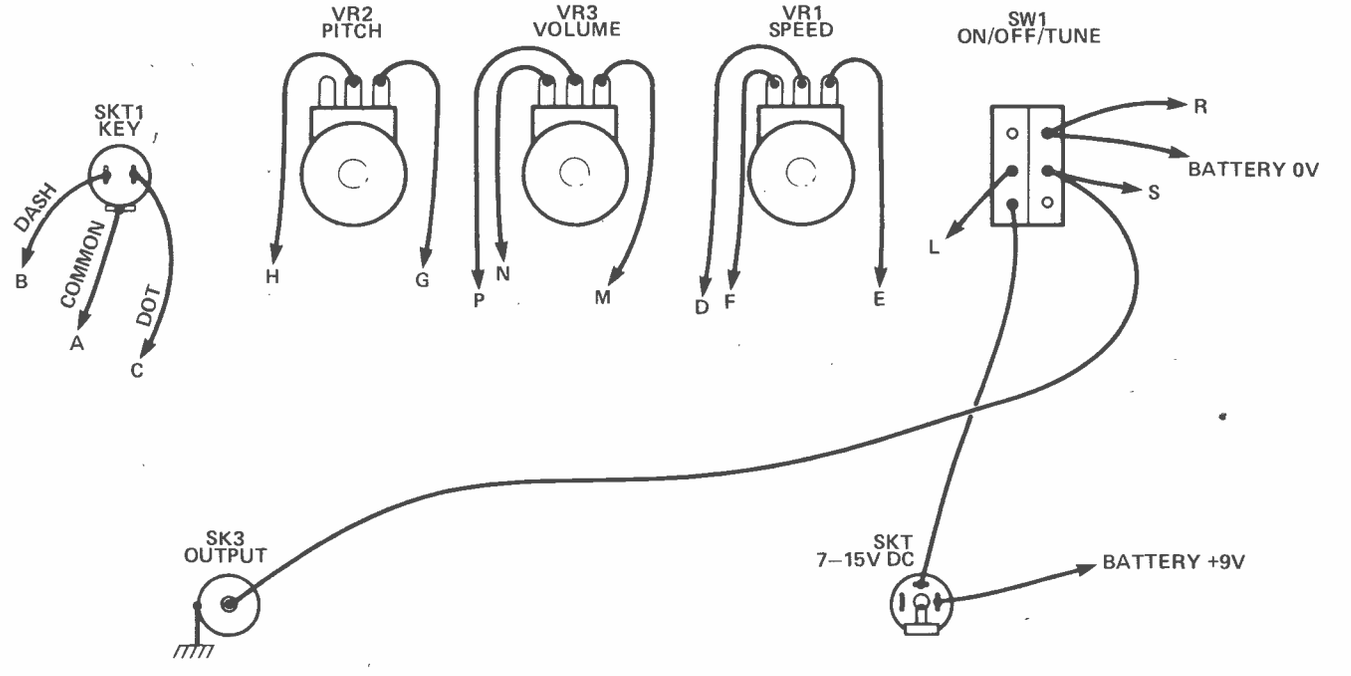


Fig. 6: Control and socket connections to the pcb

23cm

AMATEUR TV

part 3

Power meters, detectors, filters and matching devices are the subjects of this month's episode on how to get involved in amateur television, said to be the "growth band" in the amateur world.

Written by Andy Emmerson G8PTH

This month the attention is definitely on accessories, the bits I like to think really make the station work. If you like treat them as boring but necessary, but I find them the most interesting. Since we are doing the whole thing as a hobby, we can afford to do things properly. So in this section we shall be looking at power meters, detectors, filters and transmission line matching devices. We shall also take a close look at radar interference, how to combat it, and finally at some surplus goodies which you might wish to add to your station.

But before we get into all that we might as well clear up a few errors which crept into part one. At the first place I worked we were allowed to add 15 minutes to our timesheets for time spent on corrections; this was money for old rope because we always did the amendments during the working day, so I hope you won't mind casting your mind back a moment.

Boob number one was in the frequency table, where we quoted the FM repeater input frequencies; both I and the originator of this data should have known better! Due to the nature of an FM TV signal you cannot quote fixed vision and sound carrier frequencies, only a centre frequency. The audio is on a 6MHz subcarrier, added to the video.

Error two was the French deviation standard, which was quoted as 2.5MHz; it is now 3.6MHz. Sorry about these slipups. Now back to the plot.

Looking at meters

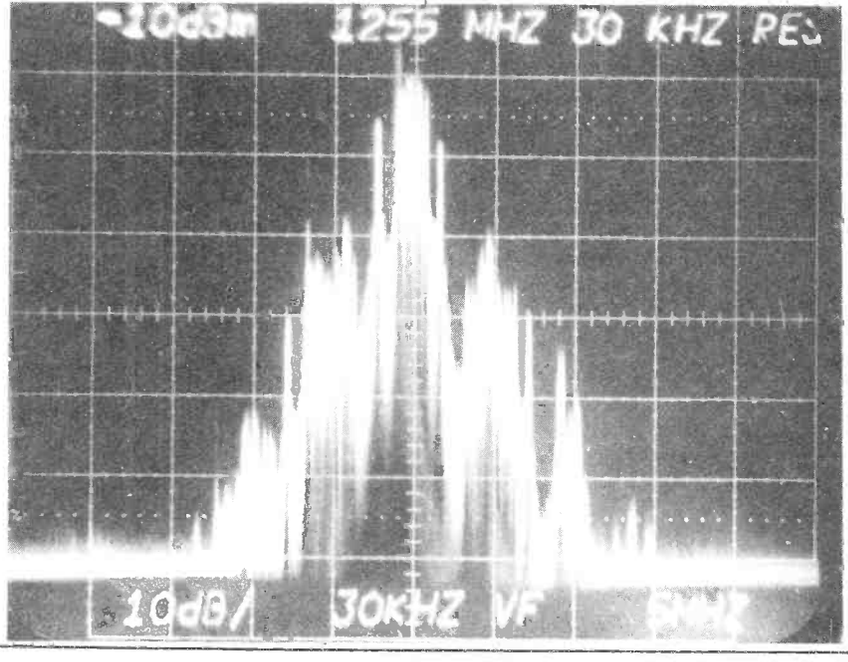
As on other bands it is useful to be able to monitor the power level transmitted, so we start looking at in-line power meters. Inserting any device in the feeder cable is likely to introduce a loss, and we must endeavour to keep this as small as possible. For this reason ycu may decide that homebrewing is not really on and a commercial product is the only answer.

Probably the nicest power meter for amateur (and professional!) use is the trusted Bird model 43. This is not cheap in any sense of the word, but the meter body can often be found at rallies for £70 or so. Considering its quality and versatility it must be worth considering. The inserts, or slugs, which are tuned to wavebands, are not cheap and will almost certainly have to be bought new from the UK agent, Aspen Electronics. They will send you a catalogue showing stock elements, which may or not cover your requirements - they can also obtain a wider range covering 23cm at higher power levels from the USA. An alternative, and superficially a bit slicker, is the Japanese Daiwa device, obtainable from Lowe Electronics. This is the popular cross-needle design of power and SWR meter, and model CN650 covers the range 1.2 - 2.5GHz up to 20 watts. Price is £128 including VAT. If you feel like suppporting cottage British industry and spending a little less you could go to Les Wicks G3ZUD, who sells a switchable 3/30W meter for around £30.

This unit is sufficiently directional to assess VSWR down to 1.1:1. Insertion loss is less than 0.5dB. It is built in a solid diecast box and further details can be obtained from L-Wave.

If you feel keen to do your own thing you can couple up a sensitive meter (eg. 100 microamps) to a home-made diode detector. One design was published by the RSGB in 1976 and reprinted in issue 120 of *CQ-TV* (November 1982). This design has some limitations, as noted in the article. The *CQ-TV* article offers an alternative project. You could of course, use a commercial, laboratory type directional coupler - this can go for £5 or so at rallies, assuming you know more about it than the stallkeeper.

Filters have a number of uses in amateur radio systems; at 24cm they serve two main purposes. If we are using a tripler from 70cm a bandpass filter is essential to prevent the radiation of highly undesirable wideband signals in bands which may or may not be ours. A filter is also essential when you test the power levels into and out of your monster PA

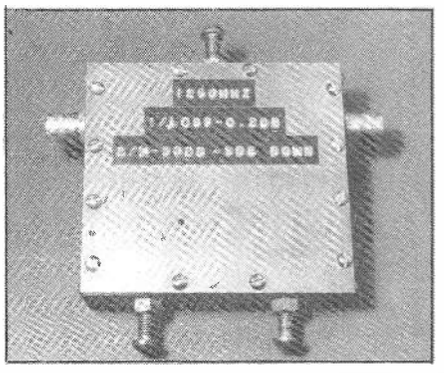


A picture taken from a spectrum analyser indicates how much an FM TV signal differs from its AM counterpart. Shown is a PAL colour test card with audio subcarrier at 5.5MHz offset. Nominal carrier frequency is 1255MHz with a swing of 3.6MHz, ie the French standard. (Photo courtesy F3YX).

