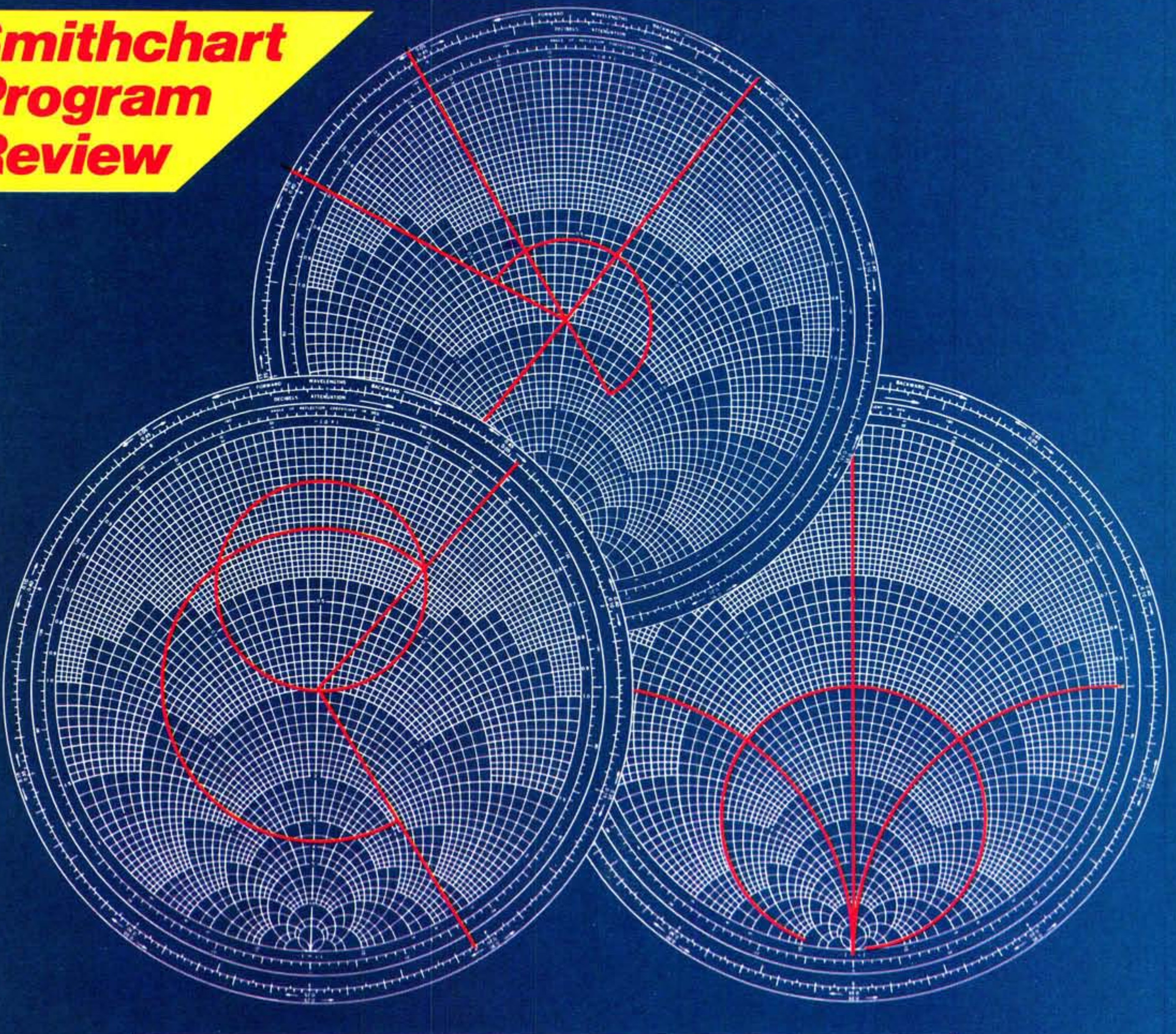
DECEMBER 1987 £1·20

ISSN 0141-0857

Practical Wireless

The Radio Magazine

Smithchart Program Review



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Practical Wireless
The Radio Magazine

DECEMBER 1987 (ON SALE 12 NOVEMBER) VOL. 63 NO. 12 ISSUE 969

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☎ Poole (0202) 678558 (Out-of-hours service by answering machine)
Prestel 202671191

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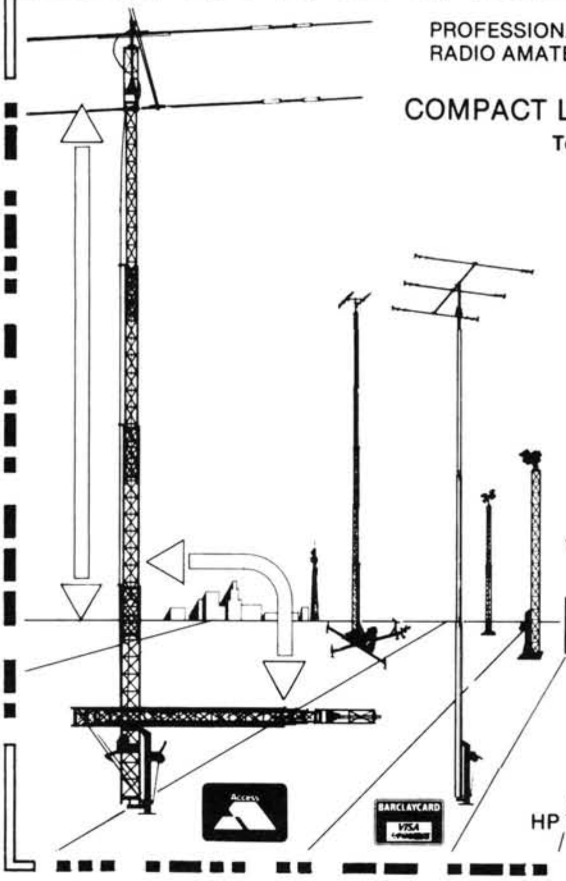

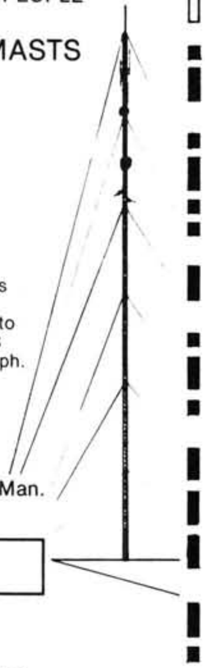

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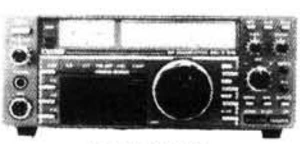

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RWC MOD KITS, ANNOUNCEMENT

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Other technical features include:

★ SWR protection circuit, that automatically reduces power under mismatch conditions, or if you forget the antenna!
★ Both PTT and RF VOX facilities are provided.
★ Low spurious outputs obtained by careful filtering. The second harmonic is at least 85dB down on the 10W output.
★ High quality components are used in the construction, ie SO239 sockets with silver plated contacts and PTFE dielectric.
★ Operators Manual supplied complete with block and circuit diagrams. A Service Manual is also to be available to repair shops and customers as an extra.

We have not just concentrated our design effort on the internals. The HC266's custom manufactured case has been specially designed to look smart and blend in neatly with modern station equipment. Finish is in dark grey paint with white lettering.

A matching 4M transverter and 10M input versions are "in the pipeline", along with an interface unit, that allows 100W HF rigs without low level outputs (TS440s, Ten-Tec etc) to drive transverters.

The HOWES HC266 is not only a nice transverter, it is also backed up by proper documentation, spares and service. It is available direct from us by mail order, or from selected retail shops.

The price: **£179.90 inclusive of post and VAT.**

NEW KIT!

The **SWB30** is more than just an **SWR Indicator** kit. It is also an attenuator, a dummy load, and a power indicator. It doesn't work in the same way as most SWR meters either, so what have HOWES come up with this time? Well you get a nice little meter unit, custom made specially for us, and a kit of parts to build the electronics. When using the built up unit, your tuning signal is fed to a resistive bridge circuit via a power attenuator, the result is less radiated signal while you tune up, and a decent match is always presented to the rig whilst you twiddle the ATU. You can use the SWB30 with transmitters up to 30W RF, and all bands up to 2M. The kit costs **£11.90 plus 90p P&P.** Interesting, useful and easy to build, it is also available as an assembled PCB at £16.50 plus P&P.

An SAE will bring you a copy of our catalogue, and further information on any item you are interested in. Don't forget our range of super little QRP kits and beginners receivers, there is simply not enough space to even start to list them here.

73 from Dave G4KQH, Technical Manager.

HELPING TO BUILD YOUR STATION

WRITE ON . . . *the page where you have your say*

STAR £10 LETTER

AR88 Receiver

The August 1987 issue of *PW* seems to have sparked off considerable interest by its article on "Valved Communications Receivers—AR88D".

However, as you may be aware, the resistor values given on the schematic are vague, to say the least, with no decimal point printed. Values such as 33M, 680M, etc., are given. One assumes that the letter M has been accidentally substituted for the letter K?

There must be a lot of your younger readers who, unlike myself, were not "weaned" on tubes or valves, and will be searching in vain for 680MΩ resistors! I had hoped to use the circuit to enable me to rebuild part of my AR88, stripped down by the previous owner, but frankly even I am confused by some values quoted. Perhaps you would print a clarification in your next issue.

A word of warning. The original 5Y3 rectifier is a directly-heated tube, so the h.t. is applied within a second or two of switch-on, not a good idea for sets containing 45-year-old capacitors! Replacing the 5Y3 with the indirectly-heated GZ34 allows a gradual safer application of h.t. to the set.

For those people searching vainly in local shops for capacitors rated at over 250V, Messrs Electromail (RS Components) have suitable small 1kV types as used in this set.

M S Lebbon
Harrogate

The circuit diagram used was directly reproduced from the original RCA manual for the AR88. Up to the early 1940s, it was the practice of some sections of the American radio industry to use "M" as a multiplier to indicate "thousands" (as in Roman numerals) of ohms, and "MEG" to indicate "megohms" on their circuit diagrams. Usually, you can work this out by inspection of the circuit, though it can be confusing if the equipment concerned contains no resistors of 1MΩ or higher.—Ed.

Abbreviations

Your query as to the origins of $\overline{\text{VE}}$ set me ferreting about for an old "Morse Tutor". This sophisticated device, bought for ninepence in 1940 or '41 (when my pocket money was, if I remember correctly, sixpence a week!) was intended to help me gain my Scouts Signaller's Badge (Semaphore and Aldis lamp).

It comprises a card wheel between two card covers, each with two windows at different radii, and was used by covering one window with one's thumb and turning the wheel with the other hand to expose a letter or Morse signal. Then the difficult bit—encode or decode what was exposed, finally checking by lifting the thumb. It was then, I suppose, the "white-hot leading edge of technology".

Now to the crunch. On the other side giving numbers and procedure signals is "$\overline{\text{VE}}$—commencing signal", whilst amongst other information provided on the cover is "Services Code". Not, perhaps, exposing the origins, but at least clearing the RAF of sole complicity.

J W Barker G3WAL
Rugby

I was interested to read the letter "Good Operating Practices" from G4NZU and the editorial comments in September *PW*. In the original code devised by Professor Morse in 1836, $\overline{\text{VE}}$ meant "Correction, or rub out". In more recent years, as commented, it has been used as an attention-holding signal at the start of transmission. When I was a Merchant Navy Radio Officer in the 1930's it was widely used for this purpose, although its official meaning was "Understood".

A M Smith G4OKL
Newport, Shropshire

There are two important criteria in the use of operating signals. First, they should make the operator's meaning immediately clear; second, they should be brief and sparingly used. The first

Particulars withheld

In November 1985, a "gentleman" arrived at our QTH in Spain, saying he held a UK G6 licence, and joined in local club activities. On checking his callsign in the RSGB Callbook and other countries' callbooks we discovered he was entered as "Particulars withheld". On this gentleman's United Kingdom passport was the name Michael Hills, and he told us he was in Spain on a working holiday.

He was active on h.f. and v.h.f., having borrowed transceivers from me and from EA3AOS. He obtained from G3RIU money for building a wall, from a handicapped EA3 money for antennas, and from EA5FUM, a UK amateur resident in Spain, money for antennas that did not work.

Finally, he left in a hurry and, of course, no money or equipment was returned. I discovered that he went on to France, operated on the Cannes repeater and took money from the Chief of the Police Gunnery School, who is a French amateur and who also accepted the "Particulars withheld" callbook details.

So, all you amateurs who elect to be "particulars withheld", you leave yourselves wide open! Please do as I did in the past, putting your name, town and county details. It's easier for beam heading, it gives your location and your correct name which lines up with your passport, and it ensures that piracy is very difficult under these circumstances.

F. J. Barnes EA3DJF
(ex G3AGP/G4GA)
Girona, Spain

RAYNET or PLAYNET?

I am a member of RAYNET. I joined because my interests are in providing communications facilities to those who need them. I am not interested in "number crunching" in contests to find out who beat everyone else. My purpose is to provide facilities and assist others in making the best of any event they run.

Emergencies do not occur every day, and they never will. What is more important is the ability to deal with problems as they arise, and to gain experience in dealing with the unknown, when it really matters. I have not taken part in many exercises, because I have not been in RAYNET very long. All I can tell you, and G8XTU (*PW* August), is that in every event I have helped to cover, our work has been useful, appreciated and saved someone's time.

Before coming involved with RAYNET, I had for a number of years carried out the same function using CB. Very boring, yes, but how are you going to rehearse a real emergency? Before WWII, Orson Welles in America broadcast a version of H. G. Wells *War of the Worlds*. It was dramatised to the extent of broadcasting as if it was happening for real, there and then, in a quoted part of America. The population local to that area panicked, and made a mass exodus. They were prevented from "escaping" by the mass of sightseers coming in to see the Martians for themselves. And this was in spite of frequent interruptions to the broadcast to announce that listeners were hearing a fictional dramatisation.

No amount of declaration will persuade all listeners that they are hearing only a practice session. Someone will take it for real. The exercises you have been asked to handle have helped you.

David Williams GM1SSA
(Treasurer, Lanarkshire RAYNET) Motherwell

criterion must also apply to abbreviations.

Some operating signals are essential:
CQ—General call
CQDX—General call, long distance
$\overline{\text{AS}}$—Please wait
K—Invitation to transmit
$\overline{\text{KN}}$—Invitation to transmit (named station only)
$\overline{\text{VA}}$—End of work
$\overline{\text{AR}}$ when it means "End of this transmission" is quite useful since it comes across well when band conditions are poor and there is much QRM. $\overline{\text{CT}}$ is used commercially to differentiate between the message-handling part of a signal and the actual text. On amateur radio we don't send a date/time group, priority code or address (at least, not in the UK) so we really don't need this one.

$\overline{\text{VE}}$ is usually used for "attention please". It is decorative but not functional, for if the listener wants to listen, he will.

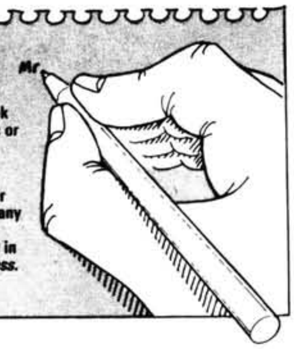
However, I really do not wish to advocate the standardisation of all these signals and abbreviations, for Morse code is a language and languages should, I think, be a living and continuously changing, adaptable means of communication. If what is sent can be clearly understood, then I am generally happy with it. My own dislike is the lad who sends CQ twenty times then slaps his callsign and DX on the end of it. He is not communicating; he just likes the sound of the way he sends CQ!

The Morse tests, I think, should stick to basics; new operators should expect to go on learning after they pass the test. Languages are fun, but one cannot learn them overnight. All a new operator needs to begin with is "survival" Morse. Like every other c.w. nut, I had to ask dozens of questions of an awful lot of other amateurs at first; I'm still asking—it's fun!

Shelagh G4UUH
Yelvertoft, Northants

Send your letter to the Editorial Offices in Poole, the address is on our Contents page. Writer of the Star Letter each month will receive a voucher worth £10, to spend on items from our PCB or Book Services, or on *PW* back numbers, binders, reprints or computer program cassettes. And there's a £5 voucher for every other letter published.

Letters must be original, and not duplicated to other magazines. We reserve the right to edit or shorten any letter. Brief letters may be filed via our Prestel Mailbox number 202671191. The views expressed in letters are not necessarily those of *Practical Wireless*.



Thank You

Following publication of my article "Trials of a New Licensee" in *PW*, February 1987 issue, I received many offers of help and several letters of support including detailed diagrams of various filters. I would like to thank everyone who encouraged me to persevere with the interference (EMC) problems I experienced in pursuing my interest in amateur radio.

I would also like to reassure any amateur suffering with EMC that in my case the RIS was very sympathetic and offered sound advice which helped me clear my problem to the satisfaction of all concerned.

With all the information I received, I have now built up a considerable file on the problems of EMC, and with this in mind I feel that I should return some of the help and advice that was given to me during my traumatic experience. I would also ask any amateur with information on filters, including low-pass, high-pass, braid-breaker, mains, etc., to send it to me to make my library even more comprehensive.

I am QTHR and would be pleased to receive letters either for or with information on this subject. Please include an s.a.e. with letters requiring a reply.

S G Bryan G1SGB
Rotherham, S Yorks

OUR SERVICES

QUERIES

We will always try to help readers having difficulties with a *Practical Wireless* project, but please observe the following simple rules:

1. We cannot give advice on modifications to our designs, nor on commercial radio, TV or electronic equipment.
2. We cannot deal with technical queries over the telephone.
3. All letters asking for advice **must** be accompanied by a stamped, self-addressed envelope (or envelope plus International Reply Coupons for overseas readers).
4. Write to the **Editor, "Practical Wireless", Enefco House, The Quay, Poole, Dorset BH15 1PP,** giving a clear description of your problem.
5. Only one project per letter, please.

COMPONENTS, KITS AND PCBS

Components for our projects are usually available from advertisers. For more difficult items, a source will be suggested in the article. **Kits** for our more recent projects are available from **CPL Electronics**, and from **FJP Kits** (see advertisements).The **printed circuit boards** are available from our **PCB SERVICE** (see page 1 of this issue).

CONSTRUCTION RATING

Each constructional project is given a rating, to guide readers as to its complexity:

Beginner
A project that can be tackled by a beginner who is able to identify components and handle a soldering iron fairly competently.

Intermediate
A fair degree of experience in building electronic or radio projects is assumed, but only basic test equipment is needed to complete any tests and adjustments.

Advanced
A project likely to appeal to an experienced constructor, and often requiring access to workshop facilities and test equipment for construction, testing and alignment. Definitely not recommended for a beginner to tackle on his own.

BACK NUMBERS AND BINDERS

Limited stocks of most issues of *PW* for the past 18 years (plus a few from earlier years) are available at £1.30 each, including post and packing to addresses at home and overseas (by surface mail).

Binders, each taking one volume of *PW*, are available price £3.95 to UK addresses, or overseas, including post and packing. Please state the year and volume number for which the binder is required. Prices include VAT where appropriate.

CLUB NEWS

If you want news of radio club activities, please send a stamped, self-addressed envelope to **Club News, "Practical Wireless", Enefco House, The Quay, Poole, Dorset BH15 1PP,** stating the county or counties you're interested in.

ORDERING

Orders for p.c.b.s, back numbers and binders, *PW* computer program cassettes and items from our Book Service, should be sent to **PW Publishing Ltd., FREEPOST, Post Sales Department, Enefco House, The Quay, Poole, Dorset BH15 1PP,** with details of your credit card or a cheque or postal order payable to PW Publishing Ltd. Cheques with overseas orders **must** be drawn on a London Clearing Bank.

Credit card orders (Access, Mastercard, Eurocard or Visa) are also welcome by telephone to Poole (0202) 678558. An answering machine will accept your order out of office hours.

SUBSCRIPTIONS

Subscriptions are available at £14 per annum to UK addresses and £18.50 overseas. For further details, see the announcement on page 36 of this issue. Airmail rates for overseas subscriptions can be quoted on request.

Delays

My girlfriend sat the Radio Amateurs Examination in May, after nine months of hard study and some considerable expenses. When I rang City and Guilds to find out when we could expect to hear the glad/sad tidings, I was told that all results were in the post (Monday, July 27).

Today, eight days later, they have still not arrived. The attitude of the local college is that we must just wait, even though other local areas have already sent off their licence applications and are now awaiting their callsigns. The C & G do not think that a week is a long time for a letter or package to travel the 300 miles involved, but I have been unable to discover whether the packages were sent by registered mail. Come on C & G, get your act together!

In closing, may I through your column, inform your readership that I hope to attend the forthcoming AGM of the RSGB, as I did last year, and if any member is unable to attend but would like to register a proxy vote or to have a question asked, then I am willing to accept them.

Martyn Bolt G4SUI
112 Leeds Road, Mirfield
West Yorks WF14 OJE

There have been postal delays over recent months in several parts of the UK, due to industrial action. A number of these delays were not announced to the public, who only found out about them as the result of enquiries when an urgent item was not delivered to its destination. Perhaps some of the C & G results were affected in this way—Ed.

Don't forget, all correspondence to the editorial offices may be delayed over Christmas —post early!

RSGB Mailshots

I cannot allow GW6RXA's letter in *PW* September 1987 to go unchallenged. There is no reason why the RSGB, or anyone else, should not sell its "product" in this way. GW6RXA may take up the offer or not, as he pleases.

These questions have to be asked: Who else's efforts got us 50MHz? Who else negotiated Class B use of 50 and 70MHz?

The subscription rate is good value for money at less than 5p per day, and the RSGB is not responsible for the "poverty-trap".

J M Dunnett G4RGA
Wellington, Somerset

0202 678558 *Practical Wireless* **0202 678558**

PCB SERVICE

Printed circuit boards for recent *PW* constructional projects are now available from the PW PCB SERVICE. The boards are fabricated in 1·5mm glass-fibre, and are fully drilled and roller tinned. All prices include VAT and postage and packing for UK orders. Add £2.00 per order for despatch to overseas addresses.

Orders and remittances should be sent to: **PCB Service, Practical Wireless, Enefco House, The Quay, Poole, Dorset BH15 1PP. Cheques should be crossed and made payable to Practical Wireless.**

When ordering, please state the Project Title and Issue Month as well as the Order Code. Please print your name and address clearly in block capitals, and do not send any other correspondence with your order. You may phone your order using Access or Visa. A telephone answering machine will accept your order outside office hours.

Please allow 28 days for delivery. Always check the latest issue of *PW* for the current details of price and availability. Please enquire for earlier p.c.b.s.

PROJECT TITLE *(Issue)*	ORDER CODE	PRICE
PW Teme—VFO/Doubler *(12/84)*	WA001	£3.76
PW Teme—RX *(1/85)*	WA002	£5.46
PW Triambic Keyer *(2/85)*	WAD280*	£4.26
FRG-7 BFO Mod *(2/85)*	WAD249	£4.00
PW Colne *(4/85)*	A004	£4.14
	A005	£4.08
PW Colne *(5/85)*	WR198	£5.01
PW Colne *(6/85)*	WR197	£4.97
Battery Charge Control *(6/85)*	WAD302	£3.94
Crystal Tester *(7/85)*	WR200	£3.43
Add-on BFO *(8/85)*	WR201	£3.42
UHF Prescaler *(9/85)*	WR202	£4.76
PW Meon 50MHz Transverter *(10/85)*	WR199	£8.28
Capacitance Meter *(10/85)*	WR203	£3.74
WQ MW Loop *(11/85)*	WR204	£3.45
RTTY/Morse Modem *(1/86)*	WR205	£6.73
	WR206	£3.78
Crystal Calibrator *(1/86)*	WR207	£2.90
Simple Audio Oscillator *(3/86)*	WR209	£5.50
RF Speech Processor *(3/86)*	WR208	£5.21
PW Meon Filter *(4/86)*	WR211	£4.04
PW Arun Parametric Filter *(5/86)*	WR210	£9.87
FRG-7 CIO Mod *(6/86)*	WR213	£3.61
Simple 50MHz Converter *(9/86)*	WR215	£4.86
NiCad Charger *(10/86)*	WR217	£3.30
Active Antenna *(11/86)*	WR216	£3.24
PW Taw VLF Converter *(11/86)*	WR222	£3.82
High Impedance MOSFET Voltmeter *(12/86)*	WR223	£3.82
Modifying the SRX-30D *(12/86)*	WR214	£3.99
Basic Wobbulator *(1/87)*	WR224	£4.52
2m Mast-head Pre-amp *(2/87)*	WR218	£5.33
	WR219	£3.37
PW "Woodstock" *(3/87)*	WR225	£5.28
PW "Blandford" *(4/87)*	WR227a, WR226a, WR228	£11.11
PW "Itchen" *(4/87)*	WR298	£4.49
PW "Axe" *(5/87)*	WR230a	£5.07
	WR231	£4.24
	WR232	£3.82
PW "Downton" *(6/87)*	WR233	£5.04
Side-tone Oscillator *(6/87)*	WR234	£3.65
Mains On/Off for Battery Radio *(9/87)*	WR235	£3.97
PW "Blenheim" VHF to HF Converter *(9/87)*	WR236	£5.99
A High-stability VFO *(10/87)*	See article	—
RTTY Tuning Indicator	WR237	£6.95

NEWS DESK ... *compiled by G4LFM and G8VFH*

Special Event Stations

GB4GWR: Steam radio comes alive again this year at Didcot Railway Centre. Members of the Great Western Society, assisted by amateurs from local clubs, will be operating this station during the Railway Centre's Santa Steaming on December 6, 13 and 20. The Railway Centre will be open from 11am to 5pm each day and presents will be available for children in Santa's steam train grotto—I think grown-ups miss out on that!

QSL cards will be available, but the group suggests that people come and collect their cards in person and visit the centre at the same time.

More details about GB4GWR and the GW150 award from John O'Hagan G4PFY, "Brubell", 27 Colne Close, Grove, Wantage, Oxon OX12 0NN—don't forget an s.a.e.

Clubs Merge

The former Buxton Amateur Radio Society has now merged with North Buxton Radio Club to become **Buxton Radio Amateurs**. The club now meets on a Tuesday, 8pm at the Haddon Hall Hotel, London Road, Buxton on alternate weeks. The secretary Tony Briggs G8YHX on 0298 6800 can tell you any other details.

PW QRP Contest

At the Scottish and Welsh Conventions this year Joan Heathershaw G4CHH, President of the RSGB, was kind enough to present the two trophies for the PW 144MHz QRP Contest.

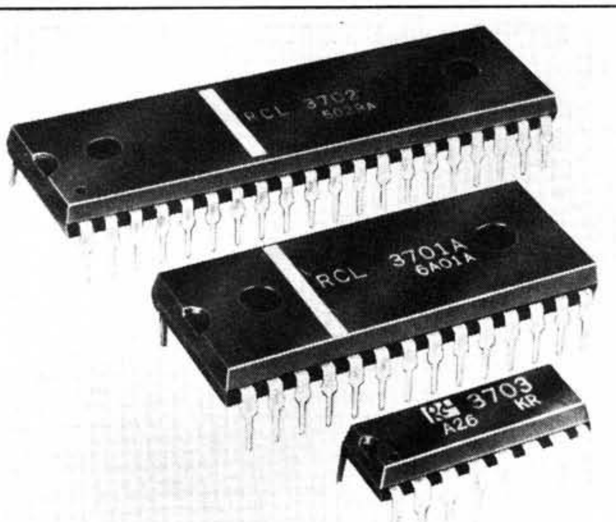
In the photographs you can see the winners of the PW Tennamast Trophy GM4CAA/P with Dick Ganderton G8VFH, Joan Heathershaw G4CHH, all at the Scottish Convention in Irvine. The other photograph shows Joan Heathershaw again, but this time with members of GW8TFI/P, at the Welsh Convention.

Don't forget, the date of next year's contest is 12 June 1988.

LSI Chips

Three c.m.o.s. l.s.i. integrated circuits, designed specifically for use in numerical control applications, are now available from Cirkit in economical plastics packages. Previous versions of the i.c.s were available in ceramic packages only.

Available are, the KM3701AD function generator l.s.i., the KM3702D comparator l.s.i. and the KM3703D a feed-back pulse generator for use with the KM3702D.



A special KM i.c. numerical prototyping kit for two-axis control is now available from Cirkit. It includes one KM3701D, two KM3702D i.c.s and two KM3703D i.c.s, complete with documentation.

For more details on these i.c.s, contact:

Cirkit Distribution Ltd., Park Lane, Broxbourne, Herts EN10 7NQ.

Charity Stamps

John Allsopp G4YDM is collecting stamps. What's that to do with amateur radio you ask? Well it's used stamps, both foreign and English he is collecting. These are going to finance the purchase of a transceiver for a disabled amateur. At least they will with your help.

Any quantity of stamps, either on or off the envelope should be sent to:

John Allsopp G4YDM, 30 Manor Road, Concordvill, District 11, Washington, Tyne & Wear NE37 2BT.

Can You Help?

Mr T. Boxhall has an early 1960s Bush radio which is in need of repair. Does anyone know of a company, in the London area, who could mend this for him. If so, write to Mr T. Boxhall, 397 Upper Elmers End Road, Beckenham, Kent BR3 3DA.

John Irvine is looking for an Atari 800XL program that will read c.w. and a manual for the Trio 9R-59DE receiver. If you can help then contact John at 19 Cuillin Close, Lambton, Washington, Tyne and Wear NE38 0PU.

Having recently moved to a flat that is too small for his comprehensive hi-fi set, A. Y. Morgan is forced to dispose of it. He has: 2 Cooper-Smith hi-fi BPI amplifiers, a Cooper-Smith pre-amplifier control unit, a Jason Mercury tuner converted for stereo, a Collaro transcription unit and an EMI 100 pick-up with diamond heads. If you would like to collect this from Mr Morgan, he is prepared to give it away. You can contact him at 5 Riverside Court, Lyons Crescent, Tonbridge, Kent TN9 1EZ.

We have a reader who would like information on the Sony CRF330K and Panasonic RF9000 receivers and how they compare with an Icom ICR-70. He is also looking for the full address of the UK agent for Pan-International Crusader RX. If you can help, write to Amoroso, 60 Highfield Road, Salford, Lancashire M6 5LA.

Deregulation

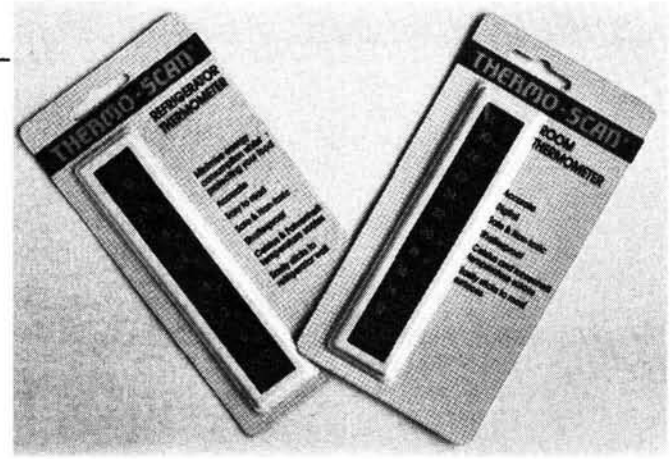
The Civil Land Mobile Radio Committee's (CLMRC) sub-group on deregulation is anxious to hear from the mobile radio industry about spectrum pricing and deregulation.

The CLMRC is the principal advisory forum to the DTI on civil land mobile radio regulatory policy. It draws its membership from organisations representing radio users, service providers, manufacturers and university researchers. In addition, a number of individuals have been invited to serve in a personal capacity.

Explaining the sub-group's call for views, Mr Whelan said, "There must be many people in the mobile radio industry who have views on these issues and we want to hear from them. By contributing now they can help to shape the future of their industry".

Comments should be sent to:
Mr Joe Whelan.
Radio Regulatory Div.,
DTI, Room 806,
Waterloo Bridge House,
Waterloo Road,
London SE1 8UA.

Thermo-scan



The Thermo-scan thermometer utilises the latest advances in liquid crystal technology to bring accurate and easy-to-read temperature indication.

The Thermo-scan is available in two ranges—first the Refrigerator Thermometer offering a range of 0° to 12°C and secondly the Room Thermometer with a range of 12° to 30°C, both incorporate °F equivalents.

The liquid crystals are programmed to change through a spectrum of colours from black as the temperature changes to green indicating the exact temperature. The cost of each thermometer is £1.25 plus VAT and postage.

More details can be obtained from:
Peter Webb.
ETI.
PO Box 81,
Worthing,
W. Sussex BN13 3PW.

IRTS

It has long been the ambition of the Irish Radio Transmitters Society to have a permanent headquarters in which to hold meetings, to store the archives and to set up a station. They have now appointed a Building Fund Organiser and have organised their first fund raising event, which should have taken place on November 19.

We'll keep up-to-date on their progress as the months go by.

Rally Dates

November 12: The Bridgend & District RC are holding their rally at the Bridgend Recreation Centre, Angle Street, Bridgend. Doors open at 11am, (10.30am for the disabled). Free parking, a bring and buy, Morse test (pre-booked with the RSGB), bar facilities and talk-in on S22. More details from Dave George GW1OUP on 0656 723508.

November 22: The West Manchester RC Winter Rally takes place in the Pembroke Halls, Walkden. Doors open at 10.30am. They say all the usual traders and features will be there. Talk-in will be provided on S22. More details from G1IOO on 0204 24104.

***December 6:** The Verulam Christmas Rally will be held at St Albans City Hall. Doors open at 11am. More from S.C.B. Dunning on 0923 52959. PW & SWM will be there!

1988

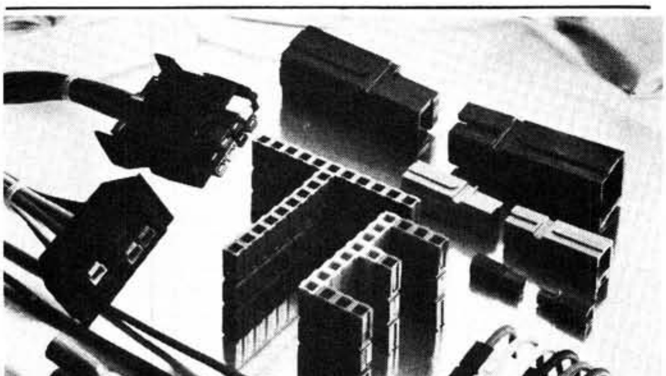
March 20: The Tiverton SW Radio Club are holding The Mid-Devon Rally at the Pannier Market, Tiverton. There is easy access from junction 27 of the M4 and excellent parking facilities on site. There will be two halls of trade stands, a bring and buy and a mobile snack bar. Talk-in will be on S22. More from G4TSW, Mid-Devon Rally, PO Box 3, Tiverton.

June 12: The Royal Naval ARS have announced the date of their Mercury rally. The venue, as always, is HMS Mercury, near Petersfield, Hampshire. Gates are open between 1000 and 1700. More details from C. G. Harper G4UJR. Tel: 0703 557469.

July 15–17: The RSGB 75th Anniversary National Convention will take place at the National Exhibition Centre, Birmingham. RSGB HQ can give you more details.

July 28–31: The AMSAT-UK Colloquium will again be held in the University of Surrey, Guildford. Details from G3AAJ on 01-989 6741.

August 14: The 1988 Derby Mobile Rally will take place at the usual venue of Lower Bemrose School, St Albans Road, Derby. Doors open 11am. More details from G3KQF, QTHR.



Connectors

A new range of low-cost high-current single pole modular connectors are available from Torberry Engineering. They are rated at 15, 30, 60, 120 or 180A 600V d.c.

Called Powerpoles, it is easy to make multi-pole configurations by dovetailing individual housings to form multiway connectors.

Incorporated are overlapping silver-plated copper contacts which give an excellent low resistance connection. The module halves are identical mechanical twins and with different coloured housings provide flexibility and ease of assembly.

More details from:
Peter Crane or Ken Button on 0730 80822 or:
Torberry Engineering Co. Ltd.,
PO Box 5,
Petersfield,
Hampshire GU31 5PP.

CB Information Sheet

Following along the lines of the Amateur Radio Information Sheets, the DTI have produced the first CB one.

It answers lots of the questions people ask about CB, what is it?, Do I need a licence?, How much does it cost?, How do I get a licence?, etc. It also gives a list of the frequencies currently available to CBers. If you would like a copy of this leaflet, then send to:
The DTI,
Radiocommunications Division,
Room 613,
Waterloo Bridge House,
Waterloo Road,
London SE1 8UA.

NEWS DESK ... compiled by G4LFM and G8VFH

Wireless Workshop

On Wednesday October 7, amid all the torrential rain, I was over on the Isle of Wight for the opening of the Communications and Electronics Museum Wireless Workshop and Transmitting Station.

The Mayor of Medina opened the museum, and it turned out he had built radios in his youth. The Museum was established in July 1984 with the objectives of establishing and preserving a reference collection of civilian and military communications and electronic equipment from the earliest times, together with relevant documentation.

They also want the collection for research and educational purposes for students at all levels and young people.

The Museum initially concentrated the major collections of Douglas Byrne G3KPO and Dr Graham Winbolt.

Cellular Operators

John Butcher, Parliamentary Under Secretary of State for Industry, confirmed that the two existing UK cellular radio operators, Telecom Securicor Cellular Radio Ltd (Cellnet) and Racal Vodafone Ltd., will provide the UK part of the pan-European digital cellular radio service due to come into operation in 1991.

As from 1991, the operators will be allocated on an equal basis the 400 channels in the 900MHz band currently held in reserve for the introduction of the pan-European system.

Beacon News

The first 144MHz beacon to be operated by the South Eastern Amateur Radio Group is sited at a mast near the village of Portlaw in County Waterford. The beacon, EI2WRB, has been on the air since September 1987 on 144.920MHz.

It has been made up from an old 50 watt Pye f.m. transmitter modified for c.w. The logic is supplied by a home-designed unit with a 16K EPROM. The antenna is a 5-element beam in a south-east direction.

The following message is transmitted:
CQ CQ CQ DE EI2WRB LAT 52D 15M NORTH LONG 07D 20M WEST QRA IO62IG 248MTR ASL ANT DIR 95D ERP 200W DE EI2WRB.

The SEARG would welcome reception reports direct to EI8GO at 2 Derrynane Close, Powerscourt, Waterford City, Eire or via the bureau to their QSL manager EI3BEB.

RadioGram

If you are interested in valved radios, or just enthusiastic for bygone days, then a subscription to *RadioGram* could well suit you.

Topics covered in the magazine include Servicing, Restoration, Discussion, Nostalgia and Constructional projects to name but a few.

RadioGram subscriptions (for six issues) are, UK and Ireland—£6.50, Europe—£8.10 and elsewhere by arrangement.

Cheques (in sterling) should be sent to:
C. E. Miller.
"Larkhill",
Newport Road,
Woodseaves,
Staffs ST20 ONP.

Morsum Magnificat

The latest edition of this quarterly has landed on my desk, I only wish there were more hours in the day to allow me to read more of it.

The issue is full of a wide range of subjects from historical to humorous. There is a very nice article called Ham Radio in 2036—A Prophecy. It tells of the amateur who fell asleep in 1936 and awoke in 2036 and the changes that had happened.

If you would like to read more about Morsum Magnificat then a subscription costs £6.00 per annum.

More details from:
Tony Smith,
1 Tash Place,
London N11 1PA.

50MHz Transverter

R.N. Electronics are offering a range of kits and ready built units that allows any popular 144MHz transceiver (up to 3W) to be used on 50MHz, any mode.

There are two versions available, 2W p.e.p. output and 25W. The units have low noise BF981 front ends, d.c. or VOX switching and low harmonic output.

The various options are: 25W complete boxed transverter @ £149 plus £4.00 P&P; 2W complete boxed transverter @ £119 plus £4.00 P&P; 2W assembled and tested p.c.b. @ £97.00 plus £2.00 P&P; 25W add-on p.c.b. @ £39.00 plus £2.00 P&P.

More details from:
R.N. Electronics.
37 Long Riding Ave.,
Hutton,
Brentwood,
Essex CM13 1EE.

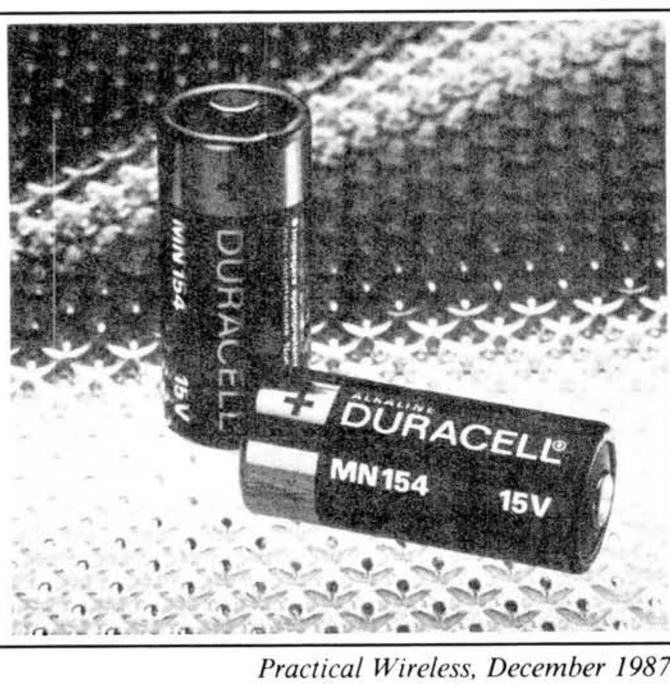
FPJ Kits

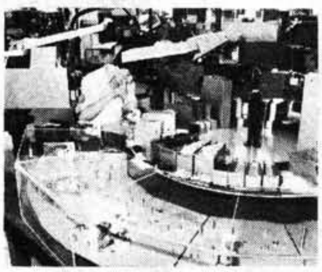
Unfortunately, in the November issue the telephone number was wrong. It should be 05435 6487 for future reference.

