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Note: Please mention AMATEUR RADIO when replying to any advertisement.
Looking at the traders one could either assume that things were going very well or that they'd had more than enough time in the beer tent!

Ex-computer power supplies were one of the real bargains to be had. If there are any left you can find them at The Computer Junk Shop, Widnes, Lancs. Tel: (051 420) 4590.

While putting in a lot of work for the Radio Amateur Invalid and Blind Club, Brian and Cathy G1CQJ were celebrating their 6th wedding anniversary.
With an attendance of approximately 12,000 amateurs, XYLs and children, the Longleat Mobile Rally can only be described as an undisputed success.

The location was obviously ideal for the family OM with a beautiful house, safari park and other activities to keep his non-amateur family amused while he went in search of a new toy for himself.

Business on the trade stands seemed to be brisk and society stands recruited a host of new members. The Microwave Society, for example, enrolled thirty new members and sold everything they had!

Congratulations must go to the RSGB City of Bristol Group for a job well done in the organisation of the event. We look forward to attending again next year.

Morse tests were held on site; the location obvious from the huddle of nervous hopefuls outside. 70% of them needn't have worried however, as 27 out of the 33 candidates walked away with a certificate and a benign grin. The tests were organised by the Bristol Group and the examiner was Gavin Williams.

See what I mean about the grin! Morris Weinstock was stuck with this specimen after passing his Morse test. Congratulations Morris.

Judging by the concentration on their faces these two are trying to work out how to explain this acquisition to the XYLs.

The Ed seems to be confused here as she appears to be telling a fishing yarn to the Welsh contingent. How big was it?!
DIGITAL ELECTRONICS

The highly successful Introducing Microelectronics package produced for the educational market by Educational Electronics Limited is now available to a broader market, being offered complete with the components, a circuit board and a 136-page course booklet, all needed to conduct a wide variety of investigations.

The course booklet, written by a leading authority on microelectronics, assumes no previous knowledge of the subject. It provides a self-study guide to basic digital electronics and computer building blocks.

The basic circuit board is cleverly designed to incorporate a range of features that enable the user to make rapid progress. It contains 4 IC socket pads, LED display diodes, a pulser button and a pulse 'clock'. Bit patterns can be set up using the integral bit set switches and the edge connector port can be utilised for further experiments using a microcomputer.

The ideal medium for entering the world of electronics and digital micro-circuitry, in both academic and practical terms, the Intro package is available at £59.50 inclusive of VAT, postage and packing from: Educational Electronics Limited, 28 Lake Street, Leighton Buzzard, Beds LU7 8RX.

PHILIPS PM8154

Available from Electronic Brokers is the new Philips PM8154 six-colour graphics plotter which features writing speeds of 400mm per second on the X and Y axes and 200mm per second in all other directions.

Features include electrostatic paper hold-down, an accuracy of less than ±0.15% ±0.3mm, and a 0.1mm resolution. With a penlift frequency of five times per second, the PM8154 has a plotting speed of two characters per second and a positioning speed of 60cm per second.

The plotter accepts A4 format paper and has a plotting area of 230mm (X-axis) x 180mm (Y-axis). A choice of interface options is available including IEC-625/IEEE-488 and V24/RS232C.

The PM8154 is supplied with a dust cover, six nylon tip pens and paper sheets.

Optional accessories include a chart transport unit supplied with one roll of chart and supporting consumables.

The plotter is ideal for a wide range of educational, engineering and business applications.

For further information contact: Electronic Brokers Limited, 140-146 Camden Street, London NW1 9PB.

FIRST CASTLE

First Castle Electronics plc, with interests ranging from the consumer electronics industry to military and nuclear markets, has formed a new company to handle the sales and marketing of five component manufacturing companies in its electromechanical division.

The new company is First Castle Components Limited, which is based at Thundersley in Essex, and the Managing Director is Mr Mark Lee. The five companies which come under the First Castle Components umbrella are:

Manby Electronics Ltd, the Lincolnshire-based company, whose main business is producing mains adaptors and PCB assemblies;

Able Electrics Ltd, of Thundersley, Essex, manufacturers of commercial harnesses for the automotive industry and mains leads with moulded-on plugs;

Darstan Ltd, of Thundersley, Essex, producing mains adaptors and PCB assemblies;

Ormandy and Stollery Electronic Components Ltd, of Brightlingsea, Essex, who make wound products and power systems for the electrical, electronic and telecommunications industries;

BRM Electronics Ltd, of Maidstone, Kent, who produce wiring harnesses for the electronic, telecommunications and domestic appliance markets.

The new company's address is: First Castle Components Ltd, 263 Church Road, Thundersley, Essex.

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

SPARK HAZARDS

The possibility that explosions at major plants such as oil rigs could accidentally be triggered by radio waves is to be the subject of an investigation by academic staff at the University of Bradford.

Dr Peter Excell, of the University’s School of Studies in Electrical and Electronic Engineering, and Dr Alfred Keller, reader in industrial technology, have been awarded a £33,572 grant from the Science and Engineering Research Council.

Radio waves from high-powered transmitters can sometimes cause sparks to form on metal structures (unintended receiving antennas) located in a zone around the transmitter. Potentially hazardous conditions exist, for example, around oil and gas plants which are co-incidently located within the predicted ‘hazard zone’ around a radio transmitter.

The purpose of the work is to determine viable safety margins within which transmitters can be built and operated. This will be done by assessing the ‘probabilistic factors’ — in other words, the likelihood of an explosion occurring, since a number of conditions must simultaneously exist, such as appropriate orientation, a spark-gap of the correct size, and flammable mixture at the optimum concentration around the spark-gap at the time of the spark.

A number of British Standards have been drawn up relating to ‘hazard zones’ around transmitters but these have proved unrealistically onerous for the needs of modern industry. This is because they have been based on the assumption that a number of unlikely events will occur simultaneously. By themselves, each of these events may be seen to be ‘just possible’, ie at the limit of reasonable probability. In fact, for a sequence of such events to occur simultaneously the probability would be so low as to be negligible compared with numerous other generally-accepted risks. The costs involved in elimination of the radio-frequency hazard would be better spent on more urgent safety matters, such as improved scaffolding, or road safety.

The philosophy of assessing the overall probability of occurrence of a hazard, and comparing it with generally-accepted risks, is well-established in the chemical and nuclear industries but has never before been applied to radio-frequency hazards. It is hoped that, by using this approach, radio systems will be freed from some unnecessary restrictions, which may of themselves constitute a hazard to safety (eg restrictions on emergency radio transmitters on ships and oil rigs).

Dr Excell has been conducting research into radio frequency hazards since 1974 and Dr Keller has specialised in reliability and risk for some thirty years, having previously worked in the nuclear power industry. Their current work at Bradford is likely to influence future safety standards for radio frequency hazard zones. At the same time, a group of related hazards will be studied, such as the possibility of radio signals from many sources (eg CB radio) setting off electro-explosive detonators, or interfering with aircraft guidance systems.

COUNTER-TIMER

A 100MHz universal counter-timer has been added to the range of low cost test instruments manufactured by Black Star Limited.

The model Apollo 100 is a compact mains operated unit, with an 8-digit LED display, for the measurement of frequency, period and period average, frequency ratio and time interval. Stop-watch, RPM and totalise modes are also provided within this model.

Full signal conditioning controls are provided on both inputs, including attenuation, edge selectors, trigger level and low pass filter.

Other controls include single measure, start/stop, reset, display hold and trigger hold-off.

A 10MHz timebase from a crystal controlled oscillator provides a typical temperature stability of ±2.5 ppm (0°C to 40°C) or an optional TCXO will improve the temperature stability to typically ±0.5 ppm.

The unit is priced at £285 (+VAT) and further details are available from: M Black, Black Star Limited, 4 Stephenson Road, St Ives, Huntingdon, Cambs PE17 4WJ. Tel: (0480) 62440.

PCB MOUNTING CONNECTORS

Klippon’s BL/SL connector range with screw terminations for direct connection to PCBs has recently been improved.

It now features tin-lead metal parts, captive screws and enhanced shaping of the moulding for better insertion of the male section into the female.

Offering both vertical and horizontal connection facilities and a coding system to ensure correct polarisation, the range will accept cabling up to 1.5mm².

Type dependent, between 2 to 15 poles, can be accommodated.

SL – the male connector – is offered with either open or closed ends, and has a voltage rating of 250V ac and a current rating of 8A.

For further details contact: Klippon Electricals, Power Station Road, Sheerness, Kent ME12 3AB. Tel: (0795) 683322.
10 FUNCTION MULTIMETER
A high performance multi-meter offering ten measurement functions and a total of forty-eight ranges the Pantec Challenger is now available from Electronic and Computer Workshop Ltd.

With a voltage sensitivity of 40kohms/volt, dc/ac, the Challenger can measure voltages from 0.25 to 1000V dc and from 5 to 2000V ac. Current is measured from 25μA to 10A dc and from 0.5 to 10A ac. Accuracy is ±2% at 20°C. Challenger also offers accurate measurement of input resistance and provides a dB output as well as VBF and capacitance.

The instrument utilises a moving coil analogue meter movement, insensitive to external magnetic fields and is contained in a high impact polycarbonate case. The rear panel has a magnet to allow Challenger to be fixed to any flat metallic surface.

Full protection is provided against misconnections and overloads using an internal discharging circuit and a quick blow fuse.

For further information please contact: Electronic and Computer Workshop Ltd. Tel: (0245) 262149.

MAPLIN MAGAZINE
The latest edition of this electronics magazine, Electronics - The Maplin Magazine, is packed with new features and projects.

Included is a major feature covering digital techniques in television receivers. The article, The Digits are Coming, suggests that with satellite and cable TV developments stalled, digital TV could be the next high technology product to hit the high street stores.

On the project side, full constructional details are provided for a compact expandable microcomputer system which can be used as a CPU-based controller in its own right or as the central processor for a more complex computer system, using the ubiquitous Z80 chip (kit price, £29.95).

An advanced level ultrasonic car (intruder) alarm system is also described in full detail.

With car thefts on the increase, such devices are becoming part of everyday life (kit price, £19.95). Competing for attention with the ultrasonic car alarm is a powerful 6-channel guitar equaliser.

Each channel provides up to 10dB of signal boost (kit price, £26.95).

With the robot population on the increase, details are given enabling the Zero 2 Turtle Robot to be interfaced directly, price 75p.

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THE RSGB City of Bristol

After the very hectic and successful Longleat Mobile Rally, which was organised by the RSGB City of Bristol Group on 30 June, things seem to be settling down again in that part of the country.

However, the group are as always very active and are holding some lectures in the next couple of months which readers might find interesting.

Ron Broadbent will be discussing satellites on 29 July and on 19 August Mark Goodfellow G4KUQ will be revealing the ins and outs of RTTY and Amtor.

Further information is available from: Colin Hollister G4SQQ, 34 Battersby Way, Hanbury, Bristol BS10 7SU. Tel: (0272) 508451.

RSGB HF Convention

The RSGB is arranging a convention for HF enthusiasts to take place on Sunday, 29 September 1985 at the Belfry Hotel near Oxford.

The programme is provisionally at the moment, but should include a twin lecture stream with lectures on: HF propagation and the USSR satellites. (G3IOR); ATUs - the least understood part of the station (G3RZP); The Sunspot Minimum, how long will it last? (G3LPT); DXpedition to Navassa Island (G3RFS); Introduction to contest operating (HF Contests Committee); G-QRP Club lectures: Applying for planning permission (RSGB Planning Committee).

Other attractions will include an HF and VHF contest forum, a display of QRP gear, DXPedition videos, RNARS QRO CW tests, an RSGB bookstall, a car boot sale (£2 per pitch), an HF demo station (G2BHF) and, of course, a bar.

Talk-in (by Mid-Thames Raynet) will be on 160, 10 FM, 4, 2 and 70cm. BYLARA, G-QRP and other groups will have stands.

The Belfry Hotel is on the A40 close to Exit 7 of the M40. It can also be reached by bus from Oxford Bus Station (25A and 790 services, every hour). Doors open at 10am, and admission is £2 per person.

Further details, including talk-in frequencies, will be released nearer the time via GB2RS and Radio Communication, or can be obtained by contacting the convention publicity officer (author of DX Diary): Don Field G3XTT, 105 Shiplake Bottom, Peppard Common, Henley on Thames RG9 5HJ. Tel: (0734) 724192.

Brazilian contest

The Electrict Antenna factory in Sao Paulo, Brazil is sponsoring a contest to celebrate its silver jubilees.

The contest will take place on the 2, 10, 15, 20, 40 and 80m bands using CW and phone modes, from 0000 UTC on 9 November through to 2400 UTC on 10 November this year.

Operators are divided into two categories. For Category 1 (single operators) a total of 12 hours rest period has to be clearly indicated in the log (it can be subdivided). Category II consists of multiple operators, ie clubs and associations, and there is no rest period.

The call for CW operators is 'CQ test 25' and for phone is 'CQ 25 years contest'. Contestants are required to exchange RS:T reports once they have a contact. Each confirmed QSO counts for one point. There are no multipliers, but different band contacts with the same station count separately.

Logs should include details of the station worked, RST sent and received, QTR and UTC, band, mode and general remarks. Completed logs should be sent to: PO Box 22, Labre, Sao Paulo Section, SP-Brazil 01000 before 31 January 1986. Electric products will be awarded to the winners.

Welsh club

Abergavenny and Neill Hall Amateur Radio Club meets every Thursday at 7.30pm in Pen-y-Fal Hospital. Regular Morse classes are held at club nights, and all newcomers are welcome.

The club will be operating a special event station at the Pen-y-Fal Hospital Fete on 3 August 1985.

The callsign will be GB2PYF and operation will be on HF and VHF.

Further information on the club and its activities is available from: The Secretary, 105 Crawshorne Place, Abergavenny, Gwent NP7 6PF.

'CO-TV'

The British Amateur Television Club (BATC) have sent us the spring issue of their very informative and interesting magazine, CO-TV.

This latest edition includes contributions from Andy Emmerson (SSTV Standbys, Passive Repeaters) plus articles on various aspects of the hobby including Interfacing the Spectrum, a Single Chip Colour Encoder, Contest ideas for an FM-TV Transmitter.

Membership and subscription enquiries should be sent to: D Lawton G0ANO, 'Grenehurst', Pinewood Rd, High Wycombe HP12 4DD.

Salisbury & ES 2m Contest

On 18 August 1985 the Salisbury Radio and Electronics Society is holding a 2m contest which will extend between 0000 and 1500GMT. The modes are SSB and CW only and power is limited to 250W ERP to make it fair for low power stations. A restriction on frequency allows amateurs who do not wish to participate in the contest to operate above 144.300MHz.

The awards consist of a specially endorsed award certificate which will be awarded to the top three contestants. Entries should include details of station, eg rig, antenna, antenna assembly and county, and an SAE for details of the results.

For full details of the rules send an SAE to: M E Wright G4RLF, 27 Bulbridge Road, Wilton, Salisbury, Wilts.

SWL Information Group

The idea of an information exchange group was suggested in Trevor Morgan's SWL column in this magazine in 1984.

The suggestion was put forward that listeners with similar interests within the hobby or using similar equipment or techniques might like to exchange information with each other, thereby reducing the need for mutual assistance without the ties of joining a club or association.

The basis of the formation of the group is that it would be self-generated by you, the listener, and be a general exchange of information between interested parties.

However, as many listeners are, for security reasons, unwilling to publicise their personal details in a general way, it was suggested that a 'bureau' be operated to handle the mail.

To get the group under way, a list of listeners who have submitted information of their stations has been compiled but no full names or addresses have been included. The idea is that if you wish to correspond with a user of similar equipment as yourself, you do so by addressing the letter to, for instance, 'John 437' and leave the addressing to the bureau controller. As letters come in to the bureau they will be fully addressed and forwarded.

Of course, if you wish to take up correspondence directly with any member of the group you can mention this in the letter to him.

The procedure is that any member may write to the person you mention in the letter in a sealed envelope and put the member's number on the flap of the envelope.

All letters should be forwarded to Trevor Morgan at: 1 Jersey Street, Hawd, Swanssea SA1 2HF, where they will be addressed and sent on. Don't forget to put a stamp on the envelope please.

Please note...

We have received information from the City and Guilds Institute that the RAE dates published in Amateur Radio in Bill Mantovani's 'Back to Basics' series (June and July 1985) are erroneous.

The exams will only take place on Monday 2 December 1985 and Monday 12 May 1986, not as previously published on 16 October and 4 December this year and 15 January, 19 March, 14 May, 9 July and 13 August 1986.

Our apologies go to the City and Guilds Institute and to any prospective RAE candidates - we didn't mean to confuse you!

The City and Guilds Institute can be contacted by telephoning 01-278 2468.

In addition to this, we managed to omit the last three answers from the Questions and Answers featured in the June issue.

Of course this was done purely to ascertain how many of you actually tackle the questions! Well, for the frustrated few who are anxious to know the answers to questions 33, 34, and 35 the answers were a, a and c respectively.
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PRINTED CIRCUIT BOARD Double sided fibre glass, good for VHF-UHF, only £1.50 per sq ft, cut to size required, minimum order £5.00 pp paid. Also single side Pass/in 50p per sq ft.

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MISLEADING
I must write to point out one or two misleading statements made by Bill Mantovani G4ZVB in his June contribution, which is subtitled 'Practical Antennas'. Bill says that end fed single wires can be of any length, but that optimum results are obtained if resonant lengths are used. This is certainly not the case and in fact such resonant lengths in an end fed system are best avoided. His advice that a length of 132ft is ideal is particularly misleading and one wonders what experience he has had with such a length? A later sentence alerting beginners to the fact that a problem with such a simple antenna is that it is prone to generating TVI is an oversimplification of the facts.
Resonant end fed wires will have high impedances and therefore high RF voltages at their far ends and at the shack end for they will contain one or more complete half wavelengths. The 'deadly' 132ft wire will have this condition on all the bands which are a multiple of 3.5MHz and will therefore have quite a high RF voltage in the shack and inside the house (if an indoor shack) on any band. This may give rise to many problems: 'hot' chassis, TVI and interference with hi-fi players, tape recorders, etc.

However, it certainly made me wonder what the authorities in this country would have had to say if the boot had been on the other foot and a Russian radio amateur had visited a GB station in England, been handed the mic and invited to contact Moscow! Douglas Byrne G3KPO/G3BWN, Ryde, IOW

SUPPORT NEEDED
I am attached to my local Air Training Corps as a Civilian Instructor in Newark. A great deal of my time is spent looking after radio equipment or in training boys aged between 14-18 years old to operate radio equipment. Amateur Radio magazine is therefore one which is often read in our workshop.

At present, training boys in sending and receiving Morse and in radio procedures is not a problem.

However, our Squadron funds, like most youth organisations, remain exceedingly small and radio equipment rather expensive or very difficult to obtain, so I wondered if any readers could help us.

I contacted the RSGB's local clubs in Mansfield and Newark two months ago and although sounding very hopeful at first, they have been unable to help.