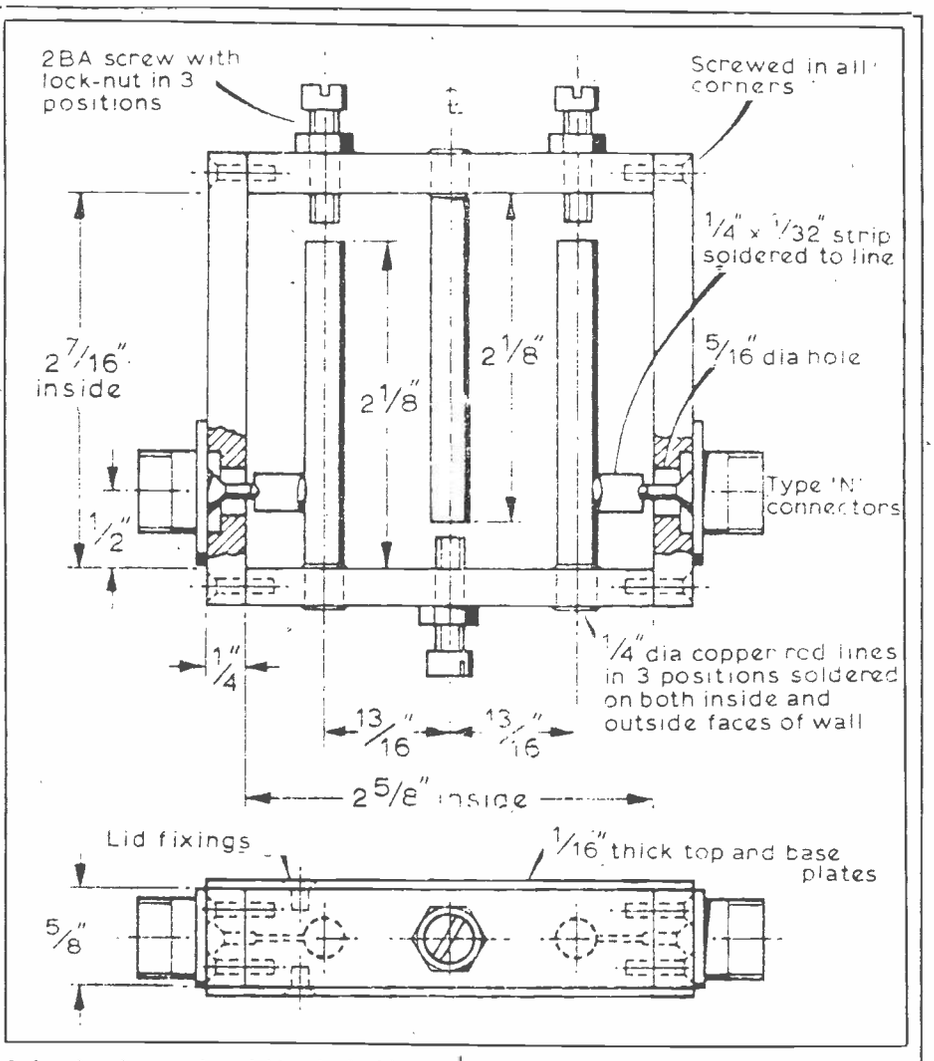
device, otherwise you might be poking more 70cm than 24cm into it! We also need filters to sharpen up the receiver passband and perhaps reduce the effects of radar interference.

The classic filter design for 23 or 24cm is the three pole interdigital job first written up by W2CQH in *QST* (March 1968). The RSGB VHF Handbook has a variant of this which serves our purpose admirably. For a negligible insertion loss of 0.5dB a passband of about 40MHz (3dB limits) can be achieved. This is a homebrew job and if you don't feel up to it there may well be someone in your local club who has workshop facilities and will make one up for you.

A slight modification of this design turns it into a simple transmit/receive splitter for a repeater, as described in *VHF Communications* a few years ago. The Winter 1976 issue of the same publication also had an article on another method of making these filters. Commercially made bandpass filters are available through Piper Communications, though I cannot see any in the catalogue which would be particularly useful to us, having rather narrow bandwidth and thus high insertion loss.

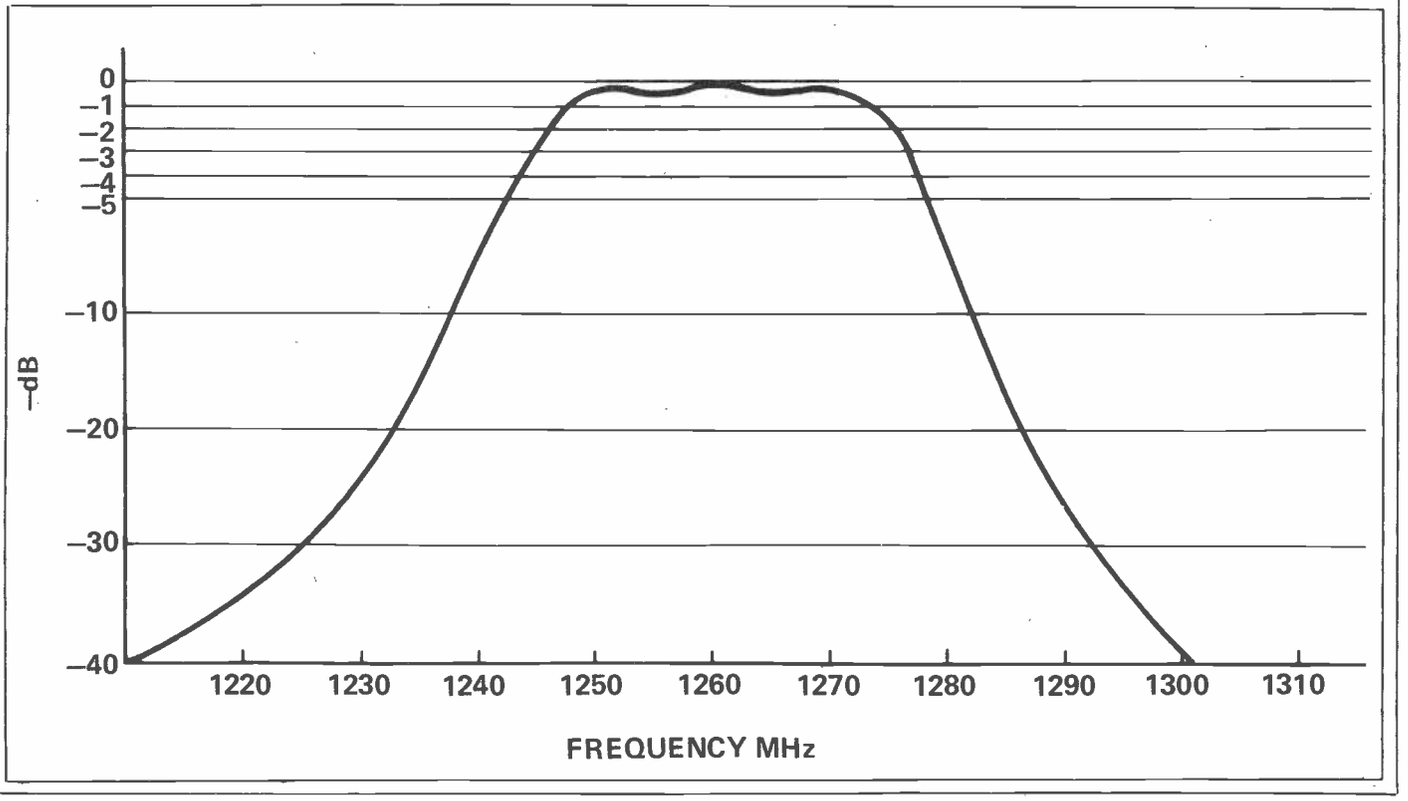


Left: what the interdigital filter looks like.



Above: constructional details of a suitable interdigital filter. (Materials not mentioned are brass; connectors may be N-type or BNC, flanged or screw-in - in the latter case you can drill and tap the side walls of the filter to take the socket.) With acknowledgement to G3LTF, G3WDG and G3YQC.

Below: typical interdigital bandpass filter response (G3YQC).