15V Batteries

Duracell have included a 15 volt alkaline battery, the MN154, to their range recently. It has a nominal capacity of 50mAh, is 35mm long and 15mm in diameter with a raised terminal connection at each end. As you may expect, it only weighs 16g.

For further information regarding Duracell products as well as the company's free Battery Advisory Service, please contact:
John Bellamy,
Duracell Technical Division,
Duracell House,
Church House,
Lowfield Heath, Crawley,
W. Sussex RH11 0PQ.





AVO & Megger Revived

I'm sure most people have heard of AVO & Megger when talking about test equipment, a large number of readers probably have some. Well, the names are being revived following the management buy-out of Thorn EMI's test and measurement instrumentation business.

Megger Instruments Ltd. are the largest British manufacturer of portable test instruments and are now based at Dover.

AVO International Ltd. also has its headquarters in Dover and is the holding company for an international group with operations in the UK, USA, France and West Germany.

As details of new products and items become available, we hope to be able to tell you more.

RAE Courses

Birmingham: There is a course that started on November 5 at the Fox Hollies Leisure Centre, and there may still be some places left. For further details contact G4ABV on 021-778 1311 ext. 31.

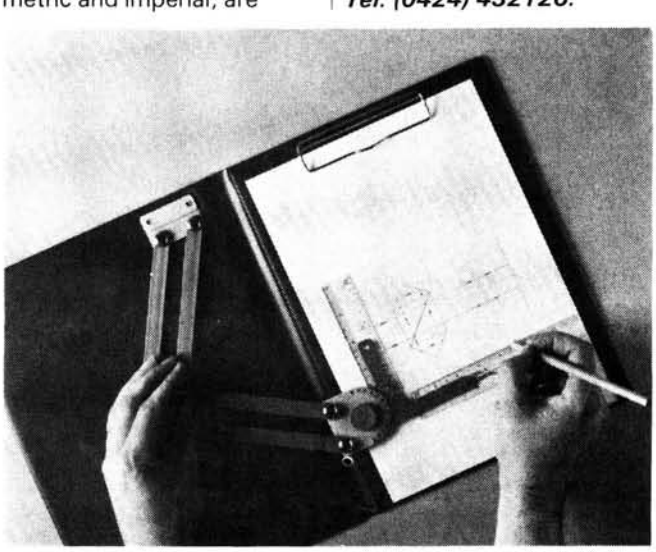
Viola

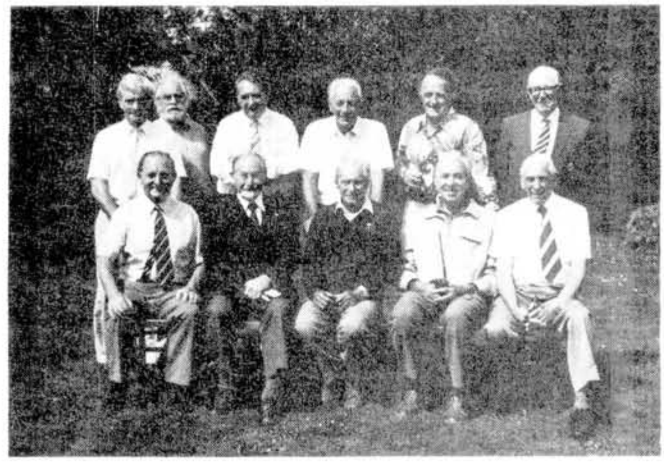
If you want to improve the standard of your drawings and circuit diagrams then this neat and compact unit will be of interest:

Essentially an A4 drawing board, complete with draughting head and integral clamping system, the Viola Plastics Compact Drafter is no larger than an A4 ring binder.

The two rules, printed metric and imperial, are reversible and interchangeable, mounted on the 180° protractor head which is carried on the four parallel motion arms. The unit can be folded up and carried around as a complete personal draughting unit.

The Viola Compact Drafter costs £10.50 inc. VAT plus £1.50 p&p from ***Viola Plastics, 36 Croft Road, Hastings, East Sussex TN34 3HE. Tel: (0424) 432126.***





50 Years on the Air

Recently G5FF celebrated 50 years on the air. Gathered around him are some of the friends he has collected over the years.

From left to right you can see: (back row) G4UPG, G4PCU, G2HCG, G3BFC and G6DZ. (front row) G5BM, G5RV, G5FF, G6AG and G8BU.

We would like to wish Arthur and his gathered friends many more happy years with amateur radio.

Price Difference

We are sorry to disappoint all those potential Icom customers who thought that they could buy an IC900 from Dressler for £329.00, as stated in their advertisement in October's *PW*. The price of £329.00 referred to the PRO-80 and we apologise for any inconvenience caused.

Tribute to G4DC

P. W. Winsford has been licensed for 50 years now, and to celebrate the event the North Ferriby ARS arranged an evening for him. North of Watford G4DC is known as Percy, but South it's Bill. Yet many local amateurs and their wives joined in the celebrations.

As you can see from the photograph Joan Heathershaw G4CHH, President of the RSGB, was there too. By the look of their faces, I think the evening was enjoyed too.

photograph G0EAA

The HF-125 short wave receiver was conceived, designed and is "Made in Britain" for the DX enthusiast. Its ability to perform on a crowded band with strong adjacent stations was a major consideration in its design. The HF-125 is also easy to use, the controls being simple and sensible. Essential bandwidth filters which are often options on other equipment are fitted as standard. Unnecessary frills are not included and their omission is deliberate. The result is an affordable receiver.

The HF-125 has continuous coverage from 30 kHz to 30 MHz. Operating modes are AM, USB, LSB and CW. An optional board (D-125) adds FM and synchronous AM. Unlike other receivers, the HF-125 comes complete with a comprehensive range of bandwidths; a 2.5 kHz filter for SSB transmissions or for resolving an AM station using SSB mode and ECSS technique (exalted carrier, selectable side band), a 4 kHz, 7 kHz or 10 kHz filter for AM reception, the width chosen dependent on the signal and band conditions (10 kHz for BBC Radio 4, 7 kHz for Vatican Radio on 6185 kHz and 4 kHz to resolve a signal when conditions are not ideal). For the CW enthusiast a 400Hz audio filter is included as standard.

Operating the HF-125 is refreshingly simple. The controls are logical in use and a large back-lit liquid crystal clearly displays the operating frequency.

Two buttons, one marked up, the other down, select the correct magahertz and you tune to the required frequency using a large heavy knob with a thoughtfully provided finger recess. The tuning rates relate to a simple design concept of two stations per knob revolution on each mode. As well as providing the optimum tuning rate whilst you are carefully looking for a weak signal, the HF-125 automatically increases its stepping increment as the knob rotation speed increases. The result is an extra rapid frequency shift to a new part of the band. There is also an optional keypad controller (K-125) for even quicker frequency selection.

To further enhance reception other facilities are included. A noise blanker is permanently in circuit to deal with vehicle ignition interference, 20 dB of attenuation can be switched in when required and an HF or LF cut tone control can be applied to the audio output.

Although memory facilities are not essential in a short wave receiver they are useful. The HF-125 has 30 memories which are available in two banks of fifteen.

The HF125 provides its owner with outstanding performance. Typical values for frequencies greater than 500 kHz are a sensitivity on SSB of 0.3 uVC for 10 dB S/N and on AM, 0.7 uV for 10 dB S/N at 70% modulation. Dynamic range is greater than 90 dB at 50 kHz from the tuned frequency (both IMD and RM) and image and spurious responses have a greater than 80 dB rejection.

Connections are included for both 50 and 600 ohm impedance aerials (SO-239 and a terminal block). The receiver has a 6mm jack socket for headphones on the front panel and two 3.5mm sockets on the rear panel, one for an external loudspeaker and the other for tape recording.

The HF-125 operates from 12 volts DC and, as such, is suitable for use from an external battery whilst caravanning or boating. For home use an AC mains adapter is supplied with the receiver. For truly portable listening, in the garden or on a hilltop, an internal rechargeable battery, charger and active whip aerial option (P-125) is available as well as a tough protective carrying case with shoulder strap (C125). Operation on a fully charged Nicad pack is around 10 hours.

Compact and lightweight, the HF-125 is 255mm wide, 100mm high and 200mm deep, a portable high performance short wave receiver.

HF125 .... **£375.00 inc VAT,** carriage £7.00
D125 .... **£59.50 inc VAT,** carriage £1.00
K125 .... **£59.50 inc VAT,** carriage £1.00
P125 .... **£69.51 inc VAT,** carriage £2.50
C125 .... **£23.85 inc VAT,** carriage £2.50

HF 125 SHORT WAVE RECEIVER

LOWE SHOPS

In Glasgow,
the shop manager is Sim, GM3SAN,
the address, 4/5 Queen Margaret Road, off Queen Margaret Drive, Glasgow, 041-945 2626.

In the North East,
the shop manager is Hank, G3ASM,
the address, 56 North Road, Darlington, 0325 486121.

In Cambridge,
the shop manager is Tony, G4NBS,
the address, 162 High Street, Chesterton, Cambridge, 0223 311230.

In Cardiff,
the shop manager is Carl, GW0CAB,
the address, c/o South Wales Carpets, Clifton Street, Cardiff, 0222 464154.

In London,
the shop manager is Paul, G4PTI,
the address, 223/225 Field End Road, Eastcote, Middlesex, 01-429 3256.

In Bournemouth,
the shop manager is Colin, G3XAS,
the address, 27 Gillam Road, Northbourne, Bournemouth, 0202 577760.

LOWE ELECTRONICS SHOPS are open from 9.00am to 5.30pm Tuesday to Friday and from 9.00am to 5.00pm on Saturday. Shop lunch hours vary and are timed to suit local needs. For exact details, please telephone the shop manager.

packet radio from Kantronics

KPC 2... This KANTRONICS designed AX25 version 2 TNC features a built-in VHF and HF modem, full duplex operation and multiple connect facilities. The serial RS232 port, combined with the enhanced generic command structure allows operation with any computer.
KPC2 ... £165.00 inc. VAT, carriage £7.00.

KPC4... A KPC4 is your gateway into packet flexibility. Having two packet ports, digipeating on each port and gateway between ports, the KPC4 lets you bridge two frequencies on one band or operate cross band. The KPC4 also includes the Personal Packet Mailbox feature.
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KAM... Combine VHF packet, HF packet, CW, RTTY, ASCII and AMTOR in one unit.
KAM ... £289.00 inc. VAT, carriage £7.00.

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Chesterfield Road, Matlock, Derbyshire DE4 5LE
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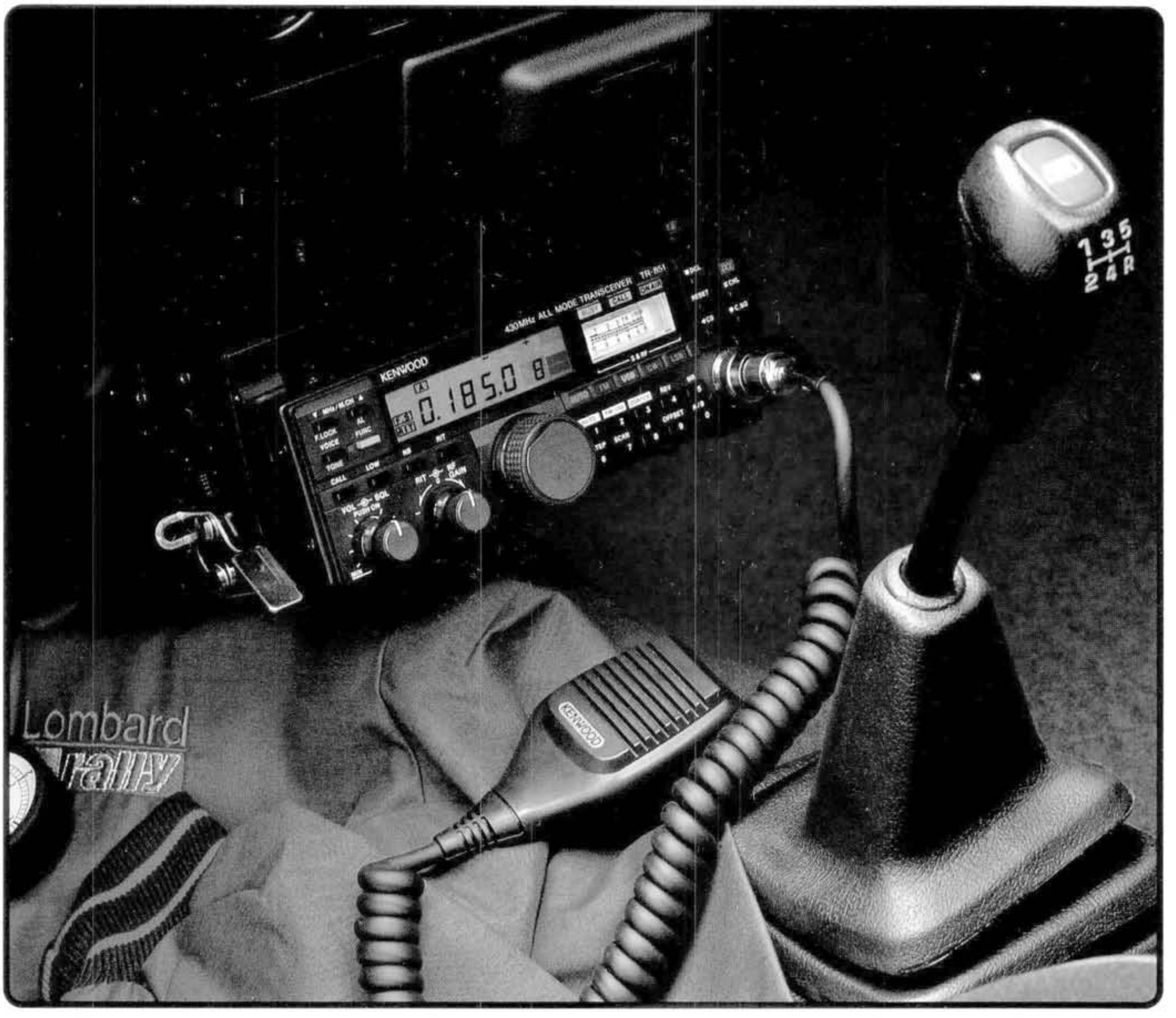
KENWOOD
430MHz ALL MODE TRANSCEIVER TR-851
Lombard
rally
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Special Offer

To *PW* readers—a special pre-publication offer on a new book by Steve Money G3FZX.

Save £1.00 off the published price of £8.95

Although conventional telephony and telegraphy are the most widely used communications techniques in amateur radio, there has been in recent years an increase in interest in the more exotic forms of communication. Radioteletype (RTTY), amateur teletype over radio (AMTOR), slow scan television (SSTV) and more recently packet radio, are communications techniques which have benefited from the widespread availability of home or personal computers, which can be used to provide the decoding and display facilities for such transmissions. In this book a simple description is given of the principles involved in these modern communications techniques. Details are also given of the frequencies where such transmissions may be found.

With the coming of the space age, radio amateurs were able to design and build their own space satellites which were launched into orbit as part of the payload when commercial satellites were launched. Earlier amateur satellites provided simple radio beacons, but the current series are used to provide communications transponders which allow radio amateurs to achieve world-wide contacts via satellite using the v.h.f. and u.h.f. bands. Details of current satellites and the frequencies used are given in this book.

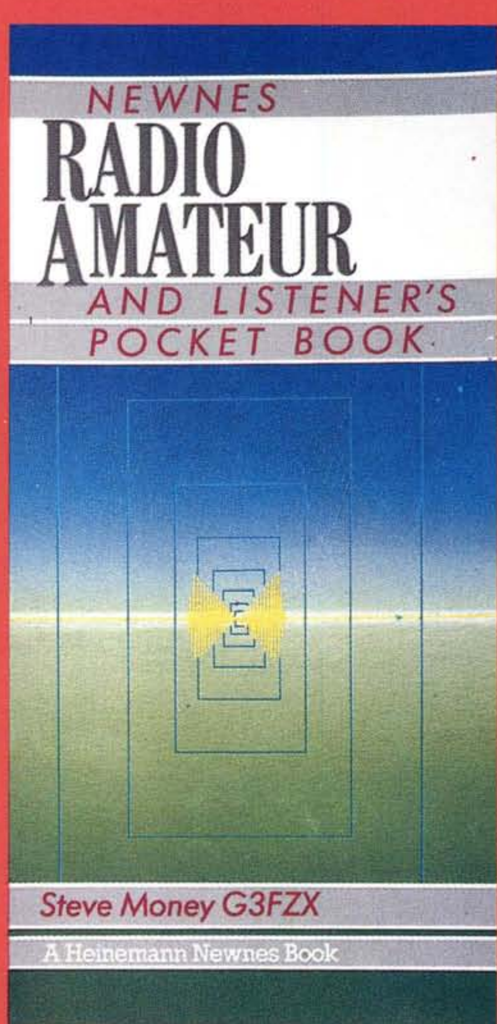
Radio enthusiasts may also be interested in receiving weather pictures from the numerous weather satellites now in orbit, or receiving television transmissions from communications satellites and the future direct broadcast TV satellites. This book gives details of these satellites and the frequencies they use.

The availability of scanner receivers and all-band communications type receivers, combined with the use of home computers, has increased interest in listening to some of the wide variety of utility stations that operate on the h.f., v.h.f. and u.h.f. bands. Among these are aircraft and maritime stations, also the various press agency stations which transmit news using radioteletype transmissions. Details of the bands where these stations are to be found, and some sample frequencies are given in this book.

As an aid to operating, the book also includes much general information such as lists of callsign prefixes, both alphabetically and by country, useful abbreviations such as Q codes, and general information on the principles of receivers, transmitters, antennas and propagation.

The aim of this book is to provide a useful quick reference for radio amateurs and listeners, and a short bibliography has been included which will provide sources of more detailed information on some of the subjects covered in this book.

The *Radio Amateur and Listener's Pocket Book* is in hardback, comprising 160 pages 90 × 190mm, and will be published by Heinemann Newnes. The special pre-publication offer price to *PW* readers is £7.95 plus 50p post and packing—a total of £8.45. (Books are zero-rated for VAT.)



HOW TO ORDER

Complete both coupons in ink, giving your name and address clearly in block capitals. Coupon (2) will be used as the address label to despatch your book to you.

Send the coupons with your cheque to: Practical Wireless Book Offer (Nov), FREEPOST, Enefco House, The Quay, Poole, Dorset BH15 1PP. No postage stamp is needed. If you wish to pay by credit card (Access, Mastercard, Eurocard or Visa only), please fill in your card number and sign the coupon where indicated.

Available to readers of *PW* in England, Scotland, Wales, N. Ireland, the Channel Islands and the Isle of Man. Orders are normally despatched within 28 days, but please allow time for carriage. The closing date for this offer is 30 December 1987.

SWAP SPOT

Have Remington Wingmaster pump action shotgun, model 870 3in magnum. Mint condition complete with guncase and accessories. Cost new £400. Would exchange for h.f. transceiver or w.h.y? Shotgun certificate holders only need phone. Tel: 08482 314. *D489*

Have RCA AR88 immaculate condition, with original manual. Also Superstar 360FM, ideal for 28MHz conversion. Would exchange for good working FT200 or similar with 27MHz fitted. Robert MmClurg, 15 Rossgana Drive, Eden, Carrickfergus, Co. Antrim. N. Ireland. *D494*

Have HR0 maj RX, 5 coils, p.s.u., speaker, spare valves, manual. Would exchange for teletex adaptor, test equipments. R. Roy, Dawnmoor, Newton Saint Petrock, Torrington, Devon EX38 8LZ. Tel: 040 926 267. *D499*

Have Yaesu FT-239R handheld, complete with charger, speaker mie 203R rubber duck, belt-clip and soft case. Would exchange for FRG-7700. Keith. Tel: 0543 360372 (W. Mids). *D503*

Have Realistic PRO-2008 programmable scanner, 68-88, 144-174 and 410-512MHz. Would exchange for R537S airband RX. Also have 28MHz 10W TX, 40 channel f.m. converted from CB. Would exchange for w.h.y? G3FAU. Tel: 0438 352932. *D504*

Have Marconi type B28 receiver and handbook. Also Marconi type H55 receiver and p.s.u., both in good condition and appearance. Would exchange for Daiwa AF606K active filter or Yaesu FRT-7700 a.t.u. or similar. Tel: Wirksworth 2675 (Derbys). *D508*

Have Tandy PRO-32 200 channel handheld scanner, also Fluke model 77 d.m.m. with analogue bargraph, shockproof case, both as new. Would exchange for SX400 or AR2001 scanner. Tel: 0207 544343 (evenings and weekends). *D513*

Have two Sandpiper mini mono-band 2-element beams, 28MHz and 21MHz. Also 144MHz $\frac{5}{8}\lambda$ whip with gutter mount and magmount. Would exchange for h.f. vertical antenna or w.h.y? Tel: 09952 5590. *D523*

Have photographic and radio gear. Would exchange for HRO or BC-348 receiver with electronics in any condition, pristine to scrap, but good condition coil pack. GW3UND. 1 Nantfawr Crescent, Cyncoed, Cardiff CF2 6JN. Tel: 0222 761813. *D530*

Have Heathkit AA1214 High Fidelity Stereo Amplifier, 25 watts per channel, plus a pair of Ambassador speaker cabinets, each containing 12in woofers, 5in mid, 3in tweeter. In mint condition. Would exchange for Sony ICF-2001D. A. Nicoleou. Tel: Gravesend 0474 334997. *D544*

Have AR88LF RX unmodified, plus laboratory standard folded horn enclosure with 15in speaker, weighs 450lb, needs collection. Would exchange for receiver type a.t.u. or w.h.y? Williams. The Torphins, New Street, Deddington, Oxon OX5 4ST. Tel: 0869 38408. *D543*

Have Roberts "Harrods" 4-valve receiver, long, medium, short wave battery portable, working well. Would exchange for s.l.r. camera. G4FFO. Tel: Cambridge 860150. *D545*

Got a camera, want a receiver? Got a v.h.f. rig, want some h.f. gear to go with your new G-zero? In fact, have you got anything to trade radio-wise?

If so, why not advertise it FREE here. Send details, including what equipment you're looking for, to "SWAP SPOT", *Practical Wireless*, Enefco House, The Quay, Poole, Dorset BH15 1PP, for inclusion in the first available issues of the magazine.

A FEW SIMPLE RULES: Your ad. should follow the format of those appearing below, it must be typed or written in block letters; it must be not more than 40 words long including name and address/telephone number. Swaps only—no items for sale—and one of the items MUST be radio related. Adverts for ILLEGAL CB equipment will not be accepted.

The appropriate licence must be held by anyone installing or operating a radio transmitter.

Have Apple 2 Europlus computer with Epson printer, 2 disk drives, green screen monitor, manuals, starter and Applewriter discs. Would exchange for Yaesu FRG-9600, dual-band rig or FT-707 in good working condition. Javed. Tel: 061-792 6067. *D550*

Have Icom R70 h.f. receiver with AT1000 a.t.u. mint and boxed. Would exchange for recent solid state h.f. transceiver plus cash adjustment. Roy G0EWC. Tel: Bristol 776891. *D551*

Have *Shortwave Magazine* world prefix wall map, great circle type. Mint and unused still in postal tube. Would exchange for one or two PT15 valves. All letters answered. Heslop. 75 Alder Park, Brandon, Durham DH7 8TJ. *D552*

Have Altron AQ6-20 2-element mini-beam one month old, was erected but never used, due to complaints. Would exchange for any Airband or 144MHz RX. Must be in mint condition. W. D. Griffiths. 20 Queens Road, Greenfield, Nr. Holywell, Clwyd, North Wales CH8 7JE. *D554*

Have superb Racal RA17L 0-30MHz receiver. Would exchange for smaller RX in good condition, e.g. R600, FT-7700 or w.h.y? Cash adjustment if necessary. Reluctant to part, but need space. Arthur. Tel: 061-624 2808 *D555*

Have Casio 4 octave keyboard with 25 voices plus 16 rhythms and tutors, cost £325. Also R/Finder camera with 3 lenses, filters and flash, plus Aldis projector. All in mint condition. Would exchange for mint FRG-7 or R600 RX scanner or anything of interest to s.w.l. Stan Brierley. 108 Bolton Road, Marland, Rochdale OL11 4QX. *D562*

Have Telequipment D43 dual-beam'scope with manual, AVO 8 MkII, Megger 1000V insulation tester plus TC11A Advance 15MHz counter timer. Would exchange for h.f. a.t.u. Bill G4WUS. Tel: 0287 42596. *D565*

Have FT-780R 430MHz Multi complete with manual, mobile mount and box. All in mint condition. Would exchange for FT-707 or h.f. receiver e.g. R2000, R1000, FRG-8800 or similar. G1SDX. Tel: 0726 66093. *D566*

Have ex-Admiralty B40 receiver 0-30MHz internal mains p.s.u. weighs 100lb. Good working order. Would exchange for smaller general coverage receiver. Tel: 091-5144565. *D579*

Have Tektronix Type 551 double-beam 'scope and power supply, and/orMarconi video camera without turret lenses. Would exchange for h.f. transceiver or receiver, or w.h.y? Tony Thomson. 109 Hyndland Road, Glasgow G12 9JD. Tel: 041-334 6381. *D585*

A large proportion of the readers of this magazine make use of radio transmission and reception as part of their hobby or work. Yet many engineers and technicians are mystified by the subject of radio wave propagation, partly because they think it is necessary to be a mathematical genius in order to understand it. Although an in-depth study certainly involves advanced mathematical analysis, nevertheless anyone who can understand elementary algebra and Ohm's Law can get a good insight into basic propagation theory and in fact will find some of it very similar. What I would like to do in this series of articles is to give an insight into the basics of propagation and show that it's not all that difficult to get a grasp of at least the fundamentals, says A.J. Harwood C Eng MIERE G4HHZ.

Making Waves—A Guide to Propagation

Part 1

How then did the air of mystery arise? The answer to that probably lies in the two words Maxwell's Equations. The mathematician Clerk Maxwell undertook a study of the subjects of magnetism and electrostatics in the late 1800s using as his starting point the previous work of people such as Michael Faraday. This resulted in the set of equations which purport to show certain relationships between electrical and magnetic energy. I say purport because there is still a lot of discussion today about what the equations actually do show. Nevertheless they do give certain information which passes the best engineering test of all. They allow us to make calculations of the expected performance of a system in which electrical power is converted into electromagnetic energy and transported, or propagated, through space. It also enables us to obtain answers which for all practical purposes are correct.

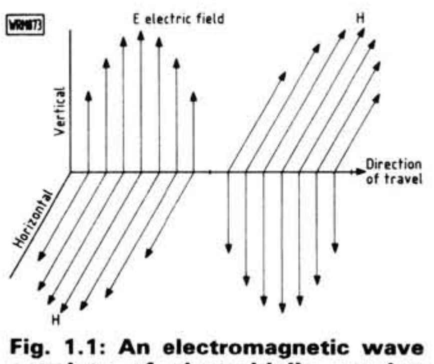


Fig. 1.1: An electromagnetic wave consists of sinusoidally varying electric and magnetic fields. They are in phase and at right angles, propagating with a speed on 3×10^8 metres per second in a direction at right angles to the two fields

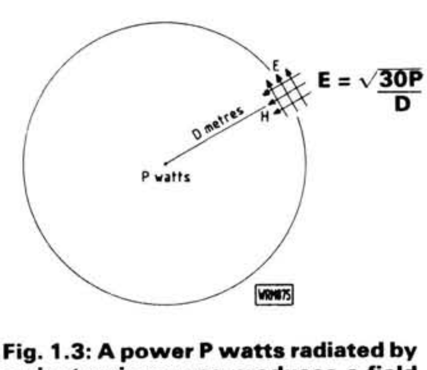


Fig. 1.3: A power P watts radiated by an isotropic source produces a field strength of $E = \sqrt{30 \times P}/D$ volts per metre at a distance of D metres. The power flux density is $P/4 \times \pi \times D^2$

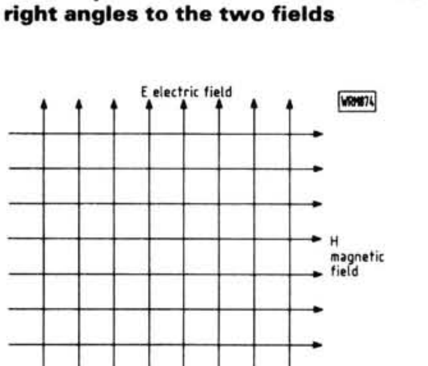


Fig. 1.2: The wave can also be considered as a wavefront with the two fields mutually perpendicular and transporting energy. Here the wave is travelling into the paper and the power flowing is given by $E^2/120 \times \pi$ or $H^2 \times 120 \times \pi$ watts per square metre

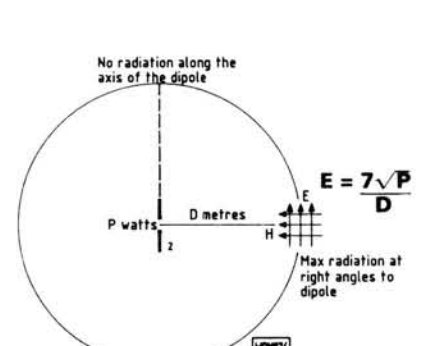


Fig. 1.4: Replacing the isotropic source by a half λ dipole increases the power flux density in the direction of maximum radiation by 1.64. The dipole has a power gain of 1.64 over the isotropic source. The field strength in this direction is $7 \times \sqrt{P}/D$

What then do the equations show, and how can we use them in the real world of radio or television engineering? The first thing they tell us is that any electrical or magnetic disturbance gives rise to a flow of energy away from the site of the disturbance. The energy is "carried" by inter-related electric and magnetic fields which are mutually perpendicular and in a plane at right angles to their direction of motion. If the disturbance is sinusoidal, say an alternating current in a wire, then the two fields also vary sinusoidally with the same frequency as the alternating current. The resultant sinusoidal magnetic and electric fields are also in phase, that is they each reach their peaks and troughs simultaneously. This concept is shown pictorially in the well known diagram, Fig. 1.1.

For a start let's get to know the terminology used in the equations. The magnetic field is usually denoted by H and the electric field by E. For our purposes, these symbols can be taken to mean the r.m.s. values for the case we are interested in, that is where they vary sinusoidally with time and, since they are moving, in space. We also need to use two other numbers if we really are going to get some useful answers and these are the values of the permeability and permittivity of free space. These are usually denoted by u_0 for the permeability and e_0 for the permittivity; the actual values for these are:

$u_0 = 4 \times \pi \times 10^{-7}$ and
$e_0 = 8.85415 \times 10^{-12}$

The value of e_0 is very nearly $10^{-9}/36 \times \pi$ and as this value simplifies some of the calculations (and the error is only about 0.15%) it is the one usually quoted. I've made the assumption that the wave we are looking at is travelling in free space. If it's not, but is in some other substance such as glass or the earth, then the permeability and permittivity need to be multiplied by a factor known as the relative permeability and relative permittivity for the particular substance and the answers given by the equations changed accordingly. It's worth remembering though that for air these relative values are each one for practical purposes and so we can assume that the free space answers are correct.

Let's have a look at some of the relationships Maxwell derived. These are:

(1) The amount of magnetic energy contained per cubic metre of space is equal to the amount of electrical energy. This is denoted mathematically as:

$$E^2 \times e_0/2 = H^2 \times u_0/2 \text{ joules}$$

The total energy contained in a cubic metre is therefore $E^2 \times e_0$ which is equal to $H^2 \times u_0$.

(2) The velocity of propagation (the speed with which the waves move away from the disturbance) is:

$$1/\sqrt{u_0 \times e_0} \text{ metres per second}$$

Inserting the values for e_0 and u_0 given previously shows that the velocity of propagation is 3×10^8 metres per second, which is the speed of light as shown by measurement.

One other quantity worth consideration is the ratio of the electric to the magnetic field, E/H. The units in which the fields are measured are volts per metre for E and (surprise, surprise) amperes per metre for H. The ratio E/H is therefore in units of volts divided by amps, which we all know is in ohms. Now by simply rearranging of equation (1) we get:

$$E/H = \sqrt{u_0/e_0} \text{ ohms}$$

Once more, by inserting the values of u_0 and e_0, we arrive at a value of $120 \times \pi$ or 377 ohms. This is often referred to as the characteristic impedance of free space. It is important in propagation as it enables us to calculate the power being transported by an electromagnetic wave. Once again those equations show the way since they tell us how much energy there is in a cubic metre of space and the speed with which it is moving; if we multiply these together, then we know how quickly the energy is moving through a square metre of the wavefront. That is the power flowing through that square metre, known as the power flux density. It is given by:

$$\frac{E^2 \times e_0 \times 1}{\sqrt{e_0 \times u_0}} = E^2 \times \sqrt{e_0/u_0}$$

$$\text{or } \frac{H^2 \times u_0 \times 1}{\sqrt{e_0 \times u_0}} = H^2 \times \sqrt{u_0/e_0}$$

and, as we have seen,

$\sqrt{u_0/e_0} = 120 \times \pi$ so we get
$E^2/120 \times \pi$ or
$H^2 \times 120 \times \pi$ watts per square metre

Now we can see the similarity to Ohm's Law which shows that the power dissipated in a resistor is V^2/R or $I^2 \times R$, (remember $120 \times \pi$ is 377 ohms).

So what happens in a real transmitting situation where a transmitter is connected to an antenna and radiates waves? To make life easy for ourselves let's put our system in space where we can safely assume that the antenna radiates equally in all directions, what is referred to as an isotropic source. Now if it really is omnidirectional then the field strength at any point on the surface of a sphere (with the radiator at its centre) must be the same, also the power flowing through each square metre of the sphere's surface must also be the same. For a sphere of radius D metres and a transmitted power of P watts the total power passing through all the surface must also be P since there is no other power available. The surface area of the sphere is $4 \times \pi \times D^2$ metres and the power per square metre, as we know is $E^2/120 \times \pi$. So we get:

$$P = (E^2/120 \times \pi) \times 4 \times \pi \times D^2 \text{ watts}$$

$$\text{so } P = E^2 \times D^2/30$$

$$\text{or } E = \frac{\sqrt{30 \times P}}{D} \text{ volts per metre}$$

This result tells us some interesting facts about wave propagation. First, in free space, propagation is entirely independent of frequency; for the same transmitting power, the field strength and power flux density (the power flowing through each square metre of the wavefront) of an l.f. signal is the same as that of a s.h.f. transmission at the same distance from the transmitter. Secondly, the attenuation, the rate at which the power flux density reduces, is inversely proportional to the square of the distance. This means doubling the distance between the receiver and transmitter results in half the field strength or a power flux density of one quarter. Finally we can see the not unexpected result that the field strength is proportional to the square root of the transmitter power; increasing the transmitter power by a factor of four doubles the received field strength.

A More Practical Case

Before closing the first chapter of the saga let's consider the more practical case where the antenna is a half wave dipole. Again a rigorous mathematical analysis is really required. However if we are simply prepared to accept the results then all is easy; the result is that in a direction at right angles to the dipole's length, for a given power, the field strength is the same as that which would be obtained with 1.64 times the power applied to an isotropic source. We can think of the dipole as having a power gain of 1.64 times over the isotropic source in the direction at right angles to its length. Of course we don't get something for nothing and in some directions the dipole field strength is less than that of the isotropic antenna; it has a directional radiation pattern. In fact if we repeated the exercise of adding all the power flowing through the sphere, this time with the dipole at its centre and taking account of the fact that the field strength would be different for different parts of the sphere's surface, we would get the actual transmitted power.

So we can now say for a dipole the field strength in the direction of maximum radiation is given by:

$$E = \frac{\sqrt{30 \times 1 \times 64 \times P}}{D}$$

$$\text{or } E = \frac{7\sqrt{P}}{D} \text{ volts per metre}$$

which isn't too hard to remember. It is of course possible to build antennas with even more gain. If the power flux density resulting from a given power is G times greater than that resulting from the same power into a dipole then the antenna is said to have a power gain of G times with respect to a dipole. We can also say that the effect of radiating power P from an antenna of gain G (with respect to a dipole) is the same as radiating power $P \times G$ from a dipole. $P \times G$ is referred to as the effective radiated power or e.r.p. So the field strength is calculated from:

$$E = \frac{7\sqrt{\text{e.r.p.}}}{D} \text{ volts per metre}$$

of if we have D in kilometres:

$$E = \frac{7\sqrt{\text{e.r.p.}}}{1000 \times D} \text{ volts per metre}$$

As an example let's see what the field strength is from 1 watt e.r.p. at a distance of 1 kilometre. This is:

$7\sqrt{1}/1000 = 0.007$ volts per metre
or 7 millivolts per metre.

We now know how to calculate what the field strength is for a given power at any distance from a dipole or antenna with a gain compared to a dipole (although don't forget we're still in free space) and how much power there is flowing in the wavefront.

In Part 2 we'll find out how to get the energy out of the wave and into the receiver.

PW REVIEW

Interested in RTTY and looking for a cheap way to get started? Mike Richards G4WNC reviews this program and interface from Technical Software which could be the answer for you.

The TX-3 transceive program is available for the BBC B and Commodore C-64 computers and enables the transmission and reception of RTTY, c.w. and ASCII with or without a terminal unit. The review program was supplied on disk for a BBC B, but I understand that the C-64 version is very similar.

One of the main problems facing amateurs who would like to try RTTY, is the costs involved. A modern RTTY station would normally comprise a computer with a RTTY decoding program, a terminal unit and tuning indicator, all this is in addition to the transceiver. When using the TX-3 program the terminal unit and tuning indicator are not required, which can lead to a significant saving.

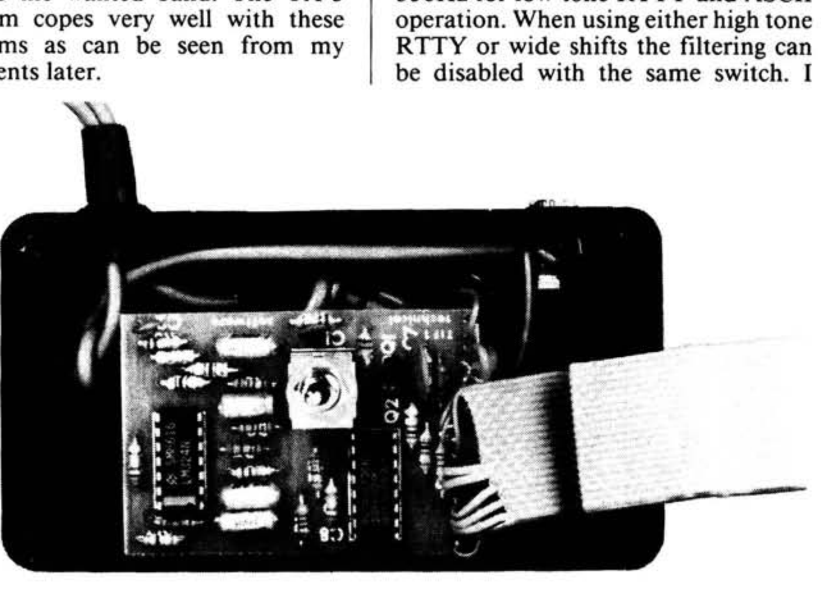
For those of you not familiar with RTTY terminology, the terminal unit is used to convert the received RTTY tones into a d.c. signal which can be processed by the computer.

You may well be thinking, how can you get by without the terminal unit, well, the secret is in the software. With some clever programming it is possible to monitor a computer input port and detect the presence of a particular tone. This direct detection technique is used in the Technical Software program. It may sound too good to be true and, to a certain extent, this is the case as there is always a catch. The main weakness with this technique is generally inferior noise immunity which can lead to problems receiving weak or noisy signals. The problems can be minimised by incorporating some external audio filtering to remove noise and signals outside the wanted band. The TX-3 program copes very well with these problems as can be seen from my comments later.

Connections

There are several options for the connection between the computer and the transceiver. The first and most difficult is to attempt direct connection. In order to achieve this the received audio from the transceiver needs to be presented to the computer as a 5V square wave. The tone output from the computer also needs to be reduced in level and finally the p.t.t. line needs to be buffered before connection to the transceiver. It is important to note that when connecting external equipment directly to the computer the applied voltage must be limited to +5V maximum in order to avoid damaging the computer.

The second option is to use the TIF1 interface which is available from Technical Software. This interface takes care of all the interfacing problems and makes connecting-up a simple operation. The interface is supplied with a lead and a 3.5mm jack for connection to the external speaker socket on the transceiver. A second screened lead has connections for the microphone input and the p.t.t. line whilst a third lead has a 6.3mm jack plug which is connected to the key jack on the transceiver. A ribbon cable with an IDC plug is used to connect the interface to the computer user port. As well as making the connection easy, the interface also includes some very effective filtering to improve the performance when receiving poor quality signals. The bandwidth of the filtering can be set to either 150Hz for c.w. or 350Hz for low tone RTTY and ASCII operation. When using either high tone RTTY or wide shifts the filtering can be disabled with the same switch. I found the bandwidth of the filters to be level dependent and the best performance was obtained with an input level of about 100mV.