I desperately need two HF transmitters capable of operating between 200MHz and 3.800MHz and further up the band from 5.200 to 7.500MHz. (The frequencies we use are all crystal controlled).

Our present requirement is anything from 20W to 100W output with the facility to raise would only serve to confuse the beginner, not make him clearer. When first considering the objectives of 'Back to Basics', I had to decide where to draw the line on explaining a particular topic. Mr Heys goes beyond this line in his letter— if a reader of my series wishes to know more he can, as recommended, refer to the various other articles that have appeared in these pages, including those by Mr Heys, which I had most certainly not forgotten.Personally, I have referred to Mr Heys's articles on antennas many times when trying out my ideas (including with the deadly 132ft long wire that knocked the XYL's favourite TV programme out cold!), but I do not think that they are of as great a relevance to the prospective RAE candidate as the other articles mentioned in the issue in question.

For an oversimplification of certain facts about TVI etc, I'm afraid Mr Heys has been just a little too quick off the mark—they are dealt with in more detail in the following month's conclusion to transmitter interference, as per the RAE syllabus. The above notwithstanding, please keep writing the practical articles Mr Heys; the wire antenna is one of my favourite subjects, too. For the record, despite the newness of my call, I am most certainly not a newcomer to amateur radio and prefer to build rather than buy any day.

Bill Mantovani G4ZVB

FB G5O IN MOSCOW!
An electronics exhibition is held in Moscow every two years, in the Economics Achievements Park, and one of its features is the exhibition short wave transmitting station run by members of the Moscow Radio Club.
When I walked through the door, my RSGB badge was immediately recognised by several radio amateurs, who introduced me to the station—they could not have been more hospitable. However, it certainly made me wonder what the authorities in this country would have had to say if the boot had been on the other foot and a Russian radio amateur had visited a GB station in England, been handed the mic and invited to contact Moscow! Douglas Byrne G3KPO/G3BWN, Ryde, IOW
LETTERS

offer CW (A1), AM (A3), and SSB (A3J) in transmit mode. Sets do not have to be in working condition for as long as parts are available we can repair them ourselves. Our new training year starts in September and we desperately need this equipment.

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PROUD ex-CBer

The heading over M Shannon's letter (Drivel, AR July 1985) was very apt! Reading the first sentence, 'Rarely do I surface on 2 metres', I would surmise that like the fabled ostrich with its head stuck in the sand, he rarely surfaces at all! And even when he does the sand is still in his eyes. In case he has not been informed, Queen Victoria is dead!

Most people do realise that obtaining a G callsign means that the holder is interested in the subject of radio enough to have taken a City and Guilds examination; whether or not they were on CB (legal or pirate) previously is of little importance. A lot of information that I needed to pass the RAE came via CB and the remainder via Howard G3SFO, who is a lecturer in the RAE, which more than made up for any deficiencies in my basic knowledge, thus giving me an RAE class B pass.

May I point out that saying the multiple choice RAE 'encouraged thousands of people to drift into amateur radio' and 'ruin it for the more dedicated folk' is the sort of statement that would be repudiated by the majority of licencees, and to further declare that 'Black box operating should be stamped out' confirms the small-minded attitude of G4GJN. Not everyone is adept with their fingers; what about those licensees who are disabled, blind or with a speech impediment and for whom amateur radio helps improve the quality of their life?

M Shannon seems hell-bent on changing amateur radio to suit himself only.

A R Johns G1MSH, Yorks

PLEA

All of my family are CBers and my parents are also licensed to use 2m. In fact, my Dad is a G4, my Mum is a G6 and I hope to retake one part of the RAE in December after failing my first attempt last year.

My point is that my parents and many ex-CBers know more about operating procedures than many old-time HF men.

I agree that some CBers do use CB jargon on the air but I think this is mainly from habit. I would also like to point out that CBers are not the only ones to use 'drivel' – the biggest offenders are sometimes those who know the most about electronics, radio and aerials.

Changing the examination procedures will not convert these offenders. In fact, passing such exams would only make them big-headed, as it has done for a certain amateur who will remain nameless.

Also, changing the exam would mean no licence for those, like me, who are very interested in amateur radio but find the ins and outs of such equipment beyond understanding.

I make two pleas to G4GJD. One, please do not generalise the attitudes of the majority by the actions of the few, and two, don't brag about your early achievements or you might trip over your own ego.

Karen Diss (aged 16), Essex

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MAKE A DIRECT LINE TO YOUR NEWSAGENT ON JULY 18
Wallace W6AM and Father Verdes in California originated in 1910 and had been outstanding operators, Don news of the passing of two to 9 rhombics on 61 poles (10 sections). This was later reduced ginically consisted of 13 rhombic antennas serving 26 directions. This was also reduced to 9 rhombics on 61 poles (10 of which were 140ft high), using 45 miles of wire.

Don led the DXCC Honor Roll for the last 25 years, no mean achievement in view of the intense competition between US DXers. Nevertheless, Don was always ready to try out new aspects of the hobby and, indeed, my own last contact with him was on the 10MHz band.

Father Dave gave many amateurs their first contact with Easter Island and could regularly be heard in Europe on all bands, 80-10. He was also responsible for encouraging a number of Easter Island residents to become radio amateurs. Father Dave had always been an active contester and DXer in his own right and will be a great loss to the airwaves.

**Rockall**

Many readers will have followed the exploits of Tom McClean, who recently landed on the treacherous island of Rockall off the Scottish coast. Unfortunately Tom chose to appear on the amateur bands with fictitious call signs such as RR1TM and GRT1TM and worked, among others, a number of British amateurs. In working him these amateurs were, of course, in breach of their licence.

There has been at least one attempt in the past to have Rockall accepted by the ARRL as a separate DXCC country, presumably on the basis of its distance from the mainland. As I recall the attempt failed because the ARRL looked at its distance from the nearest land (the Hebrides) rather than from the mainland proper. In any case, there is an ongoing dispute between Britain, Eire, Iceland and Denmark about the ownership of Rockall, although most of us would think of it as British.

**Sao Tome and Principe**

Another relatively obscure part of the world which has featured in amateur radio circles recently is the tiny ex-Portuguese colony of Sao Tome (St Thomas) and Principe (Prince). These are volcanic islands (together about 372 square miles) in the bend of the Gulf of Guinea. Sao Tome is as large again as the Isle of Man and rises to 7000ft. Principe is as large as Jersey and rises to 3000ft.

The Portuguese call the islands the 'Pearls of the Ocean'. The rich soil produces cocoa, coffee, coconuts and palm kernels as principal exports. The population, however, is only 86,000 and casual visitors are not-allowed, so the islands are not-well-known.

In amateur radio terms several CR5 stations used to be active before independence, for instance CR5SP and CR5LB. After independence in the early 70s the prefix was changed to S9, but there has been very little activity. This is because it is not possible to enter the country purely as a tourist (or therefore DXpedition operator), but visitors must be there to do a job of work.

Thus it was that Vince Thompson K5VT was able to operate in 1981 while he was travelling around Africa teaching medical techniques to local surgeons. Vince made many CW contacts as S9VCT and made lots of DXers, including myself, happy with a new country.

More recently, there was a very brief operation from Principe by PS7ABT/S9, visiting with his ship (Jose is with the Brazilian navy). This three-hour operation netted just 155 contacts in 30 countries, using the 20 and 15 metre bands. Clearly it did little to alleviate the enormous demand from newly-licensed DXers for a contact with S9.

And so to the present. Towards the end of June S92LB started to appear regularly on 20 metres in the late evenings, giving his address as PO Box 147, Sao Tome. It does rather look as though Luis CR5LB is back on the bands. Let's hope so. In the good old days Luis was never especially active, but keen DXers could rely on catching up with him sooner or later. Perhaps the same will be true again.

AR in the year 2000

Readers will recall I invited contributions on this topic in the February column. I have to hand an interesting, though pessimistic, letter from G8SQS who listens on the HF bands from time to time. He points out that increasing access to satellite communications will mean that, before too long, the main users of the short wave spectrum will be amateurs, over-the-horizon radar, and a few remaining broadcasting stations.

HF amateur radio will be plagued by interference from the radar transmissions, amateurs will seek refuge in the much less interesting black box activities of VHF and will eventually lose interest in the hobby altogether, much as many newly-licensed class B operators seem to disappear forever off the bands after an initial honeymoon period.

The above scenario would be extremely sad for amateur radio, though I have to agree that we are already seeing signs of decreasing interest in the hobby especially among our more educated brethren. Many university radio clubs are but a shadow of their former selves.

Perhaps we push the idea of amateur radio as a self-teaching experience, as a community service, a bit too much? This, at least, is the theme of a recent editorial in the American CO Magazine, where it is suggested that we should remind ourselves that the main virtue of our hobby is that it is fun! And HF operating is the most fun of all.
HF Convention
Can I remind readers that the RSGB HF Convention takes place on Sunday 29 September at the Belfry Hotel on the A40 south of Oxford? There will be a wide ranging lecture programme as well as a range of other activities of interest to HF operators. No trade stands though; the idea is to focus on the social side and involvement in the activities. Doors open at 10am and the entrance fee is £2. For my sins I am on the organising committee, so if you need more details feel free to contact me. Otherwise, full information will appear in the September issue of Radio Communication.

DX news
HB9APJ and HB9ASJ will be operational from Greenland signing their home calls /OX from 2-25 August. Frequencies will be 7020, 7080, 14050, 14180, 21050, 21180, 28050 and 28580kHz. QSL cards should be sent to their home calls. eclecticies will be 7020, 7080, 14050, 14180, 21050, 21180, 28050 and 28580kHz. QSL cards should be sent to their home calls / OX operational from Greenland DX news September issue of Radio Communication. more details feel free to committee, so if you need sins I am on the organising the entrance fee is £ 2. For my sins I am on the organising the idea is to focus on the social side and involvement in the activities. Doors open at 10am and the entrance fee is £2. For my sins I am on the organising committee, so if you need more details feel free to contact me. Otherwise, full information will appear in the September issue of Radio Communication.

The Madeira DX Club is HB9APJ and HB9ASJ will be active from the Galapagos Islands, commencing on 18 August. I have no other details on this one.

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The Madeira DX Club is planning an operation from the Selvagen (Salvage) Islands from 10-20 August. The islands, which count as Madeira for DXCC purposes, get their name because they are very treacherous and many a ship has come to grief there. If the operation takes place successfully the Islands-on-the-Air Award reference AF-47 will be allocated. Another operation for island chasers will take place from 17-31 August. This will be from Rugen Island (IOTA reference EU-57) using the callsign Y24DO/P. Low power (only about 20W) will be used. Further afield, HC1OT hopes to operate as HC8E from the Galapagos Islands, commencing on 18 August. I have no other details on this one.

G3KQL/TT8 has been active from Chad, mainly on 15/20 metres SSB, and was expecting to be back there from 26 July for one month and then from 21 September until December. KA4JRY/TT8 has also been active from the same station. However, there seems to be some doubt as to whether either of these operators has proper written authorisation, so it is possible that the operations will not count for DXCC credit.

Readers may not be aware that when any of the American space shuttles are in orbit, the ground/space communications are relayed on 14295kHz.

One of the more unusual 'countries' on the DXCC list is the sacred community of Mount Athos on a Greek peninsula.

Readers may have seen the series of programmes about Mount Athos which appeared on Channel 4 TV a couple of months ago and showed a religious life-style among the all-male monastic population of the peninsula which has changed little in hundreds of years. Although there has been occasional amateur radio operation in the past, it appears that the monks regard it as an example of 20th century corruption of their lifestyle and have now decided to ban it forever. I hope you worked this one while the going was good...

Contests
Two international contests of note in August. First is the Worked All Europe CW contest on 10/11th, run by the German DARC. The rules are quite complex but it is simple enough to join in and make a few contacts and exercise your CW. Another CW event is the All Asia CW Contest on 24/25 August, an opportunity to work lots of Japanese stations (if propagation is kind) as well as, occasionally, something a little more exotic.

Domestically, RSGB members can take part in the ROPOCO contest on 25 August. The idea is to receive and pass on post-codes, some of which, in previous years, have ended up bearing no relation to how they started, having been passed from station to station for up to two hours! (like Chinese whispers).

Enjoy the remainder of your summer operating and do pass on any comments or news to me at: 105 Shiplake Bottom, Peppard Common, Henley RG9 5HJ.

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Hard on the heels of the Yaesu FT2700RH comes this magnificent miniaturised dual bander from Icom. It covers the whole of the 70cm band as well as 2m, and it can be internally modified to cover 140-150MHz. It is remarkably small and compact, and is especially suitable for a mobile installation, the mobile mounting sleeve having a padlockable latch on the side cheek.

It has just one antenna output covering both bands, a built-in diplexer coupling the two band sections together, so the rig is ideal for use with a dual band mobile antenna such as the Trio MA4000, which incidently is limited to around 30W continuous power.

Last summer I managed to blow up my dual bander by transmitting 100W through it on 2m in GM, and this served me right! There are two VFOs and you can select the appropriate repeater shifts separately, thus 600kHz for 2m and 1.6MHz for 70cm.

The tuning knob rotates in light click steps and duplicates the up/down buttons on the electret HM15 mic supplied, which also includes PTT and a toneburst button which puts on burst and carrier. The toneburst circuit is in the mic and there is a separate one, somewhat curiously, in the rig itself.

Loudspeaker
The front panel buttons allow very comprehensive facilities, a second function key extending these considerably. Frequency and comprehensive status indications are provided on a liquid crystal display on the front panel, which is easy to see but not quite as good as that of the Trio TW4000A. One fascinating option is a speech synthesiser frequency readout, the UT23.

The loudspeaker is built into the front of the underneath panel but a 3.5mm jack socket on the back can be used to drive an external speaker. The rig operates off 13V dc, its captive short lead being provided with an in-line connector and an external lead also being supplied with built-in fuses in both lines.

Two small rotary pots on the front panel provide Rx audio gain with power switching and squelch sensitivity, which when pulled out reduces the power to around 3.5W. I am slightly concerned that this is pulled out quite a long way and could possibly break with an accidental knock. The main front panel functions include microswitch operating buttons for VFO A/B, priority channel enable, memory recall, memory write, scan enable, a cycling button switching between simplex or ± repeater shifts, call 1, which selects direct access to memory 8, and internal toneburst, which again also puts on carrier. MHz up/down buttons can also be used to switch memory channels when in that mode, the mic’s buttons achieving this as well.

Internal switches, which can only be accessed by taking the top panel off, select whether the VFO knob can VFO from memory or not. Other switches select a pip tone on/off, which can sound when changing a channel by button pushing but not by changing the VFO knob, and a scan stop interval switch, which can hold a scan on a station or continue searching, the scanning speed itself also being selectable to fast or slow.

The second function button gives some extra facilities which include repeater offset frequency write, memory skip, offset frequency check, VFO lock, tuning step rate (12.5 or 25kHz channeling on both bands) and call 2, which gives instant access to the frequency in memory 9.

The microphone socket is mounted on the front panel, and incorporates 8 pins to the standard Icom wiring. The rig is well presented, extremely well laid out internally and includes separate PAs for the two bands with a very adequate heatsink, although I am slightly concerned that no cooling fan is incorporated. This will mean that you will have to provide a very adequate ventilation for the back of the rig when you mount it in your car. In the trials it did get extremely warm, but not ridiculously hot.

It is not possible to transmit on one band and receive on the other, and if you require this facility you would have to consider the Yaesu, which is far more flexible, or the Trio, which does allow it but with difficulty (not duplex though).

It is quite clear that there is going to be heavy competition between the IC3200E, the Yaesu FT2700RH and the Trio TW4000A, for they all have strong points to commend them. The point about this little Icom is that it could be put into spaces that might not be large enough for the competitors, and if you want to be able to have a simple but effective installation for both bands its rather lower price may well swing the balance.

Berserk
I very much enjoyed using this rig as it has no serious failings. Although it takes a short time to accept a command to change frequency, I soon got used to it. However, if you tune the VFO knob too quickly the synthesiser goes berserk and you could end up going upwards when you want to go down, so you have to be slightly patient with it. The normal up/down functions, however, worked very well indeed. If you press either of these and hold it down, the rig steps channels quite rapidly.

I was rather annoyed with the MHz buttons, for these not only went from one band to the other, and thus provided the incorrect repeater shift, but when going through a band edge your kHz setting is replaced by noughts. It is so easy to press the wrong button absent-mindedly, and the Yaesu transceiver also had this problem. It is extremely useful to be able to move frequency from memory, and not many FM mobiles offer this facility, but unfortunately it is not available from either of the call access positions.

Although the displays on the front panel are back illuminated in a bright green colour, there is no illumination behind the VFO dial or the various buttons so the rig is not quite so easy to use in the dark. The instruction manual is...
very well laid out and provides adequate information for using the rig, lay-outs and circuit diagrams being incorporated.

The modulation quality was said to be very good, several amateurs commenting that speech was very clear, the microphone giving quite a bright reproduction with fairly low distortion overall. I have frequently moaned about the reproduction quality from Icom rigs, FM on many other Icoms being very muffled even on an external speaker as the result of too much RF de-emphasis of the treble end. This rig is much better and I found that the received intelligibility was the same as that which is annoyingly improved, calling gabbler being heard that much more clearly!

Sensitivity
The receiver sensitivity seemed excellent on 2m but it was just a little poorer than average on 70cm which is rather a pity. This could well be due to the way in which the two bands are coupled together to feed one antenna socket. The SO239 line socket is on a short flying coaxial lead which feeds the two band sections in parallel. Each band has its own separate bandpass filter and TX/RX diode switching network. Not only are there separate PAs used, but each band has separate RF pre-amps and mixers, the mixer outputs being selected appropriately to a common IF strip. It is possible that the 144MHz filters are slightly loading down the 433MHz RF preamp input by interaction.

I experienced no problems with repeater access using the toneburst button on the mic, and the 25W power output on both bands enabled access to almost any audible repeater. The FM squelch control could be adjusted to allow very weak stations to open it, and the hovering characteristics were reasonably acceptable.

I have always found that second functions on the majority of controls tend to get a bit confusing, but they have been chosen quite carefully so that you should not have to use them very often. What is annoying however is that you have to take the lid off completely to get at the internal switches which you might well want to change for operating in different areas. For example, you might wish to scan rapidly in a more rural area but slowly in an urban one, or alternatively you might want to hold a scanned station where there are very few of them, whilst belting across many unwanted stations in a high density area.

I feel that Icom should have provided an easy to remove bug hatch cover on the top, or even used counter-sunk switches on the panel. The review sample was not fitted with the speech frequency readout option, but I would assume that its quality would be fairly similar to those on other Icom rigs, which are adequate.

Laboratory tests
The RF sensitivity on 2m measured very well, about the same as its latest competition. On 70cm though it was 4dB less sensitive, which was disappointing, especially as you could not conveniently use an external pre-amp arrangement unless the pre-amp could pass 2m signals through it as well as 70cm on TX.