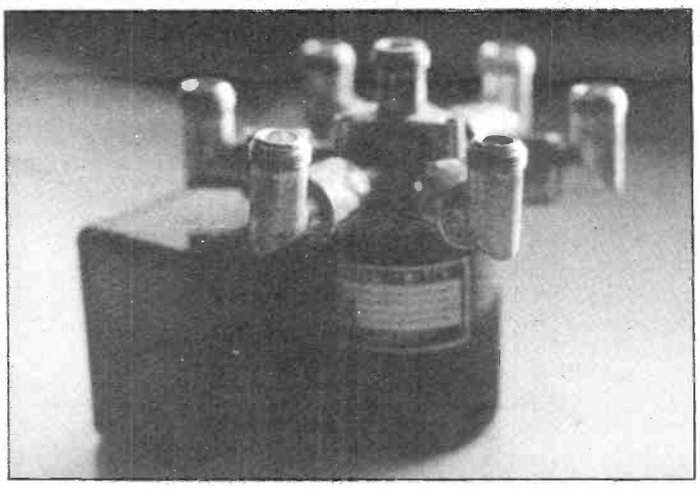
23cm AMATEUR TV

part 3

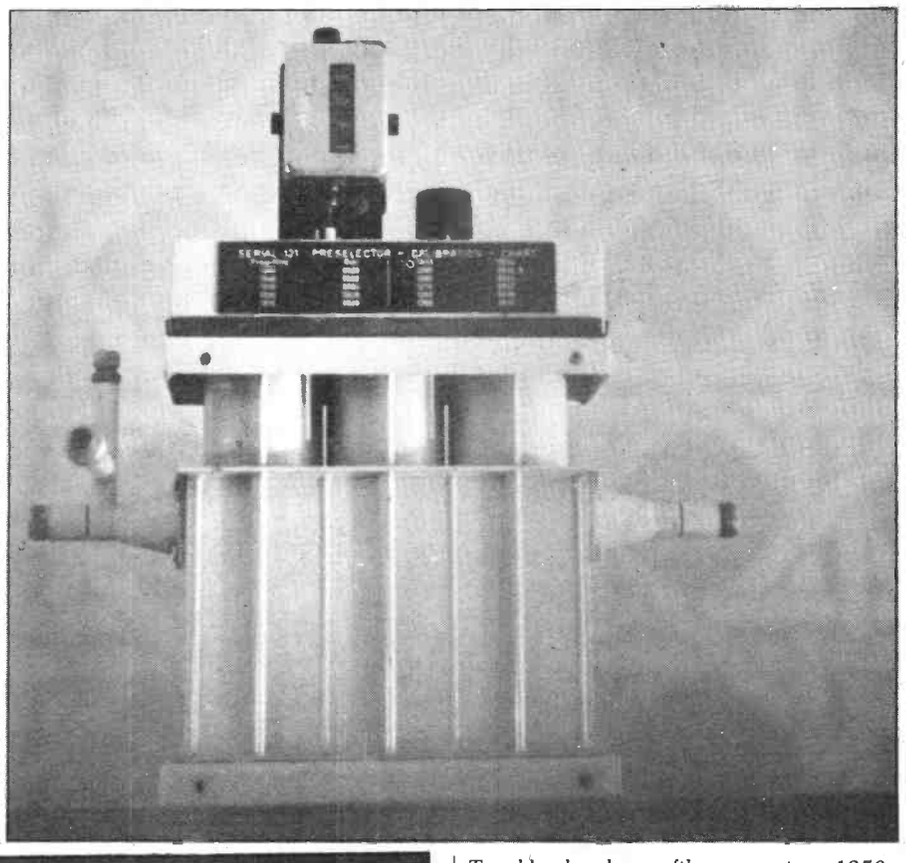
A filter is also useful on the receive side, and will help keep out-of-band signals out of wide-open front ends. Any unwanted signals, even noise, will reduce the performance of our receivers so it is as well to keep the input as narrow as possible - without cramping the desired ones of course. If and when radar becomes a problem we must take special steps. As noted last time, we share our quarter-metre band with both civil and military radar which in some parts of the country makes things rather awkward for us hams. Sites include Heathrow, Clee Hill, Pease Pottage and Burrington; if there are others no doubt the afflicted will write in!

Assuming a centre frequency of 1255MHz for our TV transmissions and positive modulation (sync = 1253 and peak white = 1257MHz, approx.) the radar interference will appear as black lines. Although annoying, it would look a lot more prominent (ie.as white lines) if our TV transmissions were negative modulation. The excellent *UHF Compendium* compiled by DJ9HO (available from RSGB Publications) devotes a chapter to the reduction of radar interference and with the aid of filters. The majority of the power is concentrated in a fairly narrow band, however, and employing a narrow-band filter ahead of the receiver is the answer. Although the filter may reduce the receiver's sensitivity by 2 or 3dB (the filter's insertion loss) it can make a 40dB improvement overall by eliminating radar signals say 15MHz away.

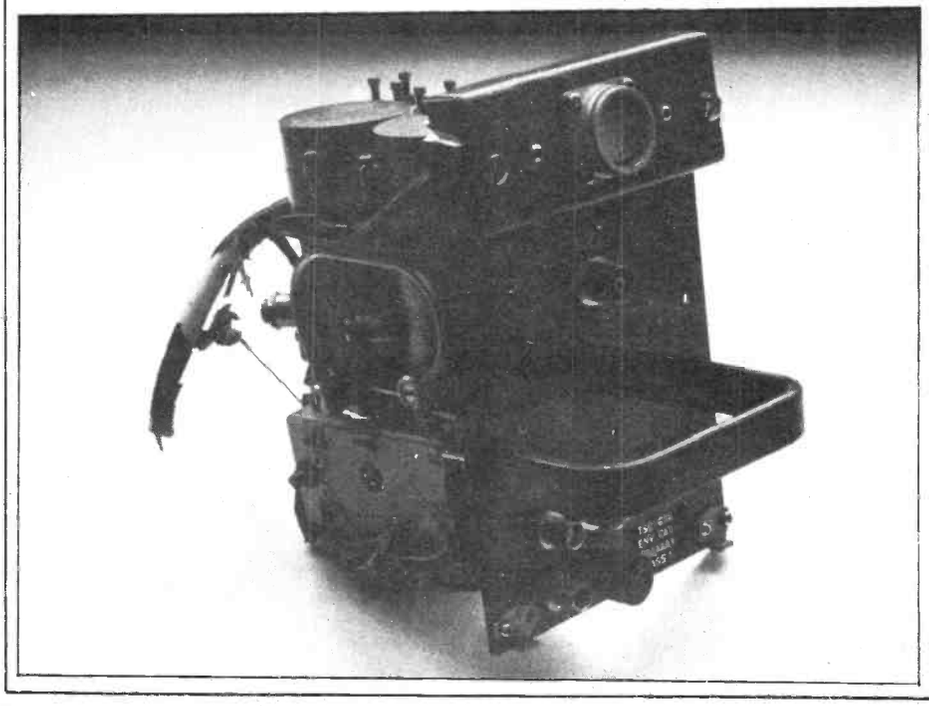
An alternative solution, sometimes practised by G8BVC is to go back to slope detection (narrow-band AM), to reduce the width of the receiver.



Surplus six-way aerial switch: the seven type N sockets are a single casting! Operated by a 24V solenoid, to which I have added a homebrew control panel.



Tunable bandpass filter covering 1250-1350MHz (bandwidth 5 to 8MHz), obtained at a Leicester rally.



A lot of hot air is expended debating the merits or otherwise of ATUs, matchboxes or whatever you call them. At 23 and 24cm we are dealing with a wide swathe of spectrum and it is a clever aerial which maintains a flat 50 ohm match between, say, 1250 and 1320MHz. If we intend to transmit at both ends of that range through the same transmitter a transmission line matching device will help ensure that the transmitter sees a fairly constant load. The tuners are even more important if we intend to transmit really high power - you know, rings of six 2C39s and the like!

Gold plated cavity assembly from a Cossor aircraft radar transponder. This cost £10 complete with valves and is worth far more!

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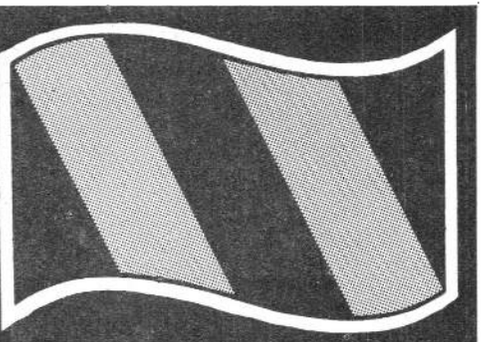

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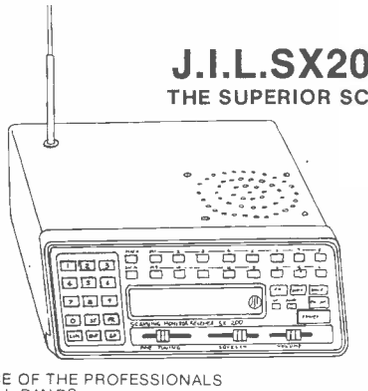

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24cm AMATEUR TV part 3

Two designs are commonly in use, the twin stub tuner and the two-slug coaxial tuner. Both devices allow standing waves to be tuned out of a 50 ohm line and when constructed turn out to be around a foot long. The two-slug tuner is slightly easier to make and certainly takes up less space in the shack.