The final option enables a conventional terminal unit to be used with this program. Connections here are very simple as all the signals are at t.t.l. level so providing your terminal unit accepts these levels all should be well. In order to activate this option pin 10 on the computer used port needs to be grounded.

Operation

Once the program has been loaded a split screen is displayed, with the top line showing the Technical Software logo. The following 11 lines display the received text, whilst the middle and bottom lines are used as status lines to inform the user of all the program settings. An essential feature of any modern RTTY program is a type ahead buffer and this is displayed on the remaining 11 lines. For those of you not familiar with the term, a type ahead buffer is used to start compiling your reply whilst the other station is still transmitting, which makes for a smoother flow of information. The screen width is set to 40 characters which gives a nice size of text, the only minor disadvantage being that this is different to the standard width used by teleprinters.

The status lines are very comprehensive and as well as details of the current shift and speed include a rather ingenious tuning indicator. To the right of the centre status line is a pair of horizontal bars, the left hand bar is used as a reference whilst the right hand bar can move vertically. This vertical movement is proportional to the received input frequency. In order to tune-in a RTTY signal, the transceiver is tuned so that the right hand bar moves equally about the reference bar, very neat! One other useful feature on the status line is a 24 hour clock which is available for automatic inclusion in the transmission or review store.

The review store is a novel feature which automatically stores both sides of a QSO. The contents of this store can be recalled to the display or alternatively saved to disk or tape for later retrieval. The review store is 11.75K long in the disk version and 14.5K in the tape version, so a lot of text can be stored. When the review store is nearly full a warning in the form of a flashing Q appears on the status line, this changes to a steady Q when the buffer is full. Once the buffer is full text storage still continues, but with the current text overwriting the earliest text thus ensuring that the last 11.75K or 14.5K is safe.

The program can handle a good range of shifts namely 170Hz (European low tones), 170Hz (American high tones), 425Hz and 850Hz. The change of shift is achieved using the function keys and the tuning indicator is automatically adjusted to match the chosen shift which is very useful. The program has all the usual facilities to invert data, unshift-on-space and force a letter or figure shift.

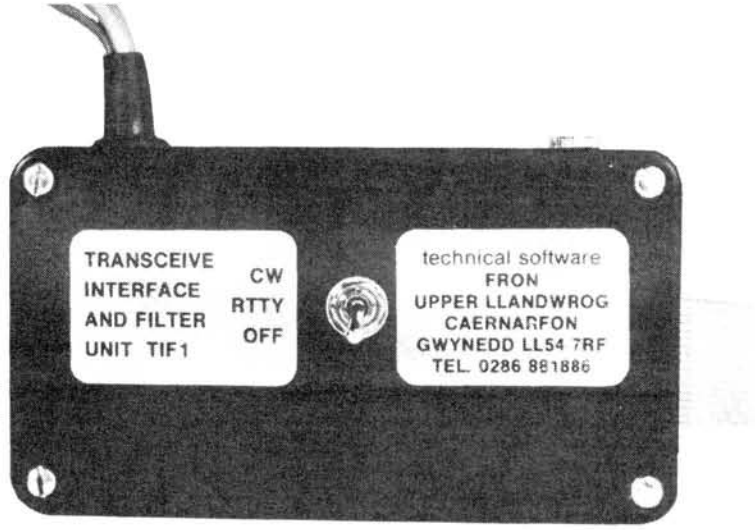
The TX-3 program has been set up with seven fixed baud rates as follows: 45, 50, 75, 100, 110, 150 and 300 baud.

The facility to store regularly used information is available in the form of 25 user programmable memories, each of which can store up to 159 characters! Some of the memories are preprogrammed with common messages, for example memory Y has RY's and memory T is updated very minute with the time from the system clock. One point I particularly liked was that the contents of any memory could be edited using the normal BBC editing keys rather than having to re-enter the entire text.

Transmit/receive switching is achieved with control T or control R, though a useful facility is the inclusion of a c.w. identification by using control I to switch from transmit to receive.

Teleprinter operators will be pleased to hear that the default line length is 69 and that this program automatically sends all the correct shift, line feed and carriage return combinations to ensure good copy on a teleprinter. For those computer users who don't realise the significance of that, a teleprinter only performs a carriage return or line feed when these characters are received. Consequently if one or both of these characters is missing, either one line is printed on top of the last or you end up with a black blob at the end of the line where several characters have been printed on top of each other! Both of which aren't much use.

When answering a CQ call, the callsign capture facility can be quite useful. This feature searches the received text for an alpha-numeric combination which could be interpreted as a callsign and stores the result in memory J. Whilst searching a flashing C appears on the status line, this stops flashing when a callsign has been captured. Obviously this technique is not fool proof, so it would be wise to check the contents of memory J before use.



The facility to transmit and receive ASCII is a useful feature as this mode is becoming more popular with the spread of multi-mode terminal units. the main functions of transmit/receive switching, memories, etc. operate in the same manner as RTTY, the differences occur in the setting of parameters. Whereas the format of RTTY is fixed at 5 information bits and 1 or $1\frac{1}{2}$ stop bits ASCII has a few more variables. The options available are: text/binary mode, 7 or 8 data bits, 1 or 2 stop bits and parity which can be odd, even, mark, space or off. The text/binary mode needs a little explanation, text mode is the one normally used and results in all error free characters being printed on the screen. Parity errors are displayed as a square block and framing errors are not printed. The binary mode is intended for the transfer of computer data i.e. programs. When in this mode the received data is sent to the review store only and not displayed on the screen, any parity or framing errors are shown as a P or F on the status line.

The c.w. transceive mode uses the same program controls as RTTY for selection of memories, etc. When receiving c.w. the program automatically tracks the speed of the incoming signal and the upper limit of this tracking can be set by the user. Once the program is successfully receiving a signal the speed can be locked to prevent the program trying to track any QRM that may be present. The software filters have been made user programmable and enable the selection of the best sidetone frequency to suit your transceiver and hence optimise the performance.

Performance

The direct detection technique employed in this program performed remarkably well and compared favourably with a conventional filter type terminal unit. For best performance I would strongly recommend using the TIF1 interface. The overall performance can be further improved by utilising any i.f. or audio filtering that may be available in the transceiver. When used with a conventional terminal unit the program performed very well and in this case the performance is limited by the terminal unit rather than the program. I found that the facility to save the user programmable memories to tape or disk was very useful as you could set up several different sets of messages to cater for h.f., v.h.f. and contest work.

Overall I think this program would make a good starting point for anyone interested in RTTY/ASCII and the option to include a conventional terminal unit means that the program will still be usable if you should decide to upgrade.

The TX-3 program and TIF1 interface are available from **Technical Software, Fron, Upper Llandwrog, Caernarfon, Gwynedd LL54 7RF.** The TX-3 costs tape £20 or disk £22 and the TIF1 kit £15 or ready built £25. My thanks to Technical Software for the loan of the review sample. ***PW***

SWAP SPOT

Have Master 128 computer with disk drive, Teletext adaptor, A.M.X. mouse and over £600 worth of software plus books, etc. Would exchange for Yaesu FRG-8800 receiver or FT-757GX transceiver, must be in good condition. Tel: Mark. 0222 830508. *D589*

Have 14-element Parabeam, 13.7dBd, varnished. Would exchange for lightweight rotator and control gear or small frequency meter or w.h.y? G1OLR. Tel: Sunbury-on-Thames 787628. *D593*

Have Mullard QQV03-20A valve and base plus 6L6G, 6V6GT. Would exchange for a copy of handbook covering the CT52 oscilloscope. Tel: Worcester 641759, evenings. *D594*

Have Spectrum+ computer with Datacorder in addition to JEP Electronics and Technical Software tapes, plus Scarab system Nite 2 filters. All boxed and nearly new (worth £200). Would exchange for general coverage h.f. receiver. Tel: 0282 815224. *D607*

Have Trio TS-811E 430MHz multimode base station (curent price £1099). Would exchange for FT-790/FT-690R/FT-290R, or combination of these with cash adjustment or w.h.y? Chris Baker. Tel: 0782 46570. *D612*

Have Cossor Telecheck Model 1322 with manual. Would exchange for marine v.h.f. receiver. Tel: Brixham 08045 4744. *D619*

An Open Letter to the RSGB

K. A. Cradock-Hartopp G4PZR, Chairman of the RNARS, gives his views on the way forward.

Sir

Having listened over a long period to a high level of gripe on local nets and repeaters in the Midlands and South West, and from many conversations, it would appear that there are large numbers of licensed amateurs who are more than disenchanted with the National Society, and who are not reluctant to broadcast the fact.

I have recently, at my request (I am a retired consultant), and as Chairman of one of the two largest affiliated societies, carried out an impartial and indeed critical enquiry at Presidential and Chief Executive level into the workings of the Society.

Unacceptable as it will seem to the doubters I have to say that the shortcomings complained of are largely, if not entirely due to the members themselves.

I wonder how many members have actually read the Society's Articles of Association which are the terms under which the Society has to operate, and which were originally written in 1922.

In them under "Structure of the Society" will be found the job specification for the Council and for the Secretary. The Council's responsibilities list, inter alia, that it will "manage the affairs of the Society". The Secretary is required to summon council meetings, notify members of their election, and to countersign documents to which the seal has been affixed—and nothing else. The post is filled by the General Manager. No mention is made of the Chief Executive or General Manager and there is no job specification for either given in the Articles of Association.

I suggest as a manager of 20 years' experience that the affairs of the Society, of ever-expanding subject coverage, cannot be "managed" by a Council which meets every two months, with a President, however distinguished, who serves for one year only. Neither in any event can it be managed by a Council, declared to be democratically elected, but whose individual management experience is in some cases virtually non-existent. Do not be misled that I am a candidate for Council, but instead be quite sure that candidates management expertise is not stated on the ballot forms but, perhaps, the standing of a candidate's sponsors may have some "clout". Just because a person is good on the key, writes a good article, runs a good net or is generally a good fellow does not mean that he/she is competent to contribute to the Society's management, but if such criteria (as seems likely) are the current basis for candidates' sponsorship Society members have absolutely no right to complain having brought the management failure situation upon themselves. However before leaving the point I have to say that it doesn't apply to all Council members as there are some who pull their weight.

The most frequently ventilated complaint is "I wrote in and never got a reply". Fair comment, I reckon, having suffered this one often myself. Just for the record, though, HQ, has sent out three quarters of a million items of mail in the last year (about 21 per member) and its master file copies for one week's handwritten letters fills two full size box files, with the computer-written letters filling a further one (I have seen them). There is a computer-held file of 350 standard reply letters which is accessed by all staff for regular enquiries, but which of course cannot answer the oddball queries. Incoming mail and telephone calls often total 1000 a day together.

The second and wholly justified complaint is "Who deputises for the Chief Executive when he is away on business or his (rare) holidays?" The answer is straightforward—Nobody.

The day-to-day administration of the HQ itself is now firmly in the hands of an HQ Manager appointed for that purpose, but the continuity and in-depth handling of all matters political and technical with which the Society is involved remain in the hands of the Chief Executive alone. There is no one else on the HQ staff who is qualified, other than to "hold the fort", to accept delegation and maintain continuity in his absence. In addition to the day-to-day business of the Society the Chief Executive has to take back situations and problems which have been referred to Council and which have been "shrugged off" undecided, and which cannot be allowed to disappear.

Dealing with, and endeavouring to obtain results from Government Departments currently occupies the Chief Executive for two whole days each week. Those who have not experienced this work will perhaps accept the analogy that Government Departments are like dry sponges, which accept a vast amount of input but which have to be squeezed to obtain output. Such is the case with the DTI, with no disrespect to any individuals in it, but to get significant progress it is necessary to camp on the doorstep (so what happens to the rest of the Society business meanwhile?). Those who doubt these words should take note that the Government controls the UK ether as it thinks best, and certainly not always as we wish or need, and those who will not support the National Society in its endeavours by becoming members—about 47 per cent of licensed amateurs—give the Government very good reason to ask why we need so many frequencies for such a small proportion of the licensed amateur population—for it is the National Society which negotiates them.

Turning to finance it is said that the National Society could be far more efficient on its present income of roughly £1 million a year. Members can make their own judgement from the Society's accounts published every year, but this judgement cannot be more than a general one as there is no backup to the accounts in language which laymen, like me, can understand.

For instance, what does it cost to run a large data bank and a 20-station computer installation? How many people are there on HQ staff and how many are of executive status? Does the Society pay above or below the level with the local/national average for the job? (It pays lower in fact, but nobody tells us). What was last year's postage bill/phone bill?

There is now a new accountant and a procedure which enables expenditure to be reviewed by Council as it is happening rather than as a fait accompli in the annual accounts. All this does not tell us why £1 million is insufficient to permit further management recruitment and development, but nevertheless it is the critical factor, as it usually is in members' household budgets, and certainly in mine!

So after all this what is really needed to put the Society on a proper basis and able to handle all matters political, technical and administrative which concern its members and the cause of amateur radio?

There are four principal requirements:

1. To make the Council do what it is supposed to do, i.e. manage the affairs of the Society. Alternatively confine its activity to general policy and transfer the management of Society affairs to the control of a Director General. Rewrite the Green Book, update the constitution/structure and hold the required EGM to approve it.
2. To recruit two additional executives of quality and experience (qualifications?) to share the load as described later.
3. To raise enough money to pay them, again described later.
4. To establish local Society liaison officers throughout the UK.

Other requirements are minor in comparison, but the four listed need amplification.

1. The Council is discussed earlier, but it is the Society members themselves who must see to it that they are competently represented on it. It would not be difficult to arrange for Affiliated Clubs to be grouped together by area throughout the UK and for each group to sponsor council candidates, rather than ten assorted individuals as at present. This would indeed be a truly democratic system. Should a Director General be given the responsibility he/she would report to Council at its meetings.
2. Two executives are necessary with responsibility as follows:
   A. To have total responsibility for the Society's dealings with Government, Continental, EEC and worldwide controlling authorities.
   B. To be responsible for liaison with, and monitoring of the (now) 17 Society Committees, and to ensure that matters referred to them are properly processed. To have a "training" portfolio which should include proper guidance to prospective radio amateurs, committee members, and perhaps council members. To be the public relations executive who will put out to members details of what is going on, what difficulties exist politically, what members can do to help the Society and themselves, and to contribute his/her piece for *Radcom.*
3. It may be horrifying to those of us on fixed incomes or retired pensions (I am one) but it is a fact that executives of the standard we require (and not the "top" at that) command salaries of £20,000 a year. You get what you pay for and you need to keep what you get or, like the Civil Service, regular or irregular changes result in a high "start again" factor which we cannot accept. It seems the only way to fund two executives is to raise the annual subscription to £20. Before people dismiss this just consider whether this sum, which amounts to the cost of a pint of beer (at 75p) per fortnight throughout the year, is a reasonable price to pay for the protection of our hobby and some services. What, for example, do our local bowls, tennis, golf or social clubs charge?
4. I see that an organisation of this sort is now proposed. My own society has already implemented it for its own use. It can only help with the workload, and surely a local liaison officer could be asked how to connect up a microphone rather than the National Society—this actually happened!

In conclusion it may be thought that the writer has been "got at" and hence his somewhat forgiving written attitude. This is quite untrue to the extent that he resigned from the Society in disgust when matters continued in chaos, but has now rejoined if only to give him the right to comment.

However members who are keen to criticise but unwilling to do anything else may care to accept the writer's suggestion to back their criticism by putting some of their spare time and energy where their mouths are.

Yours sincerely
K. A. Cradock-Hartopp G4PZR

Directional Couplers

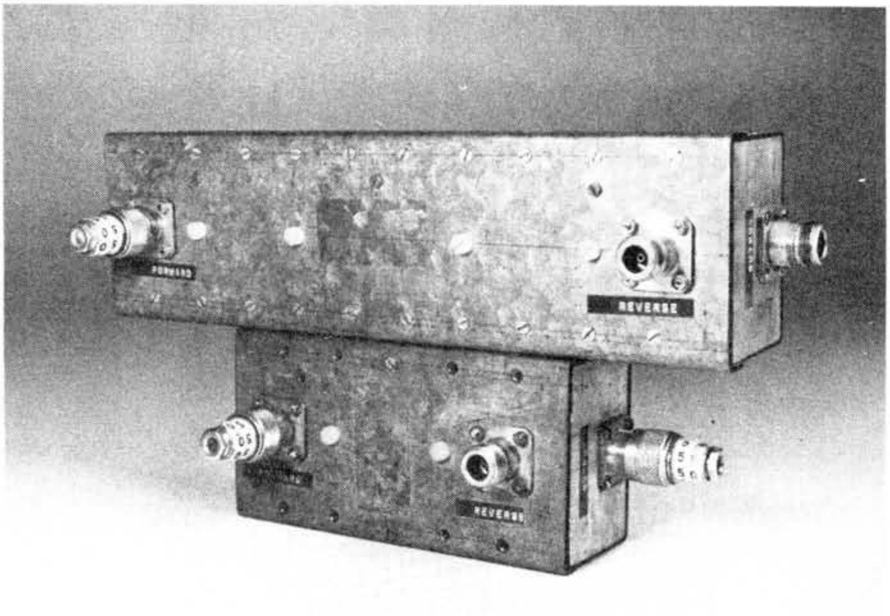
The measurement of reflected r.f. power is very important to anyone dealing with transmitters, amateur or professional. In this article Robert and David Crone explain some of the mysteries of directional couplers and give basic design data with the emphasis on the practical side of things.

There is no problem about measuring forward and reverse power in the antenna feeder—a simple device called a directional coupler is used. For the practical designs in this article only air-spaced strip-line couplers have been considered since these are quite large and hence the ordinary constructor has a sporting chance of achieving the close mechanical tolerances required. Also the frequency range has been restricted to 30MHz to 1GHz—below 30MHz the couplers become too long to handle while above 1GHz the strip-line spacing starts to become a significant fraction of a wavelength and the performance deteriorates.

Probably the best starting point is to look at the basic situation where r.f. power is transferred from a generator to a load via a length of coaxial cable. Fig. 1 shows the set up. It is called a 50 ohm system because we are sending power from the generator into the 50 ohm load through the 50 ohm coaxial cable. The load could be a simple 50 ohm resistor, an antenna, the grid circuit of a transmitting valve or many other things. The generator could be anything from a high-power transmitter down to a laboratory signal generator.

50 ohm cables range in size from the miniature 3mm diameter to the giant 155mm broadcasting feeders. However, most of us will go through life only ever having to deal with two types of coaxial cable. The thin, black, flexible type RG214/U used for test leads or interconnections and the thicker, more rigid RG213/U, similar to UR67, which can carry significant amounts of r.f. power.

There are two vectors shown in Fig. 1, V_f denotes the voltage being applied to the line and V_r represents the reflected voltage. Now in real life we don't go around drawing vectors, we deal with actual voltages and powers, which brings us to the simple, but well known formula: Power = V^2/R.



Reflection Coefficient

In our case R is 50 ohms, so that if we are sending 1 watt of power down the line the generator output must be 7·1 volts. Now suppose that 0·71 volts were to come back down the line. Obviously this is one tenth of the forward voltage and we say that the **reflection coefficient** is 10 per cent. Reflection coefficient is a key term and is usually abbreviated to r.c.

Matching

At this stage you might begin to wonder how the reflection coefficient can be measured. If the frequency was 30MHz and we looked at the output of the generator with an oscilloscope we would see just the 30MHz waveform—the 'scope cannot differentiate between the forward and reflected components in the signal. However, it is possible to build a device which is direction sensitive and can tell which parts of the signal are going up or down the line. It is called a directional coupler, but before going on to describe one we will have a further look at matching and the sort of figures involved.

Return Loss

We have already come across the term reflection coefficient—the ratio of forward to reflected voltages. Now, when voltage is reflected back down the cable from the load it means that power is being lost, the wasted power being returned to the generator and is known as the **return loss**. Return loss (r.l.) is expressed in decibels and it must be emphasised very strongly at this point that return loss and reflection coefficient are a measure of the same thing. The return loss is simply $20(\log_{10}$ r.c.). So that a 10 per cent r.c. is the same as a 20dB r.l.

Many old timers, like the authors, still think in terms of reflection coefficient, but return loss is widely used as many modern measuring instruments have dB scales. Table 1 shows a few key values of r.c. and r.l.

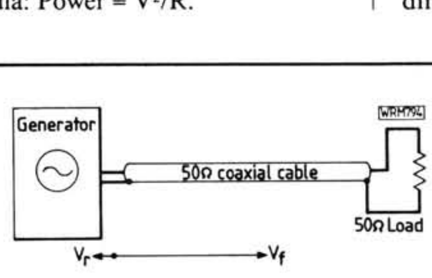


Fig. 1

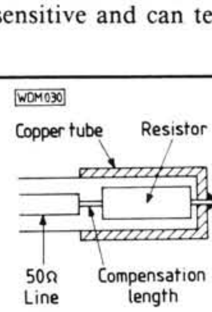


Fig. 2

r.c. (%)	r.l. (dB)
30	10
20	14
10	20
5	26
1	40

TABLE 1

It is difficult to say what is a good match as it depends on the circumstances. A 10 per cent r.c. means that only 1 per cent of the power is reflected from the antenna. This is the sort of figure that you would be looking for if you were dealing with a high power broadcasting transmitter. A typical return loss for the grid input of a small transmitting valve or low power antenna would be 14dB. Anything below about 8db r.l. or 40 per cent r.c. is generally regarded as a bad match, especially if you are dealing with any sort of power, for at certain points on the cable the reflected voltage will be in phase with the forward voltage causing a condition known as a standing wave. This could burn out the cable or blow very expensive r.f. output power transistors.

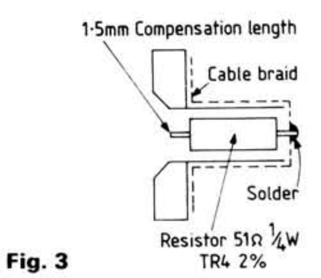


Fig. 3

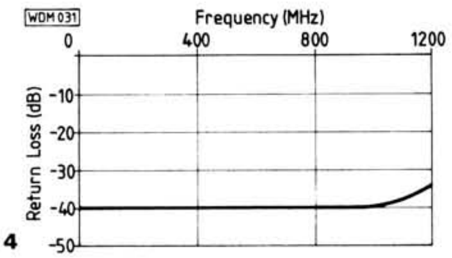


Fig. 4

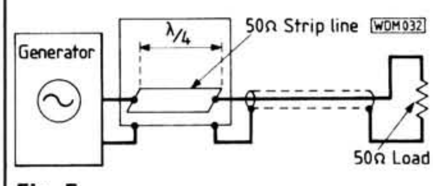


Fig. 5

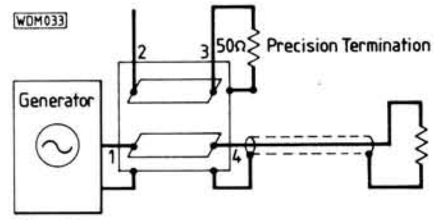


Fig. 6

Perfect Match

A 1 per cent r.c. or 40dB r.l. is usually taken to be a perfect match for the simple reason that it is about the limit of measurement accuracy with conventional equipment. Some manufacturers make precision terminations which are small low-power loads that can handle about 500mW of power and have an r.l. of better than 40dB up to several gigahertz. These terminations are constructed by inserting a 50 ohm resistor into a copper tube as shown in Fig. 2. The arrangement behaves as a very lossy length of transmission line which absorbs the applied r.f. power. Note that the tube inner diameter is only slightly greater than the resistor diameter. This gives rise to a capacitive component which is cancelled out by an inductive piece of wire called the compensation length.

By a stroke of luck it was discovered that the earthing sleeve of a Greenpar "N" connector type GE15055C10 was almost the critical diameter for a ¼ watt 51 ohm 2 per cent TR4 size metal oxide resistor.

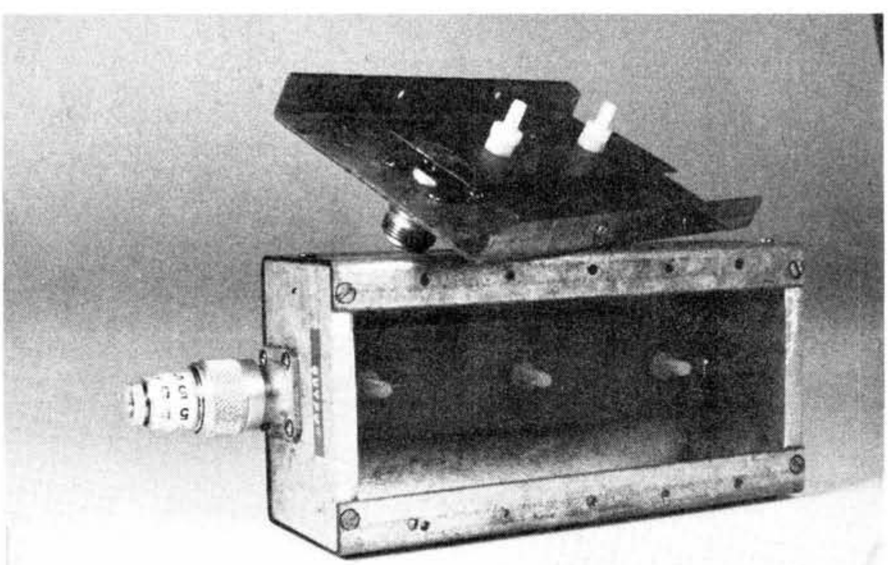
The arrangement shown in Fig. 3 is slightly capacitive, but the compensation provided by the residual 1·5mm length of resistor lead is enough to give a return loss of 34dB at 1250MHz. The actual construction of this termination is not that much more difficult or even different in putting the connector on the end of a coaxial cable. Fig. 4. shows typical return loss figures obtained in practice for the set up of Fig. 3.

The connector companies with their precision engineering facilities can make far better terminations than us. However, you have to pay for precision and what if you burned it out by mistake? This brings us to the difference between a precision termination and a test load.

A termination is a 50 ohm reference. It is not designed to absorb power, although most have a ½ watt rating. A termination should have a return loss of better than 40dB over a very large bandwidth. On the other hand the sole purpose of a test load is to dissipate power and the r.l. is only a secondary consideration.

Strip Lines

One might wonder why so much has been said about the precision termination. Well, that's because it's an integral part of the directional coupler, which won't work without it. Now the way is clear for us to move on to directional couplers, and the first step is to take a look at air-spaced strip lines.



The strip line is simply a strip of copper situated above an earth plane, usually the bottom of a metal box. For a 50 ohm line the ratio of the width of the strip to the distance above the earth plane is exactly 5, so that if the line is placed 6mm above the earth plane it will have to be 30mm wide to achieve 50 ohms. The newcomer to strip lines will probably be surprised at the large width of the strip.

Fig. 5 shows a strip line situated in the bottom of a metal box. The signal from the generator passes along the 50 ohm strip line and into the coaxial cable, and the introduction of the length of strip line has not made any difference to the operation of the circuit.

Note that we have deliberately made the length of the strip line a quarter of a wavelength, so that if the generator frequency is 300MHz the strip line will be 250mm long. The next step is to put another 50 ohm strip line in the top of the box and connect one end of it to a precision termination as shown in Fig. 6.

The two strip lines are running parallel, or broadside to each other and you would be right to think that a small amount of the main signal will be picked up by this second strip line. For example, if the generator is producing 7·1 volts and we measure 0·71 volts at Point 2 then this is one tenth of the main signal or 20dB down, and the coupling factor is −20dB.

The interesting thing is that with the termination on Point 3 only the forward power is picked up at Point 2. If the load was a perfect match at exactly 50 ohms no power would be reflected back to the generator. If we move the termination to Point 2 and measure the voltage at Point 3 we would find it to be zero, and we have a directional coupler.

Back to the real world. If we measure 0·71 volts at Point 2 and 0·071 volts at Point 3 the ratio of the two voltages is 10 and this is the **reflection coefficient** of our system. The 0·71 volts at Point 2 also tells us that the forward voltage is 7·1 volts since in this case the coupling factor is 10 per cent. Hence the directional coupler gives us two very important measurements—power and reflection coefficient.

A Practical Design

So, can we construct a coupler with a known coupling factor? The answer is yes, and there are three dimensions involved—the depth of the box D, the spacing between the two lines S and the width of the strip lines W, as shown in Fig. 7. Table 2 gives the ratios of W/D and S/D for three values of coupling factor (c.f.). Note that the strip lines are not exactly 50 ohms and this is to be expected because of the effect of the coupling between them.

Most of the writers' prototype couplers were made inside short lengths of 75 × 50mm steel electrical trunking which as an internal depth of 49·2mm. It is the length of the coupling loop that determines the coupler frequency response and the graph (Fig. 8) shows the figures for a 235mm coupling loop. For a 20dB coupler, S and W are equal, in this case 33·3mm. Simple arithmetic gives the strip line height as 7·95mm,

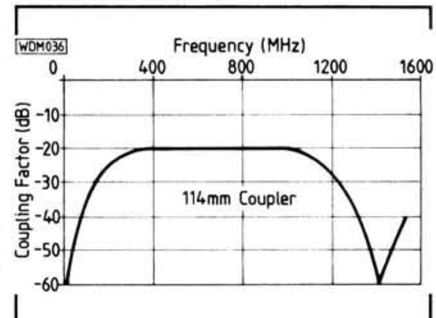


Fig. 9

and the strip lines were firmly bolted to the trunking with 2BA Nylon nuts and bolts. The trunking lid was fastened with dozens of 6BA steel screws into tapped holes and the ends were closed with 6mm aluminium plates. At v.h.f. and u.h.f. any device must be mechanically rigid and you can never have too many nuts and bolts!

Note that the curve labelled **"directivity"** in Fig. 8 is the **figure of merit** for

c.f. (dB)	W/D	S/D
−14	0·90	0·56
−20	0·68	0·68
−26	0·50	0·80

▲ TABLE 2

the coupler, and is simply the voltage at Point 3 divided by the voltage at Point 2 when a perfect 50 ohm termination is applied to the output at Point 4. The bandwidth of the coupling loop is large, in fact the 3dB points are over 400MHz apart. However, when the coupling loop becomes a half-wavelength, at 650MHz, there is no output at all. Watch the power! If you are measuring reverse power and the transmitter is running 100 watts then with a 20dB coupler there will be 1 watt dissipated in the precision termination which will eventually burn out. In this case you would be strongly advised to use a 26dB coupler. Fig. 9 shows the coupling factor for a 114mm coupling loop. The 114mm coupler is the one which appears in the photographs as it is the smallest of the prototypes and thus best suited to photography.

Finally, returning to the 1 watt situation with a 10 per cent reflection coefficient, how are we to measure the 710mV at Point 2 and the 71mV at Point 3? No problem—build a good quality r.f. voltmeter, linear down to 30mV and capable of operating up to 1GHz. Hopefully this project will be the subject of a further article. ***PW.***

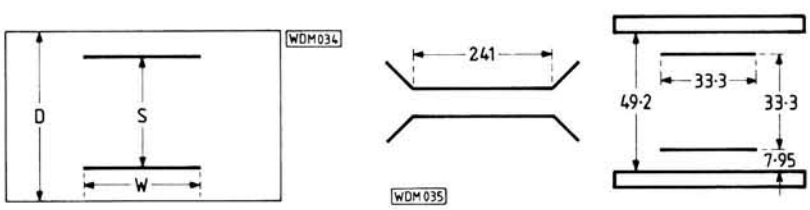


Fig. 7

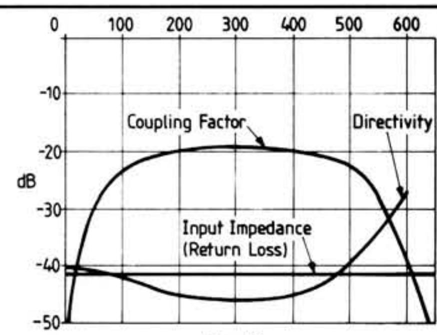


Fig. 8

ERRORS & UPDATES

PW "Blenheim" September 1987

The tapping point on L6 is made 1½ turns from the end nearest R17. The capacitor above L4 in Fig. 3 is C11 and not C1 as marked, also capacitor C12 is 5.6pF and not 5.8pF. Additionally, the SBL-1 mixer must be positioned so its blue reference pin connects to C7. Apologies to Bryan Robertson for getting his name wrong.

PAST GEMS

Odds and Ends

Practical Wireless September 24, 1932

Camouflaging the Loud-Speaker

No doubt many listeners have felt on occasions that the loud-speaker could be less obtrusive, and some manufacturers have also felt the same thing as is evidenced by more than one design. On the Continent some quite ingenious ideas have been developed to dispense with the orthodox form of loud-speakers in order not to mar the appearance of a room furnished in the ultra modern Continental style. To assist readers who would like to experiment in this direction we may mention the following ideas:

The sounding board of a Piano (that is the portion below the keyboard) will be found roomy enough at one end to accommodate a fair sized speaker. Provided this does not deal with too much power, the slight vibration of the piano strings which is set up will add tone to the reproduction. Naturally, if too much volume is used, the reproduction will suffer.

Some forms of easy chair or settee will have room at either the back or under the seat to take a moderate size of cabinet-speaker. Of course, if kapok, hair or similar filling is used this idea is impracticable. Some of the box-spring types of furniture will, however, permit this idea being carried out.

No doubt other ideas will present themselves to readers, and it will often be found that the illusion of reality is greatly improved owing to the non-appearance of the wireless apparatus.

Weinheim 1987

Since 1979, the town of Weinheim has hosted the largest v.h.f./u.h.f. convention in Europe. This year was no exception with over 6500 people paying the DM5 to attend the two day convention. M. Senior G4EFO reports.

Weinheim is one of the many wine growing towns in the Baden-Wurtemburg district of West Germany. The town lies some 50km north of Heidelberg where the Rhine Valley meets the slopes of the OdenWald Forests.

The exhibition is held in the town's large college complex (Multischule) and covers an area of almost 6½ hectares. Fifty per cent of the exhibition and all of the lecture streams were held inside. The covered walkways that surrounded the college complex provided the outside setting for the flea market for which there was no entry charge. Around another 2000 people visited this part of the rally.

Enthusiasts interested in v.h.f. were treated to some excellent exhibits and had the chance to buy from a myriad of component manufacturers all selling first class devices for the home constructor. The whole exhibition revolves around the four streams of lectures lasting the two days of the rally. The lectures, all presented in auditorium venues, dealt with an interesting range of v.h.f. associated items and offered a wide choice for all tastes. Items covered in the antenna field included broad and narrow band antennas, long Yagi design, lightning protection for antenna installations and dual-band arrays. One complete stream of lectures was devoted to ATV techniques on 1.3GHz using f.m.

Microwave Enthusiast

For the microwave enthusiast there was a presentation on a 1.3GHz linear using three 2C39 valves and delivering a cool 450 watts! Yet another series of lectures covered FAX transmissions, data boxes, Packet radio and scrambling/descrambling techniques used for satellite TV broadcast systems.

Ideal for the browsing amateur

If s.h.f. technology proved to be your main interest then the lectures on 24GHz s.s.b. transverters or 5.8GHz transverters and working techniques may have satisfied your thirst for knowledge. Whatever the interest in the hobby, it should have been covered by the variety of lectures which lasted from opening to closing on both days of the rally.

For the amateur who just wanted to browse, one of the 95 exhibitors should have provided a degree of interest. There were an abundance of component, antenna and black box dealers offering a wide choice in price and quality. Whilst inspecting many of the new transceivers on the market, it soon became apparent that most of the Japanese equipment available was cheaper than in the UK. If, for example, you were considering the purchase of a Trio TS-711E 144MHz base station, saving of around £100 could have been realised on the recommended retails in the UK. In complete contrast however, add on extras, such as linear amplifiers were considerably more expensive than in the UK.

Deutsche Bundespost

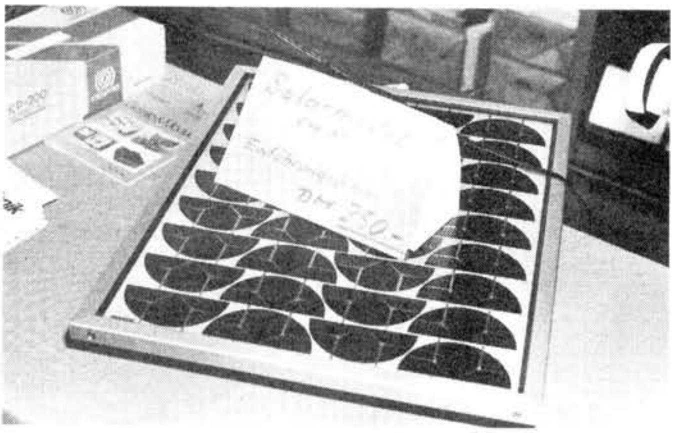
The Deutsche Bundespost (the equivalent to our RIS) were in attendance with fully equipped direction finding vehicles and a stand where the visitors could have their transceivers checked.

Visitors to the rally who wanted to obtain a CEPT licence could obtain the necessary documentation instantly. The CEPT licence allows any European amateur the use of his radio callsign in any member country. As yet, this facility is unavailable for UK amateurs.

One interesting item available from the UKW Technik stand was a solar panel. This would probably make an ideal power source, together with a

The Deutsche Bundespost

Inside the "RIS waggon"



An ideal power source?

British dealers at the exhibition

rechargeable battery, for a remote beacon or repeater. Measuring about 1 × 0.5m, it was rated as 12V giving 18 watts. Priced at DM250, it would make the basis of an interesting experiment.

DBS Systems

DBS systems were on show at the rally for as little as DM1200 (£400), although they were not of the remote controlled variety. Many amateurs who attended the rally seemed prepared to buy the receivers but were interested in the "home-brew" aspect of the dish feed systems and down converters. With a variety of stands offering modules and components for DBS systems, the home constructor was spoiled for choice!

BNOS Electronics, were one of the two British dealers at the exhibition, Capco being the other. In addition to their normal range of products, BNOS also took the wraps of their latest range of linear amplifiers designed for the low power transceiver market. They include the following products:

BAND	INPUT POWER	OUTPUT POWER (RMS)	MODEL No.
50MHz	3 watts	25 watts	L50-3-25
144MHz	3 watts	25 watts	L144-3-25
432MHz	1 watt	10 watts	L432-1-10

None of the above linears have pre amplifiers fitted and they should all be available early October costing just under £75 each.

The DARC stands proved to be a useful source of information with the AMSAT committee under constant pressure selling satellite prediction schedules. On display was a 24GHz transceiver which used the infamous FT290R for the drive source. DF6EP produced some excellent machined brass 5.8 and 3.3GHz p.a.s. The detail and finish to these items of home construction were perfect.

ATV Enthusiasts

For the ATV enthusiasts, of which there are some 1500 subscribing members in Germany, the AGAF (Arbeitgemeinschaft Amateurfunk Fernsehen) produce a publication every three months giving the members the latest hints and tips in the ATV world. The group and the publication is very similar to our own BATC and this facet of the hobby is gaining interest daily in Germany at the same speed as the UK.

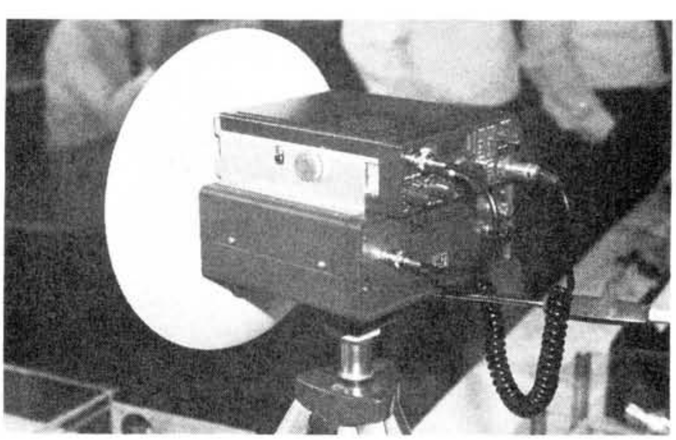
Tonna of France unveiled their new 2.3GHz 25-element Yagi. The antenna has a horn feed to it and is similar to the 1.3GHz models available in the UK. This antenna has a claimed gain of 18.2dBi and a beam width of 15 degrees to the 3dB points. It will provide a useful addition to the antenna farms of the ATV enthusiasts who are now making use of the wide bandwidths available in this amateur frequency allocation.

Weinheim 1988

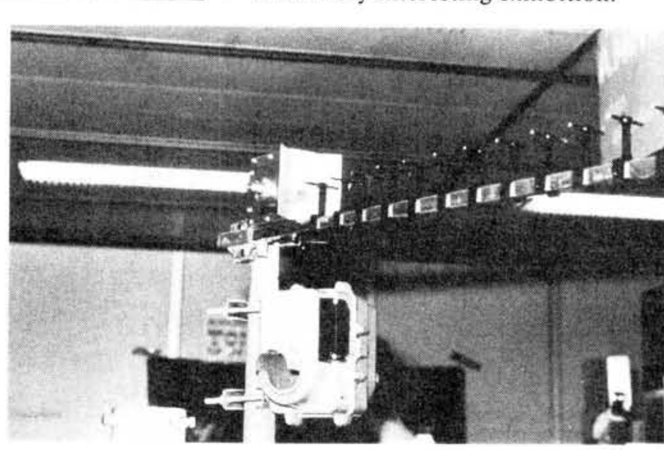
If you or your company are interested in visiting Weinheim in 1988 it will be held on 17 and 18 September and full details are obtainable from:

Lofyer Wittwer
In Der Krone 9
D 6252 Heppenheim
West Germany

Motoring to the exhibition is easy, a quick trip from Dover to Ostend, and then its about a $5\frac{1}{2}$ hour drive across Belgium and down the Rhine Valley via Cologne. There are some very beautiful views on the journey through Germany so it might make a pleasant summer break for a group of amateur friends that wish to take in scenery, sun and a very interesting exhibition.