Both the front end mixers gave a good performance, which did not deteriorate significantly when two strong carriers were very close to the wanted frequency. Furthermore, the synthesisers for both bands had relatively low sideband noise, thus giving a very good reciprocal mixing performance. A strong signal on the adjacent channel would not be likely to cause interference to the signal/noise ratio of a weak wanted signal, although the IF selectivity was none too good at 12.5kHz channelling.

Selectivity is quite important on 2m in urban areas, but I have not had problems on 70cm. Now that 25kHz channelling is in very regular use on 70cm, the addition of 12.5kHz channelling on that band is quite useful, although you should watch out carefully for commercial users who frequently use 12.5kHz offsets. It should be remembered that we are secondary users of the band, so I suggest that you avoid these offsets. 25kHz selectivity was excellent incidentally.

Now we come to one of the most ridiculous S-meters that I have yet encountered, even on an FM rig. Not only is there a mere 5dB difference between S1 and 9, but Icom have got a strange idea about their dB above S9, since an RF level increase of only 3dB takes the meter from S9 to S9 +60. The meter is thus only useful for indicating the presence of a signal which can be heard anyway, and I most certainly baulk at an average of 1dB per S-point!

The discriminator distortion was unfortunately somewhat higher than usual, and although this does not affect communication it will mean that a very clean signal would sound just a little dirtier than it might do on another rig. However, the reproduced frequency response was superb, being almost flat from 400Hz to 3.2kHz with fairly steep roll offs outside these limits. Icom have clearly changed their philosophy to conform with the average pre-emphasis and de-emphasis characteristics of other manufacturers, which is excellent.

The maximum audio output power was just 2W into 8 ohms, but quite a bit more into a 4 ohm load. The built-in speaker was fairly efficient and quite adequate.

AUGUST 1985
but since it faces downwards you would probably get a significant improvement by selecting a mini external speaker.

Whilst the rig was extremely well set up on the 2m band we noted a very slight unevenness in the IF selectivity on 70cm, but this should not affect 25kHz channelling or change the measured sensitivity. The unevenness was due to a very slight frequency error which caused a correct input transmission to be a little closer to one filter skirt than the other.

We checked the transmitter sections by dumping the power into a Rohde & Schwarz dummy load attenuator, measuring power on a Racal 9303 digital power meter. The rig was just about on spec, giving 25W output on 2m and 27.5W on 70cm. The power reduced usefully to an average 3.5W on low power. We checked the FM deviation of the tonebursts and found that the oscillator in the mic was set correctly, its frequency also being precise, but the one in the rig, which is superfluous anyway, was just under 2Hz low and with deviation some 6dB lower than that from the mic, which is very curious.

Speech deviation peaked at around 4.6kHz normally, but even when extremely provoked the peak deviation hit just 5kHz, showing a superbly set up limiter. This was confirmed also by the frequency response transmitter, which checked well below limiting and into limiting.

### Icom IC3200E Laboratory Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Results for 430MHz band are in brackets)</strong></td>
<td></td>
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<tr>
<td><strong>Receiver Results</strong></td>
<td></td>
</tr>
<tr>
<td>Sensitivity, for 12dB sinad</td>
<td></td>
</tr>
<tr>
<td>144.025MHz</td>
<td>-124dBm</td>
</tr>
<tr>
<td>144.95MHz</td>
<td>-124dBm</td>
</tr>
<tr>
<td>145.975MHz</td>
<td>-124dBm</td>
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<tr>
<td>Selectivity, off channel 3kHz modulation</td>
<td></td>
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<tr>
<td>±12.5kHz spacing</td>
<td>6.5/5.5dB</td>
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<tr>
<td>±2kHz spacing</td>
<td>71.5/75.5dB</td>
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<tr>
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<tr>
<td>S9+20</td>
<td>-100dBm</td>
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<tr>
<td>S9+40</td>
<td>not marked</td>
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<tr>
<td>S9+60</td>
<td>-99dBm</td>
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<td>Distortion at 3kHz deviation</td>
<td>4%/4%</td>
</tr>
<tr>
<td>Maximum audio output power (10%THD)</td>
<td>4 ohms 3.4W 8 ohms 2W</td>
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<tr>
<td>Calculated intercept point: 12dB sinad method</td>
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<tr>
<td>+100/+200kHz spacing</td>
<td>8dBm</td>
</tr>
<tr>
<td>+20/+40kHz spacing</td>
<td>-8dBm</td>
</tr>
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<td><strong>Weight</strong></td>
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<tr>
<td><strong>Transmitter Results</strong></td>
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<tr>
<td>Maximum output power (high/low)</td>
<td>25.3/7W (27.5/3.7W)</td>
</tr>
<tr>
<td>Harmonics and spurii</td>
<td>no harmonics or spurii above</td>
</tr>
<tr>
<td>Harmonics and spurii</td>
<td>-65dB ref full output power on both bands</td>
</tr>
<tr>
<td>Tx accuracy</td>
<td>-50Hz (+210Hz)</td>
</tr>
<tr>
<td>Repeater shift accuracy</td>
<td>within 10Hz</td>
</tr>
<tr>
<td>Deviations (rig toneburst/mic toneburst/normal speech/provoked speech)</td>
<td>2.3/4.6/4.8/5kHz</td>
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<tr>
<td>Toneburst frequency accuracy</td>
<td>1750Hz on mic 1747Hz on rig</td>
</tr>
<tr>
<td>Current drawn at full output</td>
<td>6.5A</td>
</tr>
</tbody>
</table>

The transmitted response from the mic input socket to the RF carrier after 750μs de-emphasis was almost ideal, being very flat indeed in the passband 400Hz-3.7kHz, the response falling extremely rapidly either side of this passband. The rig should therefore not pick up too much low frequency car noise, and yet the slightly extended response will make the sound quality that little bit better than that of other rigs, which are usually filtered a little lower, sometimes with a shallower cut off.

Transmitted frequency accuracy was extremely good on 2m and very good indeed on 70cm, and one might say that both were almost precisely 'on the nose'.

The maximum current drawn was 6.5A on 70cm, whilst the squelched current when receiving was down to 0.5A. The latter is slightly on the high side, so you will need to watch that you turn the rig off over a weekend! We checked quite carefully for RF harmonic and spurious outputs and none were seen, our noise floor for the test being just below -65dB.

### Conclusions

One has to weigh up the advantages and disadvantages of the three presently available dual band rigs, the IC3200E, the Yaesu FT2700RH, and the Trio TW4000A. The Trio is still my personal favourite because of its superb ergonomics, its one snag being the exclusion of 12.5kHz channelling. Having tried all three rigs the Trio seems easier to use, but you may find that since the separate antenna sockets are on the back panel itself, the 70cm one being slightly awkward to get to, the other two rigs with their short coax leads and sockets will be more convenient if you want to take the rig in and out of the car fairly frequently. The Trio has the best selectivity incidently. The Yaesu, reviewed very recently in *Amateur Radio*, offers simultaneous Tx on one band and Rx on the other, which can be great fun. It too has excellent ergonomics, with just the odd awkward feature like the MHz button problem. Personally I prefer the Trio transmit quality, although the Icom is very good as well.

If you want to obtain optimum performance on both bands, using separate antennas, you will have to exclude the Icom from consideration, especially as it would be very awkward to use an external linear pre-amp with it unless you only used one band at a time. However, for sheer convenience and simplicity the new Icom rig has so much going for it, allowing it to be very highly recommended. It is obvious that all three rigs are in the same top class and equally recommendable.

I would like to thank Thanet Electronics for getting me the review sample so quickly after it had come into the country, and Jonathan Honeyball G1LMS for helping with all the measurements and assessments. I will finally have to leave it to each individual reader to make his own choice, which is not going to be easy.
Yaesu
FRG9600 multimode receiver

Over the years many scanning receivers have come and gone, some being extremely poor whilst others have been just adequate. The exception was the AOR2001, which I reviewed about eighteen months ago in this magazine. The AOR2001 had quite good facilities and a performance well above any other available scanner, covering a range from 25MHz to well above 500MHz.

Although it performed well it had very poor ergonomics and a very nasty touch type keypad, a plastic membrane covering over the touch points. Even so, I gave it a good review but pointed out that what we all wanted was a receiver with far more facilities and with a proper tuning control.

When I first heard about the new Yaesu model I was delighted, since it seemed to have almost everything that one could want in such a receiver, except for the fact that the highest frequency covered was 905MHz and not 1GHz. A review sample arrived from Amcomm of Harrow, North West London, and whilst I was extremely impressed with all the facilities and ergonomics I have to say right now that the technical performance is extremely poor, in fact poorer in many ways than much of its competition.

Before going into details of the performance, however, let's have a look at its comprehensive facilities.

The receiver is totally encased in metal, measuring 180 by 80 by 220mm and weighing 2.2kg. The loudspeaker is mounted in the top panel. The front panel includes an extremely easy to use 5 x 4 keypad, offering superb facilities. The frequency range is nominally 60 to 905MHz, frequency being entered on the keypad as required, a 0 being put in at the beginning for frequencies below 100MHz.

The mode button cycles between wide and narrow FM, wide and narrow AM (narrow AM uses an SSB filter, unfortunately) and upper and lower SSB. A cyclic step button selects 100Hz and 1kHz steps on SSB and AM narrow, 5, 10, 12.5 or 25kHz on wide AM and NBFM, and 100kHz steps on FM.

The keypad allows you to enter frequencies in between steps, the normal channeling reverting once you alter the up/down channel buttons, or the tuning control. The tuning control itself gives click steps at the chosen channeling rate, which works extremely well, allowing one to belt up and down a particular band very rapidly, manual channeling of course being much faster than electronic scanning.

Above the tuning knob are up and down stepping buttons which can be used to select automatic up/down scanning. This, however, is rather slow. One hundred memories are incorporated, which include frequency and mode, and not only are these very easy to select, but you can transfer from memory to the VFO mode as well as putting any frequency found immediately into memory. A priority channel can be scanned every few seconds, if enabled.

An audio scan button will stop the receiver scanning only when a modulated channel is found, provided the squelch control is in use, concentrically mounted audio gain and tone controls also being provided. Additional buttons select clear entry, memory clear, antenna attenuator (20dB), and various clock functions. The front panel also includes a 3.5mm jack socket for headphone interconnection.

The back panel includes what seems to be the inevitably inappropriate S0239 socket for interconnecting a telescopic whip supplied or an external antenna, this socket being ridiculous for the UHF range. A BNC socket would have given a better performance for frequencies above 500MHz. A 13.8V coaxial power socket has a positive inner pin, which you should note carefully as there are two standards for this. An external mains adaptor is available, type PA4C, which delivers 13.8V dc at up to 700mA.

Three phono sockets provide 8V dc (maximum 200mA), video output for use with an external adaptor, and a mute control which mutes the receiver from external control. Three 5.5mm jack sockets are mounted for feeding a tape recorder at a fixed level (specified at 70mV into 50ohms), there's an 8 ohm external speaker, which mutes the internal one when in use, and an FM wide MPX output can be used to feed a stereo decoder externally, which you would have to make up yourself as Yaesu do not supply one.

A four pin molex socket provides binary band data for possible future Yaesu options. A six pin DIN socket can be used to feed an optional computer interface unit, Yaesu having the FIF232C and FIF65A available (Apple II etc). Two small presets can adjust video AGC and audio mute thresholds (the latter for FM wide).

You can thus see that this little receiver has some excellent facilities please mention AMATEUR RADIO when replying to any advertisement
and has been superbly ergonomically designed. Each time a button is pressed a pip sounds to show that the command has been accepted. Frequency entry is simplicity itself and operation on such easily readable panel is a surefire method of tuning the AOR2001. The computer interfacing possibilities are fascinating and the receiver can also be used for video and data reception with the potential of excellent interfacing.

**Subjective tests**

I interconnected the receiver with various antennas, including VHF and UHF discones, and the quality on NBFM and wide AM was quite reasonable for speech communication. Wide band FM seemed to be muffled though, and wide deviation programme peaks were very definitely distorted. In tuning around band II I was troubled by quite bad intermodulation products from the strongest FM radio stations, and unfortunately these extended well above and below the broadcasting section of the band.

The IM performance apparently improved when one switched in the attenuator, but the resulting desensitisation made it impossible to receive any but the very strongest mobile radio transmissions. The air band above 118MHz did come over quite well on AM, although sensitivity was a little lacking. However, as one tuned higher and higher the very poor sensitivity became more and more obvious, and by the 70cm band repeaters that should have normally be fully quieting were either inaudible or only just discernible.

The same situation arose for many PMR repeater and simplex channels below band IV television. I tried listening to CW and SSB and whilst the quality was tolerable at 144MHz, although clearly very subject to hiss modulation, by 432MHz many signals had an auroral quality caused by the appalling noise sidebands of the synthesised local oscillators.

Yaesu do not claim that the rig can be used for CW and SSB reception above 460MHz and I am not surprised, for carriers developed around the top end of the receiver did not produce a musical note at all, just an auroral hiss.

I am most dismayed that Yaesu's top frequency limit is 905MHz for they could, with advantage, have extended this to at least 960MHz, thus covering the 934MHz citizens' band and the cellular radio channels. However, by the time this review is published, Amcomm should be able to supply modified rigs receiving up to 960MHz, for at the time of writing they had already converted two rigs experimentally to the extended range.

If one bears in mind that there is obviously a collosal market, potentially of tens of thousands, for a receiver such as this with good ergonomics, it is very sad that the RF intermodulation, sensitivity and blockage problems are so very poor. Yaesu have been informed of my criticisms and have promised to look into the matter, but surely they must have been aware of the set's deficiencies.

After I'd had a good moan about the first review sample a second one arrived from Alec, which proved to be a few dB better at 433MHz but was actually worse at 144MHz than the first sample, so it seems you cannot win.

We took very many sensitivity readings right across the frequency range, and many of them were considerably below specification. For example, the FM sensitivity around 433MHz of the first sample was some 10dB worse than spec, the specification itself being fairly poor. To overcome this you could put a broad band RF pre-amplifier in front, and I tried a number of these made by muTek, Datong and Packer. Indeed, the sensitivity improved more or less by the gain of the pre-amplifier, but of course the intermodulation performance was so severely degraded as to make the receiver almost unusable on several of the bands which contain strong signals amongst weak ones.

It strikes me that the front end is little better than the poorest typical TV tuner types, and a hot TV front end would have been a lot better. This is not the right way to design a front end though, for what we really need are some switched frontend very low noise pre-amps covering various frequency ranges, followed by a very good ring diode passive mixer feeding a very high frequency IF, which has a narrow roofing filter mixing down to a much lower frequency for the main amplification.

In these days of microprocessor controlled synthesisers it should be possible to design one to give a mixer feed of +10dBm (around 700mV), the injection level not varying much over the total frequency range. A front end such as I have described should give an overall sensitivity equivalent to the very best 144MHz FM black boxes, and what a receiver this would then be.

Even so, there is a lot of fun to be gained from playing with this receiver and I have to emphasise that it is only because my standards are relatively high that I have been so critical. I suggest that you compare one of these receivers with the AOR2001 and a newer one which has just been announced, which incidentally is not the same as a much older model made by AOR for Regency, which also employs the very poor membrane type keypad.

**Laboratory tests**

In the lab we checked the performance with the normal signal generator/analysers equipment that I use regularly for transceiver testing. FM sensitivity varied from an appalling -103dBm (1.6µV) at 433MHz to -120dBm (0.22µV) on 2m. At the top end of the range the sensitivity was only slightly better than at 433MHz and far below what it should have been. Curiously the SSB sensitivity at 144MHz measured quite well, certainly as good as average black boxes on the band.

The reciprocal mixing ratios at spacings close in to the wanted signal were very poor indeed, typically perhaps 20dB worse than a synthesised 2m rig, but at 1MHz and more distant spacings the measurement was very satisfactory. We used the Thorpe method for measuring the RF intercept point, for the normal methods gave ridiculous readings because of the dreadful local oscillator noise problem.

What can I say about a rig that gives measurements inferior to the poorest handhelds? It should have been possible for it to have been at least 20dB better and this is therefore a serious failing. Even the Thorpe method was unusable very close in because of measurement problems! There were indications, however, that the blocking performance was not too bad.
We had a look at the SSB selectivity and found that the filter top was very broad, more so than the specification would suggest. 3.6kHz bandwidth for 6dB down is some 50% wider than it should have been. The 60dB selectivity was quite acceptable, though, showing reasonably good rejection of strong adjacent channel signals, provided these had not already demolished a weak wanted signal because of the reciprocal mixing problem!

The S-meter always showed at least an S1 signal and it only required a 9dB increase in RF level to go from S2 to S9 on SSB. Surprisingly, however, it showed more willing on FM, the same points requiring a lift of 26dB! For all the LEDs to come on required only 30µV on SSB, but a massive 11mV on FM – some signal! The SSB product detector distortion was poor, whilst NBFM discriminator distortion was tolerable. Wide band FM was rather poor, but the main problem here was that the de-emphasis was 75µS rather than the 50µS curve that is required in Europe. The antenna attenuator gave 23dB attenuation at 144MHz and I cannot see any point in attenuating an already insensitive rig. AM distortion was acceptable at middle frequencies and actually somewhat better than that of many other Japanese rigs, but the AM narrow selectivity created extremely muffled reproduction, although wide was quite reasonable. Low frequencies, however, produced quite bad audio distortion.

The rig gave an output of 1.8W for 10% distortion into 8 ohms, which is just about adequate, 2.4W being available into 4 ohms. A frequency error of 1.6kHz was noted at 144MHz on SSB, showing that the synthesiser crystal had not been set up too well. We took many measurements on the second sample, which was equally unsatisfactory, the average sensitivity being about the same, although not sinking to such low depths at 433MHz.

Conclusions

I have to write that I am bitterly disappointed with this rig, which showed such promise when I first became aware of its facilities. If you are prepared to put up with all its deficiencies then I suggest that you could try one, but my advice is to wait a few months to see if Yaesu can get their act together and produce samples which can at least come up to specification, and hopefully surpass it. In the meantime it will be worth waiting for the new AOR model, which will have an extended coverage to 1.3GHz but exclude a chunk of frequencies between 550 and 800MHz approximately.

I would like to thank Amcomm very much indeed for their great help in providing both samples. They have promised to let me try one again if the performance eventually settles down to an acceptable one. Thanks also to Jonathan G1LMS for taking many of the measurements, and to Nigel G1LSA for helping me with many of the tests.