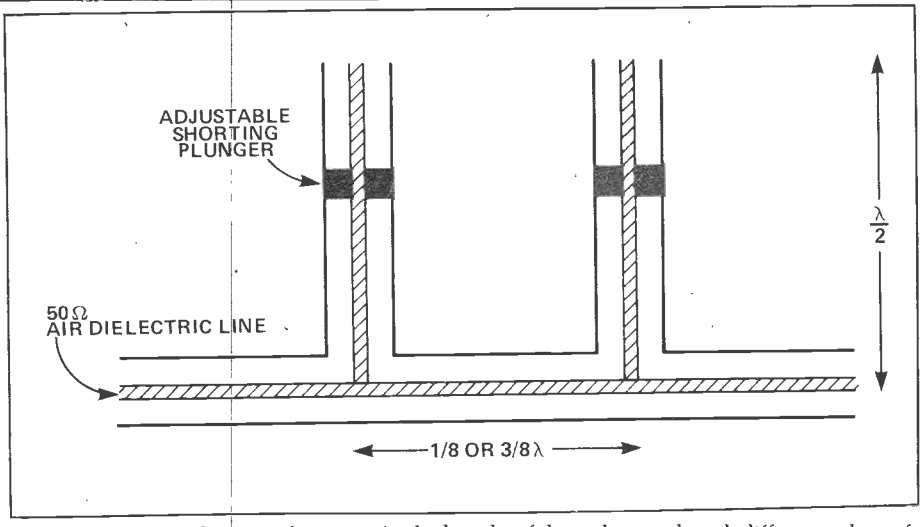
The two-slug machine was made commercially by Silverstone Electronics for a while, and you could contact Cyril to see if he could still make one for you. I have a twin-stub one but the Silverstone product looked extremely professional.

In a way I am not sure why I should turn you on to such niceties, but sheer logic indicates I cannot get round to all the rallies to snap up the bargains. Joking apart, there are a number of highly desirable types of equipment which can be found at rallies which would otherwise be quite outside our price bracket! Things like wavemeters, cavities and filters.

Cavity wavemeters are essentially a mechanical device and as such do not possess the accuracy of frequency counters. But apart from this they are much cheaper and used as absorption wavemeters are excellent for checking the frequency of a signal. A number of British and American designs of cavity wavemeter can be found on the surplus market at between £5 and £15; typically they cover 0.5 to 1.5GHz or 1 to 2GHz.

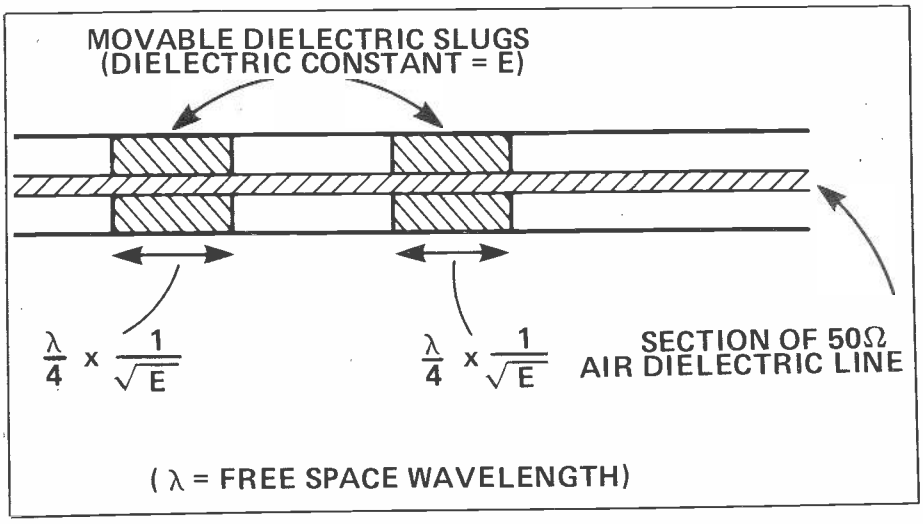
Cavities containing valves are also worth looking out for; you will be lucky to find the fabled UPX-4 device (which contains a 2C39 and is eminently capable of becoming an 80W output PA stage). Other cavities are also useful if only for their components. They usually have some high-voltage feedthrough capacitors and fingerstock, which will come in handy for building your own PA. The cavities may be for the radar bands around 1030MHz and thus not directly suitable for amateur use, but some people do strange things to alter their resonant frequencies (which are beyond the scope of this article).

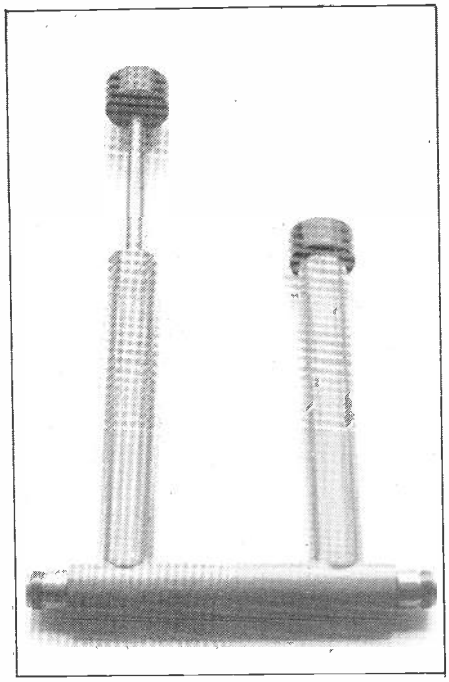
From time to time complete radar installations are broken up and you may come across the type of combined tunable bandpass filter and diode detector which I found at a Leicester rally a couple of years ago. All surplus items are a bit of a gamble and you have to have some idea of what you are buying. If the price is low enough you cannot go too far wrong. The only sad thing is that some of the surplus dealers have found that the precious metal content is worth more than amateurs can pay, and the silver-plated cavities go straight to the reclamation specialists rather than to the rallies.



Two stub tuner: schematic diagram. As the lengths of the stubs are altered, different values of inductive or capacitive susceptance are added to the 50 ohm line section.

Two slug tuner: schematic diagram.





Twin stub tuner for minimising VSWR

That's all for this month. In part four we look at where the activity is, both at home and abroad, plus how far the repeaters have progressed. Also how you can work crossband and in relay mode. See you then?

1. Aspec Electronics Ltd., 2 Kildare Close, Eastcote, Ruislip, Middx., HA4 9UR. Telephone: 01-868 1188. (This firm is prepared to deal with amateurs on a cash with order or credit card basis).

2. Lowe Electronics Ltd., Chesterfield Road, Matlock, Derbys. Telephone: 0629 2817/2430.

3. L-Wave 33 Gillam Butts, Countesthorpe, Leicester LE8 3PX.

4. Piper Communications, 4 Severn Road, Chilton, Didcot, Oxon DX11 OPW. Telephone: 0235 834328.

5. RSGB Publications (Sales), Alma House, Cranborne Road, Potters Bar, Herts., EN6 3JW.

6. Silverstone Electronics, High Street, Whittlebury, Towcester, Northants. Telephone: Silverstone 857350.

If writing to any of these organisations please include an SAE; it's a small courtesy and ensures a prompt reply.

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2. 500mW TV Transceive	(As 1 above plus TVUP2 +PSI 433)	50.00
3. 10W TV Transmit	(As above plus 70FM10 + BDX35)	50.00
4. 10W TV Transceive	(As 2 above plus 70FM10 +BDX35)	70.00
5. 70cms 500mW FM Transceive	(70'T4 + 70'R5 + SSR1)	70.00
6. 70cms 10W FM Transceive	(As 5 above plus 70FM10)	90.00
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10. 2M Synthesised 10W Transceive	(R5+SY+SY2T+SSR+144FM10)	100

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CLUB CALENDAR

Axe Vale

Meetings of the Axe Vale Amateur Radio Club are held in the Cavalier Inn, Axminster, on the first Friday in every month at 7.30pm. Further details from: Bob Newland G3VW (Secretary) on Lyme Regis 5282, or Roger Jones G3YMK (Publicity Officer) on Upottery 468.

Braintree

The Braintree and District Amateur Society meets on the first and third Fridays of each month at the Braintree Community Centre in Victoria Street at 7.45pm. More information from Pat Penny G6TAF on Braintree 26487.

British Telecom Post Office AR Club

We received a letter from S. Granger G4NSG, of Birmingham, the other day, informing us that the inaugural meeting of the above named club (assuming it is decided to call it that) is being held on April 2nd at 7.30pm in the Committee Room, Head Post Office, Blucher Street, Birmingham.

More information can be had from the club's "secretary", Mike Green, on 021 643 3258 or 6945.