24GHz equipment on show



A 2.3GHz 25-element Yagi

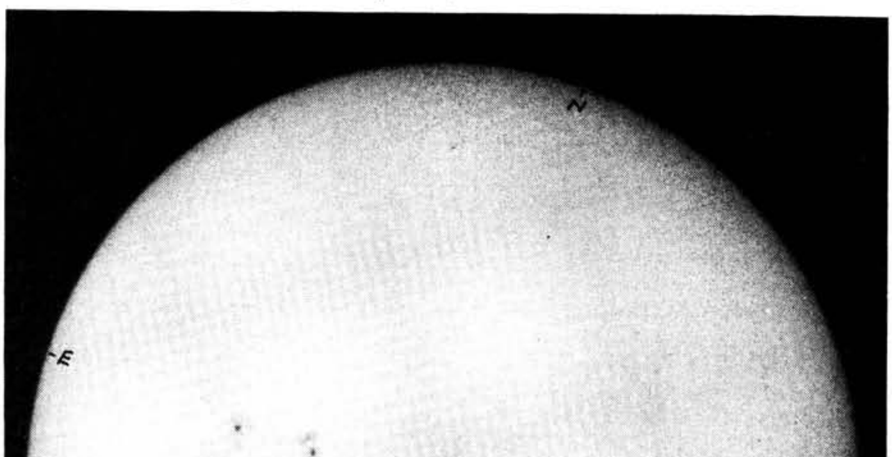
More About Sunspots

Sunspots are a very interesting, yet complex subject, so P. Newton tells us a little about the history and effects they have on communications

There is considerable interest in the effort to learn more about sunspots. These make h.f. communications possible and have various effects at v.h.f. as well—phenomena which are covered in "propagation" articles in the radio literature. This piece will try and present a picture of what is known about sunspots themselves from their historical records and note some of the ideas of their effects.

Sunspots were known to the ancient Greeks, but the knowledge seems to have been lost to the Western world until the advent of Galileo in the early 17th century. However, the church at that time rejected the discovery of spots on the sun: the sun was a perfect sphere, created as such by God who was incapable of shoddy workmanship, and so any suggestion that the sun was imperfect was a heresy—and one for which Galileo was persecuted. Even so, one would have expected interest to develop as a result of Galileo's work, and indeed astronomers did search for sunspots and report their finding—although in fact there were not many to be found. This was established in the late 19th century by Maunder and Sporer who searched records back to Galileo's time and decided that there had been few spots visible between 1645 and 1715—a period known as the "Maunder Minimum".

Poor Maunder and Sporer, however, were not taken very seriously by modern astronomers until a paper by Eddy in 1976 vindicated their conclusions. Eddy's method involved radiocarbon-14, his argument being that the quiet sun permits cosmic rays to reach earth and react with nitrogen to generate carbon-14, while the lively sun and its stronger solar wind protects the planet from cosmic rays and so reduces carbon-14. By measuring the carbon-14 in tree rings it is possible to date the sample of tree and so relate the tree growth to the presence or absence of sunspot activity. This technique has shown the Maunder Minimum to be accurate.



This is how the sun looked on 7 August 1976 at 1025. There were spot group right and left and "faring" all day in the group on the right

Other records show reports of aurorae related to sunspot activity, and Chinese and Korean records go back reliably to about 200 BC. These countries have the right conditions for naked-eye observation of sunspots; this is possible when the sun is low on the horizon and with dust in the air acting as a neutral-density filter (rather than cloud which merely obscures) to reduce the brightness to a level at which the sun can be observed without damage to the eyes.

All these records and observations support one another but for different periods when compared with the carbon-14 measure; this is the one we now take as reliable.

Wittman has been bold enough to try and test for an 11-year cycle over the entire period covered by the Chinese records. Between 500 BC and 1600 AD he defined 50 sunspot maxima even by the most modest assessment of the work, and the key discovery is that while the individual cycles vary in time, over this longer period they appear to balance out, and a mean period of 11.135 years is indicated. Thus from this and Dicke's work we may assume that something is going on inside the sun with a repetition rate of about 11 years, but that the surface effects—sunspots—resulting from this tend to wander a bit either side of the 11-year period. However, the 11-year period is in a way a 22-year period, since the polarities of the sunspots reverse with each new cycle: if the spots of one cycle are seen north of the solar equator, those of the next will be south, and so on.

Does this solar activity have any effect upon Earth directly? A Chinese group seems to have managed to isolate various lesser cycles in the basic 11-year period to the extent that they get a "fit" with what has actually occurred since 1820. They have made predictions for these events up to the turn of the century; only time, of course, will tell if they are correct.

Since 1820 changes in the length of a day of around 8 milliseconds have been noted; these changes *seem* to be related to changes in solar activity, and to the relative positions of the planets Jupiter and, to a lesser extent, Saturn. The interesting bit is the hint of 179-year period, which of course coincides with the pattern of the solar system itself: what you see tonight will not be repeated for 179 years. Back in 1962, Danjon noted a change in the length of a day associated with one large solar

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Semiconductor Tester

This simple but effective project from Martin Michaelis DK1MM, when used in conjunction with an oscilloscope, will enable you to test a whole host of semiconductors.

The circuit for the tester is based around a phase-shifting network that is capable of supplying two 50Hz signals in quadrature (phase shifted from one another by 90 degrees). This is achieved with two *CR* networks C3/R2 and C2/R3 as can be seen in Fig. 1. The two resultant signals when fed to the X and Y inputs of an oscilloscope will initially be displayed on the screen as a circular trace.

When a semiconductor is connected across the test clips of the unit, the shape of the trace will change to one corresponding to the type and condition of the device under test. Examples of these shapes are shown in Fig. 2.

A good *pnp* transistor will show a quadrant in the lower left portion of the display, while a good *npn* type shows a quadrant in the upper right portion. Components such as diodes, if they are serviceable, will cause a tilted semicircle to be displayed. Thyristors or silicon controlled rectifiers (s.c.r.) will show a horizontal semicircle, and lastly a unijunction transistor will be displayed as an oval pattern.

Switch S2 allows the selection of two sets of limiting resistors R4 and R6 or R5 and R7. On selection of R4 and R6, a high-current feed is made available at the test clips, this should be used for testing high power devices. This switch position should be marked "Hi". The other switch position which should be marked as "Lo", applies a low current feed to the test clips. This should be used for small signal devices.

Construction

Constructional layout is not critical. The author's prototype was built on Veroboard, but there is no reason why the unit could not be constructed using tag strip. The only point of note is that component tester output connection marked "scope ground", should be isolated from the component tester mains earth.

Two sets of 4mm sockets were used for output terminations. This type of connector is quite common on cheap "student" type oscilloscopes. If your oscilloscope has coaxial connections then two patch leads with suitable connectors either end will have to be made up.

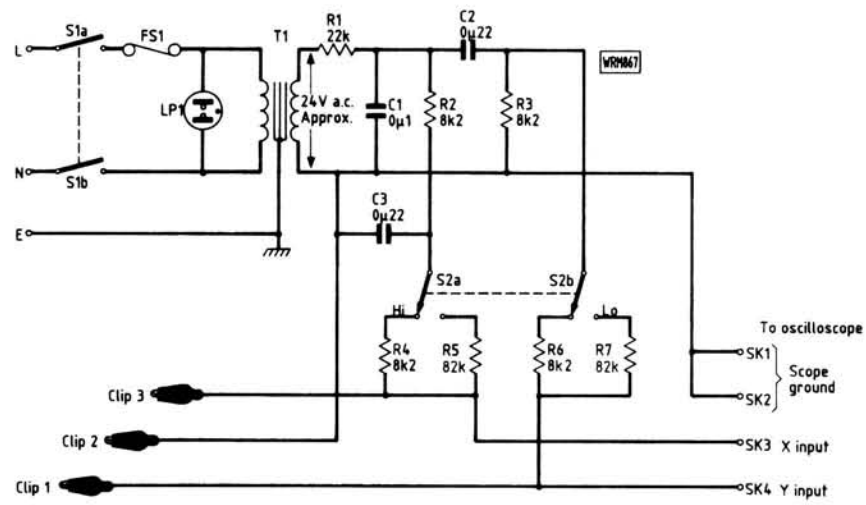


Fig. 1: Circuit diagram of tester

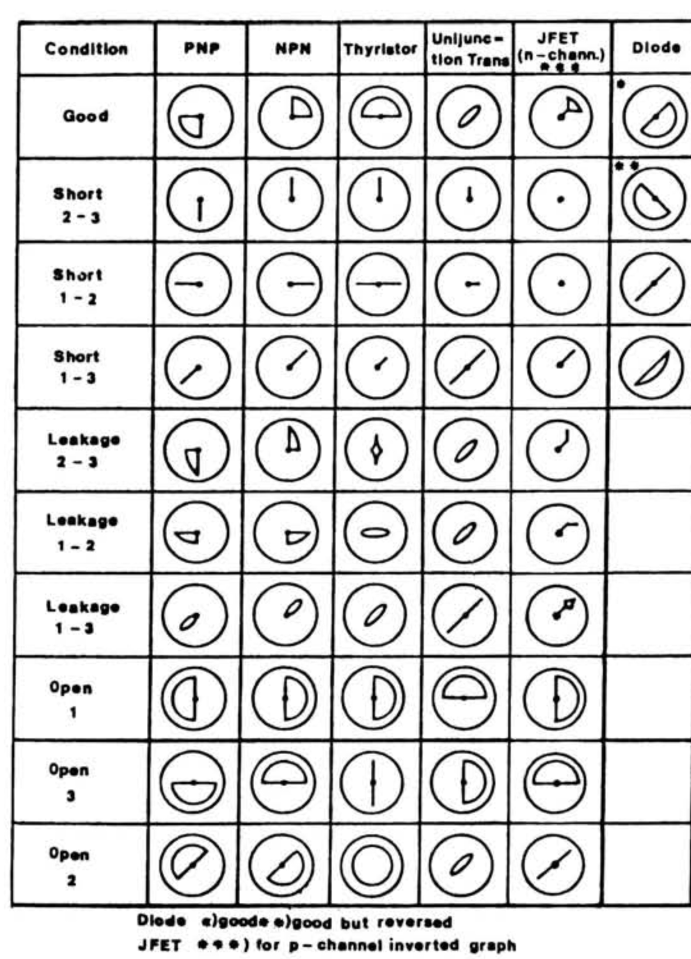


Fig. 2: Reference chart of oscilloscope patterns

Operation is quite simple. Use the tester in the following sequence:

(a) Connect the tester to the mains supply and switch on.

(b) Connect the output sockets of the tester to the oscilloscope's X and Y inputs.

(c) Switch the timebase of the oscilloscope to its EXTERNAL position.

(d) Adjust the oscilloscope horizontal and vertical amplifiers to display a perfect circle. Note that, to exhibit a perfect circle, both horizontal and vertical amplifiers must be adjusted to give an equal deflection on the 'scope and both traces must be deflected linearly.

(e) With the aid of a semiconductor data book establish the lead-out pattern of the device to be tested, and connect it to the unit's test clips (see Table 1).

(f) Note the pattern on the oscilloscope screen, then refer to the example patterns shown in Fig. 2, to ascertain the type and condition of the device.

The tester is fascinating to operate and there is no question as to its usefulness, as it can show for instance, leakage as a quantitive element. ***PW***

References

Oscilloscope measuring techniques. J. Czech, Philips Eindhoven 1965.

Radio Communications Handbook, fourth edition. RSGB

The Radio Amateur's Handbook (1976-1986). ARRL.

Table 1: Device connection data

Device	Clip 1	Clip 2	Clip 3
Transistor	Emitter	Base	Collector
Thyristor	Cathode	Gate	Anode
Unijunction	Emitter	Base 1	Base 2
Diode	Anode	—	Cathode
J-f.e.t.	Source	Gate	Drain

SHOPPING LIST

Resistors

0.25W 5% Carbon film

8.2kΩ	4	R2-4,6
22kΩ	1	R1
82kΩ	2	R5,7

Capacitors

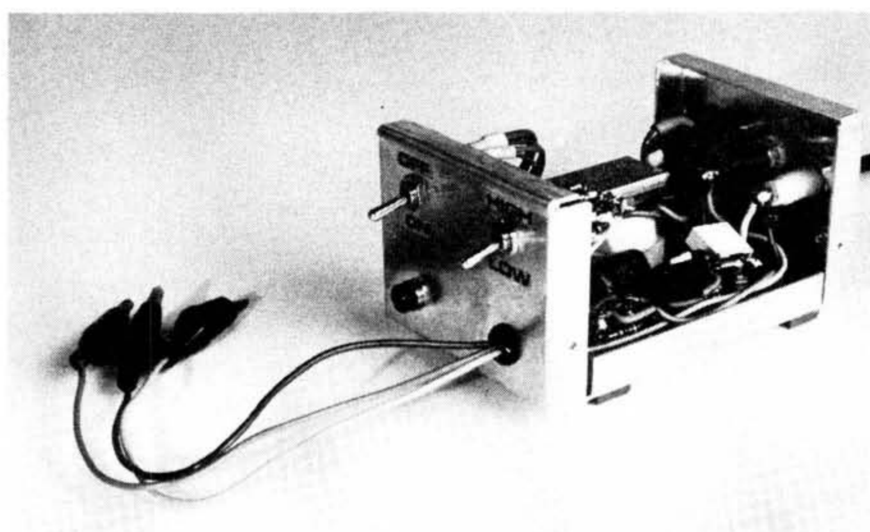
Polystyrene 5% 63V

0.1μF	1	C1
0.22μF	2	C2,3

Miscellaneous

Mains spec. d.p.s.t. toggle switch; d.p.d.t. toggle switch; 100mA 20mm fuse with chassis mount holder; Mains neon indicator; 100mA 12-0-12V chassis mount transformer; Miniature colour coded crocodile clips (3); 4mm colour coded sockets (4); 4mm colour coded plugs (4); tag strip or Veroboard; Metal project box, minimum size 51 × 102 × 64mm; Light-duty, 3-core mains cable; Strain relief grommet; Connecting wire; Nuts; Bolts; Washers; Solder tags; Rubber sleeving; Stick on feet.

How Much? & How Difficult?
£12
Intermediate



Layout of ***PW*** prototype

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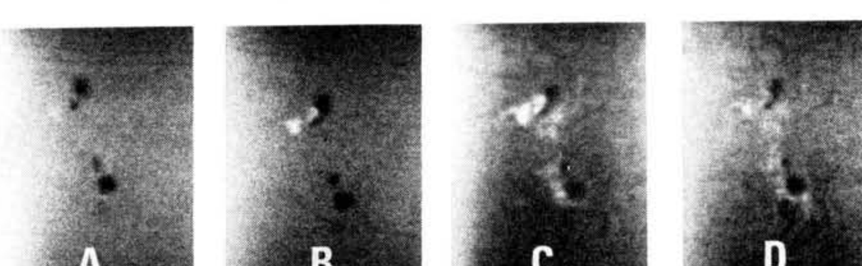
flare, but as little was known then about the solar wind his work seems to have been shelved to some degree.

Now, sunspots and the weather. First, there is just no way that you will be able to say "saw a new sunspot yesterday so it'll be wet tomorrow!" However the long-term results of Eddy's observations with radiocarbon, plotted against the advance and retreat of glaciers on Earth over the past five thousand years, show a correlation which is quite uncanny: the clear message is that in periods when sunspots are in short supply, such as the Maunder Minimum, the temperature drops and glaciers increase. It does seem that during these periods, longer than a single cycle, the sun itself may cool slightly.

So much for any idea we may have that the sun is perfect! Far from being perfect its health is quite variable over long periods of time; indeed the sun is ailing and has been for some thousands of millions of years, and if this were not so one could argue that life, and hence Man, could not have happened on this planet. What then if it returns to normality?

So—there's more to this sunspot business than appears in the RAE! These notes represent the writer's feel for the present state of knowledge; other research could have been mentioned and it is possible that the most recent work might upset many of our earlier notions. Such is progress. However, Eddy's studies seem very soundly based indeed by any criteria. The Chinese work mentioned has only been read in English and so perhaps it is unfair to criticise, but there does seem to be a tendency to 'find' patterns in the data they have. Having said that, speculation is valuable in science if it does anything towards showing the direction in which our next experiments should go. ***PW***



This shows an actual solar flare occuring on the face of the sun. Don't forget, NEVER look at the sun through binoculars or a telescope—you will be permanently blinded

ICOM Communications

'Amateur' is not the right word.

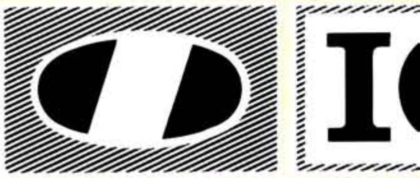
Since the very beginning, ICOM has actively pursued the development of new products designed to meet the needs of Ham Radio operators throughout the world. The result of this development is a constantly expanding range of professional Amateur radio communication equipment utilising today's latest technology.

Improved technical capabilities and higher quality have earned ICOM the reputation as one of the worlds leading communication equipment manufacturers.

With just a single call sign you can communicate around the world, increasing you circle of friends to wherever radio waves can reach. To satisfy even the most demanding operators ICOM has developed a comprehensive range of base, mobile and compact handportable units all complemented with many options and accessories.

To conclude, we would offer some worldly advice ... communicate on ICOM radio equipment, the Amateurs' *professional* friend.

The Amateurs' Pr



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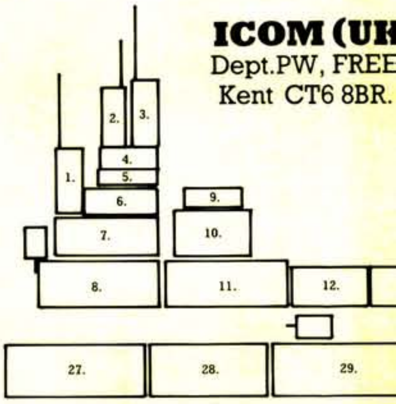

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1. IC-2E. 2 metre FM Handportable.
1.5 watts with standard nicad pack. Thumbwheel frequency entry.

2. IC-MICRO 2E. 2 metre FM Handportable.
1.5 watts with standard pack. 2.5 watts possible. Toggle switch frequency entry, LCD display, 10 memories.
NEW! IC-MICRO 4E, 70 cm FM version now available.

3. IC-02E. 2 metre FM Handportable.
2.5 watts with standard nicad pack, 5 watts from 13.8 volts DC. LCD display, keypad requency entry, 10 memories, scanning.

4. IC-28E. 2 metre FM Mobile
25 watts, 21 memories, scanning.

5. IC-27E. Discontinued.

6. IC-290D. 2 metre Multimode mobile
25 watts, 5 memories, scanning.

7. IC-275E. 2 metre Base station.
Multimode operation, 25 watts power output. New DDS system, 99 memories, high sensitivity and dynamic range. Ideal for PACKET and AMTOR.

8. IC-271E. 2 metre Base station.
Multimode, 10 or 25 watt models. IC-271H 100 watt model also available, 32 memories, scanning.

9. IC-3200E. Dual-band FM Mobile.
2 metre and 70 cm operation. 25 watt on both bands, 10 memories, scanning.

10. IC-SP3.
External base-station loud-speaker, 8 ohms.

11. IC-1271E. 23 cm Base station.
10 watt power output, 1240MHz-1300MHz. Multi-ode operation, 32 memories, scanning.

12. IC-PS55. External power supply.
Styled to match IC-735, 20 amp rating.

13. IC-735. HF Transceiver.
Amateur bands 160-10 metres, general coverage receiver from 100 kHz to 30 MHz. CW/SSB/AM/FM modes. 100 watt power output, 12 memories.

14. IC-AT150. Automatic antenna tuner.
Styled to match IC-735. 100 watt power rating.

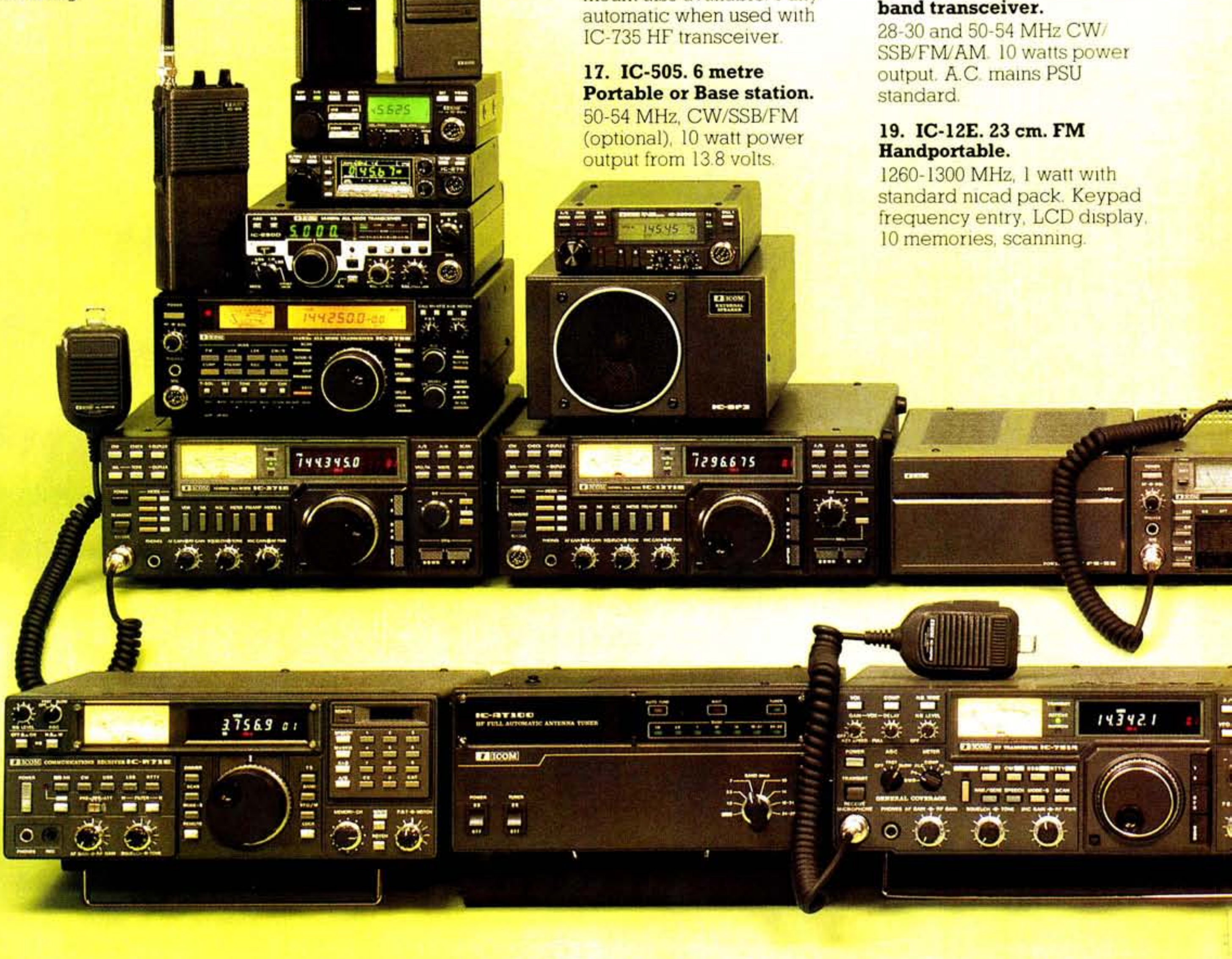
15. IC-GC5. Station world clock.

16. IC-AH2a. HF Mobile antenna tuner.
IC-AH2b mobile whip and mount also available. Fully automatic when used with IC-735 HF transceiver.

17. IC-505. 6 metre Portable or Base station.
50-54 MHz, CW/SSB/FM (optional), 10 watt power output from 13.8 volts.

18. IC-551. Discontinued
Replaced by the NEW
IC-575 6 and 10 metre Dual band transceiver.
28-30 and 50-54 MHz CW/SSB/FM/AM. 10 watts power output. A.C. mains PSU standard.

19. IC-12E. 23 cm. FM Handportable.
1260-1300 MHz, 1 watt with standard nicad pack. Keypad frequency entry, LCD display, 10 memories, scanning.



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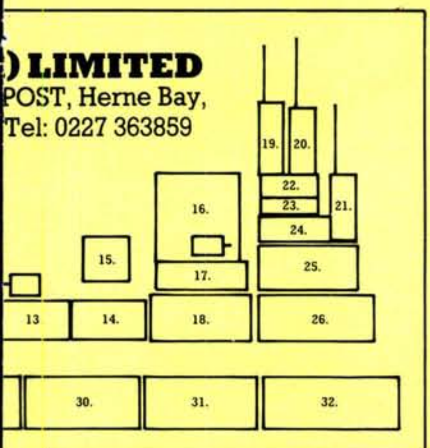


20. IC-04E. 70 cm. FM Handportable.
2.5 watts with standard nicad pack, 5 watts possible. Keypad frequency entry, LCD display, 10 memories, scanning.

21. IC-4E. 70 cm. FM Handportable.
2.5 watts with standard nicad pack. Thumbwheel frequency entry.

22. IC-48E. 70 cm. FM Mobile.
25 watt, 21 memories, scanning.

23. IC-47E. 70 cm. FM Mobile.
25 watt, 9 memories, scanning.

24. IC-490E. 70 cm. Multi-mode Mobile.
10 watt power output, 5 memories, scanning.

25. IC-PS30. System power supply.
25 amp. rating, fully protected. Up to 4 ICOM units may be connected.

26. IC-471E. Discontinued Replaced by **NEW IC-475, 70 cm. Base station.**
Multimode operation, 25 watts power output. New DDS system, 99 memories, high sensitivity and dynamic range. Ideal for PACKET and AMTOR.

27. IC-R71E. HF. Base Receiver.
100 kHz-30 MHz CW/SSB/AM/RTTY/FM (optional). Direct frequency entry. 32 memories, scanning. Remote control option. 12 volt DC. option.

28. IC-AT100. Automatic antenna tuner.
100 watt power rating. Also available is IC-AT500 with 500 watt rating. Autoband switching with ICOM HF transceivers.

29. IC-751A. HF Transceiver.
Amateur bands 160-10 metres. General coverage receiver from 100 kHz to 30 MHz. CW/SSB/AM/RTTY/FM modes. 100 watt power output, 32 memories.

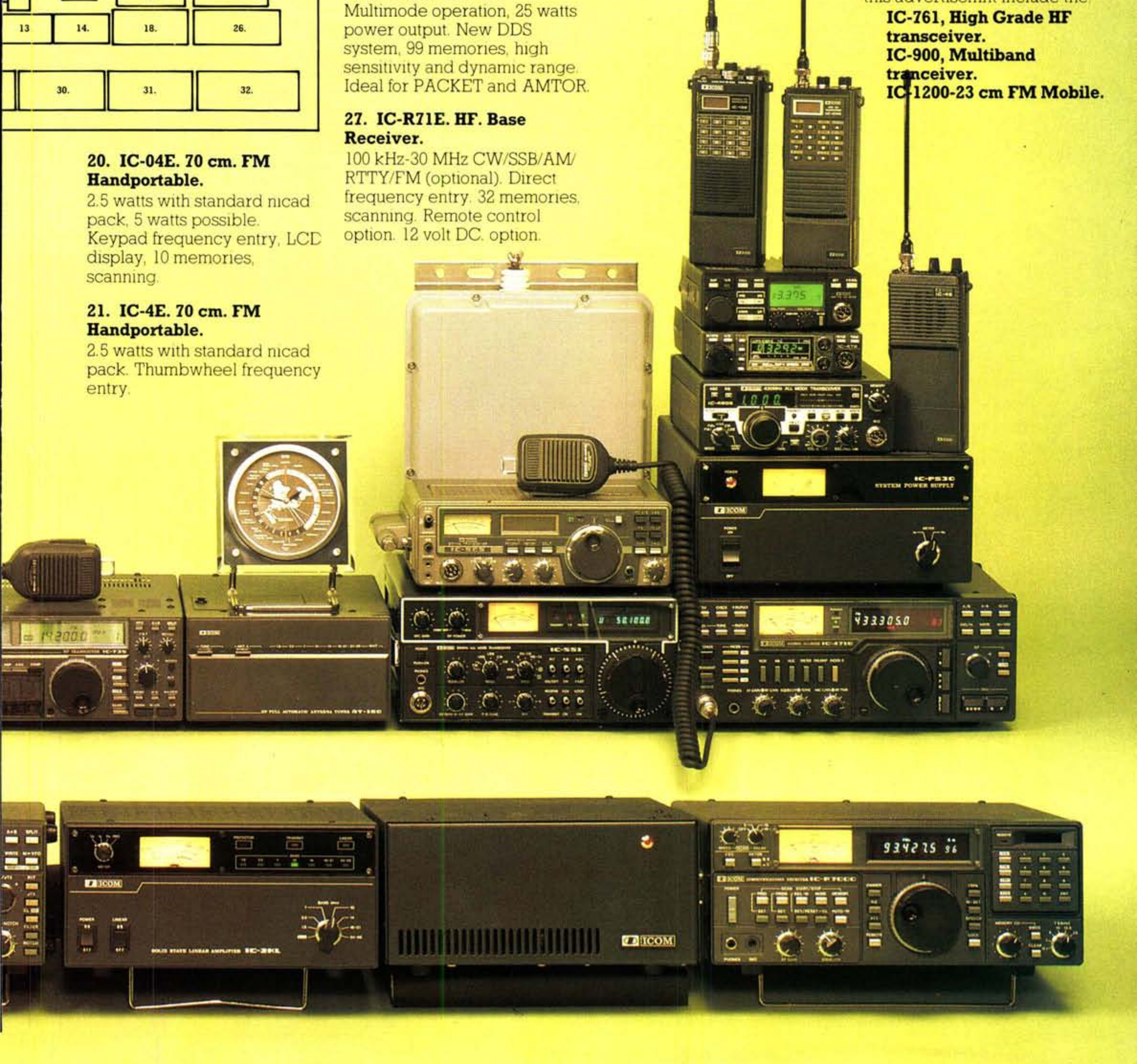
30. IC-2KL. HF 500 watt Linear amplifier.
Automatic band switching with ICOM HF transceivers. 2KLPS power supply is required. Solid state broadband tuning.

31. IC-2KLPS. AC. Power supply.
For use with IC-2KL. Regulated voltage of 40 volts DC. and metered current of 25 amps.

32. IC-R7000. VHF/UHF Continuous coverage receiver.
25 MHz-2000 MHz. FM/AM/SSB modes. Direct frequency entry. 99 memories, scanning, remote control option.

New models not shown in this advertisemnt include the:

IC-761, High Grade HF transceiver.
IC-900, Multiband tranceiver.
IC-1200-23 cm FM Mobile.



Valved Communications Receivers

The Hammarlund Manufacturing Company, of 460 West 34th Street, New York, used the name "Super-Pro" for a series of receivers over a period of years. Chas. E. Miller describes for us this month one very well-known example, which was supplied to the American Army and might be expected to have found its way into the hands of UK enthusiasts via the surplus market.

Our illustration is of the 1943 Super-Pro, which cost $318 with 10in loudspeaker and $330 with a 12in unit. The exchange rate at the time was $4 to the £. The standard model covered 540kHz to 20MHz in five bands: 540-1160kHz; 1160-2500kHz; 2.5-5.0MHz; 5.0-10.0MHz; 10.0-20.0MHz. There was another version with 1250kHz-40MHz coverage. A special feature of the Hammarlund Company was their excellent wave-change switching system, which worked on the knife-switch principle. All contacts were of silver-plated phosphor bronze, shaped to provide six points of contact at each connection. Coils not in use were automatically shorted out; the switch also featured a break-after-make action that eliminated any danger of sparking at the contacts. A main tuning dial was supplemented by a band-spread dial effective on the upper three of the five wavebands. All valves were of the UX series with 6.3V heaters.

The Line-up

The general specification is impressive. There are two r.f. amplifier stages, a mixer with separate local oscillator, and four i.f. amplifiers. Most unusually for a communications receiver, there is a high quality push-pull output stage. The a.g.c. voltage is provided by a separate amplifier/rectifier stage distinct from the main i.f. stages. The controls are comprehensive and well grouped on the front panel of the receiver in a symmetrical layout. The r.f., i.f. and a.f. gain may be varied at will by the operator, who also has to hand the band-speading device previously mentioned and optional selectivity controls that can include a crystal filter. With this fitted, the selectivity of the Super-Pro may be varied from 16kHz down to under 100Hz. An S-meter is fitted as standard.

The Circuit in Detail

Sockets are provided for long-wire or dipole antennas. The antenna coils for each band have individual primary and secondary windings, as do the subsequent inter-stage couplings. The coils are tuned by a main capacitor and a complementary band-spreading capacitor, each having four ganged sections and separate dials. The secondary of the antenna coil winding in use is directly coupled to the grid of the first r.f. amplifier (V1, 6D6). An almost identical set of coils couples the signal to the second r.f. amplifier (V2, 6D6). Both these valves are controlled by the RF GAIN potentiometer, which varies the negative bias applied to their control grids. The necessary negative voltage is supplied by a separate h.t. secondary on the mains transformer and a half-wave rectifier (V16, Type 1-V). The 53V negative line is broken down by a potential divider network to the voltages required for various stages of the receiver. When the MODE switch is set for AVC, automatic gain control is applied to the r.f. amplifiers, but the manual control remains effective if required for very powerful signals. Normally, however, it would be set at maximum for AVC operation. Another coil set, again similar to the first, couples V2 to the grid of the mixer valve (V3, 6A7). There is a separate local oscillator (V4, 6C6). The h.t. supply to the anodes of the first three valves is interrupted by a SEND-RECEIVE switch on the front panel of the receiver.

The intermediate frequency is 465kHz. The first three stages of i.f. amplification are largely similar (V5, V6, V7, all 6D6). Certain models are equipped with a crystal i.f. filter, which in conjunction with variable bandwidth i.f. transformers provides degrees of selectivity ranging from under 100Hz up to around 16kHz. Manual or automatic control of the i.f. gain is available in a similar way to that for the r.f. stages. An S-meter is inserted in the h.t. feed to the anodes of V5, V6 and V7.

The fourth i.f. amplifier and demodulator is a double-diode-pentode (V8, 6B7) operating with its diode sections strapped. As with most other signal valves (the exceptions being only V11, V12 and V14) grid bias is used and the cathode is taken directly to earth. Clearly this system will eliminate a large number of decoupling components and confer benefits in the way of stability. No bias is used, of course, on the demodulator diodes, the load resistor being returned to chassis. The a.f. signals are filtered of r.f. and passed on via a blocking capacitor to the AF GAIN control, the lower end of which goes to a negative supply to bias the grid of the 1st a.f. amplifier (V9, Type 76). This is a perfectly straightforward triode amplifier with resistance-capacitance coupling to the 2nd a.f. amplifier (V10, Type 42). A top-cut style of tone control operates on the anode load resistor of V9.

Valve V10 is a power-pentode strapped as a triode driver for the push-pull output valves (V11, V12, both Type 42), which operate in the Class AB mode and are also strapped as triodes. This arrangement produces some 13W of audio power at only 2 percent harmonic distortion—distinctly unusual and creditable for a communications receiver.

For c.w./s.s.b. reception a b.f.o. is provided (V13, 6C6). It is of conventional design and injects its output into the 4th i.f. amplifier via a tertiary winding on the transformer coupling V7 to V8. This same winding is used to feed i.f. signals to the a.g.c. amplifier (V14, 6B7). The pentode section of this valve operates as an amplifier at i.f., with its strapped diodes as the a.g.c. rectifier. Two cathode bias resistors in

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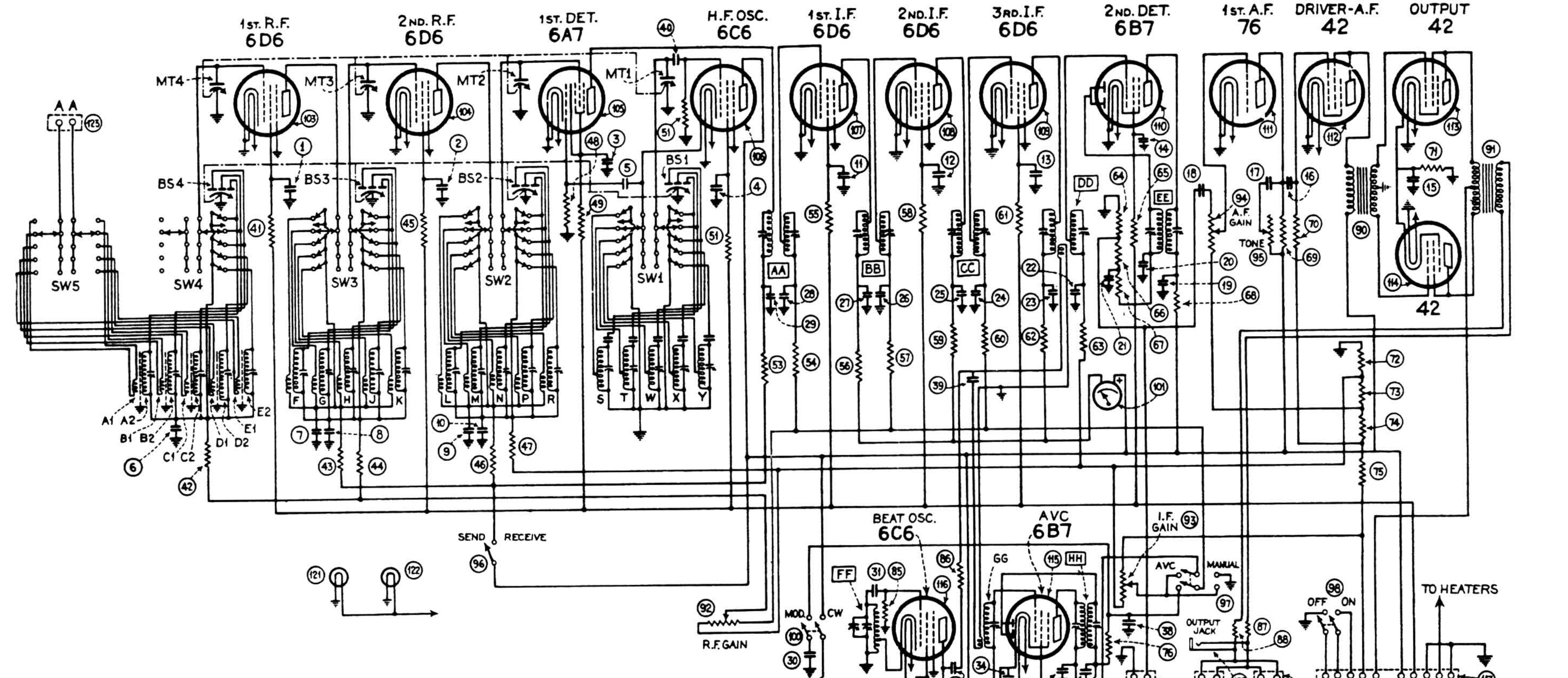
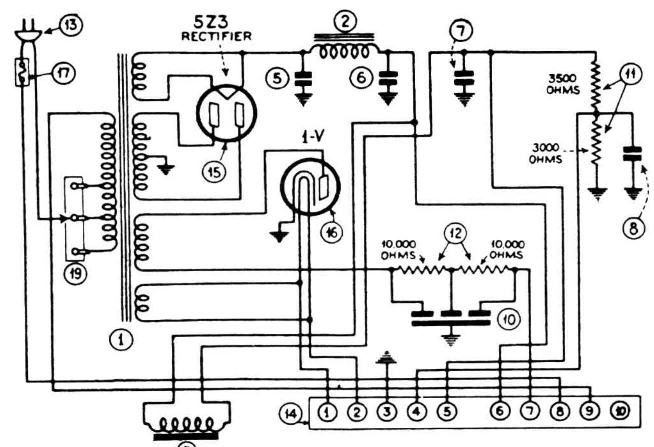
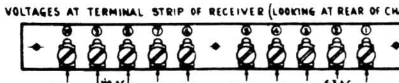




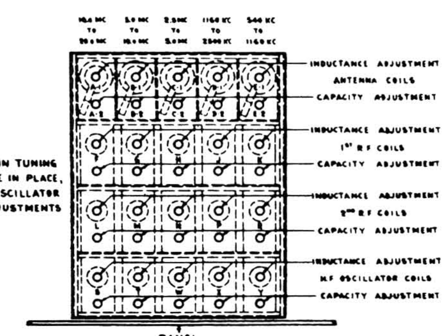
TABULATION OF VOLTAGES APPLIED TO RECEIVER TUBES

TUBE	FUNCTION IN RECEIVER	PLATE VOLTAGE	SCREEN VOLTAGE	CATHODE VOLTAGE	PLATE CURRENT MILLIAMPS
6·A·7	1st DETECTOR	260	80	0	3.
6 C 6	HIGH FREQ OSCILLATOR	275	110	0	2.5
6 D 6	1st RADIO FREQ	275	110	0	1.5
6·D·6	2nd " "	275	110	0	1.5
6 D·6	1st INTERMEDIATE FREQ	275	110	0	2.
6 D·6	2nd " "	275	110	0	2.
6 D·6	3rd " "	275	110	0	2.
6·B·7	2nd DETECTOR	260	100	0	3.
6·B·7	AUTOMATIC VOLUME CONTROL	280	145	45	7.
6·C·6	BEAT OSCILLATOR	180	30	0	.4
76	1st AUDIO	175	0	0	2.5
42	DRIVER	260	260	0	23.
42	CLASS A B AUDIO	360	360	35	21.
42	" " " "	360	360	35	21.