---

**Yaesu FRG9600 Laboratory Results**

**ALL RESULTS ARE FOR THE 144MHz BAND UNLESS OTHERWISE SPECIFIED**

<table>
<thead>
<tr>
<th>Receiver results</th>
<th>Sensitivity NBFM for 12dB sinad</th>
<th>900.5MHz</th>
<th>600.5MHz</th>
<th>433.5MHz</th>
<th>300.5MHz</th>
<th>144.825MHz</th>
<th>117.5MHz</th>
<th>100.5MHz</th>
<th>84.5MHz</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>-105dBm</td>
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<td><strong>SSB, bandwidth for given level drop</strong></td>
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<td><strong>SWM, ratio SSB</strong></td>
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<td></td>
<td>+1MHz spacing</td>
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<td>+0.1kHz</td>
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<tr>
<td></td>
<td>Thorpe method</td>
<td>4.5%</td>
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| AM received audio response with 75µS pre-emphasis |

**SSB product detector distortion**

**FM audio distortion at 3kHz deviation**

**AM distortion**

<table>
<thead>
<tr>
<th>AM narrow</th>
<th>AM wide</th>
</tr>
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<tbody>
<tr>
<td>3kHz @ 90%</td>
<td>3%</td>
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<tr>
<td>1kHz @ 90%</td>
<td>1.9%</td>
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<tr>
<td>1kHz @ 30%</td>
<td>3.3%</td>
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<tr>
<td>300Hz @ 90%</td>
<td>13%</td>
</tr>
<tr>
<td>@ 30%</td>
<td>16%</td>
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<tr>
<td>100Hz @ 30%</td>
<td>38%</td>
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<table>
<thead>
<tr>
<th>Calculated intercept point</th>
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<tbody>
<tr>
<td>Thorpe method</td>
</tr>
<tr>
<td>+100/+200kHz spacing</td>
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<tr>
<td>+50/+100kHz spacing</td>
</tr>
<tr>
<td>+20/+40kHz spacing</td>
</tr>
<tr>
<td>+10/+20kHz spacing</td>
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</table>

**Size 180(W) x 80(H) x 220(D)mm**

**Weight 2.2kg**

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<td>£25.10</td>
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AUGUST 1985 please mention AMATEUR RADIO when replying to any advertisement
Before carrying on with this month's column, I really must apologise for the abrupt ending to last month's offering. I was on the short list to enter hospital and had the admission notice as I was getting the article ready, so I had to rush things a bit.

Anyway, looking through it it's not too bad, but if you have any queries regarding the ATU feature please let me know.

Letters and entries for the Prefix Awards continued to sail in while I was away and I've had some catching up to do; this month I'm up to date again and letters are replied to by return of post.

Lots of enquiries have arrived regarding the Spectrum interface. I have had copies of the rewritten article made and this is available from me for an SAE.

What an interesting batch

So to the mailbox ... and what an interesting batch we have too.

Eric Parkes from Barnsley makes the comment that a lot of listeners (and licensed folk) are unemployed or retired etc, and because they can't afford those all singing and dancing black boxes have to make do with £50 second-hand rigs. He requests more information about the AR88s and how to fit accessories to rigs of that ilk.

Point taken Eric, but as I have said previously, there are others writing for the magazine who are doing a fine job with the older equipment (such as Hugh Allison with his Secondhand articles) and as I have had very little experience with valve type receivers I would not attempt to advise others.

Having made that statement, there are some excellent solid-state receivers around at that sort of price and a Lowe SRX30 with analogue scale was seen recently for £60, a Realistic DX160 plus ATU and digital readout for £75, Trio JR500 for £50 etc. If you want to try homemade there are some nice kits available (see later) at reasonable prices and you can improve or add to them as you go.

Well used if not clapped out!

The AR88s and Eddystones were fine receivers, and many of them still are, but a lot of those coming on the market are often well used, if not clapped out! If you've got the knowledge and skill to repair one, why not try it yourself?

So having said that, up comes Philip Davies from Market Drayton with an award claim heard with an Edystone 840A! Philip uses a folded dipole for 15 metres tucked away in the loft!

Next, a letter from John Jordan in Sheffield mentioning his bargain buy which got him interested in SWL. The receiver is a Skywood CX203 and John would be pleased to hear from anyone with experience of this receiver. Anyway, he seems to be enjoying his new hobby using a long wire and hopes to get a G5RV up when the weather breaks.

The old joystick

CH Fern wrote from Derbyshire about the old joystick antenna. He uses one in his flat and finds it most useful as he can't put up wires. These antennas were made by a company unfortunately now extinct, but an indoor antenna is still offered in design form for DIY by G2VF. An active antenna is available from Datong, among others, and Radio Nederland issue DIY plans amongst their excellent listeners' aids for an active antenna, so the flat dwellers are catered for.

Over to Eddie Brown in Wellingborough who asks about plotting his prefixes. The RSGB does a nice Amateur Prefix/Zone Map for £2.53 and an up to date prefix list is available from Geoff Watts. The new Maidenhead locator maps are also useful and are well worth looking for.

Goff Curtis (not Geoff - sorry!) in South Harrow looks forward to working the new bands and hopes to hear more amateurs on them than at present. Goff listened intently recently when a 'no call-sign wallah' was being hunted by all and sundry. He was hoping for a long awaited Clipperton contact, only to find out eventually, that it was DL8YR/ST2!

As he says, it's damned annoying when stations call 'QRZ' with no callsign for 20 odd overs.

Goff also mentions his lively tape correspondence group, exchanging information and experiences using open reel tapes at 39ips or cassettes. Listeners are welcome. Write to Goff at 45 Holyrood Avenue, South Harrow HA2 8UD.

Who needs technical innovations?

A nice letter from John Gomer G8UNZ mentioned my write-up on receivers some months ago and he agrees that, although the amateur brands have all the technical innovations, many of the 'high street' receivers are quite excellent in use and sell at reasonable prices.

As I have often said, you don't need a Rolls Royce to get to the beach - it's just a bit more comfortable and a lot more expensive! And if you disagree with that just have a chat with Rev Dobbs and Co!

An enjoyable letter from Owen Cross (chairman of vice at the Cray Valley RS). They won the HF Field Day contest last year on SSB and were, in fact, the first G station to win it. Well done lads!

The Cray Valley RS 15th SWL Contest is being held on 7 September 1985 at 1800GMT until the same time on the 8th. There are SSB and CW sections and 160, 80, 40, 15 and 10 metres can be used.

Log sheets and rules are available from: Owen Cross G4DFI, 28 Garden Avenue, Bexley Heath, Kent DA7 4LF. Please send a large SAE. Let's see a good entry from our readers this year!

Prefix awards

On to the Amateur Radio Prefix Awards, and first on the list this month is Eric Parkes of Barnsley with his claim for a Bronze award which includes an XYL in VIU2, 3B8, 5H3, AP2, 9Y2 and VQ9, to mention just a few.

S Lipscomb in Kings Lynn offered AT1, 92H, HQ7, VQ9, ZC4, ZP5, and 9Y4 amongst his claim for Bronze heard on bands from Top Band to fifteen - just shows that they're there if you listen!

Charles Morgan of Croydon used his Eddystone 840C to good effect for a Bronze claim which included an FE running portable in TK land, a JA2 maritime mobile, a Canadian in 4U, ZB2 and ZZ5 to round it off.

KA Forward of Bognor sent in 329 to make sure of the Bronze, including some nice ones from A92, AE4, DJ0/C6A, OE3/YK (a few lads had him), YT3, 4B3 and a mixed grill for the rest.

Next on the list this month is Gary Lee Hendricks in Letchworth who sends in a cracking list for the Gold award. His 1000 plus came neatly entered in a fourteen page book!

Wires, loops and verticals

Gary's hunting was done using a Racial RA17 with FR101s as back-up and a multitude of antennas ranging from the old SRV through to wires, loops and verticals. That's the way to catch 'em! CE2, CP8, D44, HL1, 8Q7, J73, J28, P2J, P29, S83, TZ6 and ZD7, to name just a few of the choice catches in the list.
Jon Sales, now GOAZJ (congratulations Jon), is still waving the wires around and submits his 500 for the Silver to add to his shack decora-
tions.
With 5H3, VP9, P29, 8P6, 8R1, J37 and 757 for starters and a nice collection of specials to make the number up, Jon comments on the drop-out of the bands for over a week. According to the reports, we’re not at the bottom of the trough yet either!
Don Hollingsworth of Sea-
ford submitted his first list for the Bronze, worked with a Yaesu FT200 feeding a half size G5RV, under GOAMH. Field used the award scheme to capture his first 250. It’s a different kettle of fish working them if there’s a pile size G5RV, under GOAMH.

Just pausing for a commer-
cial to say that Geoff Watts’ prefix/country/zone list is now backed up by an oblast list for those chasing Russian districts. It’s only 35p (the PCZ list is £1) and can be obtained from: 62 Belmore Road, Nor-
wich NR7 0PU.
From Folkestone, Mike Hudson offers his Bronze claim which includes 5N8, A4X, AP2, HZ1, YB4 and ZC4 for starters and a nice mixed bag heard from 80 to 15.

Just shows what can be done
Finally for this month, M Moss, RS66999, sends his Bronze claim commenting that he only had a DCRX on twenty until 15 March (note my previous comments about simple receivers) when he invested in an FT101E for future use. With A4X, JA2/MM, PP7, VE7, XT2, 5B4, 6Y5 and plenty of other nice catches, it just shows what can be done with the simplest of receivers and a bit of wire. The licensed fraternity have been kind to listeners during the D-Day celebra-
tions and many special call-
signs were to be heard in Britain and the USSR, with others in various countries giving us a nice selection of prefixes. The British GV series was operating throughout the D-Day week and an award was available for hearing GV0ISO, GV2ISO and GV415C, plus a number of specials to those who learned them

For hearing GVOISO, GV2ISO and GV415C, plus a number of specials to those who learned them
For hearing GVOISO, GV2ISO and GV415C, plus a number of specials to those who learned them
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The experiences of Mike G4ROM, Khee G5MUR and Will G6TXA

The summer of 1984 saw Mike G4ROM, Khee, then G5MUR, and Will G6TXA embarking on a tour of Scandinavia by train. The countries visited were Denmark (OZ), Sweden (SM) and Norway (LA). Our train tickets were valid for one calendar month of travel throughout the rail network of Western Europe but work commitments dictated that we use up only three weeks of the month. Originally, plans were made to visit Finland (OH) as well, but they had to be dropped because of the lack of time.

What a super idea to be able to operate amateur radio from all the exotic Scandinavian locations that we were going to visit! Our thoughts? Language problems? It is a well-known fact that English is widely spoken in the Scandinavian countries and this was proved to be correct later on.

Limited

The amount of radio equipment that we could take was limited by the weight penalty that was imposed, and the amount of space available in our rucksacks. It is a well-known empirical fact that the weight of a rucksack increases with travelling time! Also, three weeks was a rather long period of time. Space was rather limited after the rucksacks (they were supposed to hold 60 litres each) had been filled with the essentials – clothing, sleeping-bags and photographic gear (photography being another interest that we share).

Therefore we decided to limit our radio gear to 2m hand-held transceivers and as few accessories as possible. The transceivers that we eventually took along were an Icom IC2E, a Yaesu FT203 and an FT208. The accessories were speaker microphones (which made operating and walking around with fully laden rucksacks more tolerable), a spare battery pack each, a battery charger and a multi-standard mains plug adaptor. A Sony ICF7600D with a long piece of wire was also taken along to monitor the amateur HF bands and for reception of the BBC World Service.

The application process for our reciprocal licences started about eight weeks before our departure date. We wrote to the RSGB for information regarding reciprocal licensing in the four countries that we wished to visit. In reply we received a computer listing of all the information they had, together with copies of the application forms from the respective licensing authorities. The information from the RSGB proved to be mostly accurate and we had no problems with the licence applications, with the exception of Finland.

Our applications for Finnish reciprocal licences were returned to us with a letter from the licensing authorities saying that they only issue reciprocal licences for fixed station operations. This proved to be rather fortuitous as we had to drop Finland from our itinerary later on.

The nature of 2m operation in the countries that we visited proved to be very different from what we were used to in the UK. Owing to the sparse population, outside the major cities most QSOs on the band were through the extensive network of repeaters. There was no formal channelling system in the simplex portion of the band, with only 144.300 and 145.500MHz being designated as the SSB and FM calling frequencies respectively. We only had a few simplex contacts and heard only two SSB contacts during the three weeks of travelling. However, the fact that we were only equipped with low power hand-helds with 'rubber-duck' aerials must be taken into consideration. Furthermore, little operating was done while we were travelling in the trains, even though it was not specifically prohibited in all three countries.

Denmark

The first country that we visited was Denmark. The information that we received from the RSGB stipulated that there is no Danish licence which is equivalent to the British class B, so only G4ROM applied for a Danish reciprocal licence. It was only later when the licence for G4ROM/OZ was received that we discovered from the schedule that the Danish class D licence was equivalent to a British class B licence. The classes of Danish licence (there are four) and their technical and Morse code requirements are given in Table 1.

To obtain a Danish reciprocal licence, the completed application form (a copy of which is available from the Membership Services of the RSGB or direct from the Post og Telegrafvaesenet), together with a photocopy of the front page of one's licence and a letter from the RALU to confirm its validity, must be sent to the Post og Telegrafvaesenet. The RSGB recommended that we send our applications two months in advance. However, the licence for G4ROM/OZ arrived within a week of posting off the application.

The licence fee of DKr20 had to be paid by means of a Bank Giro transfer (similar...
to the Bank Giro system here) upon arrival in Denmark. The Danish licensing authorities did not require a fixed address to be specified as the station address. The address of G4ROM/OZ was stated on the licence as ‘mobile’, because we were not sure where we would be staying in Denmark at the time of application. The reciprocal licence was valid for a period of up to three months.

Besides /M, operation as /A and /P are allowed along the same terms as the British licence. /M operation is also permissible from ‘Private aeroplanes under visual flying conditions or in pleasure crafts’. The /MM prefix is only issued on special application together with the written approval of the ship-owner. Unlike the British licence, where there is no mention of the language in which a QSO may be conducted, the Danish licence only permits Danish, Faroese, Greenlandic, Norwegian, Swedish, English, French, German and Spanish to be used.

Table 1 lists the bands and maximum power levels that are available to the different classes of licensees. There is no mention of the bands above 70cm, because a special permit has to be obtained to operate on the amateur bands 1.2 to 24GHz. Details of ‘...the nature and extent of experiments desired...' must be included in the application.

Copenhagen is a remarkably peaceful and relaxed city with none of the hustle and bustle of other major European capital cities. The only danger to the tourist on foot would be the cyclists. There are cycle lanes on all the main roads next to the pavement. We were nearly run down by cyclists a few times while crossing the roads and alighting from buses.

We found operating 2m in Denmark, or more specifically Copenhagen, rather disappointing. There seemed to be very few stations on the band, so few in fact that most stations did not bother to QSY from the calling frequency after establishing a contact. The scarcity of activity might partly be due to the fact that it was peak holiday season at the time of our visit, late July 1984. Furthermore, we were only in Denmark for three days and most of the time was spent in Copenhagen.

The repeaters that were accessible from Copenhagen on a 2m hand-held were OZ3REU on R3 and OZ9REE on R4. All Danish repeaters have the call sign OZ*R** and most of the activity on the repeaters was from mobile stations going to and from work, with some fixed stations later in the evenings. We may have got a distorted picture of 2m in Denmark, after all, a visitor to this country working through the 2m repeaters in London would receive a bad impression of 2m operating in the UK!

The address of the Danish licensing authority is: Post-og-Telegrafvaesnet, Radio Tilladelsessektionen, Islands Brygge 83C, DK-2300 Copenhagen S.

Sweden

The next country on our itinerary was Sweden. As in Denmark, there are four classes of amateur radio licences and the details are given in Table 2. From the table, it would appear that the nearest Swedish equivalent to a British ‘B’ licence is a class T. In practice however, the British class B licensees of our group were issued with Swedish class B reciprocal licences, thereby allowing them to operate HF, albeit only on 10m. Later on we were told by Swedish amateurs that this is a common practice.

The suffixes /A and /P are no longer used in Sweden. When one is on the move then the appropriate suffix is /M, whether in a vehicle or on foot. When on board a vessel, however, the appropriate suffix is /MM. Instead of signing /A, a Swedish licensee signs /n, where n is the number of the radio district (see Table 3) in which the station is temporarily located. Similarly, a reciprocal licensee signs own-call /SMn.

The reciprocal licence is valid for a maximum period of three months in any twelve. A copy of an application form is available from the RSGB. The other documents that the Televerkets Radiodivision require are a copy of the front page of the home licence, proof of its current validity and a letter of good conduct either from the RSGB or the local police. At the time of our application, the licence fee was SEK80 and, like that for Denmark, was paid by Bank Giro transfer on our arrival in Sweden.

Liberal

The Swedish licensing regulations are far more liberal than those of Britain. For example, anyone is allowed to operate the station as long as the licensee starts and finishes the QSO and is on hand to supervise. The Swedish licence permits /A or /P operation on board a ship or a private craft without a special licence, unlike the British licence. All that is required is the consent of the captain or the owner of the ship or craft. Operation on board public transport is also permitted.

Basically, amateur radio operation is allowed anywhere, as long as no interference is suffered by other users of the radio spectrum. These interesting items of information were included in a brief booklet entitled Memorandum on the rules applicable to amateur radio activities on the part of foreign nationals in Sweden which was enclosed with our reciprocal licences. We only found out about them from the Swedish stations that we spoke to over the air. It seemed rather odd that a full English translation of the provisions of the Swedish amateur licence was not sent to us.

There is an extensive 2m repeater network in Sweden, from the southern tip to inside the Arctic Circle. In general, the remoter the location of the repeater, the more basic is its control logic. One repeater that we operated through while we were in the Arctic Circle was carrier accessed, as opposed to the more usual toneburst accessed machines elsewhere.

In Gothenberg, we could access three repeaters: SK6RFQ (R2), SK6RLV (R4) and SK6RKI (R6). SK6RFQ had a very fascinating control logic. A toneburst followed by audio within 15S was required to access the repeater. The maximum duration of the first over was 1 minute and subsequent overs were
limited to 2 minutes. If the 2 minute limit was exceeded a short recording of a marching tune was transmitted by the repeater and the operator was barred from further transmissions.

When the offending station has been transmitting through the repeater continuously for more than 3 minutes the repeater ceases talk-through, plays the tune and then closes down! This same noise also has a time switch which shuts it down after 10pm to save power as activity on the repeater is fairly low in the late evenings.

In Stockholm we had our first taste of operating 'Maritime Mobile', which, as mentioned earlier, does not require a special licence in Sweden. We were aboard a pleasure steamer (with a real steam engine) on the way to Växholm, an island in the Stockholm archipelago. We managed to obtain permission from the first officer, whom it turned out came from Gothenberg, to operate Swedish licence plates as we held Swedish amateur licences!Luck was with us after therefore earmarked it as a place to visit. We had to be content with peering through the glass partitioning at the very well equipped station. Luck was with us after when we passed the museum on a bus to Stockholm occurred while we were visiting the Museum of Science and Technology. The museum is similar to the Science Museum in London but it is smaller. There are two floors of an annex devoted entirely to telecommunications and an amateur radio station, SKOTM. We found ourselves causing a pile-up on 20m because of the SK0 call, with a Drake TR7 driving an L4 linear amplifier into a TH6DXX triband beam. One evening that rang a bell in GAROM's memory (pun intended!) was G4UJS, Bob and it transpired that Bob was local to Manchester. Bob was prepared to ring up Murray, G2CAZ, Mike's dad, to let him know that Mike was on 20m. Father and son spoke to each other over the air, thereby enhancing the image of amateur radio in the eyes of Mike's mother: '...it is useful after all!'. SKOTM is also equipped for 2m with a Trio TR9100, a collinear and a 10 ele Yagi, and for RTTY with a VDU and a fairly new Philips electronic teleprinter. There were also other receivers of various sizes and vintages around the shack.