Bury

The Bury Radio Society meets each Tuesday evening at 8pm in the Club Room at the Mosses Youth and Community Centre, Cecil Street, Bury. Main meetings are on the second Tuesday of each month. More details from Brian Tyldsley G4TBT, on Burnley 24254.

Cheshunt and District AR Club

April brings a number of special events at this club, which meets at the Church Room, Church Lane, Wormley, Cheshunt, every Wednesday at 8pm.

April 4th Dick G3NEE, will chat about his trip to Australia, while the 11th heralds a natter night. On April 18th there is a talk by Terry G8LXB, on 'The Royal Observer Corps today'. There is another natter night on the 25th, while on May 2nd John G3WFM discusses contest operations, and on the 16th Ian G3NRW talks about AMTOR, Packet radio, and RTTY. There's more information where that came from, by contacting the Secretary, Roger Frisby G4OAA, at 2 Westfield Road, Hoddesdon, Herts. Telephone number is 0992 464795.

308

The 308 Amateur Radio Club, named (numbered?) after the room at the Kingston College of Further Education where it holds its meetings, meets each Monday to study for the RAE. They also meet every Tuesday evening at the Old Coach House in Church Hill Rd., Surbiton at about 8pm. (It's not a pub, but a church hall.)

Magherafelt

The Magherafelt Amateur Radio Society meets at 12 Garden Street, Magherafelt on the first Tuesday in each month, and a varied programme of events is being planned for the coming season. Morse classes are held each Tuesday evening and an RAE class is held in the local Technical College on Monday evenings.

Visitors and new members are most welcome. Further details and programme are available from the Secretary, Jack Chapman (G14LVC), Tel: 0648 32096.

Stratford-upon-Avon

The Stratford-upon-Avon and District Amateur Radio Club meets at the Control Tower, Bearley Radio Station, Bearley on the second and fourth Mondays of each month starting at 7.30pm. (Talk-in available on 145.55MHz).

Swale

The Swale Amateur Radio Club meets at the Ivy Leaf Club, Dover Street, Sittingbourne each Monday at 7.30pm. More Details from Brian Hancock G4NPM. Tel. Minster 873147.

Eastbourne Electronics Club

The Anchovy Youth Club, Sea Side Road, is the home of the Eastbourne Electronics Club, which meets every Friday at 7.30 for a construction evening with professional guidance.

Every Sunday evening at 7.30 we hold an RAE course for those wishing to get a Radio Amateur's Licence; at the same time a Morse course is run for those wanting to get their A licence. We also have a lively computer group and organise special visits etc. For more details contact the Membership Secretary Mart Sullivan, on Eastbourne 765701.

As a matter of interest, the club has been running for less than a year and we have about 70 members already. About 30 of these are now licenced amateurs and we have a further 16 taking the RAE course, which incidently, is very successful as our last class of 14 passed part II with 100 per cent success. Unfortunately, four failed part I, which we do NOT teach!

This coming summer we intend to take part in the VHF contests now that we have enough licenced members. We also intend to have an active club station for which we are at the moment awaiting a callsign.

Horsham

The Horsham Amateur Radio Club meets on the first Thursday of each month at the Guide HQ, Derwne Road, Horsham at 8pm. Details: John Matthews G3WZT on Partridge Green 710565, or Peter Head on Horsham 64580.

Ipswich

The Ipswich Radio Club meets on the second and last Wednesdays in each month at 8pm, in the Club Room of the Rose and Crown, 77 Norwich Road, Ipswich. Morse classes are usually held on the other Wednesdays, but check beforehand with the Secretary, Jack Toothill G4IFF, on Ipswich 44047. 28: constructors' contest.

Jersey

The Jersey Amateur Electronics Club meets at the Communicare Centre, St. Brelade at 8.15pm. Details from Phil Johnson GJ8KNV (Secretary). Tel: Jersey 53333.

Lincoln

The Lincoln Short Wave Club holds formal meetings every second and fourth Wednesday of the month beginning at 8pm. Mar 28: AGM.

Microwave Society

The Microwave Society looks after the interests of all those operating on, or interested in, frequencies above 10GHz.

The well-known Datapack (which includes all you need to know to build up a complete system for under £40) has now been completely revised and is now in its 5th edition. The society's newsletter, 'Waveguide' keeps members up to date with society affairs and also includes updates for the Datapack.

This year sees the start of the society's awards and certificates scheme for acheivements on the frequencies above 10GHz. Some indication of the growth of interest in microwaves is the fact that nearly 200 new members joined the society during 1983.

The society looks forward to meeting as many microwave enthusiasts as possible on its stand at the NEC rally and the large number of club talks undertaken in the course of the year. Full details from The Microwave Society, 81 Ringwood Highway, Coventry, CV2 2GT.

Nene Valley

The Nene Valley Radio Club meets on Wednesdays at 8pm at the Dolben Arms, Finedon, Nr. Wellingborough. They transmit from the First St. Mary's Scout Hall, also in Finedon. Mar 28: RSGB by John Nelson.

North Devon Radio Club

This club meets at new venues on a regular basis. On the fourth Wednesday of even months, starting at 7.30pm, they meet at the Pilton Community College, at Chaddiford Lane, Barnstaple, while on the fourth Wednesday of odd months, the meeting place is the Bideford Community College, at Abbotsham Road, Bideford.

If you can work that one out, your next step is to contact G. Hughes, G4CG at 'Crinnis', Highwall, Barnstaple, Telephone 0271 43683.

Peterborough

The Greater Peterborough Amateur Radio Club holds its meetings at Southfields Junior School, Stanground, Peterborough, at 7.30pm, usually on the fourth Thursday of each month, when the schools are in session.

Rhyl

The Rhyl and District Amateur Radio Club meets on the first and third Mondays of the month at the lst. Rhyl Scouts' Hut, Tynewydd Road, Rhyl at 7.30pm. Information from John McCann GW4PFC on St. Asaph 583467.

Salop

The Salop Amateur Radio Society meets every Thursday at 8pm (usually) at the Albert Hotel, Smithfield Road, Shrewsbury. Every other week is a natter night. Mar 29: talk and visit by G6DYW.

South-East Derbyshire Radio Society

This society meets each Tuesday during term time at 7.30pm. Most evenings we have either a talk or discussion. Contact me for details: W.F. Peck, G4VNB Secretary, 2 Sandfield Avenue, Ravenshead, Nottingham NG15 9AR Telephone 0623 795380.

South Bristol AR Club

This club meets every Wednesday evening at the Whitchurch Folk House, East Dundry Road, Whitchurch, Bristol and more information is available from Len Baker G4RZY, secretary, who lives at 62 Court Farm Road, Whitchurch. Telephone number is 0272 834282. Activities include the following events. April 4th: lecture on data comms, RS232 to X.25 by Steve G4MCQ. April 11th: HF night. April 18th: start of club VHF DX contest. April 25th: 10 metre FM night. May 2nd: lecture on 23cm operation.

Southgate AR Club

The above club meets on the second Thursday of each month at the St. Thomas' Church Hall, Prince George Avenue, Oakwood, London, N.14, and the starting time is usually around 7.30 for 8pm.

Man to get in touch with is Robert Snary G4OBE at 12 Borden Avenue, Enfield, Middlesex, while there is a lively programme of events throughout the year. April 12: Surplus equipment sale. May 10th: talk by representative of Marconi (provisional at the time of going to press). Future dates include equipment demonstrations, home brew evenings, and construction competitions.

From May onwards, the club will be giving full support to a local amateur G3TZZ who is the Mayor of Enfield, in his efforts to raise money for charity.

South Manchester Radio Club

Forthcoming events for this club include the following:

April 6th History of the club, by G3HZM.
April 13th Radio signalling in British Rail, by G8WEN.
April 20th Closed during Easter
April 27th Home Brew equipment, plus a contest for junior. novice and senior members.

In May there are a number of interesting meetings, including one on the 11th, Japanese Morse, by Norman Kendrick G3CSG. All about receiving Japanese Morse during the war, so it should be worth attending.

The club meets at 8pm at the Sale Moor Community Centre, Norris Road, Sale, Cheshire, and they also run meetings at the same time on Mondays for a natter. Arrive and be recognised.

Midland AR Society

We have been in existence for just over 50 years with, for various reasons a fluctuating membership which now stands at 200 'paid up' and a miserable 40 or so who are proving to be reluctant to 'cough up' but a spell on the rack or whipping post should produce some results, the hardened ones have an additional penalty of an article for our magazine, the result being that we don't get either!! Don't expect to win them all.

The club premises are located at 29a Broad St, Birmingham B1 2DS, the city end of Broad St, facing the Repertory Theatre and a few doors up from the Registry Office and in the shadow of the Central TV building. The aerials will help to identify, a beam for 10-15-20, a Colinear and beam for 2 metres with a beam for 70cms to go up for the benefit of the Am TV members.