VOLTAGES AT TERMINAL STRIP OF RECEIVER (LOOKING AT REAR OF CHASSIS)



BOTTOM VIEW, MAIN TUNING UNIT, COVER PLATE IN PLACE, INDICATING H.F. OSCILLATOR AND R.F. COIL ADJUSTMENTS



SCHEMATIC DESIGNATION	DESCRIPTION - RECEIVER PARTS	
A1	Antenna Input Coil Assembly	2.5 to 5.0 M.C.
A2	Antenna Output Coil Assembly	2.5 to 5.0 M.C.
B1	Antenna Input Coil Assembly	5.0 to 10.0 M.C.
B2	Antenna Output Coil Assembly	5.0 to 10.0 M.C.
C1	Antenna Input Coil Assembly	10.0 to 20.0 M.C.
C2	Antenna Output Coil Assembly	10.0 to 20.0 M.C.
D1	Antenna Input Coil Assembly	1160 to 2500 K.C.
D2	Antenna Output Coil Assembly	1160 to 2500 K.C.
E1	Antenna Input Coil Assembly	540 to 1160 K.C.
E2	Antenna Output Coil Assembly	540 to 1160 K.C.
F	1st. R.F. Coil Assembly	2.5 to 5.0 M.C.
G	1st. R.F. Coil Assembly	5.0 to 10.0 M.C.
H	1st. R.F. Coil Assembly	10.0 to 20.0 M.C.
J	1st. R.F. Coil Assembly	1160 to 2500 K.C.
K	1st. R.F. Coil Assembly	540 to 1160 K.C.
L	2nd. R.F. Coil Assembly	2.5 to 5.0 M.C.
M	2nd. R.F. Coil Assembly	5.0 to 10.0 M.C.
N	2nd. R.F. Coil Assembly	10.0 to 20.0 M.C.
P	2nd. R.F. Coil Assembly	1160 to 2500 K.C.
R	2nd. R.F. Coil Assembly	540 to 1160 K.C.
S	High Frequency Osc. Coil Assembly	2.5 to 5.0 M.C.
T	High Frequency Osc. Coil Assembly	5.0 to 10.0 M.C.
W	High Frequency Osc. Coil Assembly	10.0 to 20.0 M.C.
X	High Frequency Osc. Coil Assembly	1160 to 2500 K.C.
Y	High Frequency Osc. Coil Assembly	540 to 1160 K.C.
AA	1st. I.F. Transformer Coil Assembly	
BB	2nd. I.F. Transformer Coil Assembly	
CC	3rd. I.F. Transformer Coil Assembly	
DD	2nd. Detector Input Coil Assembly	
EE	2nd. Detector Output Coil Assembly	
FF	Beat Osc. Coil Assembly	
GG	A.V.C. Input Coil Assembly	
HH	A.V.C. Output Coil Assembly	
1-2-3-4-34 11-12-13- 14-22-32-35	Capacitor Fixed Tubular Type	.05 MFD 200 Volts

SCHEMATIC DESIGNATION	DESCRIPTION - RECEIVER PARTS	
6-8-10-18 38-39	Capacitor Fixed Tubular Type	.02 MFD 200 Volts
7-9-16-33	Capacitor Fixed Tubular Type	.02 MFD 400 Volts
17-19-23-25 27-36-89-29	Capacitor Fixed Tubular Type	.05 MFD 400 Volts
24-26-28	Capacitor Fixed Tubular Type	.01 MFD 200 Volts
30-124	Capacitor Fixed Tubular Type	.25 MFD 200 Volts
5-20-21	Capacitor Fixed Mica Type	60 MMFD
31	Capacitor Fixed Mica Type	.0001 MFD
40	Capacitor Fixed Mica Type	.0001 MFD
37	Capacitor Fixed Mica Type	.003 MFD
15	Capacitor Fixed Tubular	50 MFD 50 Volts
52	Capacitor Fixed Tubular	.25 MFD 400 Volts
41-45-55-58- 61-65	Resistor 10,000 Ohms, Metallized ~~Carbon~~ Type 1 Watt	
42-44-47-48 54-57-60- 63-64	Resistor 100,000 Ohms. " ~~Carbon~~ Type 1/3 Watt	
69-84	Resistor 50,000 Ohms, " ~~Carbon~~ Type 1 Watt	
51	Resistor 50,000 Ohms, Metallized ~~Carbon~~ Type 1/3 Watt	
43-46-49-50 53-56-59-62 68-78-82	Resistor 5,000 Ohms. " Carbon Type 1 Watt	
66-67-70	Resistor 200,000 Ohms, " Carbon Type 1/3 Watt	
71-80	Resistor 750 Ohms, Wire Wound, 10 Watt	
72	Resistor 300 Ohms, Metallized ~~Carbon~~ Type 1 Watt	
73	Resistor 600 Ohms, " ~~Carbon~~ Type 1 Watt	
74	Resistor 1100 Ohms, " ~~Carbon~~ Type 1 Watt	
75	Resistor 3,000 Ohms, " ~~Carbon~~ Type 1 Watt	
76-77-83	Resistor 500,000 Ohms, " ~~Carbon~~ Type 1 Watt	
79	Resistor 60,000 Ohms, " ~~Carbon~~ Type 1 Watt	
81	Resistor 4,000 Ohms, " ~~Carbon~~ Type 1 Watt	
•87-83	Resistor 300 Ohms, Carbon Type 3 Watt	
90	Audio Input Transformer	
91	Audio Output Transformer	
92	Radio Frequency Gain Control 1 megohm	
93	Int. Frequency Gain Control 50,000 Ohms	
94	Audio Frequency Gain Control 250,000 Ohms	
95	Tone Control 50,000 Ohms	
96	Send-Receive Switch	

SCHEMATIC DESIGNATION	DESCRIPTION - RECEIVER PARTS
97	A.V.C. Manual Switch
98	Off-On Switch
99	Speaker - Phone Switch
100	C W - Mod Switch
101	Tuning Meter
•102	Output Jack
103-104-107 108-109	Tube Socket 6D6
105	Tube Socket 6A7
106-116	Tube Socket 6C6
110-115	Tube Socket 6B7
111	Tube Socket 76
112-113-114	Tube Socket 42
117	Connecting Terminal Strip
118	Phones Terminal Strip
119	Speaker or Output Terminal Strip
120	Phonograph Terminal Strip
121-122	Pilot Light Mazda #40 6.3. Volts
123	Antenna Terminal Strip
MT4 MT1 MT2 MT3	Main Tuning Condensers
BS 1-2-3-4	Band Spread Condensers
SW 1-2-3-4-5	Band Change Switch

SCHEMATIC DESIGNATION	DESCRIPTION - POWER SUPPLY PARTS
1	Power Transformer 110 Volts - 60 Cycle A.C.
2	1st. Filter Choke
• 3	2nd. Filter Choke
4	Fuse Block
5	Filter Condenser 4 MFD Electrolytic - 500 Volt
6-7-8	Filter Condenser 16 MFD Electrolytic - 450 Volt
10	Filter Condenser 8-8-7-MFD Electrolytic - 450 Volt
11	Resistor Voltage Divider-6500 Ohm Wire Wound 30 Watts
12	Resistor Grid Bias 20,000 Ohms Wire Wound 15 Watts

series provide a small amount of bias for the pentode and larger amount for delaying the a.g.c.; the grid winding on the input transformer is returned to the junction of the two resistors. The AVC-MANUAL switch connects the grids of the controlled valves to either the a.g.c. line or the manual i.f. gain potentiometer as required. The existing interconnection between the IF GAIN and RF GAIN controls feeds a.g.c. voltages to the r.f. amplifier valves. It is interesting to compare this circuitry with that of the R1155, to which it has certain similarities.

Sockets are provided for the connection of a gramophone pick-up, loudspeaker and 600Ω line, with an additional jack socket for headphones. The original output transformer gives only a 600Ω output, so unless this has been modified in service another matching transformer is necessary for low impedance loudspeakers. A typical ratio would be 14:1 for a 3Ω speaker.

The power supply section incorporates the bias rectifier already mentioned and a full-wave h.t. rectifier (V15, 5Z3) delivering a smoothed output of just over 360V for the anodes of the output valves, and a lower level of 275V for the rest of the valves. There is in addition a large potential divider employing a tapped 6500Ω, 30W resistor, supplying approximately 110V for the various screen grids. The main smoothing is by large choke(s); the receivers made for the US army had two as against one for civilian models. The bias rectifier, being indirectly heated, draws its filament current from the main 6.3V winding on the mains transformer, whilst V15 has the usual highly insulated 5V winding. As delivered in the USA the receiver was suitable only for mains voltages of 105V-125V a.c., a point to be borne in mind when a set of unknown origin is being put into service for the first time after a long lapse.

Receivers were supplied with a special cable for emergency use on batteries. The life of the latter must have been very limited, with an l.t. requirement of some 5.5A, and on the h.t. side of in excess of 100mA. The l.t. was to be supplied by a 6V storage battery and the h.t. by five 45V dry batteries in series. Another 45V unit was needed for the bias line. Possibly the sheer expense of this facility limited its attraction mainly to Service users having the backing of the US taxpayer!

Alignment

These notes are based on the standard 540kHz-20MHz model.

First Steps

I.F. alignment: The receiver controls should be set as follows: RF GAIN—fully left; IF GAIN—fully left; AVC/MANUAL—Manual; CW/MOD—Mod; PHONES/SPEAKER—Phones; SEND/RECEIVE—Receive; BAND SWITCH—540 to 1160kHz; AF GAIN—fully right; TONE—fully left; SELECTIVITY—fully left; BANDSPREAD—100; MAIN TUNING—low frequency end of band, avoiding broadcast signals.

The output from the signal generator should be connected to the grid of V3 via an isolating capacitor (0.1μF 500V). There are locking screws on the i.f. transformer trimmers which must be loosened off prior to adjustment. An output meter should be connected to the headphone sockets at the rear of the set. This may conveniently be a test-meter on a low a.c. voltage range.

Inject a 465kHz signal of sufficient strength to produce a meter reading of 1V. Adjust the cores of the five i.f. transformers in order, commencing with that coupling V3 to V5, for peak readings on the meter. The input may have to be reduced from time to time to prevent overloading. When these adjustments are complete the transformer which couples the i.f. signals to the a.g.c. valve must be set to give a minimum reading on the meter. Reduce the AF GAIN to just above its zero point and switch to the AVC mode. Set the IF GAIN control for an S-meter reading of between 2 and 3. Now adjust the trimmers on the transformer which couples the pentode section of V14 to its diodes. If all is well both the S-meter and the output meter will dip as the trimmers are adjusted; set them for minimum readings.

Switch the receiver to CW and turn the BFO control to its centre point. Adjust the trimmers on the b.f.o. coil for zero beat, by ear. This completes the i.f. adjustments but the manufacturers recommend that they should be repeated before the locking nuts are finally retightened.

As with all receivers, if it is possible to check the actual i.f. response curve with a wobbulator and oscilloscope the exercise is well worthwhile. It is the writer's policy to test, and reset, i.f. curves with all communications receivers that have to be aligned.

TABLE

Valve	Va(V)	Ia(mA)	Vg2(V)	Vk(V)
V1	275	1.5	110	0
V2	275	1.5	110	0
V3	260	5	80	0
V4	275	2.5	110	0
V5,V6,V7	275	2	110	0
V8	260	3	100	0
V9	175	2.5	—	0
V11,V12	360	21	360	35
V13	150	0.4	30	0
V14	230	7	145	45

The Front End

R.F. alignment: Set the controls as follows: RF GAIN—maximum; AF GAIN—maximum; TONE—fully left; CW/MOD—Mod; AVC/MANUAL—Manual; SEND/RECEIVE—Receive; PHONES/SPEAKER—Phones; BANDSPREAD—100. The IF GAIN control should be re-set as necessary to prevent overloading.

It will be seen from the diagram that the coil pack has two adjustments per coil for each of the four sets of coils making up a particular wave band. One adjustment is inductive (the core of each coil), the other capacitive (parallel trimmers). As is normal, all core adjustments are made first at the low frequency end of each band, followed by the trimmers at the high frequency end. In each case commence with the oscillator adjustments, then work back towards the antenna coils on the r.f. settings.

The comparatively low i.f. of 465kHz brings a danger of "images" on the higher frequency bands and a consequent need for extreme care to avoid these effects when the local oscillator coils are adjusted. If in doubt, tune through the range of each core/trimmer and, when more than one peak occurs, select that which gives the best output reading. This will have to be judged with great nicety when working on the highest of the wave ranges.

The appropriate settings for the tuning dial and signal generator for each band are as follows, the core frequencies appearing first, followed by the trimmer frequencies. Band 540-1160kHz: cores at 600kHz, trimmers at 1100kHz; Band 1160-2500kHz: cores at 1200kHz, trimmers at 2500kHz. For higher bands, the adjustments are made at the band extremities, for example 2.5 and 5MHz on the 2.5-5MHz band.

Servicing the Super-Pro

The apparent complexity of the Super-Pro circuitry may be somewhat off-putting at first glance. It helps to split the receiver unit up into four sections, each having four valves. These are the r.f., mixer and local oscillator section (V1-V4); the i.f. amplifier stages (V5-V8); and the a.f. stages (V9-V12). Taking these units as separate entities (if necessary by literally covering up the unwanted portions of the circuit diagram with a sheet of paper!) makes it a lot easier to comprehend the section under investigation. When a receiver appears to be "dead", narrow down the field by applying an a.f. signal to the AF GAIN control, thereby determining whether the fault lies after or before it in the circuit.

Quick overall tests may be made by voltage checks on the terminal strip at the rear of the receiver. The correct voltages are shown on the circuit diagram. For more detailed investigation, the individual valve electrode voltages are shown in the Table. With the Super-Pro having several examples of many of the valve types used, substitution may be employed in many cases without the necessity for spares. **PW**

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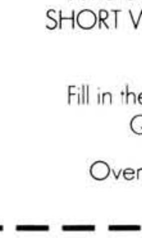

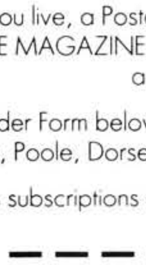

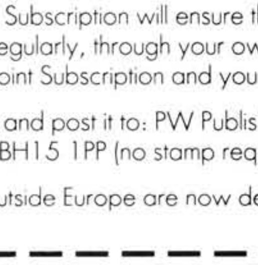

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Understanding The Smith Chart–A Practical Transmission Line Calculator

Part 1

This article, written by Captain C. A. King FSERT AMITE of the Royal School of Signals, first appeared in The Journal of The Society of Electronic & Radio Technicians. It has been reproduced here by kind permission.

Electronic equipment consists mainly of connections. These may be short lengths of coaxial cable, twisted pairs, straight wires or printed copper strips. At frequencies up to h.f., say, 20MHz, these connections present little problem except stray capacitance. Above h.f. they become much more than mere connectors.

A short length of coaxial cable, correctly used, may act as a high *Q* tuned circuit, a variable reactance or a matching transformer. Carelessly used, an apparently "through" connection may become an open circuit, or some sort of selective filter. Many other unwanted effects may also occur.

At v.h.f. and above, even shorter connectors must be regarded as transmission lines in order to predict their effect on a circuit. As many variables occur, some form of graphical analysis is desirable. Such a solution must be accurate enough for practical use. The Smith chart is one form of such a graph.

Transmission Lines

Any interconnecting system is a transmission line, the commoner ones were mentioned previously. In every case the electrical performance is determined by the physical properties of the system. For example, varying the spacing between the two wires of a cable system will have the same general effect as varying the spacing of two copper strips on a printed board. In each case, as spacing is reduced, the inductance per unit length decreases while the capacitance increases. These changes may affect the fidelity with which a signal is carried through the connection.

There are other parameters which affect transmission. These include length of system, type of dielectric and conductor shape and thickness. The combined effect of these parameters is summed up in the electrical property called characteristic impedance, or Z_0.

Any impedance can be measured by applying an e.m.f. at a selected frequency, and noting the resultant current. The ratio of e.m.f. to current then gives the magnitude of the impedance. However, if this system is applied to a line, the result may be false. This is because the current drawn is affected by the ultimate load connected.

A solution to this problem would be to use a line so long that the final load would have no noticeable affect on the transmitted current. This is the concept of the "infinite" line; but the argument can be used for a long, finite line. In such a line, the current drawn from a source of e.m.f. cannot depend initially on the load. The line must first be filled with energy; only then can the load draw any away. This can be compared with "filling" a long garden hose before water can be drawn off. Thus the initial energy flow in the line is determined solely by Z_0.

The value of Z_0 can thus be defined in terms of the impedance a very long section of line having the dimensions and insulation under consideration. For a number of standard configurations, simple equations are available for Z_0. For example, for a pair of wires,

$$Z_0 = 276\,(\mu_r k_r)\log_{10}\frac{d}{r}\ \text{ohms} \qquad (1)$$

where μ_r is the relative permeability of the dielectric
k_r is the relative permittivity of the dielectric
d is the wire spacing, centre to centre, and
r is the wire radius (d and r to be in the same units)

For an open wire antenna feeder, with k_r for air = 1, and conductor spacing 10in, the normal gauge of wire gives Z_0 as about 500Ω.

More generally, coaxial cables have values of Z_0 from 50 to 80Ω; twisted pairs from 100 to 400Ω while open wire lines may reach 800Ω.

Wavelength

Most signals applied to lines are repetitive, or cyclic; examples are sine and square waves or pulse streams. These signals travel down a line with a finite velocity. This velocity is impressive when quoted as, say 199 000km per second for a polythene insulated coaxial cable. But consider a more realistic viewpoint.

The periodic time of 50MHz signal is 20ns. In this period, the duration of one cycle, the signal will travel only 3.98m. If the cycles are identified by marker pips at each positive peak, the markers for successive cycles will be spaced down the cable every 3.98m. The whole pattern is travelling at that velocity, but the "cycle spacing" is quite small. In fact, this spacing is called the wavelength of the signal. It will vary with the signal frequency and type of line.

The wavelength is the distance travelled by the signal in the time of one cycle. Using this definition, wavelength can be quickly calculated.

Distance travelled = Velocity × Time (2)

For the usual range of dielectrics, signal velocity is about 60 per cent of the free space velocity of a radio wave. In the metric system the velocity is roughly $0.6 \times 300 \times 10^6$ metres per second, varying slightly with different dielectrics.

The time duration of one cycle of any signal is:

(1/fundamental frequency in hertz) sec

Substituting these values in (2)

Wavelength in metres = 0.6 × 300 × 10^6/F (3)

f frequency is substituted in MHz, λ, he wavelength = 180/*f*m. Using polyhene insulated cable, at 100MHz the vavelength is 1.8m. If air spaced cable s used, λ rises to 3m. This is due to the iigher velocity of signal motion, or ›ropagation.

Wavelength is usually more signifi:ant than actual line length. The reason 'or this is that over one wavelength :here is a phase lag of 360°. Thus even a 'ew feet of cable may introduce an ındesirable phase shift. For example, ıt 600MHz a 90° shift occurs at about 76mm of cable.

Reflection

When a load impedance Z_L does not :qual Z_0 the energy flow is modified. The energy flow at any time can be :onsidered to be in two parts. First, :here is a forward flow depending only ɔn Z_0. Second, there is a reverse flow, which depends on how much energy is rejected at the load. In the extreme :ase of a short circuit, at the load point, forward and reverse flow are equal. The net energy flow is zero. For other load values there is a net flow of some fraction of the forward energy.

The forward and reverse waves both contain the wavelength pattern. The movement of these two patterns in opposite directions in the line gives rise to a standing wave pattern. There are points in the line where the two waves will always come into phase. At these points, larger than average voltages will occur, reaching twice the forward voltage when all forward energy is reflected. Such points are spaced half a wavelength apart, and can easily be detected with a voltage probe. Although called a "standing" voltage, it is still at the transmitted frequency. In the same way, an eclipse of the sun occurs at one "place" in the sky, although the sun and moon are both moving at high speed in their usual orbits.

There will be other points in the line where the waves will always be antiphase. These points will occur midway between the above "in-phase" points. At these points, smaller than average voltages will occur, reaching zero on total reflection. These voltage minima can also be easily detected; the "dip" is more sharply defined than the peaks at the maxima. The presence of the minima is often used as a measure of wavelength, any adjacent pair being spaced by λ/2.

The high and low voltages which occur with a mismatched load ($Z_L \neq Z_0$) can be easily measured in a practical feeder system. Their ratio is called the Standing Wave Ratio (s.w.r.). This gives an indication of the extent of mismatch; the effect of remedial action can also be easily observed by futher

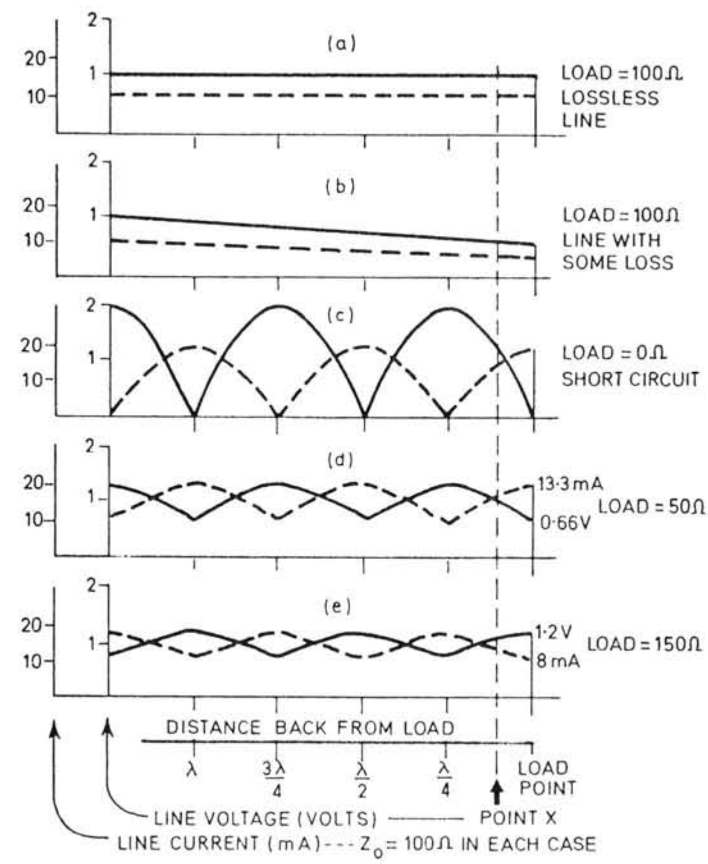

Fig. 1.1

voltage readings. Line current maxima and minima also occur; a current maximum occurs with a voltage minimum and vice versa. They are also easily detected with a loop probe. Some of the possible line conditions that can occur are shown in Fig. 1.1. In all cases the value of Z_0 is 100Ω.

(a) Shows the conditions on a lossless line, correctly terminated. A suitable voltmeter placed anywhere along the line would read 1V. Similarly, the current at any point would be 10mA. Both readings are at the frequency of the signal.

(b) Shows the effect on (a) if the line has some loss, mainly through line resistance. Both voltage and current values taper off towards the load. Their ratio would still be 100Ω at any point. If the line was cut at point x, the impedance towards the load would be 100Ω.

(c) Shows the voltage and current distribution when the line is short circuited at the load point. The current at the short is 20mA, twice the matched value at (a). Moving away from the short, measured voltage rises while the current falls. At the λ/4 point the voltage is 2V, while the current is zero. If the line were cut at this point and 2V applied at the same frequency as before, no current would flow. Thus in a quarter wavelength of line a short circuit has to be transformed to an open circuit.

If the phase angle between voltage and current at any point is examined, V is found to lead I by 90° in the first quarter wavelength. Thus the impedance at any point is purely inductive. In the next quarter wavelength it becomes capacitive. By selecting the correct length of cable, any reactance required can be presented. This is one of the uses of the Smith chart.

(d) Shows the effect of a resistive load less than Z_0. A quarter wavelength back from the 50Ω load, the measured voltage is 1.33V while the current is 0.66mA. Thus the impedance presented at this point is 200Ω. There is a limited impedance fluctuation along the line. For example, at point X the impedance would be partly inductive, with a resistive element between 50 and 200Ω, probably about 120Ω. In the next quarter wavelength the impedance will be partly capacitive.

(e) Shows a similar situation to (d), the load being greater than Z_0.

This whole example has been prepared for one set of conditions, the whole set would have to be re-drawn if Z_0 or Z_L were altered. Only one of the diagrams takes account of inevitable line loss. These diagrams are not the most convenient way of studying lines. They will be compared with the Smith chart later.

Normalising Impedance

The Smith chart is designed for a value of Z_0 of 1Ω. This enables it to be used for any line by suitable scaling. The reverse process is called normalising. For example, when a 72Ω cable is discussed, all impedances are divided by 72 before starting; the resulting solution from the chart is multiplied by the same factor as the last step in the solution. Two examples of this are given here:

Fig. 1.3, 4 and 5: Other circles can be added to give any desired grade of accuracy, and to reduce interpolation errors

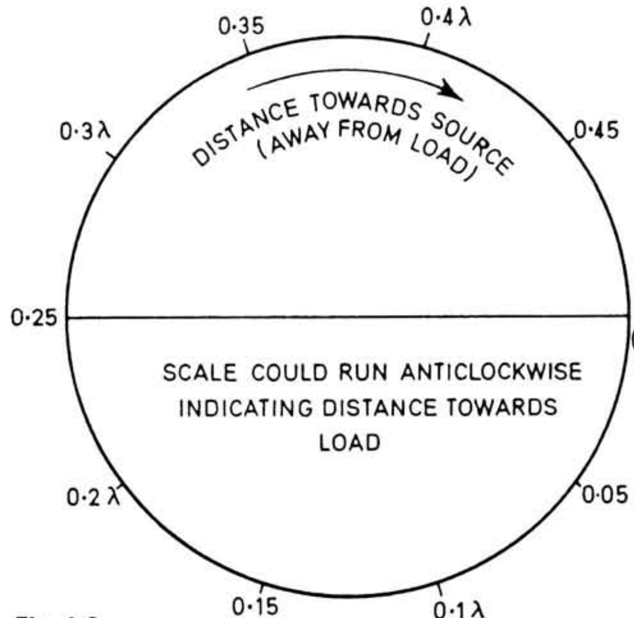

Fig. 1.2

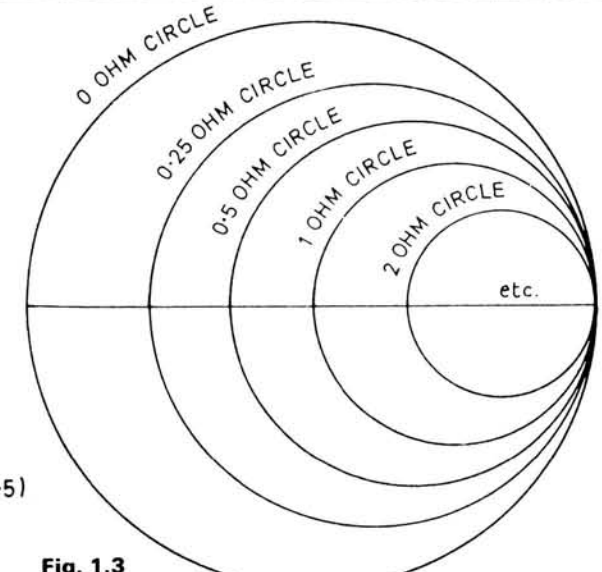

Fig. 1.3

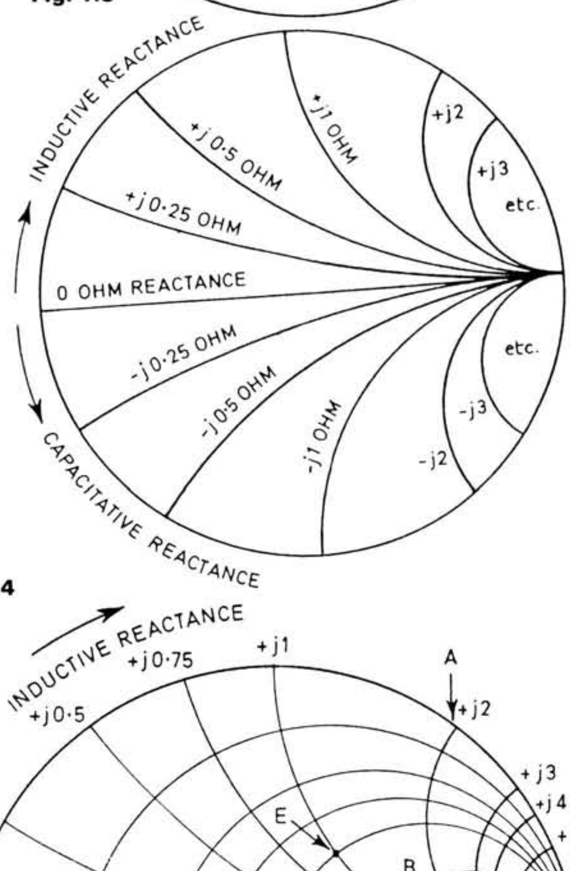

Fig. 1.4

(i) $Z_o = 72\Omega$; $Z_L = 100\Omega$ $Z_L = 100/72 = 1.388\Omega$ normalised.

(ii) $Z_o = 600\Omega$; $Z_L = 300 + j450$ (300 resistive in series with 450 inductive reactance)

Z_L normalised = $0.5 + j0.75$

Suppose chart solution is read off as $0.8 - j1.5$. Actual solution is $480 - j900$ after multiplying by 600.

The Smith Chart

The previous review is necessarily very incomplete. If should serve to make the Smith chart "come to life". The chart can be split conveniently into three parts which are superimposed into the full chart.

The outer collar is shown in Fig. 1.2. It is an even scale in wavelength. One full revolution is equivalent to travelling half a wavelength. This is all that is needed, because the line pattern repeats in each half wavelength (see Fig. 1.1(c), (d), and (e)).

A series of circles whose centres all lie on the horizontal axis is shown in Fig. 1.3. Each circle has a normalised resistive value, the largest representing zero ohms or a short circuit. The latter is also the defining outer circle for the whole diagram. An open circuit will have an infinitely small circle at the right hand edge of the diagram. The cramped portion of the diagram is for resistance above about $5Z_o$, values of little interest.

A series of partial circles is shown in Fig. 1.4. Each arc represents some value of normalised reactance. Thus $+j1$ is a normalised inductive reactance of 1Ω; $-j0.5$ is a normalised capacitive reactance of 0.5Ω, and so on. Again,

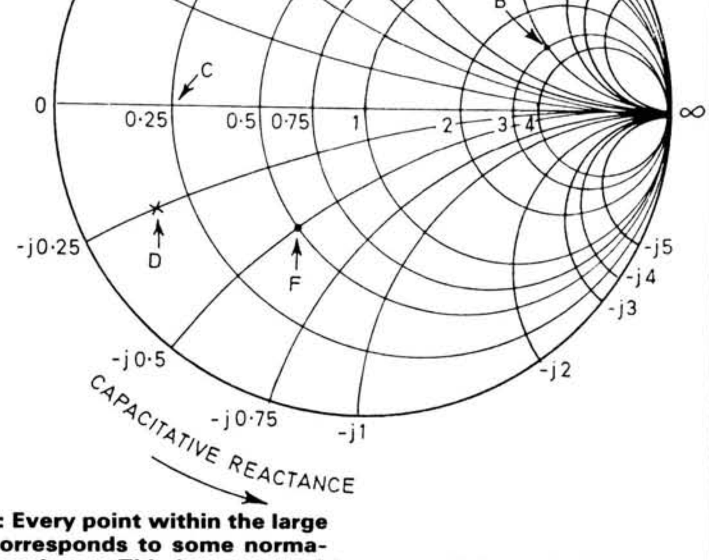

Fig. 1.5: Every point within the large circle corresponds to some normalised impedance. This is expressed in terms of the resistive and reactive circles cutting the point. Thus point B = 3 + j2

the cramped arcs represent high normalised reactances of little interest.

If Figs. 1.3 and 1.4 are superimposed, Fig. 1.5 results. If more circles and arcs are interpolated, or the diagram drawn larger, greater accuracy can be obtained.

Entering the Chart

Most problems start by the location of a normalised impedance on the chart; this is known as "entering the chart". Several examples are marked on Fig. 1.5.

Point A is a pure inductive reactance of 2Ω normalised. The word "normalised" will now be dropped, all readings in the chart being understood to be normalised. As a pure reactance has no resistance, $j2$ lies on the outer 0Ω circle.

Point B is an inductive reactance of 2Ω in series with a resistance of 3Ω. To get to point B from A simply follow the $j2$ arc down until it cuts the 3Ω circle.

It will be seen that this is just a two co-ordinate system with the axes curved round to contain a very large range of impedances in a limited area.

Point C is a pure resistance of 0.25Ω. It lies on the zero reactance line which bisects the chart.

Point D is an impedance of $0.2 - j0.25$Ω. As there is no 0.2Ω circle drawn, interpolation is necessary.

At this stage the reader may like to try locating the following impedances on the chart: $0.6 + j1.4$; $4 - j1$; $0.27 + j1.05$.

In Part 2 we look at some examples, using the chart.

Constructional

Kitchen Konstruktion

Number Two

Richard Q Marris G2BZQ, continues his occasional series, showing how even the most worthless item of domestic equipment can perform a useful function in the shack.

There have been numerous loop antenna designs published in this and many other magazines. Invariably one is told to rotate the loop for maximum signal strength, and then slightly adjust this position until any interference is nulled out. And why not? This is how you use such an antenna system.

But how, since most loop designs have no provision for easy and smooth rotation? Well, the writer uses a defunct record player turntable, salvaged from an old unit purchased for £1 in a flea market. Admittedly the amplifier didn't and the pick-up was kaput, plus the suitcase that contained it all had seen better days? But what can you expect for a pound these days. However, the most important item, the turntable, seemed to be clean and in good mechanical condition.

By this time you might be wondering what useful function this heap of junk has. Well, first it has a very solid turntable with a non-skid surface and a heavy duty, smooth running set of bearings.

Application

All you have to do to make a turntable for your loop, is to strip out the whole assembly, complete with motor. This will add some useful mechanical momentum to the finished system, preventing the turntable from wandering around at the slightest nudge. Finally remove the pick-up arm and any odd switches or levers from the turntable base plate. Before discarding the rest of the record player salvage any useful bits and pieces, such as the speaker, nut bolts and wood screws.

You now have a turntable with a non-skid surface, all fitted to a plywood mounting platform. It has heavy duty bearings and should be very smooth in its rotation.

Construction

The few holes left in the metal base plate of the turntable assembly, can be covered with blanking plates made from plastics or aluminium sheeting. Just for good measure put a drop of oil on the motor bearings before the turntable is pressed into service.

The next step is to mount the turntable assembly on a suitable wooden plinth. This can be made from four pieces of wood screwed together to form a square, then stained or painted. The exact dimensions of the wood used for the plinth will depend on the size of the turntable mounting platform and the depth of the motor. (Fig. 1).

The result is a good looking and very functional loop turntable. All that remains to be done is to place your loop antenna centrally on the turntable. **PW**

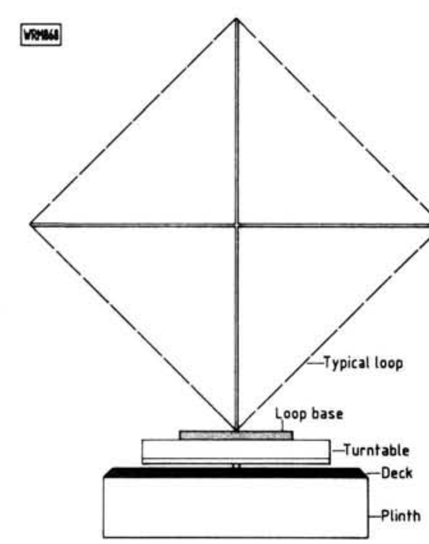

Fig. 1: Completed loop turntable showing loop position

Keep an eye out for Kitchen Konstruktion Number Three. It will deal with simple and effective coil former fabrication.

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AUDIO (BP111) (Elements of Electronics—Book 6)
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THE SIMPLE ELECTRONIC CIRCUIT AND COMPONENTS Book 1 (BP62)
The aim of this book is to provide an in expensive but comprehensive introduction to modern electronics. *209 pages* **£3.50**

PW REVIEW

Calculations requiring Smith Charts can be very time consuming and use a lot of "pencil and rubber" work. This program, reviewed by Mike Richards G4WNC, could save a lot of that work.

Smithchart by Scientific and Engineering Software has been written specifically to speed the design of matching networks for antennas and other r.f. devices. Although the program is intended for professional use it has an obvious application in amateur radio where we are constantly attempting to match transmitters and antennas.

Operation

The program is loaded in the normal way from either tape or disk. The initial display shows the program title and company logo for about 10 seconds while all the arrays are set-up. The on screen presentation of this program is very simple and there are no sophisticated graphics or error messages. The reason for this is not so much a lack of effort, but the fact that the program demands a lot of memory and there simply is not room. Because of the lack of error trapping, silly values can be input, but this is not a problem as you are given every opportunity to check your values before moving on to the next step.

The first page requests the entry of v.s.w.r. circle, nominal system impedance, number of impedance values to be entered and whether to plot or join these values on the chart. The v.s.w.r. circle is used only as an indicator on the chart. For example, if you were attempting to match a transmitter to an antenna and were quite willing to accept 1.5:1 as a satisfactory v.s.w.r. when this is the value that would be entered at this point. When using the chart, once you had entered a matching section that gave a result inside this circle you could easily see that your limit had been met.

The next page asks you to decide which format to use for the entry of impedance values. The values can either be entered as real values in ohms or as normalised values. The normalised values are relative to the system impedance entered earlier, e.g. on a 50Ω system 100Ω would be entered as 2. The program allows up to 9 different impedance values to be entered which should be more than adequate. Once the values have been entered you are asked to check that the values are correct before proceeding. If any values are wrong they can easily be amended at this point.

Once this raw data has been entered the processing can be started. The next menu gives you the option to plot the entered values on a skeleton Smith Chart or to change values or choose a matching section. This is the heart of the program where all the normally time consuming calculations are performed. There is a choice of 13 types of matching section covering from simple series and parallel L's C's and R's through to series and parallel tuned circuits, transmission lines and transformers. Once a matching section has been chosen you are requested to enter the values and then the program calculates the resultant impedance. This

SMITH CHART MATCHING PROGRAM

Copyright S.E.S. 1987

DATE: 12/5/87
NAME OF DEVICE: COMP.MONOPOLE

INPUT IS IMPEDANCE IN OHMS
VSWR indicator circle is 2
Nominal characteristic impedance of the system is 50 Ohms
Number of frequencies is 7

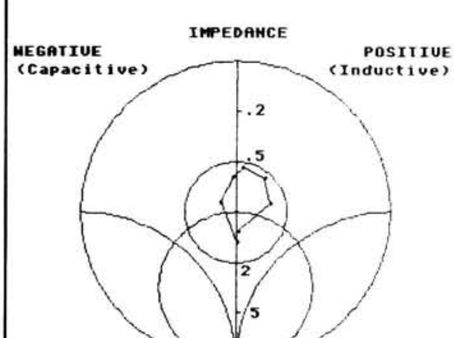
LOAD IMPEDANCE INPUTS ARE:

1	170	35.5	-37
2	175	30.5	-20.5
3	180	29	-7.5
4	185	27.5	0
5	190	30.1	12.1
6	195	35.5	22.5
7	200	52.4	24.1

RESULTS ARE NOW:-

NO	FREQ	R	X
1	170	74.06	0.42
2	175	42.55	-8.57
3	180	30.89	-1.15
4	185	27.21	2.77
5	190	29.9	12.29
6	195	40.56	19.29
7	200	63.38	2.49

USING:
PARALLEL TRANSMISSION LINE, IMPEDANCE 12 OHMS, VELOCITY RATIO 0.66,
LENGTH 0.26 METRES, SHORTED STUB



The print-out obtained if using an Alphacom 81 printer.

impedance is initially displayed in tabular form but you have the option to plot the impedance on a skeleton Smith Chart on the screen, which will quickly illustrate the effect of this section.

Real matching networks often require several stages and this program has the facility to add up to 6 matching sections which should cope with most situations. The effect of each section can be displayed as the network grows thus enabling the experienced engineer to experiment. One other essential feature is that the last section can be discarded if necessary, which eases the design process. Once a network comprising several sections has been designed you cannot go back and remove an intermediate section. The results of the final network are available either in tabular form or on the skeleton Smith Chart.