Looking through the station log most of the operators were visitors to the museum, a large proportion of whom were non-Swedish. Two months later G5MUR heard SKOTM on 20m, being operated by an HB9 visitor and he was also causing one almighty pile-up! SKOTM is certainly well worth visiting if you are ever in Stockholm, if not to see the other telecommunications exhibits, which are more comprehensive than those at the London Science Museum, then to experience the other end of a pile-up!

Repeater

Three repeaters were accessible with our hand-helds from the centre of Stockholm. However, none of them featured such exotic control logic as the one in Gothenberg. The repeaters were SKORIX (R1), SKORFO (R5) and SKORDZ (R8). Activity on the repeaters was higher than in Gothenberg due to the higher radio amateur population; about one quarter of the total population of Sweden live around Stockholm. /MM operation through the repeaters was quite common during the weekends, as it was summer then, especially between stations sailing and the Stockholm archipelago. From the number of yachts sailing or moored in the archipelago, it would seem that a yacht is like a second car to the Stockholmers.

Gothenberg is a charming little city. The wide boulevards are interspersed with tram lines and the numerous little parks scattered here and there give an airy atmosphere to Gothenberg in the summer. The harbour is one of the busiest in Western Europe but nevertheless the water in the harbour was crystal clear!

Stockholm is spread over fourteen islands and like Copenhagen also lacks the hectic activities of a major European capital city. The long waterfront, the cleanliness, the immaculate orderliness and the abundance of uncrowded wide open spaces make Stockholm a very beautiful city in the summer.

On the whole, we found operating 2m in Sweden to be very enjoyable. The level of activity on the band was such that the repeaters were seldom busy and most of the simplex channels were available at all times! We received a wealth of helpful information and directions regarding the places of interest to visit in Stockholm and Gothenberg from other radio amateurs over the air (especially from Rogan SMOKJD, who is an expatriate Englishman), which made our visits all the more enjoyable. We had no language problems at all as all the Swedes spoke English very well!

From our experience the Swedish licensing authority works very quickly. We received our reciprocal licences only two weeks after sending off our application forms! English was used in all the
correspondence. The address of the licensing authority is: Televerkets Radiodivision, Frekvenssektionen, Tillstandskontore, S-123 86, Farsta, Sweden.

**Norway**

Norway was the last of the Scandinavian countries in our train journey. The Norwegian railway network passes through areas of immense natural beauty and wilderness. If you ever want to do a hike in physical geography, especially one on the effects of glacial actions, then Norway is the country to visit for a firsthand experience. The fjords are really impressive and a must for any self-respecting visitor to Norway. Anyway, this article is supposed to be about amateur radio operating in Norway, not a promotional piece for the Norwegian Tourist Board (as if they needed any help!).

There are two classes of amateur licence in Norway. However, do not expect the Norwegian licensing authorities to issue you with a reciprocal licence if you only have a British class B licence as both classes require Morse capability. In addition, the rule that licences are only issued to nationals whose countries have a reciprocal licensing agreement with Norway is strictly enforced, as we found out later in Oslo. This was unlike Sweden which also has no agreement with Malaysia; Will and Khee are Malaysians but have British licences.

The Norwegian class A licence is known as the ‘General Licence’ while the class B is known as the ‘Beginner’s Licence’.

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<th>Table 4</th>
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<tr>
<td><strong>Class A</strong></td>
<td><strong>Class B</strong></td>
</tr>
<tr>
<td>Basic general electronics theory and specific radio topics</td>
<td>Basic general electronics theory only</td>
</tr>
<tr>
<td>Knowledge of the treatment of electrical shocks</td>
<td>Knowledge of the treatment of electrical shocks</td>
</tr>
<tr>
<td>Knowledge of the licensing regulations</td>
<td>Knowledge of the licensing regulations</td>
</tr>
<tr>
<td>Ability to send and receive correctly in Morse code at a speed of 60 characters/min (12wpm), texts in code and Norwegian and English texts in plain language</td>
<td>Ability to send and receive correctly in Morse code at a speed of 40 characters/min (8wpm), texts in code and Norwegian and English texts in plain language</td>
</tr>
<tr>
<td>Ability to send and receive correctly by telephony</td>
<td>Ability to send and receive correctly by telephony</td>
</tr>
<tr>
<td>Max power to final stage - 600W irrespective of CW or PEP. Output power must be easily reducible.</td>
<td>Max power to final stage - 15W irrespective of CW or PEP. Output power must be easily reducible.</td>
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Frequencies: The bands allocated to both classes are the same and are similar to the British ones and there are plans to introduce 6m in the future. There is however no allocation for 180m nor any at the post WARC 79 bands. Prior application to the Telelediraktatet is required before any amateur band above 700m can be used.

At such height one would have thought that we would be working DX to our hearts’ content. Unfortunately, we also became aware of the general lack of amateur stations in that part of the country. The local repeater is LA9NR (R5), situated on a small hill above Narvik, well below the summit of Fagernesfjell. Obviously most, if not all, of the local amateur population were away on their holidays as we did not hear a single OSO on the repeater during the day and a half that we were in Narvik.

From the summit of Fagernesfjell, LA7HR (R2) at Harstad, which is over 50Km to the west in the Lofoten Islands, was accessible with a couple of watts. Eventually, Mike had a QSO through it with LA9UH, Ray, who was on an island on the far western side of the Lofoten, a further 60Km away.

**Busier**

The 2m airwaves were a bit busier in Oslo and Mike even had a few QSOs on simplex. Operating portable in Oslo was not very appealing at the time that we were there. It rained almost continuously for the first two days, and most of our operating was done from the comfort of the youth hostel where we were staying, which is on a hill overlooking Oslo.

LA8FC, Steinar, returned to one of Mike’s CQs from the youth hostel and mentioned that he was rather shocked when he heard Mike’s callsign. He said that he had just seen the callsign in Practical Wireless, in the club news column, as Mike had given a talk to the South Manchester Radio Club! Practical Wireless was the only English language radio magazine that we saw on general sale in Scandinavia. You may think it is expensive here but it was twice the UK price in Norway!

It was on the first rain soaked day that we paid a visit to the offices of the Teledirektoratet to enquire about the possibility of Will and Khee (who only have British class B licences) operating under Mike’s licence. The person that we dealt with must have been a radio amateur himself as we had an interesting few minutes chat about radio equipment. He confirmed that all of us could use Mike’s callsign, ie G4ROM/LA, and regretted that even if we had all had class A licences he would still have been unable to issue reciprocal licences to us because there is no reciprocal licensing agreement between Norway and Malaysia.

There are two local 2m repeaters serving Oslo. Activity on the repeaters was not high compared with Stockholm. One, LA6OR on R2, is within the city limits and the other is LASOR on R6 at Enebakk, 20Km south west of Oslo. By now you will have deduced that all Norwegian repeaters have two letters after the number in the callsign. The first letter is usually related to the repeater location or the name of the nearest principal town, and the second letter is always ‘R’, to denote a repeater. A highly logical callsign system but it can be a nightmare when there are a number of
OPERATING IN SCANDINAVIA

different repeaters serving the same locality or located in the same area. Bergen was our next stop, in the heart of the Western Fjords. It is a more attractive place than Oslo, with cobble-stoned lanes, a picturesque setting, and none of the skyscrapers and litter of Oslo. Apparently it has weather characteristics that are similar to Manchester, ie if it is not raining then it's going to, and hence it suffers from the same kind of jokes from non-residents as Manchester does. Well it only rained for one day out of the three that we were there, a better record than Oslo!

We had no problems accessing the local repeater in Bergen, LÅSBR on R6. It was on a hilltop overlooking Bergen and the youth hostel we were staying at was halfway up the same hill. There was little activity on the band; probably most of the non-local traffic was obstructed by the terrain. In the evenings there were a number of QSOs on the simplex channels, but the only one we had through the repeater was with a station who was himself a visitor to Bergen.

After the hectic travelling of the previous three weeks we had a three day 'rest' (from travelling, anyway) at Arendal on the south eastern coast, before embarking on the 42 hour long train/ferry journey back to London via Oslo, Copenhagen, Hamburg, the Hook of Holland and Harwich.

Arendal is a little harbour which gets transformed into a sailing centre during the summer and it used to be the major centre for shipping and ship-building in the region. Nowadays its shipyards are mostly kept busy constructing oil production rigs for the North Sea oilfields.

Strange as it may seem, there was more activity on 2m around Arendal than in Bergen. We were rather bewildered by this until our Norwegian friend pointed out a large building with a tower bristling with aerials on a hilltop overlooking the town— a training school for maritime radio and radar operators. In fact, two of the local stations that we spoke to over the air for making us so were instructors at the school.

Again, as in Sweden, we had no language problems, as most Norwegians could understand, if not speak, English. Unfortunately, we did not manage to locate Slartibafast's signature despite a few trips through the fjords on the west coast!

Restrictive

To round off, a few points of note about the Norwegian licensing conditions. Unlike the tone of liberalism of the Swedish amateur licence, the Norwegian one is rather restrictive. In fact, we consider it to be stricter than our British licences. For example, a Norwegian licensee may have his/her licence revoked for causing interference to other amateur stations by key-clicks, over-modulation or constant unstable signals. The licence even specifies the minimum frequency stability and the maximum amount of spurious emissions of an amateur transmitter.

One other aspect that most of us would consider to be extremely restrictive is the keeping of the station log. In addition to the usual details, the Norwegian licence requires the licensee to list all the equipment of the station in the log and to record any technical changes to the station. Furthermore, should any radio equipment be sold, lent, rented or otherwise transferred, a record is also required in the log.

The address of the Norwegian licensing authority is: Teledirektoratet, Boks 6701, St Olavs Plass, Oslo 1, Norway.

Finland

This is going to be more of a footnote to our article. We had to drop our plans to visit Finland due to the pressure of time. With only three weeks available, we felt that a whistle stop tour would not have allowed us to explore the countries that we intended to visit in any detail, and as Finland was a bit out of the way and the train connections inconvenient, it was dropped from our itinerary.

As it turned out we had our application forms for Finnish reciprocal licences returned by the Finnish Amateur Radio League, who did the initial processing for the Finnish licensing authorities. Our applications were turned down because the Finnish licensing authorities only issue reciprocal licences for operations from a fixed location. Portable or mobile operating by reciprocal licensees is not permitted (possibly due to the proximity of the USSR!).

We cannot go into any great detail about the Finnish licence for obvious reasons. Nevertheless, here are some brief details about the application procedure. All radio amateurs in Finland must become members of the SRAL, except for visitors staying less than a month. As mentioned earlier, all applications must be made via the SRAL (address below).

The cost (in June 1984) of the licence was 38 Finnish marks and an additional 20 Finnish marks handling charge is levied by the SRAL. However, no fee is payable at the time of application. It would appear that both British class A and class B licensees can obtain reciprocal licences in Finland but we have no details about the privileges of the different classes of amateur licence.

In addition to the completed application form, a certified photocopy of the front page of your passport and a letter certifying the validity and class of your licence from the RALLU must be provided. The exact postal address of the station in Finland must also be stated.

We rather regret not being able to squeeze in Finland. The 'Land of a Thousand Lakes' and of Sibelius will have to wait for some other time. The address of the SRAL is: Suomen Radioamatootario RY (SRAL), PO Box 306, SF-00101 Helsinki 10, Finland.

And finally . . .

We wish to thank the staff of Membership Services at the RSGB HQ for providing us with all our initial information about reciprocal licensing in the various Scandinavian countries. We also wish to thank those amateurs that we spoke to over the air for making us so welcome in their respective countries.

It is the firm view of the writers that to get away from the crowds in the summer, the countries in Scandinavia are ideal. If one prefers fresh air and peacefulness to lying in the sun (or even in addition to!), the great Scandinavian outdoors with its superb and unique scenery beckons.
This new HF transceiver from ICOM is compact enough to make mobile or portable use a possibility. The IC-735 covers all Amateur frequencies from 1.8MHz to 30MHz including the three new bands 10, 18 and 24MHz. Modes include SSB, CW, AM and FM, all circuits are solid-state and output is approximately 100 watts.

Tuning ranges from 100kHz to 30MHz, made continuous by using a high-side IF and a CPU control system. RTTY operation is also possible. Dynamic range is 105dB with a 70.451 MHz first IF circuit. The direct feed mixer rejects spurious response and gives higher sensitivity and wider dynamic range. Pass-band tuning and a sharp IF notch filter provide clear reception even under duress.

The new IC-735 from ICOM is easy to operate and versatile, it has various scanning functions, comprehensive LCD and 12 memories. Computer remote control is possible via the RS-232C jack.

Options include: the AT-150 automatic antenna tuner and shown here the FS-55 AC power supply and SM-8 desk mic.

Please contact Thanet Electronics or your local ICOM dealer for even more information on this latest HF transceiver - the IC-735.

290D is the state of the art 2 meter mobile, it has 5 memories and VFO's to store your favourite repeaters and a priority channel to check your most important frequency automatically. Programmable offsets are included for odd repeater splits, tuning is 5KHz or 1KHz.

The squelch on SSB silently scans for signals, while 2 VFO's with equalising capability mark your signal frequency with the touch of a button. Other features include: RIT, 1 KHz or 100Hz tuning/CW sidetone, AGC slow or fast in SSB and CW, Noise blanker to suppress pulse type noises on SSB/CW.

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Listed here are authorised dealers who can demonstrate ICOM equipment all year round. This list covers most areas of the U.K., but if you have difficulty finding a dealer near you, contact Thanet Electronics and we will be able to help you.

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Audio distortion

Of the many factors affecting this parameter probably the most important ones are the detector distortion and the output capability of the set. However, the entire IF chain should be able to cope with short transients several dBs above the normal levels subject to AGC control through the system. After a pause, a sudden transient comes through before the AGC backs it down, and too many sets have a nasty click, which is transient distortion, on the leading edge of syllables and words. This shows insufficient IF dynamic range and poor AGC control.

Product detectors used for SSB and CW can be as good as 0.4% THD on a static measurement, but as bad as 10%. Under transient conditions distortion can be many tens of percent but it is extremely difficult to measure this, although the sound is all too familiar. What is particularly horrific is the shocking quality of reproduced AM from the average Japanese rig when at high modulation levels. I have noted up to 30% distortion, and when you compare this to a receiver having only one or two percent I can assure you that the audio differences are very startling.

The three finest AM receivers for sheer quality that I have measured are the old GEC BRT400, the Surrey Electronic modified Yaesu FRG7700 and the Icom IC751 with 30% distortion, and when you listen to the station you can get lower noise. The carrier levels can be perhaps 20dB higher than they really ought to be, so a close in figure has sometimes been stated to be 'impossible to measure'. This has caused me much concern and various methods have been employed to rectify this, including using a narrow band spectrum analyser on the audio output in order to perform the reciprocal noise. This is invalid as the reciprocal noise is generated, but very slowly you can note the noise. The carrier levels can be perhaps 20dB higher than they really ought to be, so a close in figure has sometimes been stated to be 'impossible to measure'.

Measuring RF Intercept point

If one is to avoid hearing a receiver apart and probing deep down into the inners, combined with modifying some parameters in order to measure radio frequency intermodulation distortion and blocking characteristics, one can use one of two simple methods for the measurement. I have learned by bitter experience that both the normal methods can give false results, but it is usually possible to choose one of them in an individual case which will give a fairly reliable answer.

The first method requires you to calibrate the S-meter very carefully, then measure the sensitivity at the required frequency, followed by a measurement of the off-channel carrier levels required to produce a given S-meter reading on channel.

This normally gives quite accurate measurements which allow one to calculate the intercept point when the two carriers are spaced well outside the IF roofing filter bandwidth, but problems occur if AGC is applied either to the RF stage or only to the 12dB sinad point, before the roofing filter. The measurement gets very dodgy for carriers spaced closer than 20KHz off-channel. The alternative method, after measuring basic 12dB sinad sensitivity, is to measure the levels of two identical carriers off-channel, as before, that give a 12dB sinad intermodulation product on-channel. This method works extremely well, even at close spacings. If the receiver has an excellent reciprocal mixing performance, but if there is a bad one the nearer off-channel carrier can create so much noise on-channel that it makes the sinad reading lower, which results in one having to increase the level of the two generators.

Impossible to measure

As you increase the levels yet more noise is generated, but very slowly you will reach a 12dB sinad point as the intermodulation rises faster than the noise. The carrier levels can be perhaps 20dB higher than they really ought to be, so a close in figure has sometimes been stated to be 'impossible to measure'. This has caused me much concern and various methods have been employed to rectify this, including using a narrow band spectrum analyser on the audio output in order to perform the reciprocal noise. This is invalid as the reciprocal noise is generated, but very slowly you can note the noise. The carrier levels can be perhaps 20dB higher than they really ought to be, so a close in figure has sometimes been stated to be 'impossible to measure'.

I put the problem to John Thorpe, a post grad engineer from Cambridge University, who is now working at Lowe Electronics, and it was he who came up with a most effective solution and who should take all the credit for it. Thorpe's technique involves the taking of three measurements in order to establish dynamic range and intercept point. The first measurement is to establish the on-channel 12dB sinad sensitivity, from which can be calculated the noise floor, assuming one knows the approximate filter bandwidth. The two generators are then connected as always via a coupler to the input of the receiver at spacings of X and 2X off-channel, and increased in level until an intermodulation product is just audible. The generator which is furtherest off frequency is then turned on and off at RF, and the point at which the audio output level of the receiver goes 3dB up and down is noted.

Minor contribution

At this level the intermodulation product when both generators are on is at the same level as the reciprocal noise produced by the closer generator. There is a contribution of noise from the second generator, and there are methods for eliminating this which are more complex.

The third measurement requires one to change the frequency of the generator furthest out to the wanted channel and carefully introduce a 1kHz beat note. The original closer generator is kept on at the level established in test 2. The on-channel generator is reduced to inaudibility and then brought up again until there is a change of 3dB introduced when its RF is switched on and off. This gives the receiver noise floor very precisely in the presence of the strong off-channel signal.

The difference between tests 2 and 3 in dBs is then added to the basic noise floor of the receiver, and this figure is multiplied by 1.5. The resultant figure in dBs is the number of dBs that the approximate intercept point is above the receiver noise floor. If test 2 is at -30dBm and test 3 is at -120dBm, the difference is 90dB. Multiplying by 1.5 gives 135dB and adding this to a noise floor at -135dBm would then give 0dBm as the intercept point, which would be reasonably realistic.