The premises comprise a meeting room, seating about 40; heaven preserve us from a full meeting! A 'shack', a kitchen fully equipped with sink unit with H & C on tap, an urn for the very essential job of making tea, a fridge to keep milk and other beverages cool, plus a full size electric cooker for use when the club is in use at the weekends on contests etc, and a room yet to be finished to be used as a 'lounge' to cope with overflow meetings and to lounge around in when there is nothing else to do.

Our weekly table of evening events goes something like this:

Monday: Construction nights with Ken G4SY
Tuesday: 1st in month - Committee meeting
Tuesday: 2nd in month - Computer night with a British Telecom club
Tuesday: 3rd in month - monthly meeting. Talks, surplus sales etc.
Tuesday: 4th in month - B'ham Central Raynet Group.
Wednesday: Morse class G4JBB/G4TKM Natter night.
Thursday: HF night - on the Air Natter night.
Friday: RAE class with Maurice G4JBB

Official meetings start at 19.30 with a 19.00 start for other weekly meetings, tea and biscuits are usually available if someone can be prevailed upon to act as tea-boy.

We have members in places as far apart as Austria, Gozo and Australia with UK members anywhere between Cumbria and Torquay and the magazine also goes out to the local libraries.

I am retired so can be reached on the phone most days or on S17, 145.425 on two metres which channel I monitor for about twelve hours per day to give news of club doings as requested, or even as 'navigator' to lost amateurs. Past knowledge of the area as field engineer is very useful and aided by a map and a street guide, there isn't much that cannot be found.
Tom Brady G8GAZ. Post boy for the Midland Amateur Radio Society.

Newbury

The Newbury and District Amateur Radio Society meets monthly (2nd Tuesday of the month), usually at Newbury Technical College.

CLUB CALENDAR

Southdown AR Society

This society will be running a number of contests in the near future, and we can do no better than list them briefly here:

May 19/20th: 144MHz/432MHz
June 2/3rd: 144MHz
July 7/8th: HF, NFD (CW)
August 4th: Individual 432MHz low power (including SARS contest).
August 5th: Individual 144MHz low power (including SARS contest).

Southdown's latest magazine includes a useful item on making your own pcbs. G4RUL writes: "A lot of people shy away from making pcbs because of the fiddly design work; a method that I use is to actually drill the holes first, then plot the tracks and etch. It's a bit like dot-to-dot. If you have a veroboard design, you can transfer this to a pcb quite easily; use some sticky tape to fix the vero to the pcb material, then using a suitable small drill, make the holes in the pcb through the holes in the vero, using the positions on the vero layout.

"It's then a simple matter to join up the dots, with an etch resist pen to get the pcb pattern. Even if copying a published pcb layout it's still quite convenient to drill out the IC DIL holes before making the markings for the tracks using the veroboard template. This ensures that the tracks will match the holes which in turn will match the pins on the IC.

"One word of warning. Do make sure that you allow for the mirror image effect when looking at pcb and vero layouts from the component side."

More information about this society from: T. Rawlance G4MVN, 18 Royal Sussex Crescent, Eastbourne.

Stevenage

The Stevenage and District Amateur Radio Society meets on the first and third Tuesdays of each month at 8pm at: T.S. Andromeda, Fairlands Valley Park, Shephall View, Stevenage.

Stourbridge

The Stourbridge and District Amateur Radio Society normally meets on the first and third Mondays of each month. The Society meets at the Robin Woods Centre, School Street (off Enville Street), Stourbridge at 8pm.

Thanet

The Radio Club of Thanet meets at the Grosvenor Club, Grosvenor Place, Margate at 8pm on the second and fourth Tuesdays in the month. Club nets are on 28.4MHz at 9.30am on Sundays, and on 145.575MHz at 8pm on Thursdays.

Verulam AR Club

This club meets at the RAF Association headquarters, New Kent Road, off Marlborough Road, St. Albans, on the second Tuesday in each onth. On April 24th Brian Harber G8DKK will give a talk entitled: Advances in modern mixer systems. Visitors are welcome, and can contact the Hon. Secretary of the club, who is Hilary Claytonsmith, G4JKS, 115 Marlshalswick Lane, St. Albans. Telephone 59318.

Worcester

The Worcester and District Amateur Radio Club meets at 8pm at the Oddfellows Club, New Street, Worcester

Classified Ads

• **ZENITH TRANS** Oceanic portable American communication receiver VHF LW.MW. short wave 2 to 18 MHz battery & power vgc. £80. H.C. Bach, 52 Tudor Close, Belsize Ave, London. Tel. 01 794 9796.

• **WANTED.** Drake desk mic 7075 7077 type phone Pete. Nuneaton 349461 For sale Drake MN4C ATU SWR Power Meter 160m-10m as new boxed from USA full instruction book £90. Pete. Nuneaton 349461.

• **MEDIUM WAVE** Transmitter, 50W output, crystal controlled, excellent modulation quality £130. Also FM broadcast transmitter 88 TO 105 MHz. 80 watts output. £120 with instructions. 01-672 8764. Cole. 39 Tootking Bec Gardens SW16 1RE.

• **TR1 7010** 2MT SSB transceiver 40ft lattice tower cushcraft ele 2mt ant herchman rotator 18ft stub mast 20mt UR67 20mt rotator cable. £300 ono. Contact G6 TVP Tel, Scunthorpe 853417.

• **WANTED:** built or kit Hac one valve model DX MK3 surplus to requirements. Mr. L. C. Johnson, 31 Edward Avenue, Jacksdale, Notts.

• **SINCLAIR ZX81** computer with 16K ram, will exchange for 2 metre Linear amp. 50 watts or more. Also have R107 MK 1/1 receiver in working order £30 ono. Garry Binns (G6SBA), Tel. 061 969 1681.

• **FOR SALE:** MMT 144/28 HF to VHF transverter 12W O/P new still under warranty £80. MML 144/40 Linear amp 10W in 50W out £48. Suits above transverter. Prefer to sell together £120 the pair. Ring Terry (G4/XD) 0462 35248 after 6pm.

• **YAESU 708R** 70cms Hand held transceiver. Guaranteed as new but now surplus to requirements as have gone HF. Sensible offers to G4UMC on 0395 278181.

• **WANTED: YAESU** YO901/2 multiscope. Also Collins 75A4 receiver. Tel. Manningtree 4336 (Essex).

• **FOR SALE** Hammarlund SP600JX RX good cond. Retubed £155. KW77 RX Hamband £70. SX27 VHF and discone £55. Racal diversity unit £20. Wanted: Racal RA63 SSB adaptor or exchanges 0908 314095 after 3pm.

• **FOR SALE:** FT708R portable ½ + ¼ wave/VM24A speaker/mic 2 sets FNB-2 batts PA3 car, cahrge/QD Beam 11 mths, Beam and cable never put up all six months old £185. FDK multi 700ex 2M vgc used rec only 1 year old £110. Clive, 12 Hensworth Rd, Ashford, Middx.

• **FOR SALE** Yaesu FC102 antenna tuner £130. Tono 9000E communications terminal RTTY ASCTT CW word processor etc. £500. J.R. Middleton, 49 Wolseley Road, Stafford.

• **YAESU FT301S** H/F Rig matching FT221R 7 bands inc. 10 MHz all filters £275 ono. TW 10/2 transverter + PSU. Needs work £20. C4 vertical ant. 6-20 metres £20. G411L QTHR Brighton 607737.

• **FT290R FITTED** with Mutek front end 2.2AH nicads mobile mount £230. Alinco linear £25. Both together £250. Going HF wanted 2 meter FM only mobile and HW8 or WHY G4WIF. 0322 28429 evenigns.

• **YAESU FT ONE** general coverage TX/RX with FM board and AM filter fitted plus FM 902 ATU £1,000. Reason for sale little interest in TX, used only for RX. Ring 0438 71 5055.

• **BEARCAT 220 SCANNER** receiver mains/12 volt 32-50, 118-136, 144-174, 421-512 MHZ £135. Tel. 0273 516801 (Newhaven) G8RHU.

• **FOR SALE** Yaesu 980 transceiver as new £900. Swan HF amplifier excellent cond £225. Grundig satellite 3000 receiver £150. Phone evenings 0277 823434.

• **SX200-N SCANNING** receiver for sale Price £165 ono. Please tel. 01 485 4251 London.

Classified Ads

• **SX200N SCANNING** receiver plus matching wide-band RF pre-amp plus doscone. £250. 08893 3495 evenings.

• **FOR SALE** Cushcraft junior boomer 2 metre Yagi 214B. Unused and still boxed. £45. A Brooks, 17 Grosvenor Avenue, Carshalton, Surrey. Tel. 01 647 4415.

• **WANTED CW** De coder also 10m - 2m transverter. Tel. 054 27 372.

• **YAESU FT101ZDFM** MKIII Fan, mint condition, 9 bands, transceiver, boxed, as new, FC902 matching adrial tuner, SP901 matching speaker, G4MH mini beam £650. Might take 2 metre rig part ex. Cosham (Hants) 370576.