Application

Because this program has been designed for professional use it is assumed that the engineer has full details of the impedances that are required to be matched. In order to use this program in an amateur application the same information is required. If we take the case of matching a transmitter to an antenna system we know that the transmitter impedance is 50Ω but need to know the impedance of the antenna at the shack end of the feeder. This impedance can be determined simply by measurement with an r.f. impedance bridge. An alternative application is in the design of r.f. power amplifiers where the complex output impedance of a power transistor needs to be matched to 50Ω. In this case the details of the transistor output characteristics are available in the manufacturers' data, often in the form of a Smith Chart.

Performance

Although the program is called Smithchart its main feature is the ability to quickly calculate the resultant impedance when experimenting with matching networks. The mathematical performance of the program was excellent, so accurate results are assured. The skeleton Smith Chart display although very useful only gives an indication of the result as it is not possible to display enough detail for accurate measurement. One point that the newcomer should note is that r.f. matching is not a precise science and virtually every network will need tweaking to achieve a good match, the calculations serve to establish a good starting point!

As mentioned earlier the program is available in three versions. The first two, known as NPSBT and NPSBD, are identical except that one is supplied on disk and the other on tape. The third version (PRSBT) will accept 3 extra impedance values and 2 extra matching sections. In addition this version supports an Alphacom 81 printer thus enabling a printout of the skeleton Smith Chart and network values.

Further Reading

HF Antennas for all Locations by L. A. Moxon G6XN. Published by the RSGB. Available from the PW Book Service.
Electronic Applications of the Smith-chart by Philip H. Smith. Published by Krieger Publishing Co., USA. ISBN 0898 745527
A Practical Introduction to Impedance Matching by R. L. Thomas. Published by Artech House Inc., 1976.
ARRL Antenna Book edited by Gerald Hall K1TD. Published by the ARRL. ISBN 087 259 4149.
ARRL 1987 Handbook. Published by the ARRL. Available from the RSGB.
Radio Communications Handbook. Published by the RSGB.
Reference Data for Radio Engineers 6th Edition. Published by Howard W. Sams & Co., for ITT.

The Smithchart program is available from ***Scientific and Engineering Software, PO Box 416, Marlow, Bucks SL7 1XU,*** prices are: NPSBT £46.00, NPSBD £48.00 PRSBT £48.00 all prices are inclusive. Thanks to SES for the loan of the review programs.

Did you know...

That the first words transmitted by wireless were heard in 1880?
Alexander Graham Bell, the acknowledged inventor of the telephone, also constructed a photophone, which transmitted speech along a beam of light. It consisted of a telephone-style diaphragm with a silvered rear surface; when anyone spoke in front of the diaphragm, its vibrations caused rapid variations in the strength of a beam of sunlight—later, an arc light—reflected from its rear surface towards the receiver. The receiver itself consisted of a large concave mirror which concentrated the incoming light beam onto a piece of selenium that was in circuit with a battery and a telephone earpiece. On 16 February 1880, Bell held the earpiece to his ear and heard his assistant speak the first words ever transmitted intentionally by a form of wireless telephony: "Mr Bell! Mr Bell! If you hear me, come to the window and wave your hat."

That if a clever experimenter had not been discouraged by the wrong opinion of a famous expert, wireless telegraphy would have been invented 15 years earlier?
The first person to propagate radio waves intentionally was the American professor David Hughes, already famous for inventing the carbon microphone and the telegraph typewriter. For the transmitter he used an induction coil that generated sparks, and he envisaged the possibility of tuning the transmitter and the receiver into each other. On 20 February 1880 he successfully demonstrated wireless telegraphy for three hours to the President of the Royal Society and his two Honorary Secretaries, Professors Huxley and Stokes. However, Stokes wrongly attributed his achievements to induction, not radio. Discouraged, Hughes did not publish his invention, and through the mistaken opinion of a famous professor, wireless telegraphy was delayed fifteen years until the advent of Marconi. **Eric Westman**

Gunn Diode Oscillators

For Microwave Frequencies

Brian Dance takes a look into the world of the Gunn diode and explains both how they work and what they can be used for

Gunn diodes offer a convenient means of converting a direct current supply into a source of microwave energy over a frequency range of about 4 to 60 GHz. This energy conversion is carried out in a single stage, requiring only a supply of a relatively low voltage (typically 6V to 15V). The output has a relatively low noise level.

Lower power Gunn diodes are ideal for use as low noise oscillators, locking oscillators, etc. Although Gunn diodes are essentially low power devices, they can be used in low power transmitters to provide outputs of up to 0.5mW or more. Another application is in microwave Doppler shift alarm systems which detect the movement of any intruder.

Gunn Effect

The Gunn effect is a negative resistance phenomenon produced in bulk gallium arsenide material. The word "bulk" means the effect does not occur at a *pn* junction or at a surface. The charge-carrying electrons in gallium arsenide can be in one of two conduction bands; each band contains electrons of different energies and different mobilities.

In unbiased gallium arsenide the electrons are in the high mobility band, but as the strength of an applied electric field is gradually increased, more and more of these electrons are scattered into the low mobility band. As more electrons are scattered into the latter band, the average mobility falls. The electric field strength at which the average velocity of the electrons starts to fall is known as the threshold field. In gallium arsenide this threshold field is about 3.2kV/cm as calculated theoretically and confirmed by experiment.

The graph in Fig. 1 shows how the electron velocity in the two bands increases with the applied electric field until it becomes almost constant at high fields owing to interactions with the molecules of the material in much the same way that a falling raindrop acquires a constant terminal velocity due to the viscosity of air. However, the **average** electron velocity first increases and then decreases as a greater proportion of the electrons move into the low mobility band; this is shown by the solid line of Fig. 1.

The current passing through a given block of gallium arsenide is proportional to the average electron velocity. Therefore the current first increases and subsequently decreases above the threshold as the applied voltage is increased. This decreasing current with increasing voltage is known as a negative resistance. Actually, it is only a negative incremential or dynamic resistance, since if the resistance itself were really negative, the system would be able to provide us with an eternal source of energy with no energy fed in.

Negative resistance systems (such as the tunnel diode) can provide circuit gain and can therefore be employed to generate oscillations or to amplify signals. Thus the Gunn diode can be employed as an oscillator.

Gunn diodes are fabricated on an epitaxial layer formed on a gallium arsenide substrate. The thickness of the epitaxial layer must be close to the so-called "transit time length" at the operating frequency concerned in order to create the proper phase relationship to produce negative resistance in the voltage-current device characteristic. The transit time length is equal to the distance an electron of average velocity travels during a single radio frequency cycle. That is, it is equal to the average velocity divided by the frequency.

In a given device, the thickness of the epitaxial layer, and therefore the transit time length for optimum operation, remain constant, but the average electron velocity varies with the applied voltage. Thus the device may be "tuned" for optimum operation at a given frequency by varying the applied voltage.

Application

In order to make a Gunn oscillator, the device itself must be connected to a suitable circuit which can provide a positive resistance equal to the negative resistance of the diode, at the frequency concerned. The resonant frequency of this circuit is equal to the frequency of oscillation. In practice, all such microwave circuits have many resonant frequencies, so the Gunn diode circuit must be very carefully designed to ensure that it oscillates only at the particular frequency required. Losses must be made to occur at spurious resonances in the circuit.

The graph in Fig. 2 shows that the microwave output power from a Gunn circuit is zero until the applied voltage is adequate to turn the circuit on. This occurs after the threshold field has been reached in the material; smaller values of applied voltage will not lead to a negative resistance effect and oscillation is impossible. The output power then increases with applied voltage, reaches a maximum value and subsequently declines somewhat before falling to zero at the turn-off voltage. Normally the user wishes to operate the device at the peak of the output power characteristic of Fig. 2.

Frequency of operation

The maximum negative conductance of a Gunn diode (corresponding to the minimum value of the negative resistance) is obtained when the circuit operates at the transit time frequency for the epitaxial layer thickness used in the device. Maximum output power is obtained when operating at a frequency at which this maximum negative conductance is obtained. Thus, a given Gunn diode may be voltage tuned for optimum operation over a frequency band such as 5–8GHz, 12–20GHz or 50–60GHz. The frequency coverage of any one device is somewhat limited, the ratio of the maximum to the minimum operating frequencies usually being rather less than 2:1.

Although a diode when biased just

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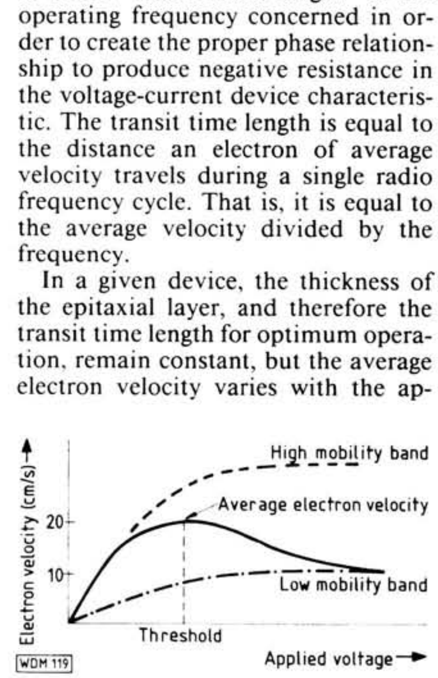

Fig. 1.

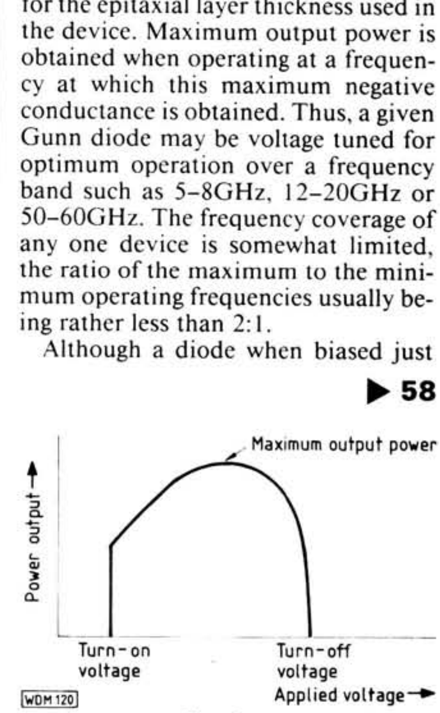

Fig. 2.

Following the interest generated by his first article Greg Baker will now be sending us a regular communication from down under. Australia's 16 000 amateurs seem to have a problem—they may become an endangered species. Read on and find out why.

Amateur Radio in Australia

There is a lot going on in VK amateur circles and in this and subsequent reports I'll bring *PW* readers some of the news on things like current debates, changes in regulations and licensing, what's in the amateur press and reports on the activities of such specialist groups as the Wireless Institute Civil Emergency Network, the Australian Traffic Net, packet radio, AMTOR, satellite and all the rest.

The Future

The apparent ageing of Australia's amateur fraternity is bringing forth some soul searching about the future direction of VK amateur radio. The Wireless Institute of Australia's (WIA) recent member survey showed that 52 per cent of respondents were over 50 years of age while only 9 per cent were 30 years of age and under. This information is being widely used to imply that Australia's amateur population is ageing. It seems to me that this inference is open to two criticisms on methodological grounds.

One is that the WIA's 5000 respondents may not be representative of VK's 16 000 amateurs. And only half of Australia's amateurs are in the WIA anyway. The other criticism is that people may become amateurs after 30 years of age and may have always done so. Nonetheless, many amateurs are worried that youth involvement is too low and I'd agree with them. Two of these, Jim Linton VK3PC and Roger Harrison VK2ZTB, writing in both the WIA's *Amateur Radio (AR)* and the commercial *Amateur Radio Action (ARA)* have examined the problem and presented some suggested solutions.

As they see it, the main reason why young people are not becoming radio amateurs is the lack of entry points which are relevant to today's technology and today's young people. In particular, Australia's novice licence does not permit data communication privileges. Harrison and Linton point out that there is an enormous interest in home computers and that at the moment the telephone network is used extensively for computer to computer contacts and access to bulletin boards. They contend that with an appropriate entry point vast numbers of computer hobbyists could be attracted to amateur radio. They estimate that there are half a million home computers in Australia and that given the right licence structure and appropriately targeted advertising, perhaps 10 000 computer hobbyists might join the ranks of amateur radio. This would give a huge boost to Australia's amateur ranks and in particular to the lower age groups.

The entry point they suggest is a new Intermediate (or Digital) licence which would combine novice theory with more advanced digital topics and delete the usual c.w. requirement. This licence could allow restricted h.f. as well as v.h.f. and u.h.f. privileges and would be a stepping stone with more theory and c.w. to the more advanced and less restrictive licences.

The other and possibly more contentious suggestion is to have a new 420MHz Telephony Beginners' licence. The idea is not only to attract young people into amateur radio but also to give a larger domestic market to make Australian manufacture of amateur transceivers a more economically viable proposition. This case is not so easy to argue. G. J. Armitage VK3XMW, writing in *ARA*, has pointed out that a Telephony Beginners' licence offers little that a no-exam entry to the ranks of Australia's 60 000 u.h.f. CB operators does not. VK3XMW also states that the constructional problems with even simple u.h.f. equipment are usually far beyond the technical competence of beginners. This would largely rule out Telephony Beginners engaging in experimentation with equipment and techniques.

Anyway, it remains to be seen what the Department of Communications does with these suggestions and whether the WIA bureaucracy decides to push for any changes along either of these two lines.

While I'm on the topic, UK amateurs will be particularly interested in this comment from Sam Voron VK2BVS in *ARA*: "When the UK amateurs voted by survey to say 'no' to the novice licence last year, they lost that country a generation of potential new radio enthusiasts."

Contests

Frankly, I've never been too interested in contests. Of recent weeks, however, I've listened to a few, long, boring monologues from VK amateurs (read *PW* December 1985 letters for G1IJG's excellent comments on this sort of thing). As a result I've begun to think that the brevity and clarity forced by contest operation would do a lot of amateurs a power of good if they got in there and had a go.

The annual John Moyle Field Day Contest was conducted in 1986 on March 15–16. The contest aims to encourage portable operation and to prepare amateurs for emergency situations. One novel feature is that bonus points are given for contacts made from stations powered totally from natural power sources such as solar cells or wind generators. Entrants are not permitted to erect any apparatus on site more than 24 hours before the beginning of the contest period and scoring is biased to give an advantage to portable operation.

Last year VK, ZL and P2 amateurs took part in the VK Novice Contest. The contest is designed to encourage contest operation with special emphasis on novice operator contacts. To this end, only VK, ZL and P2 amateurs can enter and all contacts must be made in the novice segments of the 28, 21 and 3.5MHz bands. To encourage novice c.w. operation, all c.w. contacts must be made at less than 10 words per minute and the major prize, the contest trophy, can only be won by an operator using both voice and c.w. In 1985 this event attracted 59 entrants, up on 40 from 1984. While these numbers don't seem very high, remember that Australia's biggest and most widely based contest, the annual August Remembrance Day Contest attracts only about 500 logs.

Amateur Press

Past issues of *ARA* have included a solid six-part technical series on understanding transmission lines by Ron Bertrand VK2DQ, an article by A. R. Jenkins ZL2TVT on simply constructed 420MHz power amplifiers, and reviews of the AZDEN PCS-5000 and Kyokuto FM-240 144MHz transceivers and the Kenwood TS-440S h.f. transceiver.

AR from WIA has included an important series on aircraft enhancement of v.h.f./u.h.f. signals by Gordon MacDonald VK2ZAB, a technical article on tropospheric scatter propagation by Ian Roberts ZS6BTE, and construction details for a 4W 3.5MHz c.w. transmitter costing all up about $A30 (£15 approximately). **PW**

Any VK amateur or s.w.l. with news which may interest *PW* readers can send it to me at P.O. Box 93, Braidwood, N.S.W., 2622.

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beyond the threshold may oscillate at nearly 20GHz, if biased at about four times the threshold it may operate at about 10GHz but efficient operation can be obtained only over a much narrower frequency range. A Gunn diode biased only just above its threshold will generate an extremely low power output, since the voltage swings cannot fall much below the threshold. This gives rise to one of the major problems encountered in the use of Gunn devices, namely the reduction of the output power as the voltage is reduced to provide for higher operating frequencies.

Microwave Associates of Dunstable suggest that a good choice of the operating voltage to obtain maximum power from their Gunn diodes is 3·5 times the threshold voltage. However, the device must be selected so that when it is biased to this voltage, the transit time length at the desired frequency of operation is well matched to the epitaxial thickness.

Low temperature effect

A Gunn oscillator circuit which operates satisfactorily at room temperature may fail to oscillate at temperatures appreciably below freezing. As the temperature is lowered, both the turn-on voltage and the voltage required for peak output power rise (typically about 2V/100°C for X band diodes). Thus it is important that a Gunn diode which may have to operate at low temperatures is biased in such a way that it will always start to oscillate at such temperatures. However, the operating voltage should not exceed the room temperature peak voltage, since the output power can drop quite rapidly at higher voltages and excess a.m. noise may also be formed.

The rise in turn-on voltage and peak power voltage with a fall in temperature is due to the increase in electron velocity at low temperatures under a constant electric field strength. Hence the transit time frequency increases at low temperatures. This may cause circuit operation to switch to a spurious resonant higher frequency mode.

The increasing drift velocity at low temperatures will result in an increased direct supply current and an increased power output. Optimum power stability is obtained by operating the Gunn diode at its peak power voltage at the highest temperature of operation likely to be encountered.

The design of Gunn diode circuits is obviously a complex matter and is usually finalised by trial and error, but details are beyond the scope of his article. The iris coupled waveguide cavity is one of the most widely used Gunn oscillator circuits. The size of the cavity determines the resonant operating frequency, but it can be tuned over a typical range of some 20 per cent by inserting a rod of a dielectric material. External coupling can be increased by an enlargement of the iris.

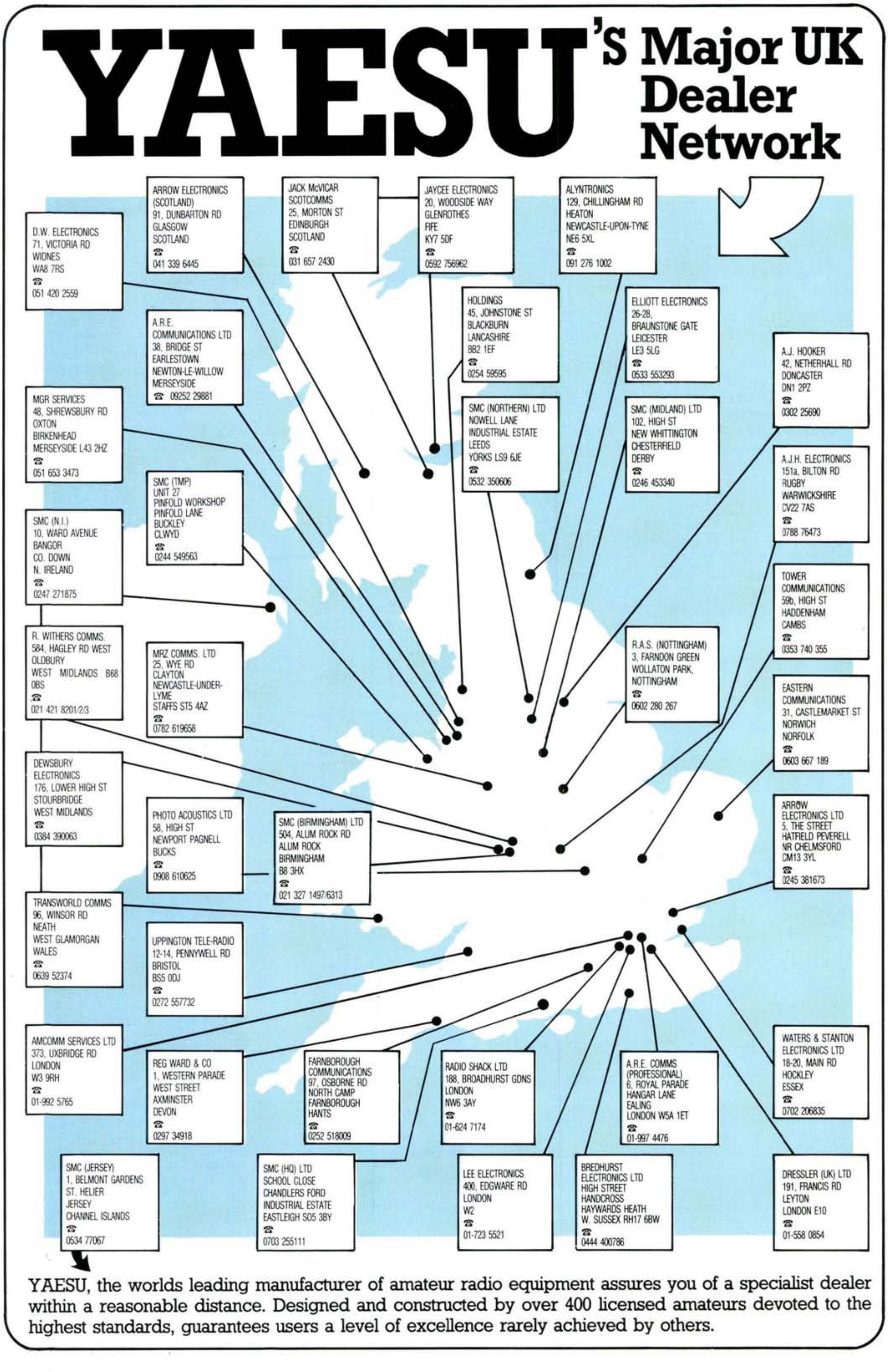
The oscillator cavity will expand as the temperature rises and this will result in a fall in the frequency of operation. Copper expands less than aluminium, so the use of copper for the cavity results in a smaller frequency change due to this cause. The change in the Gunn diode capacity with temperature also produces a frequency change in the same direction, but this may be minimised by increasing the Q of the cavity to 100 or more.

Temperature compensation can be effected by mounting the dielectric tuning rod inside a metal shaft which expands with rising temperature. The tuning rod is mounted at the end of the shaft remote from the cavity and, as the length of the shaft increases with rising temperatures, the rod will be lifted somewhat out of the cavity to provide the required compensation.

PW

Apologies!

Due to a "hiccup" in the delivery of the October and November issues, *Practical Wireless* was unfortunately late going on sale in newsagents. We trust this problem has now been overcome. The dispatch of subscription copies was unaffected.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Feature

Practically Yours

by Glen Ross G8MWR

Kill the Sacred Cow

It really is time to nail the myths of the s.w.r. legend once and for all. Not this time on the basis of whether your s.w.r. meter readings can be trusted, but simply on the basis of "does it matter anyway?" There is no doubt at all that many amateurs reject perfectly good antenna systems simply because the s.w.r. is somewhat higher than they think it ought to be whilst, at the same time, accepting poor ones because the s.w.r. is "right". Taking the "s.w.r. is right" to the ultimate conclusion would indicate that you should get out very well if you use a dummy load as the antenna; and this is obvious nonsense.

The Big One

There seems to be a general belief that reflected power is wasted power and that somehow this reflected power is used to heat up the heatsink on the back of the rig; this is NOT TRUE. Reflected power does not represent lost power except for a small increase in attenuation on the coaxial cable compared with the loss that would exist in a perfectly matched (s.w.r. 1:1) situation. If we assume a perfect lossless feeder then NO extra power is lost on it, no matter how high the s.w.r. may be.

The attenuation of the feeder and also the s.w.r. must be very high before significant losses are incurred. On the h.f. bands any extra loss due to s.w.r. will be insignificant, at v.h.f. it may start to become significant and at u.h.f. it may be a matter of importance. To put some figures on it; if you have a "matched" loss on the cable of 3dB then the extra loss with an s.w.r. of 3:1 will be only 1dB and no one is going to hear the difference in your signal (except, perhaps, if you indulge in moonbounce operating). Table 1 is worth close study.

Heating Up

Reflected power does NOT flow back into the rig and get lost. The problem here is that the makers of your rig have decided that it is going to work into a load of 50 ohms and have tuned it up to do this. As the real load impedance moves above or below this figure the p.a. becomes unmatched and starts to operate less efficiently. Because it is using less of the available power to produce r.f. the difference is produced as heat and so the hot heat sink syndrome. If you have the nerve to open the rig and re-tune the final stage so that it expects to see the impedance you have actually got and not that which the makers assumed you would have, then, you will once again get full power and no excess heat.

1:1	2:1	3:1	4:1	5:1	7:1
0.5	0.62	0.8	0.95	1.2	1.5
1.0	1.2	1.5	1.8	2.3	2.8
2.0	2.3	2.8	3.4	3.8	4.5
3.0	3.4	4.0	4.5	5.0	6.0
4.0	4.4	5.2	5.8	6.3	7.4
5.0	5.45	6.3	6.9	7.9	8.6

Total dB loss on cable compared with perfect match (1:1) conditions.

Maker's Error?

The big problem is that the components fitted in the p.a. by the makers may not have sufficient swing to meet your requirements. In this case you have to resort to an external a.t.u. to do the job for you. In passing it can be said that the old valve system of "Tune and Load" controls was, of course, simply a built-in a.t.u. capable of matching to a wide range of requirements. It cannot be overstressed that p.a. overheating is NOT caused by the s.w.r. but by overcoupling or mismatching. The output stage does not see the s.w.r. but only the impedance that results from it and the impedances can therefore be matched to that needed by the transmitter output stage without any concern for the s.w.r. on the feeder system.

Low SWR

A low s.w.r. is NOT an indication of a good antenna or of one that is working efficiently (see my earlier remarks reference a dummy load). In actual fact, a lower than normal s.w.r. over a significant frequency spread is probably a good reason to suspect that an antenna, which has not been designed specifically for broadband operation, is actually being affected by resistive losses which ought not to be there. The major causes of the problem to look for are a poor or partially disconnected earthing system, poor connections to the components parts of the antenna or a very lossy feeder line. As far as the radiation from the antenna is concerned any attempt to improve it by reducing the s.w.r. below about 2:1 is simply wasted effort.

Cut The Cable

How many times have you heard someone say that they have trimmed the length of the coaxial cable so as to reduce the s.w.r. and get a good match? It just does NOT work like that. The s.w.r. is set by the ratio at the antenna feedline junction of the impedances you wanted and those you have actually got. If, in a nominal 50 ohm system, the cable is 50 ohms and the antenna feed impedance is 100 ohms then you have an s.w.r. of 2:1. You CANNOT change this s.w.r. by chopping lengths off the coaxial cable. All that you are doing is to move the s.w.r. meter to a point on the line where there is a 50 ohm impedance; but what happens along the length of coaxial cable that connects the meter to the rig?

Were You Right?

If your theory that you have achieved a matched condition by cutting the cable was correct, then you should be able to extend the cable by adding some more 50 ohm cable to the matched point; but that is exactly what you had before you started to cut it in the first place. Equally, you cannot get a 1:1 s.w.r. on the line by cutting chunks off the antenna, what you are likely to be doing is forcing a mismatch at the antenna feeder junction of such a value that the s.w.r. meter sees 50 ohms at the point where it is connected into the line.

The Final Truth

The final test of a truly matched system is to insert an extra quarter wavelength of coaxial cable between the feeder and the s.w.r. meter. Allowing for velocity factor, this would mean about 330mm for 144MHz and, due to the fact that the same effect occurs at ODD multiples of the length the same length will also serve on 432 and 1296MHz. If the system is truly matched there will be no difference in the s.w.r. readings with this extra length in or out of circuit. Due to the transformer action of the extra length in an unmatched system the same test would then provide considerable differences in the reading with the extra length inserted or removed.

For My Next Trick

In next month's "gripping installment" we will look into some more of the facts and fallacies that surround us. Does an antenna have to be resonant, will current flow on the outside of the coaxial cable, will an a.t.u. reduce the s.w.r. on the system and most important of all; will the guy at the other end notice any difference?

On The Air

On The HF Bands

Reports to Paul Essery G3KFE
Practical Wireless, Enefco House, The Quay, Poole, Dorset BH15 1PP.

After a month which has been more down than up, quite the best conditions for several days are making me wish I didn't have a deadline!

However, the latest "form" prediction, while it shows improvement in sunspots also shows that the negative aspects are in the ascendant—and at this stage in the cycle it is the latter that can, and does, foul things up for us.

The Bands

Perhaps we could make a start with Top Band, where the main news is that I have found an address and have sent to W1BB a card on behalf of all the Top Band crowd, mentioning as many calls as I could recall from this side of the Pond. Those who recall those lovely quirky W1BB Top Band Bulletins of years ago might like to know that the "1987 Model" is in fact the *Canadian Top Band News*, edited and published by Ivan Payne VE3INQ, PO Box 146, Postal Station E, Toronto, Ontario, Canada M6H 4E1. To get one, send a $4\frac{1}{4} \times 9\frac{1}{2}$in envelope plus 4 IRCs; if you send an extra envelope it will be kept on file for next time.

G2HKU (Sheppey) returns to the fold after an absence. However, there was an s.s.b. QSO with ON7BW, and c.w. to YO3CD just to keep the rig dry.

G3BDQ (Hastings) was also not very active. Just before he went on holiday, John raised TR8JLD through a mighty pile-up, and was followed through a little later by G3BRD. However, as John says, one of the problems of Top Band DX operating is that there are those who call the DX but have only antenna capable of working round Europe—these merely create QRM in John's view. Other QSOs for G3BDQ included UW3BF, RA4CLZ, UA9FAR and YO7BI. For the record, the YO stations have now got a firm allocation in Top Band—most of the YOs previously around were with special licences.

The 3.5MHz Band

Our only reporter on this band is **Angie G0HGA** (Stevenage) who used her 2 watts to hook up with GI4JXA, G4TSD, G4AWI/P, G4ZMH, DL0BZ/DF7WZ, OF1AF, OZ4HZI and RB5WW, all on c.w.

The 7MHz Band

Most of the people who work the stuff on this band keep their doings under their hats. However, this month we have a contribution from **GM3JDR** (Wick) after a gap of some ten years or more. Don runs a half-rhombic at 20m, and this and some c.w. netted him UA9UIX, UZ9OWD, UL7YAO, UI8LB, UL7PFH, UA9SEY, RL9MM, UA9MAC, VK2KM, UZ9AXB, RH8BA, UA9SAD, PY7IW, VK3NC, JA7OEM, UA9QCR, VK3MR, WT5K, PY2MI, VK2XR, K3OO, UA9OLO, UA9AWZ, UA9CG, UI8BWI, UA9CAQ, UZ9QWM, UA9SIF, UA9OHN, Z23JO, VK2FEX, VK3MJ, VK2FOC, ZL2VS, UA9JME, VU4ODX, VU4OTTC, RSA9SVL, UA9UMI, LU0ASC, ZS1CT, UA9MHL, UZ9XXM, ZS6NT, UZ9YWC, 4K1A, RW9USA, LU3CF, UL7CEP, PP1IR, CE6JOS, PY4ZO, RH8AO, VU4ONIS, DK2SC/4S7, VU2TTC, VU4OJOS, FJ5BL, UL7JW, UA9FGJ, UA9XAB, UM9MWA /UM5P, YB0TK, 4Z9AAC, UA0BL, UL8PZZ, UL8BWW, RA0AR, JA3YKC, YB7KD, ZS6AEU, ZS5LB, YV1AB, VK2APK, OA4ADX, FT8ZA (Amsterdam Is.), RL7PAC, UA9CFH, YC8XV, JA5RH, 9M2FS, VK8MQ, JH7FMJ, VK5KL, ZL4AW, VK3GY, UA9SLK and ZS1CS.

G0CCH (Tiddington) mentions his CQ being answered by EI9CB; during the QSO, Mo reduced his power output first down to ten watts and finally to as low as four watts, still maintaining full Q5 contact; the rig an FT-901DM fed into an inverted-vee version of the G5RV antenna, at about 10m. However, Mo says Tiddington is about to be adorned by a VK2ABQ beam just as soon as the spreaders are scrounged—I look forward to having a report on the difference a beam makes to things.

For G2HKU there were c.w. QSOs with ZY3ESB, UA9SIF and UC1LWJ.

Final reporter for this band is **GW0IER** (Milford Haven) who used to report, as an s.w.l., to the late Eric Dowdeswell G4AR back around 1974–75. However, in the mid-August period, the ticket arrived and so Brian got out of bed on the morning of August 25 at 0300, on to 7.020MHz and with 50 watts of c.w. raised VE1CAF, WA8UQK and WA4BPS; on learning that this was the first DX session, WA8UQK promised a card direct, which arrived a week later. As Brian says, "Yes, I like forty".

WARC Bands

It is understood from *DXNS* that the TFs now have use of all three bands 10, 18 and 24MHz, the authorisation running until the end of 1988.

Our first report this time is from a first-timer to this piece, **G0CXT** (St. Helens). Carol says she likes this band, and also likes to operate at low power levels. This approach netted her DJ2FR and I3HYVS with five watts, FM5ES in Martinique on the morning of September 15 at 0910, OE5ORM and I5VVA/IQ5 the previous morning with thirty watts, and K3DI at 2105 on September 13 with the massive input of 45 watts. If I read Carol aright, she decides her input level on the basis of her assessment of conditions when she starts a session, and sticks to it; would that a few more operators would use this technique. I hope we will have more reports from St. Helens.

Turning to **G3BSN** (London SW9), he has been on 10MHz and heard DL, EA, I, LZ, SM, UA, YU and the UK; actually worked were OZ1HQG/A for a new country on the band, K4RF on Pawley Island, and a few Europeans.

GM3JDR also uses 10MHz, and his c.w. signals went out to KY9L, W1FD, ZS2HB, VK7RY, VK3CAL, UI9IWZ, 7X2SAX, VK7TM/P, VK3BXN, VK3CDU, VK3MJ, KB2QM, K4CNZ, W2GDV, EA8AAU, UV9OK, VK2APD and EA8AGF.

G2HKU, however, changed his allegiance to 18MHz, and as a result offers I2CZQ, VE2HN, VE3FGU and VE3OWD; plus the interesting observation that just minutes before the band "folds" for the night the VE signals rise suddenly by two S-points or so and then drop to zero during a QSO.

Oddments

With all the hoo-ha over the Jubilee DXCC, *DXNS* Editor G4DYO suggested that *DXNS* readers have their own little Silver Jubilee competition, starting on September 1. In the issue dated September 16, Bren was able to report that Hazel G4YLO, had taken up the challenge and had worked in that time, some 180 countries (170 of them between September 6–14), 110 zones, and lacked only XE for a WAZ on 14MHz. The nearest the OMs could do to that was G3HTA, who had 157 countries and 116 zones. Between them, they had worked over 200 countries in two weeks—and there were a number of gotaways!

Those of you who are into IOTA, the island-chasing activity, but have "done it all" might care to look into W4BAA's "No-Go" Award—write him direct at the *CQ* address, and enclose something for return postage.

The RSGB's ROTA trophy is awarded for consistent DX achievement. I now hear it has been awarded to G3LQP; apart from being up there with the Top Dogs, Roger has been an active and good QSL Manager for various DX stations, and for a long time ran the Commonwealth Net. Congratulations G3LQP.

There is a move towards a DXpedition to Spratly Is., the timing planned for around March 1988. All I can say is we hope no-one gets hurt or shot at this time.

Next I have a beef from **G0CJM**, back home for a brief spell; Reb notes that his interest is QRP c.w., and he has been a bit disgusted that five times he called stations heard CQing, and each time he got a deafening silence; the CQer had either shifted frequency or gone QRT. One wonders whether G0CJM is being shaken by the difference between being in a common country like G and a rarer one such as 9V1; even the difference between G and GW as prefixes is noticeable in this context, and always has been, for as long as I recall. I was certainly aware of this effect twenty years ago, and understood it was by no means a new thing then.

Contest Scores

I have the 1986 CQ WW CW results to hand, thanks to W1WY. Looking for UK callsigns, I find none in the top scorer's box, in any category. However, in the all-band, G3MXJ made a six-figure score of 1 641 150 points, with G4BUO (G4BUE?) up at 1 521 674; on 21MHz G3HCT was only just out of the top scorers box; and G3FXB followed suit on 7MHz with G4CNY close behind. In the Multi-op Single Transmitter scoring we noted GB4DX with over 2 million and GJ0AAA at 4.2 million scores. Congratulations to all.

The 28MHz Band

G3NOF says there has been a big improvement in the band, with many EU openings during the day, plus Africans from 1600, followed by Central and South Americans up to 2100, and a few East Coast Americans were heard weakly. QSOs using s.s.b. were made with A22BW, C53CR, FY4EE, J87CD,

JG1FGV/5N0, KP4GY, TJ1DL, TZ6FIC, Z21BA, ZD7BJ, ZY5CC, ZY5EG, 5N9GW, 6W7OG and 9Q5NW.

GM4ELV (Glasgow) covers two months in his report; for August there were DL, HA, HB, F, G, I, LA, LX, ON, OZ, OY, PA, SM and UA, plus CX8DM, CX7ABH, ZD8MAC (QSLs to G3IFB with a reply in three weeks), ZD8MB, YV6BN and ZP5HF. In September, Dale worked 4X4HQ, 5B4TI, YV1AVO, PY3PG, A22BW (QSLs via DK3KD), ZS6ARM, ZS6P, PZ1AP (PO Box 566 Paramaribo), plus hearings of 8R1 and A22BW on RTTY.

G4HZW (Knutsford) has returned to the fold. First, the quad had to come down, and the gamma match was repaired, with a prediction that by mid-October VK and W will be in the log! Looking at the notes from G3NOF above, the predictions are half history already at September-end. Tony worked 9Q5NW, A22BW, A22KZ, CE3GEI, CX2AAL, OZ, HB0, YU OK, OH, TZ6FIC, ZY5EG, GM0GNY on the Dunlin A oil rig, G4RZQ/M who was in a JCB in the Isle of Wight (!) and G0CGL from Bournemouth.

G3BSN notes the seasonal changes, although Sporadic-E was still noted, on this band. Phil heard DL, EA, F, I, LA, OH, SM, SP, YU and A22BW, and worked ZL7AZ, ZP5ZPH, JG1FVZ/5N0, 5N9GM, 4X1SK, PY1AKM and PY2AAM.

The 21MHz Band

First we have **GM3JDR.** Don has, as we recall, always been a bit of a 21MHz fan. This time his c.w. went out to JF6DEA, UZ9CWB, UZ9FWQ, JM1KYK, JG2LVR, UA9JJS, UA9CR, JA3YKC, JF2VHS, UA9CGL, UZ9SWY, UL7CW, UI8AFA, UJ8NA, UZ0WWA, HZ1HZ, UZ0AXX and ZS1VP.

Now G0HGA, who certainly seems to do better on this band with her QRP. After a first QSO with the States, in the shape of K1SHR, Angie managed seven assorted UA9s, a 4X, SV1TU, not to mention smaller fry such as 4N7N, IK3DBH, UA9WBL, UA4AAR, YT3ZT, DL9GBV, DL3NBW, UR1RWN, I4XJH, YU4AGL, YU2ZH, OK2SKN, I2CZQ, EC4CPI, UA3DWF, OZ4LO, RB5HID and OK3RK.

The long path to Asia and Australia has been poor except for a few JAs, reports G3NOF (Yeovil), but the short path has been much better from 1000 onwards, starting with JAs and then YB/YC signals between 1000 and 1700Z. Africans are noted around 1600 and South Americans in the early evenings. East Coast Ws were audible between noon and 2200UTC, but signals were often weak; there were a few openings to the West Coast around 1700. G3NOF notes s.s.b. contacts he made with A22FN, AP2AC, CE6EJZ, CO4RCB, CP6PX, FG/DL1FZ, FM4DN, FR4DN, H25MF, HC1OT, J87CD, JI6KVR, K6OKW, KG4GN, LA1WO (Karmoy Is.), N4MJH/DU8, N6DKP, P29KRE, PJ9EE, PA3AXU/SU, SV2RE/SY (Mt. Athos), SV2UA/SY (Mt. Athos), SV2TX/SY (Mt. Athos), TI2LCR, TI2LTA, TR8SA, TV6MED, TZ6VV, V31PC, VP2EZ, VU2NR, XX9JN, many YB/YC stations, ZP5JC&Y, ZY5CC, 3B1FP, 5N3BHF, 7J3AAB, 7P8DP and 9V1WP.

G4RWD (Burton-on-Trent) enters the scene at this point with a first report; Ken has a TS-830S run barefoot, and a trapped dipole which have given much pleasure over the past five or six years. The favourite band is 21MHz, and over the past few weeks Ken managed c.w. contacts with UD6DKZ, UM8MQ, VP2VI, VP8BNO, YC2CTW, ZY1CRP, T77C, LU8DYH, plus s.s.b. contacts with VP9LL and ZS3L (Namibia). Of course, there were some smaller fry from Europe, and Gotaways, of whom the most irritating was probably OE8PRK/YK (Golan Heights), who was called for over an hour.

The 14MHz Band

Allegedly where it all happens. For me, the band yielded VK2AU, N4NJH/DU8 on s.s.b. as the month's prizes, plus some assorted c.w. out to the east, of which the best was probably UA9 and UA0. In the Gotaway line, 9M2PE disappeared slowly and gently as the propagation tailed off in that direction.

G0HGA and her QRP managed OK3RK, UB5AKA, LZ1KOZ, HA8KUH, OH2AQ, OH2BVE, LZ2JG and LZ1KMZ, with just a couple of watts.