The 12dB sinad method in this actual instance gave a figure of +12dBm, the S-meter method also giving a similar erroneous figure. I hope knowledgeable readers will write in to the Editor and make comments on this as I consider it quite important. It has already allowed me to measure blocking performance as close as 5/10kHz spacings on several rigs with marked reciprocal mixing problems, and the measurements tie in far better with subjective assessments on the bands than do the normal methods.

Simplification

We have also tried a simplification of the new method which also seems to give consistent results. This method requires the measurement of a 12dB sinad product on-channel with the two off-channel carriers remaining on all the time. The method should also work with modulated FM carriers. Having noted the off-channel carrier levels required to produce a 12dB sinad IM product, the
more distant carrier should be put on-channel with modulation, if on FM, to give a 12dB sinad ratio in the presence of the closer off-channel carrier at the level reached in the previous check.

The approximate RF intercept point will then be 1.5 x the difference between the two test results added to the second result, ie half the difference added to the first result. You can compare the second result with the normal sinad measurement made without the off-channel carrier filtered present to obtain an indication of the reciprocal mixing problem that may exist in the receiver.

**Poor design**

We may well have a completely clean band of signals coming out of the first mixer, but poor design even in the first IF stage can completely ruin what may otherwise be a good receiver. Gone are the days when the first IF was around 400kHz. Many modern sets with the attendant bad image problems were worse as you tuned the set higher in frequency, and which could be really bad by the time you got to 28MHz.

Most sets now have a very high IF, somewhere between 40 and 70MHz. High IFs certainly have good image rejection but it is much more difficult and more expensive to provide switchable narrow filters at such a high frequency. For this reason most sets employ what is termed a roofing filter. If you are lucky they may be only 8kHz wide or so, but as often as not they can be up to 30kHz wide and have rather shallow skirts. The high IF is just there to remove the image problem and there should be hardly any amplification necessary to overcome the noise of the second mixer, after which one normally sees the main filtering.

The problem that I have noted on many modern sets is that of too much gain at the first IF, combined with hopelessly inadequate roofing filters. Strong off-channel signals therefore hit the second mixer and the increased gain with reference to the RF input causes blocking problems. The IC745 has a very good RF intercept point when tested with two carriers 100 and 200kHz off-channel. However, if the two carriers are within the roofing filter bandwidth, or one of them is not far down the filter, then the effective intercept point is very badly degraded.

The IC745 has a fairly out intercept point of at least +10dBm, but how about a close in figure of ~50dBm? In this case, although there are two roofing filters in the first IF there are also two amplifiers, both of which are subject to AGC. By the time the AGC point is reached only the nearer carrier will be filtering the second mixer as well. A receiver can be working at very high gain and the off-channel interfering signals block out the wanted one.

In the IC751 there is but one amplifier in front of the second mixer, and in some earlier Icom designs the problem is even less marked. The Yaesu FT757 and some other Yaesu models also show blocking problems but one of the worst examples was in a very old Trio TS700 2m multimode which blocked strong close off-channel signals badly, completely wrecking a weak on-channel one, despite the actual selectivity being superb.

If you look at the Ten-Tec Corsair or some of the earlier Drake receivers you will note a much lower first IF of around 9MHz, with the SSB filter following almost immediately after the first mixer. Some of these receivers have intercept points of only 5/10kHz spacing than they do at 100/200kHz spacing, and this is usually combined with a superb reciprocal mixing performance.

Filters can lose a few dB though and slightly more mixer gain is needed if it feeds straight into a filter, so sometimes a bomb-proof first IF amplifier, having quite a low gain, is then used to feed the filter.

For many years the old Collins KW/M2 the mixer was driven from crystal controlled local oscillators so that the first IF was 200kHz wide, and an analogue VFO mixed this down to a 455kHz second IF. The Collins bandpass filter is quite a good one, but even so the image response is not ideal, although it is fascinating that there is no first IF amplifier, nearly all the sets' amplification being at the second IF.

Probably the finest overall transceivers today are the TS900S and the new TS940S reviewed last month. The TS930 has no FM facility. The first IF above 2.1kHz filter is actually better as the reproducUon is so good that you will need a steeper one of say 2.1kHz wide, and an analogue VFO mixed this down to a 455kHz second IF. The Collins bandpass filter is quite a good one, but even so the image response is not ideal, although it is fascinating that there is no first IF amplifier, nearly all the sets' amplification being at the second IF.

The ideal filter will have the appropriate pass-band at the top and either side the skirts should be as steep as possible. Since you may want to receive signals which may be coming into the set in a level significantly below 1uV, and there may be adjacent stations coming in some 80dB higher, skirt measurements down to ~80dB are appropriate.

Unfortunately, this means pumping very strong signals near the skirt frequency in order to make selectivity, but these signals mix with local oscillator noise and produce reciprocal mixing noise on-channel which can be so bad that the S-meter goes way up. The S-meter reading may be primarily RM noise, and even if you leave it high. You can try other methods, but these are very tedious. Thus many selectivity measurements show that the effective filter bandwidth below ~40dB widens out very appreciably.

The standard TS700 which had a bad blocking performance had a superb RM one, and the filter itself was so splendid that we actually managed to measure the selectivity down to ~100dB.

Poor selectivity, in the form of apparent widening, at say ~60dB, can be due to another factor which is both fairly serious and difficult to fix. Either the filter itself opens out at the bottom of the skirts or there is slight coupling between the input and the output of the filter caused by bad printed circuit board layout.

**Poor selectivity**

In some cases the break-through can get through to the product detector but not to the S-meter circuit, so you hear poor selectivity but the measurements are good! This means you have to measure by another method and this was the case with both the Icom IC471 and 271 transceivers, in which the selectivity below ~60dB virtually became that of the first roofing filter and not the SSB one.

Many words have been written about the ideal selectivity for FM, AM, SSB and CW but I suggest that there is no one ideal covering all uses for each mode.

Let's have a look at the requirements, though, in the context of modern band conditions. If an HF transceiver is not going to be used for driving transverters and FM is only required on 10m, then a filter bandwidth of around 8kHz will be ideal for coping with the 10kHz channeling around 29.6MHz. The frequency response of the system will be very limited as it is on 27MHz CB. You only need a wider filter to cope with 25kHz channeling on 144 and 432MHz etc. A 10kHz filter might be useful for 12.5kHz channeling on 144MHz but is not really essential if you already have the 8kHz one for 10kHz channeling. However, many of us like to extend the frequency response on FM.

The higher deviation of wider response transmissions, and thus with a 15kHz wide filter in the receiver, is particularly useful for a relaxed QSO on FM or VHF etc. I therefore suggest that the 15kHz filter could actually be part of the normal roofing filter system, whereas the 8kHz filter should be an extremely high quality one.

If we then consider AM, the 8kHz filter will be almost ideal for quality listening, but you will need a steeper one of say 5.5kHz bandwidth for extracting weak signals on a crowded band. I see no point in allowing the user to select the SSB filter for AM as the reproduction is so muffled as to be almost beyond any entertainment value, and if you are in a QRM situation then try listening to AM using the SSB mode and zero beat the carrier.

**SSB**

When we come to SSB, the narrowest possible filter that one can use sensibly is around 1.8kHz, but as often as not a 2.1kHz filter is actually better as intelligibility is improved even if more adjacent break-through comes through.

For most QSOs I suggest at least 2.4kHz is optimum to avoid the listening fatigue problem. There would therefore be a good point in having the ability to select either 2.1 or 2.7kHz, or better still the ability to close in from 2.7kHz using band- narrowing systems, in which the selection of the TS930 and some Yaesu rigs.

If you have never heard a fairly wide
response SSB transmission on a wide Rx filter then you have missed something; for the quality can be almost as good as FM in many respects.

If CW is to be considered, you have to accept that using just an SSB filter is almost hopeless on the LF and HF bands, and you are not able to pick out much weak and allusive DX on the crowded CW band segments. You are therefore often faced with the choice of 500 or 250Hz filters, some of which have sharp side skirts whereas others are almost triangular shaped.

Personal preference shows wide differences here, and I much prefer a 500Hz bandwidth with very steep skirts to a narrower type. The precise tuning required with a very narrow filter is both tiresome to deal with and listen to, and once you have heard bad ringing on sharp filters you will know what I mean.

Once again the best alternative is to have a basic 500Hz filter with variable selectivity, such as is on the Trio T930, perhaps combined with an audio peaking filter. You can, of course, try external filters such as those in the Datong range, but these don’t stop strong close signals from backing AGC down.

There are few receivers indeed which look at the filter problem sensibly, for all modes, but there is one more problem that I have encountered when various filters are switched in. The receiver’s noise floor should vary with the bandwidth of the filter used, and if you change from the average SSB one to a 500Hz CW one you should notice the receiver noise floor reduce by around 7dB, and 10dB incidentally with a 250Hz one. Very narrow filters usually have more loss, as in the Ten-Tec Corsair where you do not see the noise floor reduce when you go to CW, and since this receiver does not have a good sensitivity on the 21 and 28MHz bands the CW sensitivity is that much poorer.

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News and comment from Glen Ross G8MWR

The Sporadics

They did arrive eventually but, as with the two last year, there seemed to be very little of it and not a lot to get very excited about. There is still time as I write this for more activity to arrive, so perhaps we should keep our fingers crossed and hope for better things to come.

One thing that has become obvious is that each year there are more and more British stations on the band waiting to grab whatever turns up, and that it is becoming more difficult to get a signal to the DX station due to the incredible amount of QRM that is flying about.

I managed a few contacts into Italy and Yugoslavia by getting the stations just as they were coming up out of the noise, but each time that I finished my contact all hell broke lose on the frequency. Various people have reported getting contacts into SV, 9H1, 9A, I, YU, HG, EA6 and YO. The stuff has been around but there have been none of the really immense openings that were common a few years ago.

Other bands

All of the above activity took place on two metres, so what of the other bands? Conditions on 50 and 70MHz have been good in patches but the continental TV stations have been making life very difficult. As you will appreciate, the sporadic activity comes in earlier on those bands and stays around for a lot longer, so these high power broadcast stations, which have every right to be there, can make life very difficult. However, the SB4CY beacons have been heard on both these bands and there are reports from America that both the GB3NHQ and GBSIX beacons on the 50MHz bands have been received over there at a good strength at around 0200GMT. (Real night-hawk stuff, this!). The report on GB3NHQ is most interesting as this beacon runs around 15 watts to a pair of dipoles and is not well sited.

New facilities

The first thing to comment on is the news that the age at which you can hold an Amateur Radio Certificate has been reduced from 14 to 10 years. This is not the same as holding a licence, it simply means that anyone holding the certificate can operate your station under your supervision.

The one thing to bear in mind is that you have to have taken the Morse test to get the certificate but the requirement to hold an A licence is that the CW test must not predate your application by more than a year, so you could find yourself having to take the Morse test all over again.

Whilst on this subject it is nice to see the test being made available at so many rallies. It needed a lot of effort to get the powers that be to go along with this idea and the fact that they eventually did is due almost entirely to the man you write to for your time slot. You may feel that a word of appreciation would not come amiss.

More good news?

The next piece of news to notice is the proposal for an intermediate licence, now before the authorities. To get this you would need to have the RAE and a certificate can operate your station under your supervision.

Just what the specific terms of the licence will be are not yet known nor is it very obvious what the hoped for benefits are.

Surely if the VHF operator is up to five words a minute (can you really use Morse at that speed)? This would then give you CW access to some of the HF bands.

Down south

Ian Morgan of Pontypool wades in for a Bronze using an FT290, a 30 watt amp and 10 ele beam, and he comments on having to work hard to get the counties. It’s not worth having it if it comes easy, Ian.

Another Ian, this time G1FXG of Bury St Edmunds, goes for Bronze with an identical set-up and, not to be out-done, Ian’s friend Mike G1IPA, also claims the Bronze award.

His was achieved using a TS700G (one of the best two metre rigs ever available) running only eight watts to a 14 element yagi, no pre-amp, no linear, as he puts it. He also makes the comment that all the contacts were made in the space of six days. On now to Chesterfield and G6PBW, who qualifies for the Bronze award with a beautifully presented check log.

The real optimist is GOBPS who claims a Bronze certificate and then asks if Moonbounce contacts can be counted towards the award! Not so surprising
when you find he has a 4CX250 and stacked parabeams! The answer is that any contacts other than those via repeaters count for the award, and that the certificate can be endorsed to your own requirement. If you think it is worth claiming an award for, then write and tell me.

One of the nicest things to come out of it so far is the number of people who say that they found the award worth working for and that it is a change from just chasing squares. That was the idea, lads.

Top Band

These four metre lads are on the ball and not missing a chance to get some publicity for their activities. The main news this month is of an expedition from the Nottingham area, which is going up to North Ronaldsway from 8 to 16 August, from where it will live up YT square, the main activity on this band being scheduled for the Tuesday 13th.

The sporadic-E hit the band on 31 May and has continued ever since. There were massive disturbances during early June with ZB2VHF, the Gibraltar beacon, being regularly heard. No contacts with the Rock have been forthcoming. Another unusual spot heard from was Lundy Island in the Bristol Channel, in the shape of GB4LIE who was there as an expedition station.

From up North comes news that Nick G4KUX has now got County Durham firmly on the four metre map. G4VOZ comments on the fact that our certificates are not issued for four metres. They could be issued for any band above 30MHz as the wording has been designed with extension possibilities in mind. How about telling us how you would set up the three grades for your particular band or interest? G4VOZ also asks us to say that all activity on four metres, irrespective of mode, is normally on horizontal polarisation.

Repeaters

Last month I commented on the report of several repeaters possibly having to move to make way for GB3GD on the Isle of Man. This has brought in a tremendous amount of comment from you, nearly all of it agreeing with the comments I made. One thing that must be firmly kept in mind is that there seems to have been no firm decision made as yet and that the comments made were based on the thinking behind the projected move.

The one thing that is overwhelmingly apparent is that you all seem to be in agreement with the proposal to make use of 12.5kHz spacing. In the USA there has been a similar move to change repeater spacing and this has resulted in a lot of heated exchanges as to the merits or otherwise of making the move. It must come sooner or later, so why not do it now and start getting the benefits as soon as possible?

Odds and ends

Remember the Belgian fiasco of a few months ago when, as this magazine so delightfully put it, the question arose: 'Is ON off?' Well, it is back with us again with reports that they may lose some allocation above two metres. This is mainly due, it would seem, to lack of use; don't think it couldn't happen... use it or lose it.

Have you noticed the reluctance to use the new Maidenhead locators? People do not seem to like them and the Dutch have given them up completely. They were supposed to be mainly for the benefit of the HF bands (where?), but listening around down there they do not seem to be getting much use. Boris is still 145kms from Moscow rather than in whatever the square is.

The shuttle flight is on, probably around the 13th of the month, and the lads are over in Eire trying to work the States on two metres. The best of luck to both activities.

The big switch

What a wide ranging column this month. Please keep your comments, news and certificate claims coming to me at: 81 Ringwood Highway, Coventry or on Prestel, as more of you are doing, on 203616941.

ANGUS McKENZIE TESTS

Next month G3OSS reviews the Icom IC735 mobile HF transceiver and some bits and pieces for the 934MHz operator.

BEGINNERS’ WORKSHOP

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AUGUST 1985

World Radio History
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NEW PRICES

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<th>Package Prices</th>
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<td>225.00</td>
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**ANYONE CAN SELL A KIT...REPUTATION SELLS OURS**
Bill Mantovani G4ZVB concludes the technical part of the RAE syllabus with a final look at MEASUREMENTS

In concluding our look at measurements this month, we also come to the end of the technical part of the RAE syllabus, so let's get straight on with it.

Frequency measurement

In order to ensure that an amateur transmission does not fall outside of the permitted frequency bands, you must have a good degree of accuracy, the calibration of the transmitter. As well as avoiding causing interference to other users of the frequency spectrum, it also means that you will not be breaching the amateur licence conditions and it is natural enough to expect to be questioned on this in the exam. Therefore, make sure you understand this part of the syllabus very well as it is quite important.

There are a number of ways in which the calibration of a transmitter can be checked, and one of them is by simply using a calibrated receiver. Obviously, if the receiver and transmitter are in extremely close proximity to each other, i.e. side by side in the shack, it would not be practicable to tune the receiver directly to the transmitter frequency, so instead the receiver is used to tune to the output frequency of the transmitter. Using this procedure the tuning range of the VFO can be fully checked and adjustments made if necessary.

Remember, though, that with the above method, the accuracy of the results depends on the receiver itself being fairly accurately calibrated in the first instance. Also, even though the VFO will probably be screened (should be screened if you recall what we covered earlier on VFO stability etc.), with the receiver very close to the transmitter, the signal from the VFO may be strong enough to swamp the RF stage (or stages) of the receiver, and thus make accurate calibration difficult. If possible, the RF gain of the receiver should be turned right down, and it will certainly not be necessary to have the antenna connected.

So, we must first look at calibrating the receiver. This can be done in a number of ways, all with reasonable accuracy. (Please note at this point that the methods to be described are not necessarily suitable for all types of receivers, for reasons that will become obvious in a moment). One simple method of checking the calibration of a receiver is to tune to one of the standard frequency transmissions, such as WWV which can be checked against it. Today, things tend to be a little bit easier than in the days before transceivers became popular. Because both transmitter and receiver share the same clock circuits in magazines that actually use this transmitter as their time standard, this method can be used with both amateur and general coverage receivers alike but, with the latter, above about 4MHz the 100kHz markers may become difficult to resolve so additional crystal frequencies of 500kHz or 1MHz would also be required as appropriate. However, amateur bands only receivers or the current solid-state general coverage receivers have adequate bandwidth so that a 100kHz (together with possibly a 25kHz) crystal oscillator is perfectly adequate.

The crystal or crystals used in the calibration oscillator should be of close tolerance to ensure good accuracy. One way of checking a 100kHz crystal is to compare the second harmonic with the BBC's Droitwich transmitter on 200kHz. This transmitter frequency is maintained very accurately and you may have sometimes come across digital clock circuits in magazines that actually use this transmitter as their time standard.

There are other ways of checking the receiver dial, for instance, using the various amateur beacons, which although not as accurate as that outlined above, will still serve to give an indication of whether the receiver dial is out of calibration. Once the receiver is properly calibrated the transmitter VFO can be checked against it.