• **HAVE SINCLAIR** Spectrum 16K ram boxed as new plus £50 of software, exchange for IC-2E or similar. Tel. David, Lurgan 5872.

• **WANTED:** Pye ecb pmr systems (PFIs/PF2s/PF2UBs) any mobile base or portable pocket phones - pocketphone 70. If DFIs would like 2 TX with 2 RX with antenna batters plus charger. Wanted: Europe Westminster, Olympic Cambridge. Would pay cash or would swap Atari computer game with three games or Amstrad CB 901. Also would like PMR antennas or base with mounts would like on any freq. Would take PYE Burn Dept. Alastair Graham. 0875 320 642 4pm to 10pm.

• **HELP** swap Atari VCS TV game plus Amstrad CB 901 plus PSU plus antenna value £210. Would like to swap for any good HF VHF 2M handset, base, mobile, TX-RX, Trio, Yaesu, Icom etc. Would like for Xmas IC 2E FT 208R, R600, R100 or swap Atari VCJ for Pye base and antenna on any MHz. Would like 88MHz for 108 swap for base plus mobile or for 30-60Pt tower. A. Hunter. Tel. 0875 320 642.

• **JVC TELE** radio radio-plus television perfect £45. Russian Vega Selena 17 transistor 5 SW bands VHF medium long wave 500 MW output only 3 mths old /30. Teleton communications receiver MW, SW, PSB, Air L. Waves AFC. Squelch fine tuning BFO good order £50. Vintage 2valve set mains lead needs replacementj £10. Very old horn speaker working £10. A. H. Billington. Northampton 830492.

• **SELLING FT101ZD** MKIII WARC, FAN ATU and speaker, all mint condition with boxes and manuals. £480, £60 and £20 respectfully or £550 the lot. Exchange with cash for 430, 102 or similar. Wanted: Triband Yagi. Clive (0279) 28857 evenings.

•**YAESU** FT1 as new, £800. R. Clifford, 01 790 8621 (da), 01 530 3167 (night).

• **WANTED:** Burndept 470 or 471 model in working order Xtals for 70cm IE GB3MC (RMO) RB10 RB14 also Pye PFIs TX plus RX Xtals for 70cm Rb14+RB10 good price paid for good sets. Tel. Leigh 675445.

• **WANTED:** 2M transceiver hand held or mobile or decent communications receiver. Will swap for black and white portable television in working order. Apply Brearey, 28 Tanhouse Street, Ravensthorpe, Dewsbury. W. Yorkshire.

• **PANASONIC** DR31 MW IW SW receiver SSB digital display. 240volt or battery as new £140 ono. Banbury (0295) 51759 evenings.

• **DESK FILING** cabinet in white. Ideal for QSLs Mr-7 rack for Yaesu FT707 series. Both as new. £7 each ono. Buyer collects. Jane, 83 Cole Valley Rd, Hall Green, Birmingham.

• **STRAIGHT SWAP** BSA C15 MIC original & running for any 2 metre multimode synthesized rig. Write or call S. Asher, 20 Stuart Rd, Market Harborough, Leics.

• **FOR SALE** or exchange Presdient KP77 homebase CB (Mains) plus Thunderpole legal rig excellent cond. £75 ono. or exchange 2 Mtr hand held rig. W. A. Jones. 0482 571647 (Hull).

• **FOR SALE** Trio two metre TR 2300 complete. boxed all accessories mint £120. Also Icom 2E two meter FM handheld boxed as new condition £120. Wanted 70cms FM mobile transceiver Tel. 0535 36701 after 6pm.

• **FOR SALE** FRG 7700 with memory plus ATU plus LF filter for £220. Tel. 01 997 9995 after 7pm. Ealing, London.

• **FOR SALE** Yaesu fT290R portable all mode with nicads and rubber ant plus mains PSU all for £250 st not used much as new. Jaybeam 10XY Yagi 10 ele crossed 2m ant £20 and Jaybeam 12XY Yasi 12 ele crossed 70cm ant £30. Buyer must collect after 5pm tel nights only Milton Keynes 678928.

• **SWAP YAESU** 290R 2 mtr all mode transceiver two months old brand new for good working HF transceiver or a good receiver. Phone Ron Wrexham, North Wales 365798.

• **BROADCAST TRANSMITTER** VHF FM 88 to 108 MHz. 80 watts output varactor modulated giving HI FI reproduction. All transistorised. Portable as used by JFM £130 01 672 8764 evenings 7.30pm to 8.30pm only.

• **FOR SALE** Yaesu FRG7, Datong active antenna frequency counter, £170. TRIO 2300 Nicads, MM 30W linear amp, PSU, SWR meter £185 will split. Rancliffe on Trent (060 73) 2327.

• **COMMUNICATIONS** receiver Realistic DX 302 10 KHz to 30 MHz quartz synthesised, digital frequency display. Absolutely mint, cost £289 sell £140 ono or swap for Pet Disc drives. G4OAK Tel. Storrington (09066) 5151 day/evening.

• **FOR SALE** standard C8800 2M FM, transceiver, memo, scan, 1 to 10 watts output, on marked condition £200. Also Yaesu FRG7000 in mint condition £200. Both can seen working. Tel. Braintree 47631.

• **FT102 HF RIG** FM and narrow SSB fitted, four months old. Original packing. A gift at £630. Contact G6AIV QTHR (02974) 3654. Morse test should be abolished!

• **XYL GIVING** marching orders to excess equipment i.e. three WW11 German receivers EX2 type and EK offers. 2 x ARC3-R37-B aircraft receivers one ARC 27 transceiver two BC 733-D; Polard SIG Gen 7-10 GCS SG 57/URM36, wireless worlds from 1946 to 1982, QST, Ham radio, & CQ Mid 70s Farnel Power pack ex computer, so much SCR625-F Mine detector offers, sensible please. R. J. Shaw, 86A High Street, Poole, Dorset.

• **TS700 2 METRE** multi mode mains 12v DC £200. C58 with Nicads charger and case 6 month old £250 ono. Pye Cambridge with accessories £40. 8 Ele beam and 20ft mast £15 7/8 May mount £10. Power/SWR meter £7.50. Peter Wilson B8VFE. 33 Norton Ave, Norton, Stockton-on-Tees, Cleveland.

• **TELESCOPIC** Microphone stand for conference table - VITAVOX CN224 £10 ono. Wanted 6GX8 valve; clearing out many items send SAE + stamps for list, 9 Millbank Rd, Wallasey, Merseyside.

• **FOR SALE** Tandy Realistic DX302 receiver 10kHz to 30MHz quartz synthesized digital frequency readout, 4 mode, CW, USB, LSB, AM, plus BFO very good cond £160 ono. Malcolm Wilkinson. Barnsley 756505.

• **TR10 DL705 DIGITAL** multimeter DC AC volts 2,20,200&1000V auto Pol changeover RES 20 MEG R protected circuitry new in original packing cost £85, also Datong RF broadband Amp TX RX switched 2-200Mz as new cost £30, and £150 in cash for HF transceiver. Ring Sid G6HVS. Wirral. (051 334) 6859.

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• **YAESU FL2100I** 160-10 metres linear amplifier new and unused £350. G4FVR QTHR. Tel. 0723 374539.

•**40-CHANNEL** Fidelity 100FM, boxed £27. Class D wavemeter £8 (no xtal). Clearing valves, meters. tools, projectors lamps, vintage 16mm cine, filmstrips, classic car spares, ¼"-1" SD sockets. List 30p & SAE. Williams, 25 Glenmore Rd., Birkenhead, Merseyside. Wanted: EAM86.

•**PYE** Cambridge AM10BV, complte, less antenna £30. Ring 0937 844078.

•**WELZ** SWR and power meter SP45M 140-470MHz, unwanted Xmas present, new price £51, my price £40 plus postage. Also Sota 144 preamp, £15. Ring Burnley 51416.

•**EDDYSTONE** 680X £100. Eddystone 880/2 £285. Hallicrafters S27 modified £50. Hallicrafters S72 £50. Pye PT2 704 £15. Husdon with 2m synthesiser £50. Phone Wokingham 782236.

•**HF5V** vertical antenna 10m-80m, vgc £35. Also DX100L 0.15-30MHz, vgc, suit beginner, £30. Delivery by arrangement. G4LQH. Lincoln 722416.

•**8XY/2M** Jaybeam aerial, crossed Yagi £25. Hirshman antenna rotator, £45. Datong D70 Morse tutor £36. Buyer collects. Phone Cwmbran 4577.

•**WANTED** KW107 Supermatch ATU. Details to G3CIM, 15 Heatherwood Close, Thorpe End, Norwich Nr13 5BN. Tel. 0603 38282.

•**YAESU** LFT290R, 7 months old, nicads, charger, rubber duck and whip aerials, case and strap £220 ono. Also Alinco 30W linear and Microwave Modules preamp, call for price. Contact Ian 01 385 2372 7-10am Mon-Fri. (office) 01-736 6183 10am-6pm Mon-Fri.