Turning to G3NOF, Don found the long path to VK opening up from 0630Z to around 0800, starting with VK2 and working across to VK6/7; the Pacific came in over the North Pole from 0730–0930Z, with the short path to VK good around noon, followed by Asians until 1700. The short path often opened up again to VK and Asia around 1900Z when some of their early birds are about. The USA and South America was often good from 2000Z. All this added up to s.s.b. contacts with AP2ASA, AP2KH, AP2SQ/40, AP5HQ/40, DU1JMG, DU9RG/8, FG/DL1FZ, FK8CR, FM5CB, FR5ES, HC2CV, HP2LCG, HS0B, I2HLZ/VP2M, IB1GRM, IV3JWR/IL3, J37AJ, JR1GSE, KA2HH/JD1 (Iwojima), KA2IJ/JD1, KH2D, KX6DS, LU3XQB (Tierra del Fuego), N4MJH/DU8, NL7JZ, OE2CHN/KH8, OH3GZ/OF0, SV2RE/SY, SV2UA/SY, TI8GBT, TI2LCR, TU2QW, UZ0KWC in Zone 19, V44KAR, VE7CRW/VE8 (Alert, NWT), VE7UBC, VE8RCS (Alert, NWT), several VKs including VK5ANC/M, VK9NI, VP2MDY, VP8VK, VS6DO, XX9JX, YB5NOF, YB0KM, YB0ZEA, ZL4BO, 3A2LF, 3D2IC, 3D2JO, 4K1F (South Shetland), 4K0D (North Pole), 4S7RO, 5V7SA, 5W1FM, 5W1FT, 8Q7MT, 9M2CW, 9M2HB, 9M2LN, 9M2RI and 9V1TJ.

Next we have G4RWD, who found FP/NT6G (St. Pierre), AP2MQ/40, VE3CNE, OD5/PA0PS, VF1YX and T77AB on s.s.b., plus c.w. to VU2GSM and UI8AI.

GM4ELV and his QRP reports show August with KH6JEB/KH7, PY1ZAK, OF0MA, TV6MED, and for September there were JAs, H25MF, EA9O, C53H (does anyone have a QSL address for this one?), plus VEs and Ws.

Now we head up further north, to GM3JDR; his half-rhombic inhaled signals from and radiated c.w. to UA0LU, UA0WW, UA0LFS, JA2FEG, UL7CW, UA9YIE, UA0KCJ, UA0SXE, UL8CWW, YB0CXN, KS4E/MM in the Indian Ocean, UA9OLO, ZS6AEU, UA0BCK, UW9WB, UG7GWB, JA3YKC, UV0BB, UJ8JW, UZ0AXX, UI8AEA, PA0GAM/ST2, UA0IDF, JH4MIC, UZ9OWM/UA0Z, AL7IF, K9EL/VS6, RD7DZZ, UW0CN, VP8VP, HC2SL, JA7AS, PY2BBO, YB0DPC, W87PAX (pan-American Games station), UA0JU, VK2BDS, BY4RB and UA0CFC.

Finally we have the c.w. of **G2HKU** (Sheppey); Ted notes PY1QN/PY9, UA9XHT, VP2MDY, PA0GAM/ST2, TK/HB9ASZ, K4KQ, W4IF, VE7ZK, K4NV, N6EA, HK3NR and K4FU.

Final-Final

This is where I acknowledge with thanks my various sources; apart from your letters these have incouded W1WY's *Contest Calendar,* VE3INQ's *Top Band Bulletin, The DX Bulletin, The Canadian Amateur* and of course *DXNS.* Please keep the letters rolling in—I can ALWAYS use more input, covering any or all of the bands 1.8–30MHz and your doings thereon. Don't forget, this column isn't just for the dab hands; it's also for the newcomer, chuffed after his first contact outside UK, for the QRPer—in fact, for everyone.

VHF Up

Reports to Norman Fitch G3FPK
40 Eskdale Gardens, Purley, Surrey CR2 1EZ.

Since last month's deadline there has not been any more spectacular tropospheric propagation to report but there have been several reasonable Auroras with the more northerly stations working some respectable DX.

Beacon News

The new Irish beacon in the 144MHz band is proving to be very useful and is usually copiable at G3FPK. It is on 144.920MHz and sends the following: "CQ CQ CQ de EI2WRB lat 52D 15M North long 07D 20M west QRA IO62IG 248 mtrs asl ant dir 95D erp 200W mode A1 F2 de EI2WRB." I have left out the space signals.

As has been mentioned many times, the sub-band from 144.85 to 144.99MHz has long been internationally agreed for beacons only with the recommendation that it not be used for normal communication purposes. Unfortunately for those in the London area, a group of amateurs seems to be using 144.95MHz on a regular basis.

From time to time, someone will ask them to move but their usual response is to offer to stay quiet for ten minutes ". . so that you can listen for your beacon." Another response is to inform the rest of us that, "the nearest beacon is in Scandinavia . . ." Well, that might be true but what these operators seem unable to understand is that quite a few of us like to monitor these distant beacons, not regularly heard on tropo, for meteor activity and in some cases to check for Auroral propagation.

These beacons have been built, installed and maintained by fellow amateurs to provide a valuable service for others who wish to study propagation. It seems very selfish of this group to knowingly deny them this opportunity when they know full well there are plenty of frequencies they could occupy in the non-channelised, all-mode section below the beacon band.

The Awards Programme

No new applications to report this month however **Gerald Nenner DL8FBD,** member number 39 of the 144MHz QTH Squares Century Club, was awarded his "250" sticker on September 8. He sent 26 QSLs and now has 251 confirmed. 16 QSOs were on c.w. and the rest on s.s.b. Only one contact was on tropo with two via Ar, nine via Es and 14 on m.s.

Some good ones as m.s. included GM4AFF/A (WR) and EI8EF (VO) on s.s.b. with c.w. accounting for EA2LU/3 (AA), SM2ILF (KY) and OH7MA (OW). Es DX included UA3ZDI (SL), UA3PPG (TN) and RV6AJ (UF) all rather exotic for British Isles folk.

If you are a QTHCC member, when applying for stickers do please quote your certificate number as all the records are kept in that order and not by callsigns.

The Annual Tables

Some readers have asked about the deadlines for the 1987 tables. The "proper" deadline for the March 1988 issue, wherein the final placings will be published, is December 30. However, for the table figures only, I can extend the deadline till Jan 2, the day I should be compiling the data.

For 1988 I propose to continue the popular v.h.f./u.h.f. table but to include also 50MHz. Also, since all now have access to all v.h.f. bands, all five bands will count for points, thus encouraging participants to operate on more bands perhaps —e.g. G3FPK! The annual c.w. table is fairly popular but obviously it is a waste of space to include a microwave column, so I will be deleting that and replacing it with a 50MHz one.

The squares table, starting date 1/1/1975, will continue but may be omitted some months if there is pressure on space. Anyone not updating their score for twelve months will be deleted on the assumption they are no longer interested; you can always rejoin later on, of course.

Meteor Shower Information

The next shower of any significance is the Leonids which should peak on Nov 17. It only lasts three hours and the right ascension and declination are 152° and +22° respectively. For a station in the centre of the mainland, the shower will be above the horizon from about 2230 to 1430UTC but bear in mind it only lasts about three hours.

Peak times for the usual four directions are; NE/SW 0430; E/W 0630; NW/SE 0900 and N/S 0300 and 1000. This shower can produce good results if you get it right.

The Geminids shower is reliable over a three day period usually, from Dec 12-14 and is above our horizon from about 1630 to 1230UTC its RA and Dec being 112° and +33° respectively. Optimum sked times for NE/SW are 2330 and 0700; E/W 0200; NW/SE 2100 and 0500 and N/S 2230 and 0600. I will include some times for the Ursids next month.

Moonbounce

The ARRL's International e.m.e. contest takes place over the 48-hour period from 0000UTC on Nov 14 which should give those who think they have a good receiving system a chance to check it out. Running this date through my computer shows this not to be a perigee weekend though.

At kick-off time, the moon will be at 8° elevation at an azimuth of 75° with maximum elevation of 53° due south at 0636. Moonset is at 1349 at 290° and it rises again on the 15th at 0017 at 74°. Max el is 47° at 180° at 0717 with moonset at 1401 at 281° being the details for the south London area.

There are some really big stations around these days, like W5UN, who reckon to be able to work single Yagi stations running about 300W on 144MHz. Even if you do not work anyone why not report what you hear? On 432MHz W3IWI will be using the 36m dish at the Greenbelt Radio Observatory. The moon will be above their horizon from 0515 on the 14th until our moonset and likewise from 0615 the next day.

The 50MHz Band

DL8FBD (EK75f) is active crossband on 50MHz using a Yaesu FT-690R and 4-ele TV Yagi and has worked about 70 stations in the British Isles 28/50MHz. Next year Gerald will be QRV for the whole season with a 5-ele home-made Yagi and an RX pre-amp.

Dave Ackrill G0DJA (WMD) finds it all very quiet now but his 2-ele quad, although very low, brings in the GB3NHQ beacon three S-points stronger than his previous antenna. **John Acton G1DOX** (CBA) uses an FT-690R at 2.5W to a 3-ele Yagi and this summer worked CT1, CT3, EA1, EA3, K2 and VE1 plus many UK stations. He also works some cross-band stations.

Bob Nixon G1KDF (LNH) worked G8ECI (AN) for his 50th square on the band on Sept 26. **Mike Johnson G6AJE** (LEC) has built a *PW* "Meon" transverter and has been making a few QSOs with 100mW to a 2-ele Yagi, the first being with local G4GVC on Sept 15. **Colin Redwood G6MXL** (DOR) reports a cross-band QSO with SM6PU on Aug 16, other in-band contacts including GB2FI on Aug 29 and GU4CJG/P (ALD) on Sept 6. **Ron Oakley G8GRT** (CBE) runs 5W to dipoles and had worked 62 UK stations in 25 counties up to Aug 31 and five countries. He also works cross-band to 28MHz.

The 70MHz Band

G1DOX is now on the band with a Spectrum transverter and home-made BLY90 amplifier driving a converted Pye A200E p.a. to 30W. John's antenna is a 3-ele Yagi and the first QSO was with G3EKP on July 22. Subsequently he has worked 19 counties including G4RDT (IOW), GW4IIL/A (DFD), GB4XN (GDD) and G3WBN (LDN).

Pat Billingham G4AGQ (SRY) participated in the contest on Sept 20 and worked two new counties, Somerset and West Sussex, the latter an all-time new one. **Dave Meadows G4TGB** (NOT) was -/P in JO03EF for the contest using a halo antenna at 8.5m. He worked 48 stations in G, GM, GW and EI9FK/P. Best DX was 502km. He operated from the same site, 10km north of Skegness, on Aug 28 too with good results. From home eight new stations were contacted including G6BDF (YSS), G3SPJ (LDN) and GU4XUM/P (ALD).

John Jennings G4VOZ (LEC) reports another good month with GU4APA/P (ALD) on Sept 3 and 5 and who was very strong and worked by most of the regulars. Somerset can be a difficult county but G0ESB/P on the 16th gave it a good airing. Six counties were heard in the Sept 20 contest but not GI, and most G counties were activated, the only ones John did not hear being CVE, SFK and WLT. He found the N/S path good in the morning with the E/W one much poorer.

QTH Locator Squares Table

Station	Band (MHz)			Total
	1296	430	144	
G8GXP	30	140	307	477
G4FRE	63	136	84	283
G3XDY	81	135	183	399
G3JXN	82	129	175	386
GJ4ICD	59	119	253	431
G1LSB	—	118	103	221
G3IMV	11	116	403	530
G3UVR	63	113	217	393
G4TIF	—	106	184	290
G6DER	70	105	182	357
G6YLO	32	104	128	264
G3COJ	44	102	186	332
G6HKM	22	101	170	293
GW4LXO	45	100	240	385
G4XEN	—	100	249	349
G4NQC	63	99	250	412
G4NBS	56	95	87	238
G4RGK	36	94	251	381
G8PNN	58	94	128	280
G0DAZ	—	91	183	274
G6MGL	50	89	135	274
G8ATK	42	89	138	269
G8XVJ	18	88	236	342
G4MUT	24	88	144	256
G1EZF	32	86	234	352
G1KDF	27	86	144	257
G6DZH	—	82	143	225
GW8UCQ	—	81	128	209
G4KUX	—	80	345	425
G4JZF/P	—	80	—	80
DL8FBD	—	69	274	343
G3NAQ	—	68	143	211
G6XVV	20	64	194	278
G6AJE	5	57	95	157
G4SSO	—	56	190	246
GM0BPY	—	54	123	177
G0FOT	—	54	49	103
G4HGT	—	52	142	194
G4CQM	—	52	100	152
G8MKD	—	49	133	182
G1GEY	—	48	139	187
GW8VHI	—	48	102	150
G1EGC	—	44	166	210
G8ZDS	—	43	129	172
G4FVK	17	43	71	131
G4AGQ	1	41	102	144
G4DEZ	44	38	246	328
G4YCD	—	36	155	191
G6MXL	10	36	66	112
EI5FK	—	35	137	172
G1DOX	28	34	53	115
G4MJC	—	33	184	217
GJ6TMM	—	31	128	159
G8LHT	2	31	81	114
GM4CXP	—	30	179	209
G1VTR	—	23	6	29
PA3EUS	—	17	56	73
G4ZTR	17	15	37	69
GW6VZW	—	6	98	104
G2DHV	1	4	27	32
G6XRK	—	1	117	118
G4IJE	—	—	338	338
G4DHF	—	—	307	307
G4SWX	—	—	288	288
I4YNO	—	—	270	270
G4IGO	—	—	223	223
G3FPK	—	—	222	222
G4SFY	—	—	222	222
G4MEJ	—	—	211	211
G8LFB	—	—	200	200
G6ECM	—	—	200	200
G4XEK	—	—	178	178
G4YUZ	—	—	177	177
G4DOL	—	—	172	172
ON1CAK	—	—	152	152
GW4FRX	—	—	126	126
G4TGK	—	—	113	113
G8XTJ	—	—	104	104
G0FEH	—	—	65	65
G1CRH	—	—	59	59
G0HDZ	—	—	55	55
GU4HUY	—	—	54	54
G8PYP	—	—	47	47
G1NVB	—	—	41	41

John Lemay G4ZTR (ESX) has been at his new QTH for a year and has decided to start his squares hunting anew. In the contest he found good conditions, best DX being GM4ZUK/P at 603km. Activity was good but only about 10 per cent of the stations were "B" calls. G6MXL was on for the contest and highlights EI9FK/P, first EI; GM8TFI/P (SCD), first GM, and GM4BVY/P. GU4XUM/P was worked on Sept 6.

Gerry Rhodes G8MYM (YSW) wrote for the first time and, at present, is only able to listen on the band using the converter in his Yaesu FR-101. He has made one 144/70MHz cross-band contact to G3KMJ (Huddersfield) on f.m. He is very disappointed at the apparent lack of activity and the Tuesday "activity" night often only reveals the GB3BUX beacon. He suggests the more active 70MHz stations monitor ". . point 5 on two metres . .' so that cross-band contacts could result. However he does not make it clear whether he means 144.5 or 145.5MHz.

Ron Oakley G8GRT (CBE) has been on the band since Aug 15 using a Spectrum transverter driven by an FT-290 and producing 2W to separate loft dipoles. Best DX is GU4APA/P (ALD) on Sept 3 of the 23 stations in 14 counties and three counties so far worked. In the Sept 20 contest Ron worked G4RXD/P (CBA) and G3BPM/P (SOM) for best DX.

Gordon Emmerson G8PNN (NLD) also took part in the contest making 34 QSOs. Looking through his log suggests the best DX were GW3UAX/P (IO71OW), EI9FX/P (IO63WC) and G4ADV/P (IO70JH).

Annual v.h.f./u.h.f. table
January to December 1987

Station	70MHz Counties	70MHz Countries	144MHz Counties	144MHz Countries	430MHz Counties	430MHz Countries	1296MHz Counties	1296MHz Countries	Total Points
G1KDF	—	—	98	16	70	12	28	8	232
G6HKM	—	—	74	26	53	13	26	7	199
G1LSB	—	—	75	25	61	22	—	—	183
G4NBS	43	6	59	12	50	12	*38*	*8*	182
G1SWH	—	—	97	12	58	11	—	—	178
G1GEY	—	—	74	26	47	12	—	—	159
G6XVV	—	—	70	13	50	8	12	2	155
G1EHJ	—	—	58	12	53	9	—	—	132
G8LHT	—	—	66	22	29	10	3	1	131
G6AJE	—	—	54	17	40	8	7	2	128
G4SEU	58	6	43	16	3	1	—	—	127
G4DEZ	—	—	34	10	42	11	13	5	115
G4ZTR	36	5	32	11	24	6	*21*	*6*	114
G4MUT	26	1	45	14	19	3	*7*	*2*	108
G4VOZ	61	6	—	—	34	7	—	—	108
G6MXL	22	5	42	11	18	7	*8*	*3*	105
GW4FRX	—	—	77	27	—	—	—	—	104
GW6VZW	—	—	68	24	9	2	—	—	103
ON1CAK	—	—	66	31	—	—	—	—	97
G3FPK	—	—	76	21	—	—	—	—	97
G4WJR	—	—	78	10	—	—	—	—	88
G4TGK	—	—	66	19	—	—	—	—	85
G8XTJ	—	—	65	16	—	—	—	—	81
G4AGQ	15	1	31	12	13	4	*1*	*1*	76
G4YIR	—	—	60	15	—	—	—	—	75
G1CRH	—	—	64	11	—	—	—	—	75
G6OKU	—	—	53	9	1	1	—	—	64
G0HDZ	—	—	53	11	—	—	—	—	64
G6MGL	—	—	25	6	25	2	1	3	62
GW4HBK	48	7	—	—	—	—	—	—	55
G0HGA	—	—	43	9	—	—	—	—	52
G1VTR	—	—	16	2	22	5	—	—	45
G2DHV	11	2	21	5	3	1	—	—	43
G3EKP	13	3	12	3	7	3	—	—	41
GM4CXP	—	—	27	8	3	3	—	—	41
G4WND	25	4	—	—	—	—	—	—	29
GU4HUY	—	—	21	6	—	—	—	—	27
G6XRK	—	—	8	6	—	—	—	—	14

Three bands only count for points. Non-scoring figures in italics.

The 144MHz Band

First the overseas input starting with **Charles Coughlan EI5FK** who reports good tropo back in August on the 11-13, 15 and 16th to France and the band opening well on the 28th. On the 29th he worked into DK and FN squares with two pages of assorted D, F, G, ON and PA QSOs. The next day conditions were equally good with best DX OK1IBL (GK) along with LX1JX from his VL19e-/P site.

Charles returned home to VL08e on the 31st and worked OK2VIL/P (JJ), SP6GWB/6 (IK), OK1KRA (HH) and OE5VRL/5 (HI).

Alex Della Casa I4YNO (FE25e) sent a copy of his DX worked in June to August and is now up to 270 squares worked in 47 DXCC countries. Modes were tropo, Es, m.s. and f.a.i.

Godfrey Hands wrote from Vianen where he now uses his new Dutch call PA3EUS. He runs 10W of c.w. and s.s.b. and is up to 56 squares worked. He promises to send details of a new propagation beacon being installed in CM square, PI7PRO on 144.825MHz with f.s.k. mode. It is an "intelligent" beacon capable of transmitting live messages programmable from a remote station via a telephone line and MODEM. It could be operational by the time you read this.

Next a report from **Don G4RNL** about the operation by the Warrington Contest Group from Guernsey where they arrived mid-morning on Sept 4. That evening they completed an m.s. sked with OK1KT with OK1ACF and OK2PZW tail-ending. Conditions were not brilliant in the contest weekend, 5/6, due to a front between the Channel Islands and the mainland which resulted in severe fading. Also it was very windy. Their contest call was GU3CKR/P.

They made some e.m.e. contacts and completed with SM2CEW (LZ) on moonrise. At moonset, VE7BQH copied their callsign GU4RNL/P with an "O" report but they were missing his callsign. Don wonders if there has been any e.m.e. activity from Guernsey before.

Other m.s. completions were with OE/PE1IWS (HH), SM5DIC (IT), SM7FWZ (HQ) and SM3PXO (GX). A sked with OH5LK (NU) failed as they did not receive his final "Rogers". Naturally the vast majority of the QSOs in the period 2200 on Sept 4 to 1600 on the 7th were by tropo. Over 1200 contacts were made in 81 squares. The group comprised G4s HGI, RNL, SHC and WDL, G6PHJ and G8XVJ.

Now the Auroral scene and **John Eden GM0EXN** (HLD), the most northerly mainland station, reports openings from Aug 25 every night for about two weeks. He found a strong event in progress at 2230 on Sept 10 with beacons DL0PR, GB3LER, Y41B and SK4MPI audible. The unidentified one he heard on 144.930MHz could have been OZ7IGY (FP39b).

Between 2230 and 2310 on s.s.b. John worked GM1AHE/P (AT)—nice one! —G1AWP, SM6EHY (GR), SM7SCJ (GP), LA3NEA (EV) and SM6CMU (FR). At 0900 on the 11th, DL0PR was still detectable aurorally and GB3LER sounded fuzzy. At 1900 another Ar was in progress and on c.w. John heard GM4UFD, GM3WOJ, LA8OW and PA3BGM plus beacons DL0PR, GB3LER and SK4MPI.

G1KDF worked GM1SMI/P (OKE) at 1555 on Sept 13 and Bob reports another good Ar on the 25th. 1605-1630 he worked GM6RGN and GM0AVR (SLD) and GM0EWX (WR) on Skye with GM1KHU heard. In the period 1704-1730 he worked GM0HBK (XR) but which cannot be in WIL, Bob.

At G3FPK (ZL60j) nothing was heard on Sept 13 but I found an event at 1730 on the 25th at QTE 355° and worked LA2AB (JO59FV) at 1803. GM0EWX, LA8SJ (JO59) and SM0FUO (JO89) were heard up till 1830 when I switched off.

Another good event was discovered at 1340 on Oct 3 which went on, spasmodically, till past 1840. Many GMs heard with GM4IPK (IO85) loudest at 1615. QTEs were 10-25° except for SM4DHN (JP60VD) at 1741 who peaked at 355°.

Next the m.s. reports which are minimal this month with only **Mick Allmark G1EZF** (YSW) writing. He is now active on c.w. mode but many of his completed QSOs were on s.s.b. and were F8OP (CG), FC1JCJ, HG2NP/O (KH), I4BXN (FE), IW5s BML and BPE (FC), IOCUT (GB), OK1s KRA and KTL (HK), OK2PZW (IJ), OK3LQ and OE3OBC (II) and OE5ECM (HI).

Contacts using c.w. were CT1WW (WB), EA3DXU/5 (AA), DL1MAJ (GI), DK3RBH, HG1S (IH), HGs OHO, 2NP and 4KYB (JH), HG4XG (HF), IK3GLD (FF), HB0/HB9QQ (EH), OK2KZR (IJ), SM2CKR (KX), SM3BIU (HX), SM5BEI (JU), UP2BKH (KP), UR1RWX (MT) and Y23NL/P (GK). All these in August.

Finally the tropo activity and G0DJA continues his QRP c.w. albeit interrupted by a Maltese holiday. **Philip Everitt G1CRH** (CBE), in the Trophy Contest on Sept 5/6, only worked 45 stations as the strong winds were giving his temporary antenna pole a bashing so he took it down after four hours. Nevertheless he did get GU4APA/P, GU3CKR/P and GM0FRT (IO87).

G1EZF's letter covered the end-of-August tropo in which Mick worked many of the OE, OK and SP stations that others did and which were reported last month. Best DX in the contest was F6HYE (DG). Although HB9HB was loud on the 19th there was no activity. He did work GM1SMI/P (YS13b) when they were on Hoy but missed them in YT square.

Don Stoker G1GEY (TWR) wrote to update his scores and has now reached the magic "ton" of points in the annual table. A point though; I see HG1YI/MM was included for a QSO with Hungary but surely he was in the western Mediterranean at the time? I suggest we do not count -/MMs or oil platforms as the countries whose prefixes they happen to use.

G1KDF advises that the IRTS Sunday morning news broadcast on 144.275MHz has been dropped but that EI6AS in Dublin still contributes to the news thereon on an informal basis for those wishing to work EIs from 1045 local time. 144.260MHz was also mentioned.

On Sept 20 he notes good conditions to the south and worked EA1BLA (VD), F6s APE and ETZ (ZH) and F6IPG in YH. **Paul Brockett G1LSB** (LCN) worked some good DX at the end of August and is now up to 103 squares worked. **Gerry Schoof G1SWH** (MCH) added some more rare counties in August to make it 97 British Isles ones so far; only seven to go for game, set and match.

In his first letter to *PW* since 1945, **Brian Bower G3COJ** (BKS) writes of new squares worked on the August Bank Holiday. Stations worked included HG0HO (KH), OK3CBU (JI), SP9EWU (JK) and HG8VF (JG). GM4DMA/A (AS) was another new one. Likewise **John Quarmby G3XDY** (SFK) did well in the end-of-August tropo with EI, OE, OK and SP stations in the log.

Dick Bacon G3WRJ (HFD) has submitted his first entry to the c.w. ladder. He uses a home-made transceiver only running 500mW to a 9-ele Yagi and the RX system is direct conversion. The transceiver is the first full prototype of the Shefford and District ARS construction project.

Peter Atkins G4DOL (DOR) added three new squares at the end of August, OE3XUA (HH), OK2BFH/P (JJ) and SP6GWB/6 (IK) the last a new country. In the Sept 5/6 contest he found EA2LU/P (ZD) and EA2AGZ (ZB) during wet and windy weather. The 16th brought EA1CJT (WD) at 1556 and the 20th EA2LP (ZD) at 1547.

In the opening on Sept 21, **Ray Baker G4SFY** (NOR) frequently monitored the beacon band from 1750 copying DL0PR, OZ7IGY and Y41B with interesting results, which suggest selective ducting was rife. He worked Y21NB and Y24LB (FN), Y24LA and Y25NA (GO), OZ1DSK (EO), SM7NJT (GQ) and other Germans in EN, FM and FN.

Two new table countries for 1987 for **June Charles G4YIR** (ESX) at the end of August were OK and Y and on Sept 5 GU4APA/P was an all-time new county. Tony Wragg G4ZNI (NOT) has entered the c.w. ladder but included a mixture of stations worked from home and -/P in North Yorkshire. His transceiver is a Trio TR-9130 running 25W and at home the antenna is a 12-ele ZL-special.

G6AJE's report started with the DX at the end of August of which Mike worked his share. However, he thinks the HG, OE and SP stations were not getting into the Leicester area. In the contest he worked up to GM and down to F plus some PA and ONs. ON4ASL/A was being operated by Reg Woolley GW8VHI.

Ela Martyr G6MKM (ESX) made 336 QSOs in the contest the one new square being DO, thanks to DL/PA3BLS on Helgoland Island. In the Irish contest on the 13th she worked EI6BA/P but could not get the county and EI9ED in Meath which was a new one. For G6MXL, the Bank Holiday weekend gave OK1FM/P (GK), Colin's first OK but he found the contest disappointing compared with previous years.

Julie Yates G8MKD (WMD) lists D, OK and Y stations worked at the end of August and she now has 133 squares on the band. **Steve Damon G8PYP** (DOR) is now up to 47 squares worked. In the contest he lists some Fs and ON7KM/A (CL) and ON9CBT (BL) these prefixes being due to licence restructuring in Belgium, it would seem. On Sept 20 he lists FC1BJD/P (ZI) and FC1GHP (ZG) at 514km.

John Fitzgerald G8XTJ (BKS) worked GM4DEZ/P (BDS) in the contest for an all-time new county. Later he worked G1IUY/P in the rare TQ91 WAB area in Kent. On the 12th he found GB2OCA (Osea Is) who was in great demand for the WAB Islands Award. GM4LIP/P (SCD) on the 19th was a new 1987 county.

The 430MHz Band

G1DOX now has 34 squares worked on the band. John's recent additions at the end of August were F6DZK (AI), F9NW (AJ), FD1DED (BI), HB9AMH/P (DH), GU4THB/P (YJ), FD1FHI (ZH) and F6EAS (ZJ).

G1GEY reckons the band is proving difficult from Gateshead but new counties worked were G4FRO (AVN), G4KZY/P (SPE), GB4XN (GDD), GU3EJL (ALD), GU-2FRO (SRK) and GD0FRE. New countries were F, GD, GU and OZ1IWT. In the tropo at the end of August Don worked F, G, GU and OZ.

G1KDF worked GU4THB/P (ALD), GW3JXN/A (DFD) and GW8TIX (GNM) on Sept 2 but the 20th produced some fine DX for Bob, viz; EA1BLA at 1139, F6APE (ZH) at 1340, EA2LP and EA2AWD (ZD) at 1615, ON4QO (BK) at 2000 and FD1FHI at 2208.

G1SWH added a couple more counties lately; G1SDX/A (CNL) on Aug 16 and EI2DJ (Dublin) on Sept 27. New table countries for Gerry at the end of August were FD1FHI, ON5RU, OK1KKH/P (HJ) and HB9AMH/P to make it 11 this year.

Phillip Stanley G3BSN (LDN) lists as heard/worked G6UUR (WMD), G8BQH (BKS), G6ICR (MSY), G1TAN (KNT), G8JXV (SRY), G0HRZ and G6IFK (ESX) and G4SSO (LDN). He worked G3AHB (AVN) one of the pioneers of the band for inter-G DX working. (The QRB you asked for is 479km but Les's YL48e does not equate to IO81RH, more like RJ). Phil mentions G6LFN/P and G8CMG/P from near St Austell (CNL), and he worked FD1FHI (ZH63d).

The lift on Aug 31 brought OE3XUA for a new square for G3COJ, while back on Aug 12 Brian worked FC1BLL (CD). G3XDY, on Aug 30, worked EI4BVB (WM), Y22ME (HM), OK2BFH/P (JJ a new square), OK1KRA (HK) and another new one OK1KKH/P (HJ). The following day John worked OE3XUA and Y23LI/P (FK).

On Sept 20, there was the F9NL Memorial Contest in France which created welcome activity. John worked F6HEO/P (BH), F1ADT/P (BF another new one), F6APE (ZH), F6FKB/P (ZI), F1DPX (ZH), FC1HGO (AF) and later in the evening FC1CPX/M (ZH) running 100W to a halo antenna.

G6AJE added G4KUX (DHM), G1GEY and GW3KJW (XM) all new on Aug 29. The following day brought Mike F1GXB (XI), Y23BD (GM), for a new country and square, DK3BU (DN) who was running 1kW and 16 x 24-ele Yagis, ON6OO (CL) and DG9PY/P (DK). Around 0800 he heard two SP6s trying to make a contact with G4CBW on 1.3GHz. On the 31st he worked PA0AD (CM) and DK6AS (FM) at 811km for another new square.

Annual c.w. ladder

Station	Band (MHz)				Points
	70	144	430	µWave	
G4ZEC	—	560	—	—	560
G4NZU	2	243	4	—	249
G4XEN	—	231	15	—	246
G4ZVS	—	166	—	—	166
G4OUT	—	140	—	—	140
G4WHZ	—	139	—	—	139
G0HGA	—	117	—	—	117
G4VOZ	89	—	23	—	112
G4ZNI	—	112	—	—	112
G4YIR	—	105	—	—	105
G0GKN	—	84	—	—	84
G0DJA	—	83	—	—	83
EI5FK	—	29	35	—	64
G4YTR	—	56	—	—	56
G4AGQ	15	21	14	1	51
G2DHV	15	28	1	—	44
GU4HUY	—	31	—	—	31
GW4HBK	27	—	—	—	27
GM4CXP	—	27	—	—	27
G0HDZ	—	9	—	—	9

Number of different stations worked since January 1.

2.3GHz all time table

Station	Counties	Countries	Squares	Points
G3JXN	27	9	37	73
G6DER	31	10	28	69
G8TFI	26	7	32	65
G8PNN	17	7	26	50
G3XDY	18	7	24	49
G6YLO	8	4	8	20
G1DOX	6	2	10	18
G8GRT	3	3	2	8

G6HKM only had three s.s.b. QSOs on the band in September, one being DL8QS (EN) on the 21st. G6MXL reports a bit more activity on Monday evenings now the 50MHz DX season is over. Colin also worked G4KUX, FD1FHI, GW3JXN/A, FC1DV (BG), DG6PY/P and HB9AMH/P.

Lastly news that **Colin Oakley G0AEA** is now operational on the band from the Isles of Scilly—and won't he be popular.

The Microwave Bands

G1DOX is still looking for AN, XK, XL, ZO and ZP squares in the UK and John's current tally is 28. On Aug 29 and 30 he added F6DKW (BI), F6CER/P (BK), HB9AMH/P, F6CGJ/P (XI), FD1FHI, F6EAS (ZJ) and G4CVI (ZK) while on Sept 2 he added GU4THB/P (YJ). All this on 1.3GHz. John has become the first G1 to get the RSGB's ten squares award on 2.3GHz back in February, the seventh one issued.

G1KDF's September QSOs on 1.3GHz included GW3JXN/A (DFD) on the 2nd and GU4THB/P and on the 20th F6APE and FD1FHI. G3BSN missed out on the Bank Holiday tropo. An attempt on 1.3GHz with G6LFN/P (CNL) failed due to lack of power but Phillip did work G3AHB (AVN).

G3XDY reports QSOs with GW3JXN/A, HB9AMH/P, GU4THB/P, F6DKV, F6DZK and F6CER. An attempt with the last on 2.3GHz on Sept 21 saw an exchange of signals but conditions faded before completion.

G6AJE was out with G3CKR/P during v.h.f. NFD and points out they were in IO93AD = ZN and not ZM. This for the benefit of G6MXL who had them down as ZM in the October *VHF Up* feature. Said G6MXL added GW3JXN/A which was an all-time new one, country, county and square on Aug 31. In the north/south lift on Sept 20, Colin also added FD1FHI, both on 1.3GHz.

G8PNN added G8CYW/P (NLD) in ZP43g on Aug 23 on 2.3GHz so Gordon has updated his table score. The only reader who has not recently amended his score for the 2.3GHz All-time Table is G8TFI and G8GRT did not include his squares figure so I have assumed two.

RTTY activity this month was given a welcome boost during the CQ World Wide contest on 26 and 27 September. **John Barber G4SKA** reports good conditions throughout the contest period. According to John there were a lot of unusual prefixes in evidence which may have caused some confusion. The following were noted: ED (Spain), CS (Portugal), YT (Yugoslavia), ZY and ZV (Brazil), 9Y25 (Trinidad), VU40 (India) and CR6AUR (Portugal). This last call, who incidentally normally operates as CT6, was accused of being a pirate by an American operator. It seems that the American wasn't taking any chances as they exchanged reports just in case! The contest seems to have attracted a very large world wide interest, but alas, very few UK stations were evident.

Whilst on the subject of unusual calls, did anyone work 5N27ZNH? This station in Kano, Nigeria was active on 14MHz RTTY during the end of September and beginning of October. The station was set up to celebrate the Nigerian Independence day celebrations on 27 September. I logged this station on 1 October just as our cold weather started while the Nigerian station reported the local weather as sunny and 40°C! If anyone worked this station I would be pleased to hear from you.

I have received a report from Martin Beer G1DPL via John Barber that there is activity from the following rare pre-fixes: A35 (Tonga) and 4U1UN (United Nations NY) so watch this space for more details.

	Frequency (MHz)			
Prefix (Country)	**3·5**	**7**	**14**	**21**
A,K,W (USA)			APR	PR
CE (Chile)				R
CO (Cuba)			R	
CT (Portugal)	R	R	R	
DA,F J,K,L (W. Germany)	AR		APR	
EA,C (Spain)	R	R	APR	R
EA6 (Balearic Is)			R	
EA8 (Canary Is.)			PR	R
F (France)			R	
FM (Martinique)			R	
G (England)	APR		APR	
GM (Scotland)	AR		AR	
GW (Wales)	AR		AR	
HA (Hungary)	R		APR	
HB (Switzerland)	R	R	PR	
HC8 (Galapagos Is.)		R	R	R
HK (Colombia)			R	
HL(Korea)			R	
I (Italy)	R	R	APR	
IS (Sardinia)			R	
JA, G (Japan)			AR	
LA (Norway)			PR	
LU (Argentina)			R	R
LZ (Bulgaria)	R	R	R	
OE (Austria)			R	
OH (Finland)		R	APR	
OK (Czechoslovakia)	R	R	R	
OX (Greenland)			P	
OZ (Denmark)	R		R	
PA (Netherlands)	R			
PP,Y (Brazil)			R	R
SG,K,L,M (Sweden)		R	APR	
SO,P (Poland)	R	R	R	
SV (Greece)			P	R
TG (Guatemala)			R	R
TI (Costa Rica)			R	
TR (Gabon)		R	R	R
UA,V (USSR)	R		R	R
UT (Ukraine)				R
UZ9 (Asiatic Russia)	R		R	
VE (Canada)			PR	R
VK (Australia)		R	R	
VU (India)			R	R
Y (East Germany)			R	
YB (Indonesia)			PR	
YU (Yugoslavia)			R	
YV (Venezuela)			R	
ZC (Cyprus)			R	
ZS (South Africa)			R	
4X (Israel)			R	R
8R (Guyana)			R	
9M2 (West Malaysia)			R	
9Y (Trinidad)			R	

FAX

Contact at last! **Chris Vernall G4VCH** has written with details of his FAX activities. Chris lives in the Hereford area and as with the rest of the country, FAX activity seems to be generally low. The FAX machine used is a modified Telecopier 400 as distributed by BARTG. Chris concentrates his activity on 144.7MHz which is the designated FAX calling frequency, though apparently GD4HOX is often to heard on weekday lunchtimes using 3.730MHz. Chris has heard reports that there is a FAX activity evening in South East England on the first Monday of the month, is this still running?

Paul Yearsley G1UTM is active on 144.7MHz on most evenings between 6.30 and 7.00pm. Paul is in the Manchester area and reports that there are several locals who are active on this mode. Paul's main problem is a common one, in that the designated FAX frequencies seem to be used for anything but FAX! In the Manchester area there is a morse teaching class called the 700 net who use the frequency nightly between 7.00 and 9.30pm. If Paul is in QSO at 7.00pm then the net QSY's but if the frequency is free the net takes it. Paul is lucky in that this net treats him with respect and courtesy but unfortunately this is not always the case. The whole point of designated calling frequencies is to enable minority interest groups to find each other, nobody in their right mind would propose an s.s.b. calling frequency for 14MHz! If anyone in the Manchester area would like to contact Paul then try 144.7MHz, but if this is in use a call on 145.5MHz or 145.3MHz should find him. My thanks to both Paul and Chris for writing to me.

Any readers who were members of BARTG in 1984 will remember the original release of Telecopier 400 FAX machines. These machines were very kindly donated to BARTG for distribution to their members. Now since that time hundreds have been distributed throughout the country so why so little activity? I suspect that there are lots of machines sitting in shacks unused and unwanted. If you have such a machine then I beg you to pass it on to someone who will use it, or alternatively use it yourself. I think quite a few people were initially deterred from activity because the machines needed modifying in order to meet the accepted standard of 120 r.p.m. and 288 IOC, well the mods have been covered in *DATACOM* but the machines are perfectly usable without any mods at all, provided both stations operate to the same standard. I was fortunate enough to receive one of the early machines and all that was required to get on the air was a microphone and speaker plug, toggle switch for T/R switching and a pot. to adjust the level into the microphone input. The quality of reproduction from these machines is excellent and well worth the effort. If you have an unwanted machine then please either contact BARTG, put up an advert in your local radio club or put it in the bring and buy at the next rally in your area.

Now for a proposal, how about a regular national FAX activity night using 144.7MHz on the first Monday of the month?

One final point regarding FAX, did any of you catch the DARC FAX contest on 31 October and 1 November? One interesting point I did note was that in the rules there were two frequencies for the 14MHz band, the usual 14.101MHz but the new frequency was 14.232MHz. It may well be worth keeping an eye on this frequency, particularly for German stations.

Prestel

Do you have access to the British Telecom Prestel database? If so you can send me your reports and problems using the mailbox facility. The mailbox system is very quick and easy to use and at present the only charge is the local phone call if you use the system after 6.00pm. For those of you who are interested my Prestel mailbox number is: **425470071**.

RTTY, The Early Days

Ted Double G8CDW has written with a very interesting letter describing his early experiences of RTTY, I have reproduced part of it here as I think it makes interesting background reading for those who have only used computers.

"Perhaps my first awareness of RTTY as a mode of communication, was due to a visit to a Radio Communication exhibition in London in the early 1960's. I came upon some large printers producing copy of amateur RTTY traffic with a group of "attendants" hovering over them. I later discovered that these "attendants" were some of the founder members of BARTG which, having been formed in 1959 was one of the first active RTTY groups in the world. Probably due to the fact that I had always been connected with the light engineering industry, it was not long before I was hooked on RTTY.

My first equipment was very simple, the terminal unit was based on an adaptation of the W2PAT design. Toroids were not generally available so my first coils were over 50mm in diameter and mounted on old octal valve bases. The printer was a Creed 3X which produced metres and metres of print on a paper strip about 13mm wide, this either had to be rolled up or cut into strips and gummed to a sheet of paper. The other main requirement was a glass jar filled with ink in which to soak spare ink rollers. The changing of these rollers was not a task to be taken lightly! A year or so after this, I became the proud owner of a Creed 7B which in those days was a highly prized piece of equipment. The addition of a surplus FSY.1.1 terminal unit and a Hammerlund HQ100 receiver meant I was soon receiving plenty of amateur RTTY signals. It was during this time that my long standing friendship with Piet PAOYZ started. Piet was the first operator of the Dutch Vernon headquarters station, PAOAA, who have transmitted a RTTY bulletin for many years as part of their regular Friday night schedule.