Table 1 A brief list of some frequency stations

<table>
<thead>
<tr>
<th>Callsign</th>
<th>Frequency</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>OMA</td>
<td>2.5MHz</td>
<td>Prague, Czechoslovakia</td>
</tr>
<tr>
<td>FFH</td>
<td>2.5MHz</td>
<td>Paris, France</td>
</tr>
<tr>
<td>IAM</td>
<td>5.0MHz</td>
<td>Rome, Italy</td>
</tr>
<tr>
<td>IBF</td>
<td>5.0MHz</td>
<td>Turin, Italy</td>
</tr>
<tr>
<td>JJY</td>
<td>2.5, 5.0, 10.0 and 15.0MHz</td>
<td>Tokyo, Japan</td>
</tr>
<tr>
<td>MSF</td>
<td>2.5, 5.0 and 10MHz</td>
<td>Rugby, GB</td>
</tr>
<tr>
<td>MSF</td>
<td>60kHz</td>
<td>Rugby, GB</td>
</tr>
<tr>
<td>WWV</td>
<td>2.5, 5.0, 10.0, 15.0 and 20.0MHz</td>
<td>Fort Collins, Colorado, USA</td>
</tr>
<tr>
<td>WWVH</td>
<td>2.5, 5.0, 10.0, 15.0 and 20.0MHz</td>
<td>Kekaha-Kauai, Hawaii</td>
</tr>
<tr>
<td>WWVB</td>
<td>60kHz</td>
<td>Fort Collins, Colorado, USA</td>
</tr>
</tbody>
</table>

Unfortunately, there are a number of problems with using this method which can detract from the accuracy of the eventual receiver calibration. Whilst the standard frequency transmissions are maintained to a very high accuracy, reception of the signals over long distances could be affected by fading (propagation would in this case be by sky-wave), and by a phenomenon known as the Doppler Effect. The latter can cause quite a large error in reception and occurs when the surface from which the sky-wave is being reflected is in motion.

This is particularly the case at the time when the various layers in the ionosphere are changing position, and is the same effect as seen on a television screen when a plane passes overhead and causes the picture to 'flutter'. To get over these problems it is preferable to use a low-frequency standard frequency transmission such as MSF Rugby on 60kHz, in which case propagation will be by ground (or surface) wave and so will not suffer from Doppler shift.

However, this may not always be possible, especially if the receiver only covers the amateur bands and does not receive even the standard frequency stations transmitting on short wave. Another more favoured method for accurately calibrating a receiver irrespective of its frequency coverage is by use of a separate crystal oscillator to produce beat notes. For example, the harmonics from a 100kHz crystal oscillator will produce beat notes every 100kHz in the receiver, which are used to calibrate the dial and thus mark the band edges.

This method can be used with both amateur and general coverage receivers alike but, with the latter, about 4MHz the 100kHz markers may become difficult to resolve so additional crystal frequencies of 500kHz or 1MHz would also be required as appropriate. However, amateur bands only receivers or the current solid-state general coverage receivers have adequate bandwidth so that a 100kHz (together with possibly a 25kHz) crystal oscillator is perfectly adequate.

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Today, things tend to be a little bit easier than in the days before transceivers became popular. Because both transmitter and receiver share the same VFO then setting up the dial on receiver using a crystal oscillator means that the
TRANSMITTER will also be calibrated accordingly. Most commercial amateur transceivers and receivers have crystal oscillators fitted as standard but failing that, or if you are building your own equipment, a very simple crystal calibrator can very easily be built using a minimal number of components and housed in the once popular tobacco tin or more modern die-cast metal box.

Just one word of warning about using a crystal oscillator for calibrating a receiver. Because the signal injected from the oscillator into the receiver will be quite strong, a superhet receiver will often give several spurious positions on the dial at which a beat note will be heard and it may not always be immediately obvious which of these is the true beat note and which are in fact spurious.

The absorption frequency meter

Having used a receiver to check the transmitter VFO frequency, we should now know what frequency our transmitter is operating on—or do we? In practice it could just be that the transmitter PA stage has in fact been inadvertently tuned to the wrong frequency; this can happen. For instance, consider the case where the transmitter is switched to the 7MHz band but the PA has for some reason been accidentally tuned up on 14MHz.

This is just one case where, although rare, the error may not become immediately apparent. To check that a transmitter is giving an output in the correct band, an absorption frequency meter (or absorption wavemeter) is used. This is a very simple device and consists of a coil and a variable capacitor. Some form of indicating the point of resonance can also be incorporated and two such simple circuits are shown in Figure 1.

If the unit is held very close to the tuned circuit to be checked and the capacitor varied, at the point of resonance some energy will be absorbed by the wavemeter from the circuit under test and the indicator will show that this point has been reached.

When checking that the PA stage is tuned to the right frequency, the absorption wavemeter does have a number of disadvantages, which I advise you to learn. It is an insensitive instrument and as such must often be held very close to the circuit under test in order to obtain an indication of resonance. This might serve to detune the circuit under test and if the circuit is screened or in a position where access is difficult it may not be possible to use the meter at all. The absorption wavemeter is not accurate enough to give a precise reading of the frequency being checked, only the order of that frequency. Thus it can indicate if a transmission falls within a certain band, but it cannot be used to check whether a transmitter is operating just inside or just outside of the band edges.

These limitations are offset by quite a few advantages. An absorption frequency meter is simple to construct for very low cost. It can be made to be rugged, requires no power supply, and most important, the direct reading off the scale agrees away with any confusion over spurious beat notes. It is also a very useful instrument for checking that frequency multiplier stages are tuned to the correct harmonic. The circuit shown in Figure 1b is often referred to as the 'field strength meter' and it can be used to check that a transmitter is free from parasitic oscillations.

The dip meter

For the absorption wavemeter to function, the circuit under test must always be energised but this is not the case with the dip meter. Originally consisting of a valve oscillator (hence the name grid dip oscillator or GDO), but now more commonly built using a FET oscillator, the dip meter is more flexible than an absorption frequency meter despite only having the same sort of accuracy.

It works as follows. The coil of the dip meter is placed close to the tuned circuit under test and the oscillator is tuned until a dip is indicated on the meter. This of course is where it gets its name from! The tuned circuit under test does not have to be energised; instead, at the point where the oscillator in the dip meter is tuned to the same frequency as the test circuit, power is absorbed from the oscillator producing a dip in source current in the case of a FET, or a dip in grid current for a valve GDO.

The heterodyne frequency meter

Another type of frequency measuring meter that basically consists of an oscillator, though in this case crystal controlled or of limited range, is the heterodyne frequency meter. This meter is designed to be extremely accurate, its tuned circuit being very stable, and if the frequency range is variable, the scale and tuning capacitor drive will allow this frequency meter to be set with great

| Table 2 Advantages and disadvantages of the heterodyne frequency meter |

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very accurate. Precise readings will indicate if a transmitter is operating just outside or inside a band edge</td>
<td>In order to obtain this accuracy in readings, the cost of the meter becomes quite high</td>
</tr>
<tr>
<td>By making use of harmonics, the meter can be used over a wide frequency range without changing coils</td>
<td>Because of the presence of harmonics, this could produce extra beat notes with the frequency being checked, causing confusion</td>
</tr>
<tr>
<td>The meter is easy to couple to the receiver or transmitter</td>
<td>A power supply is required</td>
</tr>
<tr>
<td>Calibration of the meter can be easily checked against a major broadcasting station or standard frequency station such as WWV or MSF Rugby</td>
<td>The power supply must be voltage stabilised to ensure that the oscillator calibration remains accurate at all times</td>
</tr>
</tbody>
</table>

![Fig 1a Simple absorption wavemeter](image)

World Radio History
precise. Table 2 lists the advantages and disadvantages of the heterodyne frequency meter and, once again, it is in your interest to make sure you remember these for the RAE exam.

The RAE Manual gives the circuit diagram and explains the operation of such a frequency meter, but it is not absolutely necessary to remember all of this for the exam, what we have just covered above should suffice. A typical question would be centred around its advantages or disadvantages over other meters; you will not be asked to give a detailed explanation of how it works. Remember the basic circuit layout though, you might be presented with that and asked what the circuit is.

You can see from what we have just covered that the absorption and heterodyne frequency meters go hand in hand with each other, the first being used to ascertain roughly what order a frequency is and the latter to provide a more accurate frequency measurement.

**The digital frequency meter**

Finally we come to the digital frequency meter, which is also covered in detail in the RAE Manual but about which you are only required, at this stage, to have a basic appreciation of. The digital frequency meter provides a simple but very accurate means of measuring frequency and, as its name suggests, uses integrated circuits to perform the frequency count and gives the readout on a digital display. It is also the easiest to use of the meters described.

Very briefly, the DFM measures frequency by first converting the signal applied to it into a square wave and then ANDing it with a very accurate clock to time and this voltage is then applied to the X plates, causing the electron beam to scan horizontally at a speed dictated by the speed of the timebase. By making the speed of the timebase variable or switchable over a large range the oscilloscope can be made to cover a wide frequency band. With the beam now scanning horizontally, if an alternating voltage is fed to the Y plates the beam will trace out on the screen the waveform of that voltage.

The signal to be examined is usually very low level and if applied directly to the Y plates would produce almost no appreciable deflection. So, before the signal is fed to the Y plates it is amplified in the oscilloscope by the Y amplifier to bring it up to an appreciable level. Several amplification levels are often provided so that the oscilloscope can cope with input signals of different amplitude and each level is calibrated so that a set voltage applied at the input will give a known vertical deflection on the screen.

The screen itself will have calibration markings on it so that, for example, if the Y amplifier is switched to a gain of 100 per cent, the deflection of 1 volt per centimetre on the screen and an unknown alternating signal is applied at the input which deflects the beam by 2.5 cm either side of the horizontal, that signal is being shown to have a peak to peak value of 5 volts. However, the Y amplifier does have a limited bandwidth and outside of this the calibration becomes invalid.

So that the display on the oscilloscope screen appears stationary and the waveform can be resolved, for every sweep of the beam the timebase must always start at the same point on the waveform. This is achieved by either synchronising the frequency of the timebase with that of the input signal, or by using a trigger circuit.

If you think back to what we discussed about amplitude modulation and the problems that arise from over-modulation, you can see that the oscilloscope becomes a useful instrument for checking the modulated waveform in a transmitter to ensure that it does not exceed 100 per cent.

The method for doing this is explained in detail in the RAE Manual and does not need to be repeated here, for most of it is self-explanatory. Remember this use of the oscilloscope though, and make a note of the modulation waveforms you would expect for different levels of modulation.

**Power measurement of an SSB transmitter**

Because the current drawn by the output stage of an SSB transmitter varies in accordance with the speech waveform, measuring the input power is not so easy as a conventional meter movement is not able to accurately follow this rapid variation of input current. This is why, when we covered the topic of transmitters some months ago, we learned that power rating for an SSB transmitter is normally expressed as PEP (peak envelope power). Put simply, this means the power that exists at the peaks of the speech waveform. Using an oscilloscope to look at the power being delivered by a transmitter (into a dummy load) the PEP of that transmitter can be measured as follows (refer to Figure 2).

Modulate the transmitter with two sinusoidal tones of equal amplitude (they must be non-harmonically related) and by measuring the current flowing through the load or the voltage across it, adjust the transmitter drive to give a mean power output into the dummy load of, say, 200W. Actually, any power level will do (or will have to do if you are checking a low-power transmitter), but the figure of 200W is used in the example because it conveniently corresponds to a deflection on the oscilloscope of 400W PEP (26dBW), which is the maximum power permitted by the UK amateur licence for a low power transmitter. Take a reading of the peaks of the waveform shown on the oscilloscope. As the mean power (in this case 200W) being delivered into the load by the transmitter is equivalent to a PEP of twice this value, the points
noted on the oscilloscope represent a deflection corresponding to an output PEP, in our example, of 400W. Now that the PEP positions are marked on the oscilloscope, if we replace the two input tones with a microphone (Figure 2b) we can observe the output waveform from the transmitter and adjust the drive accordingly so that the peaks of the speech waveform do not exceed the marked points (ie 400W PEP).

The above method is also suitable for measuring the power output of a transmitter operating in a mode other than SSB, although in the case of AM mode a single tone source is all that is required for initial setting up. You are required to know of this recommended method of checking PEP for a transmitter because it is part of the RAE syllabus, but you will not normally find it necessary to have to do these measurements in practice unless you are contemplating using or building a transmitter or linear amplifier capable of giving an output which will exceed the legal limit. Most amateur equipment has outputs well inside this limit.

**VSWR measurement**

Now we turn to the measurement of RF current. It is not possible to use the normal type of meter (milliammeter or voltmeter) to measure the RF current in a wire because, unlike a dc current, the RF current can vary depending upon where along the wire it is measured. Instead, to measure the RF current along the line we must look at something called the *voltage standing wave ratio* or VSWR. This VSWR is measured using a reflectometer, as shown in Figure 3. Using the reflectometer, which is more commonly referred to as a VSWR bridge or VSWR meter, the voltage standing wave ratio on the transmission line between transmitter and antenna can be checked as this then gives an indication of how well matched (or mismatched!) the system is.

The principle of the VSWR bridge is as follows. If the transmission line is not terminated in a load which matches its characteristic impedance, then some of the signal will be reflected back along the transmission line. The ratio of this reflected power to the power travelling in a forward direction along the transmission line is directly related to the VSWR, and is independent of where along the line the measurement is taken. This in theory means that irrespective of where the VSWR bridge is connected along the line, it will always produce the same result.

To explain briefly the circuit shown in Figure 3, a reflectometer bridge can be simply made by a length of insulated wire laid down between the outer shield and the inner insulation of a short length of coax cable. The ends of the wire are each connected via a diode to a milliammeter. Part of the RF signal travelling down the co-ax in a forward direction is picked up by the wire, rectified by the appropriate diode and the resulting dc displayed on the meter. This is an indication of the so-called forward power. The same goes for the reflected signal, it being rectified by the other diode and the resulting dc displayed on the other meter. This is the ‘reflected’ power. The VSWR is then calculated from the ratio of these two readings.

This is just a simple (but nevertheless practical) VSWR bridge. Other more sophisticated reflectometers will incorporate a control (sometimes labelled ‘calibration’ or ‘sensitivity’) that allows the forward meter to be set to a calibration point, such as full scale deflection, so that the VSWR can then be directly read off the reflected power meter scale. Sometimes only one meter is used, with a switch to allow it to be used to read both forward and reflected power.

Finally, a very brief look at errors in measurements. In order to know how accurate a measurement is, we must know how accurate the actual measuring equipment is. When taking meter readings, for example, we must bear in mind the effect on our results of the inaccuracies or tolerance of the meter being used. The meter may actually be giving a slightly higher or slightly lower reading than is true, so this should be allowed for, especially when checking frequency. It might also be possible for a number of items in both the test equipment and the equipment under test to each have sufficient tolerance, so that when all the tolerance effects are added together the final reading may actually be quite inaccurate.

Tolerance can be expressed in any number of ways, but the more common are as a value (eg, plus or minus 100Hz) or as a percentage (eg, plus or minus 5 per cent). Two examples of how tolerances can affect actual readings are given in the RAE Manual and these should be studied along with any such questions you may come across (such as in R E G Petri’s *Questions and Answers*, which appears in *Amateur Radio* from time to time), as these are the type of questions that you may have to answer in the RAE exam. Throughout this series I have tried to give some indication of the more popular type of questions that appear each time, so I hope you have been taking note. It is in no way possible to predict what there will be questions on but even the City and Guilds appear to have their favourites.

Anyway, back to the examples in the manual for a moment. They are both easy to follow and need no further explaining here, save to say that they serve to indicate how the adding up of tolerances can affect a final result. Whilst the examples chosen are certainly extreme case ones in practice, it’s just the sort of thing you might be asked to work out for the RAE.

The sample question about the lowest operating frequency for the transmitter in the 21MHz band is particularly interesting for it shows how a transmitter can still be inadvertently operated outside of the band edge, even if the operator thinks he is transmitting just inside it. It is sometimes forgotten that the transmission has bandwidth and that this must be taken into consideration when working very close to the band edges. The examiners however always seem to be well aware of this!

So you will now, no doubt, be relieved to know that we have concluded the ‘technical’ part of the RAE syllabus. All that remains is to cover the licence conditions, operating procedures and one or two other points that may be of benefit. This in no way means that the hard work stops here, for questions on the licence conditions take up almost two thirds of the first paper in the RAE exam and it is this part that many people actually fail on.

Next month then we will spend some time looking at the licence conditions, so do make sure that you have your copy of the publication ‘How to become a radio amateur’, which is available free of charge from: The Radio Amateur Licensing Unit, Post Office Headquarters, Chetwynd House, Chesterfield, Derbyshire S49 1PF. The licence conditions are also given in the RAE Manual, but there is other information in the RALU publication that we will look at, as well as the latter being recommended reading for the RAE.

**Acknowledgements and references**


*Radio Communication Handbook (fifth edition)* — RSGB.