•**WANTED** Pye PF70 UHF transceiver, PF2UH/UB. Non-workers considered. Ring John G8CGW evenings/weekends, Tel. 0455 47040.

•**YAESU** FR50B RX, mint cond. exchange for frequency counter or rhythm unit. V. Stimpson G3SLU, 57 Alliance Ave., Hull HU3 6QU. 0482 55906.

•**KAWASAKI** 200cc S-reg, also Grundig video, old type wkg with 3 tapes, exchange for FRG7700 or HF transceiver, rotator, or 70cm transceiver or anything to do with amateur radio. M.J. Hilton, 30 Batford Rd., Harpenden, Herts. Tel. Harpenden 64349.

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•**FRG7700,** FRT7700, FRV7700B 2m conv, discone aerial, £300 the lot. Phone (evenings) Mr. J.T. Stephens, Basingstoke 53896.

•**FRG7700** COMMS RX, vgc, manual, box £150. Tel. Bradford (0472) 593769 after 6pm.

•**WANTED** Sony ICF6800W or Grundig 3400, can exchange Sony 2001 plus PU. 12-channel 2m scanner, VFO etc 12V. Further items available. Findley, 27 Keytes Lane, Barford, Warwick CV35 8EP.

•**HYGAIN** CLR-2 27/28MHz 5/8 GPA vertical, excellent cond £10. St. Albans 32759.

•**RACAL** R17L HF RX £285. Eddystone 840C HF RX, £75. Redion VHF radiotelephone £110. large desk radio console £100.All ono. Henry Howard, 108 Lindenthorpe Road, Broadstairs, Kent. Phone 0843 601041.

•**BUYING HOUSE** need cash. TR7010 and remote VFO, full 2m SSB/CW, £95. FDK700EX 25W 2m FM, 1 yr old £135. SEM 50W 2m linear, 10W in, £50 Chris Lenn, Oakley (Beds) 5455 evenings.

•**PAM** Commander multi-band RX, £150. SX200N, mint, £185. 12 Malton Way, York. Tel. 0904 59035.

•**WANTED** AR88, B40 comms RX. Also want Pye rigs like Cambridge AM or FM, Westminster W30 or W15, Vanguard, Motafone, Bantam etc. Nicholas Kerner, 2 Ashtead Woods Rd, Ashtead, Surrey KT21 2EQ. Tel Ashtead 73428 after 4.30pm weekdays.

•**ICOM** R70 RX, 3 months old, 2 hours use, mint, boxed, £400. Would consider Sony ICF2001 or newer version in part exchange, or WHY? Ring 051 638 5554.

•**TRIO** 8400 70cm FM mobile mint, original packing etc. £145 ono. Tel. Weymouth 786930 G40WY.

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•**SZ200N** VHF scanning RX. Prefer buyer collect but will deliver and demonstrate locally. Best offer over £200. Ring Ipswich 310487.

•**ICOM** R70 RX, unused boxed £400. Phone Richard 0223 312624.

•**G2DAF** RX with spare chassis, valves and manual £60. WS19 set with rotary PSU, headset, key and cables, £35. Dubus magazines and handbook £10. Ring Dursley 811454 after 6pm.

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•**MURPHY** B40D comms RX, good cond £60. 16mm Filmosound projector, opt/mag, excellent order £85. Wanted: 50/100W 2m linear with preamp, and electronic keyboard. Tel. Worthing 66329.

•**YAESU** FRG7, perfect cond. as new £125. Tel. Romford 47912.

•**M40FM** rigs, converted to cover 10m. 2 available. All improvement modifications done. Also 2 50W linears to suit,k and 5/8 ant. Rigs £50 ono, linears £25 ono each. Phone 061 905 1040 office hours. Mr. Jones. Ideal chat channels.

•**YAESU** FRG7700 comms RX with memories, FRT7700 ATU, FRA7700 active antenna, FF5 LF filter, FRV7700 VHF converter 118-130, 140-150, 50-59MHz. All mint with manuals £350. no offers. With Datong filter. 01 656 0069 Croydon.

•**R1155** RX wanted, must be in perfect working order, unmodified, smart casing, with valves. Extra for oifficial plugs £35-40. Tel. Simon Rose, Hull 666676.

•**FRG7700** plus FRT7700 ATU, still under guarantee, hardly used, excellent cond £290 no. Tel. Mr. Robbins, Lymington (Hants) 22342.

•**RML480** computer, full hi-res graphics, 64K memory. Very powerful computer, comes with word processor, three versions of BASIC and several comprehensive manuals £800 ono. Jon 17 Lakeside, Oxford OX2 8JF. Tel. Oxford 50245.

•**REALISTIC** DX302 RX 10kHz-30MHz, LED digital readout, 6 bands, tunable reselector, as new £125. Serpent CB rig, legal FM, vgc £20.

•**SALE/SWAP** Burndept BE201 transceiver 100-156MHz ex-WD, with matching PSU, headphones, mic and connectors, excellent cond, requires xtals, £450 or swap for VHF/UHF RX equipment. 021 355 3173.

•**DOUGLAS** aircraft 80W audio amplifier 115V 60Hz, O/P 64/32/16/8/4 ohms, needs attention. Four 6146 valves. Elapsed hours meter. £10 or offer, buyer must collect. Phone Newmarker 662379.

•**FOR SALE** Standard C78, nicads, charger, 4 months old, £175. or exchange for Trio 2300 or similar 2m portable with nicads etc. Phone Brian G6WWS 051-677 4189.

•**TR2300** 3 years old, good cond. nicads. charger, helical, 10W PA. Wanted: 2m sSB/CW low power portable eg. SB2M. Offers? Tel. Sapcote 2484 G4KVT QTHR.

•**WAVEMETER** Class D £8. Sig gen/wavemeter 140-225MHz W1649 £20 with valves but no cases/crystals. Clearing workshop - lists: projector lamps, valves, car tools, filmstrips, meters, 10p each (state which) plus SAE. 25 Glenmore Road, Birkenhead.

•**WANTED** Yaesu FRG7. Will exchange for my Sony ICF2001 with PSU. Also for sale: GP27 ant., Citizen base mike, SLWR meter, CB PSU and Zetagi ATU. Tel. Ian on Burnham 64182.

•**WANTED** scanner in mint cond. SX200N or similar. Only perfect condition RX considered. R. Williams, 62 Kinscliffe Rd., Grantham, Lincs. NG31 8ET. Grantham 66047.

•**WILL SWOP** new unused 4CX250R valve for similar 4CX250B. Small cash adj. if needed. G3BDQ "Whitefriars", Friars Hill, Guestling, nr. Hastings TN35 4EP.

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•**WELZ** Diamond B285 2m an 5/8 base station and 3 radials, as new, £10 plus carr. or coll. Jaybeam 5/8 Yagi slot-fed type D5/2m in good cond., less one mast clamp, £10 ono. Creed 7E printer 230V motor £5 ono. 900+ new unused QSL cards ex-G6E--. Easily overprinted, £5. Samplke card on request. R.P. Neave G4DAN, 24 Mayfield Rd., Writtle, Essex. 0245 421031.

•**TRIO** 9R59D RX with ext. speaker, £49. Or will swap for ATU or rotator. East Grinstead 313478.

•**SX200** scanner, PSU, boxed, manual, PSU, £150. ZX81 16K, Maplin keyboard, programs, books etc. £45. Yashica SLR camera, many extras, exchange for FT208 or 70cm gear. Dave GW6UGD. Cardiff 733885.

•**WANTED** IC-R70 RX or Yaesu FRG7700. Must be in good order. K. Edmund, 24 Pryde Ave., Bonnyrigg, Midlothian EH19 2BJ. o31 660 1679.

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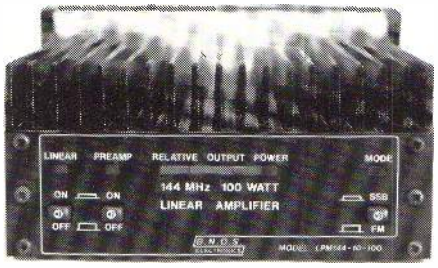

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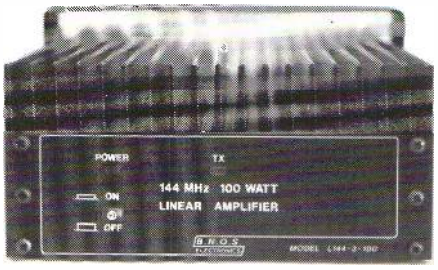

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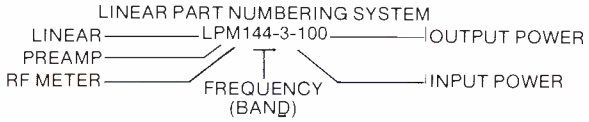

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