At about the same time a small band of UK operators had a RTTY net on the 3.5MHz band. This was used as a useful source of test signals to enable new operators to set up their gear, remembering that at that time most surplus equipment in the UK came from the Telex network which used 50 baud. When the problem of 45.45 baud arose (at that time US stations were limited to that speed) operators had to investigate speed changing and both mechanical and electronic techniques were used.

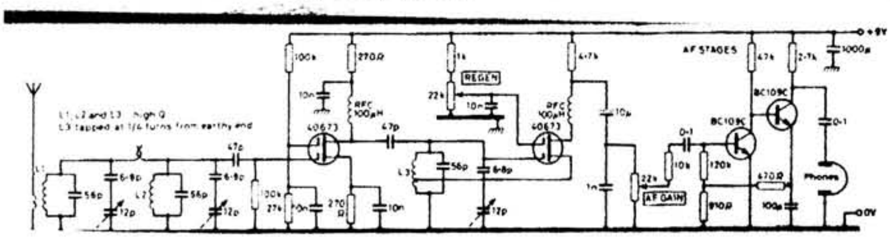
Late in 1969 I applied for and received my present callsign which allowed me to use the v.h.f. bands. I had been interested in v.h.f. since 1947 when the 58–60MHz band was available to UK amateurs; I still have memories of super-regen receivers and self-excited oscillators.

At the end of 1969 I was approached by Robin Adie G8LT to see if I would be prepared to re-organise and administer the BARTG Spring RTTY contest and the Quarter Century Award. I realised at that time there were an increasing number of Class B operators with RTTY equipment but to whom contest operating was a closed book. As a result of much early work compiling a set of rules the first v.h.f. RTTY contests were started and BARTG can claim to be one fo the first groups to run such a contest."

Ted continued as contest manager up till 1983 and is currently BARTG President and Awards manager. My thanks to Ted for supplying this potted history.

I still need your reports particularly for Packet and AMTOR, any reports should be either sent to my home address or my Prestel mailbox.

An example of amateur FAX.



Amateur Satellites

Reports to Pat Gowen G3IOR
17 Heath Crescent, Hellesdon, Norwich, Norfolk NR6 6XD.

Tackling Doppler

Since the inception of through-transponder satellite operation, the practice had been for the user station to hold his transmitting frequency steady during a QSO, and for him and the station he was in contact with to re-tune their receivers to compensate for the change of frequency brought about by the Doppler shift. With the Mode "A" 145 to 29MHz satellites, only a small adjustment was needed, as the c.w. or s.s.b. stayed well within the audio passband. As frequencies got higher, and the Doppler shift correspondingly greater, it was found that a station would shift considerably in the course of a single over, particularly around TCA, when the Doppler shift was at its most rapid.

The Doppler shift at 29MHz is some five times greater at 145MHz, and some three times greater again at 435MHz, so the first Mode "B" (435MHz to 145MHz) and Mode "J" (145 to 435MHz) transponder satellites would have had the additive effect of both the uplink and downlink shift, giving a considerable shift of frequency in the course of a QSO and a satellite pass.

Some compensation for this effect was introduced by the designers, who gave us inverting transponders, that is to say that the high frequency end of the uplink became the low frequency end of the downlink, and vice versa, meaning that a shift downwards of 1kHz on the transmitter would mean a upward shift of 1kHz on the receiver under static movement zero Doppler effect. (It also inverts l.s.b. on the uplink to u.s.b. on the downlink.) When we bring in the Doppler, the downward 1kHz drift would still give a 1kHz upward shift from the 145MHz Mode "J" transponder receiver, but the transponder transmitter would have moved down by some 3kHz to the observer. This means that instead of getting 3 + 1kHz = 4kHz of shift, the user now only receives 3—1kHz = 2kHz, i.e. half the Doppler induced QSY.

All of this is very well for two stations in the same approximate geographical area, where the amount and rate of frequency change will be common, but problems increase with user displacement. If we take FO-12 coming from west to east, and somewhere over the UK, then the W's who are losing the satellite will be getting a slowly decreasing Doppler shift towards minimum frequency. The UA's to our east, who are first seeing the pass, will be getting a slow change down from maximum shifted frequency, but the G's will be getting a very rapid rate of change from above to below nominal. All of this means that collisions can occur within the restricted pass-band between adjacent QSOs, particularly if some stations are shifting their transmitter to compensate, and others their receivers!

During the early 1980s, AMSAT operations planners agreed a single Mode "B" standard practice that would minimise disruption and facilitate compatibility in wide ranging net operations by having all stations adjusting their uplink transmission frequencies only, and maintaining their received downlink frequency. It seemed to work for OSCAR-10 on mode "B", where the Doppler was very slow, especially around apogee when the relative movement is minimal, but problems are evidenced on mode "JA". Not only does the Mode "B" practice not help reduce the Doppler induced QRM, but actually makes it three times worse, as each 1kHz of 145MHz uplink adjustment creates a far greater downlink shift.

Now it is back to basics, as WA2LQQ has done a study which concludes that when the uplink frequency is higher than the downlink, then as with mode "A", "B", etc., a transmitter adjustment is the best tactic. Conversely, when the downlink frequency is higher than the uplink, as with mode "JA", "KT", etc., then it is better to adjust the receiver. This practice is recommended to all satellite users, in the hopes of less QRM, frustration, QSO collisions and adjacent channel splatter, and more solid QSOs.

Fig. 1

FUJI-OSCAR-12 'LOOK UP' TABLE FOR PASSES OVER THE UK

	A O S		T C A			L O S	
EQX	+mins	brg	+mins	brg	EL	+mins	BRG
000	10	146	16	113	07	22	81
010	8	171	16	126	14	24	79
020	8	187	18	128	22	26	77
030	10	198	18	180	30	30	71
040	10	215	20	185	40	32	73
050	12	227	22	161	51	34	76
060	14	238	24	167	61	36	81
070	16	249	26	178	68	38	87
080	18	259	28	184	72	40	94
090	20	267	30	193	71	42	103
100	22	274	32	198	67	44	112
110	24	279	34	203	59	44	125
120	26	282	36	207	48	46	137
130	28	284	38	211	38	48	149
140	30	285	38	236	28	48	165
150	32	284	40	235	19	50	176
160	34	282	42	236	12	50	193
170	38	271	42	249	05	48	217
ORBITS EMANATING BETWEEN 180 and 340 are out of range for UK							
350	14	112	15	109	01	16	102
360	10	146	16	113	07	22	81

Fig. 2

ALLSATS EQX ON 15/11/87

SAT	UTC EQX	Brg W	Next +min	Orbit +inc	Next +min	Day +deg
F12	0147	158	115.7	29.2	64.3	20
RS5	0110	245	119.4	30	113.4	30
RS7	0023	241	119.1	29.9	108.7	29
Mir	0119	334	91.1	23.1	19.1	11
Sal	0032	173	94	23.8	64.6	22
RS1	0023	324	120.3	30.2	3.9	3
UO1	0105	89	94.1	23.5	65.9	16
UO2	0107	49	98.4	24.6	37.2	9
NO9	0022	133	102	25.5	90.2	23
N10	0007	67	101.2	25.3	78.4	20
M13	0111	110	104	26.1	16.6	6
M14	0119	86	104	26.1	16.9	6
M/1	0119	147	109.3	27.4	90.8	25
R10	0006	108	104.9	26.3	29.5	9
ERS	0028	242	89.5	22.6	82.7	25
M15	0111	170	105.6	26.5	38.4	11
Aji	0004	133	115.7	29.2	64.3	20

ALLSATS EQX ON 29/11/87

SAT	UTC EQX	Brg W	Next +min	Orbit +inc	Next +min	Day +deg
F12	0110	205	115.7	29.2	64.3	20
RS5	0155	277	119.4	30	113.4	30
RS7	0006	259	119.1	29.9	108.7	29
Mir	0059	55	91.1	23.1	19.1	11
Sal	0118	266	94	23.8	64.6	22
RS1	0128	2	120.3	30.2	3.9	3
UO1	0059	87	94.1	23.5	65.9	16
UO2	0010	34	98.4	24.6	37.2	9
NO9	0113	146	102	25.5	90.2	23
N10	0004	67	101.2	25.3	78.4	20
M13	0003	118	104	26.1	16.6	6
M14	0015	95	104	26.1	16.9	6
M/1	0049	164	109.3	27.4	90.8	25
R10	0011	134	104.9	26.3	29.5	9
ERS	0030	294	89.5	22.6	82.7	25
M15	0133	200	105.6	26.5	38.4	11
Aji	0124	209	115.7	29.2	64.3	20

Satellite Name	MIR	RS 5	RS 7	RS 10/11	OSCAR 9	OSCAR 10	OSCAR 11
Internat Design	86-017A	81-120C	81-120E	87-054A	81-100B	83-058B	84-021B
Object Number	16609	12999	13001	18129	12888	14129	14781
Epoch Year	1987	1987	1987	1987	1987	1987	1987
Epoch Day	251.77200630	243.33152192	247.00357203	250.30109429	246.25011343	243.95872771	235.21565636
Inclination	51.6302	82.9572	82.9562	82.9319	97.6461	27.4620	98.0936
RAAN	86.6548	227.4685	217.3637	357.3996	265.8068	4.2748	299.7426
Eccentricity	0.0036318	0.0008163	0.0022471	0.0013273	0.0001963	0.6025328	0.0012258
Arg of Perigee	114.7292	227.6062	122.3832	55.9292	345.5350	236.7045	248.5978
Mean Anomaly	245.7159	132.4317	237.9430	304.3123	14.5816	51.1611	111.3904
Mean Motion	15.79851866	12.05058217	12.08703101	13.71880972	15.30037654	2.05882788	14.62149346
Decay Rate	$1.5121e^{-4}$	$1.3e^{-7}$	$1.3e^{-7}$	$5.9e^{-7}$	$2.863e^{-5}$	$-1.13e^{-6}$	$9.7e^{-7}$
Orbit Number	8923	25088	25208	1042	32867	3172	18549
Nodal Period	91.08271	119.55311	119.19328	105.02465	94.17442	699.1273	98.54392
Long Increment	23.16083	30.01525	29.92508	26.38186	23.54078	175.3364	24.63635
Beacon Freq	143.625 voice 166.140 data	29.330MHz 29.452MHz	29.340MHz 29.501MHz	29.357 & .403 145.857 & .903 29.407 & .453 145.907 & .953	21.002MHz 145.825MHz 435.025MHz 2.401GHz	145.810MHz 145.987MHz	145.826MHz 435.025MHz 2.4015GHz

Satellite Name	METEOR 1/30	METEOR 2/14	METEOR 2/15	METEOR 2/16	COSMOS 1766	FO-12	SALYUT 7	NOAA 9	NOAA 10
Internat Design	80-051A	86-039A	87-001A	87-068A	86-055A	86-61B	82-033A	84-123A	86-073A
Object Number	11848	16735	17290	18312	16881	16909	13138	15427	16969
Epoch Year	1987	1987	1987	1987	1987	1987	1987	1987	1987
Epoch Day	251.80205126	251.88089577	251.14124095	250.05260544	197.79307051	238.83946838	251.79991104	247.98771242	247.96374146
Inclination	97.7229	82.5346	82.4700	82.5571	82.5265	50.0158	51.6124	99.0592	98.7148
RAAN	338.9074	40.9052	313.4846	13.7741	324.8711	168.1620	211.9248	214.3411	277.5928
Eccentricity	0.0040699	0.0015564	0.0011908	0.0011632	0.0022570	0.0011108	0.0001450	0.0017547	0.0013385
Arg of Perigee	242.8892	31.1138	278.1434	212.0172	215.8427	105.5591	140.8859	345.0008	341.6456
Mean Anomaly	116.8177	329.0941	81.8384	146.7268	144.1280	254.6460	219.2176	14.1887	18.4233
Mean Motion	14.98182369	13.83759129	13.83565986	13.83358228	14.73504686	12.44394100	15.31306398	14.11521316	14.22513771
Decay Rate	$1.176e^{-5}$	$6.0e^{-8}$	$6.0e^{-8}$	$3.651e^{-4}$	$8.8e^{-7}$	$-2.5e^{-7}$	$4.47e^{-6}$	$5.9608e^{-4}$	$2.04e^{-6}$
Orbit Number	39463	6493	3400	276	5197	4718	30879	14057	5008
Nodal Period	96.17618	104.12286	104.13756	104.14429	97.79	115.65324	93.97587	102.05113	101.28568
Long Increment	24.04368	26.15952	26.16366	26.16476	24.577	29.23941	23.89286	25.51099	25.32114
Beacon Freq	137.020MHz	137.850MHz	137.850MHz	137.4MHz	137.4MHz	435.797MHz 435.913MHz	(19.953) 142.42MHz	137.620MHz 137.770MHz	137.500MHz 136.770MHz

FO-12

In response to requests from users that do not possess computers for tracking, we produce as Fig. 1 for Fuji-OSCAR-12 a "look-up" chart similar to those earlier published for the "RS" spacecraft. It has been calculated for us by **Brain Coupe G4RHZ** of Doncaster, who is a keen exponent of all the orbiters.

We use it, like the predecessors, by first calculating the equator crossing time and bearing from our published table for all the satellites (Fig. 2) and then looking up the Fig. 1 EQX line for the nearest degrees to our equator crossing. Under "AOS" for acquisition of signal we get the time in minutes to be added to the equator crossing time to find that when we first "see" the satellite, and the bearing of the first appearance. Under "TCA" we get the time of closest approach, the minutes then to be added to the EQX, the bearing, and the elevation of the satellite above horizon. "LOS" is when we have loss of signal, the time to be added again, and the bearing at which the satellite disappears from audibility below our horizon.

Users will find that FO-12 has a pretty sharp appearance at a.o.s. and a similar rapid cut-off at l.o.s., as propagation variables have little effect at the 435MHz downlink frequency. Sub-horizon audibility is a very rare phenomenon at u.h.f., and not near common enough at v.h.f.

We cannot quarantee you will hear the satellite, as it has to spend periods off to permit battery re-charge. Fuji fans will be pleased to know that **Miki Nakayama JR1SWB**, reports that the next Japanese amateur-radio satellite, JAS-2, already built, will be modified. It will be adapted to provide a sufficiency of solar cell power for all operations, so that the difficulty of scheduling regular activity does not occur when it goes into space, now planned for February 1989.

Phase III improvements

Users of OSCAR-10 will be well aware of the limitations of signal strength, and also the off pointing effects of the rotating antenna array, when spin modulation sets in and signals both to and from the satellite become very weak, due to off-axis antenna constraints. Whilst it would be possible to incorporate a high gain system that points to the earth at apogee for a stronger signal, the narrower beam width produced would mean that as the satellite was between apogee and perigee, the main lobe would be pointing away from earth into space, and low gain side lobes with consequent problems of signal insufficiency and rapid rotational fading would again result.

This effect could be compromised by providing a lower gain wider beam width antenna, which although giving reasonable signals between apogee and perigee, would not optimise signals at apogee. Such a configuration is shown in Fig. 3. The nose of the correctly pointing antenna gives 10dB gain at apogee, and when it has moved closer to earth in its ellipse, although only 4dB of gain is now given, this is compensated for by the fact that the closer proximity (by the inverse square law) reduces the path loss, thus a reasonable signal still evolves. It is a compromise that does not offer the apogee gain maximum capability that would also be desirable.

OSCAR-10 users will be aware that unless one has a quite good antenna and pre-amplifier, signals were often marginal, and only really strong when OSCAR-10 was very close to earth at perigee. Other problems brought about by the incorrect inclination of that satellite meant that to optimise sun-angle and hence maintain maximum battery charging, the antenna was frequently off-pointing to earth, producing a 'squint' that did little to aid communications.

Dr. Karl Meinzer DJ4ZC, in his talk on the new Phase III satellites at the recent AMSAT-UK Colloquium, came up with some good ideas on improving the high elliptical orbiting satellites communications possibilities. In addition to the improved and more efficient modulation system, more downlink power, and an improved receiver, antenna ideas were under consideration. Such an idea is shown in Fig. 3, which has a 15dB gain antenna on the satellite earth pointing. If this same beam width and gain antenna was employed when the satellite was at the same position as that in the upper picture point in Fig. 3 then a very poor signal would result, as the main lobe would miss the earth altogether. If, however, the gain could be modified, giving a wider and even split main lobe, then the lobe angle and gain could be compensated for according to earth proximity, and a constant signal maintained almost regardless of the satellite's mean anomaly.

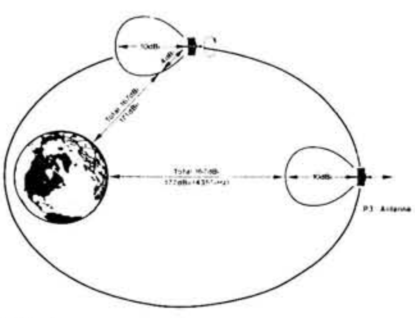


Fig. 3

This in fact can be done, electrically and/or mechanically, in the same way as that earlier pointed out on our satellite turnstile antenna in this column, where by changing the height above the reflecting surface, we can elevate or lower our main lobe. Such a method is shown in Fig. 3, now under evaluation, where the lobes of the antenna are adjusted by the IHU computer according to the spacecraft mean anomaly position, with a fairly constant optimum signal resulting. Such a system may well be introduced for the coming Phase III-c satellite due for launch early next year.

The early morning September 16 V-19 *Ariane* launch successfully placed the ECS-4 and AUSSAT-K3 communications satellites into geostationary orbit, with no

apparent problem from the previously troublesome cryogenic fuelled third stage that has caused three previous malfunctions, including AMSAT's first Phase-III spacecraft. This is excellent news, and bodes well for the launch of TV-SAT-1 in November, then TELECOM-1-C, then either GEOSTAR—RO-1 or G-STAR-3 in December. The launch of PHASE-III-c can now be expected in the early Spring of 1988, the precise date of which is anxiously awaited. There is a current cash shortfall for this project, and some £20 000 UK is being sought by the international AMSAT organisations to fund the mission and its ground functions.

The Next Phase

An interesting debate took place at the University of Surrey held AMSAT-UK Colloquium on the direction that AMSAT should take for the future. The main topic was the compatibility of further future Phase III type missions, e.g. u.h.f./v.h.f. high elliptical orbiters, or Phase IV missions, e.g. s.h.f. geostationary transponders.

Dr. Karl Meinzer DJ4ZC, of AMSAT-DL, gave the merits for Phase III, referencing its availability to all the world, the deeper interests of education and advancement required in tracking and following the satellite in orbit, and the enhanced knowledge and understanding that would evolve from this in an international context. Added to this is the fact that many of the world amateur-radio community are already geared up for the frequencies employed, as a follow-on from OSCAR-10.

The case for Phase IV was explained by Vern Riportella WA2LQQ, president of AMSAT, who described the mass user opportunity presented by a geostationary system, with the opportunity of simplicity of operation to newcomers, without the complexity of tracking. This, Rip pointed out, would result in far greater funding for the system, and bring many more people to the satellite communications scene.

It needs to be pointed out that the two possibilities are not necessarily exclusive, and are not in competition for designers, hardware or enthusiasm, but, that they could be seen to be competitive for a limited amount of funding from a declining world amateur-radio community.

The debate that followed was almost a new form of the ongoing concern of the relative merits of the new amateur technology (if indeed it can still be called amateur) versus the older d.i.y. and design and home-brew it yourself attitudes. (Indeed, I felt almost ashamed that I found I had to actually send my IC-720A away for repair, when ten years ago I would have located and repaired any problem resulting within minutes!) In balancing the enjoyment of self-dependency and home-construction with the technical wonders achievable by the modern black boxes, cost and efficiency, and user appeal all come into the picture.

Such is the case toward the new possibilities. One is an advancement of an existing system, for which many are already geared and experienced, available to a discreet number of international enthusiasts, many of whom have become expert in the whole science of satellite communications. The other is attractive in terms of numbers, hence funding and future operators due to its very simplicity of communications, not unlike a repeater in the sky with a huge coverage. We also have to recognise that the first GEOSAT would only cover some third of the world, and thus probably be available only to those who would have the financial resources to prepare for the new frequencies at s.h.f. Your views on this continuing debate would be interesting.On the other hand, you may be a Philistine like me, who openly expresses my preference for the Phase I h.f./v.h.f. transponders, on grounds of cost, accessibility, international representation, propagational interest, and ease of operation.

MIR

The manned space station followers are recommended by G3IOR and G4RHZ to visit their local library to read a copy of the October *Spaceflight*, which contains an excellent article by GM4IHJ entitled "Listening to the Cosmonauts". It explains in easy to follow terms the enormous interest that can be found in following the passes and listening to the 143.625MHz downlink, and a few other USSR used space frequencies also.

The next MIR main mission will come about in December, when cosmonauts Serebov and Titov go up to MIR for what may well be a year's continuous duration in space, relieving Yuri Romanenko, who has been there since February 1987.

All ears have been on the space frequencies this past week, it being the 30th aniversary of the launch of *Sputnik-1*, in case another space spectacular results, but nothing has been noted up to the day of writing this column, October 4. A large meeting of space experts, including WA2LQQ, President of AMSAT, has gathered today in Moscow for a Soviet space future symposium, from which it is hoped that co-operative ventures will evolve.

OSCAR-10

Observation of our ailing satellite indicates that the worst of the effects of the battery discharge are now over, and that the needed voltage is rising again. This is due in no small part to the normal users, who have kept off the transponders as requested. If progress is maintained, it is hoped that OSCAR-10 will be back with us for minimum uplink power communications employment in the first or second week of December this year.

Space QRM?

For long periods, the ROBOT frequency of RS-10 has been blocked by what appears to be a continuous carrier, and this has been co-incident with the in line path of UoSAT-1 and 2. Current thinking is that the carrier blocked keying is not on earth, but is due to the Doppler shifted 145.825MHz downlink of OSCAR-9 and 11 being heard by the sensitive RS-10 ROBOT receiver. Work is now in progress, computer aided, to find out if this is the case, and it is hoped to report any such findings later.

Keplerian Elements

Our two monthly catalogue of the elements that you need for tracking the numerous satellites of interest has this month been provided for us by **Berger Lindholm** of Dalsbruck, Finland. Berger points out that although these should not be used as a precise scientific basis, for our purposes they are adequate, being well within the limits of our beams and timepieces.

If changes result (such as frequently happens with "MIR" when cargo arrives and dockings occur) then keep in tune with the numerous AMSAT nets, which give early information. They are as follows:

AMSAT-UK Net: Sundays, 1015 local, 3.780MHz ± QRM.
AMSAT International: Sundays, 1900UTC, 14.282MHz.
AMSAT-UK Net: Mondays, 7.00pm local time, 3.780MHz ± QRM.
AMSAT-UK Net: Wednesdays, 7.00pm local, 3.780MHz ± ARM.
AMSAT Europe: Saturdays, 1000UTC, 14.280MHz ± QRM.
SPUTNIK NET: Saturdays, 1100UTC, 14.270/295MHz.

Propagation

Reports to Ron Ham
Faraday, Greyfriars, Storrington, West Sussex R20 4HE

"The sunspot cycle appears to be taking off and larger more active magnetic storms are about which could mean more radio and visual aurora," wrote **Ron Livesey** (Edinburgh) on September 7. Ron is the auroral co-ordinator for the British Astronomical Association. He learnt from Karl Lewes (Saltash) that his magnetometer was very unsettled, at times, on August 17, 26, 27, 28 and 30. It showed storm conditions throughout the morning of the 25th and the afternoon of the 31st and recorded severe storms from 1330 to 1630 on the 25th and 0120 to 0715 on the 26th. Ron pointed out that the activity on these two days was a repeat, due to the sun's rotation, of the major magnetic storm reported by the NOAA observatory in Boulder, Colorado, on July 28/29.

"The sun is waking up, but it is a very slow process!" said **Cmdr Henry Hatfield** (Sevenoaks) after using his spectrohelioscope. He located the results in Table 1. Henry also recorded a 5 minute burst of solar radio noise (136MHz) at 1505 on September 17. "Boulder reported a Type II sweep at 1515, caused by a disappearing filament," said Henry.

Ted Waring (Bristol) counted 2 sunspots on August 30, 8 on September 3, 22 on the 7th, 6 on the 14th and 2 on the 22nd.

Table 1

Date	Spots	Groups	Filaments
Aug 26	2(d)	0	10
Aug 28	0	0	4
Sept 3	0	1	3
Sept 14	0	1	11
Sept 17	1(s)	0	0
Sept 18	2(s)	0	12
Sept 20	1(d) 2(s)	0	9
Sept 23	2	0	10
Sept 26	1	0	6
Sept 27	1	0	7

Note s = single, d = double

Patrick Moore (Selsey) made sunspot drawings on August 24, 26 and September 8 (Fig. 1), 10 and 25.

"August started with 84 solar flux units (s.f.u.s) and fell to 79 on the 5th. It then rose sharply to 101 on the 13th, fell back to 100 for the following 3 days and then declined steadily to 77 on the 30th," wrote **Neil Clarke G0CAS** (Ferrybridge). He also reported that the monthly mean sunspot number for August was 38.6 and that the s.f.u. increased to 82 on the 31st.

The average number of sunspots seen by members of the Transvaal section of the Astronomical Society of Southern Africa peaked above their mean line on August 2, 8 and 16 with relative drops on the 5th, 27th and 29th.

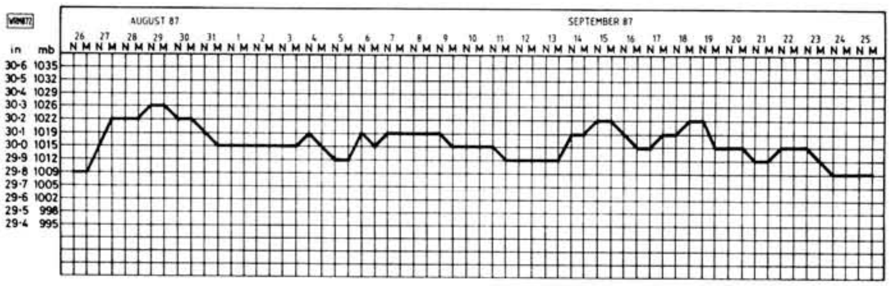
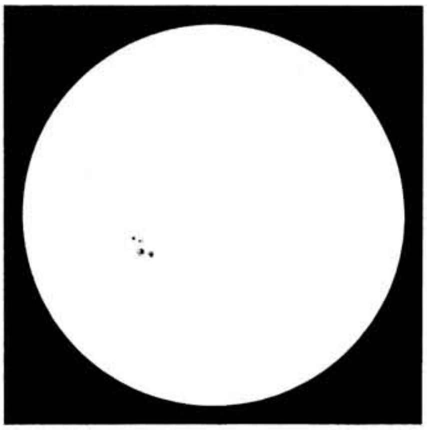


Fig. 2



◀ **Fig. 1**

	August																	September													
Beacon	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
DF0AAB										X	X					X						X				X					
DK0TEN	X	X														X				X		X									
DL0IGI	X	X					X		X	X				X		X	X	X		X		X	X	X							
EA3JA						X												X												X	
EA6RCM	X	X	X		X	X		X						X				X													
IY4M	X		X			X	X	X	X	X					X	X	X	X		X											
KO4FC																X															
LU1UG		X														X		X				X	X	X		X		X			
PY2AMI		X														X		X	X	X		X	X	X	X	X	X	X	X		
PY2GOB	X	X				X			X		X					X		X	X			X	X	X	X	X	X	X	X	X	
VP8ADE																			X												
VP9BA																X															
ZS1LA																									X	X	X			X	X
ZS6PW	X	X	X		X			X	X	X							X	X	X	X		X	X	X	X	X	X		X	X	
Z21ANB	X	X	X		X			X	X	X		X		X		X		X	X	X		X	X	X	X	X	X			X	
3B8MS																											X				
4N3ZHK	X	X				X									X				X			X									
5B4CY																											X		X	X	

Fig. 3 ▶

The 28MHz Band

"Very disappointing after last month, but that's 28MHz," wrote **John Levesley G0HJL** (Bransgore). He used his TS-430S, with a loaded vertical antenna, at 1915 on August 20, amidst QSB, to contact stations in France, Spain and Sweden. John also heard PY and LU on September 5 and 12 and Europeans on the 12th and 19th.

In Storrington, **Fred Pallant G3RNM** heard a CX4 in QSO with G at 1828 on September 13 and a CE6 working DJ at 1649 on the 27th.

"Now that the Sporadic-E season is over, I thought I would keep an eye on the 28MHz band," said **Dave Lingard G0CLH** (Soham). His efforts were rewarded when he heard stations from PY on September 13 and 22; LA and DL on the 16th and 24th; DL, EA, F, HB9, I, OZ, PT, SM, SP, TZ and Z21 on the 17th as well as TZ and Z21 on the 21st.

Propagation Beacons

First, my thanks to **Chris van den Berg** (The Hague), Henry Hatfield, **Don Hodgkinson G0EZL** (Hanworth), **Norman Hyde G2AIH** (Epsom Downs), **Bill Kelly** (Belfast), Dave Lingard, **Greg Lovelock G3III**, (Shipston-on-Stour), **Ted Owen** (Maldon), Fred Pallant and Ted Waring for their logs from which I prepared the monthly distribution of beacons heard on 28MHz, Fig. 2.

Newcomers may be interested to know where to look for the various beacons. Try: DF0AAB (Kiel—28.277MHz), DF0THD (W. Germany—28.325MHz), DK0TEN (W. Germany—28.257MHz), DL0IGI (Mt. Predigtstuhl—28.205MHz), EA3JA (Barcelona—28.247MHz), EA6RCM (???—28.213MHz), IY4M (Bologna—28.195MHz), LU1UG (Gral Pico—28.255MHz), PY2AMI (Sao Paulo—28.299MHz), PY2GOB (Sao Paulo—28.050MHz), VP8ADE (Adelaide Is.—28.284MHz) VP9BA (Southampton—28.235MHz), ZS1LA (Stillbay—28.300MHz), ZS6PW (Pretoria—28.270MHz), Z21ANB (Bulawayo—28.250MHz), 3B8MS (Mauritius—28.210MHz), 4N3ZHK (Northern Yugoslavia—28.???MHz) and 5B4CY (Cyprus—28.220MHz).

There are many more beacons on the band and a lot that only operate spasmodically, so a regular tune between 28.2 and 28.3MHz can be rewarding and provide a useful open-path indicator.

Many beacons are listed in the latest *Southern 10 Metre FM Group* newsletter, published by Jim Hicks G4XRU, 33 Hayling Rise, Worthing, W. Sussex BN13 3AL. Details of the beacons are also available from RSGB HQ at Potters Bar.

"I heard VP8ADE for the first time on September 13 and although quite weak, I was able to read it," wrote Don Hodgkinson. "Generally a poor month, but nice to hear ZS6 and Z21," commented Greg Lovelock. "A very sparse 28MHz beacon report this time," said Norman Hyde. Fred Pallant had a good showing of the Brazilian beacons and logged K04FC and VP9BA on September 10.

Tropospheric

The atmospheric pressure readings, Fig. 3, taken at noon and midnight from the Short and Mason barograph at my QTH, shows the main high, which contributed to the tropospheric opening at the end of August. In Essex, Ted Owen's barometer was at or above 1025mb on August 28, 29, 30, September 15, 16 and 19 and below 1006 on August 26 and September 12.

Between the 28th and 31st, Bill Kelly, received signals via the 144MHz repeaters in Appleby (GB3EV) on R4, Burnley (GB3RF) R7, Caldbeck (GB3AS) R0, Cork (EI5CRC) R6, Dublin (EI1DK) R0, Duns (GB3SB) R2, Princetown (GB3WD) R4, Stockport (GB3MN) R2, Stoke-on-Trent (GB3VT) R5 and Waterford (EI2WRC) R2.

Norman Hyde often works portable on 1.3GHz using an Icom IC-1200E and an 18-element Yagi, Fig. 4, from a good location on the Epsom Downs. So far he has worked 5 different stations both by simplex and through repeaters and while in Seaford recently, he contacted a mobile in Newhaven.

Fig. 4 ▼

934MHz

Although **John Levesley UK627**, exchanged signals with stations in the Channel Islands, at distances of around 160km from his Hampshire QTH, on August 18, 19 and September 17. His best DX came during the tropo-opening on August 30 when, between 2120 and 2153, he worked into Carmarthen and Swansea at 217 and 201km, respectively. John also heard stations in Sussex on the 28th as well as Jersey and the Mendips on the 29th.

"During the evening of August 17, Ralph Rowlett GR-587 (Upper Caldecote) worked into Swindon," wrote **John Raleigh DW-04** (Bedford). Being a night owl himself he had contacts in Leicester at 2100 on the 17th and on the east and south coasts between 0100 and 0230 on the 18th. A few hours later, Ralph found the band was flat, indicating that the lift was over.

At 2105 on the 29th, John Raleigh, Secretary of The Four County 32cm Club, took advantage of another opening and worked into the Channel Islands and Yorkshire. At 0645 on September 8, Ralph exchanged signals with a couple of enthusiasts in Birmingham.

Broadcast Round-up

Peter Shore

As winter approaches, and brings with it the prospect of better reception of distant stations on lower frequencies and on medium wave, the world of international broadcasting continues to change and throw surprises at the unsuspecting listener. Agreements between broadcasters for relays of programmes are being negotiated and signed, new transmitters are coming on stream almost as fast as receiver manufacturers bring out new short wave receivers and the USSR seems to have trouble making up its mind what radio stations it actually broadcasts and in what language . . .

Europe

BRT has started to use 6.035MHz for its evening transmissions, which rather spoils reception of Radio Australia on the same frequency. The antipodean station is still audible on 7.205MHz during the early evening.

Radio Austria International has dropped 6.155MHz for the European service between 0400 and 0500, although 6MHz is now used continuously between 0400 and 2300. The frequency of 9.6MHz has been dropped for European beams, but 9.685MHz can be heard 1100–1300, and 11.915MHz is on the air 0700–1300.

Radio Prague, Czechoslovakia is using new frequencies for English programming: at 0730 and 0830, 11.685, 17.840 and 21.705MHz are now heard.

Deutsche Welle is to start test transmissions in the new 13MHz band (21m), with programmes beamed to Africa and the Far East, all on 13.790MHz as per:

Japanese to Far East	1100–1150
English to Africa	1800–1850
Hausa to Africa	1900–1930
Portuguese to Africa	2000–2050

Deutsche Welle has recently started using the new out-of-band channel of 15.510MHz for morning programmes to Australasia, noted with English at 0900 in parallel with 21.680, 21.650, 17.780 and 15.205MHz.

Meanwhile, the Voice of America is to install a transmitter for broadcasts to Eastern Europe and the USSR at the Deutsche Welle Wertachtal transmitter complex in West Germany.

Radio Finland's new 600kW transmitter on 963kHz is now in operation, and the teething troubles which the station was experiencing at its new Pori transmitter site seem to have been resolved. The signal from the new medium wave transmitter is excellent in the southern UK, and plays havoc with the signal from the pirate ship Radio Monique as darkness falls. What will the pirate ship do to improve reception of its programming?

Whilst Radio Netherlands' Madagascar relay station has no satellite feed facilities as maintenance work is carried out by the island's PTT on its earth station, feeders are being used from Europe on s.s.b. and d.s.b. A 10kW s.s.b. transmitter has been hired by the station to beam a feeder to Madagascar, and a 500kW h.f. transmitter at the main transmitting complex at Flevo is providing an additional feed to the relay station. Special QSL cards are being offered by Radio Netherlands for correct reception reports on the two feeders: look out in the 13MHz (21m) and 13m bands for the 500kW transmitter, and just outside the broadcast bands for the 10kW feeder. Good hunting.

Radio Norway has English language transmissions on Sundays:

1000 on 21.730, 15.230 and 15.180MHz

1300 on 17.775, 15.310, 9.590 and 6.040MHz

1400 on 15.310, 15.300, 15.245 and 11.860MHz

1600 on 11.865, 11.860, 9.730, 9.655 and 7.265MHz

1700 on 15.310, 15.230, 11.850 and 9.655MHz

1900 on 15.225, 11.850 and 9.590MHz

2000 on 15.225, 9.655 and 6.015MHz

2200 on 9.610 and 9.585MHz

Swiss Radio International are to air programmes from Radio Beijing for two hours a day with two 250kW transmitters at Beromunster and Lenk. This is in exchange for relays of SRI programming over two 125kW transmitters in the People's Republic of China, where two hours of programmes will also be aired. No financial arrangement is involved in the relay set-up. Details of times and frequencies will be carried in this column just as soon as they become known.

Meanwhile, Radio Exterior de Espana has announced plans for a relay in China in order to improve Asian coverage, although it is unclear at present whether this arrangement will be similar to the SRI/R Beijing agreement.

Spanish Foreign Radio now carries English and French newscasts between 0400 and 0600 on 657kHz.

The timings and frequencies of many Radio Moscow programmes changed when clocks in the Soviet Union reverted to winter time on September 27. The English language World Service puts in good signals during the morning on 13.690, 13.680, 12.020 and 12.050MHz. The 12.020MHz channel carries domestic programming for most of the rest of the day. In July I reported that Radio Station Peace and Progress has dropped Chinese language programming, with mainstream Radio Moscow increasing its Chinese language broadcasts. However, at the beginning of September, Peace and Progress was noted to be back on the air in Standard Chinese at 1300–1400 on 9.685, 11.940 and 12.005MHz.

Middle East

The Cyprus Broadcasting Corporation has changed its Greek service beamed to the UK on Fridays, Saturdays and Sundays at 2015–2045 to 9.635 and 7.205MHz.

Radio Cairo, Egypt has a new time and frequency for English to Europe—9.670MHz is used 2015–2145. They are planning to expand its services to the Far East and Eastern Europe. The station currently has 31 language services, with 52 hours of programming a day.

Voice of the Masses programming from Iraq seems to have the following schedule for the morning period:

0600 on 17.630, 15.205, 15.150, 12.025 and 11.860MHz

0700 on 17.830, 17.630, 15.205, 15.150, 15.110, 13.680, 12.025 and 11.860MHz

0800 on 17.830, 17.630, 15.150, 15.110, 13.680 12.025 and 11.860MHz

0900 on 17.830, 17.630, 15.555, 15.150 and 13.680MHz

1000 on 17.830, 17.630, 15.555 and 15.150MHz

Radio Kuwait has been noted on a new frequency, 11.665. This replaces 11.675MHz for the evening transmission at 1800 until 2100.

The Arabic Programme from Qatar Broadcasting Service is on the air from 0850 on 15.395MHz until 1300 when the frequency changes to 15.265MHz through to 1700 when 11.820MHz is in use.

Radio Damascus from Syria now uses 12.085 and 15.020MHz for English to Europe at 2005. Arabic can be heard on 11.625MHz in the morning.

Voice of Turkey has English to Asia at 1230 on 15.145 and to Europe at 2000 on 7.215MHz and 9.560MHz and at 0300 on 9.560MHz and 17.760MHz. Arabic from TRT can be heard at 1045 on 11.745 and 11.955MHz, with Turkish at 1100, when 15.220 and 11.955MHz joins the earlier frequencies.

United Arab Emirates Radio in Dubai now uses 11.730MHz for English at 1600 to Europe.

Africa

Alger Chaine 3 from Algeria can be heard on 9.685 and 9.510MHz, together with 981 and 254kHz in French 1900–2400.

Ndjamena Radio from Chad on 4.9045MHz is now being jammed more intensely that ever. Radio Moundou from Chad has been heard on 5.286MHz between 1800 and 1830.

RTI from the Ivory Coast has a reported schedule of 4.940 and 7.215MHz from 0600 until 2400.

The BBC has inaugurated a new transmitter in Lesotho which operates on 3.340MHz between 1500 and 2130. This has been reported to have made a remarkable improvement to services to southern Africa. Radio RSA can be heard on a new frequency of 15.115MHz at 1100 for the one hour English programme, with the 2100 English 'cast on 7.260, 9.585 and 11.890MHz.

Asia

Radio Afghanistan in English at 0900 is heard on 17.655 and 15.255MHz, with announced frequencies including 15.435, 9.635 and 4.450MHz.

The new BBC Hong Kong relay went on the air on September 17, with programmes at the following times:

0400–0845 on 15.280MHz

0900–0945 on 7.170 and 5.995MHz

1100–1130 on 5.995MHz

1300–1330 on 7.160, 5.996 (also 1430–1515)

2115–2300 on 7.160 and 5.965MHz

2300–2345 on 5.965MHz

Plans exist in Indonesia to expand the external service of Radio Republik Indonesia to start broadcasts to the European and African continents early in 1988.

English from Radio Pakistan is heard:

1105–1120 on 15.606 and 17.660MHz

1600–1630 on 9.465, 9.785, 11.615, 11.625, 15.125 and 15.605MHz

1718–1800 on 7.100 and 11.570MHz

South America

Radio Bras has English on 15.265MHz at 1700–1800 and 11.745MHz at 0200–0300.

Radio Acari in Peru can be heard between 0145 and 0400 on 6.300MHz variable.

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