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1. The gain of a VHF antenna is described in a certain manufacturer's catalogue as having a gain of 10dBd. This means that the antenna gain is:
   a) 10dB over that of a half-wave dipole
   b) 10dB over that of an isotropic radiator
   c) 10dB below that of a standard unipole
   d) 10dB below that of a half-wave dipole

2. Figure 1 is a typical:
   a) yagi antenna
   b) crossed dipole
   c) wide band rhombic
   d) delta matched dipole

3. Referring to Figure 1, what is the direction of maximum radiation?
   a) A
   b) B
   c) C
   d) D

4. The antenna shown in Figure 1 is:
   a) bidirectional and unbalanced
   b) directional and unbalanced
   c) directional and balanced
   d) omnidirectional and unbalanced

5. The antenna shown in Figure 1:
   a) must only be used vertically polarised
   b) must only be used horizontally polarised
   c) can be used for either horizontal or vertical polarisation
   d) is only capable of circular polarisation

6. Figure 2 is that of a half-wave dipole. One of its characteristics is that:
   a) it is only suitable for operation on the VHF band
   b) it is only suitable for operation on the HF band
   c) it is only suitable for operation on bands above 70cms
   d) it is capable of operation on all amateur bands

7. Using the formula: \( \lambda = \frac{3 \times 10^8}{f} \) and reducing the dipole length by 5% to allow for the difference between the velocity of propagation in the antenna elements to that in space, calculate the actual length of a half-wave dipole for operation at 1.2GHz (1200MHz).
   a) 1.18cm
   b) 11.88cm
   c) 1.2cm
   d) 23.75cm

8. Which one of the diagrams shown below is representative of the standing wave pattern on a half-wave dipole?

9. A vertical dipole, when operating with no nearby obstructions:
   a) must be fed with 600 ohm feeder
   b) must be operated with a tuning stub to avoid interference
   c) has a very narrow horizontal beamwidth
   d) has an omnidirectional radiation pattern

10. What type of antenna would you expect to exhibit the vertical-plane radiation pattern shown in Figure 3?
    a) a yagi with a gain of 6dB
    b) an isotropic radiator
    c) a half-wave dipole with an effective ground plane
    d) a broadside array

11. The term 'feeder' is frequently used when talking about radio and transmission lines. What is a 'feeder'?
    a) The transmitter
    b) The antenna feed point
    c) The cable feeding the antenna from the transmitter
    d) The mains power feed

12. What is a typical velocity factor (vf) and characteristic impedance (Zo) for a coaxial cable with a solid polythene dielectric?
    a) vf 0.35 – Zo 600 ohms
    b) vf 0.95 – Zo 300 ohms
    c) vf 0.40 – Zo 50 ohms
    d) vf 0.65 – Zo 50 ohms

13. What is the effect of a mismatch between an antenna and its feeder?
    a) Too much power will be radiated
    b) Power will be returned to the transmitter and standing waves will be set up
    c) The velocity of the radiated signal will decrease to 3 x 10^8 m/S
    d) There will be a frequency shift due to the standing waves and the signal will be transmitted at one third of its original frequency

14. You are using an unbalanced feeder in conjunction with a balanced antenna. What precautions will you use to eliminate standing waves on the feeder?
    a) Use a balun and a correctly tuned antenna
    b) Put a series of 90 degree bends in the feeder every 2 metres
    c) Make sure that only the 'E' field is radiated
    d) Use silver plated wire for the antenna elements

15. What is the type of antenna shown in Figure 4?
    a) A trap dipole
    b) A bi-phase dipole
    c) A radix radiator
    d) A rhombic antenna
16. The inner section of the antenna shown in Figure 4 between points B-B is required to operate as a half-wave dipole at 7MHz. What is the approximate length of this section?
   a) 5m  
   b) 10m  
   c) 20m  
   d) 40m

17. The antenna shown in Figure 4 is operated as a half-wave dipole at 3.5MHz, (80m). What is the approximate length between points D-D?
   a) 350m  
   b) 160m  
   c) 80m  
   d) 40m

18. Referring to Figure 4, what is the resonant frequency of the traps?
   a) 3.5MHz  
   b) 7.0MHz  
   c) 14.0MHz  
   d) 28.0MHz

19. You are using the antenna shown in Figure 4 on a frequency of 7.0MHz. A little bird (not Buzby) hops along the antenna with a suitable detecting device. At which points will he detect a voltage antinode (voltage maximum)?
   a) A-A  
   b) B-B  
   c) C-C  
   d) D-D

20. Referring to the previous question and Figure 4. You QSY (change frequency) to 3.5MHz. Where will the little bird now detect the voltage antinode?
   a) A-A  
   b) B-B  
   c) C-C  
   d) D-D

21. You are now using the antenna shown in Figure 4 at a frequency of 3.5MHz. To what frequency are the traps tuned?
   a) 1.8MHz  
   b) 3.5MHz  
   c) 7.0MHz  
   d) 21.0MHz

22. Figure 5 shows a vertical trap dipole. The height of the lower section 'X' below trap 'A' is approximately 2.5m. What is the resonant frequency of trap 'A' likely to be?
   a) 7MHz  
   b) 14MHz  
   c) 21MHz  
   d) 28MHz

23. Ignoring harmonic operation, what frequency or band will use the full height of the antenna shown in Figure 5?
   a) The lowest design frequency of operation  
   b) The highest design frequency of operation  
   c) The shortest wavelength of operation  
   d) None of the above

24. The input impedance or feedpoint impedance of the antenna shown in Figure 5 is about:
   a) 30-40 ohms  
   b) 75 ohms  
   c) 300 ohms  
   d) 600 ohms

25. You are given the following choice of ground surfaces over which to erect your vertical antenna. Which one will make the best ground plane?
   a) Very dry heathland  
   b) Dry rock with high resistance wires buried in it radially from the base of the antenna  
   c) Moist high conductivity earth with copper wires buried in the ground and extending radially from the base of the antenna  
   d) Dry low conductivity soil with a fair size glass fibre earth mat under the centre of the antenna

26. The vertical quarter-wave antenna with a good ground plane will:
   a) have a very good vertical take-off  
   b) require increased ionisation densities  
   c) give poor low angle radiation  
   d) give good low angle radiation

27. Which of the following arrangements would be the most suitable for feeding the end fed half-wave antenna shown in Figure 6?
   a) 1  
   b) 2  
   c) 3  
   d) 4

28. Figure 7 shows an end fed antenna less than \( \lambda/4 \) in length. It has an input impedance equivalent to a resistance and capacitive reactance in series. Select a suitable tuning or matching unit from those above.
   a) 1  
   b) 2  
   c) 3  
   d) 4
29. In order to obtain more antenna gain, you decide to phase and stack two identical 10dB yagi antennas. What gain figure will you be expecting?
   a) 10dB  
   b) 13dB  
   c) 16dB  
   d) 20dB

30. Your recent RAE success is quickly followed by a pools win, and you are no longer satisfied with the array in the previous question. You contact a certain firm in Northampton, and soon you erect an array of four identical 10dB gain yagi antennas. What gain figure do you expect now?
   a) 10dB  
   b) 13dB  
   c) 16dB  
   d) 40dB

31. Use the figures shown in Figure 8 to calculate the power supplied to the antenna at X, and the effective radiated power (ERP) respectively.
   a) 100W/16W  
   b) 50W/16W  
   c) 100W/1000W  
   d) 50W/2000W

32. Which one of the following circuit configurations will be presented to the feeder cable by the folded dipole shown in Figure 9 when operating at its resonant frequency?
   a) 1  
   b) 2  
   c) 3  
   d) 4

33. A type of coaxial cable is quoted as having a characteristic impedance of 50 ohms. What is the input impedance of an infinite length of this cable?
   a) zero  
   b) 25 ohms  
   c) 50 ohms  
   d) very high

34. One advantage of using a yagi or beam antenna is that:
   a) it is the only antenna available that will directly match to 50 ohm feeder  
   b) it has the ability to radiate power in a given direction  
   c) it does not respond to interfering signals  
   d) its wind loading is lower than that of a half-wave dipole

35. Another advantage of using a beam or yagi antenna is that:
   a) it is the only antenna available to directly match a 75 ohm feeder  
   b) as well as a direction of maximum response it also has a direction of minimum response  
   c) it is the cheapest antenna available  
   d) once dimensioned, its impedance remains constant whatever the frequency change

For those of you that want the answers to this month's set of questions turn the magazine upside down etc. However, if you are still waiting (in great anticipation, no doubt) for the answers to questions 33, 34 and 35 in the June issue, you'll find them in Straight & Level, page 11.

**ANSWERS**

A type of coaxial cable is quoted as having a characteristic impedance of 50 ohms. What is the input impedance of an infinite length of this cable?
   a) zero  
   b) 25 ohms  
   c) 50 ohms  
   d) very high

**Once again (yawn) . . . .

time to plug the book**

Now, just in case you've not already purchased it (or even heard of it!), I've written a Q&A book specially for the RAE student. It contains about 1,100 questions (with multiple choice answers of course). The questions have been divided into sections and selected to progress with each part of the RAE syllabus. It also contains the C&G syllabus for 1986-88 and some computer programs written in BASIC for the Commodore 64 (which will run on most machines with suitable mods) to assist with the RAE calculations and provide Morse tuition.

It's all happening now, in fact your scribe has attended so many rallies lately he's forgotten what a free weekend is like! It was very interesting to note the complete change round at the Ipswich Wireless Revival. Three years ago the organisers were one of the founders of the 'rally' as a rally, and then only a couple of amateurs were brave enough to try it, whilst the bring-and-buy tent was packed solid. This year's Revival saw dozens of cars in the boot sale and only one taker for the flea market. In fact the rest of the tables were used, in the end, as an extension of the restaurant area.

Lucky with the weather

The Ipswich crowd were certainly lucky with the weather. Some visitors were sunbathing whilst watching the excellent model control flying display (including helicopters!), yet only ten miles away greenhouse windows were being smashed by hailstones the size of golf balls. Talk about the sun shining on the righteous. I wonder how many flea market tables, which were inside, would have been taken had the weather deteriorated?

The luxury of a car boot sale is that you can buy some real rubbish, and your scribe bought a van full (literally) at Ipswich, including a scruffy Hallicrafters S38 for £5 that cleaned up well and performs like a good 'un, and an FT290R for £15. No, that's not a misprint, an FT290R! As all owners start worrying about the resale value of their rigs, I had better explain that the good news was the price and the bad news was that the rig had been involved in a helicopter smash and, like the owner, had not survived the impact.

The main board is completely undamaged, which speaks volumes for the electrical damage is the micro, which has deteriorated? That a lot of people do not spot the advertisements for it. Perhaps 'convention' sounds boring. It is perhaps because the announcement in Radcom is under 'other events' rather than 'mobile rallies' it puts people off.

Incidentally, there was a disabled persons meeting of some sort going on and the hotel had excellent facilities available for wheelchair bound visitors, with ramps up all stairways and special toilets etc, so this may be of interest to RAIBC members.

On the bargain front, your scribe bought a non-working Sony C6 front loading video for £20, and the subsequent injection of another £14 worth of odds and ends has made it better again. Another fascinating bargain, unfortunately bought by someone else, was a colour splitter from an early camera.

Having said above that the bargains were not confined to video related objects I have just mentioned two that were, but there was also a good selection of scopes, aerial masts and other goodies, so don't let me put you off.

Southend

This rally came from nowhere four years ago to become a force to be reckoned with. A few years ago it was in the small-time league, but now, after three changes of venue, it is into the 'we'll worth a visit' category. Your scribe was well pleased with a pristine Vibroplex 'presentation' mechanical bug key for £10 (they often fetch £25+ nowadays) and other assorted toys.

The Northampton AR boot sale

This one has been the only 'rally' disappointment for me this year. It's a splendid idea to have just the boot sale without the rally, and I can't explain why it just didn't work this year. Perhaps it was that the date clashed with the BATC Convention (formation radio amateurs driving up and down the M1 were much in evidence), but it was sad to see that only about ten sellers participated. I heard a few moans on two metres about being charged to go in to view and your scribe had difficulty finding the place, but these are not real explanations as to why it failed to be a success. Maybe it too suffered from being advertised in Radcom as 'other events'. A great shame for Northampton radio amateurs and I wish you better luck (and more sellers) next year.

LA-Series linear amplifiers

I've noticed a lot of nonadscribed (ie unbranded) fairly large transistorised linear amplifiers at rallies lately. Apparently they were intended for extending somewhat dramatically the range of very naughty cordless phones. Your scribe recently bought one, bearing no name or frequency, for £2. I figured the case and heatsink were worth this, and was very pleasantly surprised when a dose of RF from a tracking oscillator/spectrum analyser gave positive indications of life at 160MHz. A quick tweak made it perform on 2 metres, 10 watts in, 100 out. I have since bought several more of these, all containing a single 2SC2630 (marked, in true Japanese fashion, C2630) and can find no correlation of these, all containing a single 2SC2630 (marked, in true Japanese fashion, C2630) and can find no correlation between model number and frequency (the 160MHz version was marked LA140). The only bad news is that these were not designed to switch to receive so a relay has to be added, but they certainly are cheap and potent and well worth keeping an eye out for.
MICROBOX II THE 6809 SINGLE BOARD COMPUTER THAT YOU BUILD YOURSELF

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768 x 576 MONOCHROME DISPLAY
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Why not join the ranks of satisfied customers building our Projects? All of our kits come with copious instructions, all components, pcb, wire, pots, etc, and many are designed for beginners. Our Products are used world wide and can help YOU get on the air. KITS are sent in 7-10 days but please allow up to 28 days for popular items. All prices include VAT and Post. OVERSEAS - Europe use UK prices and Rest of World UK + 5% for carriage, etc. CREDIT CARD orders can be left on our 24hr Answering Service. For our 40+ page CATALOGUE please send 50p in stamps. Kit Debug service available.
FOR SALE

- FT757GX includes YM38 base scanning
  micro, manual, boxed @ £75.00, FT701TR complete
  70cm/2m modules fitted, modded by SMC for UK
  70cm repeater. Operation includes FRB77 relay
  board. Radiotelephone is solid-state rig £265. Complete
  HF/VHF/UHF station for £325, would separate.
  70cm module for £185. Also spare FRB77 box new
  £10. TR2400 £125. John G4WLD Tel: 01-657 8906

- Exchange my Icom IC211E with muckTek board
  and ICROM remote controller or my Yaesu FT707S
  FM (not fitted) for TRio W4000A or Icom IC402
  or any combination of these, or sell both.
  Would prefer exchange. Both in 1st condition,
  would consider other VHF, UHF gear also.
  Keith G5HVI (021) 327 5804 Mersseyside, any-
  time.

- RTTY unit Dragon 64, plus disc drive, as new,
  edit plus 11 x 4, 6 months old, £300. M Morcher,
  19 Lower George Street, St John, Norwich, Norfolk.
  Tel: (0957) 390578.

- This space isn't big enough to describe this
  unit. Like a tank Honda CBX250 B reg swap for good
  Trio III Mast 40ft lattice telescopic heavy duty wall
  mount, complete with SW, £120. £200 ono. Elvis Bailey
  G1HUY, 19 Northway Fleetwood, Lancs FY7 BLE. Tel:
  77636.

- Yaesu FT101E mint £360. FT01B £150. Trio 7801
  FL02B £250. MS2000 £30. MM frequency counter £75.1
  (0621) 892755.

- Short Wave magazine 1954 to 1961, mostly
  advertisements are not accepted. Advertisements
  will be published in the first available issue on a first come
  first served basis. We reserved right to edit or decline any ad. Trade
  advertisements are not accepted.

- Yaesu FT29 OR two metre portable rig. 144-148.
  £200 ono. Elvis Bailey G1HUY, 19 Northway
  Fleetwood, Lancs FY7 BLE. Tel: 77636.

- Yaesu FT27E £60 or exch Yaesu FT726. Microwave
  modules 432/28 MHz transverter 1.5 MHz to 24 MHz £100
  or exch for 432/1244 transverter. Tel: (0923) 44866

- Trio TR4000A 25W 70cm 2 dual band main transceiver,
  £395.00. Yaesu FT230 25W FM mobile, I have two
  these at £180 each. Both very good mobile rigs. Trio TR5200A
  handheld mint condition, £195.00. ST2 base charger as new, £40.00
  sold as a pair. Tel: Martin (021) 8292755.

- Yaesu FRG7 communications receiver with
  manual, Mint condition, no modifications, original
  packing, can be seen in London or Essex, £125. Tel:
  Maldon (021) 8292755.

- Yaesu FT101E mint £360. FT01B £150. Trio 7801
  FL02B £250. MS2000 £30. MM frequency counter £75.1
  (0621) 892755.

- Trion handheld £343. Ono. £200 ono. Elvis Bailey
  G1HUY, 19 Northway Fleetwood, Lancs FY7 BLE. Tel:
  77636.

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- Yaesu FT101 £450. FT712 £115. trio 885 £170.
  Tel: Malvern (06845) 61898.

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- Yaesu FT101 £450. FT712 £115. trio 885 £170.
  Tel: Malvern (06845) 61898.
WANTED

- FRG7 or similar HF receiver wanted, prefer unmodified. Rob Lloyd, Myrtle Cottage, Blakeney Hill, Blakeney, Glos GL14 4BS. Tel: (01288) 879202 (Answerphone) or write to: Leckhampton House, Hill Top Lane, Lund House Green, Harrogate, N Yorks HG3 1QG.
- Collins solid state digital receiver. Must be in mint condition. Tel: (01865) 58855.
- Looking for full service manual for TR-J60. Can anyone sell or loan me a copy for photocopying? Many thanks. D Williams, 32/34 Carfin Street, New Stevenston, Motherwell ML1 4JL. Tel: (0698) 732403 after 6pm.
- Mains powered 2 metre valve linear 100 watts plus out. Please write. All letters answered. 70cm transverter, 2 metre drive. Ron Daly, 12 Stoney Lane, Newbury, Berks RG13 2NH.
- QST May 1981, loan or buy, expenses refunded. II Exchange Sharp MZ711 64K colour micro, built-in recorder, 4 manuals, 6 software tapes, for £289.2 years ago, for any AR88, RA17, SP600, Eddystone 888, S27, SX28 or Collins 75A. Must be unmodified. Rob Lloyd, Myrtle Cottage, Blakeney Hill, Blakeney, Glos GL14 4BS. Tel: (01288) 879202 (Answerphone) or write to: Leckhampton House, Hill Top Lane, Lund House Green, Harrogate, N Yorks HG3 1QG.
- Collins solid state digital receiver. Must be in mint condition. Tel: (01865) 58855.

FREE CLASSIFIED ADS

- Digital frequency meter, 200MHz or higher, minimum 10Hz resolution. Also cassette with SSTV signals off air to test programme under development. Write: Daly, 12 Stoney Lane, Newbury, Berks. All letters answered.
- FT101ZD or similar HF transceiver. Must be in mint condition. Tel: (021) 745320 after 6.30pm. 
- G4CLF/91600 PCB or Circikit. 250 + 250PF air-spaced variable capacitor, 300-500PF variables for ATU. D Jones, Bee cottage, Abbey Street, Eynsham, Oxford. Tel: (0865) 81242.
- FRV7700 VHF converter to fit Yaesu FRG7700 receiver. Prefer type A B D or E for 2meters and air band. Garry P Grigg (G1GP) Tel: (061) 4286491.
- Can anyone provide me with copies of G3OSS tests about Rxs ICR70, ICR71, AOR2001, and WHY? Wanted for museum purposes. Will collect. Please give your tel number. O28RD R Otterstad, Vejdammen 5, OK 2840 Holten, Denmark.
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Commission to approved advertising agencies is 10%.

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<th>Value</th>
<th>Price</th>
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<tbody>
<tr>
<td>±1% 10Ω to 10kΩ</td>
<td>£0.05</td>
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<tr>
<td>±0.1% 10kΩ to 1MΩ</td>
<td>£0.20</td>
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<tr>
<td>±0.01% 1MΩ to 1GΩ</td>
<td>£0.35</td>
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#### Telecommunication Equipment

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<th>Item</th>
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<td>BT Master Socket</td>
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<tr>
<td>EMT 4-core cable 1M</td>
<td>£0.08</td>
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#### Copper Wire

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<td>6-12 78p, 5154 £3</td>
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#### Switches

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<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miniature Toggles</td>
<td>£0.25</td>
</tr>
<tr>
<td>Standard Toggles</td>
<td>£0.35</td>
</tr>
</tbody>
</table>

#### Speakers

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>32p</td>
<td></td>
</tr>
</tbody>
</table>

#### Power Sockets

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>13A 10m 2p</td>
<td>£2.50</td>
</tr>
</tbody>
</table>

### Contact Information

**MARCO TRADING (DEPT ARB)**
The Matlings, High Street, Wem, Shropshire SY4 5EN
Tel: 0939 32763 Telex: 35565

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- All components are brand new and are fully specified. Please state clearly your requirements when ordering. We will charge 15% VAT to the total. Either send cheques/postal order or send by reference in your order, quote our catalogue number and your name and address. Goods will be sent for your return. Orders under £20 will be charged at cost price. Guaranteed under 14 days.

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- **Diodes**
- **Resistors**
- **Telecommunication Equipment**
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- **Switches**
- **Speakers**
- **Power Sockets**

### Contact Details

- **Marltons**, Shropshire SY4 5EN
- Phone: 0939 32763
- Telex: 35565
- Email: sales@marcotrading.com

### Additional Information

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